CLEAN AIR ACT OVERSIGHT

HEARINGS

BEFORE THE

SUBCOMMITTEE ON PUBLIC HEALTH AND ENVIRONMENT

OF THE

COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE HOUSE OF REPRESENTATIVES

NINETY-SECOND CONGRESS

FIRST AND SECOND SESSIONS

ON

A REVIEW OF THE IMPLEMENTATION OF VARIOUS PROVISIONS OF THE CLEAN AIR ACT OF 1970

November ~~DECEMBER~~ 20, 1971; JANUARY 26, 27, AND 28, 1972

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CLEAN AIR ACT OVERSIGHT

SATURDAY, NOVEMBER 20, 1971

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON PUBLIC HEALTH AND ENVIRONMENT,
COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE,
Birmingham, Ala.

The subcommittee met at 11 a.m., pursuant to notice, at the Engineering Auditorium, 1917 8th Avenue South, Birmingham, Ala., Hon. Paul G. Rogers (chairman) presiding.

Mr. ROGERS. Good morning. The Subcommittee on Public Health and Environment of the U.S. House of Representatives is here in Birmingham this morning to conduct hearings on oversight of the Clean Air Act of 1970.

Last year, this subcommittee wrote significant amendments to the Clean Air Act which afforded the States and the Federal Government broad powers to combat air pollution. One section of the Clean Air Act, section 303, authorizes the Administrator of the Environmental Protection Agency to bring suit in the U.S. District Court to immediately restrain the emission of air pollutants if the Administrator determines that an imminent and substantial danger to the health of persons exists, and if he determines that State or local authorities have not or cannot act to abate the source of the pollution. As you know, the Environmental Protection Agency used this emergency power for the first time Thursday to respond to an air pollution crisis here in Birmingham. At 2 o'clock a.m., U.S. District Judge Samuel Pointer, Jr., issued a temporary restraining order ordering these plants to bank their furnaces.

Part of our responsibilities as members of the Subcommittee on Public Health and Environment is to conduct oversight over the implementation of the Clean Air Act. It is our intention to review the adequacy of the emergency procedures which the act grants to the Environmental Protection Agency, as well as to develop the activities of industry and State, local and Federal officials with respect to the recent situation here in Birmingham. With me are two other members of the subcommittee, Representative Peter N. Kyros of Maine and Representative James F. Hastings of New York.

We appreciate the opportunity to be here in Birmingham. Our first witness this morning is Dr. George E. Hardy, Jr., Health Officer for the Jefferson County Department of Health.

I think we will use this table and the microphone over here for the witnesses. I believe that may be easiest.

Doctor, the committee welcomes you and your associates, and you might like to introduce each of them for the record.

STATEMENT OF DR. GEORGE E. HARDY, JR., M.P.H., HEALTH OFFICER, JEFFERSON COUNTY, ALA., DEPARTMENT OF HEALTH; ACCOMPANIED BY PAUL PATE, DIRECTOR, BUREAU OF ENVIRONMENTAL HEALTH; GUY TATE, DEPUTY HEALTH OFFICER; AND CHARLES B. ROBISON, ASSISTANT DIRECTOR, BUREAU OF ENVIRONMENTAL HEALTH

Dr. HARDY. Thank you, sir. I am George E. Hardy, Jr., health officer, Jefferson County Department of Health. My office address is 1912 8th Avenue South, Birmingham, Ala.

Mr. Chairman Rogers, Mr. Kyros, Mr. Hastings, I appreciate the opportunity to appear before this committee this morning to review the events of the past week in their chronological sequence and to express our appreciation to the Environmental Protection Agency for the assistance which it afforded during this week.

With me this morning are Mr. Paul Pate, who is the director of the bureau of environmental health in the Jefferson County Department of Health; Mr. Guy Tate, who is the deputy health officer of the Jefferson County Department of Health, and Mr. Charles B. Robison, the assistant director of our Bureau of Environmental Health.

Mr. ROGERS. We welcome you gentlemen to the committee, too.

Dr. HARDY. At 2 p.m., Monday, November 15, 1971, the National Weather Service issued an Air Stagnation Advisory for central Alabama, including Jefferson County.

Accordingly, the Jefferson County Department of Health's Bureau of Environmental Health activated auxiliary air sampling devices at air pollution monitoring stations in those areas of the county where particulate elevations are most likely to occur. This action permitted the issuance of afternoon particulate readings in addition to our daily morning reports.

Samples for the 24-hour period ending 8 a.m., Tuesday, November 16, 1971, read 771 micrograms per cubic meter of air at the North Birmingham sampling station, and 397 micrograms per cubic meter of air at the downtown station. As these readings were above the 375 level designated by the Environmental Protection Agency as the beginning of an air pollution alert, the Jefferson County Health Department declared an alert at 10 a.m., November 16, 1971. At that time, local news media were informed of the declaration of an alert and asked to assist in notifying the public of that fact. Simultaneously, the 23 major industrial sources whose 1969 emission inventories, (the most recent emission inventories available to us), indicated that they were the largest contributors of particulare pollution in the Birmingham area, were telephoned. Each of these industries, based on their data, was estimated to contribute approximately 100 tons or more of particulate matter to our air per year. Each of these industries was asked to take immediate steps to make voluntary reductions in particulate emissions and to insure maximum reduction during the hours between 4 p.m. and 10 a.m., the period when poorest atmospheric mixing conditions usually exist.

At 3 p.m., on November 16, 1971, the auxiliary sampler's particulate reading from North Birmingham was 722. This was the second consecutive reading in excess of 625 micrograms per cubic meter of air, the

point at which an air pollution episode enters its second, or warning level. The Jefferson County Department of Health officially declared an air pollution warning at 4:30 p.m., November 16, 1971.

Additionally, notices were delivered to each of the 23 industries previously contacted asking them, voluntarily, to make a significant reduction in particulate emissions and to maintain that reduction until the warning could be terminated. A copy of this notice will be submitted to this committee for the record. (See Exhibit A attached.) Specifically, we suggested a reduction in the order of 60 percent. This figure was developed from the information in the Emergency Episode Plan being prepared for the State of Alabama's Implementation Plan with the assistance of the EPA by TRW Systems Group, McLean, Va. We further requested each industry to submit to us within 24 hours a written report as to the nature of their action in compliance with our request and as to their estimate of the amount of particulate reduction which could be expected from such action.

At 8 o'clock a.m., Wednesday, November 17, 1971, the 24-hour sample from the North Birmingham sampling station read 758. At 9:30 a.m., the National Weather Service reported that the Air Stagnation Advisory for this area would be continued another 24 hours.

Throughout these 3 days, representatives of the Alabama State Department of Health, attorney general of the State of Alabama, and the regional and national offices of the Environmental Protection Agency were in communications with staff members of the Jefferson County Department of Health.

In the morning of November 17, 1971, I received a call from Mr. Darrell Tyler, chief, emergency operation control center, Environmental Protection Agency, requesting that the Environmental Protection Agency be permitted to come to Birmingham as observers of this episode. Being aware of the provisions of the Federal Clean Air Act which places responsibility with the Environmental Protection Agency when local or State officials cannot take effective action in an emergency episode, I concurred in his request. The State department of health was aware of this concurrence.

Because of the rapid course of events and the seriousness of the situation, the Jefferson County Department of Health initiated a telephone survey at 10 a.m., Wednesday, November 17, 1971, of the industrial sources previously contacted to obtain preliminary estimates of the reductions they were effecting.

The results of that telephone survey were as follows:

(a) Six of the 23 industries indicated that either, (1) they could not estimate the amount of reduction in particulate emission which would result from their action, or (2) that their actions would produce a reduction of 20 percent or less in their current rate of discharge;

(b) Eight of the 23 industries indicated that they would each effectuate reductions of 20 to 60 percent; and

(c) Nine of the 23 industries indicated that they were reducing particulate emission by 60 percent or more.

Thus, the majority of the 23 industries contacted advised that they were making reductions in particulate emission. However, a review of emission inventory data indicated that many major sources of particulate pollution were among those six indicating that they could not estimate the amount of reduction in particulate emission which would

result from their action or that their actions would produce a reduction of 20 percent or less in their current rate of discharge. Employing 1969 annual average particulate emission data based on information supplied by each of the 23 industries contacted, it was estimated that the overall reduction of particulate matter which would be achieved by the combined actions of these industries approximately a 15-percent reduction—far short of the overall 60-percent voluntary reduction requested. Fully cognizant of statistical bias and error inherent in such calculations, these were, nevertheless, the best available estimates which we could use.

At 3:15 p.m., on Wednesday, November 17, representatives of our department, the State department of health, the State attorney general's office, the Environmental Protection Agency, and the U.S. Department of Justice met at the Jefferson County Department of Health for the purpose of reviewing our current status and considering alternative courses of future action. At a previously scheduled 4 p.m. press conference, a statement was issued by the Jefferson County Department of Health as to the situation at the moment, and an announcement was made by Mr. John White that EPA was reviewing the Birmingham situation and would make public its recommended course of action at a later time.

By 6:30 p.m., Wednesday, November 17, written replies to our request of 24 hours earlier had been received from 18 of the 23 industrial sources (at this time we have still received only 18 of 23). On the basis of these written replies, it was then estimated that a maximum overall particulate reduction of 25 to 30 percent might be achieved. This reduction was 50 percent of that requested on November 16. These replies were made available to officials of the Environmental Protection Agency for use in their deliberations, and copies of these letters are now submitted to this subcommittee for your further consideration. (See exhibit B attached.)

Mr. Chairman, an effective air pollution control bill was passed by the Alabama State Legislature and signed into law on September 3, 1971. (See exhibit C attached.) The Commission members responsible for implementation of the act were appointed less than 1 week ago and have not yet met to appoint a director in whom emergency authority is vested by that statute. The Jefferson County Department of Health under the authority granted it in this same statute, is in the process of establishing rules and regulations pertaining to local emergency episodes and implementation procedures for the total air pollution control program. Such rules and regulations cannot take effect until public hearings have been held. These hearings are currently proposed to take place prior to January 1, 1972. Thus, the Jefferson County Department of Health and the State of Alabama Department of Health were without effective legal authority to abate this emergency episode.

At this time, representatives from the Environmental Protection Agency again conferred to develop recommendations for subsequent action on their part. From this point forward, the Jefferson County Department of Health has provided technical assistance and resource material to Federal officials.

(Testimony resumes on p. 37.)

(Exhibits A, B, and C, to Dr. Hardy's prepared statement follow:)

EXHIBIT A

JEFFERSON COUNTY DEPARTMENT OF HEALTH,
Birmingham, Ala., November 16, 1971.

Subject: Air pollution episode.

Telegram to: Major particulate sources in Jefferson County.
From: George E. Hardy, Jr., M.D., health officer.

Particulate levels in excess of 625 micrograms/cubic meter recorded by two consecutive 24 hour air samples at the North Birmingham sampling station, elevated particulate levels at the other sampling stations and predictions of continued poor atmospheric mixing conditions have necessitated the declaration of an air pollution "warning" by the Jefferson County Department of Health.

As a result, in order to protect the health of the citizens of Jefferson County, I am hereby requesting that your company make substantial reductions in particulate emissions as soon as possible and maintain said reduction until the warning is terminated. Due to the seriousness of this situation this office feels that an overall particulate emission reduction on the order of 60% is justified.

Furthermore, we request a written report within the 24 hours as to what emergency actions were taken by your organization and your estimate of reductions in particulate matter as a result of these actions. These replies will be a matter of public record.

EXHIBIT B

WOODWARD CO.,
Woodward, Ala., November 17, 1971.

Subject: Air pollution episode of November 16, 1971.

JEFFERSON COUNTY DEPARTMENT OF HEALTH,
Birmingham, Ala.
Attention (of Dr. George E. Hardy, Jr., M.D.).

DEAR SIRS: In response to your correspondence of November 16, 1971, concerning the Air Pollution warning in Jefferson County, we make the following report covering the conditions at our plant and the actions we undertook to minimize particulate emissions.

As we discussed by telephone, operations at our Coke Plant was at the absolute minimum level at the time the warning was announced, due to a strike by the Union representing our employees there. As a consequence of the strike, we had reduced our level of operations by 70 percent. Immediately upon receiving the alert from your office, on the morning of November 16, we took the following actions in anticipation of the possibility of a warning being issued later in the day.

1. Cracks in oven brickwork were grouted and sprayed to minimize emissions from the ovens.
2. The coke oven doors were mopped with a grout mixture to seal off gas emissions.
3. Standpipes, caps, and charging lids were sealed with grout on each individual coke oven.
4. Oven pushing and charging was coordinated so as to minimize the time the oven was open to the atmosphere, considerably reducing emission.
5. Air fuel ratios at both our Boiler Plant and in our coke oven heating flues were monitored much closer than usual to insure the most efficient combustion possible under the conditions.

At the Furnace Plant, we are operating only one of four blast furnaces. The following steps were taken in that area to reduce emissions:

1. Blast furnace gas is burned in the stoves attendant to furnace operation. Those people responsible for burning the gas were instructed to monitor the process closely, so as to obtain efficient combustion.
2. Blast furnace operators were instructed to keep a very close watch on the furnace to avoid sudden slippage of raw materials stock column, commonly known as kicking, that usually results in the forcing of particles into the air through the bleeder system. These instructions were carried out by furnace personnel and proved to be extremely effective, judging from both observation and instrument readings.

The Boiler Plant connected with the blast furnace operation primarily consumes blast furnace gas as a fuel. Occasionally it is necessary to supplement the blast furnace gas with either natural gas and/or fuel oil. The latter is used only as a last resort to maintain steam pressure. Our boiler operators were in-

structed to watch the combustion in the boilers closely and keep unburnt fuel to a minimum. Observation of the boiler stacks following the alert and warning convinces us that combustion was good and reduced levels of emissions were attained.

At the Electric Furnace, the normal amount of coal per batch is 250 to 300 pounds. We reduced this amount to 100 pounds. The furnace operators are instructed to stoke the furnace frequently, which will keep it from "blowing through" and considerably reducing the possibility of emissions. In addition to this, the metal chills are being lined with sand rather than the normal blacking material.

It is our considered opinion that during the twenty-four hour period following the announcement of the pollution warning, our plant has emitted at a rate less than 25 percent of what it would have under normal operating conditions. Please keep in mind that our situation during this particular alert and warning was extremely unusual for us, considering our Coke plant strike, and that our total emission level is far below anything we could expect to attain with short notice in the future, under normal operating conditions.

We have no means of definite measurement; however, our estimate is that we have reduced particulate emission by 30 percent during the twenty-four hour period since the warning was issued. We assure you of our full cooperation and expect to continue operating under the above conditions until you release us at the end of the warning period.

Sincerely yours,

GENE W. LEWIS, *Manager.*

* * *

UNITED STATES STEEL CORP.,
FAIRFIELD WORKS,
Fairfield, Ala., November 17, 1971.

Dr. GEORGE E. HARDY, Jr.,
Health Officer, Jefferson County Department of Health, Birmingham, Ala.

DEAR DR. HARDY: This will respond to your letter of November 16, 1971 requesting reductions of particulate emissions from our operations in view of the air pollution "warning" issued by your office.

In an effort to cooperate and to help alleviate current atmospheric conditions, even though operations are at a 60 per cent level, several additional steps have been taken at Fairfield Works:

1. Open hearth furnace operations are drastically reduced. Only eight of 15 furnaces are presently operating and these eight have been placed on schedules to reduce concentrations of particulate matter.
2. All coke ovens are being operated on extended coking schedules.
3. All open fires have been eliminated and trash incinerators have been taken out of operation.
4. All eight coal fired boilers have been switched to gas.
5. All steel scarfing operations have been stopped.
6. Operators are carefully monitoring controls to reduce emissions from boilers, furnaces and other combustible sources.

It is impossible at this point to give an accurate percentage of reduction in emissions as a result of these steps, however, we feel the reduction is substantial.

In addition, we are exploring ways in which emissions may be reduced still further during this period.

Please be assured of our continued desire to cooperate.

Sincerely,

L. J. WRIGHT, *Assistant General Superintendent.*

* * *

W. J. BULLOCK, INC.,
Fairfield, Ala., November 17, 1971.

Dr. GEORGE E. HARDY, Jr.,
Jefferson County Department of Health,
Birmingham, Ala.

DEAR SIR: We received your pollution notice yesterday evening and have complied with your request at the earliest moment. Our brass furnace which emits about 75% of our particulate matter was in production yesterday and this morning and afternoon we are tapping this furnace. Around one o'clock

today the furnace emissions had been reduced by 80% and the furnace will be shut down at 5:00 P.M. this evening.

Yours very truly,

E. A. BINNEY, *Plant Superintendent.*

* * *

GRIFFIN WHEEL CO.,
Bessemer, Ala., November 17, 1971.

GEORGE E. HARDY, Jr., M.D.,
Health Officer, Jefferson County Department of Health,
Birmingham, Ala.

DEAR SIR: The Bessemer Plant of Griffin Wheel Company has very recently completed installing a fume collection system for their arc furnaces at a cost of one-quarter million dollars. While some difficulties were encountered, we are proud to announce that as of now the system is 100% operational and invite you to personally see the contribution Griffin has made in their cleaner air program.

Sincerely,

L. J. SCHEIBLAUER, *Superintendent.*

* * *

ALPHA PORTLAND CEMENT CO.,
Birmingham, Ala., November 17, 1971.

Subject: Air pollution warning.

Mr. GEORGE E. HARDY, Jr., M.D.,
Jefferson County Health Department,
Birmingham, Ala.

DEAR MR. HARDY: In accordance with your request of 5 P.M. November 16, 1971, we have reduced our particulate emission by an estimated 60%.

We shut down 50% of our rotary kiln operation and 33% of our finish grinding operation.

I trust that the action taken by all industries in and around Birmingham will help alleviate the air pollution condition and we will be advised to return to normal operation at the earliest possible time.

Yours very truly,

W. E. ELLIS, *Plant Manager.*

* * *

W. A. BELCHER LUMBER CO.,
Birmingham, Ala., November 17, 1971.

Dr. GEORGE E. HARDY, Jr.,
Health Officer,
Birmingham, Ala.

DEAR DR. HARDY: In answer to your letter of November 16th, we are most happy to cooperate in every respect to lower the particulate level in our city. If you will check with the Birmingham Smoke Abatement Office, (Mr. Morgan), I am sure, will confirm this. I was a little surprised at your call, since we reduced our emissions by over seventy percent in September. This was accomplished by terminating the operation of our sawmill on September 8th. We are now operating the planer mill only and are not burning green sawdust or bark. At the time your office called we had further reduced our emission an additional twenty percent by operating off the Power Company. This accrues at the present time to a net reduction of emission of ninety percent (90%).

If there is any way in the future that our company can be of assistance to your office, please call on us.

Yours very truly,

J. R. ABERNATHY, Jr.,
Manager.

* * *

UNITED STATES PIPE AND FOUNDRY CO.,
Birmingham, Ala., November 17, 1971.

Mr. CHARLES B. ROBINSON,
Project Director of Air Pollution Control and Assistant Director, Bureau of Environmental Health, Jefferson County Department of Health, Birmingham, Ala.

DEAR MR. ROBISON: This is to acknowledge your telegram of November 16, 1971 at 5:00 p.m. to United States Pipe and Foundry Company regarding an Air

Pollution Episode in the North Birmingham area in which you request United States Pipe and Foundry Company to initiate emergency procedures to reduce the emission of particulates, the percentage of reduction in particulate emission from reduced operations, and our plans to prevent air pollution episodes in the North Birmingham area.

United States Pipe and Foundry Company was informed by Mr. Grusnick of the Jefferson County Health Department by telephone at 10:25 a.m., November 16, 1971, that the particulate emission count had reached the alert stage in the North Birmingham area. At 10:30 a.m., United States Pipe and Foundry Company commenced the following emergency actions and procedures to reduce the emissions of particulates from our Huntsville Road complex:

Emergency Operational Changes and procdures:

1. Eliminated use of coal as fuel
2. Reduced rate of operation
3. Selected charge materials
4. Eliminated flue blowing

The estimated reduction of the particulate emission from the above listed emergency operational changes and procedures is 40 per cent.

Additional changes and procedures whose reduction in the percentage of particulate emision cannot be calculated:

1. Eliminated handling of certain raw materials
2. Began moisturizing certain raw materials
3. Began moisturizing expanding slag operations
4. Eliminated certain drying operations
5. Ceased all grading construction
6. Ceased incinerator operations
7. Oiling and wetting of roadways

In the event the Air Pollution Episode continues in North Birmingham, United States Pipe and Foundry Company will further shut down the necessary plant operations in our Huntsville Road Complex.

United States Pipe and Foundry Company has been aware for many years of the particulate emission problem in the North Birmingham area. Our Department of Environmental Engineering has been studying, analyzing, researching, and developing plans to comply with all Federal, state and local laws and regulations. United States Pipe and Foundry Company's concern is not newly found. Our Huntsville Road Complex employs more than 1,650 people. Reduction and shutdown operations naturally entails loss of income to our employees whose welfare we are concerned with.

United States Pipe and Foundry Company has and will continue technological research on the many varied and complex problems in the area of control of particulate emission, many of which are unanswerable today. As we have already publicly announced, necessary capital expenditures are being made for the control of particulate emissions in the Huntsville Road Complex.

United States Pipe and Foundry Company's operations are first and foremost for men rather than materials. We believe, however, that environmental protection must coexist with economic progress.

Yours very truly,

B. F. HARRISON, *President.*

* * *

VULCAN MATERIALS CO.,
Birmingham, Ala., November 17, 1971.

Re your letter dated November 16 entitled air pollution.

Dr. GEORGE E. HARDY, Jr., M.D.,
Health Officer, Jefferson County Department of Health, Birmingham, Ala.

DEAR DR. HARDY: In an effort to help in the possible reduction of particulate emissions in the Birmingham area, Vulcan Materials Company has closed down its Wylam Basic Slag operation from 3:00 P.M., Tuesday, November 16 until 7:00 A.M. Thursday, November 18.

This is the only plant in the Birmingham area which could possibly contribute to air pollution.

Very truly yours,

J. A. CARNATHAN, *Vice President-Operations.*

* * *

McWane Cast Iron Pipe Co.,
Birmingham, Ala., November 17, 1971.

Re telegram, air pollution episode, November 16, 1971.

Dr. George E. Hardy, Jr.,
Health Officer, Jefferson County Department of Health,
Birmingham, Ala.

Dear Dr. Hardy: Upon receipt of telephone calls from your office in the a.m. of November 16, our company took immediate action relative to reduction of particulate emission. We upgraded the charge material going into our melting furnace and lowered the blast rate, which reduced the amount of emission significantly. This is the same action we took during the air pollution episode of October 14, 1971, and represents the ultimate reduction that can be made without ceasing operations entirely.

We are glad to cooperate in these emergency situations and feel these temporary steps substantially reduce our emission. We have under construction an air pollution control installation. The successful operation of this equipment upon completion in the near future should remove our plant from the list of "Major Particulate Sources in Jefferson County".

Yours very truly,

S. P. Teague, *Chief Engineer.*

* * *

Swift Agriculture Chemicals Corp.,
Birmingham, Ala., November 16, 1971.

Re air pollution.

Mr. Gary Hyche,
State of Alabama, Department of Public Health, Pollution Control Division,
Birmingham, Ala.

Dear Mr. Hyche: This is to acknowledge our telephone conversation this morning, 11/16/71, in which you requested that Swift Agricultural Chemicals cut back on emission, since the particulate count reached a high of 771 and was now an emergency condition.

We are glad to state that we will adhere to this request and have closed all manufacturing facilities till 12:00 Noon Wednesday, November 17, 1971.

I would like to take this opportunity to again remind you that we were not in operation when you called on Tuesday, 10:25 A.M., and had not operated any of our manufacturing facilities since Monday, 12:00 P.M.

Thank you for calling this emergency condition to our attention and you may expect our continued cooperation.

Sincerely,

F. M. Jenkins.

* * *

United States Gypsum Co.,
Birmingham, Ala., November 17, 1971.

Mr. George E. Hardy, Jr., M.D.,
Jefferson County Department of Health,
Birmingham, Ala.

Dear Mr. Hardy: In response to your request in your wire of 5:00 P.M. on 11-16-71, I can report the following emergency action to reduce particulate emissions from our plant. We had already shut down one rock wool cupola at 4:00 P.M. in response to an earlier request and with the receipt of your wire we elected to leave this cupola shut down. In addition, our gas fired curing oven for blanket insulation, which had been operating early the morning of 11-16-71, and then shut down was left shut down. We have instructed our operators to maintain close surveillance over all our pollution control and combustion control equipment on that part of the plant still operating to make certain particulate emissions are as low as possible. We estimate that all of this has reduced our particulate emissions by 40 to 50%.

For your information, our boilers are fired with natural gas and emit no visible particulates. Also early in 1971, we installed gas burners on our cupolas which have allowed us to reduce coke combustion by 30% to 35% with a corresponding reduction in small particulates from that source. We are currently engaged in a program which will provide collectors on our cupolas and markedly reduce particulate emissions from our plant.

Yours truly,

D. E. Johnson, *Works Manager.*

* * *

BIRMINGHAM STOVE & RANGE CO.,
Birmingham, Ala., November 17, 1971.

DR. GEORGE E. HARDY, Jr.,
Health Officer, Jefferson County Department of Health,
Birmingham, Ala.

DEAR DR. HARDY: I am in receipt of a telegram addressed to "Major Particulate Sources in Jefferson County", on the subject AIR POLLUTION EPISODE, November 16, 1971, 5:00 P.M.

I am in sympathy with your efforts to protect the health of the citizens of Jefferson County. I take exception to being included as a major particulate source in Jefferson County. We have never been classified as such in the past, nor contacted during any periods of high particulate readings.

Our company is a medium sized gray iron foundry, and we are very small in relation to our neighbors in North Birmingham, and in Jefferson County, generally.

In addition to this, we have had wet caps on our alternately operated cupolas (only one at a time is ever in use) since 1964. We have always had dust collectors attached to our cleaning equipment, and the grinding and polishing equipment. We have a wet type collector made by the American Air Filter Company, and a bag-type dry collector made by Pangborn.

In addition to this we are operating our foundry equipment at a rate of 30% less normal for this time of year already. It is difficult for me to believe that we could be considered one of the major particulate sources in Jefferson County.

Not withstanding my reservations about our contribution to the situation covered in your telegram, we are willing to make reductions as requested.

We were contacted by your office this morning, and informed of the situation. We were informed at the same time that the dangerous hours of accumulation were from four to five o'clock in the afternoon, until nine or ten o'clock the next morning, due to atmospheric conditions that prevailed during those hours.

With this in mind, we cut one and one-half hours off our day shift, which normally ends at five-thirty in the afternoon, and told the office to let us know if the situation continued as they expected, so that we might reduce our running time during our second shift, which falls in those hours when the atmospheric conditions are the least favorable.

The telegram and a subsequent phone call from your office confirming the continued seriousness of the problem caused us to cut four and one-half hours from our second shift on the night of November 16.

Our present plans are to continue this 53% reduction in our second shift operation, which falls during those hours when your office says the particulate build-up is most likely to occur.

I hope that our understanding of the situation is correct, and that these actions to reduce our second shift by 53% from a running rate that is already 30% below normal will be a satisfactory response to your request.

Again, let me say we are in complete sympathy with your efforts to protect the health of the citizens of the country, and understand your contacting any and all industries in the area. I do take exception to being included as a major particulate source in the county, considering the size of our business in the first place, and the rather extensive steps we have already taken to control emissions at our moderately sized facility.

Kindest regards.

Yours truly,

SAUNDERS JONES. *President.*

* * *

STOCKHAM VALVES & FITTINGS,
Birmingham, Ala., November 17, 1971.

DR. GEORGE E. HARDY, Jr.,
Jefferson County Department of Health,
Birmingham, Ala.

DEAR DR. HARDY: We thank you for your telegram dated November 16, 1971, relative to the "Air Pollution Episode."

You requested that there be an overall particulate emission reduction of 60%. This Company, in our judgment, more than complied with your request.

Some of the many things that were done are:

1. Existing emission controls were checked and adjusted to maximum efficiency.
2. Charging levels on our cupolas were reduced.

3. Three bronze melting furnaces were shut down.
4. Two raw material recovery units were shut down.

Should you have any additional questions, we would be glad to discuss the subject with you at your convenience.

HARRY M. BURNS,
Vice President, Manufacturing.

* * *

CLOW CORP.,
CAST IRON PIPE & FOUNDRY DIVISION,
Birmingham, Ala., November 17, 1971.

Re air pollution episode.

GEORGE E. HARDY, Jr., M.D.,
Health Officer, Jefferson County Department of Health, Birmingham, Ala.

DEAR DR. HARDY: Clow has in operation a particulate collection system on our melting units. Independent tests certify that this unit is collecting 90% of the particulate emissions. This compares to zero collection if Clow had not voluntarily installed equipment without pressure of any regulatory bodies or laws and in the absence of State standards. This past spring we signed an additional contract for further refinements on this unit. Most of the equipment has now arrived and installation will go forward shortly.

On receipt of your telephone call yesterday, our Maintenance Department went over the collection unit to be sure that top efficiency was being obtained. We also changed our scheduled sizes of production to the best mix possible to assure maximum collections.

Because this equipment has been installed and is in operation, we are reducing particulate emissions by 90% every day that we operate. No further reductions are possible short of complete plant shutdown and the resultant lay-off of approximately 400 people that this entails.

We appreciate your concern. We at Clow have expressed ours by voluntarily going ahead with equipment and demonstrated our continued efforts in this direction through planned continued improvements, some of which are under contract.

Sincerely,

H. B. WEAVER, Jr., *General Manager.*

* * *

AMERICAN CAST IRON PIPE CO.,
Birmingham, Ala., November 17, 1971.

Dr. GEORGE E. HARDY, Jr.,
Health Officer, Jefferson County Department of Health, Birmingham, Ala.

DEAR DR. HARDY: In response to your telegram indicating high particulate levels in our area, we have taken the following actions to reduce our particulate emissions today.

Cleaner scrap and premium charge materials in all our melting units.

In iron foundry shut down one of two cupolas at approximately 1:00 p.m. and reduce remaining cupola progressively to 50% by 3:00 p.m.

Shut down all electric furnaces by 2:00 p.m.

In the pipe plant reduce one cupola 25% by 1:00 p.m. and an additional 25% by 4:00 p.m.

We estimate the above curtailment will reduce our particulate emission 45% to 55%.

Yours very truly,

CARL P. FARLOW, *Vice President—Engineering.*

* * *

REPUBLIC STEEL CORP.,
SOUTHERN DISTRICT,
Birmingham, Ala., November 17, 1971.

Subject: Air pollution episode.

GEORGE E. HARDY, Jr., M.D.,
Health Officer, Jefferson County Health Department,
Birmingham, Ala.

DEAR SIR: Due to the current sluggish level of the industrial economy, Republic Steel Corporation Plant in the Thomas area of Birmingham is practically shut down.

Operations of the Blast Furnace was discontinued on June 29, 1971 and the furnace remains banked.

Operations of the Coke Ovens and the utilities are at the lowest possible level.

All caretaker personnel at the plant have been advised of the present adverse atmospheric conditions in the Birmingham area and have been directed to reduce any emissions possible and to prevent the occurrence of any transient conditions which might generate such discharge. They have also been advised to report to management any developments beyond their capability to control.

Yours truly,

E. W. CARLSON, *Manager Southern District.*

* * *

ALABAMA BY-PRODUCTS CORP.,
Birmingham, Ala., November 17, 1971.

Dr. GEORGE E. HARDY, Jr.,
Health Officer, Jefferson County Department of Health,
Birmingham, Ala.

DEAR DR. HARDY: In response to verbal notification from your office received by us about 10:30 a.m. yesterday, November 16, 1971, that an air pollution "alert" had been declared in the Birmingham area and that our company was asked to take steps to reduce particulate emissions from its coke plant at Tarrant, Alabama, we immediately put into effect on an emergency basis temporary measures, neutralizing pressure, which would be maintained some twenty-four hours and would measurably reduce emission of particulate matter.

Upon receipt about 6:00 p.m. yesterday at our Tarrant coke plant of your notice of declaration of an air pollution "warning" we promptly made adjustments to our oven heating system to accommodate a drastic reduction in operating rate without serious damage to facilities and by 8:00 p.m. we had reduced our operating rate to approximately 54% and are presently operating at this very low rate. In addition operating personnel were notified of the "alert" and "warning" and instructed to maintain continuous checks on all operations to avoid or reduce incidental emissions to the fullest extent possible. These actions have resulted in a substantial reduction in particulate emissions.

The reduction in operating rate has required substantial curtailment of shipments to our customers and with a shortage of foundry coke because of the long coal strike this will cause many customers serious difficulties. We will appreciate your advising us immediately by phone at any time of the day or night (office 841-5583, home 822-2407) when the alert is lifted so that we may avoid further curtailment of customers orders and the lay-off of employees.

Yours very truly,

H. E. WITHERS,
Vice President, Coke & Coal Chemicals Operations.

* * *

HARBISON-WALKER REFRACTORIES CO.,
Fairfield, Ala., November 17, 1971.

GEORGE E. HARDY, Jr., M.D., M.P.H.,
Jefferson County Department of Health,
Birmingham, Ala.

DEAR DR. HARDY: This is to advise that upon receipt of your telegram, dated November 16, 1971, 5 p.m., pertaining to the declared pollution warning, that the following emergency actions were taken at our Fairfield and Bessemer Operations.

Fairfield Operations.—Shut-down of drying facility, and discontinued incendiary burning of trash.

Bessemer Operations.—Shut-down of rotary kiln operation.

We estimate that the above emergency actions resulted in the elimination of 90 percent of particulate emissions from these two plants. We can continue these emergency measures over a limited time period, after that period it could become necessary to resume the rotary kiln and drying facilities at a substantial reduced feed that would result in particulate emissions of 50 percent below normal.

Sincerely yours,

M. M. CAIN, *Area Production Manager.*

EXHIBIT C

Each Probate Judge, Sheriff, and the Clerk and Register of the Circuit Court is required by law to preserve this slip or pamphlet in a book kept in his office until the Act is published in permanent form.

ALABAMA LAW

(Regular Session, 1971)

Act No. 769 H. 702—Roberts, Erdreich, Boutwell, Grainger, Doss, Burgess, Merrill, Cauthen, Benton, Kinsey, Barkett, Agee, Chesnut, King, Downing, Crowe, Lutz, Ellis, Carnes, Bank, Hobbie, Culver, Easters, Stewart, Edwards, Nettles, Cottingham, Lang, Hearn, Baker, Owens, Turner, Cross, Slate, Naramore, Coshatt, Grey (D), Mims, Brassell, Reid (R), Jones (F), Adams, Falkenburg, St. John, Timmons, Stokes, Stubbs, Headley, Reed (T), Gray (F), Flippo, Hill, Goodwin, Wynot, Hale, Wood, Taylor, Harris Drake, Turnham, Gloor

AN ACT

To provide for the regulation, control, abatement and prevention of air pollution in the State of Alabama; to provide for a declaration of purpose and policy relative to air quality; to provide for definitions; to establish an air pollution control commission; to provide for the establishment of rules and regulations to promote the purposes of this Act; to provide the powers and duties of the air pollution control commission; to provide the procedures for adopting rules and regulations relative to the purposes of this Act; to provide for emergency procedures in the event of a threat to human health or safety; to provide penalties for violations of this Act; to provide for the enforcement of the rules and regulations relative to the purposes of this Act; to provide for variances; to provide for the establishment of local air pollution control programs; to repeal Act No. 1135, Acts of Alabama, Regular Session, 1969, page 2100, establishing the Alabama Air Pollution Control Commission.

Be It Enacted by the Legislature of Alabama:

Section 1. This Act shall be known and may be cited as the "Alabama Air Pollution Control Act of 1971."

Section 2. Declaration of Policy and Purpose.

(a) It is hereby declared to be the public policy of this State and the purpose of this Act to achieve and maintain such levels of air quality as will protect human health and safety, and to the greatest degree practicable, prevent injury to plant and

animal life and property, foster the comfort and convenience of the people, promote the social development of this State and facilitate the enjoyment of the natural attractions of this State.

(b) It is also declared that local air pollution control programs are to be provided for to the extent practicable as essential instruments for the securing and maintenance of appropriate levels of air quality.

(c) To these ends it is the purpose of this Act to provide for a coordinated state-wide program of air pollution prevention, abatement and control; to facilitate cooperation across jurisdictional lines in dealing with problems of air pollution not confined within single jurisdictions; and to provide a framework within which all values may be balanced in the public interest.

Section 3. Definitions. As used in this Act, the following words and terms shall have the following meanings:

(a) "Air Pollution" means the presence in the outdoor atmosphere of one or more air contaminants in such quantities and duration as are, or tend to be, injurious to human health or welfare, animal or plant life or property, or would interfere with the enjoyment of life or property througout the State and in such territories of the State as shall be affected thereby.

(b) "Air Contaminant" means any solid, liquid, or gaseous matter, any odor, or any combination thereof, from whatever source.

(c) "Commission" means the Air Pollution Control Commission of the State of Alabama established by this Act.

(d) "Person" means the State, any individual, partnership, firm, association, municipality, public or private corporation or institution, political subdivision or agency of the State, including any Environmental Improvement Authority established pursuant to Act No. 1117, Regular Session of 1969 (Gen. Acts 1969, p. 2060), any trust, estate, or any other legal entity and any successor, representative, agent, or agency of the foregoing, the United States or any department, agency, or instrumentality of the executive, legislative or judicial branches of the Federal Government.

(e) "Emission" means a release into the outdoor atmosphere of air contaminants.

(f) "Director" means the Director of the Division of Air Pollution Control of the Department of Public Health which Division is established by this Act.

Section 4. The Air Pollution Control Commission.

(a) There is hereby created a Division of Air Pollution Control, hereinafter referred to as "the Division" in the Department of Health. The Department of Health shall administer this Act through the Division which shall be headed by a Director appointed by the commission in accordance with the Merit System laws of this State; provided that rules and regulations required or authorized to be made pursuant to this Act shall be made, amended and repealed by the Air Pollution Control Commission established pursuant to subsection (b) of this Section.

(b) There is hereby created the Air Pollution Control Commission, hereinafter referred to as "the Commission." The members of the Commission shall be as follows:

(1) The State Health Officer throughout his term of office as State Health Officer and until the appointment and qualification of his successor as such officer;

(2) Six members to be appointed by the Governor, provided however, that the initial Commission members must be appointed on or before October 1, 1971, said appointments to be made with the advice and consent of the Senate, as follows;

(i) Four members who shall be representative of the public;

(ii) One member shall be a registered professional engineer and shall be educated and experienced in matters of air pollution measurement and control; and

(iii) One member who shall be a licensed physician and shall be educated and experienced in lung and respiratory discases and related diseases resulting from air pollution or air contaminants.

(c) No person shall be eligible to serve as a member of the Commission who is an officer, employee or agent, or who is a stockholder owning 7.5 per cent or more of the voting stock of any corporation or organization holding a permit from the Commission for the discharge of air contaminants into the atmosphere, or who is an officer, employee, or agent of any trade association which represents a corporation or organization holding a permit from the Commission for the discharge of air contaminants into the atmosphere. One of the six members appointed by the Governor shall serve for a term of four years, two for a term of three years, two for a term of two years and one for a term of one year, and the Governor shall designate at the time of making such appointments the length of

the term each member shall serve. At the expiration of the terms of all members initially appointed, their successor shall be appointed by the Governor for terms of four years and shall be selected in the same manner as the first members. If a vacancy occurs in the appointed membership, and upon certification thereof by the Commission, the Governor shall fill such vacancy for the unexpired term in accordance with the procedure prescribed herein. When a Commission member is appointed during a period when the Legislature is not in session to advise and consent, such appointee shall have the full power of the office until and unless the Senate, upon the reconvening of the Legislature, shall, by affirmative vote, refuse to consent in such appointment.

(d) The State Health Officer shall serve as Chairman of the Commission. The Commission shall elect from its membership a Vice Chairman. All members of the Commission shall be voting members. The Chairman and Vice Chairman shall vote on matters before the Commission as other members.

(e) No salary or compensation shall be paid any member of the Commission for services thereon, but this provision shall not be construed to affect in any way the regular compensation of members who are also governmental employees, their services on the Commission being considered a part of their official duties. Actual and necessary travel, subsistence and other expenses, incurred by members in the discharge of their duties as members of the Commission and as directed or requested by the Commission, shall be paid at the rate allowed other State employees as provided by law from funds which are or may become available for the purpose of this Act.

(f) The Commission shall meet regularly in each calendar quarter of each year, at times and places to be fixed by the Commission. Special meetings may be called at the discretion and upon call of the Chairman and special meetings shall be called by him up written request of any three members to take up any matters within the jurisdiction of the Commission. To the extent possible, all members shall be notified of the time and place of any regular or special meeting.

(g) Four voting members of the Commission shall constitute a quorum for the transaction of Commission business in both regular and special meetings. No member may designate by proxy or otherwise an alternate representative to attend any meeting of the Commission. The Director, or his representative, shall attend all meetings but shall have no voting power.

(h) The Commission shall keep a complete and accurate

record of the proceedings of all its meetings, a copy of which shall be kept on file in the office of the Director and open to public inspection.

(i) The Commission may employ and compensate within appropriations available therefor; consultants and such assistants and employees as may be necessary to carry out the provisions of this Act and may prescribe their powers and duties. All personnel who are in the employ of or are assigned to the Air Pollution Control Commission upon the effective date of this Act shall, upon the effective date of this Act, become the employees of or assigned to the new Commission established herein. Employees of the Commission shall be employed in accordance with the State merit system.

(j) All of the matters pending before the Air Pollution Control Commission upon the effective date of this Act shall, upon the effective date of this Act, be transferred to the jurisdiction of the new Commission herein established, and all actions heretofore taken and jurisdiction heretofore exercised by the Air Pollution Control Commission shall be considered in all respects as having been acts of the new Commission established herein. All books, records, equipment, facilities, funds allocated to or in its possession (including unexpended appropriations), notes and accounts receivable and all other property of every kind whatsoever of the Air Pollution Control Commission upon the effective date of this Act shall, upon the effective date of this Act, be transferred to, vest in and become the property of the new Commission established herein, and all contracts, leases, debts, obligations and liabilities of every kind whatsoever of the Air Pollution Control Commission upon the effective date of this Act shall, upon the effective date of this Act, be transferred to, inure to the benefit of and be binding upon the new Commission established herein, it being the intent of this Act that the new Commission established herein supersede and replace, but continue all business and affairs of the Air Pollution Control Commission.

Section 5. Rules and Regulations. The Commission, pursuant to procedures prescribed in Section 13 of this Act, may adopt regulations to promote the purposes of this Act. Without limiting the generality of this authority, such regulations may among other things prescribe:

(a) Ambient air quality standards specifying the maximum permissible short-term and long-term concentrations of various air contaminants in the atmosphere;

(b) Emission standards specifying the maximum amounts

or concentrations of air contaminants that may be discharged into the atmosphere;

(c) Standards and conditions regarding the sale, offer, or use of any fuel, or other article determined to constitute an air pollution hazard, or which could constitute an air pollution hazard;

(d) Alert and abatement standards relative to air pollution episodes or emergencies constituting an acute danger to health or to the environment;

(e) Requirements and procedures for the inspection of any equipment, facility, vehicle, vessel, or aircraft that may cause or contribute to air pollution;

(f) Requirements for making reports containing information as may be required by the Commission concerning location, size and height of contaminant outlets, processes employed, fuels used and the nature and time periods or duration of emissions, and such other information as is relevant to air pollution.

(g) Effective and application dates, however, unless otherwise specified by the Commission, all rules, regulations, standards, requirements, procedures, orders, resolutions, prohibitions, amendments thereto, or repeal thereof, shall become effective and applicable upon adoption by the Commission.

Section 6. Other Powers and Duties of the Commission. In addition to other powers conferred on it by law, the Commission shall have power to:

(a) Hold hearings relating to any aspect of or matter in the administration of this Act, and in connection therewith, compell the attendance of witnesses and the production of evidence, through subpoena as hereinafter provided.

(b) Issue such orders as may be necessary to effectuate the purposes of this Act and enforce the same by all appropriate administrative and judicial proceedings.

(c) Require access to records relating to emissions which cause or contribute to air contamination.

(d) Secure necessary scientific, technical, administrative and operational services, including laboratory facilities, by contract or otherwise.

(e) Prepare and develop a comprehensive plan or plans for the prevention, abatement and control or air pollution in this State.

(f) Encourage voluntary cooperation by persons and affected groups to achieve the purposes of this Act.

(g) Encourage and conduct studies, investigations and research relating to air contamination and air pollution and their causes, effects, prevention, abatement and control.

(h) Determine by means of field studies and sampling the degree of air contamination and air pollution in the State and the several parts thereof.

(i) Make a continuing study of the effects of the emission of air contaminants from motor vehicles on the quality of the outdoor atmosphere of this State and the several parts thereof, and make recommendations to appropriate public and private bodies with respect thereto.

(j) Collect and disseminate information and conduct educational and training programs relating to air contamination and air pollution.

(k) Advise, consult, contract and cooperate with other agencies of the State, local governments, industries, other states, interstate or interlocal agencies, and the Federal Government, and with interested persons or groups.

(l) Consult, upon request, with any person proposing to construct, install, or otherwise acquire an air contaminant source or device or system for the control thereof, concerning the efficacy of such device or system, or the air pollution problem which may be related to the source, device or system. Nothing in any such consultation shall be construed to relieve any person from compliance with this Act, rules and regulations in force pursuant thereto, or any other provision of law.

(m) Accept, receive and administer grants or other funds or gifts from public and private agencies, including the Federal Government, for the purpose of carrying out any of the functions of this Act. Such funds received by the Commission pursuant to this section shall be deposited in the State Treasury to the account of the Commission. In addition to the authority to accept, receive and administer grants or other funds from the Federal Government, the Commission is hereby designated as the State Air Pollution Control Agency for the purposes of the Federal Clean Air Act, as amended, Public Law 90-148, or any amendments thereto.

(n) Provide for the performance by its officers and employees, in the name of the Commission, of any act or duty necessary or incidental to the administration of this Act.

(o) Provide for the establishment of advisory committees, appointment of the membership of such committees, scope of investigation, and other duties, of such committees. The period of duration such committees and the terms of members of such committees shall be established by the Commission. No salary or compensation shall be allowed any member of such committees for services thereon. Actual and necessary travel subsistence, and other expenses incurred by members of such committees in the discharge of their official duties as members of such committees and when approved by the Chairman or the Director, by direction of the Commission, shall be paid at the rate allowed other State employees as provided by law from any funds which are or may become available for the purpose of this Act.

Section 7. Monitoring and Reporting.

The Commission may require the owner or operator of any air contaminant source to establish the maintain such records; make such reports; install, use and maintain such monitoring equipment or methods; sample such emissions in accordance with such methods, at such locations, intervals and procedures as the Commission shall prescribe; and provide such other information as the Commission reasonably may require.

Section 8. Additional Control Measures.

(a) The Commission may require that notice be given to the Director prior to the undertaking of the construction, installation or establishment or particular types or classes of new air contamination sources specified in its rules and regulations. Within fifteen days of its receipt of such notice, the Director may require, as a condition precedent to the construction, installation or establishment of the air contaminant source or sources covered thereby, the submission of plans, specifications and such other information as it deems necessary in order to determine whether the proposed construction, installation or establishment will be in accord with applicable rules and regulations in force pursuant to this Act. If within sixty days of the receipt of plans, specifications or other information required pursuant to this Section the Director determines that the proposed construction, installation or establishment will not be in accord with the requirements of this Act or applicable rules and regulations, he shall issue an order prohibiting the construction, installation or establishment of the air contaminant source or sources. Failure of such an order to issue within the time prescribed herein shall be deemed a determination that the construction, installation or establishment may proceed; provided that it is in accordance with the plans, specifications or other information, if any, required to be submitted.

(b) In addition to any other remedies available on account of the issuance of an order prohibiting construction, installation or establishment, and prior to invoking any such remedies, the person or persons aggrieved thereby shall; upon request in accordance with rules of the Commission, be entitled to a hearing on the order. Following such hearing, the order may be affirmed, modified or withdrawn.

(c) For the purposes of this Act, addition to or enlargement or replacement of an air contaminant source, or any major alteration therein, shall be construed as construction, installation or establishment of a new air contaminant source.

(d) Any features, machines and devices constituting parts of or called for by plans, specifications or other information submitted pursuant to subsection (a) hereof shall be maintained in good working order.

(e) Nothing in this Section shall be construed to authorize the Commission to require the use of machinery, devices or equipment from a particular supplier or produced by a particular manufacturer, if the required performance standards may be met by machinery, devices or equipment otherwise available.

(f) The absence or failure to issue a rule, regulation or order pursuant to this Section shall not relieve any person from compliance with any emission control requirements or with any other provision of law.

(g) The Commission by rule or regulation may prescribe and provide for the payment and collection of reasonable fees for the review of plans and specifications required to be submitted pursuant to this Section. All such fees when collected shall be deposited in the State Treasury to the account of the Division of Air Pollution Control of the State Department of Health.

Section 9. Inspections.

(a) Any duly authorized officer, employee, or representative of the Department may enter and inspect any property, premises or place on or at which an air contaminant source is located or is being constructed, installed or established at any reasonable time for the purpose of ascertaining the state of compliance with this Act and rules and regulations in force pursuant thereto. No person shall refuse entry or access to any authorized representative of the Department who requests entry for purposes of inspection, and who presents appropriate credentials; nor shall any person obstruct, hamper or interfere with any such inspection. If requested, the owner or operator

of the premises shall receive a report setting forth all facts found which relate to compliance status.

(b) The Department may conduct tests and take samples of air contaminants, fuel, process material or other material which affects or may affect emission of air contaminants from any source. Upon request of the Department, the person responsible for the source to be tested shall provide necessary holes in stacks or ducts and such other safe and proper sampling and testing facilities, exclusive of instruments and sensing devises as may be necessary for proper determination of the emission of air contaminants. If an authorized employee of the Department during the course of an inspection obtains a sample of air contaminant, fuel, process material, or other material, he shall give the owner or operator of the equipment or fuel facility a receipt for the sample obtained.

Section 10. Emission Control Requirements. —

The Commission may establish such emission control requirements, by rule or regulation, as in its judgment may be necessary to prevent, abate, or control air pollution. Such requirements may be for the State as a whole or may vary from area to area, as may be appropriate to facilitate accomplishment of the purposes of this Act, and in order to take account of varying local conditions.

Section 11. Emergency Procedure. —

(a) Any other provisions of law to the contrary notwithstanding, if the Director finds that a generalized condition of air pollution exists and that it creates an emergency requiring immediate action to protect human health or safety, the Director shall order persons causing or contributing to the air pollution to reduce or discontinue immediately the emission of air contaminants, and such order shall fix a place and time, not later than twenty-four hours thereafter, for a hearing to be held before the Commission. Not more than twenty-four hours after the commencement of such hearing, and without adjournment thereof, the Commission shall affirm, modify or set aside the order of the Director.

(b) In the absence of a generalized condition of air pollution of the type referred to in subsection (a), but if the Director finds that emissions from the operation of one or more air contaminant sources is causing iminent danger to human health or safety, he may order the person or persons responsible for the operation or operations in question to reduce or discontinue emissions immediately, without regard to the provisions

of Section 9 of this Act. In such event, the requirements for hearing and affirmance, modification or setting aside of orders set forth in subsection (a) shall apply.

(c) Nothing in this Section shall be construed to limit any power which the Governor or any other officer may have to declare an emergency and act on the basis of such declaration, if such power is conferred by statute or constitutional provision, or inheres in the office.

(d) In addition to, and without in any way limiting the foregoing, if the State Health Officer, in his capacity as Chairman of the Commission, or any three members of the Commission, determines at any time that air pollution, in any county, locality, place or other area in the State constitutes an emergency risk to the health of those present within said area of the State, and that the resources of the Commission are not sufficient to abate said air pollution, such determination shall be communicated in writing, with the factual findings on which such determination is based, to the Governor, the State Health Officer may delegate in writing to any employee of the Commission the power to make such determination and deliver the same to the Governor in the absence of the State Health Officer from the State. Upon being so advised the Governor shall by proclamation declare, as to all or any part of said area mentioned in the aforesaid determination, that an air pollution emergency exists, and upon making such declaration the Governor shall have the following powers which he may exercise in whole or in part by the issuance of an order or orders:

(1) Tho prohibit, restrict or condition motor vehicle travel of every kind, including trucks and buses, in the area;

(2) To prohibit, restrict or condition the operation of retail, commercial, manufacturing, industrial, or similar activity in the area;

(3) To prohibit, restrict or condition operation of incinerators in the area;

(4) To prohibit, restrict or condition the burning of other consumption of any type of fuel in the area;

(5) To prohibit, restrict or condition the burning of any materials whatsoever in the area;

(6) To prohibit, restrict or condition any and all other activity in the area which contributes or may contribute to the air pollution emergency;

(e) The declaration by proclamation of the Governor of

an air pollution emergency and any order issued by the Governor pursuant to such declaration shall be given maximum publicity throughout the State.

f) Any gubernatorial order may be amended or modified by further gubernatorial orders. Said order or orders shall not require any judicial or other order or confirmation of any type in order to become immediately effective as the legal obligation of all persons, firms, corporations and other entities within the State. Said order shall remain in effect for the duration of time set forth in same, and if no time limit is specified in said order, same shall remain in effect until the Governor declares by further proclamation that the emergency has terminated.

(g) The aforesaid orders of the Governor shall be enforced by the State and County Departments of Health, the State and local police, Commission personnel, the Alabama National Guard if same is authorized in the Governor's order, and such other persons or agencies as may be designated by the Governor. Those enforcing any Governor's order shall require no further authority or warrant in executing same than the issuance of the order itself. Those authorized to enforce said orders may use such reasonable force as is required in the enforcement thereof, and may take such reasonable steps as are required to assure compliance therewith including, but without limiting the generality of the foregoing, the following:

(1) Entering any property or establishment whatsoever, commercial, industrial, or residential believed, on reasonable cause, to be violating said order (excepting single or double family homes or any dwelling unit within a multiple dwelling unit larger than a double family home) and, if a request does not produce compliance, causing compliance with said order;

(2) Stopping, detouring, rerouting, and prohibiting motor vehicle travel and traffic;

(3) Disconnecting incinerator or other types of combustion facilities;

(4) Terminating all burning activities;

(5) Closing down or restricting the use of any business, commercial, retail, manufacturing, industrial or other establishment.

Where any person authorized to enforce such an order believes on reasonable cause that same is being violated in a single or double family residence or within the dwelling portion of a

larger multiple dwelling unit, said residence or dwelling portion thereof may be entered only upon obtaining a search warrant from any magistrate having power to issue same.

(h) Any person, firm or corporation or other entity aggrieved by any gubernatorial order upon application to the State Health Officer shall be granted a public hearing on the question of whether or not the continuance of any such order in whole or in part is unreasonable in the light of the then prevailing conditions of air pollution, the contribution to the same of any particular activity, and the purposes of this Act. Said public hearing shall be conducted as quickly as possible by said State Health Officer or his delegate who shall give public notice of same. The State Health Officer or his delegate shall have the power to compel attendance, testimony, and the production of documents by the use of subpoena powers. The number of witnesses and the extent of testimony shall be within his control. If the State Health Officer, upon conclusion of such hearing, determines that any such order should be terminated, or modified in any way whatsoever, he shall report such findings and recommendations to the Governor for such action as he deems appropriate.

Section 12. Variances.

(a) The Commission may grant individual variances beyond the limitations prescribed in this Act, whenever it is found, upon presentation of adequate proof, that compliance with any rule or regulation, requirement or order of the Commission would impose serious hardship without equal or greater benefits to the public, and the emissions occurring or proposed to occur do not endanger or tend to endanger human health or safety, human comfort, and aesthetic values. In granting or denying a variance the Commission shall file and publish a written opinion stating the facts and reasons leading to its decision.

(b) In granting a variance the Commission may impose such conditions as the policies of this Act may require. If the hardship complained of consists solely of the need for a reasonable delay in which to correct a violation of this Act or of the Commission regulations, the Commission shall condition the grant of such variance upon the posting of sufficient performance bond or other security to assure the correction of such violation within the time prescribed.

(c) Any variance granted pursuant to the provisions of this section shall be granted for such period of time, not exceeding one year, as shall be specified by the Commission at the

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time of the grant of such variance, and upon the condition that the person who receives such variance shall make such periodic progress reports as the Commission shall specify. Such variance may be extended from year to year by affirmative action of the Commission, but only if satisfactory progress has been shown.

(d) Any person seeking a variance shall do so by filing a petition for variance with the Commission, which shall promptly give notice of such petition in a newspaper of general circulation in the county in which the installation or property for which variance sought is located. The Director shall promptly investigate such petition, consider the views of persons who might be adversely affected by the grant of a variance, and make a recommendation to the Commission as to the disposition of the petition. If the Commission, in its discretion, concludes that a hearing would be advisable, or if any person files a written objection to the grant of such variance within 21 days, then a hearing shall be held, under the rules prescribed in Section 13 (b) of this Act, and the burden of proof shall be on the petitioner.

(e) If the Commission fails to take final action upon a variance request within 90 days after the filing of the petition, the petitioner may deem the request denied under this Act.

(f) A variance or renewal shall not be a right of the applicant or holder thereof but shall be in the discretion of the Commissions; however, any person adversely affected by a variance or renewal granted by the Commission may obtain judicial review by filing notice of appeal with the Register in Chancery of the Circuit Court in Equity in the county where the pollution source is located within twenty days from the action of the commission thereon. The case shall be heard by the Court under the same rules and with the same requirements as a petition for injunction would be heard. On appeal, the Circuit Court shall grant said variance unless it finds the operation of the air contamination source in the manner allowed in the variance would amount to a private or public nuisance, or unless it finds that the Commission acted arbitrarily and capriciously.

Section 13. Adopting Rules and Regulations.

(a) No substantive regulations shall be adopted, amended, or repealed until after a public hearing. At least 20 days prior to the scheduled date of the hearing the Commission shall give notice of such hearing by public advertisement in a newspaper of general circulation in the area of the state concerned of the

date, time, place and purpose of such hearing; and make available to any person upon request copies of the proposed regulations, together with summaries of the reasons supporting their adoption.

(b) Any public hearing relating to the adoption, amendment, or repeal of Commission regulations under this section shall be held before a hearing officer, who shall be designated by the Chairman. All such hearings shall be open to the public, and reasonable opportunity to be heard with respect to the subject of the hearing shall be afforded to any person. All testimony taken before the Commission shall be recorded stenographically. The transcript so recorded, and any written submissions to the Commission in relation to such hearings, shall be open to public inspection.

(c) After such hearing the Commission may revise the proposed regulations before adoption in response to testimony made at the hearing, without conducting a further hearing on the revisions.

(d) Any such regulations may make different provisions as required by circumstances for different contaminant sources and for different geographical areas; may apply to sources outside this State causing, contributing to, or threatening environmental damage in Alabama; and may make special provision for alert and abatement standards and procedures respecting occurrences or emergencies of pollution or on other short-term conditions constituting an acute danger to health or to the environment. In promulgating regulations under this Act, the Commission shall take into account the purpose of the Act.

(e) Nothing in this Section shall be construed to require a hearing prior to the issuance of an emergency order pursuant to Section 11 of this Act.

Section 14. Confidentiality of Records.

Any records, reports or information obtained under this act shall be available to the public, except that upon a showing satisfactory to the Commission by any person that records, reports, or information, or particular part thereof, (other than emission data) to which the Commission has access if made public, would divulge production or sales figures or methods, processes or production unique to such person, or would otherwise tend to affect adversely the competitive position of such person by revealing trade secrets, the Commission shall consider such record, report, or information or particular portion thereof confidential in the administration of this Act.

Nothing herein shall be construed to prevent disclosure of such report, record or information to Federal, State, or local representatives as necessary for purposes of administration of any Federal, State or local air pollution control laws, or when relevant in any proceeding under this Act.

Section 15. Local Programs

(a) Except as provided herein, it is the intention of this Act to occupy by pre-emption the field of air pollution control within all areas of the State of Alabama. However, nothing herein shall be construed to limit or abrogate any private remedies now available to any person for the alleviation, abatement, control, correction, or prevention of air pollution or restitution for damage resulting therefrom.

(b) Subject to the provisions of this Section, each municipal governing body, which had municipal ordinances in effect on or before July 1, 1969, which pertain to air pollution control and which provide for the creation and establishment of an air pollution control board, and each county Board of Health shall have the authority to establish, and thereafter administer, within its jurisdiction a local air pollution control program, which:

(1) Provides, subject to subsection (d) by ordinance, regulation, or resolution, for requirements for the control or prevention of air pollution consistent with, or more strict than, those imposed by this Act or the rules, regulations and standards promulgated by the Commission hereunder;

(2) Provides for the enforcement of such requirement by appropriate administrative and judicial process. Each such municipal governing body and each county Board of Health establishing a program hereunder is hereby authorized and required to advertise and adopt all rules and regulations in accordance with the same procedure provided herein for the adoption of said rules, regulations and standards by the Commission, and all judicial remedies provided by this Act shall be available and enforceable by such municipal governing body and by such county Board of Health: and

(3) Provides for administrative organization, staff, financial and other resources necessary to effectively and efficiently carry out its program. The Board of County Commissioners of each county, and the council or other governing body of each municipal governing body within the jurisdiction of a local air pollution control program established by a county Board of Health, is hereby authorized to appropriate such sums as it

may determine necessary and desirable for the establishment, administration and enforcement of such a program.

(c) No county Board of Health shall have the authority to exercise air pollution control jurisdiction within the bounds of any incorporated municipality or the police jurisdiction thereof having an air pollution control program as herein before authorized.

(d) Any such municipal governing body and each county Board of Health may adopt and enforce any ordinance, regulation, or resolution requiring the control or prevention of air pollution as follows:

(1) Where any ordinance, regulation, or resolution is identical in substance to requirements for the control or prevention of air pollution imposed by this Act or the rules, regulations and standards promulgated by the Commission hereunder, then such ordinance, regulation, or resolution may be adopted and enforced without further approval of the Commission.

(2) Where any ordinance, regulation, or resolution provides for the control or prevention of air pollution regarding classes or types of sources or classes or types of air contaminants for which the Commission has not promulgated rules, regulations or standards applicable to such sources or air contaminants within the area of jurisdiction of the local air pollution control program of such municipal governing body or county Board of Health, then such ordinance, regulation, or resolution may be adopted and enforced without further approval of the Commission.

(3) Where any ordinance, regulation, or resolution is adopted which provides for requirements for the control or prevention of air pollution for particular classes or types of sources or classes or types of air contaminants which requirements are more strict than those imposed by this Act or the rules, regulations and standards promulgated by the Commission hereunder which are applicable within the area of jurisdiction of the local air pollution control program of such municipal governing body or county Board of Health, then such ordinance, regulation, or resolution may not be enforced unless the Commission finds within 60 days of such adoption that such ordinance, regulation, or resolution is compatible with the purposes of this Act and with any comprehensive plan adopted by the Commission pursuant to Section 6 of this Act.

(4) Each such municipal governing body or county Board of Health shall notify the Commission of the adoption of any

ordinance, regulation, or resolution requiring the control or prevention of air pollution and provide to the Commission a certified copy of such ordinance, regulation, or resolution within 15 days of such adoption.

(e) (1) If the Commission has reason to believe that a local air pollution control program established pursuant to subsection (b) is inadequate to prevent and control air pollution in the jurisdiction to which such program relates, or that such program is being administered in a manner inconsistent with the requirements of this Act, the Commission shall, on due notice, conduct a hearing on the matter.

(2) If, after such hearing, the Commission finds that such program is inadequate to prevent and control air pollution in the jurisdiction to which such program relates, that such program is not accomplishing the purposes of this Act, that such program is not adhering to the requirements of subsection (f), or that such program is being administered in a manner inconsistent with requirements of this Act, the Commission may preempt the local enforcement authority of such program.

(f) (1) Each municipal governing body or county board of health which has established and administers a local air pollution control program pursuant to this section shall submit to the Commission a detailed report of its activities during the previous year. Such annual report shall be submitted as of October 1 of each year. Such reports shall include, but not be limited to, information regarding:

(i) Ordinances and resolutions adopted or under consideration requiring control or prevention or air pollution; and administrative procedures followed in such adoption;

(ii) Administrative organization;

(iii) Staff, financial and other resources;

(iv) Enforcement activities;

(v) Emission inventories;

(vi) Air quality monitoring systems and data;

(vii) Progress and problems related to administration of the local air pollution control program; and,

(vii) Any other information which the Commission may reasonably require.

(2) The Commission may also require special interim reports by such municipal governing body or county board of

health regarding activities of its local air pollution control program.

(g) Nothing in this section shall be construed to prohibit the Commission from enforcing any provision of this Act or any rule or regulation issued thereunder, nor to supersede or oust the jurisdiction of the Commission in any matter.

Section 16. Motor Vehicle Trains, Boats, Ships, Airplanes, Rockets and all other self-propelled vehicles which may travel upon the land, waterways, or through the air in or above the State of Alabama Pollution

(a) As the state of knowledge and technology relating to the control of emissions from motor vehicles may permit or make appropriate, and in furtherance of the purposes of this Act, the Commission may provide by rules and regulations for the control of emissions from any class or classes of motor vehicles. Such rules and regulations may in addition, prescribe requirements for the installation and use of equipment designed to reduce or eliminate emissions and for the proper maintenance of such equipment and of such vehicles.

(b) (1) The Commission may establish standards and requirements providing for periodic inspections and testing of motor vehicles by the Commission to enforce compliance with this section.

(2) The Commission may establish reasonable fees for the inspection and testing of motor vehicles and provide by rules and regulations for the payment and collection of such fees.

(3) If, after inspecting and testing any motor vehicle, the Commission determines that such motor vehicle complies in every respect with rules, regulations, standards and requirements issued by the Commission pursuant to this section, the Commission shall attach to such vehicle in a clearly visible location a certificate of inspection and approval.

(c) (1) The Commission may suspend or revoke the certificate of inspection and approval of any motor vehicle not equipped with an air pollution control system or mechanism in good working order and adjustment as required by the rules and regulations of the Commission. The vehicle shall not thereafter be eligible for such certificate until all parts and equipment constituting operational elements of the motor vehicle have been restored, replaced or repaired and are in good working order.

(2) No motor vehicle shall be issued an official certifi-

cate of inspection and approval as required pursuant to this section, unless all features or equipment required in or on the motor vehicles for the purpose of controlling emissions therefrom have been inspected in accordance with the standards and testing techniques required by the Commission pursuant to sub-section (b) hereof and have been found to meet these standards.

(3) No person shall drive or move and no owner shall cause or knowingly permit to be driven or moved on any highway any motor vehicle unless the vehicle is equipped with an air pollution control system or mechanism in good working order and adjustment as required by rules and regulations of the Commission.

(4) When, and if, the Commission shall establish standards and requirements for periodic inspections and testing of motor vehicles pursuant to sub-section (b) hereof, no person shall drive or move and no owner shall cause or knowingly permit to be driven or moved on any highway any motor vehicle unless there is attached to such vehicle by the Commission a valid certificate of inspection and approval which has not been suspended or revoked.

(5) Failure to comply with subparagraphs (3) and (4) of this sub-section shall subject the driver or owner to a penalty as provided in this Act.

(d) The Commission, in its discretion, is hereby authorized to delegate any or all of the authority vested in it by this section to any agency or instrumentality of the state now or hereafter authorized to inspect motor vehicles for any purpose.

(e) As used in this section "motor vehicle" shall mean every self-propelled device in, or upon or by which any person or property is or may be transported or drawn upon a public highway.

Section 17. Penalties and Citations.

(a) Any person who violates any provision of this Act, or any regulation adopted by the Commission, or who violates any determination or order of the Commission pursuant to this Act, shall be liable to a penalty not to exceed $10,000 for said violation and an additional penalty not to exceed $10,000 for each day during which violation continues, which may be recovered by the Commission in a civil action in the Circuit Court, and such person may be enjoined from continuing such violation.

(b) Any money so recovered shall be deposited in the State Treasury to the account of the Commission.

(c) It shall be the duty of the Attorney General of the State, or of the District Attorney of the Judicial Circuit under his direction, to bring such actions, in the Circuit Court at the request of the Commission in the name of the State of Alabama. Prosecution may also be commenced under this section by the Commission.

(d) Any person who knowingly violates or fails or refuses to obey or comply with this Act or any rule or regulation adopted thereunder or knowingly submits any false information under this Act or any rule or regulation thereunder shall be guilty of a misdemeanor and upon conviction may be sentenced to hard labor for the county for not more than one year.

(e) The Commission may, by rule or regulation, authorize the Director to issue citations to any person violating this act, or any rule or regulation of the Commission, commanding said person to cease and desist from violating this act, or any rule or regulation adopted pursuant to this act. The citation shall specify the provision of this act, or rule, or regulation alleged to be violated and shall specify, generally, the facts alleged to constitute a violation thereof. Said citation shall command the person to appear at a hearing in person, or by attorney, at a time and place specified before the Commission and show cause why a prosecution for the violation of this act, or of any rule or regulation of the Commission, should not be commenced. No citation shall be issued for an appearance before the Commission on a date less than ten days next after the issuance thereof, except when an emergency air episode has been declared, in which case appearance may be required within twenty-four hours. The citation may be directed to a business or corporation, or to the president, manager, superintendent, or other person in charge of the business or corporation. The citation may be executed by leaving a copy thereof at any office of the business or corporation, or by leaving a copy with some person at said office or at the residence of the president, manager, superintendent, or other person in charge.

(f) The issuance of a citation shall not be a condition precedent to the beginning of a prosecution under the sections (a) & (b) hereof, however, where a citation has been issued the accused shall be afforded an opportunity to be heard upon said citation before any prosecution is commenced hereunder. At the conclusion of the hearing on the citation, the Commission may cause a prosecution to be commenced for said violation in which

case the Chairman, Director, or any member of the Commission shall appear before a magistrate authorized to take oath and issue warrants of arrest for State law in the county where the air contaminant source is located and make affidavit setting out the finding of the Commission. The magistrate shall forthwith issue a warrant of arrest for the party charged commanding any sheriff or any officer of the State authorized by State law to execute warrants of arrest for violation of State law to arrest the defendant and forthwith bring him before him. The warrant shall be returnable to the Circuit Court of the county where the air contamination source is located. The Commission shall not cause a prosecution to be commenced if it finds that the proximate cause of the alleged violation was not the fault of the alleged defender.

(g) The testimony taken at any hearing may be under oath and may be recorded stenographically, but the parties shall not be bound by the strict rules of evidence prevailing in the courts of law and equity. True copies of any transcript and of any other record made of or at such hearing shall be furnished to any party hereto upon request and at his expense.

(h) Any hearing required by this Act to be held before the Commission shall be held before a hearing officer designated by the Chairman who shall have power to subpoena witnesses and compel their attendance, administer oaths and require the production for examination of any books or papers relating to any matter under investigation in any such hearing. The hearing officer, at the request of any interested person, may subpoena and compel the attendance of such witnesses as such person may designate and require the production for examination of any books or papers relating to any matter under investigation in any such hearing.

(i) Any duly designated employee of the Commission, including any hearing officer, may administer oath to witnesses and may conduct hearings or investigations and any such duly designated employee of the Commission may sign and issue subpoenaes requiring persons to appear before him or the Commission and the Commission, through its designated officers, shall have the power to serve said subpoenas upon any such person by sending a copy of such subpoena through the United States mail, postage prepaid, which said mail shall be registered with return receipt attached and such service shall be complete when said registered mail shall be delivered to said person and such receipt returned to the Commission or its designated employee, signed by the person sought to be subpoenaed. Obedience to a subpoena issued by the Commission or any

person authorized and designated by the Commission to issue said subpoena may be enforced by application to any judge of the Circuit Court of the county in which said subpoena was issued or to the judge of any Circuit Court in which such person subpoenaed resides in the same manner as is provided by law for the grand jury of a county to enforce its subpoenaes and with the same penalty as provided therefor for the failure of any person failing or refusing to comply with such subpoena.

(j) The State Air Pollution Control Commission, the Attorney General, or any District Attorney, may file in the Circuit Court, sitting in equity, in the county in which the air contamination source is located, a bill or petition to enjoin the maintenance or operation of any air contamination source in violation of this act or any rule or regulation adopted pursuant to it. No bill or petition shall be filed by the Commission unless the filing of same has first been authorized by the Commission. The filing, presentation, and hearing of a bill or petition, as herein authorized, and the dissolution of any injunction issued pursuant thereto, and including appeals from the judgment of the Circuit Court, in Equity shall be governed by the general laws of the State of Alabama, which now or hereafter may govern applications for injunctive relief, except as herein provided. The Court shall not grant a temporary injunction unless it has a reasonable cause to believe that a respondent is operating or maintaining an air contamination source in violation of this act or in violation of any rule or regulation adopted pursuant thereto. The Court shall, upon final hearing, if the proof be sufficient, grant a final injunction restraining the respondent from operating or maintaining said air contamination source. No bond shall be required in any proceedings under this subsection.

Section 18. Permits. —

(1) The Commission by regulation shall prohibit the construction, installation, modification, or use of any equipment, device, or other article which it finds may cause or contribute to air pollution or which is intended primarily to prevent or control the emission of air pollutants, unless a permit therefor has been obtained from the Director.

(2) The Commission may require that applications for such permits shall be accompanied by plans, specifications, and such other information as it deems necessary.

(3) The Commission shall provide for the issuance, suspension, revocation and renewal of any permits which it may require pursuant to this section.

(4) No person shall construct, install, modify or use any equipment, device or other article designated by regulations, capable of causing or contributing to air pollution or designated to prevent air pollution without a permit from the Director or in violation of any conditions imposed by such permits.

Section 19. Severability. The provisions of this Act are severable and if any part, section, subsection, clause, paragraph or phrase of this Act shall be adjudged to be invalid or unconstitutional by any court of competent jurisdiction, the judgment shall not affect, impair or invalidate the remainder of this Act, but shall be confined in its operation to the part, section, subsection, clause, paragraph or phrase of this Act that shall be directly involved in the controversy in which such judgment shall have been rendered.

Section 20. Repealer. This Act is intended to supplement existing law, and no part thereof shall be construed to repeal any existing laws specifically enacted for the protection of health or the control of radiation; however, Act No. 1135, Regular Session of 1969 (Gen. Acts 1969, p. 2100) is hereby expressly repealed.

Section 21. Effective Date. This Act shall become effective immediately upon its passage and approval by the Governor, or upon its otherwise becoming law.

Approved September 3, 1971.

Time: 10:00 A.M.

I hereby certify that the foregoing copy of an Act of the Legislature of Alabama has been compared with the enrolled Act and it is a true and correct copy thereof.

Given under my hand this 16th day of September, 1971.

JOHN W. PEMBERTON
Clerk of the House

Mr. ROGERS. Thank you, Dr. Hardy. Would you tell us just for the knowledge of the committee if there are any extraordinary powers in the Alabama law to act on an emergency air pollution problem?

Dr. HARDY. There are, indeed, Mr. Rogers, and I would defer specific answer, if I might, to Mr. John Daniel from the State health department—the attorney working with that law.

Mr. ROGERS. That will be fine, Mr. Daniel is going to testify, is he?

Dr. HARDY. He will be with Mr. Willis during his testimony.

Mr. ROGERS. Fine, if they would cover it.

Are there any questions, Mr. Kyros?

Mr. KYROS. Just one or two. Dr. Hardy, you availed yourself of section 303 of the Clean Air Act to put into effect a temporary injunction. Is that correct?

Dr. HARDY. That is not quite correct, Mr. Kyros. That decision was made by representatives of the Environmental Protection Agency and under authority given to them by section 303 of the Clean Air Act. We agreed that further action needed to be taken. We could not take any further action.

Mr. KYROS. All primarily because the State law was not in effect?

Dr. HARDY. That is right.

Mr. KYROS. And there were no other legal means that you could have utilized?

Dr. HARDY. There were no other effective legal means that our attorneys could see at the moment.

Mr. KYROS. There was not at that time a possibility that you would get an agreement by all of the companies to act further—the companies which you said were in the inventory group that was putting the particulate out?

Dr. HARDY. At that time, we had spoken with industry representatives at least twice by phone and had received written replies. No further attempt at communication was made.

Mr. KYROS. Thank you very much.

Mr. ROGERS. Mr. Hastings.

Mr. HASTINGS. Thank you, Mr. Chairman, I am not quite clear as to whether or not you, in fact, in your official capacity requested EPA to take action under section 303 of the Clean Air Act.

Dr. HARDY. Mr. Hastings, we did not specifically request action. We concurred with a decision that action be taken.

Mr. HASTINGS. Then, there technically was no local request, local, county, or State to EPA to take action?

Dr. HARDY. There was technically no official request; however, there was complete concurrence.

Mr. HASTINGS. Thank you. I have no further questions, Mr. Chairman.

Mr. ROGERS. Who were the six of the 23 industries who indicated that they could not estimate the amount or that their actions would produce a reduction of 20 percent or less? Could you let us have their names?

Dr. HARDY. I would have to be speaking from memory, sir. These names have been released publicly, and I will be happy to make them part of this record for you.

Mr. ROGERS. Is there any indication in the letters that you received of—of those companies that you have submitted with your estimate?

Dr. HARDY. Yes, those reports are attached.

(See "Tabulation of estimated particle emission reduction achieved by 23 pollution sources as per request dated Nov. 16, 1971, p. 38, this hearing, and letters from industries in response to telegram dated Nov. 16, 1971, pp. 5–12, this hearing.)

Mr. ROGERS. Would it indicate that?

Dr. HARDY. Yes, sir. It will indicate that.

Mr. Chairman, if I may point out, there are differences among estimated degrees of compliance in the telephone survey, the written responses and statements issued after the injunction.

Mr. ROGERS. I think it might be well if you could submit for the record just a summary of which industries did what in that telephone response, if you have those names.

Dr. HARDY. Yes, sir. We have a typed summary to that effect. We will submit it to you.

(The summary referred to follows:)

TABULATION OF ESTIMATED PARTICULATE EMISSION REDUCTION ACHIEVED BY 23 POLLUTION SOURCES AS PER REQUEST DATED NOVEMBER 16, 1971

United States Steel Corporation. Requested time to consider action as of 10:15 a.m., November 17, 1971. No response received.

W. J. Bullock, Inc. Will shut down cupola at 12:00 noon, November 17, 1971, and achieve 75% emission reduction.

Woodward Iron. One blast furnace out of four operating; 75 out of 200 coke ovens operating. 30% reduction of emissions estimated.

Griffin Wheel. Bag house put on line. Approximately 100% reduction achieved.

Alpha Portland Cement. Unable to contact as of 10:15 a.m., November 17, 1971.

Belcher Lumber Company. Boiler usage down 75%.

United States Pipe. As of 10:15 a.m., November 17, 1971, has not returned our call requesting information.

Connors Steel. No reduction in production. Improved housekeeping activities only.

Vulcan Materials. Wylam plant closed down until Thursday, November 18, 1971. Other plants still operating.

McWane Cast Iron Pipe. Adjustments in cupola operation. Estimate 50% reduction.

Swift Agricultural Chemicals. Closed since Monday, noon, November 15, 1971.

United States Gypsum. One cupola down; 33% reduction.

Jefferson Foundry. Estimate 75% emission reduction.

Birmingham Stove and Range. Estimate between 25 and 50% reduction.

Wade Sand and Gravel Company. Increasing water usage. Estimate 80% reduction.

Stockham Valves & Fittings. No reduction in production. House cleaning improvements only.

Clow Corporation. Medium energy, wet scrubber activated. Claimed 90% reduction.

Southern Electric Steel. Shut down one furnace at 8:00 a.m. this morning, November 17, 1971. Estimate 50% reduction.

Lone Star Cement. One out of three kilns down; 33% reduction.

ACIPCO. No reduction in production. House cleaning adjustments. 20% reduction in emissions maximum.

Republic Steel. Coke ovens operating below normal capacities. Blast furnaces banked.

A.B.C. Improved operating conditions; approximately 50% reduction.

Mr. ROGERS. And also just a quick summary from what you got from a written reply. Now, who has not responded in writing, or have they all?

Dr. HARDY. There are still several companies that have not responded

in writing. We will make a list of these firms available to you in the summary handed out.

Mr. ROGERS. How many?

Dr. HARDY. Eighteen of 23 have responded. That would be five that have not responded.

Mr. ROGERS. Have not. You don't recall which five those are?

Dr. HARDY. No, sir. But I can have that available for you in 5 minutes.

Mr. ROGERS. I thought you indicated that maybe your Association might know. Do you?

Dr. HARDY. We just have two of the five. We have them available and will bring them to you.

Mr. ROGERS. Yes, sir. Yes, I think the committee would like to know that.

(The following information was received for the record:)

NAMES OF FIVE INDUSTRIES NOT RESPONDING TO TELEGRAM OF NOVEMBER 16

Connors Steel, Jefferson Foundry, Wade Sand and Gravel Company, Southern Electric Steel, and Lone Star Cement.

Mr. ROGERS. Thank you very much.

Dr. HARDY. Thank you, sir.

Mr. ROGERS. Our next witness is Mr. W. T. Willis, director of the technical staff, Division of Air Pollution Control, State of Alabama.

Mr. Willis, we welcome you and will be glad to receive your statement at this time.

STATEMENT OF WILLIAM T. WILLIS, DIRECTOR OF TECHNICAL STAFF, DIVISION OF AIR POLLUTION CONTROL, ALABAMA DEPARTMENT OF HEALTH; ACCOMPANIED BY JOHN DANIEL, STAFF ATTORNEY

Mr. WILLIS. Mr. Chairman Rogers, Mr. Kyros, Mr. Hastings, I am William T. Willis, director of the technical staff of the Division of Air Pollution Control of the State of Alabama Department of Public Health. Also with me is Mr. John Daniel, staff attorney of the Division of Air Pollution Control of the State of Alabama Department of Public Health, Also with me is Mr. John Daniel, staff attorney of the division of air pollution control.

It is a pleasure to have the opportunity to appear before this hearing to express the appreciation of the State of Alabama Department of Public Health Division of Air Pollution Control for the actions taken by the Environmental Protection Agency under the provisions of section 303 of the Clean Air Act as amended.

We feel that this action was necessary to protect the public health in this very serious situation and was undertaken and accomplished with the full support and concurrence of the division of air pollution control. However, we are unable to speak upon the sufficiency of section 303 since this is a Federal administrative procedure. In this situation, it appears that while there may be administrative problems associated with invoking its powers, on the surface, it seems to have worked efficiently in this episode.

In the complaint filed by the Justice Department it was alleged the appropriate State and local authorities have diligently attempted to

decrease the level of contamination in the atmosphere. Our one regret in this matter is that it was necessary for the Environmental Protection Agency to come to our assistance since under the provisions of the Alabama Air Pollution Control Act of 1971, the new State Air Pollution Control Commission does have adequate authority to cope with situations such as this once the agency has made operable its legal authority.

Under the provisions of the Alabama act, the commission is directed to appoint a director who shall have the powers delegated to him by the commission and assigned to him under the provisions of the law. Mr. Chairman, to clarify the term, I should point out at this time that I am not the director of the division of air pollution control as visualized by this law. Once the director is appointed by the commission, he is given broad powers under section 11 of the new State law to respond to emergency situations such as the one which presented itself here in Birmingham this week. This power is set forth in section 11 as follows:

Emergency Procedure.

(a) Any other provisions of law to the contrary notwithstanding, if the Director finds that a generalized condition of air pollution exists and that it creates an emergency requiring immediate action to protect human health or safety, the Director shall order persons causing or contributing to the air pollution to reduce or discontinue immediately the emission of air contaminants, and such other order shall fix a place and time, not later than 24 hours thereafter, for a hearing to be held before the Commission. Not more than 24 hours after the commencement of such hearing, and without adjournment thereof, the Commission shall affirm, modify, or set aside the order of the Director.

(b) In the absence of a generalized condition of air pollution of the type referred to in subsection (a), but if the Director finds that emissions from the operation of one or more air contaminant sources is causing imminent danger to human health or safety, he may order the person or persons responsible for the operation or operations in question to reduce or discontinue emissions immediately, without regard to the Provisions of Section 9 of this Act. In such event, the requirements for hearing and affirmance, modification or setting aside of orders set forth in subsection (a) shall apply.

As you will note, Mr. Chairman, that authority of the director will be every bit as broad and effective as that of the Administrator under section 303, and possibly more so since it will not be necessary to awaken a judge at 1 a.m. to invoke the authority. If the language in our act's emergency procedure section sounds familiar, it is because it was extracted from the Model State Air Pollution Control Act, and, as a result, has the approval of EPA as meeting its requirements that the State Agency have "authority comparable to that in section 303."

While, of course, we would hope that all air contaminants sources subjected to the director's orders would obey them, our State Act provides for sufficient penalties and injunctive procedures to enforce the orders if necessary. For instance, violation of the order subjects the violator to civil penalties of up to $10,000 per day, and knowing violations could result in a year's sentence for the violator. It is also possible for the new commission, the attorney general, or any district attorney to petition our State's circuit courts for injunction to enjoin the operation of any air contaminant source violating an order. I might add at this point, Mr. Chairman, that our division staff has already worked out procedures with the Alabama Attorney General, Mr. Bill Baxley, to keep him informed of all enforcement actions or possible enforcement action which might issue from the administration of our State

Air Pollution Control Act. In addition, Mr. Baxley has named several of his Department members to assist us and has assigned one assistant attorney general to be at our immediate disposal at all times. Most assuredly, when our act becomes operable, there will be no lack of resources, nor of determination, to see that, in the future, air pollution emergencies are forestalled or at least foreshortened.

Announcement of the appointment of the members of the new Air Pollution Control Commission was made on Monday of this week. As a result the commission was unable to meet prior to the creation of the episode conditions on Tuesday afternoon. It had been hoped by the commission chairman that the request made by the Jefferson County health officer to the 23 major pollution sources would be honored and would result in the alleviation of the problem. As late as Wednesday morning it still did not appear that State intervention in the situation would be needed. Therefore, at that point, it could be argued that employment of State action was not yet necessary. However, as the day wore on, it became evident that most of the pollution sources were not heeding the county health officer's request. By this time it was much too late to attempt to convene the State commission for its first meeting to attempt to use our State law.

The Environmental Protection Agency officials quite appropriately recognized that we were then unable to act and proceeded to use section 303.

Looking back, we can see that certain misjudgments were made; but looking forward, we are confident that within the week, the commission will be convened and will appoint, at least on an acting basis, a director who can exercise the authority available under State law.

Thus, we are optimistic that should further episodes occur, or should conditions likely to cause an episode occur, the appropriate State agency, acting through its director, could and would respond so as to negate the need for the Environmental Protection Agency to invoke section 303. This statement should not be interpreted as any criticism of the EPA for I feel I have already explained our pleasure over its action; nor should this be interpreted as discouraging further use of section 303 by the EPA in Alabama, for I think that the EPA would be derelict in its duty if a similar situation were presented in Birmingham and it failed to act.

To this point, Mr. Chairman, we have discussed the actual invoking of section 303's powers, but we both know that public health could better be protected, and commerce and business less disrupted if the factors bearing on the creation of the air pollution emergencies could be predicted, assessed, and reacted to prior to the need for section 303 action. Not the least of these factors is meteorological conditions conducive to an air pollution episode.

As you may be aware, the Weather Bureau of the Commerce Department's National Oceanic and Atmospheric Administration issues air stagnation advisories from time to time. Certainly these advisories are of assistance to the State and local air pollution control agencies of Alabama, and, of course, the prediction of meteorological conditions weighed heavily in Judge Pointer's decision to issue the temporary restraining order two mornings ago.

Almost 2 years ago, the Department of Commerce announced that the weather station here in Birmingham would be upgraded to provide

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for the latest in air stagnation prediction capability. The Department's promise should have resulted in the establishment, in Birmingham, of an Environmental Meteorological Support Unit, EMSU for short, which would have primary responsibility for preparation and issuance of Air Stagnation Advisories. To date, the Commerce Department has not delivered on its promise. The nearest EMSU facilities are in Houston, Tex., Louisville, Ky., and Washington, D.C., all far removed from Birmingham, Ala. This failure exists notwithstanding that Birmingham is probably the most episode prone industrial city in the Nation.

I need not tell you that developing this kind of capability is beyond the resources of my State's Air Pollution Control Agency, and I chance to say, every other State's agency. The Weather Bureau is looked to for leadership and provision of service in this area, and certainly, my agency needs their assistance.

Mr. Chairman, I know that your parent Committee on Interstate and Foreign Commerce has oversight authority on the Commerce Department, and more specifically, the Weather Bureau. And should nothing else be accomplished by this hearing, I beseech you to use your offices, which are not inconsiderable, to have an environmental meteorological support unit established here in Birmingham, forthwith. To delay further may deny to the appropriate Federal, State, and local air pollution control authorities the very necessary information to avoid further endangerment of the health of citizens of Birmingham and of Alabama.

Mr. Chairman, may we again express our appreciation for the opportunity to appear before this committee and express a few of our thoughts, and to assure you that the Division of Air Pollution Control appreciates the action taken in this situation by the Environmental Protection Agency and also to express to you our intention of cooperating to the maximum extent with the Federal authorities in developing effective air pollution control programs in Alabama which will protect the public health and enhance the quality of the lives of its citizens.

Thank you, Mr. Rogers.

Mr. ROGERS. Thank you, Mr. Willis, very much for your statement and your explanation of the State law. A copy of that law has already been placed in the record by Dr. Hardy. (See exhibit C, p. 13, this hearing.)

Mr. KYROS. Mr. Willis, regarding the air monitoring devices giving you the more than 625 micrograms of concentration particulation, were those company devices, or were they devices provided by your own agency?

Mr. WILLIS. No, sir. The State of Alabama works very closely with the local air pollution control agency here in Jefferson County. These particulate devices are operated by the Jefferson County Health Department.

Mr. KYROS. I see. So, it was their own readings when the figures went over 700 micrograms?

Mr. WILLIS. Yes, sir.

Mr. KYROS. Now, wasn't it possible even though the local Alabama law hadn't gone into effect, to go to the Governor to seek exercise of his police power before you utilized section 303 of the Clean Air Act?

Mr. WILLIS. Mr. Kyros, as I understand section 303, I do not think that the EPA is required to go through this procedure. In other words,

the EPA, as I understand it, is authorized to act on its own in this area. They do not have to have the specific request of the State of Alabama, the Governor or anyone else.

Mr. KYROS. I agree with you, but, nevertheless, the law also provides that State action must not be pre-empted. My question was: Was there any attempt to go to the Governor to seek exercise of his police powers to abate the pollution?

Mr. WILLIS. No, sir, at the meeting which Dr. Hardy referred to, which occurred in the afternoon on Wednesday, the state attorney general, representatives of the State health department, myself, the County Health Department, and EPA, gathered into the room, reviewed the technical information that was available to us, reviewed the situation as far as the various factors were concerned.

Now, I think, Mr. Kyros, that we must remember here that at this point and time, we had experienced two days of levels in excess of 700. The people present from EPA had indicated that this was equivalent to a level of 1,000 micrograms for 24 hours at which imminent and substantial danger to the public health is manifest. Under these conditions, that at that point in time, the most appropriate route to go was in joining immediate action in order to protect the public health, and this was the prime consideration—the only consideration was to protect the public health.

Mr. KYROS. And you say the State's attorney general took part in those deliberations?

Mr. WILLIS. He was present.

Mr. KYROS. So, in effect, the Governor was represented, and, then, you apparently had exhausted all State remedies?

Mr. WILLIS. If I may explain, the attorney general wasn't considered present at these meetings. The attorney general is a constitutional officer who is elected by the people of the State and is not a member of the Governor's State staff and is not subject to the Governor's discretion, but the assistant attorny general that was with us during these deliberations expressed his opinion that at that point the State had exhausted its remedies. Now, we—we, of course, had to rely on his determination, and, I think it was on this basis that—that the Environmental Protection Agency took its action.

Mr. KYROS. Then, in the light of the action that happened here in Birmingham, you feel it may have helped, and, you feel that section 303 is well drafted to protect a State until it gets the authority that it needs to act to abate pollution?

Mr. DANIEL. Yes, sir. And I think that one thing that Mr. Willis said should be mentioned here, that section 303 does not anticipate that there must be any request from any local or State official. If that was the case, in several States, the Environmental Protection Agency would never be obligated to invoke its authority. But, it does depend on the determination by the Administrator independent of any kind of opinion that the State might express, and I think that its powers are—are specific enough to accomplish what it is to accomplish.

I might also mention that we were—we were shocked that the determination was made to invoke the authority since this was the first time since this law has been in effect. It was in effect actually back in 1968 when you enacted the Air Quality Act in 1967, and your own committee last year in deliberations leading up to the enactment of the Clean Air Act Amendment of 1970 had expressed some very

serious doubts over whether the National Air Pollution Control Commission was effectively administering the law.

The powers are there, and it's at least good that they have now been invoked, and maybe we can see with some later analysis what it meant. It's still a little too early to determine whether it needs to have any kind of reworking.

Mr. KYROS. Thank you very much, sir.

Mr. HASTINGS. Mr. Chairman, Mr. Kyros, Mr. Willis, you just stated that you were in concert with the action taken by EPA. There is no reservation about that?

Mr. WILLIS. That's correct, Mr. Hastings. We had exhausted all available means to cope with this situation, the public health of the community was endangered, and, so, we had no reservation whatsoever in the EPA pursuing the actions they did.

Mr. HASTINGS. Was there any request on the part of your Agency to the EPA to take this action?

Mr. WILLIS. In a technical sense, there was no formal request on our part. In the discussions, I did contribute to encouraging that they go ahead and take this action.

Mr. HASTINGS. Just to get the record completely straight, at the point of time where EPA invoked 303, there was no local or State legislation—of course, I realize that your Air Pollution Control was not in effect, but there was no other available source or remedy available to you or any local authority other than the action taken by EPA?

Mr. WILLIS. This was the opinion of the representative from the attorney general's office, Mr. Hastings.

Mr. HASTINGS. Just following up the question that Mr. Kyros asked where the Governor could have invoked some police power, I am not sure that it would be available to him.

Mr. WILLIS. I am not sure that he could invoke——

Mr. DANIEL. This is an unusual situation. I don't know that any Governor has ever invoked the broad police powers of a Governor in—in this type of a situation. It's also been the thought that a Governor has had broad police powers that were inherent and he has had some other powers—the invocation of the Governor's powers—which were soon struck down by the Federal courts. There is at least some doubt as to whether or not the Governor has such powers, but it was at least the opinion of the attorney general's staff that we had exhausted our remedies.

Mr. WILLIS. Mr. Hastings, I might emphasize, if I may, that we are dealing with what is classified and defined by the Government agency, EPA, as an imminent and substantial danger to the public health. Certainly, we tried to go to other legal remedies. We had nothing to indicate at this point in time that there was any relief in sight, and, so, we felt we were justified in trying to seek an unknown remedy where the health of the citizens of this community had been declared in an imminent and substantial danger. We took this as the prime motivating factor of moving at this point in time.

Mr. HASTINGS. I suggest that's the reason we put the section into the law and also so that it might be a little easier for any Governor to allow EPA and Federal agencies to take action because of the possible sensitivity of an act on the part of the local agency.

Thank you, I have no further questions.

Mr. ROGERS. Mr. Willis, you pointed out that the Commerce Department has not responded as they indicated they would in giving you the necessary equipment. We will check into that and see if we can be helpful.

Mr. WILLIS. Thank you, Mr. Rogers.

Mr. ROGERS. This is often one of the problems—the lack of followthrough in some of these governmental agencies sometimes because of fundings. Of course, I am sure you realize that, but we will check and see if we can be helpful.

Mr. DANIEL. This is the kind of project that was announced 2 years ago by the Commerce Department and has been reannounced on a regular schedule. We keep wondering when it's going to be established, but it certainly would be a help to our agency.

Mr. ROGERS. I think it would be helpful if you would let us have a copy of that letter where it was announced and no followthrough. Did the State agency ask industry to cut down pollution at all? Was this simply handled through the county office?

Mr. WILLIS. This is handled through the county health office.

Mr. ROGERS. With your consent?

Mr. WILLIS. Yes. Under the State law, the State agency can recognize local authority; in fact, they are specifically authorized, and Jefferson County has passed a resolution by the county health department which authorizes them to develop an air pollution control agency. So, the State agency recognizes the autonomy of the local health department.

Mr. ROGERS. Let me ask you this: Are you in the process of developing your State plan for air pollution control?

Mr. WILLIS. Yes, sir. We are working very closely with our contractor, TRW Associates. The EPA and our staff are working diligently to bring this implementation plan to completion. We are anticipating at this point in time that a group of public hearings will be made in the near future and they will be conducted probably the first part of January so that we might submit this to the Adminisrator of EPA, and then we can begin to effectively regulate air pollution in Alabama.

Mr. ROGERS. As I recall the law, we asked that State plans be presented by the end of January, I believe.

Mr. WILLIS. That's correct. Yes, sir.

Mr. ROGERS. You anticipate your time schedule will permit you to submit that plan?

Mr. WILLIS. It's going to be close, but we are anticipating making it.

Mr. ROGERS. That you will be able to do. Also, as I recall the law, that as soon as you present a plan, before the Federal Government comes in on an emergency situation, they would come in only after notification of the State government and only in emergency situations where it's necessary.

Mr. WILLIS. Yes, sir.

Mr. ROGERS. When we wrote this, we didn't go quite as far as you have done in the State agency where you allowed an Administrator's decision to close a plant or to require a reduction of pollutants.

Mr. WILLIS. That's correct.

Mr. ROGERS. Do you think we should consider changing the Federal law whereas you won't have to go back to a judge up there at 1:30 at

night or go find a judge to allow the Administrator to make that determination and have a judge hold a later hearing? What would be your feeling about that?

Mr. WILLIS. Mr. Chairman, this is really a rather awesome responsibility, but I think you must realize that this would only be invoked in an extreme emergency where the public health is in a dire emergency. Whether it's wise for Congress to want to modify the section 303 to provide this authority to the Administrator would be a matter of opinion, and I certainly, personally, would have some reservations about it.

Mr. ROGERS. Yeah. Well, I think the reason we didn't do it, and we discussed doing that, is that we felt that coming in on an emergency basis—it would give assurance to the people in the whole area if they went through a regular court process, even though it was an extraordinary process.

Mr. WILLIS. Yes, sir.

Mr. ROGERS. And I get the sense of it from your testimony that you feel that it is not a bad technique.

Mr. WILLIS. No, sir. I do not feel that it is unduly burdensome.

Mr. ROGERS. All right. Are there any other questions?

Thank you very much. We are grateful to you for your presence here today.

Our next witness will be Mr. Robert Baum, Assistant General Counsel for Air Pollution, Environmental Protection Agency, accompanied by Mr. Darrell Tyler, Head of Emergency Operations Control Center, Environmental Protection Agency.

We welcome you gentlemen here today and will be pleased to receive your testimony.

STATEMENT OF ROBERT BAUM, ASSISTANT GENERAL COUNSEL FOR AIR POLLUTION, ENVIRONMENTAL PROTECTION AGENCY; ACCOMPANIED BY DARRELL TYLER, HEAD OF EMERGENCY OPERATIONS CONTROL CENTER AT DURHAM, N.C.

Mr. BAUM. Thank you, sir.

Mr. Chairman and members of the committee, it's a pleasure to be here, and what I plan to do is very briefly go through chronologically the actions and consideration of EPA in the last few days with regard to the Birmingham episode. I have here, as you have indicated, Mr. Chairman, Darrell Tyler, who is the operator of the center in Durham. This group is a group that works full time in monitoring conditions throughout the United States, both in terms of air quality and meteorological conditions to be able to determine if there will be emergencies. They receive air quality data on a daily basis from 60 cities. They receive the latest meteorological information daily from throughout the Nation.

On Monday when the Weather Bureau issued the air stagnation advisory, this group, of course, was aware of that and immediately contacted the Birmingham program. Due to some equipment malfunction, there were no readings from the monitoring equipment for particulate matter on Monday. The first reading that we got was on Tuesday, and it was a 24-hour average. It was an 8 o'clock reading Tuesday morn-

ing which means that it is a reading which covered the previous 24 hours ending at 8 o'clock Tuesday morning, and that level was 771 micrograms per cubic meter of air. That, of course, was an extremely high reading.

At that point, there was almost constant communication between the Durham group headed by Mr. Tyler and the local people in the air pollution control program in Jefferson County, the General Counsel of the Environmental Protection Agency in Washington and the State of Alabama and other people throughout the Environmental Protection Agency who have knowledge and interest in these types of activities as the day went on.

On Tuesday, Mr. Tyler, in conversation with the local program, was particularly interested in two things: One, at that time we were not absolutely certain of the legal authority possessed by the State nor the county. We knew there were questions concerning it, but we couldn't absolutely certify as to what they could do. We were, of course, told of the attempt at voluntary reduction asked for by Jefferson County.

Now, in this respect, I want to point out that approximately 1 month prior to this incident in Birmingham, there had been another incident when the levels had started to rise here, not to the extent that they did this time. Now, at that time, again the emergency operation group was in conact with the Jefferson County program, and they told us that they had achieved some reduction emission by voluntary compliance. Because of our previous experience here, we had to wait a certain amount of time to make certain what was going on. We were hopeful that there would again be sufficient voluntary compliance to make some change in these readings.

Now, as Tuesday went on, Mr. Tyler, again, in contact with the Birmingham people, began to come to the conclusion that it was time for us to step up our preparation to act or to prepare for action. We had indication from Jefferson County that the voluntary action was not as good as they would have hoped for. They sent out the formal notice to industry, the written notice asking for written response within 24 hours, and the Tuesday afternoon reading was still high. It was 722 micrograms per cubic meter of air. I contacted the Department of Justice to alert them to the fact that we might be coming to Birmingham just so they would be able to assign someone in Washington to work with us, and also to alert the U.S. Attorney's office here in the event that they had to come down.

By Tuesday evening, it was pretty clear that we should come down here to be on the scene in the event that action by the Federal Government was needed. No decision was made to take any action, but, again, we decided we better get here. By Wednesday morning, we were ready to go, and Mr. Tyler had specifically requested the Jefferson County program that the main thing we would be interested in when we got here was what has been done? Some of the responses to the written request by the program—by the Jefferson County program—were not expected to be in by that time, and we advised that Dr. Hardy should call the industries that he had not heard from so that we would be able to review that situation upon arrival.

We all arrived here at about 2:30, coming from different areas. In addition to Mr. Tyler, we had a doctor who was an expert in air pollution effects, we had an air pollution meteorologist, and we had a per-

son who was an expert in the types of industries that are found in this area, and I will get back to the reason for this type of person. We also had a representative from theDepartment of Justice, and we were met at the airport by someone from the U.S. Attorney's office here. We also had John White, who was the Director of Enforcement in the Atlanta Region, which includes Birmingham in the EPA regional setup. As previous witnesses have testified, we then proceded to the Jefferson County Board of Health Building, and we met with State and county officials and we reviewed the situation. To make a long story short, it was apparent that there had not been adequate action taken. It was also apparent that there was not going to be adequate action taken unless the Federal Government took it. It was represented to us by the State attorney general's office that there was no legal means by which reductions could be required. Now, we had—in my opinion, we had no reason to go behind that opinion. The levels were so high that there just had to be action taken, but I want to emphasize something that—that John Daniel, I think, pointed out, a few minutes ago: The fact that there was no legal authority is not a typical situation. We do not feel that our decision to act was based on the fact that there was no legal authority. Our duty, as we interpret it under section 303, of the act, to abate these things if they have not been adequately abated. That, to us, means that even if the State had authority and hadn't used it or had used it ineffectively, we are still required to act if the situation warrants it.

Mr. ROGERS. May I say I think this is the intent of the Congress in writing the legislation to abate the pollution.

Mr. BAUM. All right. Now—again, this situation—it wasn't usual, because these people had been making a valid effort to do the right thing and were frustrated by the lack of legal authority which existed because of some very unusual circumstances.

At any rate, Dr. Hardy held a press conference which was announced by the county, and announced that he had determined that the action taken by request—in their request for voluntary action—the action was inadequate. We then went back to a meeting in private with the State and local people, and EPA came to the same conclusion; that is, the action had been inadequate. Then, we announced that we were going to attempt to obtain a temporary restraining order. We then all retired to the U.S. Department of Justice, the local attorney general's office, and worked to the early hours of the morning in preparing the necessary documents which were required for obtaining the issuing of the temporary restraining order without notice.

We felt very strongly that if something was not done immediately, we would lose the situation. Although the meteorological forecast gave us some reason for optimism, we made the decision that we just could not rely on that, without making any jokes about weather forecasters. We just felt that we should not put ourselves and the people of Birmingham in the position of depending on a weather forecast. The judge agreed and issued the order. He suggested to us that we telephone an all night radio station here and that we also start telephoning the industries.

Let me back up for just a moment. One of the things that we did in the 5 or 6 hours when we were working preparing a complaint and motion for a temporary restraining order was to carefully tailor the

order so that it was done with what was, in our opinion, the least disruption—unnecessary disruption. I mentioned that one of the people who was here from EPA was one of the people who understood these types of industries. You just can't shut down these things immediately. This order was intended to shut down these things as quickly as possible without damaging any of the equipment. I might add that the county and State people were with us all of the time. It was a joint effort by everyone who was involved here.

At any rate, getting back to the evening after the judge signed the order, we called all of the listed people that we could reach. We told them that the order had been entered, but that it had not yet been served. We would get a Federal Marshal to serve it as early as we could in the morning, but we wanted them to know before they started up so they could take whatever action they wanted, but we felt we should inform them. We read them the parts of the order that applied to them. The order mentioned that—mentioned each of these sources specifically with certain things they had to do or not to do, and we read that to them so they would know.

The next day, we were just watching the readings and the weather was starting to improve as we had expected it to. On Thursday morning, the reading was at 410 micrograms per cubic meter. We had been hoping that by Thursday afternoon, that was November 18, we would have been able to ask the judge to vacate this. As it turned out we could not do that. On Thursday afternoon we could not be absolutely certain that if we did not continue the order that the levels would not then start up again. By Friday morning, the weather was still continuing to improve. It started to rain just about the time we were going into court, and at 9 o'clock—and this is—this is—the judge had scheduled a hearing on Friday morning here at 9 o'clock when he had signed the order. We went in at that time and asked that he vacate the temporary order and dismiss the case, that the emergency was over. The 9 o'clock reading on the 18th was 271 micrograms per cubic centimeter which is actually up somewhat high, but not for around here. This morning, I understand the 9 o'clock or 8 o'clock reading was somewhere in the area of a hundred. There are excellent weather conditions today.

In summary, I can only emphasize that the action that was taken here, in our opinion, was obviously absolutely necessary. These levels were extremely high. Somebody had to do something, and, again, it was the consensus of opinion among all of those who were here, and it is not to be looked at as a Federal intervention or Federal overriding or anything of that nature. It was a joint effort, by all of the people that were concerned, to do something, and we were pleased with the way it came out. Every effort was made to do it in a manner that was as least disruptive as possible, as fair as possible, but we just could not lose sight of the fact that those levels were such that action was needed, and it's been accomplished.

That concludes my statement.

Mr. ROGERS. Thank you.

Mr. KYROS. Do I understand that you were aware of some negotiations that were going on between some of the firms that were alleged to be the polluters in the area?

Mr. BAUM. We were aware, sir, that they were going on. We weren't aware of the substance of them. We were told, and this was—again, this

was when we came down here, the thing that we had asked specifically to have ready for us. We could not gage the extent to which anything had been done when we got down here.

Mr. KYROS. We read the court proceedings on determining or dismissing the TRO, and, in there, it would seem to me that U.S. Steel was enormously cooperative. What I am saying is, if a company were in a position where they were willing to completely cooperate, then I don't see why you need a TRO in relation to them.

Mr. BAUM. In the case of United States Steel, I think probably the statement you were referring to was the statement that we made in court on Friday morning.

Mr. KYROS. Right.

Mr. BAUM. And, of course, that, when it was being resolved, that was not indicative of what was going on on Wednesday, late afternoon. I was reasonably sure that that was the statement that you were referring to.

We had a choice of trying to go through this thing in reliance on what, at that time, were unsubstantiated statements by some industries as to what they had done and as to what reductions they had accomplished. We had no way at all of determining those things, and we had no reason to doubt when they said they had done something, but most of these things were very rough estimates of what kind of reduction had been accomplished. Our choice was to go in here and take what the county said—of 23 major industries, these sources are the ones that have to be controlled, tell each of them what they had to do or leave some out and perhaps lose the ballgame because of this, and tomorrow if they are not doing what they said they are doing or the results of what they did are not as good as they thought they were, we are out of the ballgame. So, we just tried to cover the field.

I understand what difficulty it causes someone just to be named in a complaint like this, but, on the other hand, the risk was such that at the time we felt that we had to cover those sources and be able to point to something and say: "This is it," something that is legally enforceable.

Mr. KYROS. I am not being critical, and as a matter of fact, I commend you for the action you took. It seems to me that we had a plant in Osaka, Japan. There, they have a sulfur dioxide problem. They have monitoring systems throughout the city, and when they get to a certain level, they use low sulfur residuals and they shut down certain industries. Now, it seems to me that Birmingham, Ala. in this country is sophisticated enough to devise a plan whereby 25 or 26 industries with a certain level of micrograms in the air would provide ample reason for closing some of those industries on a staggered basis. I can't understand why there hasn't been such a plan in operation.

Why hasn't this been done?

Mr. BAUM. I agree with everything you've said, and I can't answer the question why they haven't done it. I can only hope that it will be done. It will be done under the implementation plan. It must be done. They will have to submit to us in January an implementation plan which contains either this type of procedure or the procedures for establishing these things immediately. There is—every area of the country in which there is—likely to be this type of episode will have sub-

mitted one of those plans in the very near future. If not EPA will prepare one.

Mr. KYROS. And will part of that plan include the fact that you will use plans for maximum effectiveness within minutes of disruptiton?

Mr. BAUM. Absolutely. This is—theoretically, the way it should work and the way it should work here. These actions are negotiated and agreed on between the industries, and the air pollution control agency. We will sit down and say "When levels get to here,—what actions do you think you can take? What actions can you reasonably take? We need this much of a reduction" so that there is not—when the time occurs, there isn't any argument about what you're making them do. We have agreed what they are going to do and when they are going to do it, but, unfortunately, in the absence of that, you get what has happened here.

Mr. KYROS. Were there any specific cases cited to you of respiratory problems or people feeling discomfort from what had happened here?

Mr. BAUM. No, sir. The criteria document that we use doesn't consider the health effects at these levels. We made no attempt to try and contact individuals or have that type of thing. There is no need of it in this type of case.

Mr. KYROS. Thank you very much.

Thank you, Mr. Chairman.

Mr. ROGERS. Mr. Hastings.

Mr. HASTINGS. Thank you, Mr. Chairman.

Before you even engaged the authority of 303, was there any indication from any local or State agency that they did not concur with the action that you were going to take?

Mr. BAUM. None whatsoever.

Mr. HASTINGS. And you can state positively that every single local or State agency concurred then with your ultimate decision to utilize 303?

Mr. BAUM. Anyone that I had spoken to, and I think I have spoken to all of them, concudred, and I have heard no one or of no one who did not concur.

Mr. HASTINGS. Did you yourself EPA, at any point, talk with the industry prior to this action, or were you completely dependent on the County Health Department to give you a reflection of their negotiations with the industry to try and reduce voluntarily?

Mr. BAUM. In any case, sir, it is the latter. We did not talk to industries prior to taking this action. In other instances, for instance, in the previous one here, we have contacted industries in Birmingham. We have sent telegrams. Again, it's very difficult to say that there is a standard procedure for this thing. In this one, there was no time for individual negotiations. Unless we got the order entered that night, we were not going to be able to get the order in on time and really do any good. We had——

Mr. HASTINGS. I take it that you were satisfied then that the local agency had negotiated sufficiently with industry to make it clear that you should use 303?

Mr. BAUM. Yes, sir. We—when we got here on Wednesday, the local agency had already scheduled press conferences on this. They an-

nounced to the public that they had not achieved adequate compliance with their request. We reviewed independently the responses to those requests as we were bound to do under the statute. It's our purpose to determine if there was adequate action, but we were satisfied—we had a written record of a request and a response to that request from the industry which we could review. Assuming that everything the industry said was done, had actually been done—the effect that it had was it wasn't adequate.

Mr. HASTINGS. Thank you.

I have no further questions, Mr. Chairman.

Mr. ROGERS. How does your Emergency Operation Control Center work, Mr. Tyler?

Mr. TYLER. As Mr. Baum indicated earlier, we, through cooperation with State and local Air Pollution Control Agencies throughout the country, receive air quality data from approximately 60 cities over the country everyday covering the various pollutants. We also, in cooperation with the Weather Service, Department of Commerce, have a complete weather station in our operation. Excuse me, meteorological information from throughout the country.

When an air stagnation advisory is issued or when our air quality—in other words, the concentration of this, in effect, puts us in an active position. We have—at that time, when there is an advisory to be issued or if elevated pollutant concentrations have occurred, even though an advisory may not have been issued, we begin a series of contacts with the appropriate agency in the affected area in an attempt to verify what we have assessed the problem to be as accurate and to find out more or less what the State or local officials are doing to abate the situation, and then based on our assessment of facts, whether or not an imminent, substantial danger does exist, and, if the action taken by the State or local officials is inadequate, it's our recommendation that they then proceed under section 303, and then, at that point, go into a phase of trying to determine what should be done to abate the situation.

The same thing, of course, is done, and we were trying to assess adequacy and in order for us to assess adequacy of what's being done, we have to have some idea ourselves—a very good idea ourselves as to what can be done. Of course, air pollution is going to be the final judgment of adequacy even if what appears to be a 50-percent reduction appears to be adequate from an engineering standpoint, if air quality doesn't improve, that will indicate it isn't adequate and additional action is needed.

Mr. ROGERS. Did the court say that there had to be a reduction of any particular percentage?

Mr. BAUM. No, sir. The court entered the order, which we requested, which was framed in terms of specific action.

Mr. ROGERS. To be taken by each industry?

Mr. BAUM. Right. That was one of the problems with the 60 percent reduction asked for by the county agency. They didn't know what the industries had emitted last week. So, it's difficult to achieve a 60-percent reduction, and it is improper. So, we just asked for action which we knew would sufficiently reduce the emissions.

Mr. ROGERS. I think it would be well for the record if I have the complaint and all of the motions, the orders and supporting papers

that were presented to the judge and the orders, if you would submit these.

Mr. BAUM. Submit these?

Mr. ROGERS. For the record. I think it would be helpful.

(Testimony resumes on p. 58.)

(The following material was received for the record:)

IN THE UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF ALABAMA, SOUTHERN DIVISION

UNITED STATES OF AMERICA, PLAINTIFF,

v.

U.S. STEEL CORPORATION, FAIRFIELD WORKS; U.S. STEEL CORPORATION, ENSLEY WORKS; U.S. STEEL CORPORATION, WENONAH WORKS; U.S. PIPE & FOUNDRY COMPANY, NORTH BIRMINGHAM OPERATIONS; U.S. PIPE & FOUNDRY COMPANY, BESSEMER PLANT; WOODWARD COMPANY, DIVISION OF THE MEAD CORPORATION; CONNORS STEEL DIVISION, H. K. PORTER COMPANY, INC.; SOUTHERN ELECTRIC STEEL COMPANY, REPUBLIC STEEL CORPORATION, ALABAMA-BY-PRODUCTS CORPORATION; STOCKHAM VALVES & FITTINGS, GRIFFIN WHEEL COMPANY, MCWANE CAST IRON PIPE COMPANY, JEFFERSON FOUNDRY COMPANY, BIRMINGHAM STOVE & RANGE COMPANY, CLOW CORPORATION, AMERICAN CAST IRON PIPE COMPANY, VULCAN MATERIAL COMPANY, FAIRFIELD PLANT; VULCAN MATERIAL COMPANY, WYLAM PLANT; SWIFT AGRICULTURAL CHEMICALS CORPORATION, W. A. BELCHER LUMBER COMPANY, U.S. GYPSUM COMPANY, LONE STAR CEMENT CORPORATION, ALPHA PORTLAND CEMENT COMPANY, W. J. BULLOCK, INC., R. A. WADE SAND & GRAVEL COMPANY, HARBISON-WALKER REFRACTORIES COMPANY, DIVISION DRESSER INDUSTRIES, INC., BESSEMER PLANT, DEFENDANTS.

CIVIL ACTION NO. 71-1041

The United States of America, by its undersigned attorneys and by authority of the Attorney General alleges that:

1. This is a civil action to enjoin the above named defendants from discharging any particulate matter into the ambient atmosphere from their manufacturing operations in the Birmingham, Alabama, area. Such discharges contribute to the imminent and substantial endangerment to the health of persons as determined by the Administrator of the Environmental Protection Agency, Authority to bring this action is in the Department of Justice by 42 USC 1857h-3.

2. This Court has jurisdiction of the subject matter of this action pursuant to 28 USC 1345.

3. Defendants are corporations doing business in Birmingham, Alabama, within the Northern District of Alabama.

4. During normal operation of the defendants' plants, the defendants discharge particulate matter into the ambient air.

5. The Administrator of the Environmental Protection Agency has received evidence that a combination of pollution sources, including the defendants' plants, are presenting an imminent and substantial endangerment to the health of persons by discharging particulate matter into the ambient air.

6. The appropriate State and local authorities have diligently attempted to decrease the level of contamination in the atmosphere. However, the various sources emitting particulate matter in significant quantities, including the defendants' plants, continue to discharge particulate matter into the ambient atmosphere to levels that cause significant harm to the health of human beings.

7. The average particulate level in the ambient air for the past forty-eight (48) hours is approximately 725 micrograms per cubic meter. Such particulate levels for such periods of time are harmful to the health of human beings.

8. The discharges of particulate matter by the defendants should be eliminated pursuant to Section 303 of the Clear Air Act which provides:

"EMERGENCY POWERS

"Section 303. Notwithstanding any other provisions of this Act, the Administrator upon receipt of evidence that a pollution source or combination of sources (including moving sources) is presenting an imminent and substantial endangerment to the health of persons, and that appropriate State or local

authorities have not acted to abate such sources, may bring suit on behalf of the United States in the appropraite United States district court to immediately restrain any person causing or contributing to the alleged pollution to stop the emission of air pollutants causing or contributing to such pollution or to take such other action as may be necessary."

9. The continuous emission of particulate matter into the ambient air by the defendants contributes to the present situation which, if allowed to continue, will cause significant harm to the health of persons in the Birmingham area.

10. The United States of America and its citizens will suffer immediate and irreparable harm to their health unless the defendants are immediately restrained from discharging particulate matter into the ambient atmosphere.

WHEREFORE, THE UNITED STATES PRAYS

a. That the defendants, their officers, directors, agents, servants, employees, attorneys, successors, and assigns, and each of them cease the discharge of particulate matter into the ambient air in a manner prescribed by this Court and not discharge such matter thereafter unless pursuant to instruction to do so from this Court.

b. That costs and disbursements of this atcion be awarded to the plaintiffs; and

c. That this Court grant such other and further relief as it may deem just and proper.

SHIRO KASHIWA,
Assistant Attorney General.
WAYMAN G. SHERRER,
United States Attorney.
By: WILLIAM D. MALLARD, Jr.,
Assistant United States Attorney.
JAMES R. WALPOLE,
Attorney, Department of Justice, Washington, D.C., Attorneys for Plaintiff.

IN THE UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF ALABAMA

UNITED STATES OF AMERICA, PLAINTIFF

v.

UNITED STATES STEEL CORP., ET AL, DEFENDANTS

MOTION FOR TEMPORARY RESTRAINING ORDER

The United States of America, by its undersigned attorneys, by authorization of the Attorney General and acting at the request of the Administrator of the Environmental Protection Agency, moves that this Court, in order to prevent irreparable injury to the United States and its citizens, enter immediately an order to restrain temporarily the defendants set forth in the complaint from discharging excessive particulate matter into the ambient air pending action by this Court on the complaint filed this day by the United States in this cause, and in support of this motion, states:

Defendants are discharging from their plants and/or installations at Birmingham, Alabama substantial amounts of particulate matter into the ambient air. Such discharges in combination with adverse weather conditions have caused, or are contributing to, concentrations of particulate matter in the ambient air exceeding a level over 700 micrograms per cubic meter of particulate matter. This level presents an imminent and substantial endangerment to the health of persons.

The appropriate state and local authorities have diligently attempted to decrease the level of contamination in the atmosphere. However, defendants continue to discharge particulate matter into the ambient atmosphere causing imminent and substantial endangerment to the health of persons.

The presence of such levels of particulate matter is a present and continuing danger to the human health. Unless the discharges of particulate matter are immediately restrained, the health of people in the area will continue to suffer immediate and irreparable harm.

Plaintiff further moves for said Temporary Restraining Order to be issued

forthwith and without notice, on the ground that the discharges constitute an imminent and substantial endangerment to the health of persons.

Therefore, in view of the immediate danger to public health that the defendants are contributing to by the release of particulate matter into the ambient air, plaintiff prays that the Court enter a temporary restraining order immediately.

Respectfully submitted,

SHIRO KASHIWA,
Assistant Attorney General.
WAYMAN G. SHERRER,
United States Attorney.
By WILLIAM D. MALLARD, Jr.,
Assistant United States Attorney.
JAMES R. WALPOLE,
Attorney, Department of Justice, Washington, D.C., Attorneys for Plaintiff.

IN THE UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF ALABAMA, SOUTHERN DIVISION

UNITED STATES OF AMERICA, PLAINTIFF, *v.* UNITED STATES STEEL CORP., ET AL, DEFENDANTS

CIVIL ACTION NO. ——

TEMPORARY RESTRAINING ORDER

This cause came on to be heard on the motion of plaintiff, upon the complaint herein and the affidavits attached thereto, for a temporary restraining order; and, it appearing to the court therefrom that immediate and irresponsible injury, loss and damage will result to the plaintiff before notice can be given and the defendant or his attorney can be heard in opposition to the granting of a temporary restraining order for the reason that continued levels of pollution by particulate matter will cause irreparable damage to the health of persons, it is

Ordered, That defendants set out in the complaint filed herein, their agents, servants, employees and attorneys and all persons in active concert or participation with them are hereby restrained from causing or contributing to the alleged pollution and each defendant separately must take the following action:

U.S. STEEL CORPORATION—FAIRFIELD WORKS

Must stop the emission of particulate matter from incineration, scrafing, slag quenching, open burning and other operations that can be postponed.

Must increase coking time to the maximum extent possible consistent with gas heating requirements.

Must reduce emissions of particulate matter from all open hearth furnaces by ceasing feed to the open hearth and maintaining the heat.

U.S. STEEL CORPORATION—ENSLEY WORKS

Must reduce emissions of particulate matter from all open hearth furnaces by ceasing feed to the open hearth and maintaining the heat.

U.S. STEEL CORPORATION—WENONAH WORKS

Must stop the emissions of particulate matter from all sintering operations by ceasing operations.

U.S. PIPE & FOUNDRY COMPANY—NORTH BIRMINGHAM OPERATIONS

Must eliminate emissions of particulate matter from all cupolas adding no heating requirements.

Must eliminate emissions of partciulate matter from all cupolas adding no new charges and shutting down cupolas after present heat is finished.

Must eliminate emissions of particulate matter from all mineral wool cupolas by shutting down such cupolas as rapidly as possible without damage to equipment.

U.S. PIPE & FOUNDRY COMPANY—BESSEMER PLANT

Must eliminate emissions of particulate matter from all cupolas adding no new charges and shutting down cupolas after present heat is finished.

WOODWARD COMPANY, DIVISION OF THE MEAD CORPORATION

Must increase coking time to the maximum extent possible consistent with gas heating requirements.
Must eliminate emissions of particulate matter from all electric arc furnaces by making no new heats.

CONNORS STEEL DIVISION, H. K. PORTER COMPANY, INC.

Must eliminate emissions of particulate matter from all electric arc furnaces by making no new heats.

SOUTHERN ELECTRIC STEEL COMPANY

Must eliminate emissions of particulate matter from all electric arc furnaces by making no new heats.

REPUBLIC STEEL CORPORATION

Must increase coking time to the maximum extent possible consistent with gas heating requirements.

ALABAMA-BY-PRODUCTS CORPORATION

Must increase coking time to the maximum extent possible consistent with gas heating requirements.

STOCKHAM VALVES & FITTINGS

Must eliminate emissions of particulate matter from all electric arc furnaces by making no new heats.
Must eliminate emissions of particulate matter from all cupolas adding no new charges and shutting down cupolas after present heat is finished.

GRIFFIN WHEEL COMPANY

Must eliminate emissions of particulate matter from all electric arc furnaces by making no new heats.

M'WANE CAST IRON PIPE COMPANY

Must eliminate emissions of particulate matter from all cupolas adding no new charges and shutting down cupolas after present heat is finished.

JEFFERSON FOUNDRY COMPANY

Must eliminate emissions of particulate matter from all cupolas adding no new charges and shutting down cupolas after present heat is finished.

BIRMINGHAM STOVE AND RANGE COMPANY

Must eliminate emissions of particulate matter from all cupolas adding no new charges and shutting down cupolas after present heat is finished.

CLOW CORPORATION

Must eliminate emissions of particulate matter from all cupolas adding no new charges and shutting down cupolas after present heat is finished.

AMERICAN CAST IRON PIPE COMPANY

Must eliminate emissions of particulate matter from all electric arc furnaces by making no new heats.
Must eliminate emissions of particulate matter from all cupolas adding no new charges and shutting down cupolas after present heat is finished.

VULCAN MATERIALS COMPANY—FAIRFIELD WORKS

Must eliminate emissions of particulate matter by phasing down all operations as rapidly as possible without causing damage to equipment.

VULCAN MATERIALS COMPANY—WYLAM PLANT

Must eliminate emission of particulate matter by phasing down all operations as rapidly as possible without causing damage to equipment.

SWIFT AGRICULTURAL CHEMICALS CORPORATION

Must eliminate emission of particulate matter by phasing down all operations as rapidly as possible without causing damage to equipment.

W. A. BELCHER LUMBER COMPANY

Must eliminate emissions of particulate matter by shutting down wood burning boiler.

U.S. GYPSUM COMPANY

Must eliminate emissions of particulate matter from all mineral wool cupolas by shutting down such cupolas as rapidly as possible without damage to equipment.

LONE STAR CEMENT CORPORATION

Must eliminate emission of particulate matter from crushing, mixing, cleaning, conveying and transferring operations.

Must eliminate emission of particulate matter from kilns by starting no new batches and allowing processes in operation to phase down.

ALPHA PORTLAND CEMENT COMPANY

Must eliminate emissions of particulate matter from crushing, mixing, cleaning, conveying and transferring operations.

Must eliminate emission of particulate matter from kilns by starting no new batches and allowing processes in operation to phase down.

W. J. BULLOCK, INC.

Must eliminate emission of particulate matter by shutting down all furnaces and smelters and stopping all incineration processes.

R. A. WADE SAND AND GRAVEL COMPANY

Must eliminate emission of particulate matter from crushing, mixing, cleaning, conveying and transferring operations.

Must eliminate emissions of particulate matter from dryers by ceasing feed of new materials and phasing down operations as rapidly as possible without damage to equipment.

HARBISON-WALKER REFRACTORIES COMPANY, DIVISION DRESSER INDUSTRIES, INC.—BESSEMER PLANT

Must eliminate emission of particulate matter from dryers and kilns by ceasing feed of new materials and phasing down operations as rapidly as possible without damage to equipment.

Ordered, that this order expire within 10 days after entry, unless within said time it is for good cause shown extended for a longer period, or unless defendants consent that it may be extended for a longer period; and it is further

Ordered, that plaintiff's complaint be set for hearing on preliminary injunction on November 19th, 1971, at 9:00 o'clock A.M., of that day or as soon thereafter as counsel can be heard, in the United States District courtroom in the City of Birmingham, State of Alabama.

This order isued at Birmingham, Ala., this 18th day of November, 1971. (1:45 A.M.)

———— ————,

United States District Judge.

Mr. ROGERS. Now, also about this same time, as I recall in the newspaper, Pittsburgh had a problem, did they not?

Mr. BAUM. Yes, they did, sir.

Mr. ROGERS. Tell us a little bit about that. I understand they asked 29 industries there to cut down, and, evidently, there was a voluntary reduction. Do you know if it was voluntary, or what happened?

Mr. TYLER. Pittsburgh is a little further down the road than Birmingham. It has a plan more closely resembling what Mr. Kyros supposed in Osaka, Japan. Well, Pittsburgh has a law which requires that the industries in the area submit a plan on abatement and what action will be taken at each level, and they are getting those plans so that when in Pittsburgh a particulate episode level is declared and the industry gets asked to take alert or warning or emergency level action, they do this, and the agency, as well as the industry, knows what will be done at that time. They have just passed the new law here within the last month in Pittsburgh.

Mr. ROGERS. Do they have the authority to require it?

Mr. TYLER. That's correct, sir.

Mr. ROGERS. And they are operational?

Mr. TYLER. That's correct, sir.

Mr. ROGERS. Was the authority necessary or was it from a voluntary basis? In other words, did they have to issue orders in Pittsburgh, or was this done simply by the issuance of an alert?

Mr. TYLER. It was done by the issuance of an alert. Assuming that authority, it's hard to separate whether it was voluntary or——

Mr. ROGERS. What is your alert level?

Mr. TYLER. We will have to go into a little bit of the Department here. We have established levels of pollution in it. OC—I believe OC 28. Twenty-three Federal registers outline levels which should not be reached. This is the ultimate level. Everything should have been done before that to prevent that from having been reached. Now, also in a Federal registered document which outlines the specifications as to what we expected a State to include in their episode portion, we gave in there a suggested set of criteria, and, in there, we gave—we outlined certain alert, warning, and emergency steps and action that would be triggered at these three steps to prevent that situation to be reached, and, in there, we suggested for particulate materials an alert level of 375 micrograms per cubic meter. Had more than this level would then trigger our first stage reduction emission action.

The form of this differs in that the level never to be reached is the effect of all of this. It is a recommendation. Some cities may adopt alert levels slightly different from that. The objective though is that the series of criteria levels in the action taken will prevent this level. We say it should never be reached.

Mr. ROGERS. Yes. What is the level that should never be reached?

Mr. TYLER. The level for particulate in absnce of large quantities of SO_2 is a thousand grams per cubic meter for 24 hours.

Mr. ROGERS. As I understand it, there is no large SO_2 problem in Birmingham?

Mr. TYLER. That's right.

Mr. ROGERS. So, you should never reach a thousand, and they reached seven—what was the highest?

Mr. BAUM. Seven seventy-one.

Mr. ROGERS. How many days in Birmingham does it go beyond 375, do we know, a year?

Mr. TYLER. I can't give you an exact value on that.

Mr. ROGERS. I wonder if the Public Health people here would know about it?

Dr. HARDY. The answer to that depends on which station we are monitoring. The figure that we look at most routinely is the EPA figure of 260, a figure that should not be exceeded more than once in a 365 day period, because, at this level, we will see initial health effects in certain segments of the population. That figure has been exceeded 66 times in the past 365 days in downtown Birmingham and more than 50 percent of the time in North Birmingham.

Mr. ROGERS. Over 50 percent of the time?

Dr. HARDY. Yes, sir.

Mr. ROGERS. You mean actions taken on this——

Mr. BAUM. Let me just——

Mr. ROGERS. They will get a plan, as I understand it, since the new law has been passed to deal with that problem?

Mr. BAUM. The figure that Dr. Hardy has given us is the National Primary Standard for particulates that's in the implementation plan which will be submitted within the next month or so.

Mr. ROGERS. But the determination has been made that for people's health, this level should not be exceeded more than once in each year?

Mr. BAUM. That's correct. That's the National——

Mr. ROGERS. But it's being exceeded 50 percent of the time in Birmingham?

Dr. HARDY. In one area of Birmingham, this is correct.

Mr. ROGERS. How many people live in that area, do you think?

Dr. HARDY. May I admit first that there are modifiers attached to that figure. That is the level at which health effects—mild health effects will first be seen in certain segments of the population. This does not mean that we have serious health effects on all people. We are talking about a mild effect on most elderly people, the very young, the——

Mr. ROGERS. But you have it 50 percent of the time?

Dr. HARDY. Yes, sir. The effects are not only related to the level, but how long these levels are maintained, the presence of other gaseous pollutants have been mentioned, and then the individual's health status.

Mr. ROGERS. Thank you. That's rather a shocking figure, I think.

Mr. BAUM. Yes, sir.

Mr. ROGERS. Is this typical of very many cities in the United States?

Mr. TYLER. Sir, as far as particulate pollution is concerned—of the area that we have received information, about 60 cities, Birmingham is the top or almost near the top of any city in the United States.

Mr. ROGERS. For particulate pollution?

Mr. TYLER. Yes, sir. That's right. There are other cities who have said that Birmingham doesn't have a particular gaseous pollution problem. There are other cities that have gaseous pollution problems as well as particulate problems.

Mr. ROGERS. I think it would be helpful if we could have any studies that have been made as far as emphysema, any bronchial diseases, respiratory diseases, and so forth. That would be helpful in pointing up this problem.

Mr. BAUM. I might point that there is some sensitivity studies going on in Birmingham done by the University of Alabama Medical School and local people with funding by EPA. These are in depth studies as to what effects these levels cause.

Mr. ROGERS. Could you give us any interim reports?

Mr. BAUM. I am sure that we can give you some report on this.

(Testimony resumes on p. 68.)

(The following material was received for the record:)

A PROGRAM OF COMMUNITY HEALTH AND ENVIRONMENTAL SURVEILLANCE STUDIES (CHESS)

(By Carl M. Shy, M.D., Dr.P.H.; John F. Finklea, M.D., Dr.P.H.; Dorothy C. Calaflore, R.N., Dr.P.H.; Ferris Benson, William Nelson, Ph.D., Vaun A. Newill, M.D., M.S.H.)

PRESENTED AT THE AMERICAN CHEMICAL SOCIETY ANNUAL MEETING IN A SYMPOSIUM ON THE DETERMINANTS OF AIR QUALITY, APRIL 1, 1971, LOS ANGELES, CALIFORNIA; TO BE PUBLISHED IN AN ACS SYMPOSIUM VOLUME, FALL, 1971

CHESS is an acronym for Community Health and Environmental Surveillance Studies. In this paper, we describe the objectives, structure and operating methods of the CHESS program, which is conducted by the Community Research Branch, Division of Effects Research, Office of Research and Monitoring (Environmental Protection Agency), in cooperation with local public health agencies. Our basic intent is to relate community health to changing environmental quality. CHESS consists of a continuing series of epidemiologic studies conducted in selected communities representing an exposure gradient for the most common air pollutants. The program involves monitoring of environmental quality with simultaneous surveillance of health indicators known to be sensitive to variations in environmental quality. The purpose of the CHESS program is to evaluate environmental standards, quantitate pollutant burdens, and document the health benefit of air pollution control.

The CHESS program has three key elements as shown in Table 1: area sets, sensitive health indicators, and environmental monitoring.

AREA SETS

An area set consists of a group of communities, usually three or four, selected to represent an exposure gradient for a pollutant, but similar with respect to climate and socioeconomic traits. Each community in an area set is a defined middle class residential segment of a city containing three or four elementary schools of 500 to 1000 children per school and often a secondary school. In the Southeast, duplicate communities were chosen to represent black and white segments of the population.

We intend to operate the CHESS program in each area set for a minimum of five years. In the first year, communities within the same set are expected to show a gradient in pollution exposure. Over time, this gradient should diminish with control of air pollution levels. By measuring sensitive health indicators through this period of change, we hope to document and quantitate the health benefits of air pollution control.

HEALTH INDICATORS

In the CHESS program, we measure pollutant effects over a broad spectrum of human responses, including: no demonstrable effect, increase in body burden, altered physiology of uncertain significance, physiologic sentinels of disease, acute and chronic disease and death. We may conveniently divide CHESS health

indicators into acute and chronic responses, as shown in Table 2. For the most part, we observe acute responses by systematically following pre-enrolled panels of subjects and comparing response frequency against daily variations in pollutant levels. Observations in communities having consistently low exposure allow us to quantitate the simultaneous effects of environmental covariates such as season of year, temperature and other climatologic changes. We relate acute response frequencies to pollutant concentrations measured by continuous or 24-hour integrated samplers.

We expect the chronic responses listed in Table 2 to reflect effects of exposure to long term average pollutant levels or of repeated exposure to short term peak levels. We do not hope to discriminate between effects of long term exposure and repeated short term peak levels by means of community studies with uncontrolled exposures.

In addition to the pollutant exposures monitored in the CHESS program, we obtain information on other community determinants of response frequency. These determinants or "covariates", along with environmental pollution, codetermine the quantitative level of the health indicator in the community. Covariates include (1) demographic variables such as age, sex, race, socioeconomic level, family size, (2) environmental variables such as occupational dust exposure, geographical migration, intake of pollutants through routes such as food and water and (3) personal variables such as cigarette smoking, past illness experience and genetic markers. Information about these covariates is used to compare like groups across exposure gradients and to compute response rates adjusted for differences which may influence are found, we can state with reasonable confidence that these differences are not due to other known epidemiologic determinants of the response.

ENVIRONMENTAL MONITORING

We establish an environmental monitoring station near the geographic center of study populations. In most cases, this setting places the residences of subjects within one and one-half miles of the monitoring station. In placing the station, we consider topography, land use adjacent to the study area and emission sources. Whenever possible, we place the inlet of the monitoring instruments at head level in an appropriate shelter removed from proximate sources of pollution such as road dust, if these sources are not common to the study areas as a whole.

Tabel 3 lists pollutants, measurement methods and averaging times involved in the environmental monitoring portion of the CHESS program. To maintain both our acronym and the associated analogy, we call this phase CHESS–CHAMP (Community Health and Ambient Monitoring Program). We are currently collecting monthly samples and daily twenty-four hour samples for particulates and gases at 20 environmental monitoring stations. Continuous monitors are operating in some of the New York and Utah stations. To relate environmental variations to the acute response health indicators, we need the data from continuous monitors providing real time pollutant concentrations. A prototype continuous monitoring station having automatic acquisition with magnetic tape storage and "on-call" telemetry output of data is now under development and will be established in the entire CHESS–CHAMP system in the near future. We feel that the telemetry system is necessary on an "on-call" basis to enable routine checks on instrument performance, to process data on a daily schedule, and to provide access to current data during air pollution episodes.

Duplicate sampling and calibration of all instruments are to be obtained on a systematic basis and are critical to insure accuracy and consistency of instrument performance in the CHESS–CHAMP system.

STUDY STRATEGY

Selection of CHESS area sets and pollutant exposure is dictated by the existence of the six published air quality criteria. These include criteria for particulate matter, sulfur oxides, nitrogen oxides, photochemical oxidants, hydrocarbons and carbon monoxide. We do not include carbon monoxide in our pollutant exposure sets because we feel that short-term exposure effects of carbon monoxide can be more precisely studied in controlled exposure chambers, while the effects

of long-term area exposure to carbon monoxide are likely to be confounded with the effects of other emission products of vehicles. Furthermore, to date we have found no area set demonstrating a consistent exposure gradient for carbon monoxide.

We select from the community a stable, middle class residential sector having the desired pollutant exposure within the area set. We choose middle class neighborhoods because these are most prevalent and because the social class of families is more evenly distributed in such areas.

Through enrollment listings of elementary schools in selected neighborhoods, we recruit family units for participation in the acute upper, acute lower and chronic respiratory disease surveys and for episode panels. We contact these families through single-time questionnaires for prevalence surveys, weekly diaries for panel studies, and bi-weekly telephone calls for acute respiratory disease incidence studies. We measure lung function of children in the schools which, in spite of busing, still represent a large proportion of neighborhood families with children of school age. We collect hair, urine and blood samples from selected households previously enrolled for other of our surveys. These households also provide a source of other environmental samples, including vacuum cleaner house dust, water and soil samples, and locally grown vegetables.

Listings of subjects for enrollment in the asthma, chronic respiratory and cardiac disease panels are obtained partially from results of the prevalence surveys and partially from patient listings of physicians. For mortality studies, we use data for the entire metropolitan area and compute expected mortality based on a model which takes into account season, daily temperature and reported pneumonia-influenza deaths. These models provide the local health agency with the capability to quantitate excess mortality during air pollution episodes as soon as data on current mortality counts become available.

As feasibility studies are successfully completed, we intend to monitor other health indicators. Among these we are considering tear lysozymes, red blood cell fragility and survival studies, placental enzymatic activity profiles, reversible lung function changes in subject panels, and exfoliative cytoloty of sputum samples.

In the CHESS program, we do not measure health characteristics in probability samples of the population. We have two reasons for this study strategy. Firstly, we are establishing air quality standards to protect segments of the population particularly vulnerable to the effects of environmental pollution. Secondly, our methods for enrolling subjects are far less costly and cumbersome than methods for obtaining probability samples. We focus our surveys on two segments of the population: susceptible groups and easily accessible groups. We try to match these groups within the same area set for characteristics which may influence the frequency of the health indicator; that is, we identify and measure the covariates of each health indicator. The ubiquity of middle class families with school children and of subjects with asthma, heart or lung disease allows us to be reasonably confident about the applicability of our findings to most communities in the United States.

The existence of pre-enrolled subjects in area sets provides us with a readily accessible group of concerned, cooperative middle class families with identified exposure to known pollutants. By monitoring health indicators over a broad spectrum of possible biological responses, and by simultaneously quantitating the environmental exposure, we feel that we are making a scientifically valid effort to achieve our stated objectives; namely, to evaluate existing standards, to quantitate pollutant burdens, and to document the health benefits of environmental control. The large cost of environmental control should justify the effort.

TABLE 1

ELEMENTS OF THE CHESS PROGRAM

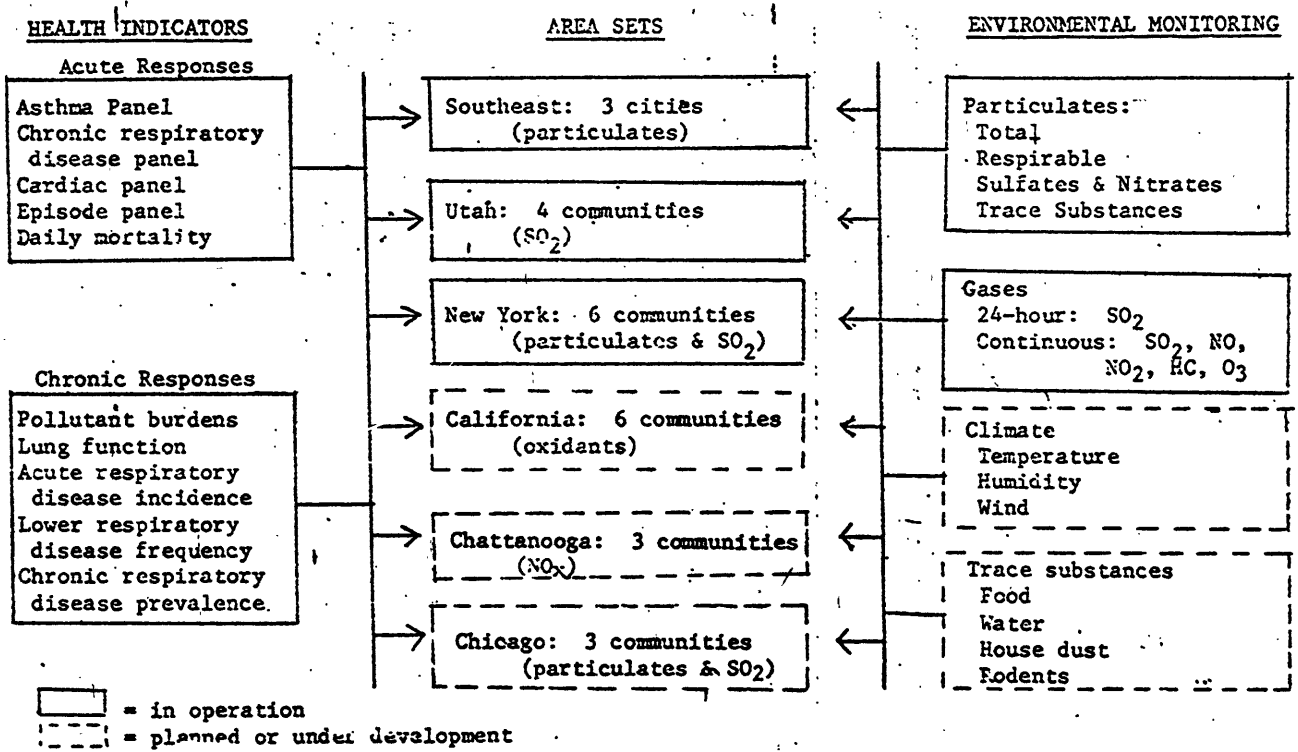

TABLE 2.—CHESS HEALTH INDICATORS

I. Acute Response
1. Daily sympton diary of asthmatics.
2. Daily symptom diary of subjects with chronic respiratory disease.
3. Daily symptom diary of subjects with cardiac disease.
4. Acute irritation symptoms (cough, eye irritation, chest pain) in families during "episodes."
5. Deviation from expected mortality (predicted from temperature, season and pneumonia—influenza deaths) during episodes.

II. Chronic Response
1. Pollutant burdens: concentrations of trace substances in tissue specimens, including hair, blood, urine, placentae, necropsy specimens.
2. Lung function (spirometry) of school children.
3. Bi-weekly acute respiratory disease incidence in families of elementary school children.
4. Frequency of lower respiratory disease episodes (croup, pneumonia, acute bronchitis) in children.
5. Prevalence of chronic respiratory disease symptoms in parents of school children.

TABLE 3.—CHESS ENVIRONMENTAL MONITORING

I. Monthly samples (all stations)
1. Dustfall: trace substances, including: lead, cadmium, zinc, arsenic, mercury, and polychlorinated biphenyl compounds.
2. Composited daily high volume sampler filters: trace substances (as ing #1).
3. Sulfation plates.

II. Twenty-four hour samples (all stations)
1. High volume sampler:
   Total suspended particulates.
   Suspended sulfates and nitrates.
2. Cyclone sampler: respirable partciulates and trace substances.
3. Integrated gas bubbler: SO_2 (West Gaeke Method).

III. Continuous samples (under development for all stations)
1. Automatic data acquisition with magnetic tape storage:
   SO_2 (coulometric method).
   NO and NO_2 (coulometric method).
   Hydrocarbons (flame ionization).
   Ozone (chemiluminescent method).

IV. Meteorological samples (under development for all stations)
1. Hygrothermograph (temperature and relative humidity).
2. Wind speed and direction.

V. Other Environmental samples (under development)
1. Milk from wholesalers.
2. Tap water.
3. Rainfall samples.
4. Market basket samples.
5. Locally grown vegetables (where practical).
6. Rodents.
7. Vacuum cleaner house dust.
8. Additional dustfall sites in each residential area.
9. Soil samples.

PULMONARY FUNCTION DURING AN ACUTE AIR POLLUTION EPISODE, AN INTERIM REPORT ON THE BIRMINGHAM AIR POLLUTION EPISODE—NOVEMBER 14–18, 1971

(By John H. Farmer, Sigismond Duetscher, Dennis E. House, Carl G. Hayes)

DHER was in the process of measuring lung function values in school children in Birmingham, Alabama, and Charlotte, North Carolina, when the recent air pollution episode occurred in Birmingham. Although this project was not specifically designed to study acute effects of air pollution, it provided an opportunity to compare lung function values occurring during an acute episode to those observed under normal circumstances. To accomplish this, a subset of data con-

sisting of second grade children tested in Birmingham before and during the acute episodes, and of second grade children tested in Charlotte, a relatively clean city, was analyzed.

Preliminary results show a significant difference in lung function between Charlotte and Birmingham during the aforementioned episode. Children in Birmingham had decreased lung function values in comparison to those of Charlotte. Furthermore, the data suggest that values were lower in Birmingham during the episode than before (See appendix).

In conclusion, the available evidence supports the hypothesis that the elevated levels of pollutants observed during the recent acute episode in Birmingham exerted a deleterious effect on pulmonary function and were significantly harmful to health.

ANALYSIS OF VARIANCE TABLE FOR MAX $FEV_{.75}$

Factor	D.F.	SS	F
Schools	8	0.577704	1.91
Birmingham H versus Birmingham L	1	.060157	1.57
Birmingham L versus Charlotte	1	.052586	1.37
Birmingham H versus Charlotte	1	.254387	[1] 6.73
Within Birmingham H	2	.186025	2.46
Within Birmingham L	2	.042171	.56
Within Charlotte	2	.014908	.20
Sex	1	.295160	[1] 7.79
Height	1	5.496719	[1] 145.14
Race	1	.588185	[1] 15.531
Error	430	16.284546	
Total	441	23.272476	

[1] Indicates significance at $p<0.01$ level.

Note: M.S.E.=0.037700; Mult R:=0.54547.

PULMONARY FUNCTION MEANS ($FEV_{.75}$), BY CITY AND SCHOOL (NOVEMBER 1971)

	Unadjusted	Race, sex, and height—adjusted
Birmingham (high) [1] (N=193)	1.262	1.231
Tarrant	1.318	
North Birmingham	1.210	
Gibson	1.247	
Birmingham (low) (N=166)	1.245	1.255
McAurther	1.251	
Dupey	1.218	
Boyles	1.267	
Charlotte (N=83)	1.307	1.308
1st	1.315	
2d	1.320	
3d	1.280	

[1] High refers to the time period during which the pollution episode occurred, while low refers to a period during which no episode was occurring.

Irritation Symptoms During the November 1971 Air Pollution Episode in Birmingham, Ala. (Interim Analysis)

(By C. J. Nelson, C. G. Hayes, V. Hasselblad, W. B. Riggan, Jose M. Sune, J. E. Gerding)

Introduction.—During November, 1971, the Birmingham metropolitan area experienced an acute air pollution episode characterized by elevated levels of suspended particulate matter. The impact of this episode upon irritation symptoms of the eye and respiratory tract among panels of previously selected volunteers composed of families with school children was ascertained by telephone.

Methods.—The Community Health and Environmental Surveillance System (CHESS) has been previously described by Shy et al. Acute irritation symptoms constitute one of the rapid response health effects indicators in CHESS. Since communities in three southeastern cities, Birmingham, Alabama, Greensboro, North Carolina and Charlotte, North Carolina comprise a "CHESS set" designed to measure the impact of suspended particulate air pollution, it was possible to compare symptom frequency across an exposure gradient. Moreover, the same symptoms had been investigated in Birmingham during April, 1971, when the levels of suspended particulates were roughly the same as the November 1971 episode. The symptoms were also monitored during a control period in May, 1971 when particulate levels were considerably lower than either episode, but still well above the national ambient air quality standard. Concurrent aerometric data were collected from monitoring stations situated within each of the three residential neighborhoods under study. CHESS also permits examinations of the effects of important covariates upon the health indicators in each study. These covariates include age, sex, socioeconomic class, smoking history, concurrent acute infectious disease, meteorologic observations and reporting bias.

RESULTS AND DISCUSSION

Air monitoring.—Suspended particulate levels (212μg/m^3) in Birmingham residential neighborhoods during the current episode were higher than the April '71 episode (183 μg/m^3) as shown in Table 1. During the control period, suspended particulate levels in Birmingham (120 μg/m^3) were approximately one half the value of the current episode. Substantial variation among the three study communities was noted and the cleanest community (103 μg/m^3) had levels one third to one half those of the dirtier communities. During the April episode suspended particulate levels in Greensboro and Charlotte were 59 and 75μg/m^3 respectively lower than the Birmingham level. During November 1971 the comparable particulate levels were higher than in April, 116 μg/m^3 for Greensboro and 139 μg/m^3 for Charlotte. The effects of dose rate response shorter than 24 hours could have been investigated if the CHESS-CHAMP aeromatic stations had been deployed. Average minimum temperature levels were roughly the same in all cities during the studies.

Symptom reporting.—Age, sex, smoking status and respondent bias usually exert significant effects upon the prevalence of irritation symptoms. Thus, symptom prevalence for adult females, the usual questionnaire respondent, was partitioned into smokers and non-smokers (Table 2) as were adult males (Table 3). All non-smoking children of these families were grouped together since no difference between male and female children was detected (Table 4). Too few childhood smokers, less than 5 percent, were available for a good analysis of pollution effects.

Over 1600 families participated in the study. To facilitate comparison of symptom rates across cities in Tables 2 through 4, all rates were standardized to the Charlotte rate to preserve comparably with the April analysis.

Severity of symptoms.—Two measures of symptom severity, restricted activity and medical visits, are tabulated in Tables 2 through 4. Medical visits were highest in Greensboro among all population segments except male smokers. Other CHESS studies provided evidence of a concurrent respiratory illness peak in Greensboro which may well account for this. Restricted activity was highest in Charlotte. Thus, there was no clear evidence of either excess restricted activity or excess physician visits in Birmingham.

Symptom bias.—Evidence of reporting bias in Birmingham can be seen by comparing prevalence ratios for joint pain, a control symptom not likely to be influenced by pollution. During April, 1971, Birmingham clearly over-reported this symptom, apparently reflecting an anti-pollution bias. In November 1971, Birmingham residents grossly under-reported this symptom, probably reflecting concern over their economic well being in the face of industrial closings. A number of families had reservations about answering the questions and some indicated they would no longer cooperate in the studies because their jobs were threatened by antipollution measures. Despite this bias, an excess in upper-respiratory irritation symptoms was still evident. There is also evidence of over-reporting in Greensboro which may be explained by interviewer bias introduced by DHER teams who could have elicited symptom reporting.

Effect of time.—A comparison of Charlotte rates in April, 1971 with these of November, 1971 (Table 5) showed that symptom frequency decreased among all

females and among male smokers. Symptom rates, however, increased among male non-smokers. Children showed little change except for an increase in physician visits. Thus, "time effects" demonstrate the need for a temprospatial approach to acute episode evaluation. There is also more than cursory evidence to support a decline in reporting that is a function of the number of times a volunteer is questioned. Since there was no differential between cities with regard to length of study participation, time and repeated reporting effects should not unduly influence inferences made regarding air pollution.

Effects of air pollution episode on symptoms.—Throat discomfort, chest discomfort, cough and shortness of breath symptom frequency was increased in all Birmingham groups. The largest increases were observed among the male smokers. These symptom frequencies are nearly doubled and would be more than doubled if we adjust for the under-reporting previously mentioned. There was evidence of intercurrent respiratory illness in Greensboro as shown by increased reporting rates for restricted activity and medical visits among adult females and children. Eye discomfort and headache were much more variable than the other symptoms. Increasing particulate levels from 116 $\mu g/m^3$ in Greensboro to 139 $\mu g/m^3$ in Charlotte did not detectably increase the frequency of irritation symptoms.

An independent analysis comparing the Birmingham May control period with the November episode also indicated there was increased reporting frequency among adults for throat discomfort, chest discomfort, cough and shortness of breath.

SUMMARY

Acute irritation symptoms of throat discomfort, chest discomfort, cough and shortness of breath were substantially increased in panels of normal well families with school age children during an acute air pollution episode (212 $\mu g/m^3$ particulates) in Birmingham, Alabama whether compared to a cleaner period earlier in the year or compared to cleaner cities (116 and 139 $\mu g/m^3$) during the same period of time. There was clear evidence of under-reporting in Birmingham reflecting concern over their economic well being.

TABLE 1.—AVERAGE TOTAL SUSPENDED PARTICULATE LEVELS AND MINIMUM AVERAGE TEMPERATURES IN SELECTED RESIDENTIAL COMMUNITIES OF 3 SOUTHEASTERN CITIES DURING AND AFTER AIR POLLUTION EPISODES

City	Dates	24-hour average TSP	Minimum average temperature in degrees Fahrenheit
Birmingham	Apr. 18, 1971 to Apr. 25, 1971 (episode 1)	183	54
	Nov. 12, 1971, to Nov. 16, 1971 (episode 2)	212	43
	May 16, 1971, to May 59, 1971 (control)	120	54
Charlotte	Apr. 25, 1971, to Apr. 68, 1971	76	48
	Nov. 16, 1971, to Nov. 57, 1971	139	43
Greensboro	Apr. 25, 1971, to Apr. 68, 1971	59	44
	Nov. 12, 1975, to Nov. 16, 1971	116	43

TABLE 2.—IRRIGATION SYMPTOM PREVALENCE RATIOS AMONG FEMALES IN 3 SOUTHEASTERN CITIES DISTRIBUTED BY SMOKING AND EPISODE STATUS

	Adult female smokers				Adult female nonsmokers			
	Birmingham (N=193)	Greensboro [1] (N=230)	Charlotte [1] (N=572)	Charlotte prevalence rate (percent)	Birmingham (N=388)	Greensboro [1] (N=367)	Charlotte [1] (N=247)	Charlotte prevalence rate (percent)
Eye discomfort	5.0	1.8	1	4.1	1.1	1.5	1	3.2
Throat discomfort	1.8	2.4	1	5.8	1.5	1.4	1	6.5
Chest discomfort	1.1	3.4	1	2.3	2.5	2.2	1	2.4
Cough	1.4	1.7	1	8.7	1.9	1.7	1	5.7
Shortness of breath	.7	1.0	1	2.9	4.2	1.8	1	.8
Headache	1.6	1.2	1	7.6	1.0	1.1	1	7.7
Joint pains	.2	1.7	1	2.9	.2	1.1	1	3.3
Medical visits	.4	4.0	1	1.6	1.1	2.1	1	1.6
Restricted activity	0	2.4	1	2.9	.5	1.1	1	2.8

[1] Less polluted.

TABLE 3.—IRRITATION SYMPTOM PREVALENCE RATIOS AMONG MALES IN 3 SOUTHEASTERN CITIES DISTRIBUTED BY SMOKING AND EPISODE STATUS

	Adult male smokers				Adult male nonsmokers			
	Birmingham (N=281)	Greensboro [1] (N=291)	Charlotte [1] (N=171)	Charlotte prevalence rate (percent)	Birmingham (N=263)	Greensboro (N=258)	Charlotte (N=195)	Charlotte prevalence rate (percent)
Eye discomfort	2.9	2.6	1.0	2.3	0.6	0.7	1.0	7.0
Throat discomfort	1.4	2.2	1.0	5.1	1.2	1.0	1.0	9.7
Chest discomfort	4.5	5.3	1.0	1.1	2.1	1.9	1.0	2.7
Cough	1.7	1.5	1.0	7.3	1.3	1.5	1.0	9.2
Shortness of breath	6.5	1.7	1.0	.6	1.7	.4	1.0	1.1
Headache	1.4	1.2	1.0	7.3	1.2	1.2	1.0	7.6
Joint pains	.6	2.2	1.0	1.7	.5	8.2	1.0	1.1
Medical visits	.3	.6	1.0	2.3	1.1	2.2	1.0	1.6
Restricted activity	.2	.8	1.0	4.0	.3	.7	1.0	5.4

[1] Less polluted.

TABLE 4.—IRRITATION SYMPTOM PREVALENCE RATIOS AMONG CHILDREN IN 3 SOUTHEASTERN CITIES DISTRIBUTED BY EPISODE STATUS

Symptom	Birmingham episode (N=1887)	(Less polluted) Greensboro (N=1819)	(Less polluted) Charlotte (N=1305)	Charlotte prevalence rate (percent)
Eye discomfort	1.3	1.5	1	2.9
Throat discomfort	1.0	1.5	1	6.4
Chest discomfort	1.4	3.0	1	1.9
Cough	1.5	1.7	1	6.6
Shortness of breath	1.3	1.2	1	1.6
Headache	1.0	1.3	1	7.2
Joint pains	.2	1.4	1	2.6
Medical visists	1.4	5.0	1	.5
Restricted activity	.3	1.3	1	3.0

TABLE 5.—IRRITATION SYMPTOM PREVALENCE RATIOS IN CHARLOTTE DISTRIBUTED BY AGE AND SMOKING [1]

	Adult females		Adult males		
	Smokers	Nonsmokers	Smokers	Nonsmokers	Children
Eye discomfort	1.9	2.9	1.1	0.6	1.3
Throat discomfort	1.5	1.3	1.0	.3	1.0
Chest discomfort	2.4	1.4	2.7	.4	1.0
Cough	1.6	1.5	1.5	.5	1.5
Shortness of breath	1.6	6.2	3.3	.6	.7
Headache	2.1	2.1	1.1	1.0	.7
Joint pains	5.1	3.9	2.9	4.8	1.1
Medical visits	.8	.8	.1	1.1	8.0
Restricted activity	.8	1.1	.4	.2	.7

[1] Charlotte prevalence rate in April 1971, divided by Charlotte prevalence rate in November 1971.

Mr. ROGERS. Thank you.

Now, as to these industries that were picked out, what was the basis of the selection of these industries?

Mr. BAUM. The basis was that these industries are all, according to the Jefferson County Program, industries which emit a hundred tons or more of particulate per year and were those which, because of location, would have to be controlled to reduce the level of that monitoring station.

Mr. ROGERS. Thank you. Any other questions?

Mr. KYROS. I have a question, Mr. Chairman. When you talk about particulate micrograms per cubic meter of air, what are the particulates made of?

Mr. BAUM. I will let Darrell answer that.

Mr. TYLER. They are just small particles.

Mr. KYROS. Suspended solids?

Mr. TYLER. They are suspended particles, that's right.

Mr. KYROS. Do automobile emissions add to the particulates?

Mr. TYLER. Yes. But the automobile is primarily a gaseous problem. There are some particulates from automobiles, but it's not—that's not major.

Mr. KYROS. It says in one of the motions for the temporary restraining order that such discharges, that is, the particulates, are from the plants. You have no question, then, that these particulates come from the plants?

Mr. TYLER. Yes. We—we in discussions with Jefferson County and in reviewing our inventory emission data led us to believe that the sources were responsible for approximately 90 percent of the total particulate—particulates in the area.

Mr. KYROS. In a discussion before the court, does one attorney suggest that there is no cause or relation between the plants and the condition, or is he saying that one cannot be singled out as contributing?

Mr. BAUM. Sir, I don't know how appropriate it is to talk about that statement anymore than to say——

Mr. KYROS. You may say anything you wish. We have a right, as Congressmen, to listen to whatever testimony you have.

Mr. BAUM. These industries that were named in that complaint, all emit a hundred tons or more of the particulate matter a year. Jefferson County determined, and we have no reason to doubt the determination, that they emitted 90 percent of the particulates in the area. The statute says that the court may restrain any person causing or contributing to the alleged pollution. To say that the air pollution that Birmingham was suffering is not known to come from those industries is completely baseless; of course it comes from the industries. We know that industries of this type emit particulates, unless they have controls on them. Some of them have controls, but these industries do emit particulate matter, and there is no question as to their causing or contributing to the air pollution.

Mr. KYROS. Thank you very much.

Mr. ROGERS. I would like for you to submit that list of days when the major pollution problems occurred, in what percentages they occurred and for how many days of the year.

Mr. BAUM. Yes, sir. We will do that.

Mr. ROGERS. And how it jibes with your standards and alerts.

Mr. BAUM. Yes, sir.

(Testimony resumes on p. 74.)

(The following information was received for the record:)

Air Pollution Episodes

There are two types of air pollution episodes, meteorological and accidental. A meteorological episode is the result of poor atmospheric dispersion conditions. An accidental episode is an unexpected event during which contaminants are released into the air in potentially hazardous amounts, but not necessarily associated with a period of meteorological stagnation. The Birmingham episode of November 15–19, 1971, was a meterologically induced situation.

There are two factors that contribute to the creation of a meteorologically induced air pollution episode, one of emission and another of poor meteorological dispersion conditions. The enclosed Figure 1 shows the number of high air pollution potential days that have occurred in various sections of the country as a result of poor dispersion conditoins. As can be seen from the figure, New York and Chicago have far fewer days when the meteorological potential for episodes exist than does Atlanta, Georgia; however, Atlanta has far fewer sources of pollution and thus few episode situations. By contrast, New York and Chicago have heavy emissions and when the poor meteorological conditions do exsit, they are likely to experience an episode situation. Birmingham not only has heavy emissions but also, as seen in Figure 1, experiences many days with poor meteorological dispersion conditions. Birmingham thus experiences many air pollution episodes.

Our experience has shown that the following metropolitan areas have both a meteorological and a source potential for air pollution episodes:

New York City	Birmingham	Los Angeles-Riverside
Philadelphia	Cincinnati	Charleston, W. Va.
Pittsburgh	Mobile	Houston
Baltimore	Chicago-Gary	Denver
Washington, D.C.	St. Louis	
Chattanooga	San Francisco Bay Area	

Our Emergency Operations Control Center (EOCC) presently receives air quality data on a daily basis from approximately 60 cities throughout the country. Of these 60 cities, Table A shows the number of times high concentrations and air pollution alerts, warnings, and emergencies have been reached for each of the pollutants presented. Only those cities for which elevated pollutant levels have been recorded are presented in Table A. Since the EOCC's 60 city network does not cover every area of the country, Table A does not present every city or area that may have episode situations. It does, however, cover most of the large population centers of the country.

In order to obtain more extensive information on past and present air quality throughout the nation and of the improvements in air quality brought about by the 1970 Clean Air Act, the Environmental Protection Agency is establishing with the assistance of State and local air pollution control agencies a National Aerometric Data Information Service (NADIS). NADIS will receive air quality data from all State and local air quality monitoring networks, compiling that information in a common format for easy retrieval and statistical analysis. With such a system, it will be a relatively simple matter to obtain detailed summaries of the type, severity, and number of episodes experienced in any section of the country. This system, however, is not expected fully operational before 1975 and thus less extensive air quality surveillance systems must be used until that time.

FORECAST HIGH AIR POLLUTION POTENTIAL DAYS

39 EPISODES WEST

1 OCT. 1963 - 3 APRIL 1970

75 EPISODES EAST

1 AUG. 1960 - 3 APRIL 1970

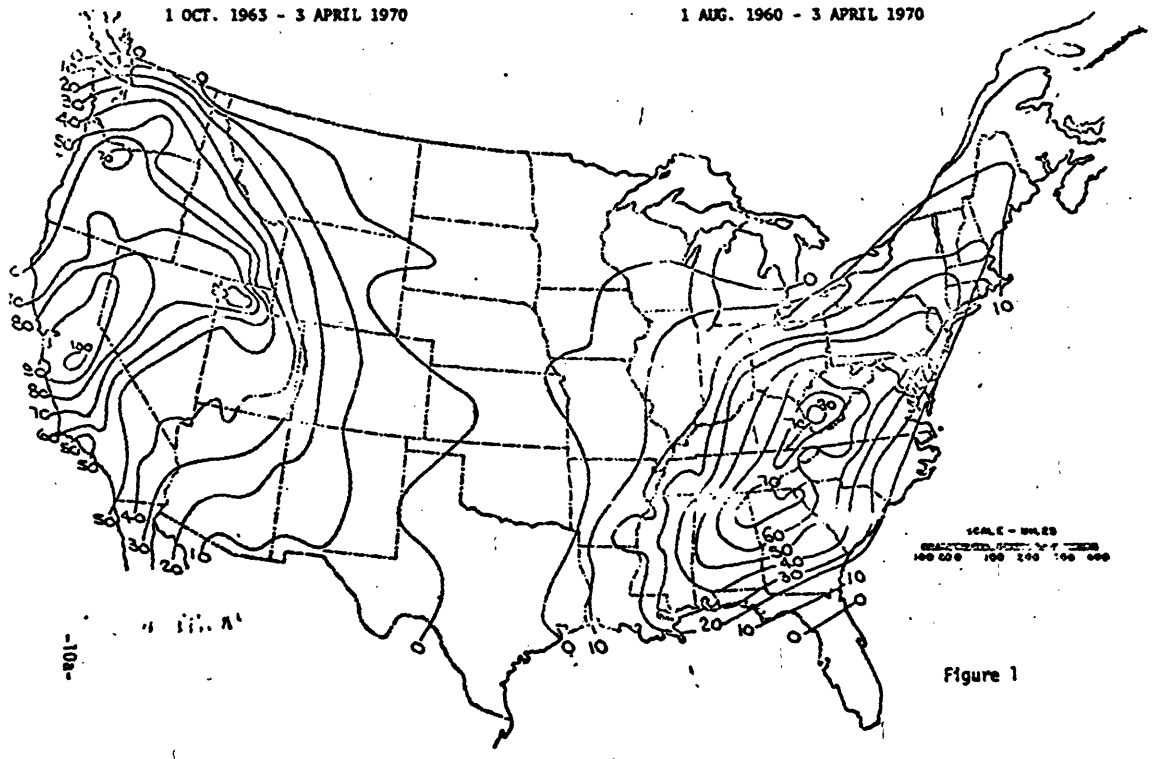

Figure 1

TABLE A.—EPISODE DAYS, NUMBER OF ALERTS, WARNINGS, AND EMERGENCIES

	Time period	High concentration	Alerts	Warnings	Emergency
Washington	Nov. 24, 1970, to Nov. 30, 1971				
Ox			19		
CO			2		
COH's		6	1		
Philadelphia	Nov. 24, 1970, to Nov. 30, 1971				
SO_2		1			
Ox			2		
COH's		3	1		
Product SO_2 and COH's			1		
Cincinnati	Nov. 24, 1970, to Nov. 30, 1971				
SO_2		1			
Ox			16		
COH's		1			
Part		1			
Chicago	Nov. 24, 1970, to Nov. 30, 1971				
SO_2		21			
Ox			11		
CO			5		
COH's		4			
Product SO_2 and COH's			6		
NO_2		3			
St. Louis	Nov. 24, 1970, to Nov. 30, 1971				
SO_2		2			
Ox			7		
COH's		1			
Denver	Nov. 24, 1970, to Nov. 30, 1971				
Ox			9		
CO			8		
COH's		3	2		
Chattanooga	Dec. 10, 1970, to Nov. 30, 1971				
COH's		25	3		
Part		8			
Minneapolis-St. Paul	Nov. 24, 1970, to Nov. 30, 1971				
SO_2		7			
Product SO_2 and COH's			2		
Houston	Dec. 16, 1970, to Nov. 30, 1971				
Ox			7		
Baltimore, Md	Nov. 24, 1970, to Nov. 30, 1971				
SO_2		26			
Product SO_2 and COH's			3		
COH's		1			
Jacksonville, Fla	Nov. 24, 1970, to Nov. 30, 1971				
Part		4			
Atlanta, Ga	Nov. 24, 1970, to Nov. 30, 1971				
Ox			2		
Phoenix, Ariz	Nov. 24, 1970, to Nov. 30, 1971				
CO			1		
NO_2			1		
Puget Sound, Wash	Nov. 24, 1970, to Nov. 30, 1971				
COH's		1			
Birmingham, Ala	Nov. 24, 1970, to Nov. 30, 1971				
Ox			8		
CO			4		
COH's		17	11		
Part		34	8	2	[1] 1
San Francisco, Calif	Nov. 24, 1970 to Nov. 30, 1971				
Ox			2		
COH's			1		
Pittsburgh, Pa	Nov. 24, 1970 to Nov. 30, 1971				
SO_2		14			
CO			7	1	
COH's		5	1		
Product SO_2 and COH's			4		
Part			1		
Salt Lake City, Utah	Nov. 24, 1970 to Nov. 30, 1971				
CO			1		
Magna, Utah	Nov. 24, 1970 to Nov. 33, 1971				
SO_2		17	2		
East Chicago, Ind	Nov. 24, 197. to Nov. 30, 1971				
SO_2		22			
Product SO_2 and COH's			1		
Newark, N.J	Nov. 27, 1970 to Nov. 30, 1971				
Ox			1		
CO			1		
COH's		3			
New York City	Nov. 24, 1970 to Nov. 30, 1971				
SO_2		45			
Ox			9		
CO			1		
COH's		51	28	1	
NO_2		6	2		
Product SO_2 and COH's			37	1	

See footnotes at end of table, p. 73.

TABLE A.—EPISODE DAYS, NUMBER OF ALERTS, WARNINGS, AND EMERGENCIES—Continued

	Time period	High concentration	Alerts	Warnings	Emergency
Riverside, Calif.	Nov. 24, 1970 to July 16, 1971				
Ox.			18		
Durham, N.C.	Jan. 5, 1970 to Nov. 30, 1971				
Ox.			14		
Kansas City, Mo.	Apr. 13, 1971 to Nov. 30, 1971				
Ox.			2		
COH's.			1		
Mobile, Ala.	June 4, 1971 to Nov. 30, 1971				
Ox.			9		
Part.		18	1	1	
Akron, Ohio.	Aug. 12, 1971 to Nov. 30, 1971				
Ox.			6		
Louisville, Ky.	Sept. 2, 1971 to Nov. 30, 1971				
Ox.			1		
CO.			1		
Providence, R.I.	(2)				
COH's.		2			
NO_2.		1			
Memphis, Tenn.	(2)				
COH's.		1			
Willmington, Del.	May 16, 1971 to Nov. 30, 1971				
SO_2.		7			
Ox.			1		
COH's.		1			
NO_2.		3	2		
Rennselaer, N.Y.	Apr. 2, 1971 to Nov. 30, 1971				
SO_2.		2			
Ox.			2		
Kingston, N.Y.	Apr. 2, 1971 to Nov. 30, 1971				
Ox.			1		
Niagara Falls, N.Y.	Apr. 2, 1971 to Nov. 30, 1971				
SO_2.		3			
NO_2.		2	2		
Buffalo, N.Y.	Apr. 2, 1971 to Nov. 30, 1971				
SO_2.		2			
Ox.			2		
COH's.			1		
NO_2.		1			
Paulsboro, N.J.	May 3, 1971 to Nov. 30, 1971				
SO_2.		1			
Rochester, N.Y.	Apr. 2, 1971 to Nov. 30, 1971				
SO_2.		1			
Ox.			1		
Syracuse, N.Y.	Apr. 2, 1971 to Nov. 30, 1971				
Ox.			2		
CO.			2		
NO_2.			1		
Freehold, N.J.	May 3, 1971 to Nov. 30, 1971				
COH's.		1			
Elizabeth, N.J.	May 3, 1971 to Nov. 30, 1971				
CO.			1		
COH's.		1	1		
Burlington, N.J.	May 3, 1971 to Nov. 30, 1971				
COH's.		1			
Jersey City, N.J.	May 3, 1971 to Nov. 30, 1971				
COH's.		8	1		
Copper Hill, Tenn.	(2)				
SO_2.			1		
Atlantic City, N.J.	May 3, 1971 to Nov. 30, 1971				
CO.			1		
Kingsport, Tenn.	(2)				
CO.			1		
Montgomery, W. Va.	(2)				
Part.		2	1		
Bayonne, N.J.	May 3, 1971 to Nov. 30, 1971				
Ox.			1		
COH's.		1			
Trenton, N.J.	May 3, 1971 to Nov. 30, 1971				
CO.			2		
Camden, N.J.	May 3, 1971 to Nov. 30, 1971				
SO_2.		1			
CO.			3		
COH's.		1			

[1] A concentration of 750 ug/m³ particulate for 60 hours is in excess of 875 ug/m³ for 24 hours.
[2] Data received only in periods of air stagnation.

KEY TO TABLE A

Pollutant	High concentration	Alert	Warning	Emergency
SO_2—24-hr. average (ug/m³)	266	800	1600	2100
(ppm)	.10	.3	.6	.8
Part.—24-hr. average (ug/m³)	200	375	625	875
(COHs)	2.0	3.0	5.0	7.0
Product of SO_2(ug/m³) and part (ug/m³)	65×10^3	65×10^3	261×10^3	393×10^3
Product of SO_2(ppm) and part (COHs)	.2	.2	.8	1.2
CO—8-hr. average (mg/m³)	15.2	17	34	46
(ppm)	13.5	15	30	40
Ox—1-hr. average (ug/m³)	200	200	800	1200
(ppm)	.10	.10	.40	.60
NO_2—24-hr. average (ug/m³)	220	282	565	750
(ppm)	.12	.15	.30	.40

Mr. ROGERS. Do you think it's necessary for EPA to actually issue a public alert itself rather than waiting on local officials?

Mr. BAUM. We would have had the State or county not done it.

Mr. ROGERS. This would be a normal procedure for you if not done locally?

Mr. BAUM. Yes, sir.

Mr. ROGERS. Thank you. We appreciate you coming here today and giving your testimony.

Our next witnesses are from the industries affected, Mr. Herbert J. Dunsmore of U.S. Steel, Mr. Pete Montgomery of Connors Steel, and Mr. Harry Gilmer of Woodward Iron.

Good morning. We appreciate you being able to be here with us.

STATEMENTS OF HERBERT J. DUNSMORE, DIRECTOR OF ENVIRONMENTAL CONTROL, UNITED STATES STEEL; H. T. MONTGOMERY, VICE PRESIDENT AND GENERAL MANAGER, CONNORS STEEL; AND HARRY GILMER, SPECIAL PROJECT ENGINEER, WOODWARD IRON CO.; ACCOMPANIED BY JOHN S. FOSTER, ATTORNEY

Mr. DUNSMORE. With me today is our general attorney, Mr. Foster, in the center over here is Mr. H. T. Montgomery, vice president and general manager of Connors Steel, and——

Mr. GILMER. My name is Harry Gilmer. I am special project engineer for Woodward Iron.

Mr. ROGERS. We welcome you gentlemen and will be pleased to receive your testimony.

Mr. DUNSMORE. We appreciate very much the opportunity to appear before your committee and to present our views as to the recent air pollution buildup in Birmingham. United States Steel Corp. is now and has always been concerned about protection of environmental quality and most especially where the public health and well being are concerned. We, therefore, seek in good faith, to comply with requests from governmental bodies to adjust our industrial activities in emergency situations so as to minimize or eliminate such emissions to the environment as may be detrimental.

It was in the context of this policy that we announce last April, when the particulate count in certain sections of the Birmingham area exceeded 600 micrograms per cubic meter, that we were prepared to meet with governmental officials to devise procedures for dealing with such emergencies. It became apparent last week that a thermal inver-

sion over Birmingham was causing another large scale buildup of atmospheric pollutants. When, on Tuesday of this week, the Jefferson County Health Department requested action by industry to assist in reducing the pollution count, we began to reduce and, in some cases, to halt entirely those of our operations which lent themselves to immediate action.

Our steel making furnaces then in production were placed on schedules to reduce concentrations of pariculate matter. In addition, all coke ovens were on extended coking schedules; all open fires were eliminated and trash incinerators were taken out of operation; all coal-fired steam boilers were switched to gas firing; all steel scarfing operations were halted and operators were monitoring their controls constantly to hold emissions from all equipment to an absolute minimum.

In that regard, we would like to read a letter we got from a similar action we took on October 18, 1970, and I would read just the first——

Mr. ROGERS. If you would like to put it in the record and without objection it be made a part of it.

Mr. DUNSMORE. From the Health Department it says,

> This is to officially inform you as per earlier verbal notification that last Thursday's air pollution alert was terminated Friday, October 15, 1971. An alert termination resulted from improved weather conditions and reduction of pollution levels. Undoubtedly, at least the portion of the lower particulate count can be contributed to emission reduction effected by your organization as well as others in the Birmingham area.

When word was received at approximately 3:30 a.m. on Thursday, November 18, that the U.S. Department of Justice had sought and received from Federal District Judge Sam C. Pointer, an order directing Fairfield Works, along with other industrial firms, to take specific action to reduce operations for the purpose of further lowering atmospheric emissions, we took the required action immediately. The cutbacks were effective and remain in full effect at the time of the court hearing at 9 a.m. on Friday, November 19.

Before the start of the hearing, United States Steel Corp., unequivocably stated to Government counsel that we had completely obeyed the temporary restraining order and did not contest the legal action in any manner whatsoever.

I would like to report the total action taken by U.S. Steel to cope with the pollution problem.

Our total cutback was as follows: (1) no scarfing was being performed; (2) all slag quenching operations were discontinued; (3) all incinerators were out of service; (4) there were no open fires; (5) welding and burning were reduced 75 percent; (6) all construction projects which might create a dust problem were halted; (7) coke plant operations were reduced to a minimum sustaining rate; (8) all steam boilers in operation were being fired by gas; (9) the ore conditioning plant at Wenonah was shutdown completely; (10) open hearth operations were reduced and all oxygen feed was stopped resulting in a 70-percent reduction of emissions; (11) we substantially reduced blowing rates in the blast furnaces.

In conclusion, as we informed the court yesterday, we stand prepared to cooperate in every way whenever Government officials deem it necessary to act to protect the public health.

It is our understanding that your committee also desires the views of industry as to the workability of this emergency provision of the

Clean Air Act of 1970. From our point of view, the major problem area in the current pollution picture is the lack of suitable procedure for putting into effect actions which can provide a reduction in plant operations as conditions dictate in an orderly manner and within a minimum of delay—in a word, a plan.

A plan is the key to handling such situations as developed this week. We discussed this briefly in court yesterday, and we intend to initiate immediate discussions with Government officials to effectuate such a plan.

I am well aware of the many problems inherent in invoking an emergency decision of this nature. I believe the officials in this case acted promptly and appropriately, and we agree with the plea made yesterday that an emergency plan is needed, and that, as we have said since last April, we are ready and anxious to meet with Government officials to develop such a plan.

Thank you.

Mr. ROGERS. Thank you very much and I commend you for that attitude. I think that will be helpful, because it's a problem that everybody has to work together to solve, and, particularly, according to these figures, there is about a 50 percent exceeding of the suggested level for health when it should only be 1 day a year at that level. I think that emphasizes the need to work out a coordinate plan.

Does U.S. Steel at the present time have a plan to work out or have you even approached the problem yet here?

Mr. DUNSMORE. Yes, we have our ideas at least of a plan; in fact, many of the things that we put into operation at this time is what we think would be the elements to build up a plan.

Mr. ROGERS. Has there been an industry meeting on this with other industries in the area? Are you aware of this or not?

Mr. DUNSMORE. Not that I am aware of.

Mr. ROGERS. Because, you know, often we, in Washington, hear that if you just, you know, keep our nose out of things, you all will get together and handle it, and, if it can be done that way, I think it's just as preferable, and this committee generally has adopted that idea, but, I think it is necessary and I am sure as you have said in your statement, you agree that something will have to be done, and, although we would have hoped that this plan could have been worked out with industry itself whenever an alert came in, then, I think, this would have probably helped in this one situation.

Now, as I understand it, other statements are to be made. So, perhaps, we won't question right at this time, gentlemen, if you will.

Mr. DUNSMORE. Let me make just this one more comment about the plan while you are talking about it.

We have plans, one that has been referred to here, and in other areas of the United States, and mostly those plans have been worked out separately between the industry and the controlling agency rather than a group.

Mr. ROGERS. As a group. Thank you.

STATEMENT OF H. T. MONTGOMERY

Mr. MONTGOMERY. My company operates a steel treating plant in Woodlawn, about 3 miles east of downtown Birmingham. We operate three electric furnaces producing about 200,000 tons a year with rolling

mills and finishing facilities to go with it. The principal source of pollutants from our plants comes from our furnace operation.

On Tuesday morning of this week, I received a call from a representative from the Jefferson County Health Department who told me that he was calling us to alert us to the fact that conditions were developing unfavorably, that the pollution was building up in the atmosphere, and that they were calling the various companies in the city to let them know about this so that appropriate action could be taken in the event that it became necessary. I thanked him for his call, told him that my firm would fully cooperate with whatever recommendations that the health department deemed necessary.

Tuesday afternoon, about 5 o'clock, I received another call from a representative of the health department who indicated to me that the pollution buildup had increased to a point considered a dangerous level and they were requesting the industrial plants on their list to reduce operations by a considerable extent, suggesting a 60-percent reduction in the emission of the pollutant materials. I asked him what the count was at the North Birmingham station. He said it was in excess of 700. Downtown, I think he said it was close to 500, but we have a monitoring station in Woodlawn about a quarter of a mile from our plant, and I asked him what it was there. He said it was 184.

So, I told him that our employees had not been enjoying full-time work for about 3 months. Most of them were on part time, some were laid off, but that we would be ready to agree to whatever measures that were deemed necessary to control this problem. I didn't want to force our people to miss any work and lose any money unnecessarily and asked him, in view of the fact that the reading in Woodlawn was substantially lower than that reported in the North Birmingham area and downtown, if it would be all right for us to take no action at that time. He said that they were sending this to everybody and I told him that we had already moved on the first alert to eliminate all sources of pollution as generally outlined by the gentleman on my left. Mr. Dunsmore said we would be back in touch with you in the morning.

In the morning, I received a call from a representative of the health department at about 9:30 a.m. and he informed me that the pollution count was still high, and he asked me what we had done, and I told him the actions we had taken. He asked me for an idea as to how much we had reduced the pollutants in the atmosphere, and I told him I couldn't give him an answer, that we had taken all steps short of shutting down our electric furnaces. These steps did not cause anybody to lose any employment and we didn't have to tell anybody not to report on the following shift.

He said: "Well, this thing is pretty severe," and I said: "Well, what is it in Woodlawn?" And he said: "About the same as it was yesterday."

We are several miles from north Birmingham and 3 miles from downtown, and I explained that our people had not been enjoying full-time work and that we hated to cause them to miss wages that they needed. So, he told me he would call me back. He said: "We are going to have a meeting here at 11 o'clock, and I will call you back after the meeting." I didn't hear from him after the meeting, and, after lunch, I called the health department office and asked for the person who had called me, who was not available. He was in confer-

ence. Then, I asked for Dr. Hardy, and he was in conference. So, I left a message and asked him to call me. I didn't receive a call, and, about 4:30 or 5 o'clock, I called down there again trying to contact somebody who could give us some idea what we were to do, and I still didn't get through to anybody, was told that they were still in a meeting, and, again I left my office number and my home phone number and asked them to call me as soon as they were available.

I didn't hear from any one of them at any time that evening. After I went home, and I didn't get a call, I called our plant and instructed our people to shut down two of our furnaces that night, and we did so. I did not submit a report because we were in an uncertain state as to what we were going to do on waiting on their advice. We are perfectly willing at all times—we have been in the past and will be ready at any time in the future to do whatever is deemed necessary, but we didn't have a clear indication that we should close down our plant at that time and cause those people to lose work and lose wages, particularly in view of the fact that in our section of the city, we did not have a serious problem, and that this action didn't seem to be indicated. But, in spite of it, we went ahead and closed two of our furnaces that night. The next day we received a court order to cease all operations, and we complied immediately.

For the information of this committee, my company has air pollution control equipment on order. This equipment we are told, and believe, will eliminate above 90 percent of the particulate matter from the emissions from our furnaces. It will be installed and in operation by, we estimate, July or August at the latest, of this coming year.

If you have any questions, I will be glad to try to answer them for you.

Mr. ROGERS. Thank you very much. We will be holding questions until each has made a statement.

STATEMENT OF HARRY GILMER

Mr. GILMER. Mr. Chairman, I believe I might be quicker if I just read a memo from Mr. Gene Lewis, who is the——

Mr. ROGERS. Certainly it will be. What is his position?

Mr. GILMER. He is the manager of the manufacturing operations at the Woodward plant. He is over the blast furnaces and the coke ovens and he is the man that would normally be contacted for abatement action at those operations there.

This memo concerns the air pollution episode of November 16, 1971.

"At approximately 9 a.m., this date, I received a telephone call from Mr. Grusnick, of the Jefferson County Health Department, putting me on notice that there was an air pollution alert in effect in the Jefferson County area and saying that their office was not authorized to take any action at this time, but that unless the particulate count in the area decreased considerably, an air pollution warning would probably go into effect later in the day. Should this situation occur, they would be back in touch with us.

"I took this opportunity to bring Mr. Grusnick up to date on our current situation: that is, the strike, which was occurring at our coke plant, had already reduced the level of operations from 250 pushes a day down to 75" (that's probably a 70-percent reduction in opera-

tion at the coke plant), "but that we would take steps to reduce our particulate emissions to the absolute minimum at both the coke works and the furnace department.

"At approximately 4:45 p.m. the same day, Mr. Grusnick again telephoned me and informed me that the air pollution warning had been put into effect and that some 23 industries in the area would receive written notification from his office, delivered by hand that night, officially notifying us of the situation and instructing us in broad terms as to what actions we would be expected to take.

"I remained in the office until approximately 6:30 p.m., but received no further contact from the Jefferson County Health Department on this date.

"At approximately 8 a.m. on November 17, we discovered a Xerox copy of a telegram from the Health Department at the plant superintendent's office, a copy of which is attached. After considerable investigation, we discovered this copy had been hand delivered at approximately 7 p.m., November 16, to the coke plant gate" (that was the previous evening). "At approximately 8:30 a.m. on the morning of November 17, 1971, I received another phone call from Mr. Grusnick of the Jefferson County Health Department. He said he was told that the Environmental Protection people seemed likely to get involved in the Birmingham situation, and, although the 24 hours which we had been given to respond to his notice had not yet expired, he would appreciate some verbal indication on our part as to the effectiveness of the action we had taken to minimize particulate emissions since receiving their order the night before. I gave him the same information as outlined in my written response to his office," (which is attached, and from which I will read certain sections) "and confirmed that we would also respond in writing as requested in his order.

"At approximately 6:10 a.m., November the 18th, I received a telephone call from a gentleman who identified himself as Mr. Bill Mallard, an Assistant U.S. attorney, who informed me that a court order would be served upon the Woodward Co. as close to 8 a.m. as possible ordering us to extend coking time to the maximum extent possible consistent with gas heating requirements, and to eliminate all particulate emission from our electric furnace by producing no new heats. He explained that he was calling to give as much advance notice as possible since we would not be bound by the order until it was served upon us. The advance notice was being given so that we could reduce operations in an orderly manner.

"I explained to Mr. Mallard that we were already operating the coke plant at the minimum possible level, and that we were in compliance with the orders, as I understood them by phone, at the coke plant, and that we would comply with the electric furnace request.

"Mr. Mallard stated that a hearing would be held on Friday, November 19 at 9 a.m. to assess these orders. If we had any questions, their office would be available to answer them."

The report which Mr. Lewis had made on November 17 indicated that our coke plant was operating at the minimum level—I quote this particular paragraph: "As we discussed by telephone, operations at our coke plant was at the absolute minimum level at the time the warning was announced, due to a strike by the union representing

our employees there." Mr. Lewis' letter of November 17 to the Jefferson County Department of Health listed these actions taken to minimize emissions from the Woodward operations. "Immediately upon receiving the alert from your office, on the morning of November 16, we took the following action in anticipation of the possibility of a warning being issued later in the day: (1) cracks in the oven brickwork were grouted and sprayed to minimize emissions from the ovens; (2) the coke oven doors were mopped with a grout mixture to seal off gas emissions; (3) standpipes, caps, and discharging lids were sealed with grout on each individual coke oven; (4) oven pushing and charging was coordinated so as to minimize the time the oven was open to the atmosphere, considerably reducing emission; (5) air fuel ratios at both our boiler plant and in our coke oven heating flues were monitored much closer than usual to insure the most efficient combustion possible under the circumstances.

"At the furnace plant, we were operating only one of the four blast furnaces. The following steps were taken in that area to reduce emissions; (1) blast furnace gas was burned in the stoves attendant to furnace operation. Those people responsible for burning the gas were instructed to monitor the process closely so as to obtain efficient combustion, and, (2) blast furnace operators were instructed to keep a very close watch on the furnace to avoid sudden slippage of raw materials stock column, commonly known as kicking, that usually results in the forcing of particles into the air through the bleeder system. These instructions were carried out by furnace personnel and proved to be extremely effective, judging from both observation and instrument readings.

"At the electric furnace, the normal amount of coal per batch is 250 to 300 pounds. We reduced this amount to 100 pounds. The furnace operators were instructed to stoke the furnace frequently, which will keep it from "blowing through" and considerably reducing the possibility of emissions. In addition, the metal chills are being lined with sand rather than the normal blacking material.

"It is our considered opinion that during the 24-hour period following the announcement of the pollution warning, our plant had emitted at a rate less than 25 percent of what it would have under normal operating conditions. Please keep in mind that our situation during this particular alert and warning was extremely unusual for us, considering our coke plant strike, and that our total emission level was far below anything we could expect to attain with short notice in the future, under normal operating conditions."

I think that explains the steps we had taken to curtail emissions and indicated considerable amount of cooperation far in excess of that action requested or required by the Public Health Service. It might be of interest to note that the Woodward plant is approximately 12 to 14 miles from the one station which was reporting the very high particulate level of 771.

Mr. ROGERS. The was the information, I believe, from Mr. Lewis, the manager?

Mr. GILMER. Correct.

Mr. ROGERS. I notice in the letter that was submitted, I don't believe you read that part where he said: "We have no means of definite measurement; however, our estimate is that we have reduced particulate

emission by 30 percent during the 24-hour period since the warning was issued." So, the total overall action there, I believe, Mr. Lewis estimates at about a 30 percent reduction, is that right? Would that be correct?

Mr. GILMER. No, sir. The second paragraph I did read that, sir. It says: "As a consequence of the strike, we had reduced our level of operation by 70 percent", is that the one you are reading?

Mr. ROGERS. That the——

Mr. GILMER. On November 17.

Mr. ROGERS. This was his letter on November 17 in response to the letter of November 16?

Mr. GILMER. Yes, sir.

Mr. ROGERS. The last—his summary sentence, I believe, states what I read.

Mr. GILMER. On the second page?

Mr. ROGERS. Yes, at the bottom.

Mr. GILMER. At the bottom—"It's our considered opinion that during the 24-hour period——"

Mr. ROGERS. I think it's the next paragraph, if you will read——

Mr. GILMER. Oh, all right. Pardon me. Yes, sir.

Mr. ROGERS. Isn't that correct, that in the summary it's estimated at 30 percent reduction?

Mr. GILMER. Yes, sir.

Mr. ROGERS. It was my understanding that the letter that you received on the 16th had requested a 60 percent reduction.

Mr. GILMER. Correct.

Mr. ROGERS. So, you hadn't gone down to the 60 percent, but stayed at half. Maybe I am misunderstanding——

Mr. GILMER. I am not following that, sir. Just a moment.

Mr. ROGERS. I thought the letter said that they wanted a 60 percent reduction of particulates.

Mr. GILMER. Oh, wait a minute.

Mr. ROGERS. And you say you had brought about a 30 percent reduction.

Mr. GILMER. I believe that the statement might be incorrect, because the ovens had been reduced by 70 percent of their normal operating conditions. Now, the reductions from the previous 2 days would be considerably less. It might be closer to 30 percent.

Mr. ROGERS. So, 30 percent would be the actual reduction from the——

Mr. GILMER. From the previous days—2 previous days, probably so.

Mr. ROGERS. Well, that's the point I want to make clear. That's what I understood Mr. Lewis had said.

(The following letter was received for the record:)

WOODWARD CO.,
Woodward, Ala., March 10, 1972.

Hon. PAUL G. ROGERS,
Congress of the United States,
House of Representatives,
Rayburn House Office Building,
Washington, D.C.

DEAR MR. ROGERS: I am returning the corrected testimony for inclusion in the finished report on the review of the Clean Air Act which was held in Birmingham last November.

On pages 76 through 78 the exchange of comments between you and myself indicated that there was some misunderstanding of the operating of By-Product coke ovens. These comments should be included on page 78 as supplemental material to clarify that discussion:

A minimum level of operation exists for By-Product coke ovens in order to prevent damage to the coke ovens, maintain safe working conditions and minimize emissions to the atmosphere. This level will be different for each coke battery and is dependent upon the type of battery, the current condition of the battery, the coal being coked and the type of coke being produced. The maximum reduction of emissions by reduction of operations, therefore, can only be achieved when the plant is operating at a maximum level of production. If the plant is operating at any intermediate level, then the percent of emission reduction by reducing operations to this minimum level will be less. If the plant is already at the minimum level of operation—which was the case as I reported in our testimony—then additional reduction of emissions can only be minimal. To have further reduced our operations at the time of this episode might have been disastrous in that damage would have occurred to the oven walls and explosive conditions would have existed in the gas collection mains. Emissions to the atmosphere actually would have been increased in order to prevent gas explosion.

If I may be of further assistance, please contact me.

Sincerely,

HARRY U. GILMER,
Director of Environmental Control.

Mr. ROGERS. Mr. Montgomery, did you also receive a letter on the 16th? I know you had a telephone conversation, but I wonder if you received a letter.

Mr. MONTGOMERY. We received a message late Tuesday evening about 5:30 p.m. subsequent to the telephone conversation I had with the gentleman from the Health Department.

Mr. ROGERS. I see.

Mr. MONTGOMERY. And in that conversation I had outlined our position and asked if, in fact, the crisis was severe enough that they felt that we should take further action at our plant, and he didn't tell me to do that. He said, "We will talk to you again in the morning."

Mr. ROGERS. Yes, sir. So, you had a conversation with them after you received the letter.

Mr. MONTGOMERY. Yes, sir. At 9:30 Wednesday morning, I had a conversation by phone at which time I was told that the count was still high, and they were going into a conference. I indicated our willingness to shut down completely, if necessary. He said it looked like the weather conditions might improve, and we may not have to, that he would prefer not telling us to have to tell our men to go home.

Mr. ROGERS. That was after you received the letter asking a 60 percent reduction?

Mr. MONTGOMERY. Yes, sir. I received the letter on Tuesday evening about 5:30.

Mr. ROGERS. And this was Thursday morning?

Mr. MONTGOMERY. Wednesday morning about 9:30.

Mr. ROGERS. Yes, sir.

Mr. Dunsmore, how many plants does U.S. Steel have in the Birmingham area?

Mr. DUNSMORE. Well, there were three plants affected under this order. We have a cement plant in the area that is at Leeds which is out of the county.

Mr. ROGERS. So, three plants?

Mr. DUNSMORE. Yes.

Mr. ROGERS. I had understood from the 1969 report that this was a statement from industry themselves on the pollutants, is that correct?

Mr. DUNSMORE. It's an air emission inventory submitted by the Agency. It probably submitted five industries.

Mr. ROGERS. From that, was the statement that U.S. Steel contributed 35 percent of the pollution problem?

Mr. DUNSMORE. I assume that that is correct.

Mr. ROGERS. I was asking, I had understood that. I didn't know if that was so.

Mr. DUNSMORE. We submitted an emission inventory, our estimate on it, and there were standard formulas that I believe that are proper that were used by the Agency to estimate the emissions, and we are familiar with them. We furnished the information to them, but they did not have a way then, or yet, to know how much others are contributing. So, the 35 percent would have to be their figures and not ours.

Mr. ROGERS. Depending on how correct the other industries were in the estimate of what they were also contributing. That's the point you are making.

Mr. DUNSMORE. Right.

Mr. ROGERS. Yes. Now, I notice that you say that you are prepared to cooperate—I guess it was in April when the particulate count reached 600?

Mr. DUNSMORE. Yes.

Mr. ROGERS. And, yet, I thought in your statement you said you felt you would be willing to cooperate at a lesser figure. I wonder does this have a significance, the 600——

Mr. DUNSMORE. No.

Mr. ROGERS (continuing). Micrograms per cubic meter, because I understood the alert—well, we shouldn't have it more than 1 day in a year over 260, I believe.

Mr. DUNSMORE. No. The reference I had there was that last April the count did get up to 600.

Mr. ROGERS. I see.

Mr. DUNSMORE. And there was a similar concern about it on the part of the Control Agency and the EPA.

Mr. ROGERS. Yes.

Mr. DUNSMORE. And it was at that time that we suggested that——

Mr. ROGERS. Certainly.

Mr. DUNSMORE (continuing). Let's sit down and develop an emergency plan.

Mr. ROGERS. And nobody expanded on that?

Mr. DUNSMORE. Well, let's just say it hasn't been done. There—there have been some discussions, but not enough to really come up with a plan.

Mr. ROGERS. To do anything in a concrete way? Although, I suppose the passage of this law is some indication that the State is acting.

Mr. DUNSMORE. Oh, I have every hope that this incident, plus the law, will certainly flush out a plan now. I think we ought to get at it.

Mr. ROGERS. Thank you. I agree with you.

Mr. KYROS. Mr. Dunsmore, I want to commend your company for agreeing all along with the action taken.

Mr. DUNSMORE. That's correct. Where matters of health are concerned, we think that the official Health agency and the Government must respond as they did.

Mr. KYROS. I think it's a tribute to you and your company, and I certainly hope that the pollution control devices you have put in will keep us competitive.

Mr. DUNSMORE. Mr. Kyros, we are spending $600,000 or approximately that to install these devices at our little plant. This is not productive at all, and it will not bring us a penny but will add to our cost of operation. We are in a very severe competitive squeeze that exists now, and your—I'm sure you are familiar with the reasons why. However, we regard this as a necessary measure. We are doing it cheerfully, and we started it and were not under duress when we started it, and we felt it had to be done. In light of today's technology, it needs to be done; therefore, we are doing it, but there is no question about it, it will hamper our competitiveness in the world steel markets.

Mr. KYROS. I hope that when we begin writing tax tables that we will do something to help you. It is a cost that has to be shared by many industries, not only by yours alone.

I have one question for you, Mr. Gilmer. In court, you were represented by a lawyer named Murray Alley.

Mr. GILMER. Yes, sir.

Mr. KYROS. On page 28, he states after the court says: "That there needs to be some type of presently available national procedure at these plants that can be put into effect on a reasonably short notice in stepping down emissions with less detriment to the particular plant."

Mr. Alley said on page 27: "Judge, that was this, and it was being done." He said, "It is the Federal Government that walked in and said 'Ya'all step aside. We will take it over.' But it was also the Federal Government that had no conversation whatever with these industries or their attorneys."

I am not degrading Mr. Alley, because I have been in court myself and said many things, but that statement has no warrant or basis. In the light of testimony this morning, I assume that you disagree with the things he said?

Mr. GILMER. I would rather not make a comment, because I have not read it, and I was not in court with him.

Mr. KYROS. I certainly didn't see any of that kind of testimony. We are concerned about your business and concerned about the employment to this area. I must say, you could have cooperated before having this condition develop.

Mr. GILMER. Probably certain measures could have been taken earlier, but I must say that there are certain facilities that are very difficult to control and proper techniques have not been developed yet, although there is much work being done in developing techniques for these particular operations.

Mr. KYROS. Do you think the Clean Air Act provides sufficient time for industries like yours to accommodate themselves to the act?

Mr. GILMER. It's rather difficult to say on that, sir. There are certain operations that can be controlled, as I have just said, but there are certain others that controls have to be developed and are being worked upon at the present time. Probably the most notable is that the coke plant itself is very difficult to control right now, and there are no techniques that I am aware of that do that. There is a considerable amount of work being done though to develop the control techniques

for that. We are sharing in that expense as a member of the American Iron & Steel Institute as other coke producers are also.

Mr. KYROS. Thank you very much.

Mr. GILMER. At the present, I do not know what is sufficient time for developing this equipment or technique.

Mr. KYROS. Thank you.

Mr. ROGERS. Mr. Hastings.

Mr. HASTINGS. In the case of Woodward and Connors, did you agree with the action taken by EPA and in invoking 303?

Mr. GILMER. Would you repeat that, please, sir.

Mr. HASTINGS. Do you think it was necessary for EPA to invoke section 303 as they did?

Mr. GILMER. In our own case, in one paragraph of Mr. Lewis' letter to the Jefferson County Department of Health, we had already indicated that our coke oven operation was approximately 70 percent under normal operation, and, therefore, our emissions should have been at least 70 percent under the normal operating level in light of that. We did take action to further reduce the emissions at that particular time, in response to the Jefferson County Department of Health request, by an additional 25 percent.

Mr. HASTINGS. Do I interpret that as being no, that you don't agree with them in their action?

Mr. GILMER. In our case, I would say that we were cooperating voluntarily and without the need of legal action, yes, sir.

Mr. HASTINGS. All right. Thank you then.

In the case of Connors, do you have——

Mr. MONTGOMERY. We are not here to criticize anybody's action or to—we believe that all of the witnesses who have appeared at the hearing are motivated only by the best of impulses. We would wish for a little better assurance that some of the actions that were taken were necessary. My original question to the first fellow I had conversation with from the health department was, "Is it necessary for us to reduce in this amount?"

The steel industry is in a dire situation and the steelworkers are suffering from lack of work, and we are most reluctant to add to the hardship that the men are already experiencing by taking an unwarranted action to shutdown on short notice unless it's an emergency.

Mr. HASTINGS. What I am trying to determine is whether in fact, you do disagree with the action that EPA has taken. It's just a question of yes or no.

Mr. MONTGOMERY. Well(I think in—certainly, in some aspects of the case, perhaps it's entirely warranted when you have no indication that the level is critical and such action is even necessary, but my question is: Should we base action on a reading you get at only one monitoring station? I am not a Health Department official, I am not an M.D., I am simply a business man, but, counsel, common sense would seem to indicate that you take a reading or you look at a different section and try to see what the problem is in this particular area before you take a sweeping approach and shutdown, in this case, 23 industries. Some of these industries, I am told, were not even in operation, which indicates that perhaps a little better consideration of the individual circumstances with those companies should have been initially taken into account.

Mr. HASTINGS. I understand too that you testified in court that both Woodward and Connor were going to ask for a hearing to ask compensation be paid. Are you aware of that?

Mr. MONTGOMERY. We are not seeking any compensation.

Mr. HASTINGS. Well, your attorneys suggest that you are.

Mr. MONTGOMERY. I wasn't present at that hearing, but I assure you that we are not.

Mr. HASTINGS. I was also disturbed with some language—"There was no evidence that there was anything related to this emergency as to what a particular defendant was doing."

Do you share that?

Mr. MONTGOMERY. I can't speak about the other 22, Mr. Hastings, but I do feel in our own situation that with the monitoring station as close as it is to our own plant that no such action was indicated.

Mr. HASTINGS. I understood, however, from testimony here today that in each case every plant was emitting at least 100 tons of particulates per year, and that was the criteria for establishing a list of 23 industries.

Mr. MONTGOMERY. I don't deny that point. What I am talking about is that the monitoring station in Woodlawn is fairly close to our plant and it did not indicate any crisis in our area of the city, but we—we were swept up with the other 22 defendants and ordered to close our operation.

Mr. HASTINGS. I suggest that any industry that emits 100 tons of particulates a year is not making a contribution to the ambient air quality all over the region.

Mr. MONTGOMERY. Of course they do, Mr. Hastings. That is not my point. My point is I do not feel that the proper consideration was given to our particular situation.

Mr. HASTINGS. I say, that's one reason we are down here, and also, I would like to make just a closing statement. I am aware, as most Members of Congress are, of the serious situation in the steel industry, probably caused in part by these problems, and, in line with what Mr. Kyros said, if you are going to purchase and install pollution abatement equipment, we certainly ought to consider the question of taxation, and action is being given on this. It's not that we are just being critical of the steel industry. We do understand that to a greater degree than you think we do. I have steel plants in my own State. We have those problems. We have to strike a balance, however, a legislative line between the public good and a—a necessity to keep the economy moving. That's what we hope to be able to do.

Thank you very much.

Mr. MONTGOMERY. Yes, sir.

Mr. ROGERS. May I ask the gentleman from U.S. Steel, you cannot tell from your letter from November 17th in response to the letter of the 16th you received whether you had actually reduced emissions. I don't see any statement that you had actually reduced emissions 60 percent to the best of your knowledge.

Mr. DUNSMORE. That is correct.

Mr. ROGERS. Was there any estimate as to what the reduction was?

Mr. DUNSMORE. The statement that we have made was that it was a substantial reduction, and, if you look at the letter or the telegram that we received from the health office here, he said—the officer—he said:

As a result in order to protect the health of the citizens of Jefferson County, I am requesting your plants to make an additional reduction in particulate emissions as soon as possible and to maintain said reduction until the warning is terminated.

Then, he goes on with the next sentence:

Due to the seriousness of the situation, this office feels that an overall particulate emission reduction of 60 percent is justified.

Now, we did make an additional reduction, and we have quantitated it in a letter, precisely what things we did do. My judgment is that we were in the area of 30 percent.

Mr. ROGERS. About 30 percent?

Mr. DUNSMORE. Yes, sir.

Mr. ROGERS. I see. Do you know now what you did when the order was issued?

Mr. DUNSMORE. Turned the oxygen off from the open hearth.

Mr. ROGERS. What was the reduction percentage there?

Mr. DUNSMORE. In the open hearth itself, it would reduce that something over 60 percent.

Mr. ROGERS. And what other operations might contribute to the particulate situation?

Mr. DUNSMORE. I think other than a further change on the coking—I think we already had inaugurated all of the plant—we did slow down the blast furnaces, and you have to understand a little bit about the steelmaking industry. A blast furnace is really heating the hot metal for an open hearth. So, if you slow down the open hearth——

Mr. ROGERS. I understand the order did not close blast furnaces.

Mr. DUNSMORE. That is correct.

Mr. ROGERS. So, you didn't have to do anything for the order except just to stop feeding them, wasn't that it?

Mr. DUNSMORE. Well, we did stop feeding it oxygen, but what I am—the point I am trying to make is that—that a blast furnace was pushing the hot metal out at a fixed rate, and, if you are going to close your open hearth so that it couldn't handle the hot metal, then you have to slow down your blast furnaces; otherwise, you are not going to have any place to put the hot metal.

Mr. ROGERS. So, the overall reduction as a result of the ordering was 60 percent?

Mr. DUNSMORE. Over 60 percent.

Mr. ROGERS. Little over 60 percent, fine.

Are there any other questions?

Mr. KYROS. No, sir.

Mr. ROGERS. I want to make a part of the record at this point the record of the proceedings in the U.S. District Court for the Northern District of Alabama, and without objection, it be made a part of the record.

(Testimony resumes on p. 93.)

(The proceedings in the U.S. District Court referred to follow:)

IN THE UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF ALABAMA, SOUTHERN DIVISION

(Civil Action No. 71-1041)

UNITED STATES OF AMERICA, PLAINTIFF, *v.* U.S. STEEL CORPORATION—FAIRFIELD WORKS; U.S. STEEL CORPORATION—ENSLEY WORKS; U.S. STEEL CORPORATION—WENONAH WORKS; U.S. PIPE & FOUNDRY COMPANY—NORTH BIRMINGHAM

OPERATIONS; U.S. PIPE & FOUNDRY COMPANY—BESSEMER PLANT; WOODWARD COMPANY—DIVISION OF THE MEAD CORPORATION; CONNORS STEEL DIVISION—H. K. PORTER COMPANY, INC.; SOUTHERN ELECTRIC STEEL COMPANY; REPUBLIC STEEL CORPORATION; ALABAMA-BY-PRODUCTS CORPORATION; STOCKHAM VALVES & FITTINGS; GRIFFIN WHEEL COMPANY; MCWANE CAST IRON PIPE COMPANY; JEFFERSON FOUNDRY COMPANY; BIRMINGHAM STOVE & RANGE COMPANY; CLOW CORPORATION; AMERICAN CAST IRON PIPE COMPANY; VULCAN MATERIAL COMPANY, FAIRFIELD PLANT; VULCAN MATERIAL COMPANY, WYLAM PLANT; SWIFT AGRICULTURE CHEMICALS CORPORATION; W. A. BELCHER LUMBER COMPANY; U.S. GYPSUM COMPANY; LONE STAR CEMENT CORPORATION; ALPHA PORTLAND CEMENT COMPANY; W. J. BULLOCK, INC.; R. A. WADE SAND & GRAVEL COMPANY; HARRISON-WALKER REFRACTORIES COMPANY; AND DIVISION DRESSER INDUSTRIES, INC. BESSEMER PLANT, DEFENDANTS.

The United States of America, by its undersigned attorneys and by authority of the Attorney General alleges that:

1. This is a civil action to enjoin the above named defendants from discharging any particulate matter into the ambient atmosphere from their manufacturing operations in the Birmingham, Alabama, area. Such discharges contribute to the imminent and substantial endangerment to the health of persons as determined by the Administrator of the Environmental Protection Agency. Authority to bring this action is in the Department of Justice by 42 USC 1857h-3.

This Court has jurisdiction of the subject matter of this action pursuant to 28 USC 1345.

3. Defendants are corporations doing business in Birmingham, Alabama, within the Northern District of Alabama.

4. During normal operation of the defendants' plants, the defendants discharge particulate matter into the ambient air.

5. The Administrator of the Environmental Protection Agency has received evidence that a combination of pollution sources, including the defendants' plants, are presenting an imminent and substantial endangerment to the health of persons by discharging particulate matter into the ambient air.

6. The appropriate State and local authorities have diligently attempted to decrease the level of contamination in the atmosphere. However, the various sources emitting particulate matter in significant quantities, including the defendants' plants, continue to discharge particulate matter into the ambient atmosphere to levels that cause significant harm to the health of human beings.

7. The average particulate level in the ambient air for the past forty-eight (48) hours is approximately 725 micrograms per cubic meter. Such particulate levels for such periods of time are harmful to the health of human beings.

8. The discharges of particulate matter by the defendants should be eliminated pursuant to Section 303 of the Clear Air Act which provides:

"EMERGENCY POWERS

"Section 303. Notwithstanding any other provisions of this Act, the Administrator upon receipt of evidence that a pollution source or combination of sources (including moving sources) is presenting an imminent and substantial endangerment to the health of persons, and that appropriate State or local authorities have not acted to abate such sources, may bring suit on behalf of the United States in the appropriate United States district court to immediately restrain any person causing or contributing to the alleged pollution to stop the emission of air pollutants causing or contributing to such pollution or to take such other action as may be necessary."

9. The continuous emission of particulate matter into the ambient air by the defendants contributes to the present situation which, if allowed to continue, will cause significant harm to the health of persons in the Birmingham area.

10. The United States of America and its citizens will suffer immediate and irreparable harm to their health unless the defendants are immediately restrained from discharging particulate matter into the ambient atmosphere.

Wherefore, the United States prays:

a. That the defendants, their officers, directors, agents, servants, employees, attorneys, successors, and assigns, and each of them cease the discharge of particulate matter into the ambient air in a manner prescribed by this Court and

not discharge such matter thereafter unless pursuant to instruction to do so from this Court.

b. That costs and disbursements of this action be awarded to the plaintiff; and

c. That this Court grant such other and further relief as it may deem just and proper.

SHIRO KASHIWA,
Assistant Attorney General.
WAYMAN G. SHERRER,
U.S. Attorney.
(By William D. Mallard, Jr.)
Assistant U.S. Attorney.
JAMES R. WALPOLE,
Attorney, Department of Justice,
Attorneys for Plaintiff.

IN THE UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF ALABAMA, SOUTHERN DIVISION

(Civil Action No. 71-1041)

UNITED STATES OF AMERICA, PLAINTIFF *v.* UNITED STATES STEEL CORP., ET AL, DEFENDANTS

MOTION FOR TEMPORARY RESTRAINING ORDER

The United States of America, by its undersigned attorneys, by authorization of the Attorney General and acting at the request of the Administrator of the Environmental Protection Agency, moves that this Court, in order to prevent irreparable injury to the United States and its citizens, enter immediately an order to restrain temporarily the defendants set forth in the complaint from discharging excessive particulate matter into the ambient air pending action by this Court on the complaint filed this day by the United States in this cause, and in support of this motion, states:

Defendants are discharging from their plants and/or installations at Birmingham, Alabama, substantial amounts of particulate matter into the ambient air. Such discharges in combination with adverse weather conditions have caused, or are contributing to, concentrations of particulate matter in the ambient air exceeding a level over 700 micrograms per cubic meter of particulate matter. This level presents an imminent and substantial endangerment to the health of persons.

The appropriate state and local authorities have diligently attempted to decrease the level of contamination in the atmosphere. However, defendants continue to discharge particulate matter into the ambient atmosphere causing imminent and substantial endangerment to the health of persons.

The presence of such levels of particulate matter is a present and continuing danger to the human health. Unless the discharges of particulate matter are immediately restrained, the health of people in the area will continue to suffer immediate and irreparable harm.

Plaintiff further moves for said Temporary Restraining Order to be issued forthwith and without notice, on the ground that the discharges constitute an imminent and substantial endangerment to the heatlh of persons.

Therefore, in view of the immediate danger to public health that the defendants are contributing to by the release of particulate matter into the ambient air, plaintiff prays that the Court enter a temporary restraining order immediaely.

Respectfully submitted,

SHIRO KASHIWA,
Assistant Attorney General.
WAYMAN G. SHERRER,
U.S. Attorney.
(By William D. Mallard, Jr.)
Assistant U.S. Attorney.
JAMES R. WALPOLE,
Attorney, Department of Justice,
Attorneys for Plaintiff.

IN THE UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF ALABAMA, SOUTHERN DIVISION

(Civil Action No. 71-1041)

UNITED STATES OF AMERICA, PLAINTIFF

v.

UNITED STATES STEEL CORP., ET AL., DEFENDANTS

TEMPORARY RESTRAINING ORDER

This cause came on to be heard on the motion of plaintiff, upon the complaint herein and the affidavits attached thereto, for a temporary restraining order; and, it appearing to the court therefrom that immediate and irreparable injury, loss and damage will result to the plainiff before notice can be given and the defendant or his attorney can be heard in opposition to the granting of a temporary restraining order for the reason that continued levels of pollution by particulate matter will cause irreparable damage to the health of persons, it is

Ordered, that defendants set out in the complaint filed herein, their agents, servants, employees and attorneys and all persons in active concert or participation with them are hereby restrained from causing or contributing to the alleged pollution and each defendant separately must take the following action: U.S. Steel Corporation—Fairfield Works must stop the emission of particulate matter from incineration, scrafing, slag quenching, open burning and other operations that can be postponed.

Must increase coking time to the maximum extent possible consistent with gas heating requirements.

Must reduce emissions of particulate matter from all open hearth furnaces by ceasing feed to the open hearth and maintaining the heat.

U. S. Steel Corporation, Ensley Works must reduce emissions of particulate matter from all open hearth furnaces by ceasing feed to the open hearth and maintaining the heat.

U. S. Steel Corporation, Wenonah Works must stop the emissions of particulate matter from all sintering operations by ceasing operations.

U. S. Pipe & Foundry Company, North Birmingham Operations must increase coking time to the maximum extent possible consistent with gas heating requirements.

Must eliminate emissions of particulate matter from all cupolas adding no new charges and shutting down cupolas after present heat is finished.

Must eliminate emissions of particulate matter from all mineral wool cupolas by shutting down such cupolas as rapidly as possible without damage to equipment.

U. S. Pipe & Foundry Company, Bessemer Plant must eliminate emissions of particulate matter from all cupolas adding no new charges and shutting down cupolas after present heat is finished.

Woodward Company, Division of the Mead Corporation must increase coking time to the maximum extent possible consistent with gas heating requirements.

Must eliminate emissions of particulate matter from all electric arc furnaces by making no new heats.

Connors Steel Division, H. K. Porter Company, Inc. must eliminate emissions of particulate matter from all electric are furnaces by making no new heats.

Southern Electric Steel Company must eliminate emissions of particulate matter from all electric arc furnaces by making no new heats.

Republic Steel Corporation must increase coking time to the maximum extent possible consistent with gas heating requirements.

Alabama-by-Products Corporation must increase coking time to the maximum extent possible consistent with gas heating requirements.

Stockham Valves & Fitting must eliminate emissions of particulate matter from all electric arc furnaces by making no new heats.

Must eliminate emissions of particulate matter from all cupolas adding no new charges and shutting down cupolas after present heat is finished.

Griffin Wheel Company must eliminate emissions of particulate matter from all electric arc furnaces by making no new heats.

McWane Cast Iron Pipe Company must eliminate emissions of particulate matter from all cupolas adding no new charges and shutting down cupolas after present heat is finished.

Jefferson Foundry Company must eliminate emissions of particulate matter from all cupolas adding no new charges and shutting down cupolas after present heat is finished.

Birmingham Stove and Range Company must eliminate emissions of particulate matter from all cupolas adding no new charges and shutting down cupolas after present heat is finished.

Clow Corporation must eliminate emissions of particulate matter from all cupolas adding no new charges and shutting down cupolas after present heat is finished.

American Cast Iron Pipe Company must eliminate emissions of particulate matter from all electric arc furnaces by making no new heats.

Must eliminate emissions of particulate matter from all cupolas adding no new charges and shutting down cupolas after present heat is finished.

Vulcan Materials Company, Fairfield Works must eliminate emissions of particulate matter by phasing down all operations as rapidly as possible without causing damage to equipment.

Vulcan Materials Company, Wylam Plant must eliminate emission of particulate matter by phasing down all operators as rapidly as possible without causing damage to equipment.

Swift Agricultural Chemical Corporation must eliminate emission of particulate matter by phasing down all operations as rapidly as possible without causing damage to equipment.

W. A. Belcher Lumber Company must eliminate emissions of particulate matter by shutting down wood burning boiler.

U.S. Gypsum Company must eliminate emissions of particulate matter from all mineral wool cupolas by shutting down such cupolas as rapidly as possible without damage to equipment.

Lone Star Cement Corporation must eliminate emission of particulate matter from crushing, mixing, cleaning, conveying and transferring operations.

Must eliminate emission of particulate matter from kilns by starting no new batches and allowing processes in operation to phase down.

Alpha Portland Cement Company must eliminate emissions of particulate matter from crushing, mixing, cleaning, conveying and transferring operations.

Must eliminate emission of particulate matter from kilns by starting no new batches and allowing processes in operation to phase down.

W. J. Bullock, Inc. must eliminate emission of particulate matter by shutting down all furnaces and smelters and stopping all incineration processes.

R. A. Wade Sand and Gravel Company must eliminate emission of particulate matter from crushing, mixing, cleaning, conveying and transferring operations.

Must eliminate emissions of particulate matter from dryers by ceasing feed of new materials and phasing down operations as rapidly as possible without damage to equipment.

Harbison-Walker Refractories Company, Division Dresser Industries, Inc., Bessemer Plant must eliminate emission of particulate matter from dryers and kilns by ceasing feed of new materials and phasing down operations as rapidly as possible without damage to equipment.

Ordered, that this order expire within 10 days after entry, unless within said time it is for good cause shown extended for a longer period, or unless defendants consent that it may be extended for a longer period; and it is further

Ordered, that plaintiff's complaint be set for hearing on preliminary injunction on November 19, 1971, at 9:00 o'clock A.M. of that day or as soon thereafter as counsel can be heard, in the United States District courtroom in the City of Birmingham, State of Alabama.

This order issued at Birmingham, Ala., this 18th day of November, 1971. (1:45 A.M.)

SAM C. PORTER,
U.S. District Judge.

IN THE UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF ALABAMA, SOUTHERN DIVISION

(Civil Action No. 71-1041)

UNITED STATES OF AMERICA, PLAINTIFF V. UNITED STATES STEEL CORPORATION, DEFENDANTS

STATE OF ALABAMA, *Jefferson County*

AFFIDAVIT

Charles B. Robison, Assistant Director of the Jefferson County Bureau of Environmental Health, being duly sworn deposes and states:

1. That he is the Assistant Director of the Bureau of Environmental Health for Jefferson County, Alabama;

2. As part of his duties he supervises the air pollution control program for Jefferson County Health Department, including the collection and analysis of air quality data;

3. A sample of partciulate matter, collected by a standard high volume air sampler, indicated a particulate level of 771 micrograms per cubic meter of air for the time period beginning 2:00 P.M., Monday, November 15, 1971, and ending at 8:00 A.M,, Tuesday, November 16, 1971, in North Birmingham;

4. A later sample from the same location indicated a particulate level of 722 micrograms per cubic meter of air for the time period beginning at 5:00 P.M., Monday, November 15, 1971, and ending at 2:30 P.M. on Tuesday, November 16, 1971;

5. A later sample at the same location, indicated a particulate level of 758 micrograms per cubic meter of air for the time period beginning 8:00 A.M. on Tuesday, November 16, 1971, and ending at 8:00 A.M., Wednesday, November 17, 1971;

6. A later sample at the same location, indicated a particulate level of 728 micrograms per cubic meter of air for the time period beginning at 2:30 P.M. on Tuesday, November 16, 1971 and ending at 2:30 P.M., Wednesday, November 17, 1971;

7. For the forty-five hours ending at 2:30 P.M. on Wednesday, November 17, the average particulate level was 725 micrograms per cubic meter of air.

CHARLES B. ROBISON.

IN THE UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF ALABAMA, SOUTHERN DIVISION

UNITED STATES OF AMERICA, PLAINTIFF V. UNITED STATES STEEL CORPORATION, ET AL., DEFENDANTS

STATE OF ALABAMA, *Jefferson County:*

AFFIDAVIT

Robert A. Kornasiewicz being duly sworn deposes and says:

1. I am a Meteorologist with the Atmosphere Research Laboratories of the National Oceanic & Atmosphere Administration;

2. Since January, 1970, I have been assigned to the Environmental Protection Agency and have been involved in work in air pollution control;

3. As part of my duties, I assist the Environmental Protection Agency's concern with air pollution emergencies throughout the country;

4. On Monday, November 15, 1971, in the course of my duties of observing national weather conditions, I became aware that the National Weather Service Forecast Office in Birmingham had issued an Air Stagnation Advisory for the Birmingham area;

5. An Air Stagnation Advisory is issued when winds are calm and atmospheric conditions are such that there is limited vertical mixing of pollutants.

During these conditions, due to the lack of winds to move pollutants out of the area, and the limited height to which pollutants can rise, unless emissions of

pollutants are curtailed or terminated, the concentrations of such pollutants will increase;

6. At this time the Air Stagnation Advisory is still in effect. Although there is a frontal system moving in from the West which is expected to gradually improve weather conditions, i.e., increase dispersion characteristics of the atmosphere, it is expected that the Advisory will continue in effect until at least 11:00 A.M. on Thursday, November 18, 1971, and that although the Advisory may be terminated at that time, dispersion will still be poor for some time thereafter. If the frontal system should slow down or stop, it will result in the extension of the Advisory until such time as the frontal system reaches the Birmingham area;

7. Until such time as weather conditions improve, the continued emissions of pollutants in the same quantities as have been emitted in the last seven days will cause concentrations in the atmosphere to remain at existing levels or to increase.

ROBERT A. KORNASIEWICS.

IN THE UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF ALABAMA, SOUTHERN DIVISION

(Civil Action No. 71-1041)

UNITED STATES OF AMERICA, PLAINTIFF V. UNITED STATES STEEL CORPORATION, ET. AL., DEFENDANTS

STATE OF ALABAMA,

Jefferson County

AFFIDAVIT

Douglas Ira Hammer, Acting Chief, Epidemiology Branch, Division of Health Effects Research, United States Environmental Protection Agency, being duly sworn deposes and states:

1. I, Douglas Ira Hammer, am the Acting Chief of the Epidemiology Branch, Division of Health Effects Research of the United States Environmental Protection Agency;

2. I have received a Bachelor of Science Degree and a Doctor of Medicine Degree from Tufts University, and a Master of Public Health Degree from Harvard University. I have completed my Specialty Boards in General Preventive Medicine. I have worked full time in the field of air pollution health effects research since 1963.

3. It is my opinion that exposure to suspended particulate levels of 1000 micrograms per cubic meter per twenty-four hours in the ambient air for a single twenty-four hour period would constitute an imminent and substantial endangerment to the health of persons, i.e., an immediate and serious threat of significant harm to the health of a significant portion of the general population.

4. Furthermore, it is my opinion that exposure to ambient particulate levels of greater than 700 micrograms per cubic meter per twenty-four hours for two consecutive days would constitute an equivalent endangerment to the public health.

DOUGLAS IRA HAMMER.

Mr. ROGERS. Gentlemen, thank you for your presence here today. I think as you saw this instance probably has pointed out the need for quick action in trying to work out some plan that will make it easier for people to try to respond to what is needed for the public health. Thank you so much for being here today.

We have two witnesses which I think will not require much more time. Our next witness is Mr. Alan W. Heldman, who is an attorney, and represents the Alabama Clean Air Committee and Greater Alliance to Stop Pollution, GASP.

We welcome you, Mr. Heldman.

STATEMENT OF ALAN W. HELDMAN, ATTORNEY, BIRMINGHAM, ALA.

Mr. HELDMAN. I should emphasize to you that my views are those of myself. I do represent these two groups as legal counsel, but I am not their official spokesman.

I have observed what has happened in Birmingham in the last week. I did not represent any parties as to the legal aspects. I take it your position here is to see how well the Clean Air Act of 1970 and, especially this section 303, is working, and, for whatever expertise I might offer, I might state that it is my opinion that it's worked very well here.

In my opinion, the EPA officials as well as the State and County Health Department people are to be commended for a good job. I think the Justice Department and the local U.S. Attorney's Office did a good job, and I think—and I hesitate to say this as a member of the local bar, but on the other hand, I feel compelled to say it because of some remarks that were made in court yesterday which suggested the contrary. I think that our local district judge did a good job. It is true that it is unusual in our local Federal Court practice to have a temporary restraining order without notice to the parties affected, although the rules of civil procedure for some years have generally okayed that in the appropriate case.

The Clean Air Act specifically makes reference to the availability of that remedy, because of the health of the public being affected, and I was particularly impressed with one statement of counsel for some of the defendants which appeared in the record you have here. He said: "To come in here in the middle of the night and get injunctions without notice to me is unthinkable." I suggest that's not only thinkable, it's appropriate, and I urge the committee not, on the one hand, to move away from the judicial role in the emergency procedure or, on the other hand, to require anything more deliberate and time consuming than we have.

I think the chairman suggested some consideration, when you were examining Mr. Willis, of perhaps removing the role of the court entirely, and it would be my thought that especially when you are speaking in terms of a Federal administrative official coming in as an official, that he is somewhat more foreign than the local district judge, who is very comfortable to the local community, and I think the way that the proceedings were handled here speaks well for—for that procedure.

That's all I have.

Mr. ROGERS. Thank you very much. This is one of the things I want to commend, and I think it's very interesting that your State law does, in the interest of time, use that procedure—it allows the administrator or your Director to move and then have a hearing before your board, but I concur with you. I think that probably the way the committee designed the law to use the Federal judiciary is probably a more appropriate procedure, if it works and works properly and correctly, and this is why we are here—to see if industry felt that they had been given a—if the action was appropriate, if the public was protected, and if the agencies were able to operate quickly to protect health, because that's the purpose of the law.

Mr. HELDMAN. There were perhaps two reasons why it perhaps was more appropriate in the State law to let the Administrator proceed without judicial intervention in the first incident. The first being that he would be a local or almost a local person thoroughly familiar with the local situation.

Mr. ROGERS. Yes, sir.

Mr. HELDMAN. And secondly, State courts are simply not moving nearly so quickly on injunction proceedings.

Mr. ROGERS. Thank you. Mr. Kyros.

Mr. KYROS. Just one statement, Mr. Chairman. To the list of people commended, I think we ought to add the industries. They do provide jobs in the community which you need. I think that all of you working together will be able to solve this problem with our help.

Mr. HELDMAN. I might partially disagree with you by telling the committee that we had a long and hard a struggle starting the beginning of this year to get the present new air pollution law statute passed, and there was not one, to my recollection, of the 23 defendants here who did anything but unequivocably opposed the better provisions. The industries were united against effective air pollution control here, and I would further suggest of those who did appear here this morning, presumably they were the ones who, of the 23, who felt most comfortable about appearing and exposing themselves, and, yet none of the three having been asked to reduce emissions to the tune of 60 percent could say that they reduced more than 30 percent, sirs, as I heard the testimony.

Mr. KYROS. I see though, they have a cooperative attitude, and that does not limit the role that public minded people like yourself, have played as a catalyst. The fact is that we have all got to go ahead cooperatively.

Mr. HELDMAN. That's right, certainly.

Mr. KYROS. Thank you, sir.

Mr. ROGERS. Mr. Hastings.

Mr. HASTINGS. I would just like to thank you for your statement and your interest. I hope that you will continue your efforts in this matter.

Thank you.

Mr. ROGERS. Thank you very much for your presence here and for your statement from you and those you represent. I am sure you have played a role in bringing about this change in Alabama, where you have an effective law; it is necessary.

Our last witness is Mr. William T. Edwards, representative of the United Steelworkers of America, and, Mr. Edwards, the committee welcomes you and will be pleased to receive your statement.

STATEMENT OF WILLIAM T. EDWARDS, UNITED STEELWORKERS OF AMERICA

Mr. EDWARDS. Mr. Chairman and members of the committee, I appreciate the opportunity to make a statement here to you this morning. Unfortunately, our legislative director who normally would handle these affairs is not able to make it and our director, Mr. Howard Strevel, also competent to speak on this matter, is enroute back to Birmingham from Miami.

Mr. ROGERS. We are very pleased to have you, Mr. Edwards.

Mr. EDWARDS. However, we do have a statement, Congressman Rogers, from my union, from Director Strevel——

Mr. ROGERS. Certainly.

Mr. EDWARDS (continuing). Concerning this crisis, and, in a moment, I might like to read it.

Mr. ROGERS. Certainly.

Mr. EDWARDS. It's very brief.

Mr. ROGERS. I would be delighted and without objection have it be made part of the record.

Mr. EDWARDS. I would like to say that in preference, however, it is our men who bore the brunt of unemployment because of the closedown of these 23 plants, and I might add to that we, of course, are aware that this would happen to us, and we are concerned with the high pollution levels in north Birmingham and throughout the city. I ask you to imagine how they are at times in the plant itself. So, we are somewhat skeptical of the industries concern for jobs that were temporarily lost due to this crisis. We think a real concern would have prompted them to have installed the proper devices sometime back so that we would not have had this crisis in Birmingham.

Ten years ago, we were told that the pollution and smoke was a sign of prosperity. A few years subsequent to that, we were told "Well, it takes time to make these corrections, and we are going to begin," and we appreciate that and just in April, when the pollution count hit 607, we were again told that "Well, it takes time," and I am not just referring to the statements by the industry, but by other prominent spokesman of the community: "But it takes time to make the corrections needed."

Well, all of the devices have been invented. All of the technology is known. It is a matter of economics. We appreciate it. We appreciate the fact that the corporation was trying to—is trying to do something. We believe it will try hard when it's obliged to by the law. We can't recall any action taken on pollution which was not an obligatory matter of the law. We assume that in 10 years if—if our new law in Alabama, which appears to be a very effective one, if that law is not enforced, we assume in 10 years we will be told again that it takes time. Pollution counts in this town have frequently become high enough to endanger health, and I was interested in your question as to what extent this had occurred. There has been no record yet of the people whose heart failed. There have been some of our lives that were shortened by the high levels of pollution also.

We of labor are necessarily concerned with the success of the company. Our people are going to be affected by these layoffs, and this probably will not be the last one until new equipment is installed and will correct it. Temperature inversions are a natural phenomenon in this area. The nice mist on the hills is caused by inversion. The smoke on the Smoky Mountains is really caused by temperature inversions, and we are going to have more of that. Now, then, our people have lost income, and we are looking to try to encourage industry to make these necessary corrections as quickly as possible. We know they can be made. We know they have been made elsewhere. We appreciate the costs involved. We are quite prepared to pay the additional costs involved in the product to see that these remedies are effectuated, and, with those remarks, I would like to read Director Strevel's statement:

Birmingham has reached the crucial point where further tolerance of industrial pollution can only mean an escalating danger to health.

The present court ordered closure of 23 plants comes after years of callous disregard of the health of this community. It comes after years of warning and pleading.

For the first time, even the economic excuse for despoiling the air has been made meaningless. People were laid off because of the traumatic pollution levels.

Of the plants closed by court order, several are owned by companies having contracts with the United Steelworkers of America.

The Union has joined with the steel industry in a new joint effort to increase productivity and, thereby, assure continued, expanding employment in the industry. The Union has joined with the industry in attempts to secure legislative action to stop the dumping of foreign steel in the American market.

For several years, the Union has tried at all levels of corporate authority, and before both State and Federal Governments, to secure remedies against pollution which would protect the health of our members and the community generally. The assault upon the air we breathe has continued and increased.

Speaking for the 24,000 members of the United Steelworkers living and working in Jefferson County, I call on every member to raise his voice now in support of the life and health of all people in our community.

I urge all members and citizens alike to demand from their appropriate elected officials the immediate enforcement of present laws to require the installation of facilities needed to stop the threat to the health and economic well being of metropolitan Birmingham.

Mr. ROGERS. Thank you very much, Mr. Edwards. We appreciate your presenco here and also the statement that you have read.

Mr. KYROS. Thank you, Mr. Chairman. Mr. Edwards, I feel your remarks are enlightening. I commend your cooperation with the steel company and also your attitudes and your union's attitudes toward the environment. I am very proud of you.

Thank you very much.

Mr. ROGERS. Mr. Hastings, do you have any questions?

Mr. HASTINGS. I have no questions. I would just like to thank you for your interest and the statement. I might add you said that the question of pollution equipment was strictly a matter of economics. We are aware of some technological problems which exempt themselves, and I agree that we will not do this job without the pressure of Government and organizations such as yours over their head. It isn't true that technologically, there is all the equipment available to take care of all of the pollution. We hope there will be in the foreseeable future. The economics, of course, do play an important part in it.

Mr. EDWARDS. I would like to recommend a very enlightening film on the subject. It's been produced by the Bethlehem Steel Co. and it shows how they, in another part of the United States, were able to clean up the mills. We are aware that it's almost impossible to make steel without some particulate emission and so on. It's a color film and very, very, enlightening.

Mr. HASTINGS. I have seen it.

Mr. ROGERS. Thank you. We do appreciate your being here and sorry to have imposed on everyone so long here on a Saturday afternoon. Thank you, Mr. Edwards, for your presence.

Mr. EDWARDS. Thank you very much.

Mr. ROGERS. In concluding the hearings today which have been most helpful and enlightening to the committee, may I say that I think this incident has pointed out the necessity for an alert citizenry and cooperation between Government and industry and the public. I do think, particularly in Birmingham because of the record of pollution that you have had, this need is accelerated, and I would think that

with the passage of the Clean Air Act sometime back and particularly last year in its amendments, we are noticing this type of concern nationally that has been transferred into law with certain authorities that those involved would get together quickly and plan to handle these situations.

Something will have to be done in Birmingham to prevent 50 percent of the days being polluted beyond the level which is adverse to good health. Certainly, I think you're making progress here in the community, and, if the statements now are translated into action from the industry, that they will cooperate in getting a plan quickly, and I am sure that this will be true with the followup of the dollars, and, with the law that you have, I hope that we will see this entire situation changed and that such action can be translated to other parts of the Nation.

Thank you all for being present here today. The hearing is hereby concluded.

(Whereupon, the committee adjourned at 1:45 p.m., November 20, 1971, subject to the call of the chair.)

CLEAN AIR ACT OVERSIGHT

WEDNESDAY, JANUARY 26, 1972

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON PUBLIC HEALTH AND ENVIRONMENT,
COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE,
Washington, D.C.

The subcommittee met at 10 a.m., pursuant to notice, in room 2141, Rayburn House Office Building, Hon. Paul Rogers (chairman) presiding.

Mr. ROGERS. The subcommittee will come to order.

This morning, the subcommittee will continue oversight hearings on the implementation of various provisions of the Clean Air Act.

The first such hearing was conducted in Birmingham, Ala., and focused on implementation of emergency provisions of the act in response to the air pollution crisis experienced in that city.

This week's hearings will focus primarily on the 1975 automobile emissions standards and the announced intentions of the major automobile manufacturers to seek a 1-year extension of the imposition of these standards.

We are nearing the time when a decision must be made as to whether or not the automobile manufacturers should be granted an extension of time to meet the 1975 deadlines which the legislation requires. This deadline was the heart of the legislation. I believe it is vital that the considerations involved with respect to the attempts to secure this extension be spread on the record now, rather than on an after-the-fact basis.

I emphasize that the statutory burden of proving the necessity for a delay is on industry, not the Environmental Protection Agency.

This subcommittee also intends to inquire into recently publicized meetings of some industry groups and public officials which purportedly resulted in a decision to seek amendments to the Clean Air Act. The public—and the Congress—has the right to know fully the reasons for these meetings and this committee intends to inquire fully into this matter.

As a matter of fact, the meetings were held in California.

As you know, the National Academy of Sciences' Committee on Motor Vehicle Emissions recently released its study on the technological feasibility of the 1975 standards. This committee is grateful to the members of the NAS committee for giving so fully of their time to compile this report during a relatively short period. Many members devoted virtually full-time effort to the committee for months.

I am very pleased to ask the President of the National Academy of Sciences, Dr. Philip Handler, to come forth and to introduce the chair-

man of this committee and the witnesses for the National Academy of Sciences today.

We are very pleased to have you, Dr. Handler, and we are grateful to you and to the members of your Academy for the fine work they are doing.

We would be pleased to have you introduce your other members.

STATEMENTS OF DR. PHILIP HANDLER, PRESIDENT, NATIONAL ACADEMY OF SCIENCES AND EDWARD L. GINZTON, CHAIRMAN, COMMITTEE ON MOTOR VEHICLE EMISSIONS, NAS; ACCOMPANIED BY JAMES E. A. JOHN, EXECUTIVE DIRECTOR FOR THE COMMITTEE; AND RICHARD J. BARBER, LEGAL COUNSEL TO THE COMMITTEE

Dr. HANDLER. Thank you, Mr. Chairman.

I am Philip Handler, President of the National Academy of Sciences. As you know, the Academy exists essentially for one purpose and that is to provide independent technical advice to the U.S. Government. In this instance, it was Congress and the Environmental Protection Agency.

It was a considerable task to put together an appropriate committee for this assignment. Whenever request is made to the Academy, we do our very best to create a committee which is balanced. If there is a matter in controversy, we try to provide a committee membership which is technically competent and which represents the various viewpoints involved.

Our members, as you indicated, Mr. Chairman, serve without compensation and we are very happy that so far, in our history, those whom we called upon to serve have given most generously of their time under these circumstances.

The chairman of the present committee is with us, Dr. Edward Ginzton. Dr. Ginzton is a distinguished engineer and physicist who has led the advance of a company which is of that unusual kind which grew up after World War II. Based on new understanding of some physical phenomena, his company, Varian Associates, began with modest resources and grew into an important contributor to our country.

Dr. Ginzton is distinguished in his own right as an engineer and as a physicist and is highly regarded in his professional as well as his business capacity. Like his committee, he has given completely of himself in addressing the present task. We are proud of the committee report and I am very pleased to have Dr. Ginzton come to the stand with us.

Dr. Ginzton.

With Dr. Ginzton are Prof. James John of the University of Toledo, who has served as staff director of this enterprise and Mr. Richard Barber who has served as the legal counsel to this committee.

Mr. ROGERS. Thank you very much, Dr. Handler.

Dr. Ginzton, Professor John, and Mr. Barber, we welcome you to the committee and we do appreciate all of the time and effort you have given to be of service to the Congress and to the executive branch in coming to decisions that must be made very shortly.

We will be pleased to receive your testimony at this time.

Mr. GINZTON. Thank you, Mr. Rogers.

My name is Edward L. Ginzton and I am Chairman of the Motor Vehicle Emissions Committee of the National Academy of Sciences.

I am privileged to testify before the subcommittee to describe the work being carried out in conjunction with our evaluation of the technological feasibility of meeting the automobile air emission standards prescribed in the 1970 Clean Air Act amendments.

At the outset, let me describe briefly the role of the committee and how its findings relate to the standards prescribed in the law and the exercise of discretion by the Administrator of the Environmental Protection Agency. In doing so, let me make clear that I am attempting merely to summarize a detailed 78-page report, copies of which have previously been submitted to this subcommittee, the Congress, the Environmental Protection Agency (EPA), and the public, I would urge all those interested in the work of the Academy Committee to read the entire report so that they may become familiar with the body of evidence that underlies the conclusions which I will summarize.

Indeed, let me suggest, Mr. Chairman, that the full report might usefully be included in the subcommittee hearings.

Mr. ROGERS. I agree with you, Doctor, and without objection, the full report will be made a part of the record.

(See "Semiannual Report by the Committee on Motor Vehicle Emissions of the National Academy of Sciences to the Environmental Protection Agency," p. 106, this hearing.)

Mr. GINZTON. In adopting the Clean Air Amendments of 1970, Public Law 91-604, which established exhaust emission standards for 1975 and 1976 light-duty vehicles and engines, Congress directed the Administrator of EPA—

> to enter into appropriate arrangements with the National Academy of Sciences, NAS, to conduct a comprehensive study and investigation of the technological feasibility of meeting the emissions standards promulgated in the legislation. The results of this study are to be made available both to EPA and to Congress, with semi-annual interim reports and with a final report to be submitted at the completion of the project. The Academy's study and investigation is intended to provide informaion and expert judgment about the technologically related issues pertinent to the automobile emission standards, but Congress also contemplated that the Academy's interim reports would play a major role in helping the Administrator exercise his discretion to postpone or not to postpone the applicable deadline if such postponement be requested. In this latter respect, the Administrator, pursuant to Section 202(b)(5)(d), may grant a one-year suspension only if he determines, among other things, that "the study and investigation of the NAS and other information available to him has not indicated that technology, processes or other alternatives are available to meet (the established) standards.

Shortly after the clean air amendments became law on December 31, 1970, discussions were initiated between EPA and NAS for the purpose of defining the most effective way of conducting the study called for in section 202(c). Pursuant to a preliminary contract between EPA and NAS, a strategy committee was formed by NAS in March 1971, to develop a proposed work statement and to identify members for the Committee on Motor Vehicle Emissions. The initial committee membership was selected by the National Academy of Sciences in April 1971, with other members added in later months. Committee membership is listed in an attachment to my testimony. A work

statement and contract proposal were submitted by the Academy to EPA in May 1971 and a contract was signed by EPA on August 2, 1971. The first meeting of the committee took place June 16, 1971, and several meetings of the full committee have been held since then.

The contract with EPA calls for the Committee on Motor Vehicle Emissions to conduct a many-faceted study of the technological feasibility of meeting the motor vehicle emission standards. As defined in our contract with EPA the term technological feasibility—

includes the ability within the automobile industry or elsewhere to—

1. Design an engine, control system, or device capable of meeting the statutory emissions standards using fuels that are or could be available;
2. Mass produce such an engine, control system or device;
3. Maintain such an engine, control system, or device so that it will continue to meet the statutory emission standards with safety for a period of 5 years or 50,000 miles of operation, whichever is shorter.

It was agreed that the study of technological feasibility will include an investigation of the anticipated costs to be incurred and the estimated time for the design, development, and mass production of an engine, control system, or device capable of meeting the standards. Also to be included is a study of the estimated annual costs incurred in maintaining such an engine, control system, or device so that it will meet the emission standards for 5 years or 50,000 miles, whichever is shorter. Finally, should the committee conclude that the attainment of emission standards on the schedule provided in section 202(b)(1) of the Clean Air Act is not technologically feasible, the committee is to propose interim emission levels to assist the Administrator in exercising his responsibilities under section 202(b)(5) of the act.

It was decided by the committee early in its deliberations that, in order to obtain the necessary technical information upon which to base a responsible judgment, it would be necessary to form a series of panels of consultants dealing with principal topical areas and composed of recognized experts in the relevant fields. Seven panels have been formed; emission standards; testing, inspection and maintenance; emission control systems (for spark-ignition internal-combustion engines); alternate power sources; manufacturing and producibility; driveability; atmospheric chemistry. Membership of the panels is given in appendix C to the full report.

As you know, under the clean air amendments, at any time after January 1, 1972, any manufacturer may file with the Administrator an application requesting the suspension for 1 year of the regulations applicable to emissions of carbon monoxide and hydrocarbons from light-duty vehicles for the 1975 model year. At any time after January 1, 1973, requests can be made for a similar 1-year suspension of the regulations applicable to oxides of nitrogen for 1976 model year light-duty vehicles.

In order to provide maximum assistance to the Administrator in the possible exercise of his discretion to suspend for 1 year the deadline date for meeting the 1975 standards, and in view of the limited time available from the formation of the committee to the January 1, 1972, interim report date, it was decided to concentrate the initial work of the committee and the panels on issues pertaining to the technological feasibility of meeting the standards applicable to 1975 model year cars. It is recognized that emission-control systems for 1975 vehicles

cannot be completely divorced from those that must be provided for vehicles that will have to meet the 1976 standards. Some degree of compatibility between the two must be provided. Nevertheless, because a decision on the technological feasibility of meeting the 1975 standards may have to be made early this year, the main emphasis was placed on the technological feasibility of the emission standards applicable to 1975 model year vehicles.

The first panels in operation were those dealing with emission standards; testing, inspection, and maintenance; emission control systems for spark-ignition internal combustion engines; driveability; and manufacturing and producibility. These five panels began operation in July 1971, and have not been active since that time. Many of the panelists have devoted virtually full-time effort to the work of the committee since July. Panel visits have been made to all the domestic automobile manufacturers, to EPA laboratories in Ann Arbor, Ypsilanti, Research Triangle Park, to the U.S. Army Tank-Automotive Command, many catalyst suppliers, manufacturers of testing equipment, the California Air Resources Board, and to other groups engaged in emission-control research and development.

Extensive information was also obtained from a questionnaire sent on September 27, 1971, to the domestic light motor vehicle manufacturers to 16 foreign automobile manufacturers that export a significant number of cars to the United States. A copy of this questionnaire and lists of those to whom it was sent and those who responded are included in appendix D to the committee report. The high degree of detail of the replies was very gratifying. Most of these documents were received in time for the committee and pertinent panel members to read them prior to a further meeting held in Washington, D.C., on October 25–27, 1971, between the committee and the manufacturers. At this meeting, the committee and panel members questioned the manufacturers individually with respect to their responses to the questionnaire and sought the latest information with regard to the technological feasibility of meeting the requirements of the Clean Air Act of 1970. In addition, many committee and panel members made personal contacts with the automobile manufacturers and others in order to clarify points they felt could be important in making their evaluation. In addition, the committee isued a public statement on September 21, 1971, inviting the submission of information concerning the technological feasibility of meeting the requirements of the act. This statement was sent to over 700 organizations and individuals, including major newspapers, wire services, general science magazines, engineering and industry publications, and environmental groups.

In the limited time that the committee has had available since its creation in the summer of 1971, all possible efforts have been made to secure the material and information needed to reach the judgments called for in the legislation. Perforce, most of the pertinent data required were in the possession of the various concerned manufacturers, primarily the automobile companies. Necessarily, therefore, the analyses to follow rest primarily upon the information received from those sources. However, recognizing the possible bias that this might introduce the committee has endeavored, in various ways, to insure that the information obtained from the companies is com-

plete, accurate, and timely. Members of the committee and its panels, along with special consultants, have interrogated working level company technicians and engineers, have personally examined laboratories and testing facilities and have reviewed intensively the techniques employed by the companies in analyzing their experiments and data. In addition, the committee has utilized certain information provided by EPA as well as data gathered in the hearings conducted by EPA in May 1971.

Based on an assessment of the evidence the committee came to some important conclusions: The Clean Air Amendments of 1970 have had the effect of accelerating progress by automobile manufacturers in emission control. Experimental vehicles have been built and operated that, at low mileage, exhibit levels of emissions less than those specified for 1975 model year vehicles. However, information establishing the sustained effectiveness, durability, and reliability of prototype 1975 vehicles systems during typical consumer mileage accumulation is not available. The committee finds that the technology necessary to meet the requirements of the Clean Air Amendments for 1975 model year light-duty motor vehicles is not available at this time.

While there is no certainty today that any 1975 model year vehicles will meet the requirements of the act, the status of development and rate of progress made it possible that the larger manufacturers will be able to produce vehicles that will qualify, provided that provisions are made for catalyst replacement and other maintenance, for averaging emissions of production vehicles, and for the general availability of fuel containing suitably low levels of catalyst poisons. Conversely, if these three provisions are not deemed acceptable by EPA, it appears most unlikely that any manufacturer will be able to meet the requirements of the act.

The committee believes that the emission levels required in the Clean Air Amendments will not be achieved in service, in any event, unless regular, periodic maintenance of the emission-control system is required of the owner.

The estimated costs to the consumer of meeting the requirements of the act for 1975 vehicles, in comparison with those for 1973 vehicles, include an increase in sticker price of about $200, 3 to 12 percent increase in fuel consumption, some increase in maintenance cost, and some deterioration in drivability of the car.

If enforcement of the requirements of the act for 1975 vehicles were deferred for 1 year, the opportunity thus provided for further development and field testing would enable manufacturers to significantly improve the performance and reliability of vehicles equipped to meet the requirements in the hands of the customer.

The Committee found that the technology necessary to meet 1976 standards in 1976 model year cars is not currently available. The technology of catalysts suitable for NO_x reduction is not nearly as advanced as that of oxidation catalysts. The level of current research and development on reduction catalysts for NO_x control is not commensurate with the importance of this problem.

Looking ahead to our future plans, the results of the investigations of the committee to date indicate several areas in which work should be continued or intensified. In 1972, the committee will consider the technological feasibility of meeting the standards of the Clean Air Amend-

ments applicable to emissions of oxides of nitrogen from light-duty vehicles manufactured during or after model year 1976. Another principal focus of attention will be the state of technology of alternate power systems and the potential they offer for emissions reductions over that of conventional engines. This study will consider costs, producibility, and maintainability of such alternate power sources. Investigation of the technological feasibility of meeting the standards applicable to 1975 model year vehicles will continue, of course, with monitoring of any significant new developments.

Mr. Chairman, that concludes my prepared testimony. I will be pleased to respond to your questions and those of the other members of the subcommittee.

(The testimony resumes on p. 187.)

(The full report of the committee, referred to, follows:)

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Semiannual Report

Prepared by

THE COMMITTEE ON MOTOR VEHICLE EMISSIONS,
Division of Engineering, National Research Council,
in accordance with Section 202(c) of the
Clean Air Amendments of 1970 and
in partial fulfillment of Contract No. 68-01-0402

between

THE ENVIRONMENTAL PROTECTION AGENCY

and

THE NATIONAL ACADEMY OF SCIENCES

National Academy of Sciences
Washington, D. C.

January 1, 1972

NATIONAL ACADEMY OF SCIENCES

OFFICE OF THE PRESIDENT
2101 CONSTITUTION AVENUE
WASHINGTON, D. C. 20418

January 1, 1972

Sirs:

I have the honor to transmit a semi-annual progress report summarizing the work and the findings of our Committee on Motor Vehicle Emissions in accord with the provisions of Section 6 of Public Law 91-604, the Clean Air Amendments of 1970. The distinguished membership of this Committee has given of itself, in full measure, to this task, addressing itself, within the limited time available, almost exclusively to the matter of the feasibility of meeting the standards established, for emissions from light-duty motor vehicles, for model year 1975.

We trust that this report will be of assistance to the Administrator of the Environmental Protection Agency in discharging his responsibilities under that Act. As indicated in the Report, the Committee will continue to address itself to the various responsibilities accepted by the Academy in these regards.

Respectfully yours,

Philip Handler
President

The President of the Senate

The Speaker of the House of Representatives

The Administrator of the Environmental Protection Agency

NATIONAL RESEARCH COUNCIL
NATIONAL ACADEMY OF SCIENCES NATIONAL ACADEMY OF ENGINEERING
2101 CONSTITUTION AVENUE WASHINGTON, D.C. 20418

COMMITTEE ON MOTOR VEHICLE EMISSIONS
OF THE DIVISION OF ENGINEERING

TELEPHONE: 202-961-1621

December 30, 1971

Dr. Philip Handler
President
National Academy of Sciences
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

Dear Dr. Handler:

On behalf of Dr. Ginzton and the Committee on Motor Vehicle Emissions, I hereby transmit to you the January 1, 1972 semiannual report from the Committee to be submitted to the Congress and to the Administrator of the Environmental Protection Agency.

Sincerely yours,

James E. A. John

James E. A. John
Executive Director
Committee on
Motor Vehicle Emissions

CONTENTS

APPENDIXES

TABLES

FIGURES

1. INTRODUCTION

In adopting the Clean Air Amendments of 1970 (Public Law 91-604), which established exhaust emission standards for 1975 and 1976, light-duty vehicles and engines, Congress directed the Administrator of the Environmental Protection Agency (EPA) "to enter into appropriate arrangements with the National Academy of Sciences (NAS) to conduct a comprehensive study and investigation of the technological feasibility of meeting the emissions standards" promulgated in the legislation. The results of this study are to be made available both to EPA and to Congress, with semiannual interim reports and with a final report to be submitted at the completion of the project. Although the Academy's study and investigation is intended to provide information and expert judgment about the full range of technologically related issues pertinent to the automobile emission standards, Congress also contemplated that the Academy's interim reports would play a major role in helping the Administrator exercise his discretion to postpone or not to postpone the applicable deadline if such postponement be requested. In this latter respect, the Administrator, pursuant to Section 202(b)(5)(D), may grant a one-year suspension only if he determines, among other things, that "the study and investigation of the NAS... and other information available to him has not indicated that technology, processes or other alternatives are available to meet (the established) standards."

As a result of the Clean Air Amendments, signed December 31, 1970, discussions were held between EPA and NAS for the purpose of exploring the character of and the most effective way of conducting the study called for in Section 202(c). Pursuant to a contract between EPA and NAS, signed March 10, 1971, and retroactive to February 1, 1971, a strategy committee was formed by NAS in March 1971 to develop a proposed work statement and to suggest members for the Committee on Motor Vehicle Emissions. The initial Committee membership was selected by the National Academy of Sciences in April 1971, with other members added in later months. Committee membership is listed in Appendix A along with the members of the Committee staff. A work statement and contract proposal were submitted by the Academy to EPA in May 1971. A contract for $612,175 was signed by EPA on August 2, 1971. The first meeting of the Committee took place June 16, 1971 and subsequent meetings were held monthly.

According to the work statement, (Appendix B) the Committee on Motor Vehicle Emissions is to conduct a many-faceted study of the technological feasibility of meeting the motor-vehicle emission standards prescribed by the Administrator of EPA, as required by Section 202 of the Clean Air Act, as amended. Technological feasibility as defined in the work statement, "includes the ability within the automobile industry or elsewhere to:

1. Design an engine, control system, or device capable of meeting the statutory emission standards using fuels that are or could be available;

2. Mass produce such an engine, control system, or device;

3. Maintain such an engine, control system, or device so that it will continue to meet the statutory emission standards with safety for a period of five years or 50,000 miles of operation, whichever is shorter."

It was agreed that the study of technological feasibility will include an investigation of the anticipated costs to be incurred and the estimated time for the design, development, and mass production of an engine, control system, or device capable of meeting the standards. Also to be included is a study of the estimated annual costs incurred in maintaining such an engine, control system, or device so that it will meet the emission standards for five years or 50,000 miles, whichever is shorter. Finally, should the Committee conclude that the attainment of emission standards on the schedule provided in Section 202(b)(1) of the Clean Air Act is not technologically feasible, the Committee is to determine technologically feasible interim emission levels to assist the Administrator in exercising his responsibilities under Section 202(b)(5) of the Act.

It was decided by the Committee early in its deliberations that, in order to obtain the necessary technical information upon which to base a responsible judgment, it would be necessary to form a series of panels of consultants dealing with principal topical areas and composed of recognized experts in the relevant fields. Seven Panels have been formed as shown in Table 1.1. Membership of the Panels is given in Appendix C.

Under the Clean Air Amendments, at any time after January 1, 1972, any manufacturer may file with the Administrator an application requesting the suspension for one year of the regulations applicable to emissions of carbon monoxide and hydrocarbons from light-duty vehicles for the 1975 model year. At any time after January 1, 1973, requests can be made for a similar one-year suspension of the regulations applicable to oxides of nitrogen for 1976 model year light-duty vehicles.

In order to provide maximum assistance to the Administrator in the possible exercise of his discretion to suspend for one year the deadline date for meeting the 1975 standards, and in view of the limited time available from the formation of the Committee to the January 1, 1972, interim report date, it was decided to concentrate the initial work of the Committee and the Panels on issues pertaining to the technological feasibility of meeting the standards applicable to 1975 model year cars.

Table 1.1

Panels of the Committee on Motor Vehicle Emissions

Panel 1:	Emission Standards
Panel 2:	Testing, Inspection, and Maintenance
Panel 3:	Emission Control Systems (for spark-ignition internal-combustion engines)
Panel 4:	Alternate Power Sources
Panel 5:	Manufacturing and Producibility
Panel 6:	Driveability
Panel 7:	Atmospheric Chemistry

It is recognized that emission-control systems for 1975 vehicles cannot be completely divorced from those that must be provided for vehicles that will have to meet the 1976 standards (see Section 3.4). Some degree of compatibility between the two must be provided. Nevertheless, because a decision on the technological feasibility of meeting the 1975 standards may have to be made within 60 days of January 1, 1972, the main emphasis of this report will be on the technological feasibility of the emission standards applicable to 1975 model year vehicles.

The first Panels in operation were Emission Standards; Testing, Inspection, and Maintenance; Emission Control Systems (for spark-ignition internal-combustion engines); Driveability; and Manufacturing and Producibility.

The five Panels mentioned above began operation in July 1971, and have been active since that time. Many of the Panelists have devoted virtually full-time effort to the work of the Committee since July. Panel visits have been made to all the domestic automobile manufacturers, to EPA laboratories in Ann Arbor, Ypsilanti, and Research Triangle Park, to the U. S. Army Tank-Automotive Command, many catalyst suppliers, manufacturers of various testing equipment, the California Air Resources Board, and to other groups engaged in emission-control research and development.

Extensive information has been obtained from a questionnaire sent on September 27, 1971, to all five domestic automobile manufacturers and to all sixteen foreign automobile manufacturers exporting a significant number of cars into the United States. A copy of this questionnaire and lists of those to whom it was sent and those who responded are included in Appendix D. The high degree of detail of the replies was very gratifying. Most of these documents were received in time for the Committee and pertinent Panel members to read them prior to a further meeting held in Washington, D. C., on October 25-27, 1971, between the Committee and the manufacturers. (Those who attended are so designated in Appendix D). At this meeting the Committee and Panel members questioned the manufacturers individually with respect to their responses to the questionnaire and sought the latest information with regard to the technological feasibility of meeting the requirements of the Clean Air Act of 1970. In addition, many Committee and Panel members made personal contacts with the automobile manufacturers and others in order to clarify points they felt could be important in making their evaluation. Further, the Committee issued a statement (Appendix E) on September 21, 1971, inviting the submission of information on behalf of the public concerning the technological feasibility of meeting the requirements of the Act. This statement was sent to over 700 organizations and individuals, including major newspapers, wire services, general science magazines, engineering and industry publications, and environmental groups and publications.

The statement was also placed in the Federal Register of December 3, 1971. But, as yet, the number of direct responses has been disappointingly small.

In the limited time that the Committee has had available since its creation in the summer of 1971, all possible efforts have been made to secure the material and information needed to reach the judgments called for in the legislation. Perforce most of the pertinent data required were in the possession of the various concerned manufacturers, primarily the automobile companies. Necessarily, therefore, the analyses to follow rest primarily upon the information received from those sources.

However, recognizing the possible bias that this might introduce the Committee has endeavored, in various ways, to ensure that the information obtained from the companies is complete, accurate and timely. Members of the Committee and its Panels, along with special consultants, have interrogated working-level company technicians and engineers, have personally examined laboratories and testing facilities and have reviewed intensively the techniques employed by the companies in analyzing their experiments and data. In addition, the Committee has utilized certain information provided by EPA as well as data gathered in the hearings conducted by EPA in May 1971.

The Committee's work in all of these respects will continue in the coming year, but, as of now, it is the judgment of the members that the information it has received is sufficiently reliable and comprehensive as to constitute an appropriate basis for the judgments it has reached and which are set forth in this report. In the coming months, the Committee will continue its investigation so as to ensure that the most complete and sound scientific information is available both for its own purposes and for the use of EPA and the Congress.

The emphasis in this report is on the 1975 standards, for the reasons noted earlier. The Committee's study and investigation will continue as it expands its inquiry into areas pertinent to the 1976 standards.

2. STANDARDS AND TESTING

2.1 Introduction

According to Section 202 of the Clean Air Amendments of 1970, the Administrator of EPA is required to prescribe emission standards for light-duty motor vehicles and measurement techniques on which such standards are based. Pursuant to Section 202(b)(1)(A) such standards require that the emissions of carbon monoxide and hydrocarbons from light-duty vehicles manufactured during or after model year 1975 shall be reduced by 90 percent from those required of 1970 vehicles; also, emissions of oxides of nitrogen from light-duty motor vehicles manufactured during or after model year 1976 are to be 90 percent below the average of those actually measured from 1971 model year light-duty vehicles.

Standards and test procedures were promulgated by EPA and are contained in the Federal Registers of November 10, 1970, and July 2, 1971. The 1975 model year standards are:

0.41 grams per vehicle mile for hydrocarbons,

3.4 grams per vehicle mile for carbon monoxide,

and 3.0 grams per vehicle mile for oxides of nitrogen.

For 1976 model year vehicles, exhaust emission standards are:

0.41 grams per vehicle mile for hydrocarbons,

3.4 grams per vehicle mile for carbon monoxide,

and 0.4 grams per vehicle mile for oxides of nitrogen.

The Clean Air Act Amendments further call for vehicle compliance with these standards for the useful life of the vehicle, defined in the Law as five years or 50,000 miles, whichever occurs first.

Testing to ensure compliance with these standards is to be conducted in three stages. First, prototype models of each engine class are to be tested prior to issuing a "certificate of conformity." Next, production-line testing is contemplated to ascertain whether production models conform with the regulations with respect to which a certificate has been issued. Finally, provision is made for testing emissions and for continuing compliance while a vehicle is in actual use.

2.2 Testing for the Certificate of Conformity

The test procedure for determining whether a certificate of conformity may be issued for 1975 and later model year vehicles consists of emission and 50,000-mile durability tests with a limited amount of maintenance on a fleet of vehicles representing each engine class for each vehicle manufacturer. As now defined by EPA this procedure permits one engine tuneup but no emission-control system replacements during the 50,000-mile durability test and requires that emissions be less than the standard for 50,000 miles.

The emission test, as described in the Federal Register of July 2, 1971, is designed to determine hydrocarbon, carbon monoxide and oxides of nitrogen mass emissions while simulating an average trip of 7.5 miles in an urban area. Each emission test consists of a twelve-hour wait at 70 degrees F, a cold-engine startup, a continuous sequence of different driving modes similar to actual driving over a 23-minute route and a 10-minute shutdown followed by a hot-engine restart and a repeat of the first 505 seconds of the 23-minute cycle. Diluted exhaust emissions are collected continuously using a constant volume sampler. Emissions collected during the first 505 seconds from cold start are collected in one bag, those from the remainder of the 23-minute cycle in a second bag, and the emissions from the hot-restart phase collected in a third bag. The contents of the three bags are then analyzed and weighted in accordance with the EPA test procedure to attain the final mass emissions, in grams per mile.

The technology of testing according to the prescribed procedures requires expensive equipment and instruments. At the present, the equipment and procedures are more characteristic of a laboratory than of an industrial production line or state inspection station. The estimated cost of equipping a single test cell with the necessary equipment to perform a complete vehicle test according to the prescribed procedure is approximately $100,000. This includes the dynamometer, constant volume sampling equipment, instrumentation for analyzing the sample bags for the three pollutants, and the other required equipment. Such a test would require two people per cell and would consume approximately one hour, following the twelve-hour wait at 70 degrees F. The time required and equipment needed for this test make it difficult to conceive of its use for production testing of every vehicle or for service testing or vehicle-inspection programs for vehicles in use.

2.3 Production-Line Testing

To satisfy the requirements of Section 206, testing procedures for new production-line vehicles will be needed. Consideration of possible effective procedures immediately raises three significant questions:

(1) How many vehicles should be tested?

(2) What test procedures should be used?

(3) Should every vehicle tested meet the prescribed emission standards?

While these questions are not independent, we shall discuss them in sequence.

Given the large number of vehicles produced, testing a sample of new vehicles by the full cold-hot CVS* test can determine the emission characteristics of the vehicle population as precisely as is necessary. Sample testing and statistical analysis for quality-control purposes is a thoroughly developed and accepted procedure in industrial operations. There is no reason why testing of samples of new vehicles according to the certification procedure cannot be used to establish with sufficient accuracy the average emission characteristics and the probability of occurrence of vehicles having high emissions. A simple test on all vehicles may make possible the detection of some individual improperly manufactured cars that are very high emitters. Unfortunately, no such short test is available at present that correlates well with the complete test.

As will be described, the technology of emission-control systems for conventional reciprocating spark-ignition internal-combustion engines is complex. Control of the quality of manufacturer and assembly of the components will have to be thorough if these systems are to function effectively for an extended period. Laboratory models of the systems that are being developed are constructed and maintained to their highest level of performance by highly qualified personnel; variations from the optimum configuration tend to lead to degraded performance and increased emissions. Not only will the production quality of the emission-control systems need to be precisely controlled, but also new diagnostic techniques for detecting and correcting the occasional defective production vehicle must be developed. These are the responsibilities of the manufacturer, but strict enforcement of the production-line tests and standards will be necessary. Production-line emission-control testing should therefore be concerned with assuring that the manufacturer has met his responsibility to produce an effective emission-control system on his new vehicles.

Due to the nature of mass-production processes, emission-control systems will not be precisely identical. As far as contribution to air pollution is concerned, it is the total emissions from all emitting vehicles that are of consequence. In other words, it is the average emissions that affect air quality, where average emissions refer to the total emissions divided by the number of vehicles. Therefore, the Committee believes

*Constant volume sampling test described previously.

it necessary that the averaged emissions from all vehicles meet the emission standards over the vehicle lifetimes.

As discussed below, it is likely that periodic inspection of emission-control systems in used vehicles may be instituted, and the purchaser of a new vehicle must be assured that it is not so defective as to be incapable of passing such tests as are likely to be used. Therefore, new vehicles whose emissions are significantly higher than the standards must be corrected by the manufacturer prior to sale, even though their contributions to total emissions may be minor. It will therefore be necessary, through statistical quality control and diagnostic testing on all new vehicles, to put limits on vehicle emissions.

2.4 Surveillance Testing of Used Vehicles

It is contemplated that there will be emission testing of a sample of vehicles in service, as maintained by their owners, to determine their emissions. The results will be compared with the standards and the durability tests run during compliance. The responsibility for correcting vehicle emissions, if found necessary, will lie with the manufacturer, provided the owner has complied with the terms of a legally acceptable warranty concerning maintenance of the emission-control system.

2.5 State and Local Inspection of Used Vehicles

Under the Law EPA is to encourage state periodic inspections of used vehicles where necessary and feasible if the Administrator of EPA finds that a suitable test is available. New Jersey and California are about to begin inspections with a simple idle test that correlates well with the 7-mode test currently used for vehicle certification; this idle test does not, however, correlate with the EPA test procedure to be used for 1975 model year vehicles. Descriptions of the various test procedures are given in Table 3.1.

In 1975 and later model year cars, one of the primary modes of emission-test failure is expected to be associated with the cold-start portion of the test; this would not be caught by present idle tests. The presently available emission performance inspection tests do not correlate well enough with the CVS-CH test required for certification of 1975-1976 vehicles to show great promise. Until a suitable test is available, a functional inspection to determine whether the control system is present and operational would have to be used.

3. EMISSION-CONTROL TECHNOLOGY

3.1 Background

The vast majority of the engines used in the 1975 model year vehicles will inevitably be conventional reciprocating spark-ignition internal combustion engines. Wankel rotary combustion and stratified-charge spark-ignition engines* may eventually have a place in the automotive market, as may alternative types of power plants. However, for 1975 production, the lead times of two years or more required to design, erect and equip modern mass-production facilities, as described in Section 5, are such that irreversible decisions on the basic engine and control system must be made by mid-1972. These alternatives to the conventional engine are at an early stage of development and need extensive testing and evaluation before rational decisions can be made. As a result, the Committee, in evaluating the technology available to meet the 1975 emission standards, has decided to concentrate on the reciprocating spark-ignition engine, deferring its studies of alternate power sources to the future (see Section 9). Though engine modifications to reduce emissions are likely to be incorporated, the basic geometry and operation of the engine will be similar to what it is today.

Emissions from uncontrolled automobiles, as manufactured prior to 1968, came from the crankcase blowby gases, fuel evaporation from the fuel tank and carburetor, and the engine exhaust. The crankcase and evaporative losses have now been controlled. The emissions from the engine exhaust are a consequence of the details of the combustion process occurring inside the engine cylinder. Hydrocarbons (HC) and carbon monoxide (CO) result from incomplete combustion of the fuel-air mixture; oxides of nitrogen (NO_x) form in the high-temperature burnt gases as the combustion process proceeds. Indeed, it was due to this fact that when 1968 standards were set for CO and HC in California, the NO_x levels in the atmosphere rose because of the adjustments made to reduce only CO and HC.

As a result of the Federal Emission Control Program, commencing in 1968, considerable emission control on new vehicles has already been achieved by engine modifications and improvements in engine design (Table 3.1). It is unfortunate that the automobile industry did not seriously undertake such a program on its own volition until subject to this governmental pressure and general recognition of the role of automobile emissions in the generation of smog in California. This long lag period together with the growth in automobile sales gave rise to the sense of urgency expressed in the Clean Air Amendments.

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* Described in Section 3.7

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Exhaust-emission standards measured in grams of pollutant per mile of vehicle travel were first introduced for HC and CO on 1968 model year vehicles and have since been progressively tightened. As understanding of factors affecting vehicle emissions has increased, the test procedure has been changed to determine more accurately the automobile's contribution to total urban emissions. The different test procedures used are described briefly in Table 3.1. Note that each emission standard is associated with a particular test procedure and that, though standards for 1972 are stricter than those for 1970, the values are higher as a consequence of the different tests used.

Figure 3.1 shows the percentage reduction in exhaust emissions represented by these standards. The exhaust-emission standards are compared with average exhaust emissions from uncontrolled vehicles measured with the 1972 test procedure. This figure shows that for 1972 model year vehicles, about 80-percent control of HC and 70-percent control of CO are now required.* With control of crankcase emissions and fuel evaporation included, about 85-percent reduction in total HC emissions is being achieved. Federal NO_x standards start in 1973, and about 50-percent control will be required. In California, about 30-percent control of NO_x is now required on new vehicles sold there.

The substantial reductions in HC and CO exhaust emissions already achieved have resulted from engine-design modifications and changes in engine-operating conditions. These include adjustments to the carburetor to provide leaner fuel-air mixtures and improved mixture uniformity, controlled heating of the intake air, increased idle speed, retarded spark timing, reduced engine compression ratio, and improved cylinder head design. In some systems, air injection into the exhaust manifold has been used to burn up a fraction of the HC and CO emissions in the exhaust.

The federal emission standards for NO_x in 1973 and 1976, and for HC and CO in 1975 given in Table 3.1 will require new control techniques. Control of HC and CO emissions to the 1975 standard levels appears to be unattainable through engine modifications of the type used to date. With conventional engines, HC and CO emissions from the engine itself are much higher than the 1975 standards under all practical operating modes. Special reactors or converters located in the exhaust system will be required to burn up the emissions from the engine. NO_x control to below 3 g/mile will require some exhaust-gas recycling to the engine intake to reduce peak burnt gas temperatures. Both these new control techniques have a substantial impact on engine operation and performance.

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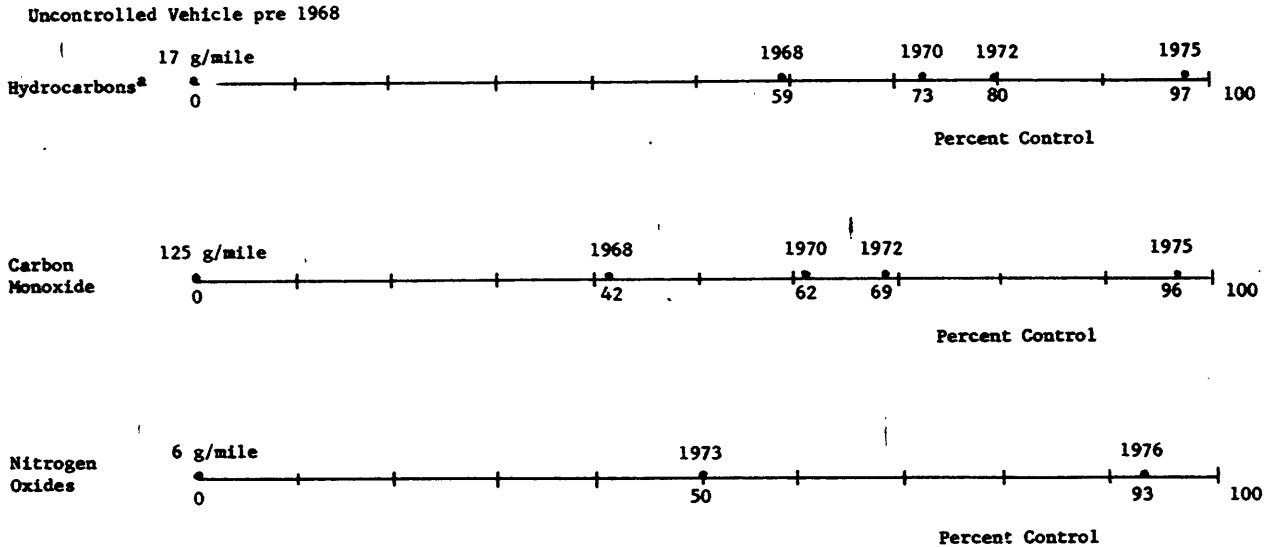
* 80-percent control requires a five-fold reduction in emissions; 70-percent control about a three-fold reduction.



a Blowby HC emissions (about 4 g/mile) have been 100-percent controlled since 1963; evaporative HC emissions (about 3 g/mile) will be 95-percent controlled with 1972 model year cars.

b All standards have been converted to values corresponding to CVS-C Test.

Figure 3.1. Percentage Reduction in Exhaust Emissions Represented by the Federal Standards [b]

Table 3.1

Federal Emission-Control Requirements for Light-Duty Vehicles

Model Year	Pre 1968*		1968	1970	1971	1972	1973	1975	1976
Test Procedure	FTP	CVS-C	FTP	FTP	FTP	CVS-C	CVS-C	CVS-CH	CVS-CH
Emissions, grams/mile									
Hydrocarbons	10	17	3.4	2.2	2.2	3.4	3.4	0.41	0.41
Carbon Monoxide	77	125	35.0	23.0	23.0	39.0	39.0	3.4	3.4
Nitrogen Oxides	4-6	6	NR	NR	NR	NR	3.0	3.0	0.4
Evaporative losses grams/test	40		NR	NR	6.0	2.0	2.0	2.0	2.0

NR - No requirement

*Uncontrolled vehicle except for crankcase blowby control.

Test Procedures Used to Measure Emissions

FTP — Federal Test Procedure - The driving cycle is the California 7-mode cycle repeated nine times. Pollutant concentrations in the exhaust are analyzed continuously throughout the 16-minute test. Concentrations in each mode are multiplied by weighting factors to give grams/mile. This is not a true mass emissions measurement.

CVS-C — Constant Volume Sampling Procedure - This is a cold start mass emissions test. The vehicle stands at constant temperature for 12 hours at 70 degrees F before engine startup. The driving cycle is a 23-minute, 7.5-mile non-repetitive pattern. A constant fraction of the exhaust flow is collected in a bag, and concentration measurements at the end of the test give true mass emissions in grams/mile.

CVS-CH — Constant Volume Sampling Procedure - This is a cold-hot start weighted mass emissions test. The vehicle standr at constant temperature for 12 hours at 70 degrees F before engine startup. The driving cycle is the 23-minute pattern used in CVS-C. After a 10-minute shutdown, the engine is restarted and the first 505 seconds of the driving cycle repeated. A constant fraction of the exhaust flow is collected: the first 505 seconds in a "cold transient bag"; the next 864 seconds in a "stabilized bag"; and the repeat 505 seconds in a "hot transient bag." Emissions in cold and hot transient bags are weighted 0.43 to 0.57 respectively, and added to emissions in stabilized bag to give true mass emissions.

The effectiveness of these new control systems depends to a large extent on how well the individual components in the system have been integrated. It must be remembered that typical vehicle driving is a continuous sequence of different operating modes--engine startup, idle, acceleration, cruise, deceleration, and so forth. To obtain satisfactory engine and vehicle performance over this wide range of modes, the air flow into the engine, the air-fuel ratio, and spark timing are all varied as engine loads and speeds change. The engine must also start and operate satisfactorily over the complete range of ambient temperatures, humidity, and altitude (which affects air density and hence fuel metering) found throughout the United States.

The federal emissions test that has been promulgated by EPA to certify prototypes of the 1975 production vehicles, as described in Section 2 and Table 3.1, incorporates a driving cycle that includes the common driving modes. The overall emission-control system must be optimized to operate effectively over the entire range of engine conditions covered in the test to achieve average HC and CO emissions below the 1975 standards.

The cold-engine start and first few minutes of the test before the engine fully warms up prove to be especially important. In current automobile engines, a choke is used to enrich the fuel-air mixture when the intake manifold is cold and fuel vaporization is poor. This enrichment is necessary to ensure that enough fuel is vaporized to provide a combustible mixture near the spark plug and achieve safe and satisfactory vehicle operation. It results in high engine HC and CO emissions during the warm-up phase because not all this fuel can be fully burnt. Moreover, the reactors in the exhaust, which are provided to burn up the HC and CO emissions from the engine itself, also must warm up before they become effective for typical 1975 control systems. It turns out that HC and CO emissions during the first two minutes of the test are greater than HC and CO emissions during the last 21 minutes. Thus, the importance of adequate emission control during the warm-up phase is obvious.

3.2 Proposed 1975 Emission-Control System

Although many possibilities exist, in principle, for reducing emissions from a reciprocating engine and for removing such emissions prior to the exhaust gas entering the air, the Committee finds that most manufacturers have selected systems and components that are similar to each other. In reviewing the available technology for reduction of emissions, the Committee and its Panels, after considerable study of the alternatives, believe that the basic choice of components made by the manufacturers throughout the world is reasonable, and that no other concepts have been proposed that offer greater potential for meeting the 1975 requirements in 1975.

Further, the basic configurations needed for the 1975 systems must reach final design stage by mid-1972 to permit system testing, endurance testing of components, modifications and corrections, and to assure that the final systems are acceptable to the public.

As will be discussed in the subsequent sections of this report, numerous advances in emission controls have been suggested and tested. To make our discussion more coherent, we shall describe the principal components of the suggested systems and comment on their state of development and reliability.

3.2.a Exhaust-Gas Recycle

Exhaust gas recycle (EGR) will be used to diminish NO_x emissions. The recycling of 10-20 percent of the exhaust flow to the intake manifold is used to dilute the fresh fuel-air mixture entering the engine with a largely inert gas. The additional thermal capacity of the recycled exhaust lowers peak burnt gas temperatures inside the cylinder, which reduces the formation of nitrogen oxides. Some losses in vehicle performance result. The fraction of the exhaust recycled must be carefully matched to engine conditions, otherwise serious degradation in vehicle-performance characteristics, such as engine stall, stumble, and rough operation, can occur. A valve activated by the intake-manifold vacuum or throttle position is proposed to control the recycled flow. The use of EGR generally requires that the fuel-air mixture be enriched to maintain satisfactory engine operation. This enrichment increases the HC and CO emissions from the engine, which must then be burnt up in a thermal reactor or catalytic converter, and it increases the fuel consumption.

3.2.b Secondary Air System

The use of EGR and richer fuel-air mixtures requires the addition of air to the exhaust flow before the engine HC and CO emissions can be burnt up in a reactor or converter. An engine-driven air pump drives this air through a distribution manifold into the exhaust ports.

3.2.c Thermal Reactor

A thermal reactor is an enlarged exhaust manifold that bolts directly onto the cylinder head. Its function is to promote rapid mixing of the hot exhaust gas with the secondary air and retain the gases at a high enough temperature for sufficient time to burn up most of the HC and CO. To achieve rapid warm-up after engine start, a thin steel liner acts as the core of the reactor inside a cast iron outer casing with heat losses held to a minimum. The fuel-air mixture in this case is enriched so that the chemical energy released inside the reactor in the burn-up process holds the core at temperatures of 1600-1800 degrees F.

3.2.d Oxidizing Catalytic Converter

Oxidation of the HC and CO in the exhaust gas can be accomplished by means of catalysts at temperatures lower than those in a thermal reactor. A catalytic converter can be placed farther from the engine than a thermal reactor, and can maintain its effectiveness without mixture enrichment to increase the chemical energy in the exhaust. As a consequence, the fuel-economy penalty is lower. The catalyst used is made up of a small mass of active material such as noble metal or a combination of transition and non-transition metals, deposited on thermally stable support materials such as alumina. To prevent loss in catalytic activity due to mechanical damage, small spherical pellets or a honeycomb (monolithic structure) have been found the most suitable geometries. The catalyst is contained in a metal casing designed to direct the exhaust flow through the catalyst bed.

For high conversion efficiency throughout the test cycle, the catalyst must attain its "light-off" temperature* as soon as possible after engine startup. Considerable development work has therefore been done to reduce the density of the support material and increase the surface area of the active components. To maintain high catalytic activity, the fuels employed need to be low in concentration of various catalyst poisons such as lead, phosphorus, and sulphur. For most catalysts, the relative conversion efficiency is independent of exhaust-gas compositions over a wide range of HC and CO concentrations.

3.2.e Major Engine Modifications

More precise fuel metering following changing engine conditions is required to maintain effective emission control. Fuel-air mixture preparation during the engine warm-up phase is especially important. The exhaust-gas composition and temperature at entry to the thermal reactor or catalytic converter must be matched to reactor or converter performance, which requires more accurate fuel-air-ratio control. Fuel and air distribution between different cylinders of the engine must be made more uniform. The use of EGR further complicates the problem of mixture preparation. Good mixing and distribution are required to maintain adequate vehicle performance. Improved carburetors are being developed to satisfy these requirements. Alternative fuel-metering concepts, such as fuel injection, that may offer better control are also being explored. Compensation for air-density changes with altitude will probably be required. Greater metering accuracy during engine startup and warm-up is also necessary. Power chokes have been incorporated to make choke operation more reliable. The choke is being released earlier in the engine warm-up phase to reduce HC and CO emissions. Intake manifolds are being redesigned to improve fuel, air, and recycled exhaust-gas distribution between cylinders. Quick heat intake manifolds are also

*The temperature at which the catalyst effectively oxidizes HC and CO emissions.

being developed to reduce emissions during the engine warm-up phase. A part of the intake with low thermal inertia is directly heated by the exhaust gas to achieve good fuel vaporization before the engine is fully warmed up. As a consequence, the fuel-air mixture can be leaned out sooner after engine startup.

Ignition-system malfunction due to wear and inadequate maintenance is a common cause of increased HC emissions in current vehicles. For 1975 vehicles, electronic and inductive ignition systems have been developed that will improve reliability in customer use. Control of spark timing can be made more easily and will be used to reduce HC and NO_x emissions. Spark-retard during engine warm-up will also be used to increase exhaust-gas temperatures and hence reduce the time required for reactor and converter to become effective.

Cylinder-head modifications are made primarily to maintain adequate vehicle driveability when EGR is used to reduce NO_x emissions. While optimized surface-to-volume ratio gives some reduction in HC emissions, the major gain is improved combustion characteristics. For systems using a catalytic converter, exhaust ports and manifolds and exhaust pipes are being modified to promote rapid mixing of exhaust gas and secondary air, and to reduce heat losses to a minimum.

3.2.f Control-System Integration

Most of the complete emission-control systems that show some promise of approaching the 1975 emission standards require the following: improved carburetor performance, fast-acting and more accurate choke, inductive or electronic ignition system with modified timing, exhaust-gas recycle, secondary air pump with air injection into the exhaust ports or manifolds, and an oxidizing catalytic converter to complete the burn-up of HC and CO. When its performance is optimized, this system can achieve very low HC and CO emissions once the catalyst attains its light-off temperature. However, unless additional controls are used, the catalytic converter warms up too slowly to adequately control emissions when the engine is cold. The rich fuel-air mixtures used while the engine is warming up result in high exhaust HC and CO emissions.

Two main approaches are being developed with the objective of achieving greater emission control during the engine-warm-up phase. In one approach, the conventional exhaust manifold is replaced with a small-volume thermal reactor located upstream of the catalytic converter. The reactor is designed so that, very quickly after engine start, it will reach temperatures at which HC and CO will be burnt up. The combustion of some of the HC and CO raises the temperature of the gas leaving the reactor. Consequently, the catalyst bed heats up more rapidly. Once the catalyst reaches its operating temperature, the reactor and catalyst share the burn-up duty, with the catalyst bed playing the major role.

The other approach attempts to lean out the fuel-air mixture earlier in the engine warm-up phase by modifying the intake manifold. A quick heat manifold design is used, in which part of the intake is heated rapidly by the exhaust gases to obtain better fuel vaporization. The need for fuel-rich mixtures is obviated during the period a conventional intake would take to warm up, and HC and CO emissions are substantially reduced. Once the catalyst is warmed up, HC and CO emissions are brought down to very low levels.

Emission-control systems must also be designed to withstand types of vehicle operation other than those included in the emission test cycle. High-speed cruise, maximum acceleration, long-duration descent along a downgrade, and operation with a vehicle overload may place extra demands upon the emission-control system. Some manufacturers plan to install cut-out devices that will bypass some or all the control-system components in these operational modes in order to preserve the system's functional integrity during normal urban driving conditions. Thus a great variety of vehicle uses, and even abuses, must be withstood without damage to the emission-control system if it is to function successfully throughout the lifetime of the vehicle.

3.3 Current Stage of Development

3.3.a Emissions at Low Accumulated Mileage

The emission-control systems described in Section 3.2 have been under intensive development on experimental vehicles. This development includes both improvement in performance and durability of individual components, and optimization of the interaction between the many components to achieve the most effective overall emission control. To allow for degradation in control-system effectiveness (especially catalyst deterioration), and for slippage in emission control when moving from experimental to production vehicles, most manufacturers have set low-mileage emission targets for their experimental vehicles that are below the standards. Furthermore, even these targets are based on the assumption by manufacturers that standards need to be met only on the average, and not by each vehicle. In the past, system deterioration and slippage in the transfer to production vehicles have been significant. Manufacturers' development efforts are concentrated first on achieving low-mileage emission targets with systems having mass-production potential and subsequently on testing the durability of system components over extended mileage.

A number of uncertainties still exist concerning the definition of compliance with the law, which affect the choice of values of these low-mileage emission targets. These uncertainties are allowable maintenance during the 50,000-mile certification procedure, the testing of vehicles at the end of the assembly line, and whether all vehicle emissions or only the average of vehicle emissions, as defined in Section 2.3, must meet the standards during the vehicle's useful life.

The present durability-testing procedure is to allow maintenance comparable to the average that vehicles receive in customers' hands. The question whether catalyst replacement can be regarded as part of this normal maintenance is particularly important since, as will be described in more detail later, catalyst deterioration is a major problem with the contemplated 1975 emission-control systems.

If the full recommended customer maintenance is not allowed during the certification procedure, then deterioration in emission control over the 50,000 miles will be greater. EPA has not yet determined whether this option is open to manufacturers.

An end-of-assembly-line emissions test, as distinct from a test intended to ensure effective manufacture and assembly, might require a further lowering of these low-mileage emission targets. The combination of production tolerances on piece parts and subassemblies will inevitably result in a distribution of emissions about the mean, some vehicles emitting more than the mean value, some less. The requirement that emissions from all, or almost all, production vehicles be below the standard would be a much more severe requirement than the requirement that only the average emissions of all production vehicles be below the standard.

Typical manufacturers' low-mileage emission targets are shown in Table 3.2. Values vary somewhat depending on manufacturers' past experience and judgment. These targets are currently being set at about 50 to 60 percent below the emission standards to allow for a 10-20 percent increase in emissions as the control system is transferred from experimental to production vehicles, for a factor of about 2 deterioration in HC and CO emission control over 50,000 miles (primarily from the decreasing effectiveness of the catalyst), and for deterioration in the EGR system due to plugging of the line and valve with deposits. The low-mileage emission targets set at about 50 to 60 percent below the standards are based on the assumption that only the average emissions of production vehicles must meet the standards, and that recommended customer maintenance (including catalyst replacement if necessary) will be allowed during the 50,000-mile certification testing.

Table 3.2 presents a summary of data on the best emissions results attained to date* supplied to the Committee by the automobile-manufacturing industry. The emissions measurements summarized in the table were done on vehicles equipped with the prototype versions of each manufacturer's 1975 control system. They represent the average of several tests on each vehicle. The mileage accumulated on these vehicles and systems is a few thousand miles at most. Appendix F gives the emissions measured from each manufacturer's best car. The data from Appendix F were used to compile Table 3.2. These results show that, at the present stage of development, most manufacturers have been able to achieve emission levels close

*October 15, 1971

Table 3.2

Low-Mileage Emission Targets and Measurements[a]

	Emissions, grams/mile		
	HC	CO	NO_x
1975 Standards	0.41	3.4	3.0(1.5)[b]
Low-mileage targets[c]	0.19	1.5	1.9(0.9)
Major U. S. Manufacturers			
Single best car (car C from Appendix F)	0.13	1.9	1.3
Average of each manufacturer's best car (average of cars A, B, C, D, E from Appendix F)	0.21	2.8	2.2
Range of best-car emissions	0.13-0.31	1.9-3.7	1.2-4.5
Range of emissions from one manufacturer's development fleet[d]	0.2 -0.9	3-12	0.9-1.4
Foreign Manufacturers			
Average of each manufacturer's best car	0.33	3.7	1.7
Range of best-car emissions	0.10-0.63	2.4-5.8	0.6-2.5

[a]The data are as of October 15, 1971. The emission data are the average of several tests on laboratory-engineered vehicles at low mileage using the 1975 test procedure except where indicated in Appendix F. More detailed data are given in Appendix F.

[b]Values in parentheses are applied to proposed California 1975 standards.

[c]These are typical values; targets vary between manufacturers depending on past experience and judgment. Certain assumptions about production vehicles affect these targets.

[d]Typical development fleets contain 5-10 vehicles, with different-size engines and different drive transmissions. Control systems are at different stages of development.

to the 1975 standards on laboratory-engineered vehicles at low mileage. However, it will be shown in Section 3.3.b that vehicle emissions increase steadily with accumulated mileage, the main reason being the deterioration of catalyst performance.

One U. S. manufacturer with one vehicle has come close to the listed low-mileage emission targets. The major U. S. manufacturers each have one or a few vehicles with emissions between these targets and the standards. Better HC-emission control has been achieved than CO-emission control; the average of United States manufacturers' best vehicles shows HC low-mileage emissions 49 percent below the 1975 standard and CO low-mileage emissions 18 percent below the 1975 standard.

Table 3.2 also shows the range in emissions in one U. S. manufacturer's 1975 development fleet. These fleets are typically five to ten cars, each equipped with the basic elements in the 1975 emission-control system. These vehicles are usually different models in the manufacturer's product line, with different engines and drive trains. Other manufacturers' fleets show a similar range in emissions. These results indicate that the same emission-control system applied to vehicles with different engines and drive trains shows a spread in low-mileage emissions of a factor of 2 to 3 above and below the mean. This spread is due both to the different stages of development of each of the experimental vehicles and to different individual vehicle reactions to the control-system components.

The emission levels achieved by foreign automobile manufacturers shown in Table 3.2 also indicate that considerable progress has been made. The magnitude of their emissions research and development efforts is generally less than that of U. S. manufacturers and appears to depend on the importance placed on retaining their share of the U. S. market. Availability of test equipment and trained manpower have also been stated to be limitations on the programs of foreign manufacturers. The averages of emissions from each manufacturer's best-effort vehicles are higher than the corresponding averages of U. S. manufacturers' best efforts. The spread in emissions from these best-effort vehicles is also greater. It is clear that some of these manufacturers have not progressed to a stage at which they can evaluate their position in relation to the 1975 standards with any confidence. In general, the Committee judges that foreign manufacturers have not achieved the degree of emission control achieved by the major United States manufacturers.

The results summarized in Table 3.2 also show that the NO_x emission control required by federal standards in 1975 (3 g/mile) appears to be within the capability of these laboratory control systems. However, the proposed California NO_x 1975 standard of 1.5 g/mile* may not be

*This standard is for all production vehicles and not just the average emission.

feasible and may affect manufacturers' ability to hold HC and CO emissions at levels close to the 1975 federal standards. The potential of these control systems to achieve greater NO_x reductions is explored more fully in Section 3.4.

At this point, it must be stressed that emissions measurements on a single vehicle should be interpreted with caution. There is a significant variation in results when the same vehicle is tested several times with the same test equipment, due to changes in control-system performance and errors and inadvertent variations in the test procedure. Variations in emissions of $\pm$ 50 percent about the average value are not uncommon. Thus, conclusions can be drawn only from the average of several tests on any one vehicle. Currently available data are also insufficient for determination of whether excellent performance with the control system on one vehicle can be achieved on another vehicle with different weight, engine, and drive train. The effectiveness of a given system on a manufacturer's entire product line can, at present, only be inferred.

Data submitted to the Committee and its Panels by research and development groups outside the automobile industry attempting to achieve emission control to the 1975 standards with reciprocating spark-ignition engines have not indicated the achievement of better emissions control. Moreover, few of these groups have attempted to test and demonstrate the durability of their systems over extended mileage.

3.3.b System Durability

Before these laboratory-built and controlled systems can be considered suitable for production, the reliability and durability of the system and its components over extended mileage must be demonstrated. The performance of the catalyst is especially important. Since accumulation of 50,000 miles on a vehicle simulating typical customer use takes at least four months, and since few systems have yet reached the low-mileage emission targets, such durability data are sparse. Though more durability data are available on some of the system components, these must be used with caution since the laboratory conditions under which durability was tested are far different from the conditions that will be experienced with the complete 1975 system. This is especially true of catalyst tests performed with 1970 or 1971 production automobiles. Engines in these production vehicles operate with a leaner carburetor setting than is expected in 1975 model year vehicles, and hence with a lower HC and CO loading on the catalytic converter.

Deterioration in catalyst effectiveness is the greatest problem with all these systems. It causes vehicle emissions to rise steadily with accumulated mileage. This deterioration results in part from poisoning of the active catalyst material, and in part from damage to the catalyst surface structure caused by overheating. Both these effects

reduce the activity of the catalyst when fully warmed up; they also raise the bed temperature required for the catalyst to become fully effective. Emission control in both the cold-start and warm-engine phases is impaired.

It is well known that the lead compounds resulting from combustion of antiknock additives in commercial gasoline (present in amounts up to 3 grams lead alkyls per gallon) rapidly poison the active catalyst materials being used. Vehicles with catalytic converters must therefore be operated with "lead-free" fuel. However, today's "lead-free" gasoline still contains trace quantities of lead as well as other elements such as phosphorus and sulphur. All have been found to increase catalyst deterioration significantly. The concentrations of these elements in currently available "lead-free" gasoline are high enough to be of concern. Also lubricants, and detergent and dispersant additives, may contain small amounts of these and other elements that contaminate the catalyst material.

There is therefore a need for federal action to ensure wide availability of lead-free fuel at the time vehicles with catalytic converters come onto the road. Action is also required to control the amounts of catalyst poisons in the fuel. Some manufacturers' data suggest that fuel with less than about 0.03 gram lead per gallon, and less than about 0.01 percent sulphur and 0.005 grams phosphorus per gallon, may be required. It is also essential that the automotive and petroleum industries devise techniques for ensuring that vehicles that must use lead-free gasoline cannot have their fuel tanks filled with conventional leaded gasoline.

Catalyst damage due to overheating in vehicle use is not adequately understood. Certain vehicle-operating modes result in high exhaust-gas temperatures and high HC and CO concentrations. When these emissions are burnt up in the catalytic converter, the heat released in the oxidation process can raise bed temperatures to 1600°F or more and cause physical damage to the catalyst surface structure. Examples of detrimental vehicle-operation modes are sustained operation at high engine power and descent down long hills. The driving schedule used to accumulate mileage rapidly during driveability tests, while typical of average customer use, does not include several of these operating modes in which overheating can occur. Also, any engine failures, such as spark-plug misfire, which substantially increase HC and CO emissions, are likely to result in severe overheating and catalyst damage. While recent developments in catalyst technology have improved the structural properties of catalysts at high temperatures, there will probably still be a need for a catalytic converter by-pass system to prevent permanent damage to the catalyst in those modes in which overheating is likely. The by-pass system must seal tightly during normal use to prevent excessive emissions. It would be operated by signals from sensors measuring catalyst-bed or exhaust-gas temperature. Such systems are under development, but satisfactory performance has not yet been obtained.

Most of the oxidation catalysts tested on vehicles show an initial loss of activity, especially in CO-conversion efficiency, over the first few thousand miles of vehicle operation followed by a more gradual loss in activity over the subsequent tens of thousands of miles.

Data in Appendix G illustrate these points. Variations in emissions during engine startup at the beginning of the test and changes in carburetor settings as well as catalyst deterioration affect the emission results.

Few of the catalysts with the high initial activity required to achieve emissions close to the 1975 standards have yet been tested over extended mileage. Not all the tests made were conducted with HC and CO loadings on the converter comparable to those expected with the complete 1975 system. For example, exhaust-gas recirculation to control NO_x emissions was not always used. Since this requires enrichment of the fuel-air mixture to maintain adequate vehicle driveability, HC and CO emissions from the engine itself increase. Increasing the load on the converter appears to result in faster catalyst deterioration.

Only a few of the automobile manufacturers have carried out durability tests with their 1975 emission-control systems over sufficient mileage to allow estimates of deterioration over 50,000 miles. The best results available to date with catalytic converters in emission-control systems similar to those being developed for 1975 model year vehicles are summarized in Table 3.3. The emissions measured at low mileages were not always below the 1975 HC and CO standards. The 50,000-mile deterioration factor is the ratio of emissions measured at 50,000 miles to emissions measured at 4,000 miles. Smoothing of the data is required to obtain this factor because the scatter can be up to $\pm$ 50 percent about the average, due to variation in control-system performance and test procedure. The best measured or projected increase in emissions over 50,000 miles is by a factor of 2.5 or more when low-mileage emissions were below the 1975 HC or CO standard. While lower deterioration factors have been measured when initial emissions levels were above the 1975 HC or CO standards, it is not clear that this improved performance can be retained as the activity of the catalyst is increased to reduce emission levels below the standards. At this time, automobile manufacturers do not have adequate data to assess the durability of their catalytic converters over extended mileage. Their experimental vehicles with promising low-mileage emissions have exceeded one or both of the 1975 HC and CO standards early in the durability tests. Catalyst replacement during the 50,000-mile durability test would improve this situation. Whether emissions after catalyst replacement would be close to the values achieved at low mileage would depend on the deterioration of engine adjustments and other components in the system that affect emission control.

Table 3.3

Deterioration in Emission Control Over 50,000 miles[a]

Catalyst Type	Emission (g/mile) at 4,000 miles		50,000-Mile deterioration factor[b]
A-Base metal, pellets	HC	0.6	2.8
	CO	10	2.4
B-Base metal, pellets	HC	0.24[c]	2.5
	CO	5.4 [c]	1.6
C-Platinum, monolith[d]	HC	0.19	2.5
	CO	4.2	2.5
D-Base metal, pellet	HC	0.8	1.5
	CO	9.5[e]	---

[a]Examples of best results obtained to date over 50,000-mile durability tests by automobile manufacturers with control systems similar to those being developed for 1975 vehicles. CVS-C test procedure used (see Table 3.1) except where noted. Data supplied to Panel on Emission Control Systems.

[b]Deterioration factor as used by EPA is emissions at 50,000 miles divided by emissions at 4,000 miles. A straight line is drawn through the emissions data plotted against mileage to obtain this ratio. The scatter in the data about this line is about ± 50 percent.

[c]These emissions measured with 1975 test procedure at zero miles.

[d]No EGR used with this vehicle. When EGR is used to reduce NO_x emissions below 3 g/mile, HC and CO emissions from engine will rise.

[e]Average value. CO emissions varied over the range 6.5-14 g/mile. Not possible to determine a deterioration factor.

The durability of other components in the emission-control system has not yet been adequately demonstrated. EGR systems show deterioration with mileage due to plugging of the recycle line and control valve with deposits. While the manifold reactors used by some manufacturers have shown promise of extended mileage durability under normal operating conditions, their ability to withstand higher temperatures during extreme operating conditions is open to question. Quick heat intake manifolds are a new development and their durability has not been adequately assessed.

It is also essential that new production carburetor and choke designs, and quick heat manifolds, be thoroughly proven in field-testing before they are placed on customer cars. Proper fuel-air mixture preparation is a critical element in assuring adequate and safe vehicle operation and the effectiveness of the emission-control system.

In view of these problems it should be asked whether systems with a catalytic converter as the major HC and CO burn-up device are the best choice. The alternative is a system with a manifold thermal reactor. The best low-mileage emissions results reported to date with two different thermal-reactor concepts are given in Table 3.4. The best results obtained with a proposed 1975 catalytic converter system are included for comparison. The thermal-reactor system includes EGR and fuel-rich carburetion to control NO_x. It also requires this rich carburetion to provide enough chemical energy in the engine exhaust to hold the reactor core at high enough temperatures for burn-up to be effective.

The main problems with the thermal-reactor system are: substantial fuel-economy penalty (e.g., 17-22 percent for reactor B); inadequate CO-emission control; inability to control NO_x emissions to the 1976 standard (the thermal reactor bolts directly onto the cylinder head and does not provide the proper reducing atmosphere for an NO_x catalyst); need for over-temperature protection, and high emissions in the event of failure. At present, the Committee judges that the oxidizing-catalytic-converter approach offers more promise of meeting the 1975 standards and better potential, with a reducing catalyst, of meeting 1976 NO_x levels (the oxidation catalyst can be located downstream of the NO_x catalyst).

3.4 System Compatibility with 1976 NO_x Standard

An important consideration is the potential of the 1975 control systems, with further development, to meet the 1976 NO_x-emission standard of 0.4 g/mile. Almost all manufacturers have focused their development efforts on control systems that can achieve much lower NO_x emissions than are required in 1975.

NO_x control to below 3 g/mile in the systems proposed for 1975 model year vehicles is achieved with EGR, fuel-air mixture enrichment, and adjustments in spark timing. The best NO_x control achieved in

Table 3.4

Best Low-Mileage Emissions from Thermal-Reactor Systems*

	Emissions, grams/mile		
	HC	CO	NO_x
Thermal-Reactor Concept A	0.05	9.2	0.51
Thermal-Reactor Concept B	0.1	4.0	0.7
Best 1975 Catalytic-Converter System	0.13	1.9	1.3

* As of November 1, 1971

experimental vehicles by using increased amounts of EGR and richer mixtures is 0.8 - 1.0 g/mile. A fuel-economy penalty of 20 percent or more results, and the HC and CO loading on the catalyst is increased. Attempts at greater NO_x control with these approaches lead to higher HC and CO emissions, an increased fuel-economy penalty, and poor vehicle driveability. The 1975 proposed California NO_x standard of 1.5 g/mile may even be beyond the capabilities of some of the systems being developed to meet the federal 1975 HC and CO standards (see Table 3.2).

While EGR with fuel-air mixture enrichment is effective in reducing NO_x emissions to levels approaching 1.5 g/mile, it is not a satisfactory method of achieving the very low NO_x emissions required in 1976. Large amounts of EGR (about 20 percent) degrade engine performance and fuel economy and significantly increase the difficulty of HC- and CO-emission control. The use of rich mixtures results in high engine HC and CO emissions. The increased thermal load on the catalytic converter makes damage from overheating more likely; in the event of catalyst failure, the vehicle emissions would be greater than those from current new vehicles.

The basic 1975 emission-control systems now being developed will require either the addition of a high-performance NO_x-reducing catalyst in addition to an oxidation catalyst, or an effective three-way catalyst (which controls NO_x, HC, and CO emissions) to achieve NO_x control to the level of the 1976 standards. In the first approach, the additional NO_x catalyst bed would be placed in the exhaust system upstream of the HC- and CO-oxidizing catalyst. Recalibration of the carburetor to a richer setting to provide a reducing exhaust-gas stream would be required. Some EGR would probably be retained to reduce the NO_x levels entering the NO_x catalyst bed. The secondary air would be added downstream of the NO_x catalyst once the system was warmed up. During the warm-up phase, secondary air would be added in the exhaust manifold and the NO_x catalyst would act as an oxidizing catalyst to control HC and CO emissions. If a three-way catalyst were to prove practicable, all three pollutants could be controlled in one converter and a simpler system would result. For both these approaches, the carburetor setting used for the 1975 systems would need recalibration. The measures taken to control emissions in the 1975 system while the engine warms up may not be as effective in these 1976 systems and additional development of the system to adequately control HC and CO emissions during the engine and catalyst bed warm-up phases would then be required.

Laboratory-engineered systems of this type are now being evaluated, but the technology of suitable NO_x-reducing catalysts or three-way catalysts is not nearly as advanced as the technology of oxidation catalysts. Although NO_x-emissions reductions to levels approaching the 1976 standard of 0.4 g/mile have been achieved on a few experimental vehicles, the catalyst durability is poor, and the mass-production potential of these

systems cannot yet be established. Contacts between the Committee and catalyst manufacturers have indicated optimism among the catalyst manufacturers that a three-way catalyst system can be developed. Efforts in this area during the next year will be monitored very closely by the Committee.

The techniques proposed to control NO_x emissions make it harder to achieve HC- and CO-emission control to the levels required by the 1975 standards. The use of EGR as explained above requires mixture enrichment to maintain vehicle driveability and increases the engine's HC and CO emissions. The inclusion of an NO_x-reduction catalyst adds extra mass upstream of the oxidation catalyst and, therefore, slows down the warm-up of this HC and CO converter during the cold-start portion of the test. The use of an NO_x catalyst also requires some mixture enrichment to provide the correct composition of gases entering the catalyst chamber.

3.5 Effects of Emission-Control System on Vehicle Performance

Three areas of vehicle performance are likely to be adversely affected by the 1975 emission-control systems. These are fuel economy, vehicle-acceleration capability, and vehicle driveability (or ability to perform adequately in all normal operating modes and ambient conditions).

Reductions in compression ratios for 1971 and later model year vehicles, to enable these engines to burn 91-octane gasoline, have already resulted in losses in fuel economy and acceleration capability for engines of given displacements. The use of EGR to control NO_x emissions is the primary cause of the expected additional performance losses in 1975 model year vehicles. Because EGR slows down the combustion process inside the engine, the fuel-air mixture must be enriched to maintain flame speeds and retain adequate driveability. Spark retard is also used and has a similar effect. Data from the automobile manufacturers indicates that these changes are expected to result in a direct fuel-economy penalty of 3 to 12 percent compared with 1973 prototype vehicles, depending on engine size, axle ratio, vehicle weight, and details of the emission-control system.

Again because EGR is used, the power output for a given engine displacement, engine speed, and throttle setting is reduced. Because the fresh mixture is now diluted, less fuel and air enter the cylinder, and the effective size of the engine is decreased. The resulting loss in acceleration capability can be offset by increasing engine displacement (which results in a further fuel-economy penalty) and by cutting out EGR at wide-open throttle. The precise performance loss is difficult to estimate at this stage, since it also depends on details of engine size, vehicle weight, and the emission-control system. It is likely that some of the smaller engines now available in some model lines will have to be discontinued, due to the reduction in performance of such engines to unacceptable levels when operated with EGR.

The effects of emission controls on vehicle driveability are difficult to quantify. Driveability after a cold-engine start, and especially with cold ambient conditions, is likely to be impaired. To reduce HC and CO emissions during engine warm-up, the choke is set to release quickly, and the fuel-air mixture is leaned out as early as possible after engine startup. Under these conditions, problems of engine stall, and vehicle stumble and hesitation on rapid acceleration, have been prevalent. Vehicle stall and stumble are safety hazards in some traffic situations. Similar problems during startup and drive-away after a hot-engine restart have been experienced. By careful tailoring of the fuel-air mixture control, such problems have in the past generally been resolved, though there has been a deterioration in driveability in 1971 and 1972 model year vehicles. The impact of more stringent air-fuel ratio control for 1975 model year vehicles on vehicle driveability cannot yet be accurately established, because these 1975 prototype systems have not been tested under a wide range of ambient conditions. The use of EGR affects driveability. Adequate vehicle performance depends on good mixture preparation and distribution between the different engine cylinders to avoid engine misfire. Exhaust gas is one more component to be mixed with the fresh mixture in the intake manifold. It makes this problem more critical because it reduces the tolerable cylinder-to-cylinder fuel-air variation.

The successful resolution of many of these driveability problems depends on extensive field-testing of production prototypes. The vehicles need to be tested under as complete a range of vehicle-operating modes and ambient conditions as possible. This is an essential stage in the development process if the engine and emission-control system are to perform safely and reliably in the customer's hands. Severe driveability problems could have significant safety implications.

3.6 Developments Required to Meet 1975 Standards

From the data reviewed in Section 3.3, it is clear that no major manufacturer has yet demonstrated the technology needed to meet the requirements of the 1970 Clean Air Act Amendments of 1975 model year vehicles. However, both the automobile and catalyst manufacturers have intensive development efforts under way. Thus, there remains some possibility that a control system can be developed in time to permit the mass production of vehicles that will meet the 1975 standards.

It must be stressed that the major automobile manufacturers are at different stages in this development. Also, although the control systems being proposed for 1975 by most manufacturers are similar in concept, the details of the system components differ significantly among them and the integrated systems have been optimized for different engine-operating conditions. Fuel-air ratios used and mixture preparation are two important differences. Thus, although one or perhaps two manufacturers

have shown on a few of their vehicles that their systems have the potential of meeting the low-mileage emission targets, it is not clear that the other manufacturers' systems, in their present forms, have this potential. Especially important are the variations in catalyst durability obtained by different automobile manufacturers using catalysts that, according to laboratory tests, should have similar properties. The different HC and CO loadings on these catalytic converters appear to be significant.

Most manufacturers evaluate the low-mileage emissions performance of their systems in relation to emission targets, which, as shown in Table 3.2, are substantially below the 1975 standards. Intensive durability testing commences only when the system shows promise of reaching these targets. It must, therefore, be asked whether these targets are realistic or unduly stringent. This depends in part on decisions the Administrator of EPA has yet to make. One decision is whether only the average emissions of production-line vehicles, or all or almost all vehicle emissions, must be below the standard (Section 2). The second is what maintenance procedures are allowed during the 50,000-mile certification test. The question of catalyst replacement at more frequent intervals than 50,000 miles is crucial. The targets listed in Table 3.2 assume that only the average of production-line vehicle emissions must be below the standards for the vehicle's useful life, that provision is made for catalyst replacement and other maintenance during the certification procedure, and that fuels with sufficiently low levels of catalyst poisons will be widely available. Available catalyst durability data and a reasonable assessment of improvements likely over the next year or so suggest that, without catalyst replacement, these low-mileage targets are optimistic. If catalyst replacement at 20,000 - 30,000 mile intervals is to be allowed, and if these anticipated improvements in catalyst performance are realized, then these targets represent a reasonable judgment of necessary low-mileage performance of the emission-control system.

The developments required to enable most major manufacturers to meet the 1975 standards in 1975 model year vehicles can now be laid out. First, an experimental version of the control system must be shown capable of meeting the necessary low-mileage emission targets. One or two manufacturers have reached this stage with HC emissions and are approaching this stage with CO emissions provided the assumptions about averaging, catalyst replacement and maintenance already described can be applied. Second, the durability not only of the catalyst but of the entire experimental systems must then be demonstrated under conditions typical of both normal and extreme customer usage. Better built-in control of engine adjustments than in present engines will be essential. Catalysts with initial activity equal to that of the best materials now available, but with improved durability, will be required. It appears now that catalyst replacement within 50,000 miles will be necessary to prevent deterioration in HC- and CO-emission control by more than a factor of 2 and, hence, to retain low-mileage emission targets at 50 to 60 percent below the standards.

For those manufacturers who are close to meeting their low-mileage goals and who have already demonstrated catalyst durability approaching what will eventually be required, these developments are extrapolations of their current technology. The development effort required to realize these improvements in time for 1975 model year production may be such that only the larger manufacturers have sufficient resources.

A critical factor in this development process is the need for extended reliability and durability testing, not only of the engine and emission-control system, but also of other vehicle components whose design must be changed as a result of emission control. Examples of such changes are redesign of parts of the vehicle frame to obtain extra space for enlarged exhaust manifolds and catalytic converters, and modifications to power steering and brakes as EGR changes the intake-manifold vacuum. Most of these additional problems can be solved with standard engineering techniques; there will be many such changes, however, and each new component must be adequately tested before mass production.

Historically, the automobile manufacturers have introduced new components only after extensive testing on a small part of their total production. The reasons for this are sound; customers use their vehicles in a wide variety of ways and expect reliable, safe, and satisfactory performance. Adequate design data become available only after customer field experience has been obtained. This process can be accelerated by increasing development effort, but time contraints for 1975 model production are such that many engineering decisions may be made during the next two years without benefit of adequate information.

3.7 Stratified-Charge and Wankel Engines

Two alternative spark-ignition engine concepts have received considerable attention of late. These are the stratified-charge and the Wankel rotary-combustion engines. Neither of these concepts is new. The stratified-charge principle was first suggested in the early 1920's; the Wankel engine in its current form dates back to 1957. Emission control is one of the several reasons for the renewed interest in these alternative approaches. These engines would represent a less radical change than other low-emission alternatives such as gas turbines and Rankine cycle engines. Their low-emission potential relative to conventional spark-ignition engines, and the time scale required to realize that potential, are important considerations.

Several different stratified-charge engine concepts are now being explored at the research stage. In each of these, fuel is injected directly into the engine cylinder. The engine geometry, timing of fuel injection, fuel and air-flow patterns, spark-plug position, and spark timing are all carefully adjusted so that combustion of the stratified fuel-air mixture inside the cylinder takes place under conditions that

minimize pollutant formation. With precise control of mixture preparation and combustion over the entire engine speed and load range, the basic engine emissions are considerably below those of conventional engines. The emissions are not at this stage low enough to meet the 1975 or 1976 standards without additional control devices such as EGR and a catalytic converter.

The two most advanced versions of the stratified-charge concept are being developed for the U. S. Army Tank-Automotive Command's M151 military jeep. The engine for this vehicle is a four-cylinder engine nominally rated at 70 horsepower. The version of this engine developed by the Ford Motor Company was tested recently by EPA and gave emissions at low-vehicle mileage below the 1975 and 1976 standards.

However, this engine is far from ready for mass production. It is known that tolerances on engine adjustments to maintain this low-emissions performance are narrow; no data are yet available on the durability of these adjustments over extended mileage. Components such as the fuel injector and spark plugs are laboratory prototypes, and designs suitable for mass production need to be developed. The low-emissions results were obtained in a low-powered military vehicle with driving characteristics different from those of a normal passenger car. The low-emissions potential of the system on larger engines in full-size vehicles is only now beginning to be explored.

Another type of stratified-charge engine is being developed with a divided chamber or prechamber design. Fuel-air stratification is obtained by injecting fuel into a precombustion chamber. The resulting fuel-air mixture is sparked, and burning gases then enter the main chamber above the piston where they mix with excess air and burn to completion. This concept is still in the research stage though it also appears to have inherent low-emissions characteristics.

The low emissions of these existing experimental stratified-charge engines may make this engine attractive in the longer term. This engine may also offer a fuel-economy advantage compared with emission controlled conventional engines. However, its potential for the mass automotive market cannot yet be accurately assessed. It represents a more radical departure from current technology than might appear at first sight. The cylinder head, piston, intake port and intake manifold geometries are all different from those of a conventional engine and designs have not yet been fully optimized. The fuel injector and nozzle must provide better spray control than is achieved in diesel engines. The spark plugs extend into the cylinder and require a different electrode configuration. All these changes present new design and durability problems. Several manufacturers now have development programs to explore the potential for the stratified-charge engine; only when results from these programs become available can sound judgments as to its future be made. Even with the most optimistic

development schedule practicable, 1978 is the earliest date at which this engine could be introduced into a substantial fraction of any manufacturer's product line

Wankel engine technology is further advanced. Though NSU's early experience with limited production of this engine in Germany was not encouraging, Toyo Kogyo in Japan have successfully marketed Wankel engines for the last three years. A major problem has been rotor apex seal wear, but acceptable solutions now appear to have been found. The claimed advantages of the engine are: lighter weight, smaller size, smoother and quieter operation, and fewer moving parts. It is therefore claimed that it would be cheaper to manufacturer.

The emission characteristics of the engine have not been explored as extensively as have those of the conventional engine. There are variations in geometry between different Wankel engine designs that appear to affect emissions significantly. In current production Wankel engines, HC emissions from the engine itself appear higher, CO emissions are about the same, and NO_x emissions are lower than emissions from a comparable reciprocating engine. The lower NO_x emissions appear to be a significant advantage. Much of the emission-control technology being developed for conventional engines can be applied to the Wankel engine. However, the optimization of the engine design for low emissions and integration with other control devices, such as thermal reactors and catalytic converters, is at an earlier stage of development.

The claimed advantages of the Wankel engine lie primarily in areas other than emissions. Thus, while a small fraction of 1975 model year vehicles may use Wankel engines, the HC- and CO-emission-control problem will not be substantially different.

4. MAINTENANCE

The emission-control systems necessary to meet the 1975 and 1976 model year standards are complex systems that must be carefully controlled and maintained to enable a vehicle to continue to meet the standards for 50,000 miles, and have very low emissions for their entire life. For example, more precise fuel metering will be required. Control of the air-fuel ratio will have to be maintained to within narrower limits than heretofore has been required or possible. To try to obviate the difficulties of ensuring adequate and proper maintenance, there will have to be an increased tendency to replace rather than repair or readjust defective parts, e.g., sealed, electronic ignition systems. This will involve, in many cases, an increase of maintenance costs.

A critical item in the 1975 emission-control system is the catalyst. As discussed previously, whereas some manufacturers have attained results below the 1975 emission standards on experimental vehicles, no one has yet been able to do this for 50,000 miles, catalyst durability being a critical problem. According to the federally prescribed emission-test procedure relating to durability, a major engine tuneup is allowed at 24,000 miles with replacement of spark plugs, condenser, breaker points, etc. The lack of a catalyst of proven durability may require that replacement of the catalyst at specified intervals be permitted in the federal emission-test procedure and also become part of the standard maintenance procedure indicated in manufacturers' warranties.

The problem of maintenance of emission-control systems is made more difficult by the fact that devices such as manifold thermal reactors and catalysts may fail without the motorist even becoming aware of it. As discussed previously, the inadvertent use of leaded gasoline or the failure to replace a misfiring spark plug may well cause irreversible damage to the catalyst. Under these conditions it is possible for the vehicle actually to emit as much or even more pollutant material than the vehicle without a catalyst and EGR, because of the richer carburetor setting required by the emission-control system.

Further, the motorist will have no natural incentive to have maintenance performed on his vehicle. The EGR system, for example, carries a loss of performance and increases fuel consumption. There is an apparent advantage to the individual motorist in allowing this system to plug up, or even purposely to disable it.

The additional maintenance cost of a 1975 or 1976 model year car is difficult to estimate, since even experimental vehicles have not exhibited satisfactory 50,000-mile durability. Accurate cost estimates cannot be made until such vehicles have been in service in the hands of customers. Many motorists will not voluntarily pay the necessary costs to maintain their cars at low emission levels,

with poorer performance and impaired driveability as the penalty. If the additional emission control is to be realized in service, it is necessary that adequate maintenance be required for the life of the vehicle. Procedures to ensure such maintenance might include state or local laws prohibiting deactivation of emission-control systems and requiring that they be maintained, state or local inspection requiring correction of cars with excessive emissions, and required replacement of certain components at specified intervals. Since some of the emission-control systems are not yet completely developed, failure modes are not well enough known to determine the best method of enforcement at this time. The problems of developing enforceable procedures, including the provision of economically feasible test equipment and personnel training, have not as yet been attacked by either the automotive industry or public bodies.

5. MANUFACTURING

In order to prepare for production of 1975 model year vehicles, new production facilities will have to be made available for such items as air pumps, catalytic-converter housings, catalysts and their carriers, and a multiplicity of valves, regulators, and safety devices. New or extensively modified production facilities will have to be provided for new carburetion and ignition systems, new exhaust and intake manifolds, and new engine heads. Final assembly-line and subassembly-line additions and modifications will be necessary. The task of providing facilities for meeting the 1975 values is a large one.

Long lead times are required to design, erect, and equip modern mass-production facilities. The design of some manufacturing equipment has already been detailed and irreversible decisions will have to be made by mid-1972 if the industry is to be ready for August 1974, full-scale production. A typical example of the time schedule for critical equipment construction is shown in Table 5.1. Compared with normal practice in the automobile industry this is an accelerated schedule. The most undesirable features of the schedule are the inadequate time allowed for gaining sufficient experience with production vehicles in customers' hands and the very limited time available to correct and adjust production equipment, processes and procedures.

Some of the tooling will be more sophisticated than has been previously made for the automobile industry. For instance, carburetors will have to be inspected and adjusted by advanced modern electronic techniques before installation. In turn, machined parts will have to be made on machines capable of correcting any dimensional errors that might develop.

Most automobile companies purchase many component parts from vendors. The rapidly fluctuating thinking about design criteria for items such as catalytic converters so retards decision-making that vendors cannot commence the construction of production facilities and assume amortization of their own investment until firm commitments are made.

It has become apparent that if engines are designed and manufactured to close dimensional tolerances, the emission characteristics of the vehicles will be much more consistent. It will be costly and require much change in management techniques for the automobile industry to acquire expertise and equipment for adequate quality control. It will also be difficult to arrange for similar control of vendors' products, although the techniques of quality control are well known in other industries and can be acquired.

Table 5.1

Scheduling and Lead Times for Mass Production

January 1, 1971	-	Accelerate design of heavy machine tools. Make preliminary designs of emission-control systems. Accelerate emission testing on vehicles. Make preliminary designs for most tooling.
July 1, 1971	-	Approve design for large machines and make layouts for new factories and major modifications. Select tentative design for emission-control system.
January 1, 1972	-	Prepare materials for requesting bids. Start final phase of obtaining facilities approvals.
April 1, 1972	-	Finalize design of emission-control system for production.
July 1, 1972	-	Make contracts for vendor-manufactured items. Make contracts for equipment. Make contracts for production tooling. Start accelerated testing program of handmade vehicles.
January 1, 1973	-	Order materials. Finish design of minor tooling and factory rearrangements. Redesign to meet change requirements.
July 1, 1973	-	Start production tests from partial tooling. Start certification runs. Accelerate production plans. Start extensive field tests of vehicles.
January 1, 1974	-	Complete component-production facilities and start production. Start intensive preparation of equipment for making pilot production on mass-production equipment.
July 1, 1974	-	Start production of automobiles. For the entire industry, this is at a rate of approximately 10 million vehicles per year.
January 1, 1975	-	Evaluate field behavior of mass-produced vehicles and introduce minor modifications.

The emission values are critically associated with configuration and dimension control. The closer the dimensions approach the values specified for a particular configuration, the closer the emission values will be to those required by the Act.

The Committee was sympathetic to all these difficulties. Nevertheless, based on information provided by a Committee Panel and based on the evaluation of the Committee, it is the opinion of the Committee that the automobile manufacturers have the experience and capability to arrange to mass produce the type of hardware indicated in Section 3 that would be necessary to meet the 1975 standards in sufficient time. However, as was discussed in Section 3, data presented to the Committee (Appendixes F and G) show that, at present, not even experimental vehicles are available that can satisfy the complete requirements of the 1975 standards. Thus, even though the hardware for the 1975 model year vehicle can be outlined, improvement and optimization of the emission-control systems will be necessary in order to provide the necessary reliability and durability to achieve the 1975 requirements in service.

Likewise, as a result of panel visits to catalyst manufacturers, the Committee has been informed that, within one year after receipt of a firm purchase order, the catalyst manufacturers could install sufficient capacity to supply the projected needs of the automobile manufacturers, once an acceptable catalyst is developed or identified. The Committee emphasizes that according to the data provided to it by both the automobile manufacturers and the catalyst suppliers, as shown in Appendix G, there has, as yet, been no demonstration of an adequate oxidation catalyst of sufficient durability to satisfy the 1975 requirements.

6. COSTS OF MEETING 1975 EMISSION REQUIREMENTS

The designs for the emission-control systems for vehicles to meet the 1975 requirements are now definite enough so that the initial cost to the customer can be estimated. Estimates of the range of additional initial costs to the ultimate customer for meeting the 1975 requirements over the 1970 requirements were requested of foreign and domestic automobile manufacturers in Question 17 of the questionnaire. Replies were based on the assumption that only the average emissions of vehicles need meet the standards, and that a 100-percent assembly-line test will not be required; 50,000-mile warranty costs are not included. Several of the foreign manufacturers indicated that the state of development of their 1975 emission-control systems was such that they could not now give a realistic estimate of additional costs. Of the seven foreign manufacturers that did reply positively to the question, estimates ranged from $200 to $500.

Of the five American manufacturers, two submitted estimates of about $250 while the others were of the order of $500. The higher estimates reflected the proposed use of a thermal reactor as well as a catalyst in the emission-control system.

To provide substantiation of the manufacturing estimates, the Panel on Manufacturing and Producibility has made an independent study of these costs. The system used for the Panel estimates was one that in light of the results of Section 3 of the report, appeared most promising. The cost effectiveness of the thermal reactor and associated hardware was so poor that this item was not included in the system.

Table 6.1 shows, on a year-by-year basis, the items that have been added to current vehicles for emission-control and also those that will be added for a promising system for 1973, 1974, and 1975 model year vehicles. In estimating the cost of these items, the Panel assumed that all vehicles in the certification fleet will perform within the 1975 standards for 50,000 miles with no more than one catalyst change allowable, that automobile manufacturers will substantially increase their in-house testing and quality control of major components so that no additional end-of-the-line rework will be necessary, that a short end-of-the-line test will be used to identify grossly malfunctioning vehicles with the full CVS-CH test done only on a small statistical sample by engine family, and that only the average emissions of customer vehicles must satisfy the federal standards.

For the Panel estimates, the cost of a component was based on such factors as the typical cost per pound of worked or machined metal and the actual price charged by parts dealers in California for similar components already used in California cars. Tooling and equipment were amortized over three years, dealer margin was taken as 22 percent of the

Table 6.1

Typical Pattern of Installation of Automotive Emission Hardware

Model Year Added	Item
1966	PCV valve
1968	fuel-evaporation-control system
1970	a) retarded ignition timing b) decreased compression ratio c) change of fuel/air ratio d) transmission control system
1972	a) anti-dieseling solenoid valve b) thermostatic air valve c) choke-heat by-pass
1973*	a) exhaust-gas recirculation b) air-injection reactor c) induction hardened valve seats d) spark-advance control e) air pump
1974*	precision cams, bores, and pistons
1975*	a) proportional exhaust-gas recirculation b) carburetor with altitude compensation c) advanced air-injection control d) air/fuel preheater e) electric choke f) electronic distributor (pointless) g) improved timing control (‡ 1) h) catalytic (oxidizing) converter i) catalyst pellet charge j) cooling-system changes k) improved underhood materials l) body revisions

*Hardware listed for 1973, 1974, and 1975 model years is for a system deemed by the Panel to be promising.

sticker price, profit as 10 percent of the list price, and excise tax 5 percent of the sticker price. Excise tax was included in both the Panel and the manufacturers' estimates. Details of the Panel's estimates are given in Appendix H and results shown in Table 6.2. The Panel estimate shows an increase of initial cost of $288 for the 1975 model year projected system over the 1970 model year system, and an increase of $214 for the 1975 system over the 1973 system.

The increased dollar cost of a vehicle to the customer at the time of purchase is only part of the true cost to the user. According to the manufacturers' estimates the reduction in fuel economy to achieve the 1975 values will increase fuel consumption by 3 to 12 percent. The Committee anticipates that the cost of routine maintenance may increase by several times present costs depending on inspection procedures that are prescribed and enforced. There will be some deterioration in vehicle driveability.

Whether these costs are justified by the benefits to be gained is outside the scope of this interim report. But it should be noted that many who have concerned themselves with restoration of the quality of the environment have indicated that this process must necessarily be expensive and would probably include the necessity to forego certain material advantages made possible by a less regulated industrial technology. The present instance would appear to be a significant case in point.

Table 6.2

Summary of Cost for Likely Emission Hardware Based on Panel Estimates

Year	Yearly Cost	Accumulated Cost
1966	$ 3.00	$ 3.00
1968	15.00	18.00
1970	8.00	26.00
1971-1972	14.00	40.00
1973	60.00	100.00
1974	20.60	120.60
1975	193.40	314.00

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7. THE CONSEQUENCES OF A ONE-YEAR SUSPENSION OF 1975 STANDARDS

The current state of the art of emission-control technology, as presented in this report, strongly suggests the likelihood that some, if not all, of the automobile manufacturers will request that the Administrator grant a one-year suspension of the emission standards applicable to 1975 model year light-duty vehicles. At this point, it is useful to discuss the possible consequences of the granting of such a suspension.

At present, not even experimental vehicles have been shown to satisfy the 1975 emission standards for 50,000 miles. Certainly, developmental work is still required to further reduce emissions at low mileage and to provide the required durability. Durability testing is expensive and time-consuming; three to four months are required for a 50,000-mile test. Each major change in the basic system configuration or operating conditions will require new durability tests on components such as the catalytic converter. Catalyst technology for automotive emission control is relatively new, and some of the failure modes now being experienced are not well understood.

One important advantage of a one-year suspension, therefore, is that it would allow an additional year's work on development of the complete emission-control system before major design details of components must be "frozen" for production. Systems may need significant modifications before they can achieve both emission levels close to their low-mileage targets and improved catalyst life. The basic system configuration must shortly be fixed if the engine and control system are to be in mass production in 1974. Most manufacturers do not at this stage have adequate information to make many of the major engineering decisions that would be required over the next six months.

Furthermore, uncertainties in the definition of compliance need to be resolved by EPA before major commitments to production of the control systems are made. If decisions made on the concept of averaging emissions and on allowable maintenance during certification increase the difficulties of meeting the requirements of the Act, then further improvements in emission reduction beyond the best results achieved to date will be required.

As has been explained, many engine modifications are required in these prototype 1975 vehicles. With such a large number of modifications, there is considerable question of the overall system reliability in the hands of customers. Approximately 10,000,000 new vehicles will be purchased in 1975 by customers with a wide variety of driving habits. Conditions to which an emission-control system would be exposed by the driving public are more variable and extreme than those to which it would be exposed during the emission test. Extensive road testing under the ambient conditions experienced throughout the United States is essential to give the

manufacturer an understanding of problems and failure modes that will occur in practice. For the 1975 model year, the time scale is so short that many new production items will not be adequately proven. An example of such a critical item is the new carburetor design many manufacturers intend to use. Normal field testing and durability testing of production samples of such components may not be completed before these components are installed on assembly-line vehicles. Problems may therefore occur in customer use that did not show up in the limited test period now available. The public may be buying vehicles whose components are more likely to malfunction and whose driveability and reliability may not be satisfactory. A year's suspension would give more nearly adequate time for component durability and system reliability testing and thus would give the customer added assurance that the additional expenditure in emission control is indeed effective in improving air quality.

An essential requirement for effective emission control over extended mileage for vehicles with catalytic converters is wide availability of fuel of sufficiently low lead, sulphur, and phosphorus content. Not only must there be sufficient production of such fuel; there must also be available pumps, storage tanks, and transfer equipment that are free of contaminants. A year's delay in the imposition of the standards would help to ensure the nationwide availability of such fuel and facilities.

The necessity for adequate maintenance of emission-control systems has been discussed. Enforced inspection and maintenance procedures will be required to assure that the owner will pay the cost involved in adequately maintaining his vehicle's emission-control system. An extra year would again help the development of inspection programs and ensure the availability of inspection facilities in areas in which they will be required.

One of the more important factors that needs to be considered in the decision of whether or not to grant a suspension is the effect on total automobile emissions and overall air quality. A simple way to estimate the effect of the suspension is to calculate the change in total emissions from all automobiles in the late 1970's and 1980's if meeting the 1975 standards is delayed for one year. The ratio of total emissions at some future date to emissions now will be a measure of the improvement in air quality likely to be achieved. Figures 7.1 and 7.2 have been prepared for the purpose of evaluating these effects, and show the results of a one-year delay in implementing the 1975 emission standards for hydrocarbons and carbon monoxide. These curves take into account such factors as the vehicle-age distribution among all automobiles, the decrease in vehicle miles driven per year per car as vehicle age increases, the predicted nationwide growth in vehicle miles driven each year, the emission reduction achieved through crankcase blowby and evaporative-loss control, the effect of federal exhaust emission standards, and deterioration with mileage of emission controls from 1968 to 1974 model year cars. This deterioration

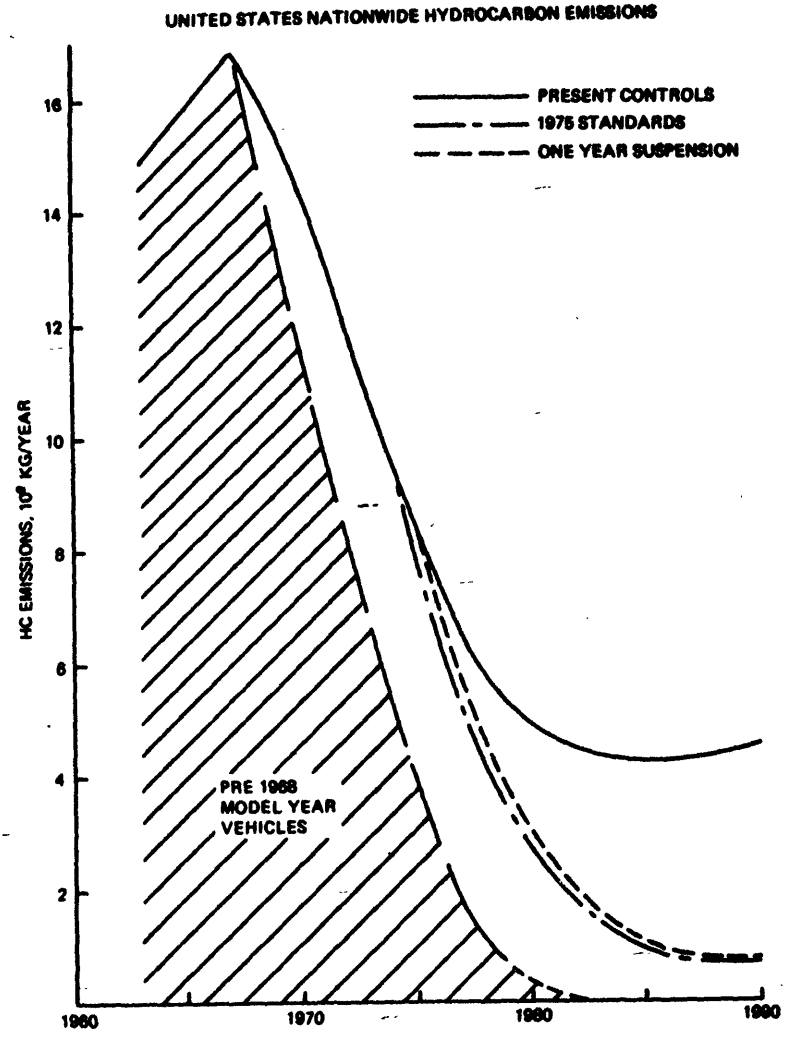
UNITED STATES NATIONWIDE HYDROCARBON EMISSIONS
PRESENT CONTROLS
1975 STANDARDS
ONE YEAR SUSPENSION
HC EMISSIONS, 10⁹ KG/YEAR
16
14
12
10
8
6
4
2
PRE 1968
MODEL YEAR
VEHICLES
1960
1970
1980
1990

Figure 7.1

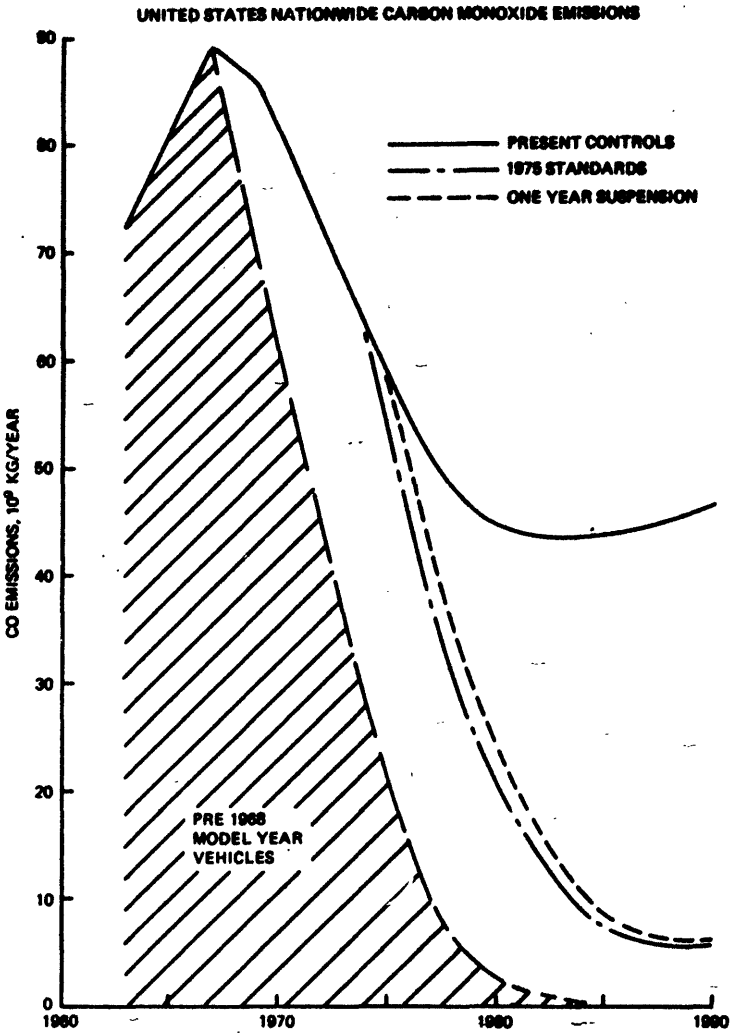
UNITED STATES NATIONWIDE CARBON MONOXIDE EMISSIONS
CO EMISSIONS, 10⁹ KG/YEAR
90
80
70
60
50
40
30
20
10
0
1960
1970
1980
1990
PRESENT CONTROLS
1975 STANDARDS
ONE YEAR SUSPENSION
PRE 1968
MODEL YEAR
VEHICLES

Figure 7.2

is estimated from California Air Resources Board field surveillance data. Deterioration is not allowed for in post-1974 model year vehicles since no reliable estimate of its magnitude can now be made. Further details of the calculations are given in Appendix I.

For any given calendar year, the figures show total HC and CO emissions from (1) pre-1968 uncontrolled vehicles, (2) all vehicles, with the 1975 standards for HC and CO met in 1975 and subsequent model year vehicles, (3) all vehicles, with 1975 HC and CO standards met in 1976 and subsequent model year vehicles - a one-year suspension with the 1973 standard maintained, and (4) all vehicles with present standards only. It can be seen that the rate of decrease in emissions until about 1980 depends primarily on the retirement of pre-1968 uncontrolled vehicles from use. Thus the effect on total emissions of a one-year suspension with no additional interim standards appears to be small. The effect is not more significant because the emission reduction now required of model year 1974 vehicles, as compared with uncontrolled vehicles (80 percent for HC and 69 percent for CO), is already so substantial.

8. CONCLUDING STATEMENT

The Clean Air Amendments of 1970 have had the effect of accelerating progress by automobile manufacturers in emission control. Experimental vehicles have been built and operated that, at low mileage, exhibit levels of emissions less than those specified for 1975 model year vehicles. However, information establishing the sustained effectiveness, durability, and reliability of prototype 1975 vehicle systems during typical consumer mileage accumulation is not available. The Committee finds that the technology necessary to meet the requirements of the Clean Air Amendments for 1975 model year light-duty motor vehicles is not available at this time.

While there is no certainty today that any 1975 model year vehicles will meet the requirements of the Act, the status of development and rate of progress make it possible that the larger manufacturers will be able to produce vehicles that will qualify, provided that provisions are made for catalyst replacement and other maintenance, for averaging emissions of production vehicles, and for the general availability of fuel containing suitably low levels of catalyst poisons. Conversely, if the above provisions are not deemed acceptable by EPA, it appears most unlikely that any manufacturer will be able to meet the requirements of the Act. The Committee believes that the emission levels required in the Clean Air Amendments will not be achieved in service, in any event, unless regular, periodic maintenance of the emission-control system is required of the owner.

The estimated costs to the consumer of meeting the requirements of the Act for 1975 vehicles, in comparison with those for 1973 vehicles, include an increase in sticker price of about $200, 3 to 12 percent increase in fuel consumption, an increase in maintenance cost, and a deterioration in driveability of the car.

If enforcement of the requirements of the Act for 1975 vehicles were deferred for one year, the opportunity thus provided for further development and field testing would enable manufacturers to significantly improve the performance and reliability of vehicles equipped to meet the requirements in the hands of the customer.

The Committee finds that the technology necessary to meet 1976 standards in 1976 model year cars is not currently available. The technology of catalysts suitable for NO_x reduction is not nearly as advanced as that of oxidation catalysts. The level of current research and development on reduction catalysts for NO_x control is not commensurate with the importance of this problem.

9. FUTURE PLANS

The results of the investigations of the Committee to date indicate several areas in which work should be continued or intensified and several areas in which studies should be initiated.

The Committee will study in depth the technological feasibility of meeting the standards of the Clean Air Amendments applicable to emissions of oxides of nitrogen from light-duty vehicles manufactured during or after model year 1976. Investigation of the technological feasibility of meeting the standards applicable to 1975 model year vehicles will continue, with monitoring of new developments in this regard.

As emission systems are designed and put into production, the problems of inspection and maintenance will continue to be of interest to the Committee.

Extensive investigations will be initiated into the state of technology of alternate power systems and the potential they offer for emissions reductions over that of conventional engines. This study will consider cost, producibility, and maintainability of such alternate power sources.

Finally, an extensive study will be made of the consequences to the nation of achieving or failing to achieve the emissions standards of the 1970 Clean Air Amendments. This study will assist the Committee as it attempts to determine suitable interim emission levels as called for in the Work Statement of the Committee.

APPENDIX A

Committee on Motor Vehicle Emissions

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APPENDIX B

Statement of Work

The Contractor shall conduct a many-faceted study of the technological feasibility of meeting the motor vehicle emission standards prescribed by the Administrator of the Environmental Protection Agency, as required by Section 202(b) of the Clean Air Act, as amended.

For the purposes of this study the term "technological feasibility" includes the ability within the automobile industry or elsewhere to

1. Design an engine, control system or device capable of meeting the statutory emission standards using fuels which are or could be available

2. Mass produce such an engine, control system or device

3. Maintain such an engine, control system or device so that it will continue to meet the statutory emission standards with safety for a period of five years or 50,000 miles of operation, whichever is shorter.

The study of technological feasibility as defined shall include a study emphasizing the technical aspects of the reported costs expected to be incurred in and the estimated time for the design, development and mass production of an engine, control system or device capable of meeting the statutory emission standards.

The study of technological feasibility shall include a study emphasizing the technical aspects of the reported estimates of extra cost incurred in maintaining such an engine, control system or device so that it will meet the statutory emission standards for a period of five years or 50,000 miles, whichever is shorter.

Should the Contractor conclude that the attainment of emission standards on the schedule provided by Section 202(b)(1) of the Clean Air Act is not technologically feasible, the Contractor shall specifically determine technologically feasible interim emission levels to assist the Administrator in exercising his responsibilities under Section 202(b)(5) of the Act.

APPENDIX C

Panels of Consultants

EMISSION STANDARDS

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School of Public Health
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Panel Chairman

Leslie A. Chambers
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John A. Maga
Air Resources Board
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TESTING, INSPECTION AND MAINTENANCE OF VEHICLES

John N. Pattison
Civil Engineering Department
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Marian Chew
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G. C. Hass
Air Resources Board
State of California

William Scott
Scott Research Laboratories

EMISSION CONTROL SYSTEMS
(for spark ignition internal combustion engines)

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Clarence Zener
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Highway Safety Research Institute
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MANUFACTURING AND PRODUCIBILITY

Maurice Nelles
La Jolla, California
Panel Chairman

Donald Bartlett
A. T. Kearney & Company, Inc.

George D. Clayton
George D. Clayton and Associates

Merrill L. Ebner
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Leroy H. Lindgren
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ATMOSPHERIC CHEMISTRY

Edward Stephens
Statewide Air Pollution Research Center
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Lowell Wayne
Los Angeles, California

APPENDIX D

List of Questions Sent to Foreign and Domestic Automobile Manufacturers; Recipients of Questionnaire and List of Attendees at CMVE meeting on October 25-27, 1971

1. Do you expect to meet the federal and California emission standards with 1975 model year vehicles? Explain any factors which qualify your answers.

2. What emission controls, and engine modifications which reduce emissions, do you expect to be using in your 1975 model year automobiles?

3. What are the best emissions results you have obtained with these control systems to date? Explain any factors you feel qualify these emissions measurements and their relation to the emission standards.

4. What are your engineering emissions goals for 1975 model experimental vehicles so that the production vehicles will meet the requirements of the 1970 Clean Air Act Amendments?

   Explain how possible requirements that
   - (a) assembly line vehicles pass a short emissions test,
   - (b) a certain fraction of assembly line vehicles pass the full federal emissions test,
   - (c) a certain fraction of vehicles in customer use pass the full federal emissions test,

   affect these engineering emission goals and hence affect your ability to meet the 1975 emissions standards.

5. What major development problems do you have to solve before you can meet these experimental vehicle emission goals?

6. At what date do you expect to meet these experimental vehicle emission goals?

7. What changes in vehicle performance, driving characteristics, and fuel consumption do you anticipate with these systems in your 1975 model year production vehicles?

8. If you do not expect to meet the 1975 Federal Emission Standards with 1975 model year vehicles, what emission levels do you anticipate achieving with production vehicles?

9. Do your 1975 model year emission control systems have the potential with further development of meeting the 1976 emission standards? If not, what emissions reduction from 1975 levels do you anticipate achieving?

10. What is the degree of statistical reproducibility of the test procedure results as applied to your 1975-type cars? Explain.
    (a) What combination of maintenance and inspection will be required for your 1975 vehicles in order to meet federal requirements for 1975 used vehicles? What inspection systems will be needed, if any?
    (b) What do you expect the average annual maintenance and inspection costs will be? If there are compensating savings in fuel or other costs, show these. Explain your reply.

11. Have you the capability of producing automobiles to meet the federal 1975 model requirements? If not how must your capabilities be augmented?

12. Are you executing plans to acquire capabilities and items from others to enable you to produce vehicles to meet the 1975 requirements? What are the major items you must acquire, including machinery?

13. What is the maximum decrease in HC, CO and NO_x exhaust content you could achieve with the use of your normal production capabilities during the next three years? Base decrease on 1960 emissions.

14. Provide PERT, GANTT or similar charts indicating plans for meeting the 1975 emission standards. The end point may be the time you have chosen to meet the 1975 standards. Events and times should be labeled.

15. What advantage would there be to you if the date 1975 standards would be effective were delayed one year?

16. Approximately, what will the extra cost be to prepare to produce medium weight vehicles to meet the 1975 standards? What are the chief items of cost?

17. What will the range of additional costs to the ultimate customer be for meeting the 1975 requirements over the 1970 requirements, if you find it necessary to meet the requirement for the 1975 model? For the 1976 model?

18. Construct the following curves using your best available data and judgment.
    (a) Cost to customer $ vs % of CO eliminated (based on 1960 emissions including crank case and evaporation).

(b) Cost to customer $ vs % of HC eliminated (based on 1960 emissions including crank case and evaporation).
(c) Cost to customer $ vs % of NO_x eliminated (based on 1960 emissions including crank case and evaporation).
(d) Cost to customer $ vs equal % of HC and NO_x eliminated (based on 1960 emissions including crank case and evaporation).
(e) Cost to customer $ vs equal % of HC, CO, NO_x eliminated (based on 1970 emissions).
(f) Any other similar type curve which will show the cost to the customer for various amounts of pollution eliminated.

19. Will warranty costs be increased to cover the guarantees required by the Amendment? If increased, how much?

20. Do you expect to meet the Federal Emission Standards for 1976 model year vehicles? Explain any factors which qualify your answer.

21. What additional or alternative control systems are you investigating for spark-ignition engines to meet the 1976 model year emission standards which promise greater NO_x emission control?

22. What are the best emissions results you have obtained with the different systems you are developing to meet the 1976 emission standards? List any factors you feel qualify these emission measurements and their relation to the emission standards.

23. What are the major development problems to be solved for each of these systems before you meet your 1976 emission goals with these different approaches?

24. How much time do you anticipate you will require to resolve these development problems for the 1976 Federal Emission Standards?

25. What changes in vehicle performance penalties, driving characteristics, and fuel consumption do you anticipate for the different 1976 emission control approaches you are considering?

26. If you do not expect to meet the 1976 emission standards for 1976 model year vehicles, what emission levels do you anticipate achieving with production vehicles?

27. (a) Do you anticipate using the Wankel rotating combustion engine in any of your 1975 or 1976 production vehicles?
(b) If you are evaluating Wankel engines for possible future production, what are the best emissions results you have achieved to date, and with what additional emissions controls?

(c) Do you feel the Wankel engine has any special emissions advantages for achieving emissions levels that would satisfy the 1975 or 1976 emission standards?
(d) What is the magnitude of your research and development effort to reduce emissions from Wankel engine?

28. (a) Do you anticipate using the stratified charge engine in any of your 1976 production vehicles?
(b) Do you feel the stratified charge engine (open chamber type, or divided or precombustion chamber type) has any special advantages for achieving emissions levels that would satisfy the 1975 or 1976 emission standards?
(c) What is your estimate of the potential for emissions reduction with the stratified charge engine when used with other emission controls?
(d) What are the major development problems to be overcome with the stratified charge engine?
(e) What is the magnitude of your research and development effort on stratified charge engines?
(f) What is your estimate of the earliest date at which the stratified charge engine could be used in a substantial fraction of your production vehicles?

29. (a) Do you feel that the gas turbine is a promising automotive power plant? List its advantages and disadvantages in relation to current engines.
(b) What is your estimate of the low emissions potential of the automotive gas turbine?
(c) What are the major development problems to be overcome before the automotive gas turbine is a viable mass production engine?
(d) What is the magnitude of your research and development effort on automotive gas turbines?
(e) What is your estimate of the earliest date at which the gas turbine could be used in a substantial fraction of your production automobiles?

30. Which of all the emission control approaches you have investigated (or other approaches) is most attractive with respect to vehicle performance, fuel economy, and cost, and which with further development has the potential of meeting the 1976 emission standards with production vehicles at some time during the period 1977-1982?

31. If this approach is different from your basic 1975 or 1976 model year control systems, what major development problems have to be overcome to make these alternative approaches attractive for production vehicles, and what is your estimate of the time and effort which would be required?

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Recipients of Questionnaire

Domestic Manufacturers

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Engineering and Research Office
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Detroit, Michigan
Attn: Charles M. Heinen
Executive Engineer

Ford Motor Company
Automotive Emissions Office
Engineering Staff
The American Road
Dearborn, Michigan
Attn: Donald A. Jensen
Director

General Motors Corporation
General Motors Technical Center
Warren, Michigan
Attn: Ernest S. Starkman
Vice President
Environmental Activities Staff

International Harvester Company
Motor Truck Engineering Department
P. O. Box 1109
Fort Wayne, Indiana
Attn: Mark Sherbinski
Staff Engineer
Vehicle Emission

Jeep Corporation
940 North Cove Boulevard
Toledo, Ohio
Attn: Frederick A. Stewart
Vice President,
Engineering

U. S. Army Tank-Automotive Command
Headquarters
Warren, Michigan
Attn: Ernest Petrick
Chief Scientist

White Motor Corporation
Advanced Products Division
3201 Lomita Boulevard
Torrance, California
Attn: John McLean

Foreign Manufacturers

Alfa Romeo - S.p.A.
Via Gattanelata 45
20149 Milano, Italy
Attn: O. Satta
General Manager

Alfa Romeo
215 Douglas Street
El Segundo, California
Attn: Michael Pokorny
Service Manager

Audi
NSU Motorenwerke
General Series Design and
Development
Aktiengesselschaft
7107 Neckarsulm
Germany
Attn: P. A. Praxl

Bayerische Motoren Werke A.G.
8 Munchen 13
Lerchenauer Str. 76
W. Germany
Attn: W. Stork

British Leyland Motors, Inc.
600 Willow Tree Road
Leonia, New Jersey
Attn: G. W. Gardner

Daimler-Benz A.G.
Stuttgart-Underturkheim
Germany
Attn: The President

Mercedes Benz
815 Connecticut Avenue, N.W.
Washington, D. C.
Attn: Jerry Sanosky

FIAT S.p.A.
375 Park Avenue
New York, New York
Attn: Alberto Negro
Liaison Engineer
Technical Development

FIAT S.p.A.
Strada del Drosso 145
10135 Torino, Italy
Attn: Carlo Pollone
Direzione ricerca

Fuji Heavy Industries Ltd.
Sabaru Building
7-2, 1-chone, nishishinjuku
Tokyo, Japan
Attn: Nobuko Sakata
Managing Director

Mitsubishi Company
33-8, 5-Chome, Siba, Minato-Ku
Tokyo, Japan
Attn: Yuji Satoh
President

Mitsubishi International Corporation
606 South Hill Street
Los Angeles, California
Attn: K. Hirota
Machinery Division

Mitsubishi Motors
Trowell Building
Suite 410
24681 Northwestern Highway
Southfield, Michigan
Attn: Yasuta Kiso, General Manager, Detroit Liaison Office

Mitsubishi Motors Corporation
1 Tatsumi-Cho, Uzumasa
Ukyo-ku, Kyoto, Japan
Attn: Yasuo Kaneko
Chief of Research Section

Nissan Motor Company, Ltd.
6-1, Daikokucho, Tsurumi-ku
Yokohama, Japan
Attn: Hiroshi Takahashi
Director and Manager, Design Department

Nissan Motor Corporation in U.S.A.
137 East Alondra Boulevard
Gardena, California
Attn: Noboru Hayakawa
Factory Representative

Nissan Motor Corporation of the U.S.A.
400 County Avenue
Secaucus, New Jersey
Attn: Tadaaki Yukawa
Chief Representative

Peugeot, Inc.
300 Kuller Road
Clifton, New Jersey
Attn: Michael Rossman
Engineering Advisor

Porsche Audi
600 Sylvan Avenue
Englewood Cliffs, New Jersey
Attn: Normann Roethlein
Product Planning Department

Renault, Inc.
100 Sylvan Avenue
Englewood Cliffs, New Jersey
Attn: François Louis
National Manager, Service and Parts Division

Regie Nationale des Usines Renault
10, Avenue Emile Zola
92 Billancourt, France
Attn: Pierre Vernay
Engineer, Research for Export Department

SAAB U.S.A., Inc.
100 Waterfront Street
New Haven, Connecticut
Attn: Don Tayler
President

SAAB-Scania Automotive Group
S-461 01
Trollhattan, Sweden
Attn: Henrik Gustavsson
Technical Director

Toyo Kogyo Company, Ltd.
6047 Suchu-Machi, Aki-gun
Hiroshima, Japan
Attn: Eisuke Niguma
Manager, Export Vehicle Engineering Department

Toyota Motor Company, Ltd.
1 Toyota-Cho, Toyota-Shi
Aichi-Ken, Japan
Attn: Masaaki Noguchi
Executive Managing Director

Toyota Motor Sales U.S.A., Inc.
2055 W. 190th Street
P. O. Box 2991
Torrance, California
Attn: Dan N. Koda
Manager, Technical Services

VW of America, Inc.
Product Development Engineering
Englewood Cliffs, New Jersey
Attn: Bernard R. Patok

VW of America, Inc.
818 Sylvan Avenue
Englewood Cliffs, New Jersey
Attn: G. Stobeck
Product Planning Manager

AB Volvo
Car Engine Department
S-405 08
Gothenberg, Sweden
Attn: G. Zackrisson
Chief Engineer

Volvo, Inc.
Rockleigh, New Jersey
Attn: Charles J. Simerlein
Special Assistant,
Federal Regulations

Responses were received from all recipients of questionnaires.

Attendees at CMVE Meeting, October 25-27, 1971

October 25

1:00 - 2:30 General Motors Corporation

F. W. Bowditch
Director of Automotive Emissions Control
W. C. Chapman
International Government Relations Staff
David Milne
Manufacturing Development Staff
J. C. Salrin
Financial Staff
Ernest S. Starkman
Vice President

2:30 - 4:00 Toyota Motor Company, Ltd.

Keitaro Nakajima
Director, General Manager
Factory Representative Office
Kuniyasu Onoda
Staff Engineer
Factory Representative Office
Hidemasa Takagi
Staff Engineer
Factory Representative Office

8:00 - 9:00 Renault, Inc.

François Louis
Manager

October 26

9:00 - 10:30 International Harvester Company

Rodger Ringham
Vice President of Engineering
Mark Sherbinsky
Staff Engineer, Vehicle Emissions

10:30 - 12:00 Chrysler Corporation

Charles M. Heinen
Executive Engineer, Materials Engineering
George Lacey
Chief, Emissions Control
S. L. Terry
Vice President for Environmental and Safety Relations

1:00 - 2:30 American Motors

John F. Adamson
Vice President, Engineering and Research
Carl E. Burke
Assistant Chief Engineer of Advanced Engineering and Research
Albert R. Ebi
Executive Director, Product Planning
Daniel L. Hittler
Manager, Development Department, Engineering and Research
Robert A. Petersen
Chief Engineer of Advanced Engineering and Research

2:30 - 4:00 U. S. Army Tank-Automotive Command

Wayne Anderson
Chief, Propulsion Systems Division
Bruce Hildebrand
Chief, Environmental Control Office
U. S. Army Matériel Command
Ernest Petrick
Chief Scientist

4:00 - 5:30 Nissan Motor Company, Ltd.

L. Raymond
Engineering Consultant
Y. Tamuchi
Engineering Representative
T. Tanuma
Senior Engineer
T. Yukawa
Chief Representative

8:00 - 9:00 Mitsubishi Motors Corporation

Y. Kiso
General Manager
Detroit Liaison Office
Hachiro Ursumi
Project Manager
Emissions Control Systems
K. Wada
Engineer

October 27

9:00 - 10:30 Volkswagen

Karl H. Neumann
Staff Engineer, Emissions Control
Volkswagenwerke, A. G.
Gerhard Reichel
Attorney, Legal Department
Hans Weisbarth
Technical Development Liaison Engineer
Volkswagen of America, Inc.

10:30 - 12:00 Ford Motor Company

G. C. Gagliardi
Principal, Research Engineering
Product Division Group
D. A. Jensen
Director, Automotive Emissions Office
J. M. MacNee
Office of the General Counsel
Herbert L. Misch
Vice President, Engineering and
Manufacturing
H. A. Poling
Comptroller, Product Development
R. Ronzi
Emission Planning Association
R. E. Taylor
Chief Engineer
Engineering and Foundry Division

1:00 - 2:30 Volvo, Inc.

Douglas Jarman
Vice President
National Sales, U. S.
Magnus Straakander
Engine Division

APPENDIX E

Letter Requesting Information from Public

The Clean Air Act Amendments of 1970 (PL 91-604) call for the National Academy of Sciences to conduct "a comprehensive study and investigation of the technological feasibility of meeting" the auto-emission standard prescribed by the law. These standards, in general, are designed to achieve a reduction compared with 1970 of 90 percent by 1975 in automobile emissions of carbon monoxide and hydrocarbons and by 1976 in oxides of nitrogen.

In its study the Academy is concerned solely with the "technological feasibility" of meeting these standards by the specified model years. Intensive scientific and engineering work is being conducted by a special Academy committee. The most immediate concern of the committee is with the 1975 standards for carbon monoxide and hydrocarbons, since in these respects the automobile manufacturers are entitled by law to seek a suspension in the effective date of one year on or after January 1, 1972, from the Environmental Protection Agency. In acting on such a request the Administrator is obligated to consider the Academy's findings with respect to technological feasibility.

In order to assist it in its work and to elicit as wide as possible a range of technical opinion, the committee invites organizations and others possessing technical competence to submit in writing any materials or information directly relevant to the "technological feasibility" of meeting the 1975 Clean Air Act Auto Emissions Standards. It should be emphasized that the following matters are beyond the scope of the NAS present undertaking: (1) public health consequences of air pollution, (2) emissions other than carbon monoxide and hydrocarbons and, (3) new power sources which cannot be mass produced by 1975.

All materials submitted in response to this invitation must be received by the Academy not later than October 20, 1971.

Submissions should be addressed to

National Academy of Sciences
Committee on Motor Vehicle Emissions
Attn: Public Comments
Washington, D. C. 20418

APPENDIX F

Emissions at Low Mileage from Each Automobile Manufacturer's Best Vehicle+

Manufacturer	Emissions, grams/mile*		
United States	HC	CO	NO_x
A	0.21	3.5	1.2
B	0.15	2.4	2.1
C	0.13	1.9	1.3
D	0.31	2.3	1.7
E	0.24	3.7	4.5
Foreign**			
F	0.11	3.7	2.2
G	0.3	3.0	0.6
H	0.26	3.1	1.1
I	0.4	4.7	2.1
J	0.25	3.0	2.5
K	0.26	2.4	1.0
L	0.6	3.5	2.3
M	0.62	5.7	2.2
N	0.2	4.4	-
O	0.63	5.8	-
P	0.3	3.1	1.9
Q	0.1	2.5	1.0
R	0.3	3.2	1.5

* As of October 15, 1971. Usually average of several tests. 1975 CVS-CH test procedure used except for manufacturers A, D, N, O, R, which employed the 1972 CVS-C test procedure.

** Some of these results are with research systems at very low mileage which do not have mass production potential in their current form.

\+ Data obtained from visits of Emission Control Systems Panel to manufacturers and manufacturers' responses to Committee questionnaire dated September 27, 1971.

APPENDIX G

Emissions as Function of Miles for Durability Tests on Different Catalysts and Vehicles

Catalyst		Vehicle	Mileage	Emissions, gram/mile* HC	CO
Catalyst manufacturer A, platinum on pellets	(i)	Current production vehicle. Lean carburetion and air pump. No EGR.	0	0.19	1.5
			8,000	0.54	2.4
			16,500	0.42	1.2
			21,933	0.66	2.9
Catalyst manufacturer B, platinum on monolith	(ii)	Current production vehicle. Lean carburetion and air pump. No EGR	50,000	0.7	3.8
	(iii)	Current production vehicle. Lean carburetion and air pump. No EGR	0	0.04	2.3
			4,000	0.18	4.4
			44,000	0.45	9.6
	(iv)	Prototype 1975 system including rich carburetion, air pump and EGR.	0	0.4	4.0
			4,000	0.8	8.0
			10,000	1.2	14.0
			15,000	0.8	12.5
			20,000	0.9	17.0
Catalyst manufacturer C, base metal on pellets	(v)	Prototype 1975 system.	0	0.32	5.5
			4,000	0.36	4.6
			8,000	0.26	3.5
			12,000	0.26	4.0
			16,000	0.35	5.5
			20,000	0.39	4.5
			24,000	0.35	5.8
			28,000	0.50	6.5
			32,000	0.34	5.0

* 1972, CVS-C test procedure used, except for vehicle (v) where 1975 CVS-CH was used.

Notes

1. Vehicles (i) (iv) and (v) show fluctuations in emissions due to variation in emissions during engine start up at the beginning of the test and changes in carburetor setting, as well as catalyst deterioration.

2. Vehicles (ii), (iii) and (iv) used similar catalysts. Vehicles (ii) and (iii) are carbureted lean and did not use EGR to reduce NO_x emissions below 1975 standards of 3 g/mile. Vehicle (iv) has EGR and richer carburetor setting so HC and CO emissions in exhaust gas entering the converter are substantially higher. Emissions at converter exit are higher and deterioration in control is greater.

3. Tests on vehicles (i) and (ii) were run by catalyst manufacturers, tests on vehicles (iii), (iv) and (v) were run by automobile manufacturers.

4. Data received by Committee up to December 3, 1971.

APPENDIX H

Panel Estimate of Sticker Prices of Likely Emissions Hardware

Model Year	Configuration	Value Added[1]	Tooling Amortization[2]	Dealer Margin[3]	Profit[4]	List Price	Excise Tax[5]	Sticker Price
1966	PCV-Crank Case	1.90		.66	.29	2.85	.15	3.00
1968	Fuel Evaporation Control System	9.07	.50	3.30	1.43	14.30	.75	15.00
								(18.00)
1970	Ignition Timing	.61	.02	.22	.10	.95	.05	1.00
	Carburetor A/F Ratio	.61	.02	.22	.10	.95	.05	1.00
	Compression Ratio	1.24	.03	.44	.19	1.90	.10	2.00
	Transmission Control System	2.49	.05	.88	.38	3.80	.20	4.00
								(8.00)
1971 1972	Anti-Dieseling Solenoid	3.07	.10	1.10	.48	4.75	.25	5.00
	Thermostatic Air Valve	2.49	.05	.88	.38	3.80	.20	4.00
	Choke Heat Bypass	2.74	.05	.97	.42	4.18	.22	4.40
	Assembly Line Tests for California (1/10 Volume)	.18	.20	.13	.06	.57	.03	.60
								(14.00)

Model Year	Configuration	Value Added[1]	Tooling Amortization[2]	Dealer Margin[3]	Profit[4]	List Price	Excise Tax[5]	Sticker Price
1973	EGR (11-14%)	5.48	.82	2.20	.95	9.45	.50	10.00
	Air Pump - Air Injection System	27.16	1.80	10.03	4.33	43.32	2.28	45.60
	Induction Hardened Valve Seats	.72	.55	.44	.19	1.90	.10	2.00
	Spark Advance Control	.48	.15	.22	.10	.95	.05	1.00
	Transmission Changes (Some Models)	.63	-	.22	.10	.95	.05	1.00
	Quality Audit Assembly Line for California (1/10 Volume)	.22	.02	.09	.04	.38	.02	.40
								(60.00)
1974	Precision Cams -- Bores - Pistons	2.44	.10	.88	.38	3.80	.20	4.00
	Induction Hardened Valve Seat V-8	.72	.55	.44	.19	1.90	.10	2.00
	Some Proportional EGR (10% @ 52.00)	3.21	.10	1.14	.49	4.94	.26	5.20
	Pretest Engines -- Emissions	1.80	.10	.66	.29	2.85	.15	3.00
	Catalytic Converter System for California (1/10 Volume)	4.02	.06	1.40	.61	6.09	.31	6.40
								(20.60)

Model Year	Configuration	Value[1] Added	Tooling[2] Amortization	Dealer[3] Margin	Profit[4]	List Price	Excise[5] Tax	Sticker Price
1975	Proportional EGR	29.71	-	10.30	4.45	44.46	2.34	46.80
	New Design Carburetor with Altitude Compensation	7.52	2.00	3.30	1.43	14.25	.75	15.00
	Advanced Air Injection Control	24.90	.50	8.80	3.80	38.00	2.00	40.00
	Air/fuel Preheater	2.87	.30	1.10	.48	4.75	.25	5.00
	Electric Choke (element)	2.67	.50	1.10	.48	4.75	.25	5.00
	Electronic Distributor (Pointless)	4.35	2.00	2.20	.95	9.50	.50	10.00
	Improved Timing Control $\pm 1^{\circ}$	1.40	.50	.66	.29	2.85	.15	3.00
	Catalytic (Oxidizing) Converter	18.86	4.00	7.92	3.42	34.20	1.80	36.00
	Pellet Charge 6 lbs @ $2.00 lb.	12.00	1.70	4.75	2.05	20.50	1.10	21.60
	Cooling System Changes	1.17	.10	.44	.19	1.90	.10	2.00
	Improved Underhood Materials	.63	-	.22	.10	.95	.05	1.00
	Body Revisions	.67	.60	.44	.19	1.90	.10	2.00

Model Year	Configuration	Value Added[1]	Tooling Amortization[2]	Dealer Margin[3]	Profit[4]	List Price	Excise Tax[5]	Sticker Price
1975	Assembly Line Changes	.08	.50	.22	.10	.90	.05	1.00
	End of Line Test Go - No Go	1.85	.05	.66	.29	2.85	.15	3.00
	Quality Emission Test	1.22	.05	.44	.19	1.90	.10	2.00
								(193.40)

Notes to Appendix

1. Either value added or hardware cost, including material, labor, overhead and general administrative costs.

2. Tooling and equipment amortized over three years.

3. As 22% of selling price.

4. As 10% of list price.

5. As 5% of sticker price.

APPENDIX I

Data Used to Calculate Emissions from Light Duty Motor Vehicles

Tables I1 to I4 summarize the data used to calculate emissions as a function of calendar year for Figures 7.1 and 7.2.

Table I-1

Percent of Annual Vehicle Miles Traveled by Different Age Groups

Vehicle Age (years)	Percent of total annual vehicle miles
1	15.73
2	13.64
3	12.02
4	10.07
5	9.35
6	8.18
7	7.5
8	6.6
9	5.3
10	4.3
11	2.8
12	1.7
13	0.8
14	0.4
more than 14	1.6

Source: United States Department of Commerce

Table I-2

Assumed New Car Emissions as Function of Model Year

Model Year	EMISSIONS, GRAMS/MILE*			
	Hydrocarbons			Carbon Monoxide
	Exhaust	Blowby	Evaporation	
pre-1963	17	4.08	2.77	125
1963-1967	17	0.82	2.77	125
1968-1969	7.0	0	2.77	71
1970-1971	4.6	0	2.77	47
1972-1974	3.4	0	0.14	39
1975-1990	0.45	0	0.14	4.7

*Corresponds to CVS-C (1972) test procedure.

Source for conversion factors: Environmental Protection Agency.

Since test procedure corresponds to summer, annual emissions are obtained by multiplying g/mile values in above table by 1.12 (urban) and 1.0 (rural) for HC, and by 1.085 (urban) and 0.92 (rural) for CO.

77-166 O - 72 - 13

Table I-3

Examples of Average Vehicle Emissions Deterioration Factors

Vehicle Age (years)	Deterioration Factor*	
	HC	CO
1	1.063	1.055
5	1.252	1.195
10	1.296	1.201
15	1.302	1.203

*Based on California Air Resources Board field surveillance data. Deterioration above the standards in 1975 and later model year vehicles is not allowed for.

Table I-4

Annual Total Light-Duty Vehicle-Miles of Travel In United States

Year	Total Miles (10^9)	Percent	
		Urban	Rural*
1963	655.5	0.50	0.50
1970	898.5	0.53	0.47
1980	1208.0	0.57	0.43
1990	1437.0	0.61	0.39

Source: United States Department of Transportation

*To allow for higher average speed in rural driving, emissions in grams/rural mile are values given in Table I-2 multiplied by 0.552 for HC and 0.466 for CO.

Mr. ROGERS. Thank you very much, Dr. Ginzton, for stating the conclusions of the panel.

Dr. Carter?

Mr. CARTER. Mr. Chairman, I want to compliment the gentleman on his presentation here today. I have read in advance that it is practically impossible for the automotive industry to meet the standards which are set by the Clean Air Act for 1975.

I am pleased to see that he does in his statement mention the possible use of an alternative engine. That is all I have to say, Mr. Chairman.

Mr. ROGERS. Mr. Hastings?

Mr. HASTINGS. Thank you, Mr. Chairman.

I join my colleague in commending the National Academy for this report. I am not satisfied with the results, either. I am sure 1975 is completely out as far as meeting the standards and 1976 is out, too, is that correct?

Mr. GINZTON. I think that is an overstatement of our position, Mr. Hastings. In the first place, with regard to 1976, we say almost nothing. We have not yet looked at what is involved. We have heard the automobile people say they don't know how they can be met.

Mr. HASTINGS. The technology is not presently available for 1976 cars.

Mr. GINZTON. That is correct. As we try to say in our report, if EPA is reasonably lenient in the interpretation of the law, then it is possible that the larger manufacturers will be able to meet, at least in some cases, the requirements of the law. It is possible.

Mr. HASTINGS. With the penalties such as lower mileage and so on.

Mr. GINZTON. There are penalties almost certainly that will have to be paid.

Mr. HASTINGS. Are you satisfied that the manufacturers have spent sufficient resources in their research to find solutions?

Mr. GINZTON. I do not know how to answer that. I believe the industry, both domestic and foreign, are diligently pursuing their obligations.

In certain places, such as in Europe, there are only dozens of individuals involved in trying to solve these problems, whereas, there are literally thousands in the United States.

They are working very hard indeed to meet the requirements of the law. However, I believe your question goes beyond my personal knowledge.

Mr. HASTINGS. My concern develops from an article in the Wall Street Journal in which it is reported that General Motors is asking Standard Oil to be able to produce a fuel but they don't expect to be able to meet the standards unless they lean on the oil industry to help meet those standards.

I am sure you have seen this article.

Mr. GINZTON. Yes.

Mr. Hastings, this is an extremely complex technical matter. Certain provisions for proper control of emissions are made easier with certain types of fuel: but they may be more expensive to produce.

We have not had the time in our committee to examine details of the engineering trade-offs which exist between the two sides of the question.

For example, we do know that the fuels must be free of certain pollutants which would spoil the catalyst. There are some uncertainties about numerical details, but aside from these, there can be no significant amounts of lead in the fuels and so on.

Conversely, the automobile manufacturers believe certain of their engineering problems would be eased if fuels were changed—made more volatile—and the fuel companies, in turn, believe that this would be expensive to do. This is a complex trade-off question which I am not prepared to discuss.

Mr. HASTINGS. Do you anticipate you would take a look at this?

Mr. GINZTON. It is an important question and we intend to look at it to the best of our ability.

Mr. HASTINGS. Without any technical knowledge, between the automobile manufacturers and the oil industry.

Mr. GINZTON. We shall do our best.

Mr. HASTINGS. High volatility gasoline may be a poorly written testing procedure for the 1975 cars. Have you taken a look at those testing procedures and can you comment on the validity of that statement?

Mr. GINZTON. We do know a large fraction of the pollutants emitted from the car come from the cold start. The problem is eased considerably by making the fuels more volatile. The problems of meeting the requirements of the law are based upon an assumed driving cycle in Los Angeles and we accept for the moment EPA's promulgated standards.

Some standards have to be established. At the moment, we have no basis for questioning the EPA standards, although we intend to look at some aspects of them in the future.

Mr. HASTINGS. I guess that is what I wanted to hear—that you will take a look at those standards and hopefully, you will pass your findings on to us.

Mr. GINZTON. Yes, sir.

Mr. HASTINGS. Thank you very much, I have no further questions.

Mr. ROGERS. Mr. Schmitz.

Mr. SCHMITZ. I have no questions, Mr. Chairman.

I would just like to add my appreciation for the work of these gentlemen.

Mr. ROGERS. I think it would be well to start out by putting in the record the standards which the industry must meet with which you were concerned. There were two pollutants with which you were particularly concerned. What are those standards?

Mr. GINZTON. The 1975 standards for hydrocarbons are 0.41 gram per mile emitted by the vehicle driven and for carbon monoxide the standard is 3.4 grams per mile.

Mr. ROGERS. What were the standards for 1970 when the law was enacted?

Mr. GINZTON. For 1970, the standards were 2.2 for hydrocarbons, 2.2 grams per mile, and 2.3 grams per mile for carbon monoxide.

I think I should mention that this is under the Federal test procedure which was the concentration measurement procedure applicable at this time. Discussion of exact testing procedures are beyond the ability of the audience to comprehend at the moment.

If you wish for me to define this more clearly, we would be pleased to submit a memorandum which would be comprehensive. It is in our report which is in abbreviated form in table 2.1 on page 13 of the report.

If further elaboration of this is required, as it may well be, we would be glad to supply it.

Mr. ROGERS. It is my understanding that a new testing procedure was put into effect which merely changed the 1970 requirement from 2.2 hydrocarbons to 4.6. Is that correct?

Mr. GINZTON. I think that is correct, Mr. Chairman.

Mr. ROGERS. Have you determined the 1975 requirements, then, on the basis of the 2.2 or the 4.6?

Mr. GINZTON. Mr. Chairman, this is the area which, I think, is so complex that it requires very careful discussion. The 4.6 is the standard which is set in accordance with present measurements. These are the numbers which are reduced by a factor of 10 in accordance with the law.

Mr. ROGERS. In other words, at the time we passed the law, it was our understanding that the requirement for the hydrocarbon was 2.2—at the time we passed the law.

Now, I understand EPA came in and refined the testimony perhaps because of technology—I don't know—but nevertheless, if we carried out the requirement of the law, it would even be less than what we would require now because they are basing it on a 4.6, 1970 basis, are they not, and requiring a 90-percent reduction from the 4.6 rather than the 2.2; is that correct?

Mr. GINZTON. Mr. Chairman, the numbers are different. You are quite right about this. The intent of EPA in changing the numbers was not to change the standards which Congress heard of but to establish a test procedure which was equivalent but more meaningful in practice.

For the purposes of this committee, I would say the two numbers are in fact equivalent. It all depends upon how you measure and which you measure. It is that kind of difference that is involved in the measurements involved. It is a different way of measuring something.

Mr. ROGERS. Except, you allow a greater capacity, so many grams per mile more under one testing procedure than you do under the other; do you not?

Mr. GINZTON. To the best of our knowledge, Mr. Chairman, the two procedures in terms of what actually happens to a car on the road, the two measurements are equivalent.

Mr. ROGERS. How do we get a different result? I am not sure I follow that. That would make a significant difference in the requirement, I would think, whether a car has to test out at 2.2 or at 4.6 grams per mile.

Mr. GINZTON. Mr. Chairman, the problem arises out of the fact in order to get a meaningful number, some number, the EPA had to stipulate a typical driving procedure to which an average car would be exposed.

The initial procedure that EPA promulgated, so-called CVS procedure, took into account that in many situations, a car starting early in the morning under cold conditions would emit more hydrocarbons than it would under some other possible conditions that you could imagine.

This resulted in some criticism of the procedure and finally, a CVS-CH test procedure was promulgated. It took into account more typical conditions: a car started by a person in the morning when the engine is cold and once again, perhaps for lunch, when the engine is not quite so cold. Because of the way EPA interpreted typical use of the car in the American environment, they promulgated certain standards which resulted in a different test procedure.

Mr. ROGERS. I understand that, but what I am saying is that EPA can actually vary the requirements by their testing procedure so they can change it all no matter what is in the law and in effect, there has been some cleaning from what we started out with, what Congress thought so there has already been a relaxation.

Mr. HANDLER. I don't think that is quite the point. The point is that the same engine would have emitted this pair of values, depending on which test procedure was used for examining that same engine.

Mr. ROGERS. I understand, but what I am saying is that the Congress thought we were getting an emission of 2.2.

Mr. HANDLER. Under certain test procedures.

Mr. ROGERS. And a reduction of 90 percent of that.

Mr. GINZTON. Mr. Chairman, you are certainly right in the line of questioning you are following. The question is very complicated. EPA is trying to interpret the law and apply it in a way which they think is most appropriate.

(See letter dated February 15, 1972, p. 193, this hearing.)

Mr. ROGERS. We will take that up with EPA.

I notice you do make this finding that experimental vehicles have been built and operated, that at low mileage exhibit levels of emission less than those specified for 1975 model year vehicles.

Have all of the companies done that or just some?

Mr. GINZTON. No, not all; just some. There are examples of such performance.

Mr. ROGERS. You say next:

> However, information establishing the sustained effectiveness, durability, and reliability of prototype 1975 vehicle systems during typical consumer mileage accumulation is not available.

Does that mean the testing has not been done sufficiently or the information was not given to you or they simply have not conducted the necessary tests?

Mr. GINZTON. At the time our report was written, the information simply was not available. Some cars had accumulated just a few miles, 3,000, 4,000, and these are the best numbers that could be available to us.

The other experiments, however, with catalysts would indicate that it is simply not reasonable to expect a catalyst to remain active for 50,000 miles, so it is a combination of tests performed on the low-mileage cars on the one hand and knowledge of how catalysts behave generally.

Mr. ROGERS. I would think, until we have this information and the tests have actually been made, we will not really know, will we?

Mr. GINZTON. I think that is a correct statement, Mr. Chairman.

On the other hand, a lot of tests have been made in a catalyst. One knows what to expect of them and it is simply not reasonable to

expect the kind of performance that is essential in the duration of catalysts.

Mr. ROGERS. I understand that, but what I am saying is, and I want to be sure I am clear, we have not really completed sufficient testing of these vehicles that have gone below the 1975 standards to make a judgment at the time the report was made.

Mr. GINZTON. That is right.

Mr. ROGERS. So, it is possible that some testing could show up that this is feasible?

Mr. GINZTON. It is possible but under the present circumstances, it is highly unlikely.

Mr. ROGERS. Then we have not gotten the results yet, and I know you will follow this and advise the committee as soon as we have this information.

What period of time would you think it would be necessary before sufficient testing has been done on some of these particular vehicles?

Mr. GINZTON. Accumulation of 50,000 miles implies a duration of about 4 months. So today, if one had a system which is just about what you want, it would take 4 months to ascertain that one car would possess the characteristics required.

If the car did not quite work, it would take another 4 months.

Mr. ROGERS. Are you satisfied that you have been given all of these test results and figures?

Mr. GINZTON. Yes, sir; we are satisfied.

Mr. ROGERS. I notice there is a feeling if they could put on a catalyst, say, for only 25,000 miles rather than the 50,000 requirement, this possibly would solve basically the problem, is that correct?

Mr. GINZTON. That is one of the three conditions, Mr. Chairman. One is fuel, which we are taking for granted, which would be poison-free fuel.

Mr. ROGERS. At a 91 octane rating?

Mr. GINZTON. Octane rating is one question but the absence of poisons in the fuel is an imperative. In addition then, you are quite right now, if catalysts were replaced at 25,000 miles, something of that sort, then it would make a major difference in the manufacturers being able to make a car to meet the 1975 standards.

Mr. ROGERS. Then I think this is fairly optimistic where we have the possibility of 25,000 miles.

Mr. GINZTON. That is the reason, Mr. Chairman, for our saying it is quite possible.

Mr. ROGERS. Did you have an opportunity to look at what the fuel manufacturers were doing?

Mr. GINZTON. No, sir, we have not done enough to be of any help to you at the moment.

Mr. ROGERS. But it is my understanding that they are capable of making this fuel. Is this your understanding?

Mr. GINZTON. Yes.

Mr. ROGERS. And some in fact are doing it now?

Mr. GINZTON. Yes, sir.

Mr. ROGERS. As I understand it, you did make on-site inspections. You had your committee go to the plants to see what was being done and the techniques. You are not prepared to make a judgment nor will we ask you whether they have exerted a sufficient effort.

I presume you did not go into that question.

Mr. GINZTON. The question of effort we have not.

Mr. ROGERS. I think that is a determination for the agency to make whenever they submit a request for extension.

Mr. GINZTON. Yes, sir.

Mr. ROGERS. I notice you talked a little bit about cost. Does this include a profit factor or not?

Mr. GINZTON. Yes, it does.

Mr. ROGERS. Any particular amount?

Mr. GINZTON. Yes, there is a 10 percent profit included in the estimates we have made.

Mr. ROGERS. If you just put this item on the vehicle for costs, it would reduce it about 10 percent?

Mr. GINZTON. Something of that sort. Of course, 10 percent is small compared to the uncertainty. Our concentration is that the system which would work would cost about $200 more. There is a substantial disagreement within the industry of what it would be, so I think 10 percent as a measure of meaningfulness is not large compared to other uncertainties.

Mr. ROGERS. Although I believe everybody believes in the profit system, I don't know whether you should produce a polluting car and then charge a profit for correcting the pollution. That kind of gets to a circle there. I think you make profit on the car but maybe it ought to be corrected for costs. I am not certain.

I don't think the committee got into that.

What about hot and cold starts in the testing procedure? As I understand it, you claim in your report that the smog problem is worse between 6 and 9 a.m. and I presume that is where most of the cold starts occur, probably in that time.

Mr. GINZTON. Yes, sir.

Mr. ROGERS. Should more weight be given to hot starts than cold starts? Does the cold start weigh more heavily on the problem?

Mr. GINZTON. I cannot comment on this. This is a question we have not looked at to date. To date, we have simply taken as the first responsibility to advise Congress and EPA with regard to the technological feasibility of the standards as promulgated. We find that the standards are not certain to be met by any means, and it is now the intent of our Committee to take a good look at what reasonable modifications to the standards one might conceive.

The questions you pose are good ones, but we would like to examine them as far as overall review of what kind of interim standards are most appropriate.

Mr. ROGERS. Did you look at the cold start and hot start problem and what the manufacturers would do in these areas and how their cars polluted?

Mr. GINZTON. Yes, we do know where the pollution comes from, what period of driving cycle is most responsible for the pollution. These matters we do understand.

Mr. ROGERS. What are those?

Mr. GINZTON. About 40 percent of the pollution from a car comes from the very short period when the car is started when it is cold. That is the most difficult period in a car's operation.

Beyond that, as the control devices warm up, the pollution becomes progressively less and less.

Mr. ROGERS. Could you let us have, and I don't care about manufacturers, for the record your finding on the hot and cold pollution starts? I think you give us an average.

Mr. GINZTON. At the moment, we do not have information in that particular form. We will try to obtain it and we would like to supply it for the record, if it is possible.

Mr. ROGERS. If it is not possible, is there any reason why this should not be made available? Is it just a question of getting it from the automobile companies?

Mr. GINZTON. No; there is no problem, I don't believe.

Mr. ROGERS. The companies did not furnish information as to cold starts and hot starts.

Mr. GINZTON. We did not ask for information in that form and they did not volunteer it.

Mr. ROGERS. Of course, the committee is very much concerned if there would be any relaxation of a law passed by Congress. I think your report is encouraging so it is certainly up to 25,000 miles and if there is a change in the catalyst then this might be the solution.

(The following letter was received from the record:)

NATIONAL RESEARCH COUNCIL,
NATIONAL ACADEMY OF SCIENCES, NATIONAL ACADEMY OF ENGINEERING,
COMMITTEE ON MOTOR VEHICLE EMISSIONS OF THE DIVISION OF ENGINEERING,
Washington, D.C., February 15, 1972.

Hon. PAUL G. ROGERS,
Chairman, Subcommittee on Public Health and Environment, Committee on Interstate and Foreign Commerce, House of Representatives, Washington, D.C.

SIR: I would like to attempt to elaborate upon the responses to the questions you posed to the Academy witnesses at the Hearings of the Subcommittee on Public Health and Environment, Committee on Interstate and Foreign Commerce, with regard to the various motor vehicle emission testing procedures and resultant standards.

These questions appear on pages 22-25 of the transcript of testimony of January 26, 1972. The test procedure used for 1970 model year cars in 1970 involved a concentration measurement and was not a mass emission measurement. In this test, the vehicle was run through seven different driving modes, with the concentration of pollutants in the exhaust flow multiplied by a weighting factor to get an estimate of mass emissions. This procedure was labeled the Federal Test Procedure (FTP) and, using this procedure and the applicable driving cycle, the standard for hydrocarbon emissions was set at 2.2 grams per mile.

Since the standards are based on mass emissions, in grams per mile, it was felt by the Environmental Protection Agency that it would be preferable to develop a test that would directly measure mass emissions rather than having to apply a calculated weighting factor to a concentration measurement. Also the importance of the cold start portion of the test was recognized, and it was thought that more weight should be given to that portion of the test. Thus, there evolved the constant volume sampling procedure (CVS-C) to be used on 1972 and 1973 model year cars. With this test, the vehicle is started cold and is run through a representative driving cycle of 23 minutes. A constant fraction of the exhaust is collected in a bag, with the contents of the bag analyzed to give mass emissions in grams per mile. The test procedure, instrumentation and driving cycle of the CVS-C procedure are different than those of the FTP. The change in test procedures was for the purpose of making test results more representative of emissions from in-use vehicles. Naturally, these changes in test procedures had the effect of changing the measured mass emissions from a vehicle. We are advised by EPA, for example, that *a typical 1973 vehicle with hydrocarbon emissions of 2.2 grams per mile measured under the old FTP procedure would have hydrocarbon emissions of 4.6 grams per mile with the CVS-C procedure* (the same vehicle with

the same emission control system). In other words, the 2.2 grams per mile of the FTP are equivalent to the 4.6 grams per mile of the CVS-C procedure for the 1970 vehicle.

A further refinement in the emission test was made for 1975 model year vehicles. It was felt that since the average car was started more than once per day, and only the first start was a cold one, it would be more representative to have a hot restart of the engine after the cold start portion of the test. For this reason, we now have the CVS-CH test, to be used on 1975 model year vehicles, in which the vehicle is started cold, run through a typical 23 minute driving cycle, shut down, restarted in ten minutes, and run through another cycle. Emissions from each portion of the test are collected in bags, with the contents of the bag analyzed and weighted. With this test, EPA states that the hydrocarbon emissions for the 1970 vehicle would be 4.1 grams per mile, slightly less than the emissions measured using the CVS-C procedures. Since the Clean Air Amendments call for a 90% reduction of CO and hydrocarbons allowable under the 1970 standards, the hydrocarbon standard for 1975 model year vehicles is 0.41 grams per mile.

The test procedure to be used for 1975 model year cars is the CVS-CH procedure. In order to achieve compliance with the Clean Air Amendments, emissions for 1975 vehicles measured in the CVS-CH procedure must be compared with the 1970 standards. The 1970 standards are based on the FTP, and yielded 2.2 grams per mile; this number must be adjusted to 4.1 grams per mile so as to compare 1970 standards and 1975 vehicle emissions on the basis of the same test procedures.

In a letter last year to Mr. Eric Stork, Director, Mobile Source Pollution Control, Office of Air Programs, Environmental Protection Agency, we requested information concerning the tests used to establish the standards.

Quoting from the reply of a letter to Dr. John, Executive Director, CMVE, from Mr. Stork of August 5, 1971:

"You have also requested information on the tests conducted to establish the numerical values of the 1975 emission standards. The final values of 0.41 gm/mi hydrocarbons and 3.4 gm/mi carbon monoxide were arrived at in two steps.

"A fleet of approximately 130 1970 model year vehicles was tested using both the 1970 Federal test procedure and the 1972 Federal test procedure. From these test data, average conversion factors were calculated on a production weighted basis and were applied to the 1970 Federal emission standards of 2.2 gm/mi hydrocarbons and 23.0 gm/mi carbon monoxide. It was thus determined that the 1970 standards were equivalent to standards of 4.6 gm/mi hydrocarbons and 47.0 gm/mi carbon monoxide when referred to the 1972 test procedure. These figures were the basis of the emission standards of 0.46 gm/mi hydrocarbons and 4.7 gm/mi carbon monoxide proposed in the February 26, 1971 *Federal Register*.

"When it was subsequently concluded that the test procedure would be revised to reflect the 24-hour average weighting of vehicle cold and hot start operations, two fleets containing a total of 90 1970 model vehicles were tested to determine the conversion factors between the 1972 and 1975 test procedures. These conversion factors were applied to the previously proposed standards to arrive at the final values promulgated in the July 2, 1971 *Federal Register*."

Another point that I would like to clarify concerns the cold start problem referred to on page 31 of the transcript of testimony. The actual percentage of pollutants that are emitted by a vehicle during the cold start portion of the emissions test is dependent on the type of emission control system utilized on the vehicle. For some vehicles with certain emission control systems this percentage may be as high as 70%. Certainly, a large percentage of the carbon monoxide and unburned hydrocarbon emission occurs during the first two minutes of operation from a cold start.

I trust this has cleared up some of the points in our testimony. Please call on us if any further questions arise.

Very truly yours,

E. L. GINZTON, *Chairman*.

Mr. ROGERS. Mr. Kyros.

Mr. KYROS. Has your group sought the advice of environmental scientists?

Mr. GINZTON. We have written to many different organizations asking for any contribution they could make in examining the questions before us at the time.

The questions we asked were strictly dealing with 1975 standards.

Mr. KYROS. From which environmental groups, if any, did you receive that information?

Mr. GINZTON. To the best of my knowledge, none.

Mr. KYROS. Is this kind of information that you have developed available to environmental scientists for study and research?

Mr. GINZTON. Mr. Kyros, would you mind repeating what kind of basic information you have in mind?

Mr. KYROS. I meant general background information on the problem as you developed it. Has it been made available to environmental scientists for comment or evaluation?

Mr. GINZTON. Most of the information available to us is available except under specific provisions of proprietary information, except for those limitations, the information is available in the offices of the committee.

Mr. KYROS. I understand that you have gotten information from automobile manufacturers. Is that so?

Mr. GINZTON. Yes, sir.

Mr. KYROS. And from oil companies?

Mr. GINZTON. To some extent, as well.

Mr. KYROS. How about from catalyst manufacturers?

Mr. GINZTON. Yes.

Mr. KYROS. How about from fuel injection system manufacturers?

Mr. GINZTON. To some extent, yes, yes, sir.

Mr. KYROS. How about from suppliers to the automotive industry, like people who make valves or pistons or spark plugs or carburetors?

Mr. GINZTON. We have a substantial amount of information not in all of those fields, but in many.

Mr. KYROS. So, you are still in the process of trying to get it together?

Mr. GINZTON. Yes, sir.

Mr. KYROS. Thank you very much.

Mr. ROGERS. Dr. Carter?

Mr. CARTER. How many car manufacturers here in the United States use the fuel injection system?

Mr. GINZTON. Do many use them?

Mr. CARTER. Yes, sir.

Mr. GINZTON. No, sir, they do not.

Mr. CARTER. Which saves more gasoline, the fuel injection system or the present spark plug system of ignition that we have?

Mr. GINZTON. I think, Dr. Carter, it is a question to which the committee has not paid a great deal of attention.

I can reply casually that the fuel injection system at an added additional cost, can save on fuel.

Mr. CARTER. As less fuel is consumed, there would be less emission.

Mr. GINZTON. I think, Dr. Carter, the main point of your question, if I understand it correctly, is that the fuel injection engine with more careful control of the fuel delivered to the cylinder is capable of delivering lower levels of emissions. That would be correct.

Mr. CARTER. That is one angle that our motor industry might think about. I wondered so many times why the industry continues to use automobiles which use more and more gas and for that very reason, at least have more pollutants that they have to control or at least try to control according to the present legislation.

Mr. GINZTON. There are important suggestions in that regard to make use of fuel injection systems as soon as possible, but there is no known way today for sure which would make fuel injection systems good enough in every respect to provide the kind of performance that is called for under the act.

Mr. CARTER. I have seen many of the cars which use this system and actually, they are just as fine as any that are made in the United States.

You have to admit the Mercedes is as well-engineered car in the world as any that uses this fuel injection system.

Mr. GINZTON. Yes, sir, but it does not perform adequately to meet the law.

Mr. CARTER. Neither do ours. They have less pollutants to control; isn't that correct?

Mr. GINZTON. Yes, sir.

Mr. CARTER. I was pleased to see that part of the vehicles which had passed the test, the 1975 vehicles.

However, it was stated that you did not know whether they could maintain this efficiency of control of pollutants; is that true?

Mr. GINZTON. Yes, Dr. Carter; that is correct.

Mr. CARTER. There was doubt as to the durability of the mechanism and so on.

Thank you.

Mr. ROGERS. Mr. Hastings?

Mr. HASTINGS. Mr. Chairman, I have just one question.

On page 23 of this report, we find: "There is, therefore, need for Federal action to insure wide variability of lead-free fuel . . ."

What type of Federal action is anticipated?

Mr. GINZTON. I could give an answer, but I think you would get a more complete answer from representatives of EPA.

Mr. HASTINGS. You have no recommendation of your own?

Mr. GINZTON. No, sir.

Mr. ROGERS. I get, from your report on page 10, that the committee's feeling was that we would probably not be in this kind of situation on 1975 standards if the automobile industry had tackled this problem faithfully in the last 10 years on an earnest basis.

Is that what I read from your page 10 statement?

Mr. GINZTON. I think that is perfectly correct, Mr. Chairman.

Mr. ROGERS. Also, I want to conclude with asking this: I notice Mr. Kyros asked about information from the industry itself and the fact that you also got information from other groups as well, the catalyst makers and so forth.

Did the information vary any? Was there much variance in information on claims?

Mr. GINZTON. Yes, Mr. Chairman, there was a great deal of variation in attitudes towards these questions.

There are individuals who had virtually no experience in this field who will tell you that the problems are easy. There are people such as catalyst manufacturers who think that there is important business to be developed, that things might not be all that bad to provide for 1975 vehicles in 1975, and there are other people who attempted to test them.

Our judgment is that, overall, the performance of the catalysts is

not yet good enough. This is our judgment, not the judgment of some one segment of industry.

Mr. ROGERS. At least your report says that if only 25,000 miles were required, then it is quite possible to meet the standards?

Mr. GINZTON. It is quite possible. We stipulated three conditions but just now you did refer to only one of them.

Mr. ROGERS. The gas, the fuel and the averaging of the testing; is that correct?

Mr. GINZTON. Yes.

Mr. ROGERS. Thank you so much. Your testimony has been most helpful.

The Congress and I am sure the American people are very grateful to the Academy for the service you are rendering.

Thank you very much.

Mr. GINZTON. Thank you very much, Mr. Chairman. It has been a pleasure.

Mr. ROGERS. Our next witness will be Mr. Ernest S. Starkman, vice president, Environmental Activities, General Motors Corporation.

Mr. Starkman, we welcome you to the committee.

STATEMENT OF ERNEST S. STARKMAN, VICE PRESIDENT, ENVIRONMENTAL ACTIVITIES STAFF, GENERAL MOTORS CORP.; ACCOMPANIED BY DR. FRED W. BOWDITCH, DIRECTOR OF AUTOMOTIVE EMISSION CONTROL; AND GEORGE NIEPOTH, ENGINEERING STAFF

Mr. STARKMAN. Mr. Chairman, and members of the Subcommittee on Public Health and Welfare, I am Ernest S. Starkman, vice president of General Motors Corp., in charge of the environmental activities staff. I have held this position since April of 1971, at which time General Motors consolidated under one staff administration its activities in vehicular emissions, safety, the experimental safety vehicle and other environmental concerns.

You might be interested in knowing that prior to my joining General Motors, I was a professor of mechanical engineering at the University of California in Berkeley. Just before leaving that position, I was an assistant vice president of that institution. During the past decade I have been active in many local, State and Federal automotive emission air pollution advisory groups. As an example, I was chairman of the Technical Advisory Committee to the State of California's Air Resources Board.

The purpose of this hearing, as we understand it, is to consider the Clean Air Act of 1963 and more particularly, the amendments to it which were adopted in 1970. I am prepared today to discuss the consequences of those 1970 amendments as they have affected General Motors. I am accompanied by Dr. Fred W. Bowditch, director of automotive emission control of my staff, and Mr. George Niepoth of the engineering staff.

To begin with, I wish to assure you that vehicular emissions control continues to be one of the highest priority concerns within General Motors. Our undiminished goal remains that of eliminating General Motors automobiles as significant contributors to the air pollu-

tion problem of the Nation, and we are irrevocably committed to this end. As an indication of the depth of our efforts, I think it would be worthwhile to state that we have expended almost $300 million in total in the past 2 years in this area and our present programs indicate that we will spend around $225 million in 1972 toward even further reductions in vehicular emissions. The equivalent of more than 3,000 scientists, engineers, technicians and supporting staff are presently working toward this objective at General Motors.

Attachment I shows the emission control system components characteristic of present General Motors cars. This equipment was installed on 1972 GM models and control systems such as this—in the hands of the public—will reduce total hydrocarbon emissions 80 percent, carbon monoxide 70 percent, and oxides of nitrogen 30 percent, compared to nonequipped models prior to 1961.

The effect on atmospheric pollution of the 1972 automotive control systems and those on past model years has most recently been examined by the Committee of the National Academy of Sciences in its January 1, 1972, report to Congress. The curves in attachments II and III show the calculated results of this examination.

The crosshatched areas in attachments II and III are what is contributed and will continue to be contributed by the automobile built to date, and which vehicles will last until such time as they will be discarded. The uppermost curve relates to what is and will be the state of the atmosphere if we retain the emission control systems we presently are building until that time at which these cars are discarded—in other words, if all cars from now on were controlled to the 1972 model levels.

The intermediate dashed curves relate to 1975 standards to which we are addressing ourselves today; the introduction of those cars that would have levels of control by 1975 or, alternately, 1976.

I repeat, this is taken from the National Academy report.

We wish to call this to your attention so you would have some idea of what we face in the future.

The following chart (attachment III) shows the situation with respect to carbon monoxide if we had discarded cars in the normal fashion; and if we replaced those vehicles on the other hand with those having 1972 model control systems; or if we go to 1975 systems which would accommodate the law as it is stated in the amendments of 1970.

I would particularly like to call your attention on these curves to the fact that the atmospheric levels of automotive-related hydrocarbons have decreased 28 percent since the peak in 1968 and carbon monoxide has decreased 17 percent since a similar peak, also in 1968.

Once again, I will say this is for the whole Nation.

Since there are many older cars still in use which have no controls, the decrease in total atmospheric levels is still not as great as the emission reductions in current model cars. As the curves suggest, reductions in automotive-related hydrocarbons and carbon monoxide will continue to occur in the future.

These data are confirmed by publications of the Los Angeles County Air Pollution Control District, which forecast, for example, that in the Los Angeles basin present levels of hydrocarbons are down 36 percent from the 1966 peak, and carbon monoxide is down 25 percent from its 1966 peak.

I am sure you realize control systems were introduced in California 2 years prior to their going across the Nation.

Due to the fact that controls for oxides of nitrogen have only recently been installed on new cars nationwide, a similar downward trend in oxides of nitrogen has not taken place. However, the turning point for atmospheric levels for this pollutant is expected to take place this year. This results from the fact that controls for NO_x installed on recent models of motor cars have reduced this component of vehicle exhaust. For GM cars, the reduction presently is about 30 percent.

The downtrend in air pollution alerts experienced by Los Angeles in 1971 is evidence that the situation there has been improved. It is not unreasonable to expect that the same trend is being experienced across the Nation. This is encouraging, but we do not wish to leave the impression that the air pollution problem has been completely resolved—either in Los Angeles or in other cities of the Nation. We do, however, wish to call your attention to the fact that significant progress is being made in cleaning up our air, even though more than half of the cars on the road have no exhaust emission control systems whatever.

Although the automobile is blamed for approximately 40 percent of the Nation's air pollution problems, this is based on a total tonnage basis. It is now recognized by experts that a more accurate measure should be based on relative effects on health and plant life. The most recent information incorporating health and plant damage—together with tonnage—would show that the automobile is more nearly 10 percent of the Nation's problem. This varies, of course, from one urban area to another.

The atmospheric improvements resulting from the levels of control already applied to the automobile have not been without penalty. Many who have purchased recent model cars have experienced a decrease in the driving response, and, sometimes, difficulty in starting these cars. This adverse effect on driveability, as we call it, is an unfortunate consequence of modifications made in order to decrease the concentration of pollutants which emit from the exhaust pipe.

While the individual vehicle owner usually does not measure precisely the fuel consumption of his vehicle, I can confirm what is perhaps your own experience that the public is paying a penalty in increased fuel usage for the same vehicle applications.

This result is not pleasing to any manufacturer—and certainly not to the car buyer. Indeed, General Motors has had to discontinue some of its engine-vehicle combinations after making modifications to emissions control systems. In our opinion, driveability and fuel economy of such engine-vehicle combinations would not have been acceptable to the public.

Turning now to what is being done to meet the 1975 exhaust emission requirements under the 1970 amendments to the Clean Air Act, I am sure that you are all aware of the fact that General Motors has applied for a 1-year suspension provided for in the act. We came to this conclusion with reluctance. Let me explain how we got there.

Since enactment of the 1970 amendments to the Clean Air Act, we have been striving to meet the emission levels which are prescribed for 1975 and subsequent model years. I am sure that you have heard of various experimental control systems which have met the hydro-

carbon, carbon monoxide, and oxides of nitrogen emission levels on a laboratory basis. As you may know, some of these systems have been developed by General Motors.

In our judgment, the better systems utilize a rather complex combination of components including particularly a catalytic converter in the exhaust line. We are presently convinced that the catalytic converter method of treating hydrocarbons and carbon monoxide is the most effective means for controlling these two emittants. The Committee of the National Academy of Sciences in its report to Congress came to the same conclusion.

Since there are, of course, many other components besides the catalytic converter in the total package of components necessary to control emissions, we must be assured of the satisfactory performance of the total system under the varied conditions of customer service before systems can be released for the 1975 or subsequent model years.

We must solve two large technical problems before we can translate the experimental systems into mass production hardware. These are durability and reliability. By law, the systems will have to be sufficiently reliable and durable to last for 50,000 miles or 5 years. Involved in this is owner maintenance, which includes catalyst replacement schedules, and availability of appropriate fuel which will not render the catalyst ineffective.

Testing has shown that such materials as lead, sulfur, and phosphorus can shorten catalyst life and effectiveness.

Some of these difficulties may be resolved by administrative determination. For example, in our request to Administrator Ruckelshaus for a 1-year suspension of the 1975 standards for vehicular emission control, General Motors pointed out many definitions which will have to be made by the Environmental Protection Agency before manufacturers can be certain of the reliability and durability requirements that they must meet. These are items which the Committee of the National Academy of Sciences also said must be satisfactorily resolved before the 1975 model year prescribed levels of emissions could possibly be attained.

There are major problems to the automobile manufacturer which depend upon how the Environmental Protection Agency develops regulations which would affect catalyst replacement, owner maintenance requirements, specification of fuels and whether averaging the emissions produced by our vehicles over total production will be allowed.

Moreover, the Environmental Protection Agency must establish details of the assembly line test required by the Clean Air Act before we will know whether our systems will accommodate such requirements.

I would like to dwell for just a moment on this matter. Having been deeply involved in the promulgation of California's emission control levels as chairman of the Technical Advisory Committee of the California Air Resources Board prior to joining General Motors, let me assure this subcommittee that all present emission control standards for automobiles are derived from the effect on the atmosphere of average emissions. Atmospheric pollution consists of the output of so many individual vehicles that its total dimension can be determined only by averaging emissions. Therefore, the scientific community uniformly has recognized the averaging concept. Until now, regulations intended to bring atmospheric pollutants down to the prescribed levels have been

based on achieving an average rather than an absolute maximum level for motor vehicles.

If the averaging concept for end-of-the-line assembly testing is accepted, then field surveillance standards and methods based on the same philosophy must be developed.

There is no technical foundation related to either health or esthetics that would prescribe vehicle emission control on an absolute basis for an individual car. The validity of the averaging concept is now and always has been accepted by the technical and scientific community.

Unfortunately, all of the preceding matters must be resolved before we could make an evaluation on how close we could come to meeting all of the 1975 requirements.

Surely, you can agree that for General Motors it would be a most foolhardy step to commit the tremendous sum of hundreds of millions of dollars today without this kind of knowledge. Regrettably, we have to make this decision promptly in order to meet the requirements for tooling and commitments to outside suppliers for the necessary equipment and materials, including catalysts. This decision is critical to our ability to manufacture any 1975 model vehicles.

I want to emphasize that General Motors' efforts to control emissions from motor vehicles are not limited to development of systems for the present kinds of gasoline engines. I believe it is generally agreed—and has been confirmed in the report of the Committee of the National Academy of Sciences—that no alternative powerplant can be developed in time to meet the 1975 and 1976 standards.

I will, therefore, not dwell at this time upon the subjects of alternative systems or alternative powerplants other than to say that we continue to research and investigate all potential promising vehicular emission control systems and alternate powerplants and means for transportation. However, I would like to note briefly our progress in some of these areas.

I am sure that you are aware of our increased involvement in rotary combustion engines and gas turbines and other alternate powerplants. The rotary combustion engine is of interest to us because of the potential that this smaller sized engine—together with its emission control system—has for better packaging into future motor vehicles than present engines. However, from our investigation we do not believe the rotary combustion engine is inherently any less of a contributor of carbon monoxide, hydrocarbons, and oxides of nitrogen than is the piston engine when both are developed to the same level of technology.

We are also continuing our development of the gas turbine as an alternate powerplant, and have recently expanded our work in this area. Additionally, we are supporting outside efforts to develop gas turbines as well as steam engines. Among those with whom we are associated are Bill Lear and Sam Williams, both of them well known for their involvement in their respective areas.

We would like to close by addressing the matter of emission control levels prescribed for 1975 and 1976 in the 1970 amendments to the Clean Air Act. Technical experts both outside and within the automobile industry have questioned the extreme reductions prescribed in the act. Specifically, the act requires reductions in vehicular emissions of 90 percent below the low levels already achieved as of 1970 models, and in the case of oxides of nitrogen, 1971. The 1975 stand-

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ards, on which we are asking a 1-year suspension would require hydrocarbons to be reduced 98 percent and carbon monoxide, 97.5 percent, compared to 1960 precontrol levels.

Technical experts do not believe that such stringency is necessary to provide air quality levels which will adequately protect health through the 1980's and 1990's. This is evident from the reports of such bodies as, for example, the California State Air Resources Board.

Two other problems may be equally important as is the appropriate level of air quality. One is the disproportionate economic burden which these standards could place upon this country and its citizens. The other is the trade-off between a specific air quality and what appears to be our Nation's dwindling petroleum reserves.

The question is not whether there should be controls. The real question is at what level controls should be established to achieve the best balance between appropriate environmental protection and the resulting impact on our national economy. The price to achieve the last several steps toward the required 1975 control level can be greater than the combined price of all previous steps. This was clear in the National Academy of Sciences Committee report, where it was estimated that the consumer price for hardware alone to achieve emission levels up through 1974 would be $120.60; the additional consumer price to reach 1975 levels would be $193.40.

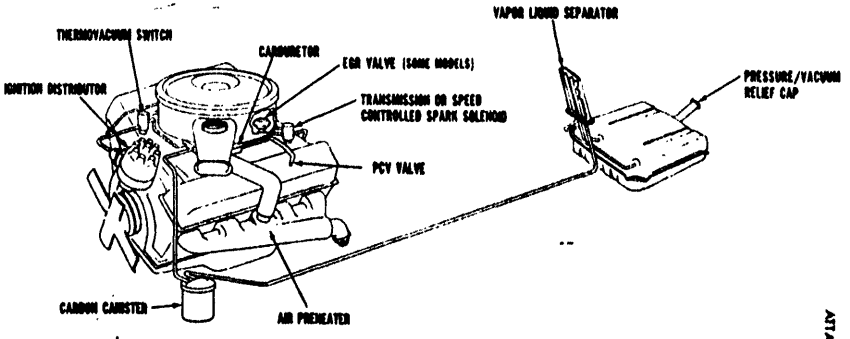
These important questions are of interest not only to the technical community but also to the general public, which must pay the price. These questions certainly appear to be worthy of congressional study, and we would suggest your consideration of this matter.

Thank you.

We would be happy to answer any questions.

(The charts referred to follow:)

1972 EMISSION CONTROL SYSTEMS



ATTACHMENT I

ATTACHMENT II

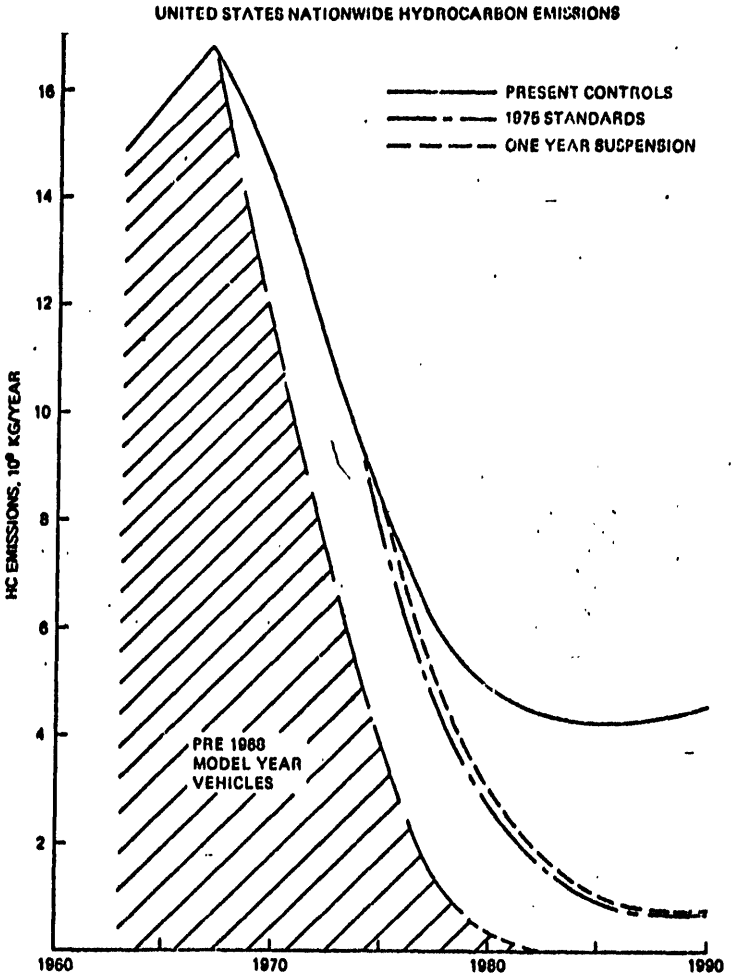


Figure 7.1

Semiannual Report by the Committee on Motor Vehicle Emissions
of the
National Academy of Sciences
to the
Environmental Protection Agency

ATTACHMENT III

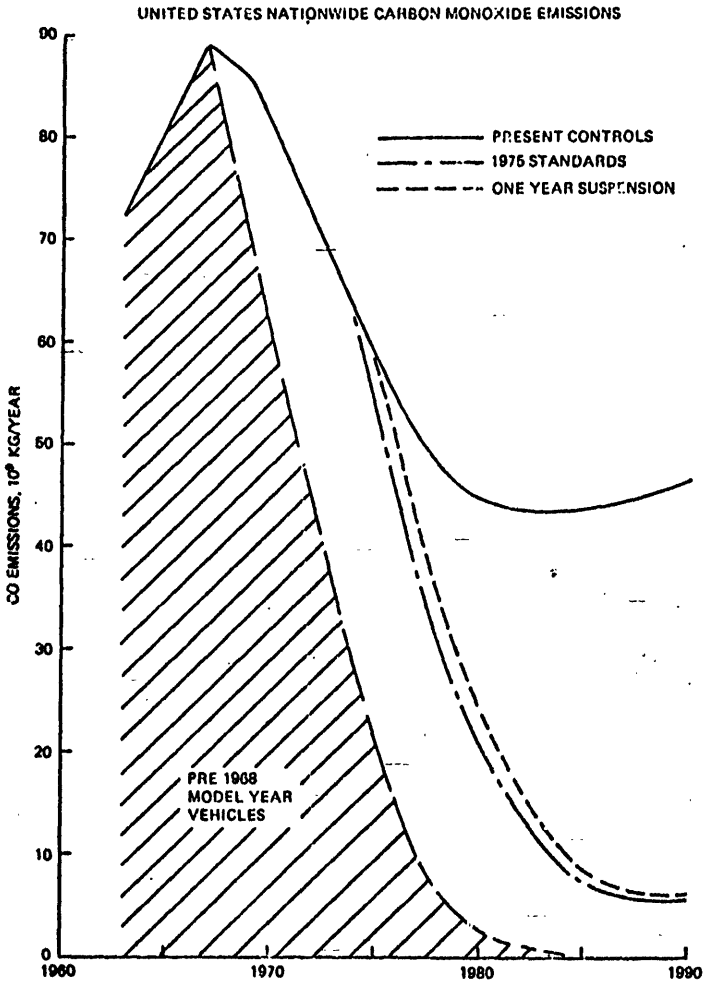


Figure 7.2

Semiannual Report by the Committee on Motor Vehicle Emissions
of the
National Academy of Sciences
to the
Environmental Protection Agency

Mr. ROGERS. Thank you very much, Mr. Starkman, for your statement. We appreciate your being here.

Let me just ask this and then I will have others question you: It is my understanding that General Motors has entered into discussion with individual oil companies. I understand you can't get them together because of the antitrust situation but you have begun discussions with individual companies regarding a proposal that you have which you feel would be helpful in cleaning up the air as far as the automobile is concerned.

I wondered if you would comment on that.

Mr. STARKMAN. I would be happy to, yes, indeed. General Motors has held and has programed to hold, meetings with individual oil company representatives for the purpose of describing to them our attempts at accommodating the 1975–76 standards, the approaches we have made and some of the results we have obtained.

I have already mentioned in my statement to you that we believe that lead and phosphorus and sulphur will have to be constrained in motor fuels in order that the appropriate durability of the catalyst systems is obtained.

In the course of our investigation we have been very much troubled by the extent to which the front end or first part of the emission test cycle has contributed to total emissions of hydrocarbons and carbon monoxide. Most of the emissions come in the first couple of minutes.

In looking for ways to decrease the proportion of total emissions that these first few minutes would contribute, we have discovered it is possible if we could get a fuel that would run satisfactorily once the engine has fired up, we could then reduce that front end part of the emissions.

One way to get to this is by changing compositions so that the hydrocarbons that are incorporated in the higher boiling fraction of that fuel were reduced in concentration.

Another way to put it is, given a fuel with a lower than 90 percent distillation point, it would be easier to reduce the emissions of particularly carbon monoxide from the tailpipe of our vehicles. We have presented this information to the oil companies in an effort to show one of the possible trade-offs. There are also other ways we can effect the hardware.

This is one way that there might be a contribution from the standpoint of the materials used in the vehicle, over which we have no control in designing the vehicle, other than to accommodate what the fuel and oil might be.

Mr. ROGERS. Could you tell us what a change in this fuel would do as far as reducing the pollutants? Have you projected that?

Mr. STARKMAN. I do not have the precise figures with me, but this change in the back-end volatility of the fuel, or back-end distillation of the fuel would have a significant effect.

I can't give you the number.

Mr. ROGERS. Perhaps you could supply it for the record.

Mr. STARKMAN. Let me add this point: One of the things this change in fuel would do if you were able to obtain it would be to improve the driveability of the vehicle which is a problem to us. This would also help us to accommodate the first part of the cycle.

Mr. ROGERS. Two answers?

Mr. STARKMAN. Yes.

Mr. ROGERS. Would you let us know what the projection of reduction of pollutants would be?

Mr. STARKMAN. Yes, sir; we will supply you with that information.

(See letter dated July 20, 1972, from Mr. Starkman to Chairman Rogers, p. 216, this hearing.)

Mr. ROGERS. What about the standards?

Mr. STARKMAN. It would make the job easier. But we have not said we can meet the standards even with this modification.

Mr. ROGERS. Your figures will show us what could possibly happen.

Mr. Kyros?

Mr. KYROS. Thank you, Mr. Chairman.

In looking at your statistics and your chart, I am wondering, if you gain this 1-year suspension, what will be the change in actual figures? For example, the standard calls for a 90-percent reduction in hydrocarbons and carbon monoxide over the 1970 model to 1975.

If you gained the suspension, how far would you have gone to reach the 95-percent figure?

Mr. STARKMAN. This additional year would give us a better opportunity to provide a system that will last for 50,000 miles or for 5 years.

Mr. KYROS. For model year 1975, instead of a 90-percent reduction from 1970, what percentage would you estimate that reduction would be?

Mr. STARKMAN. This has been a matter to which we have given our attention. For the reason that we think we will have to go to catalyst, we would not wish to go part way and then have to make a subsequent change. We have requested no change be permitted, that we be allowed to work toward a target in time rather than a number of targets in time.

I think this would be an approach that would be most economical to us and to the person who buys the car.

Mr. KYROS. Are you saying that you may not reach the 90-percent figure which we recommended in the act, and that you would indeed want to work toward the best possible figure you can?

Mr. STARKMAN. No, I would like to answer it this way, Mr. Kyros: We have made the statement in our testimony here that we and others question that the 90-percent reduction is required for health and esthetics.

We believe these should be given attention to determining whether or not indeed that 90-percent reduction is something we do need.

Mr. KYROS. I respect that viewpoint, but my question remains do you mean then to suspend the 90 percent or your year to attain 90 percent?

Mr. STARKMAN. All we can do is ask for that 1-year suspension.

Mr. KYROS. But you don't know where you will be a year from now.

Mr. STARKMAN. Mr. Kyros, if we were to express our opinion, which I think I did, we would prefer to work toward a goal set for 1976 if the 90-percent level is to be retained rather than something in between. This is what we would prefer to do.

Mr. KYROS. If we follow your curves which you show on the board and in your appendix, and which also appear in the NAS report, looking at the curves and a casual overview, there does not seem to be that much difference between the dotted line and the broadly dotted spaced line. Is that correct?

Mr. STARKMAN. That is correct. All of these curves are National Academy Committee curves. They are not ours. They should be given full credit.

Our conclusion is the same as theirs: That to specify an additional year to this goal is not going to affect the atmosphere significantly.

Mr. KYROS. That is the point I wish to make. If you follow these curves, it appears that you have practically reached the 90-percent line. The two dotted curves appearing on that chart look like minimal differences.

Mr. STARKMAN. That is correct.

Mr. KYROS. So you are targeted in getting close to that goal.

Mr. STARKMAN. We continue to work toward that goal.

Mr. KYROS. Simply for the nitrogen oxide emissions?

Does the curve look the same for the nitrogen oxide emissions?

Mr. STARKMAN. We have not looked at the comparable curve, I am sorry. We don't know what would be the effect of 1 year's postponement.

Mr. KYROS. How close to 90 percent would you judge the 1967 model which calls for 90 percent?

Mr. STARKMAN. We don't believe that there would be any significant differences in that set of curves from the sets that have already been prepared for hydrocarbon and carbon monoxide.

Mr. KYROS. You talked about drivability. By that, do you mean that when my car is going over a hill, and I have high-test gas, it still knocks even when I shift to second?

Mr. STARKMAN. No.

Mr. KYROS. It is not a General Motors car, is that why?

Mr. STARKMAN. It may well be. We cannot deny some of our cars knock regardless of the quality of the gas you receive from the station. Some do.

This is a fact of manufacturing capabilities.

My point had to do with the extent to which the car responds to the throttle. When you step on the throttle, you may not obtain what you expect. This can be even as severe an example as a stall. Perhaps I could explain drivability a little better if I could call upon Mr. Niepoth to show you a chart of our assessment of what constitutes points for or against drivability. This matter of drivability is a little obscure until you know more about it.

Mr. ROGERS. Could we hold that for the moment?

Mr. KYROS. What should the Government require of the industry?

Mr. STARKMAN. We believe it will be necessary to do something about constraint of lead and perhaps phosphorus and sulfur, too. We have discovered that changes in volatility and distillation characteristics could help.

As far as what the Government should require, I think I would rather not state.

Mr. KYROS. Thank you very much for your very forthright answers to my questions.

Mr. ROGERS. Dr. Carter?

Mr. CARTER. Thank you, Mr. Chairman.

Dr. Bowditch, are you related to the author of the book on navigation?

Dr. BOWDITCH. Yes, sir.

Mr. STARKMAN. He steers me away from the shoals.

Mr. CARTER. I agree pollution of our cities seems to be somewhat less. I think I have noticed in visiting, particularly, some of the less modern cities of the world, that there is more pollution there than there is here at the present time. Being in Seoul, Korea, this past year and also in Manila, I think we have made strides in diminishing the amount of pollution and, of course, we will continue in that area.

I notice another statement in which you state automobiles contribute only 10 percent now to the total pollution we have. Is that your position?

Mr. STARKMAN. Yes, sir. When one assesses the total amount of carbon monoxide, hydrocarbons, oxides of nitrogens, sulphur oxides, and particulates in the air, and then one asks what is the health concentration of each of those components and multiplies the health effect by the number of tons of each, for the whole Nation, the answer is that the automobile, because of its contribution in carbon monoxide, oxides and nitrogens, and hydrocarbons, contributes 10 percent.

In some cities it is larger because the automobile contributes a larger fraction and in some cities it is smaller because the automobile contribute a smaller fraction.

Mr. CARTER. It is interesting to hear you make that statement but I would like to see that backed up by the opinion of the National Academy of Sciences. It is rather difficult for me to agree with that, frankly.

Mr. STARKMAN. Dr. Carter, we would be most pleased if the National Academy would undertake such a study. We have not suggested it to them.

Mr. CARTER. It is quite a diminution in level from the 40-percent level a year ago to a 10-percent contribution to the total pollution of our atmosphere.

Why have you not ever used fuel-injection systems at General Motors?

Mr. STARKMAN. We have, sir. We made fuel-injection systems before my time but for certain models of vehicles that were sold. I hope that you have not gotten the opinion that General Motors is not and has not been working upon fuel-injection systems or has not kept abreast of fuel-injection systems, because General Motors has done a considerable amount of work in electrical and mechanical fuel-injection systems.

Mr. CARTER. Most European manufacturers outside the United States have them.

Mr. STARKMAN. I think the principal reason is we have been able to develop appropriate carburetors to do the job.

Mr. CARTER. I have driven some of your General Motors cars and they use a lot of gas. Some of them are called gas hogs, I regret to say. I think it is an accepted fact with a fuel-injection system you do conserve gas.

If you conserve gas, you would have less pollution to control, isn't that true?

Mr. STARKMAN. Not exactly.

Mr. CARTER. If you put less in you will certainly have less coming out to control.

Mr. STARKMAN. May I try to explain a bit?

Mr. CARTER. By all means.

Mr. STARKMAN. The larger difficulties in controlling emissions—and this is not data from General Motors, but rather California Air Resources Board—are with the small cars, unfortunately, and cars with fuel injection.

The smaller engine, the more economical engine, is working harder and it is perhaps not a good simile to try to draw, but just like any man or animal that works harder, sweats more.

The vehicle getting more miles per gallon will pollute the atmosphere as much or at least as much as the big engine in the big car. It evolves, and this seems anomalous, that the lowest polluting combination is a big engine in a small car, to go from point A to point B, and to do the same job.

This is the consequence of the manner in which the unburned hydrocarbons are formed, the manner in which the carbon monoxides are formed, and the manner in which the oxides of nitrogen are formed.

Mr. CARTER. I thought the emissions would be less.

Mr. STARKMAN. It is a small fraction of the fuel you put into the engine that becomes pollutants. This is with respect to hydrocarbons and carbon monoxide, and more so in the engines that we were running 10 years ago.

It is not true with oxides of nitrogen. It is unfortunately true that the more efficient the engine, the more oxides of oxygen one will produce. It is a principle of thermaldynamics.

Mr. CARTER. Unfortunately we have just tried recently to control oxides of nitrogen.

Mr. STARKMAN. That is correct.

Mr. CARTER. How long will our petroleum supplies last in the United States?

Mr. STARKMAN. I know the American Petroleum Institute is due to appear and I would like them to estimate rather than me. I am not an expert in this area.

Mr. CARTER. I believe it has been estimated at 10 years. Certainly if we could eliminate the gas hogs which some of our automotive industry have, and work diligently on that pollution problem, it would help.

Thank you, Mr. Chairman.

Mr. ROGERS. Mr. Roy?

Mr. ROY. I have no questions.

Mr. ROGERS. Mr. Hastings?

Mr. HASTINGS. I know you will be delighted to know I drive one of your competitor's cars and do not get very good mileage either.

What is the current status of your request for a 1-year suspension?

Mr. STARKMAN. We have had a response from Mr. Ruckelshaus that we have to provide additional information and we are presently putting that information into a form to submit to him right at the moment.

Mr HASTINGS. He has accepted your application?

Mr. STARKMAN. As far as I know he has not accepted our application. He has said in effect that the letter that we wrote was insufficient to constitute a formal application.

Mr. HASTINGS. But you have had no indications of action from Mr. Ruckelshaus?

Mr. STARKMAN. So far as I know, there has been no action other than response to us with respect to our original letter.

Mr. HASTINGS. Referring to the Wall Street Journal story, do you feel that without a new fuel you would not be able to meet those standards?

Mr. STARKMAN. We are not sure. We say we need all of the help we can get.

Dr. Bowditch reminds me that if we do not have fuels which have reasonably low levels of lead, unleaded fuels, we will not be able to use catalysts for any significant period of time between replacements; so, at least as far as lead is concerned, it will have to be a must for low levels.

Mr. HASTINGS. Yet, you state the most viable approach to meet the standards is the catalyst converter?

Mr. STARKMAN. Yes, sir.

Mr. HASTINGS. Therefore, unless you have unleaded gas you are not going to be able to meet these problems?

Mr. STARKMAN. That is correct.

Mr. ROGERS. Mr. Schmitz?

Mr. SCHMITZ. I have two or three questions and a comment.

As I summarize your comments on page 9 where you agreed no alternative powerplant would be developed to meet the 1975 and 1976 standards, could I paraphrase that by saying that it does not do any good to have a crash program until you have a breakthrough in technology on which that crash program could be placed.

Is that basically what you are saying?

Mr. STARKMAN. That is one of the things I am saying. I believe one of the other things I am saying is that we cannot program breakthroughs, if you will. A lot of what we are doing is development work which is just blood, sweat, and tears.

Mr. SCHMITZ. I think it is interesting to this committee because there is a point of similarity to a discussion this very subcommittee had regarding the Cancer Act that the President signed just prior to Christmas in which there was a disagreement between this committee and the Senate bill, namely that the Senate bill, in effect, ordered the Government to "conquer cancer" and spend *x* number of dollars to do so.

Whereas, the scientific community, in general, in testifying before this subcommittee, said that that would all be well and good, but you can't compare it to the flight to the moon or to the atom bomb because we don't have the breakthrough on which to base that push.

I think it ought to be interesting to committee members that there seems to be somewhat of an analogy here.

In both cases, the truth comes through that the Government may feel that they can do all things and be almost godlike in their collective orders, but you just can't pass a law saying certain things will be done in the technological field such as curing cancer or developing a smogless engine until there are certain breakthroughs.

It occurred to be during your testimony that there does seem to be this similarity with our discussion on cancer, despite the fact that cars and cancer are only indirectly related.

Now I have a couple of questions.

One is on page 10 of your testimony—on page 10 where you mention an association with Bill Lear and Sam Williams.

When I was in our State legislature, I voted for one of our pollution bills setting 1975 as the target date, or was it earlier?

Mr. STARKMAN. We had a series of bills, Mr. Schmitz, which first set levels for succeeding years to 1974 and a further bill setting a level for 1975.

Mr. SCHMITZ. It seems to me that I voted for this bill on the basis of the testimony of Bill Lear at that time. He claimed it was technologically possible to come up with, shall we call it, a smog-free engine by 1975.

Has Bill Lear changed his mind since his testimony was given quite a while ago before the State legislature?

Mr. STARKMAN. Again, I prefer Bill Lear express his own opinions. He is still working and working hard. He has not given up yet.

Mr. SCHMITZ. Does he still feel 1975 is a reasonable target date?

Mr. STARKMAN. I don't know.

Mr. SCHMITZ. Somewhere I thought I had heard he revised his thinking on the target date.

Mr. STARKMAN. I am not aware of it.

Mr. SCHMITZ. On page 4, as a point of clarification, I wish you would elaborate, very quickly since we are running out of time, on this relationship of tonnage to pollution.

I did not follow that. You said automobiles get the blame for more pollution than they really cause because the statistics do not take into consideration the tonnage factors. I wish you would comment on that.

Mr. STARKMAN. Yes, sir.

I think, as an example, the concentration of oxides of sulfur that are experienced in those cities which have oxides of sulfur in significant quantities—and I don't wish to name them, but they have been established in publications of the Environmental Protection Agency—might have a worse problem from the sources of the oxides of sulfur as far as health is concerned than from the automobiles in that city.

There are variations around the country. I will name Los Angeles because we both know it will. The principal problem in Los Angeles is the automobile whether it is on a tonnage basis or otherwise, and I believe you will find the automobile industry will agree, but I think the recent unfortunate circumstances in the South having to do with an air pollution problem which was existent just before Christmas was not contributed to by the automobile.

This, again, was particulates and oxides of sulfur. We don't quarrel with the statement that the automobile on a total tonnage basis is putting something into the atmosphere on the order of what the EPA says it is.

I think other people have already come forth to make these calculations and we will then have an assessment around the country that the automobile is x percent in one city and y percent in another city rather than as we have: a carte blanche assessment of so many tons per year.

I can only say further that, as far as oxides of sulfur are concerned, in equal concentration, they are much more harmful to health than carbon monoxide. Fortunately, the concentrations don't get up as high for oxides of sulfur even in the cities plagued by it as carbon

monoxide. But the medical people have told us it is worse than carbon monoxide in some cities, at its maximum concentration.

Mr. SCHMITZ. In other words, the health hazard would only be 10 percent from automobiles. Is that what you are saying?

Mr. STARKMAN. Yes, sir; across the country, national average. If we wish to talk national averages, we wish to get it into perspective.

Mr. ROGERS. I understand there was a meeting held in California to discuss the whole problem recently. I saw reports of it in the paper. Did you have representatives there or were you present?

Mr. STARKMAN. I was not present. Dr. Bowditch attended the meeting, which was at the Western White House. Is this the one?

Dr. BOWDITCH. There was one held there recently.

Mr. ROGERS. Do you know who called the meeting?

Mr. STARKMAN. If I may answer that, Mr. Rogers, the original letter to our organization, and if it is the meeting to which you make reference, was to Mr. Cole in our organization, and it was from Representative Veysey of the State of California.

Mr. ROGERS. Did Mr. Veysey invite you to meet at the White House?

Mr. SCHMITZ. Mr. Veysey was here earlier.

Mr. ROGERS. I think he is going to testify. I would like for him to.

Mr. SCHMITZ. It seems to me he called it in conjunction with the University of California at Riverside which is his district. My invitation was from Mr. Veysey along with the University of California Riverside campus.

Mr. ROGERS. As I understand it, it was at the request of Representative Veysey that this meeting was called?

Dr. BOWDITCH. That is our understanding.

Mr. ROGERS. And it was held at the Western White House?

Dr. BOWDITCH. Yes, sir.

Mr. ROGERS. Who conducted the meeting?

Dr. BOWDITCH. Representative Veysey was the prime coordinator, certainly. There were various other Congressmen there as well as representatives of State legislatures.

Mr. ROGERS. Did representatives of EPA attend?

Dr. BOWDITCH. Yes, sir.

Mr. ROGERS. Were there any White House officials present?

Dr. BOWDITCH. White House officials beyond EPA? Not to my recollection. I do not have the attendance sheet here with me. There were 40 people there.

Mr. ROGERS. Was the President's science adviser there?

Dr. BOWDITCH. No, sir; he was not.

Mr. ROGERS. Or Mr. Flanigan?

Dr. BOWDITCH. No, sir.

Mr. ROGERS. If you have that list, could you let us have it of those present for the record?

Mr. STARKMAN. I see no reason why not. I presume Representative Veysey would have it.

Dr. BOWDITCH. I have the list.

Mr. ROGERS. I understood it was closed to the public and the press was not allowed into the meetings.

Dr. BOWDITCH. That is right.

Mr. ROGERS. I wondered why. They called it a public meeting.

Dr. BOWDITCH. I would prefer you ask this of the Congressman why he did this, but it is true this is the way the meetings were conducted.

Mr. ROGERS. Were oil companies present?

Dr. BOWDITCH. There were some representatives of oil companies present, yes.

Mr. ROGERS. Were all of the major car manufacturers represented?

Dr. BOWDITCH. Yes.

Mr. ROGERS. Were there any representatives you know of from the Department of Commerce?

Dr. BOWDITCH. GSA had a representative there. I am not quite certain of the organization.

Mr. ROGERS. How much notification prior to the meeting was given?

Mr. STARKMAN. It was about 3 weeks.

Mr. ROGERS. Was there any discussion of the antitrust divisions of the law?

Dr. BOWDITCH. Yes, sir; there was a representative there from the Justice Department to assure that this problem would not occur.

Mr. ROGERS. Was there any general input from EPA at that time given?

Dr. BOWDITCH. They were asked to comment on the various subjects as they came along, as were the rest of us.

Mr. ROGERS. What was the real point of the meeting?

Dr. BOWDITCH. To examine where we were today and what progress was being made and what the future seemed to hold, what were some of the problems, what was the progress that might be anticipated.

Mr. ROGERS. Of course, any Member of Congress has a right to look into anything he wants. I just wondered why this was called and given the sanction of the meeting at the White House. I did not recall their being on the Air Committee.

Dr. BOWDITCH. I can't help you much with that.

Mr. ROGERS. We will go into that.

Were there any environmentalists present representing any environmental organization?

Dr. BOWDITCH. I think so. I wish I had the list here so I could be more informative.

Mr. ROGERS. Were you required to send any letters or any information as a result of these meetings?

Dr. BOWDITCH. No, we were there to provide what input we could while we were there.

Mr. ROGERS. What was the conclusion of the meeting held at the Western White House?

Dr. BOWDITCH. As I recall it, there were three in number and I am afraid I will not remember all three, but one was certainly there should be more work done on health-oriented problems. Another was the recommendation that more work be spent on alternate powerplants. At the moment the third one escapes me, I am sorry to say.

Mr. ROGERS. Was it also the conclusion to seek amendments to the Clean Air Act of 1970 so that instead of requiring the 90-percent reduction it would require that automobile air emissions standards be set to meet air quality standards?

Dr. BOWDITCH. This was certainly discussed. I was not at the final news conference so I am not sure what the stated conclusions were.

Mr. ROGERS. I see a paper here from the Western Oil and Gas Association that this was their understanding.

Dr. BOWDITCH. I do have this information but I do not have it with me, and it is not that clear in my mind at the moment.

Mr. ROGERS. We will want to go into that further, but I will not pursue that further at this time.

I notice you said that you are spending now upward of—what?—$300 million?

Mr. STARKMAN. Our combined expenditures for 1970 and 1971 were $300 million. We project our expenditures for 1972 to be $325 million.

Mr. ROGERS. What is the total business done by General Motors?

Mr. STARKMAN. It is on the order of $20 billion for all of its products. I don't have the exact figures.

Mr. ROGERS. The profit is what—half a billion six hundred million dollars?

Dr. BOWDITCH. We can certainly get this for you.

Mr. ROGERS. Do your stockholders approve budget items like that or do you take it up with stockholders? In other words, to get their feeling as to what moneys should be spent or what emphasis should be given to particular programs?

Mr. STARKMAN. There is, of course, the annual stockholders' meeting and some of the stockholders express themselves quite forcefully at those meetings.

Mr. ROGERS. I wonder if you got into discussions of whether you are spending enough or not enough, according to your stockholders.

Mr. STARKMAN. Aside from circularizing a questionnaire, I don't think so, but we get letters continuously from our stockholders as to their ideas.

Mr. ROGERS. But it is not addressed particularly to this particular question?

Mr. STARKMAN. The manner in which the corporation is conducting itself and how it is using its resources becomes, of course, a report each year to stockholders, a very extensive report these past few years, Mr. Rogers.

Mr. ROGERS. Let me ask you this: What would you think if perhaps we do this by law so everyone would be affected in a like manner, and suppose we said there should be no style changes for a certain period of time until pollution control is effected according to law so that the funds that have to go into style changes, which are considerable, could be devoted to this effort or else to keep the costs down to the consumer and have a tradeoff there if everyone had to do it? I understand one company could not do that, but what would be your feeling if everyone would be required to do that?

Mr. STARKMAN. I would wish to point out, Mr. Rogers, we think we are putting as much effort as we can possibly put into this.

Mr. ROGERS. I understand this, but this would save the public, perhaps, the $200 that it might require to put on the device.

Mr. STARKMAN. Not all of the money that goes into styling is to change the external form of the vehicle. The accommodation of the emission control devices is part of what styling is involved with. We are worrying very much about how much we are going to put the catalytic converter into the car. In the case of the engines we have now, the only place where we see we can do it is underneath the floor

pan. This means another pan because there is not enough clearance from the ground to the bottom of the vehicle. This is an example: I would say it would be unfortunate if such an approach were taken. If you will allow me just a little philosophy, I would say from an engineering standpoint styling and engineering advances can be made compatible and normally are. Our styling staff has a very large fraction of its professional people from engineering ranks.

Mr. ROGERS. Some manufacturers take pride in the fact that they don't have any style changes. Maybe if we all did that there could be some savings. I understand if you had to make a change because of the function of the device, this, I would think, would be acceptable. For instance, as I recall, the Lincoln has not changed greatly.

Mr. STARKMAN. It is presumptuous but I would hope you have observed the styling change frequency has been reduced considerably within our organization, and within others. We are not doing as much changing of external appearance or internal appearance as we used to. We have already gone in that direction because of the constraints that have been placed upon us and because of economics.

Mr. ROGERS. It might be helpful to us if you could let us have a breakdown of what you think your changes in styling cost. I realize it would be somewhat difficult if it were just to accommodate a change in a motor or something of that sort.

Mr. STARKMAN. Let me call to your attention, Mr. Rogers, among the other things we have to face these days are accommodating the safety requirements issued by the Department of Transportation. As an example, devising bumper systems that will withstand the impacts which have been prescribed is done within styling. They have to come up with the design of bumper systems and accommodations to the automobile.

Mr. ROGERS. I am thinking about styling and comfort and this sort of thing for esthetic reasons or sales reasons rather than for safety requirements. I just wanted to get your reaction. I appreciate your comments.

(See letter dated July 20, 1972, from Mr. Starkman to Mr. Rogers, p. 216, this hearing.)

Mr. ROGERS. I notice you were talking about changing gasoline. There was some complaint saying that lead-free gas, at least the story in the Wall Street Journal or a spokesman from the oil industry said that lead-free gas might result in vapor locks in hot weather and difficult starts in winter weather, but I notice there is an ad from an oil company presently marketing lead-free gas that has made the point in North Dakota that a certain country singer had no trouble starting up in −35°. What is the true situation that you found?

Mr. STARKMAN. Again, I think this is something that should be addressed by the API.

Mr. ROGERS. It probably will, but I wondered how it actually works in your cars.

Mr. STARKMAN. I will give you an answer, which is to say there is no relationship between the amount of lead in the fuel and the capability for starting it up or for its drivability. Lead has to do with the question asked by Mr. Kyros, which is whether the engine will knock or not at a given compression ratio with a different mixture of the hydrocarbons in that composition of oil that the oil company produces.

Mr. ROGERS. On your hardware that you give the costs for of $120.60 for 1974 and $193.40 for 1975, what is the profit figure involved there?

Mr. STARKMAN. As far as the corporation is concerned, it does not do any marking up of emission control or safety items. These are marketed from the corporation at corporation costs.

Mr. ROGERS. That is very commendable.

Are these gotten from subcontractors?

Mr. STARKMAN. Many of the components are purchased from the outside.

Mr. ROGERS. They would have a cost-and-profit factor?

Mr. STARKMAN. I would presume so.

Mr. ROGERS. So you would not know what the other assembled device would represent in the way of profits?

Mr. STARKMAN. No, sir.

Mr. ROGERS. Could you give us that figure?

Dr. BOWDITCH. We can certainly try.

Mr. ROGERS. I would not think it would be too difficult. Just list the parts and how much they cost.

Dr. BOWDITCH. We can list how much they cost us.

Mr. ROGERS. If you can't get it, let me know and maybe we can.

Mr. STARKMAN. I thought you were asking for the total profit.

Mr. ROGERS. How many cars do you have in testing, could you estimate, say, during the past year if you want to give us a number? Just furnish it for the record. I won't pursue it right now.

Mr. STARKMAN. We can do this.

Mr. ROGERS. And how many different devices are you working with? What combinations and what modifications, anything like that that I think would be helpful to know, and how many men do you assign to this program? I noticed that you said an accumulation of 3,000.

Mr. STARKMAN. Some of them are part time so you take two people and put them together and call them one.

Mr. ROGERS. Tell us how many engineers you have working and, for instance, I would be interested to know how many you have working on styling. I understand that your styling can go with requirements for safety, too.

Mr. STARKMAN. And emissions, too.

Mr. ROGERS. I think you have given us the amount of the budget for air pollution problems and you will let us have that for your style changes.

(Testimony resumes on p. 231.)

(The following letter and attachments were received for the record:)

GENERAL MOTORS CORP.,
GENERAL MOTORS TECHNICAL CENTER,
ENVIRONMENTAL ACTIVITIES STAFF,
Warren, Mich., July 20, 1792.

Hon. PAUL G. ROGERS,
U.S. House of Representatives,
Washington, D.C.

DEAR MR. ROGERS: Your staff has recently informed our Washington Office that the record will shortly be printed covering hearings held earlier this year by your Subcommittee on Public Health and the Environment.

During my testimony, January 26, I was asked to provide information in re-

sponse to several questions. Some of the information requested was not readily available and required some time to assemble. The questions posed by the Subcommittee and our responses follow, insofar as the information is available.

1. Request for the projected reduction of pollutants which might be expected from a modification of fuel distillation characteristics along the lines which were the subject of discussions between General Motors and various oil companies at the time of the hearing. (Transcript page 54.)

Response.—Figures 7, 8, and 12, attached with explanatory text, supply the requested information. In my testimony, I indicated that there were some driveability advantages which might result from such a fuel modification. The attachments, from material presented to the oil companies, also provide information on this.

Figure 12, with explanation, indicates the fact that approximately a 50% reduction in carbon monoxide can be achieved under a cold start condition with a quick release choke using more volatile fuel than with a standard choke arrangement and using commercial fuel.

Figure 7 and accompanying text indicate the manner in which driveability characteristics were rated.

Figure 8 and text show, in the small box, how various fuels compared in the rating systems, depending upon the temperatures at which given percentages of the fuel had evaporated. The results show that experimental fuel GM-3 received the highest driveability rating in both temperature ranges plotted in the Driveability Rating Chart (small box). Ninety per cent of this fuel evaporates at a lower temperature than any of the other fuels (shown in the larger chart), a performance characteristic which the data suggests is more important than other ranges from a driveability viewpoint.

2. Request for profit projections for 1974–75 systems. (Transcript page 78.)

Response.—This question and the subsequent discussion appear to ask for the costs to GM for parts purchased from outside suppliers for the 1974 and 1975 control systems. This information is not available because we have not established contracts with any outside suppliers to purchase parts for the 1974 and 1975 emissions control systems. The designs for these systems are not finalized and indeed are still in research and development.

Unfortunately, Dr. Bowditch, who accompanied me, apparently misunderstood questions (transcript page 79) as to specific parts and prices of components for 1974/75 systems. He responded on the basis of attempting to provide information related to current model production systems rather than systems being developed currently for 1974/75.

The price estimates cited by you on page 78 were made by the National Academy of Sciences (NAS) and reported by the NAS in their report issued January 1, 1972. While General Motors has made general estimates for the NAS, the Environmental Protection Agency (EPA) and the study on Cumulative Regulatory Effects on the Cost of Automotive Transportation (RECAT), we advised these agencies that such estimates were only approximations because: (1) we were still in the process of developing systems to meet the standards, (2) it would be extremely difficult to ascribe with precision any segment of total vehicle price to any individual component or system, and (3) it is not possible to specifically identify profit in connection with any single component of total vehicle. (The statistical projections which were supplied included no element of profit for General Motors.)

For whatever value these statistical projections may be in your Committee deliberations, because the data apparently are relevant to the questions and discussions at this point in the hearing, the same information supplied earlier to the previously named agencies and study groups and transmitted with our request to the EPA for suspension of 1975 federal standards, is provided in the table on page four.

The *statistical* price ranges for the 1975 system include some components which were used in earlier systems as well as some parts designed for the 1974 system. These *statistical* prices show increases in comparison to an uncontrolled car. You should note that the estimates—including only major components and modifications—cover a range of possibilities since, as we have indicated previously, the designs are not yet finalized.

77-166 O - 72 - 15

Major components and modifications

[Amounts in dollars]

	Statistical sticker price range
Positive crankcase ventilation	3 to 4
Changes for unleaded fuel: Valve rotators added, valve seats hardened, compression ratios altered	4 to 6
Evaporative control system: Domed tank vapor separator, carbon canister	13 to 15
Induction system: Electronic ignition, idle limiter, anti-dieseling, modified spark timing, early fuel evaporation, exhaust gas recirculation, improved carburetion and choke with altitude and temperature compensations	135 to 155
Exhaust treatment: Air injection reactor, long-life exhaust, catalytic oxidizing converter	130 to 145
Total	285 to 325

NOTE.—The range estimated for the total sticker prices would permit an average figure of about $300, which is the figure that we have submitted for use in various reports and reviews.

3. Request asking: "How many cars do you have in testing, could you estimate, say, during the past year if you want to give us a number?" (Transcript page 79.)

Response.—GM maintains emission test facilities at 40 different locations throughout the United States not only to accommodate many engineering, design and development groups, but also to encompass a wide range of ambient and altitude conditions. Twenty-eight of these test locations have the capability to measure mass emissions with the CVS sampler technique. Included in these locations are 43 individual test units which can perform the mass test. In addition, another 42 test units are equipped to conduct concentration test measurements. During 1971, the engineering development laboratories, excluding any production plant emission testing, conducted more than 46,000 emission tests on more than 12,000 vehicles.

During the past year, there have been very extensive reliability and durability test programs being developed for 1975 models. For example, more than two million test miles were accumulated on a wide range of catalysts to evaluate their durability and emission control potential.

4. Request asking: "And how many different devices are you working with? What combinations and what modifications, any thing like that that I think would be helpful to know?" (Transcript page 80.)

Response.—A complete description of our efforts on a project-by-project basis was included as Section 3(a) of our application for suspension of the 1975 hydrocarbon and carbon monoxide standards. This section is attached for your review on this question.

5. Request asking for the ". . . amount of the budget for air pollution problems and you will let us have that for your style changes." (Transcript page 80.)

Response.—During 1971, GM spent $182 million in the U.S. to make emission controls more efficient and effective and to research and develop new emission control systems. Expenditures for these activities are running at a substantially higher level this year.

The design staff, contrary to popular concept, is involved in much more than vehicle appearance change. For example, a designer who was working in 1971 on bumper designs for future models had three design objectives: (1) safety requirements associated with the bumper, (2) repairability requirements which were

separate from safety and (3) appearance, which customers demonstrate is an important consideration in their buying decisions. Unfortunately, we do not maintain our rceords in such a manner that we can identify the total cost or the number of personnel working exclusively on styling per se.

Style changes are made at the same time as, and are related to, changes in functional aspects of the car—e.g., changes which relate to comfort, reliability, safety, and operating characteristics. Thus, most of the GM Design Staff employes are occupied in activities that are in engineering, technical, structural, clerical, and mechanical areas. Styling, in the conventional sense, is only a minor part of the total work activity of the Design Staff.

The bulk of style change costs is included in the cost of special tools. In 1971, General Motors' Annual Report showed that the total tool amortization expense was $918 million (page 32). This would amount to $118 per vehicle for the 7.8 million vehicles sold worldwide by General Motors in 1971. Even this figure of $118 overstates the cost of styling, since it includes a large amount for tool amortization relating to functional changes, including vehicle emission control equipment. It also includes tool amortization relating to non-automotive products.

Any styling changes which are made clearly contribute to increased sales volume and thereby reduce other costs on a per-unit basis. The manufacturer also relies on new tooling, in large part, to contribute to productivity improvement, which is essential to remaining competitive in both domestic and world markets.

In addition, of course, tooling costs would exist even in the absence of any changes in the car at all, because of normal wear and tear to those tools and because of changes in production techniques. Many of our production tools either wear out physically or become technologically obsolete. In many instances, it would be just as costly to replace the tools as it is to provide an improved product.

Although no question was posed on the subject, there was an exchange of estimates on the total amount of General Motors business and its profit. (Transcript page 74.) For purposes of a correct record, we are attaching a copy of the Annual Report for 1971 which, on page 4, indicates that the total dollar sales of all products in that year was $28,263,918,000; the income was $1,935,709,000.

Sincerely,

ERNEST S. STARKMAN,
Vice President.

Attachments:

Figure 7.—Driveability rating

Problem	*Demerits*
Cranking duration	1 per sec.
Idle roughness	1 to 2
Stalls	8
Backfires	2
Hesitation, stumble, sag, surge	2 to 4

Rating = 100 − total demerits.

A number of different driveability rating procedures are being used in the GM studies, but the general kinds of driveability problems encountered are similar. There are listed in Figure 7. Since even with a quick choke, the choke is still on during crank and start, the first potential problem listed, "cranking duration," hasn't really been a problem with the fuels and temperatures currently used. All of the other problems listed, however, have been encountered depending on the volatility of the fuel used. This Figure also shows the demerits for particular driveability problems, with stalls obviously the most important problem because of safety implications. The driveability ratings used are derived—as shown at the bottom of the Figure—by subtracting the demerits obtained for a particular driving cycle from 100. Thus, the higher the driveability rating number, the better the driveability.

EFFECT OF FUEL VOLATILITY ON DRIVEABILITY
(AMBIENT STUDY)

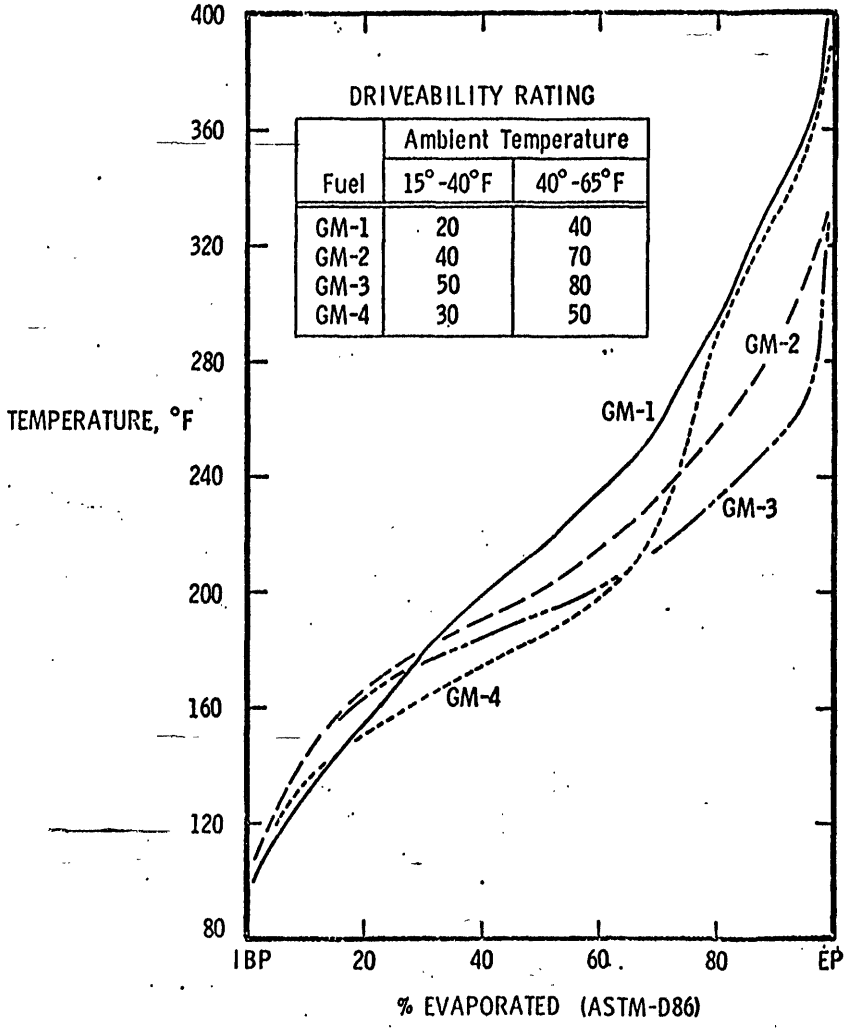


FIGURE 8

EXPLANATION OF FIGURE 8

One of the studies underway is an ambient study using whatever ambient temperature prevails. The results, to date, of this study are summarized in Figure 8. At the time this Figure was prepared, 15° F. was the lowest ambient experienced, although lower ambients have been encountered since then. For simplicity, the data have been divided into two ambient temperature ranges. These data illustrate two points. First, no matter what fuel is used, cold-vehicle driveability increases with ambient temperature when a quick-choke is used.

The data also show the relative importance of the 50% and 90% evaporated points of the fuel in determining driveability with a quick-choke. These fuels are numbered in the order of their 50% evaporated temperature. Thus, fuel GM-4 has a lower 50% temperature than fuel GM-3. The driveability results indicate, however, that fuel GM-3 gave better driveability than fuel GM-4 for both ranges of ambient temperatures. Fuel GM-3, however, had a 90% point temperature lower than any of the other fuels, and gave the best driveability. In fact, these appears to be a general correlation between the 90% point temperature and driveability.

FIGURE 12.—EMISSION REDUCTION WITH VOLATILE FUELS—EQUIVALENT DRIVEABILITY—70° F

Expanded control system	Fuel	Choke	(gms/mile) HC	CO	NO_x
A	Commercial	Standard	0.51	4.6	1.4
	Volatile	Quick	.55	1.6	1.6
B	Commercial	Standard	.15	4.5	.9
	Volatile	Quick	.23	2.8	.7
C	Commercial	Standard	.24	1.5	.7
	Volatile	Quick	.26	.6	.4

Volatile fuel, 10 percent, 120° F.; 50 percent, 195° F.; 90 percent, 250° F.

This is confirmed by the data shown in Figure 12. The emissions from three vehicles equipped with experimental control systems were measured by the 1975 test procedure. In one case, the vehicles had a standard choke and ran on commercial fuel, while in the other case a quick-choke and volatile fuel (as defined at the bottom of the Figure) was used. In this way, vehicle driveability was maintained equivalent.

For each of the experimental control systems, the quick-choke volatile fuel combination gave much lower carbon monoxide emissions—about 50% lower—than the standard choke commercial fuel combination, without any sacrifice in driveability.

Thus, fuels with modified volatility (low 50% and 90% point temperatures) can be used together with quick-chokes to give appreciably lower cold-start carbon monoxide emissions.

SECTION 3A—PROJECT DESCRIPTIONS

General Motors programs in automative emission control include a number of projects as outlined in Section 2 of this document. These projects include activities in all areas of research, development and engineering. The contents of this section are organized by project to describe the projects including the project objectives, approach and status. Details of significant results of each project are integrated into the discussion of potential overall system performance (Section 4a).

I. AIR INJECTION REACTOR AND OTHER AIR PUMPS

For some years prior to 1966, when exhaust controls were first introduced on California cars, General Motors was actively involved in the development of air pump systems for external oxidation of exhaust products. There were various pump designs, each an improvement over the other, leading up to the current production semi-articulated unit. (Figure 1)[1]

[1] Figures and tables referred to not printed in this hearing.

The basic objectives of this project are twofold:

1. Develop an air supply system to provide necessary secondary oxidizing air.
2. Determine optimum air injection location in the exhaust system to maximize manifold reactor oxidation process.

As emission control requirements change and technologies improve, the design of the present semi-articulated vane pump must be continually re-examined.

At this point in time, however, our review of other design approaches continues to show that this basic design concept for an air pump is preferred because it does a better job of meeting the basic objectives.

The 19 cubic inch per revolution semi-articulated pump and similar pumps have been used extensively in production vehicles, and have demonstrated a record of excellent performance and reliability. The current production version incorporates a substantial number of design refinements over original designs first used in 1966. Replacement of the original three-vane rotor by a two-vane rotor has resulted in improved noise frequency characteristics which allowed substitution of a maintenance-free centrifugal air filter for the original external filter. All current installations of this pump are driven directly from the engine through the conventional V-belt arrangement with most of applications having a drive ratio of about 1.2.

Present experimental control system studies suggest that an increased air requirement of about 30% may be required for some of the advanced control systems with the catalytic converter for exhaust HC, CO control. (Figure 2). To obtain these increased flow rates with the current pump would require a drive ratio approaching 2:1. Present design durability performance limits continuous pump speeds to about 6,000 RPM which could be exceeded using a 2:1 drive ratio. Therefore, more than a simple drive ratio change may be required for some applications. Additionally, the higher pump speed introduces new noise problems which would require the added cost and complexity of noise reduction material or devices and possibly a return to the external filter-muffler. The approach being considered for 1975 includes both a larger displacement pump and slightly higher drive ratios, depending on the application requirements.

Air pump systems being designed for 1975 model vehicles continue to introduce secondary air near the exhaust port. Prior experience with our Air Injection Reactor (AIR) systems has shown this to be the optimum location for exhaust cleanup. We have seen no reason to believe, in our experimental oxidation catalyst work, that another location would be more desirable. However, if successful reducing catalytic converters can be developed for NOx control, a secondary air introduction point downstream from the reducing converter will be required. This treatment could either replace or augment the exhaust port injection, depending on the secondary air "programming" ultimately required for such a dual catalytic exhaust emission control system.

II. CATALYTIC CONVERTERS

During the past two years, General Motors has greatly expanded its program to develop and evaluate both oxidizing and reducing catalysts for automotive exhaust emission control. This project includes both research and development as well as engineering. The basic objectives of this project are as follows:

1. Meet 1975–76 Federal standards
3. Provide long-life exhaust system
2. Provide minimum 25,000 mile catalyst durability
4. Use non-nickel steel
5. Use non-noble metal catalyst

We have met the objectives of long-life exhaust system and use of non-nickel steel. The steel companies have done an excellent job in working with us to develop a new steel identified as GM–6125–M. It does not require any nickel and our tests demonstrate it will give a long-life exhaust system.

The General Motors catalyst development program has been based solely on unleaded fuel because lead contaminates the catalyst, rendering it ineffective in a very short time.

Our search has been for non-noble metal catalysts, also referred to as base metal catalysts, for the obvious reasons of availability and lower cost. However, we also have an active noble metal catalyst program to evaluate these if noble metal catalysts are ultimately required.

In July 1970, it became apparent to us that the state of the art of bulk type catalyst supports was well ahead of monolithic supports for automotive applications. Consequently, our program since that time has concentrated on bulk type supports; however, we are still maintaining a very active research program in monolithics.

General Motors has an open door policy to anyone and everyone who feels he can contribute to our catalyst development program. To date, 42 different companies have submitted a total of 612 different catalyst formulations. Thirty-three of these companies have actually submitted samples of 394 different oxidizing bulk catalyst formulations for performance and durability evaluation. (Figure 3). These do not include the many formulations which the catalyst companies made and tested before submitting samples. We require assurance through bench testing that any new submission is an improvement over the previous one. So far as monolithic supported oxidizing catalysts are concerned, to date, 16 different companies have supplied 162 different formulations. (Figure 4).

During the past six months there has been greatly increased activity in the development of a satisfactory reducing catalyst for NO_x control. So far, 20 potential suppliers have submitted 119 different reducing catalysts for evaluation (Figure 5). These are split about equally between bulk and monolithic type supports.

When catalyst samples are received from suppliers, bench tests are conducted to confirm the test results submitted by the supplier. The results of these tests are then compared with base line requirements and with samples submitted by other suppliers. If the sample measures up, it is then tested in a catalyst evaluation car according to the 1975 EPA test procedure.

Each catalyst supplier receives the results of the tests we run on his catalyst formulations so that he can use them to improve performance.

By written agreement with each catalyst supplier, General Motors is not permitted to analyze any of the catalyst formulations submitted. We are only allowed to test them and submit the results to the supplier.

Once it is determined that a catalyst has potential for adequate emission reduction efficiency, it receives further evaluation and testing to determine its performance, including its interactions with other components in the total system.

The status of this catalytic converter project is now in the reiterative process of catalyst selection and evaluation of experimental total system performance. During the past two years, we have built 783 experimental catalytic converters to permit more rapid evaluations of catalysts in the total control system. However, studies on catalyst life cannot be initiated until this reiterative process defines the optimum basic system components. Results of these system studies are discussed at some length in Section 4a of this application.

III. MANIFOLD REACTORS

General Motors has conducted studies of manifold reactor concepts for exhaust emission control continuously for more than ten years. During the past two years, these studies have been accelerated to evaluate manifold reactor performance relative to meeting the emission levels required for 1975 and later. The primary objectives of this project are:

1. Determine emission-reduction potential for both lean and rich reactors.
2. Define engine and reactor operating parameters to achieve maximum emission reduction.
3. Integrate system concepts into expermiental vehicle configurations for performance and service life evaluations.
4. Develop system designs which can be mass produced with existing technology.
5. Define areas where there are deficiencies in technology and institute research studies to fill those technological gaps.

Manifold reactor studies to date have concentrated on defining operating parameters and determining major problem areas which must be resolved, such as material requirements. Although a large portion of this project is in the research phase to find solutions to major problems, some relatively efficient experimental manifold reactors have been built. Results of past research studies are summarized in publications referenced in Section 2c. Recent results of efforts to adapt manifold reactors to production engine configurations is included in Section 4a.

IV. EXHAUST GAS RECIRCULATION

Research studies of exhaust gas recirculation for the control of NO_x emissions have been under way as far back as 1967. The objective was to design an EGR system which could be mass produced and which would meet the following design considerations:

1. Programming for proper flow rate control to provide optimum NO_x control while maintaining satisfactory driveability (12 to 15% recirculation appears to be the optimum rate).

2. Providing on-off control. EGR must be shut off at idle, for example, to provide a stable idle quality. There is only a small amount of NO_x formed during this operating mode.

3. Providing good exhaust gas distribution to maximize NO_x reduction and minimize the loss in driveability.

4. Maintaining high EGR gas temperatures. Our studies show that leaded fuel and cool exhaust gas cause lead salt deposits to accumulate and eventually deteriorate the NO_x control; hot EGR gas reduces this effect. We have also found that a constant mass rate of recirculated exhaust gases within the temperature range of 200°F to 800°F did not have a significant effect on the total NO_x reduction.

5. Designing to withstand high temperatures, the corrosiveness of exhaust gas, and with a tolerance for particle accumulation.

6. Tailoring the spark advance to achieve the best combination of NO_x control and driveability. Our experience indicates that spark retard should be minimized to reduce engine exhaust flow rate and improve driveability.

In the current GM design for recirculating exhaust gas, the gas is drawn from the exhaust crossover, through a control valve which regulates the amount of exhaust gas flow and then introduced into the intake manifold (Figure 6). These passages are cast into the manifold resulting in a neat, compact package.

The ported slot type EGR control valve (Figure 7) used on 1972 model Buicks manufactured for sale in California, was selected after investigating various other designs, including mechanical linkage control, simple on-off and two-stage designs controlled by manifold vacuum, carburetor venturi vacuum control, and back-pressure signal control. In the ported-slot design, an actuating vacuum signal is produced by a vertical slot in the throttle body which blends atmospheric pressure above the throttle blade with a manifold vacuum signal below the blade. As the blade opens, the vacuum signal to the valve diaphragm increases as engine air flow rate increases, and when the slot is fully uncovered the diaphragm is fully exposed to intake vacuum. The EGR flow rate decreases from this point as manifold vacuum decreases. The valve is fully closed at 3–5″ Hg intake vacuum. The original NO_x control potential for this valve was thought to be about 3 grams/mile (1972 Federal Test Procedure), but some GM car divisions are now reporting levels on experimental vehicles of under 2 grams/mile with this design, and are considering using it on 1973 models nationwide.

GM studies have indicated that the optimum NO_x control using EGR is achieved if the recirculation rate is approximately proportional to engine air flow. However, ported-slot design does not provide this proportional flow. Consequently, a different valve design concept is needed to reach lower levels of NO_x control. Another valve was designed which has this proportional flow characteristic. EGR flow is controlled by an orifice between the exhaust back-pressure and a regulated control pressure (8″ H_2O). This design worked well in the experimental stage, achieving NO_x emissions control as low as 1 gram/mile (1972 FTP). However, production prototypes were unacceptable because the valve failed to seal properly at idle conditions, resulting in rough idle, engine stall or both. Failure to seal was caused by the dual seat construction required to balance the valve and the low closing force. This dual seat design has been dropped. A single-seat design using exhaust back-pressure for the signal is undergoing development.

This project remains very active with the aims of adapting current designs to future control systems and designing and developing flow control systems which are nearer the optimum required for maximum NO_x control.

V. EVAPORATIVE EMISSION CONTROL

Development efforts on evaporative emission control have concentrated on the charcoal canister system currently used by General Motors. This system was first installed on 1970 model light-duty vehicles in California, and on all 1971 models nationwide. The emission control performance of this system has been demonstrated in all certification test programs to date to be more than adequate to satisfy requirements of the present (and 1975) Federal regulatory test procedure. The 1972 certification tests showed that all GM cars have projected 50,000-mile evaporative emission levels less than 1 gram/test based on the Federal regulatory test procedure. This level is half the 2 gram/test standard

specified for 1975. In addition, the certification testing has shown that deterioration of this system, when properly maintained, is essentially nonexistent. Deterioration factors from the certification test program are all near 1.0. Based on this performance, we plan to continue using charcoal vapor storage systems for evaporative emission control through the 1975–76 model years.

Meanwhile, this system is being refined to improve its simplicity, reliability and producibility, while maintaining its good emission control performance. One such refinemnet is a domed tank configuration which will allow increased reliability and product quality through easier producibility because of the smaller number of components required for the new system (Figure 8). We plan to install these kinds of refinements in production vehicles as soon as possible, not waiting for the 1975 model introduction. For example, the domed tank configuration is planned for installation on some 1973 model GM passenger cars.

Evaporative control systems other than this basic charcoal canister system have been studied extensively, and these studies are continuing at the present time. Those being considered seriously include various combinations of sealed and insulated fuel tanks. Sealed tanks with high level pressure relief have the potential not only of good evaporative emission control, but also for substantially simplified fuel system plumbing. However, tests to date show that cars equipped with this system can experience pressure levels as high as 5 psi. Such pressure levels, in addition to requiring greater structural capability of the tank, also involve potential user hazards such as fuel cap removal, and these must be very carefully considered before such a system could be used in production vehicles.

Reduction in these maximum pressure excursions through use of thermal insulation of the tank has some promise, although the pressure still would be substantial, probably in excess of 2 psi. Studies of this sealed tank system as a means of controlling evaporative emissions are continuing, primarily to develop structural capability of the tank, further reduce the pressure excursions that might occur in customer service, and develop techniques for consuming in the engine, fuel tank vapors generated in the tank. Since we are not optimistic that these developments can be completed in time for 1975 model introduction, we plan to continue use of the basic canister storage system.

VI. SPARK CONTROL AND ELECTRONIC IGNITION SYSTEMS

The objectives of this project are twofold. First, we are continuing to develop optimum centrifugal and vacuum spark calibration and on-off spark timing controls such as those currently used in production vehicles. The second objective is to develop a reliable electronic ignition system. Not only does electronic ignition eliminate ignition breaker points, but it also has the potential for more dependable ignition for a longer period of time.

The basic electronic ignition system being developed for 1975 models is similar to the ones being used in some 1972 model Pontiacs, except that the system being developed for 1975 models will have higher capacity, allowing a wider spark plug gap and long-duration spark for improved ignition of lean mixtures. Currently, this system is in the experimental design stage.

If adequate design life can be attained, proper firing of the spark plugs (including even degraded plugs) will be achieved with greater reliability over the life of the vehicle, thus retaining good emission performance.

In general, use of electronic ignition systems has not shown any major emission performance improvement compared with the performance of the standard breaker point systems when they are operating properly. However, the wider plug gap and longer duration spark have the potential to allow operation at leaner air/fuel mixture ratios with acceptable driveability. This potential and the greater reliability over the life of the vehicle comprise the main reasons for wanting to incorporate electronic ignition in our 1975 control systems. However, if its potential advantages cannot be realized in a system that can be mass produced, the added expense of the system would not be justified. Extensive design evaluation programs are under way, however, to develop this system to its ultimate potential.

VII. CRANKCASE BLOWBY (PCV)

A crankcase emission control system (PCV) was first installed in 1961 model passenger cars sold in California, and 1963 models nationwide. Since that time, significant advances in PCV control system effectiveness have been made which essentially eliminate crankcase emissions by recirculating them to the engine

intake. Adaptation of this technology to future engines and further refinements based on field experience, will continue.

VIII. FUEL INJECTION

Fuel injection studies at General Motors encompass mechanical fuel injection and electronic fuel injection. The objective of these studies is to assess the emission advantages a precision fuel injection system may have over carburetor fuel metering.

A. Mechanical fuel injection

While mechanical fuel injection has been highly developed for diesel engines, it has shown no promise as a means of reaching the required emission levels for 1975 with gasoline engines. Despite refinements developed by GM, mechanical injection still suffers from too much variation in fuel metering at low engine speeds and loads which are a predominate part of light-duty vehicle operation. Development work on this type fuel injection for light-duty vehicles is now inactive, having been superseded by work on electronic fuel injection.

At this time we have no plans to use conventional mechanical fuel injection as a part of our 1975 light-duty vehicle emission control systems. However, further development of the mechanical injection approach is continuing for application to heavy-duty engines, particularly the diesel.

B. Electronic fuel injection

Two electronic fuel injection systems are under development. The first is a high-pressure "direct cylinder" injection system; the second, a low-pressure "port" or manifold injection system. For purposes of clarity, the two systems will be discussed separately.

1. High-pressure direct cylinder injection

The program to use high pressure, direct cylinder injection as a means of reducing emissions from present production gasoline internal combustion engines produced so little advantage that it has been abandoned for this application. However, because of the renewed interest in stratified charge engines, its development for possible use on these engines has been resumed.

This injection system exists in a "breadboard" or laboratory experimental form only. No attempt has been made to produce a production prototype. Although injection characteristics such as injection pressure, duration, spray geometry and quantity can be varied as required with these systems, a number of major obstacles must be overcome before they could be considered for production vehicles. Such obstacles include:

Supply pump reliability.
Supply pressure regulation.
Injector reliability.
Electronic circuit and transducer stability.
Service complexity.
Hydrocarbon and smoke emission levels.

Because the new engines on which this system is being applied are in the very early research-development stages, little meaningful data on either emissions or long-range durability performance have been obtained.

Development work will continue, but there are no plans at present for applying this work to engines currently in production.

2. Low-pressure "port" fuel injection

General Motors has maintained an extensive program to develop a low pressure "port" injection system. Serious work started with several test installations in 1967. In 1970, 22 units were built and tested. In 1971, 38 units were built and 32 of these were installed for tests. This experimental program has reached the stage of production prototype designs. During this development period, progress has been made in a number of areas with the following results:

Limited success was achieved in both hot and cold lean engine operation.
System development has precluded the need for an enrichment device.
Fuel cutoff on decelerations was found to be ineffective in reducing emissions.
Altitude compensation was found to be automatic, since it is responsive to absolute pressure.

Success in meeting the 1975 standards has been very limited with these experimental systems. Following are some typical data using the electronic fuel injec-

tion in combination with some other control system components. In general, we find that electronic fuel injection emission performance potential approaches, but does not exceed, that of a "good" carburetor system as shown in the following tabulation:

	(1975 test, gm./mi.)		
	HC	CO	NO_x
1971 carburetor	0.9	18.3	5.1
Electronic fuel injection (E.F.I.)	1.2	9.1	4.9
E.F.I. plus catalytic converter	.5	7.3	5.0
E.F.I. plus exhaust gas recirculation	1.7	22.5	1.6

Significant improvement in emission performance must be achieved before this system could be released for production. High priority development work on this approach has been reduced, therefore, to allow greater concentration on the carburetion system. Some of the problems which must be resolved to improve the performance of electronic fuel injection are as follows:

Adaptation of EGR system—the speed density system does not compensate for variations in percent exhaust gas recirculation from design conditions.

Injector tolerance—driveability and emissions are very sensitive to variations in the system, particularly very slight injector pulse length variations from nominal.

System complexity—high cost of service problems are anticipated due to complexity of injector control system.

Component durability and remability of fuel handling is unsatisfactory, and durability of some parts is highly questionable.

Pulse length and circuit stability improvements in injector pulse length control and stability of several electronic control circuits (sensitive to temperature change and outside interference) are required.

Altitude compensation—a sensing element is required.

The following will be emphasized in plans for future development:

Evaluation of alternate injector sequencing patterns, such as "two at a time" operation.

Improvement in enrichment system.

IX. LOW-LEAD FUELS—FUEL SPECIFICATIONS

The scope of this project area includes investigation of low lead fuel effects on engine performance, development of technology in both engine design and materials to allow reliable engine operation on low lead fuels, and development of fuel specifications that appear to be required for advanced emission control systems. We stated publicly in 1970 that our future engines will be capable of operating reliably on unleaded or low lead fuels with a Research octane level of at least 91, and a Motor octane of at least 86. This has been accomplished with our current design engines. However, continuing research and engineering development are required to maintain this capability as the engine operating conditions are modified to approach the emission levels required for 1975 and 1976 models. This will involve significant changes in the combustion process such as air/fuel ratio, spark timing and exhaust gas recirculation.

Optimum performance of advanced emission control systems depends on a number of fuel characteristics. These include mainly the level of catalyst poisoning, constituents in the fuel and volatility. The effect of fuel composition is discussed in detail in Section 5b.

X. CONTROLLED COMBUSTION SYSTEM

The basic objective in the controlled combustion system (CCS) is to combine advances in both engine design and fuel system design so as to maximize emission reductions without using any external emission control systems.

Development work in this area has included major refinements in carburetion fuel controls, spark controls, valve timing and modification of the induction system, as well as the combustion chamber. This controlled combustion system approach was first used on 1967 model passenger cars in California, and has been very successful in meeting the Federal emission requirements since that time.

Continued development of the CCS is essential for future control systems in order to reduce the requirements on external control systems. One major area of development is the quick heat early fuel evaporation (EFE) manifold (Figure 9). The EFE system was described in the March 12, 1971, advance emission system development progress report submitted to Mr. Ruckelshaus. The need for a positive acting heat crossover control is critical with the EFE system, and such controls also are under development. One design possibility is a vacuum powered control valve (Figure 10). In this design, water temperature controls the vacuum signal to the unit to provide positive control of the valve position. This assures a good seal in the cold position for quick EFE warmup, and proper opening during engine warmup to prevent overheating. Cycling durability tests are under way by the valve supplier.

XI. LPG AND OTHER ALTERNATE (GASEOUS) FUELS

Complete systems for burning liquid petroleum gas (LPG) or compressed natural gas (CNG) in automobiles have been marketed for a number of years by various suppliers. Gaseous fuels do produce lower emissions than gasoline. However, gas systems do not by themselves meet the 1975 standards. Gas-fueled engines require supplementary emission control systems, such as EGR and catalytic converters, as do gasoline fueled engines.

Our project work on gaseous fuels has concentrated on an extensive study to determine the capability of gaseous fuels (both LPG and CNG) in reducing emissions from automobiles. Economy, performance and driveability were also studied. Results of the study were presented at the January, 1972, SAE Congress. During this study, neither the LPG nor the CNG car could be adjusted to meet the 1975 emissions standards.

General Motors does not plan to use a gaseous fuel system as a part of its 1975 emission control systems. Oil company contacts have indicated there is an insufficient supply of LPG to fuel a significant portion of the vehicle population. In addition, very major changes in current fuel distribution systems would be required to provide this fuel at locations easily accessible to the vehicle owner. Other disadvantages include safety and added vehicle weight.

Project work on gaseous fuels will be continued on a research basis to keep abreast of gaseous fuel technology and to assemble information which might be adaptable to emission control systems used on gasoline-fueled engines.

XII. SMOKE AND ODOR

The basic objective of investigations into smoke and odor is to develop precision fuel supply systems and controls along with design and development studies of the combustion process to reduce smoke and odor formation. Most of the activities in this project area have been directed toward the reduction of smoke and odor from diesel engines. While this engineering effort has concentrated on heavy duty diesel engines, the technology developed certainly will apply to projects now under way to develop diesel engines which might be used in passenger cars.

Significant progress already has been made in reducing smoke and odor from diesel engines. We are optimistic that further reductions can be achieved by continuing these research and engineering development studies. In particular, odor reduction activities are now concentrated on determining those constituents of the exhaust that actually contribute to the odor. Beter definition of these constituents will lead to progress in developing more effective control techniques.

XIII. CARBURETION

Improvements in fuel carburetion are a very important part of efforts to develop control systems which will meet the 1975 emission standards. Very precise fuel metering control must be provided for maximum emissions reduction in the basic engine emission level. The following summarizes recent activities to achieve this objective.

Three major carburetor types are planned as a part of our basic 1975 control system: a modified one-barrel, a new plain tube two-stage progressive two-barrel, and a modified four-barrel. A fourth design, which may be possible and preferred, is an air valve carburetor in place of the new 2-barrel carburetor. The modified one-barrel includes added control features, such as altitude compensation and a new choke. The new two-barrel carburetor is being designed with primary and

secondary venturi systems having progressive action similar to the present four-barrel carburetor. Current plans are to continue the present basic four-barrel carburetor with improvements to achieve optimum overall emissions control system performance. Modifications include altitude compensation, improved choke operation, improved metering accuracy, and revised evaporation control provisions.

An experimental altitude compensation system has been built into several carburetor models and tested for retention of correct air/fuel ratio at various altitudes. Metering control with this altitude compensator appears satisfactory up to 7,000 feet. Additional improvements above 7,000 feet are being pursued through refinements in the design. Metering control in this area is necessary to provide control of emissions as well as to avoid potential damage to the catalyst and catalytic converter canister from overheating with high emission exhaust.

Experimental hot air choke systems, integral with the carburetor, are showing promise of more consistent operation. The choke systems on 1972 model GM production cars are refined to provide positive closing for cold starting, and rapid opening during initial warmup to reduce cold start emissions. This choke mechanism is marginal for acceptable start and driveaway, and does not appear to have potential for further emission improvement during cold start without seriously deteriorating vehicle driveability. This new system, combined with higher temperature intake air and the Early Fuel Evaporation (EFE) intake manifold design to provide additional heating of the mixture, is providing lower CO emissions with acceptable driveability than would be possible with current emissions control systems.

The precision control of air/fuel mixture ratios with current two-barrel designs is near the limit of production capability. An experimental progressive two-barrel carburetor is being developed to achieve higher venturi velocity and, therefore, a better signal to control metering during operation modes critical for emissions.

A carburetor bowl vent valve has been designed for more effective control of evaporative losses from the carburetor. This valve arrangement is planned to provide venting of the carburetor bowl to atmosphere when the engine is running and to the evaporative control system canister to trap evaporative emissions during hot-soak periods.

Many major areas of the carburetor are currently undergoing design improvements. These carburetor improvements, in conjunction with other system developments, have shown some potential of achieving 1975 emission levels on experimental vehicles. These new carburetors are being developed to optimize overall system performance, but because of the interaction of carburetion with the other parts of the system, emission improvements as a direct result of the carburetor alone cannot be reliably documented. In addition, these carburetion developments are still in the experimental stage. Although they show some potential for allowing development of an overall control system to meet the 1975 levels, insufficient durability experience has been obtained to determine if a reliable carburetor could be mass produced. This determination cannot be effectively made until pilot production units have been tested. A listing of the major carburetor areas being redesigned follows:

CARBURETOR FOR 1975–76

Improvements being evaluated:
- New choke mechanism:
  - Quick pull-off (quick heat intake).
  - Separate fast-idle cam operation.
- Velocity pull-over enrichment.
- Improved primary main metering system:
  - Better modulation of nozzle.
  - "Cut in" and transient flow.
- Improved secondary metering:
  - Accuracy of control.
  - Reduced hysteresis.
- Altitude compensation.
- Improved off-idle flow control:
  - Adjust in production.
- Deceleration mixture control (converter protection)
- Shaft seals, external.
- Evaporative loss control valve.

XIV. EMISSION ANALYSIS, AUDIT, TESTING AND RELATED FACILITIES

The primary objectives of this project area are to provide facilities for emission performance testing, reliability evaluations and durability test programs, and assemble the manpower necessary to conduct these evaluations. Efforts in this project area not only include facilities at individual GM divisions and system evaluation programs, but also include Central Office activities to provide centralized facilities and manpower for certain aspects of overall system evaluation. For example, we maintain emission test facilities at 40 different locations throughout the United States not only to accommodate many engineering, design and development groups, but also to encompass a wide range of ambient and altitude conditions. Twenty-eight of these test locations have the capability to measure mass emissions with the CVS sampler technique. Included in these locations are 48 individual test units which can perform the mass test. In addition, another 42 test units are equipped to conduct concentration test measurements. During 1971, the engineering development laboratories, excluding any production plant emission testing, conducted more than 46,000 emission tests on more than 12,000 vehicles.

During the past year, there have been very extensive reliability and durability test programs being developed for 1975 models. For example, more than two million test miles were accumulated on a wide range of catalysts to evaluate their durability and emission control potential.

XV. ALTERNATE ENGINES

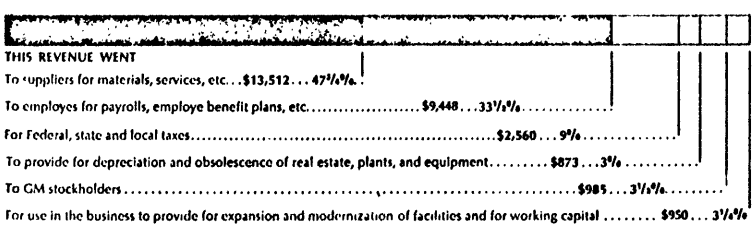
Extensive project activities on a number of different power systems are being pursued within General Motors. The discussion of these projects is included in Section 4g of this application.

[Excerpt from General Motors Corp. Annual Report, 1971]

GENERAL MOTORS HIGHLIGHTS

	1971	1970	1969
DOLLAR SALES OF ALL PRODUCTS			
United States Operations			
Automotive products	$22,619,113,000	$13,420,833,000	$18,895,778,000
Nonautomotive products	1,560,884,000	1,523,190,000	1,622,732,000
Defense and space	414,617,000	534,884,000	698,019,000
Total United States Operations	24,594,614,000	15,478,907,000	21,216,529,000
Canadian Operations	2,470,395,000	1,309,509,000	1,985,455,000
Overseas Operations	4,112,314,000	3,652,151,000	3,378,453,000
Elimination of Intercompany Sales	(2,913,405,000)	(1,688,213,000)	(2,285,296,000)
Total	$28,263,918,000	$18,752,354,000	$24,295,141,000
FACTORY SALES OF CARS AND TRUCKS			
Manufactured in U.S. plants	5,767,000	3,591,000	5,260,000
Manufactured in Canadian plants	509,000	291,000	501,000
Manufactured in Overseas plants	1,503,000	1,426,000	1,399,000
Total	7,779,000	5,308,000	7,160,000
NET INCOME	$ 1,935,709,000	$ 609,087,000	$ 1,710,695,000
As a percent of sales	6.8%	3.2%	7.0%
Earned per share of common stock	$6.72	$2.09	$5.95
Dividends per share of common stock	$3.40	$3.40	$4.30
TAXES			
United States, foreign and other income taxes provided	$ 1,784,100,000	$ 185,100,000	$ 1,866,300,000
Other taxes provided	775,900,000	679,800,000	670,400,000
Total	$ 2,560,000,000	$ 864,900,000	$ 2,536,700,000
Total taxes per share of common stock	$8.95	$3.03	$8.89
Total taxes per dollar of net income	$1.32	$1.42	$1.48
Total taxes per dollar of dividends	$2.60	$0.88	$2.05
REAL ESTATE, PLANTS, AND EQUIPMENT (Excluding Special Tools)			
Plant expenditures for year	$ 1,012,968,000	$ 1,134,165,000	$ 1,043,842,000
Balance at December 31	5,507,392,000	5,413,457,000	5,133,691,000
INVESTMENT AS OF DECEMBER 31			
Net working capital	$ 4,530,387,000	$ 3,267,591,000	$ 4,548,891,000
Stockholders' equity	10,803,237,000	9,853,771,000	10,227,904,000
WORLDWIDE EMPLOYMENT			
Average number of employes	773,000	696,000	794,000
Total payrolls	$ 8,015,072,000	$ 6,259,841,000	$ 6,928,279,000

WHAT HAPPENED TO THE REVENUE GM RECEIVED DURING 1971



Mr. ROGERS. Are there any other questions?

Thank you very much for you and your colleagues being here.

The committee may have further hearings later on, but I think this will get us started in what needs to be done.

We have additional witnesses but it is now 12:30. We will now adjourn until 1:30 this afternoon.

(Whereupon, at 12:30 p.m., the subcommittee recessed, to reconvene at 1:30 p.m., the same day.)

AFTER RECESS

(The subcommittee reconvened at 1:30 p.m., Hon. Paul G. Rogers, chairman, presiding.)

Mr. ROGERS. The subcommittee will be in order, please.

We will continue our hearings on the Oversight Clean Air Act.

Our next witness is Mr. P. N. Gammelgard, senior vice president for public and environmental affairs, American Petroleum Institute, Washington, D.C.

We welcome you back to the subcommittee.

STATEMENT OF P. N. GAMMELGARD, SENIOR VICE PRESIDENT FOR PUBLIC AND ENVIRONMENTAL AFFAIRS, AMERICAN PETROLEUM INSTITUTE

Mr. GAMMELGARD. I would like to point out that there are a few changes in my statement as I will deliver it. They are minor, yet they are rather significant in meaning.

I would like to thank the committee for this opportunity to present the views of the petroleum industry on the national program to control automobile emissions.

In the late 1960's, the petroleum industry sponsored research into the effects of lead on the environment and an economic study of producing lead-free fuels. Our economic study was based on the assumption that all gasoline would be lead-free and that the then current octane levels of "regular" and "premium" gasoline would not be changed.

Then, in 1970, several important things happened which made this economic study obsolete. In January of that year, Ford and General Motors claimed that the advanced emission control devices required to meet the administration's proposed tailpipe emission standards for the mid-1970's would operate properly only on an unleaded grade of gasoline. Within a matter of weeks, the individual oil companies, one by one, stated publicly that they were prepared to make no-lead gasoline available when Detroit produced cars that required it.

Later in the year, General Motors announced that all of its 1971 model cars would operate satisfactorily on 91 research octane fuel, leaded or unleaded, and the other car manufacturers announced that most of their 1971 models would do the same. Following these announcements, new low-lead and no-lead, low-octane gasolines began to appear on the market. All this took place without any Government regulation.

I might add for the sake of the record there were several no-lead grades of gasoline which had been on the market for some years.

Then, in December 1970, the Congress adopted Clean Air Act amendments which granted to the Federal Government the power to regulate fuel composition and fuel additives, including lead. Congress also adopted an amendment requiring, by 1975, a 90-percent reduction from 1970 levels of hydrocarbons and carbon monoxide exhaust emissions and, by 1976, a 90-percent reduction from 1971 levels of nitrogen oxides. Passage of these amendments meant that the oil companies had to expect that one grade of lead-free fuel would be required by mid-1974.

In view of uncertainties over what actions Detroit may take, and what form Federal regulations also may take, the oil industry has not initiated any new economic studies.

The Environmental Protection Agency, however, did commission a consulting engineering firm to make an economic analysis of 12 possi-

ble schedules for phasing out lead. From that study, published in June 1971, it could be concluded that the increased cost of unleaded fuel alone to the motorist whose car is equipped with advanced emission control systems would range from about 5½ cents to 7 cents per gallon. This is taking into account the reduction in engine efficiency necessary to achieve proposed 1975 emission standards.

An oil industry task force that analyzed the report concluded that it tended to understate the true cost of phasing out lead. The critique prepared by the task force was forwarded to EPA in October 1971. One of the key criticisms of the report was that it was based on a mathematical model of a single, large, modern refinery, including petrochemicals which, of course, is not typical of the majority of existing refineries.

A single refinery case obviously cannot be representative of the entire refining segment of the industry with some 260 or so operating refineries.

Very recently, further uncertainties have been introduced by General Motors, which has inquired of some of the oil companies what would be involved in producing a special type of unleaded gasoline. Understandably, the API itself, as a trade association, has not been consulted on this matter by General Motors.

Talks between individual companies and General Motors are taking place as you heard this morning from Dr. Starkman. It is obvious that any major change in fuel specifications that narrowed the traditional boiling range of gasolines could substantially increase manufacturing costs and consumption of crude oil resources. Moreover, it would substantially reduce gasoline mileage and vehicle performance. In other words, the motorist would have to pay more per gallon and get less in return.

I might say at this point, Mr. Chairman, I make these remarks because my background, before I came with API some 6 years ago, was entirely in the manufacturing end of running refineries and I do know something about making gasoline.

There are other things that make forward planning difficult for the oil industry. The Clean Air Act amendments, for example, provide for Federal preemption of regulation over fuel composition and fuel additives. But until such preemption is exercised, any State or any municipality can adopt—and some have adopted—regulations of their own. It is still not clear whether the impending Federal regulations on lead will be comprehensive enough to provide the nationwide uniformity and stability which are generally, though not always, desirable.

At this point in time, the cost of meeting the automobile exhaust emission goals in the clean air amendments cannot be known precisely, but certainly the economic impact is going to be great. The recent study of the National Academy of Sciences indicates that for the motorist there will be a substantial increase in the initial cost of the new automobile, a reduction of mileage per gallon of fuel, and an increase in maintenance costs.

The NAS study is an excellent analysis of the technological feasibility of meeting the exhaust emission goals set forth in the clean air amendments. The study, however, does not, and was not intended to, explore the merits of the goals themselves—that is, whether the social and economic costs to the public will bring commensurate benefits.

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In other words, there has been no study to determine whether this step—this drastic step—is really necessary. I would respectfully suggest that Congress give serious consideration to making such a study, with a view toward reexamining the exhaust emission goals of the clean air amendments.

Mr. Chairman and members of the committee, earlier I mentioned the importance of Federal preemption in the field of fuel-composition regulations. I would like to turn now to a different but related problem, because it deals with hydrocarbons going into the atmosphere.

By the end of the current month, each of the 50 States must submit to EPA an acceptable plan for implementing national air quality standards. Although not required to do so by the statute, EPA issued, last August, guidelines to the States on the preparation of these plans. Although the guidelines properly give the States considerable flexibility in determining how to meet the national standards, they do contain model regulations which have been interpreted by some as minimum requirements for an approvable plan. Among these are requirements for severe controls on hydrocarbon emissions from storage facilities.

On December 30, however, just 1 month to the day before the State plans were due—and long after deliberations on many plans had been completed—EPA published an important amendment to the guidelines in the Federal Register. This amendment stated, in effect, that the model requirements for hydrocarbon storage are needed only in the areas where a photochemical smog problem exists.

As late as last week, word of this amendment had not reached some States and at least one EPA regional office that I know of.

On the strength of this amendment, which our industry brought to its attention, South Dakota deleted an unnecessary section from its implementation plan. This change means a saving of literally millions of dollars in that one State.

The point I am making is that there is an obligation, I feel, for EPA to provide clearer guidance to the States, and, in this particular case, to advise the States when they go too far—because they have misinterpreted EPA guidelines—as well as when they don't go far enough.

This concludes my prepared remarks. I will be glad to answer any questions you may have.

Mr. ROGERS. Thank you very much, Mr. Gammelgard.

Mr. Carter?

Mr. CARTER. Thank you, Mr. Chairman.

I noticed in your presentation, Mr. Gammelgard, that this question—in what ways would it not be desirable to have uniform Federal and State regulations on gasoline?

Mr. GAMMELGARD. The problem is of a different magnitude in different parts of the country.

I can foresee the day when stricter requirements on emissions might be required in a particular part of the country than in others.

At that time, I think you might have to have different regulations on the amount of lead or in the composition of fuels for those particular regions.

Mr. CARTER. You would regard Los Angeles to be such an area in which stricter regulations might have to be issued?

Mr. GAMMELGARD. I think the Los Angeles Basin is unquestionably the one area of the country that has the worst photochemical smog condition, yes, sir.

Mr. CARTER. You say that this will result in a substantial increase in auto costs and a reduction in gas mileage per gallon also—I mean trying to reach the goals we mean to reach in 1975?

Mr. GAMMELGARD. Yes, sir, there will be a reduction in gasoline mileage from several aspects. One is the reduced compression ratio of the car results in a slightly lower engine efficiency. That is minor compared to the effect the emission controls will have on gas mileage. This penalty would be greatly increased by this very low end-point special fuel that General Motors talked about this morning as being an assist to them in reaching the 1975 standards where they have the problem of the warmup period the first 2 minutes of the test cycle.

Mr. CARTER. You state that it would cost 5½ to 7 cents per gallon to manufacture a lead-free gasoline or is it that high-volatile gasoline that you are referring to there?

Mr. GAMMELGARD. That is the first case I referred to. I do not know what the cost would be to make this low end-point, low-volatility 9-pound Reid vapor pressure fuel. It has been said this is the type of fuel that General Motors would like to see.

Gasoline is a mixture of hydrocarbons that normally start to boil in the vicinity of 100° F. and it is all boiled off at approximately 400° F.

Now, if there is a 90-percent point at 250° F., this would probably lead to an end-point of around 290° or 300° F. so you would be chopping off the tail end of the gasoline, or that portion between 290° and 400° F.

This is the heavy portion of the gasoline that boils off last. This also has the highest B.t.u. content.

If you take that out, something has to be done with that fraction. It would call for additional processing to break it up into lighter molecules that could be blended back into the gasoline pool of the lighter product.

That would mean an additional refining cost, it would mean a lighter gasoline with less B.t.u.'s per gallon and all an internal combustion engine does is convert the B.t.u.'s in the fuel into power, so a car would require more gasoline to drive at the same number of miles.

If the gasoline would cost more to make and each gallon would drive the car fewer miles, there would be a double penalty. I don't know the magnitude of that, but it would be very substantial.

Mr. CARTER. In addition to that, you might have vapor lock with this high-volatile gas.

Mr. GAMMELGARD. In spite of the fuel being lighter, General Motors would also like to have a 9-pound Reid vapor pressure limit—which should prevent any vapor lock problems.

The problem it would cause, I am quite certain, is starting in midwinter. If you have a 9-pound Reid vapor pressure gasoline where the temperature—say, in Minnesota—reaches 40° below zero, trying to start a car that has not been in a garage overnight, you would have difficulty.

Currently, it is 9 pounds for summertime, 11 pounds in the fall and spring, and 13 pounds in wintertime.

Now, if it is made 9 pounds year-round, I think you would have real starting problems in the colder climes.

Mr. CARTER. I thought the more volatile a gas, the easier it was to ignite.

Mr. GAMMELGARD. It is the lighter fractions of the gasoline that GM is proposing to retain with a limit of 9 pounds Reid vapor pressure—a combination of the two. You would have a light gasoline with the tail, the heavier part, out. In the cold part of the driving cycle, in the warmup period, the heavier fractions have a tendency to go through partially unburned, and if the catalyst system is not warmed up at that point, which it would not be for the first minute or two, then they would go into the atmosphere. This is one of the automobile industry's problems, what to do with the emissions in the warmup period of the car when you first start your car on any day.

I don't mean each time you start it in 1 day, but the first start after being parked overnight.

If your car has been parked 4, 5, 6, or 7, or even 8 hours, you do not have an equivalent problem with warmup.

Mr. CARTER. I believe that was the reason for using high-volatile gasoline to begin with, wasn't it, that there would be fewer emissions when the car was started? That is where, with regular gasoline, we get this increase in emissions.

Mr. GAMMELGARD. Yes, during the first couple of minutes.

Mr. CARTER. I have difficulty in seeing how you resolve this problem. What about our essential supply of gasoline in the United States?

Mr. GAMMELGARD. I think you mentioned a figure of 8 years——

Mr. CARTER. Ten years.

Mr. GAMMELGARD. The ratio of proved reserves to demand at current levels show about a 9-year crude supply in the United States. This ratio has dropped down rather consistently over the last 20 years, due partly to not finding enough new reserves of crude oil and partly to the 4- or 5-percent increase in consumption per year.

Even if your reserves stayed the same and if your consumption doubled, your reserve-to-demand ratio would decrease.

Mr. CARTER. I believe in your presentation you speak of the advisability of perhaps using the fuel-injection system, the automotive industry using that.

Why did you do that?

Mr. GAMMELGARD. Fuel injection has been around for a good, long time. It is used on some of the higher priced European cars. It was tried out about 15 years ago on one line of Chevrolet cars which were available with a fuel-injection system at additional cost of several hundred dollars per car.

Mr. CARTER. What method is used on the Volkswagen? That is one of the cheaper cars.

Mr. GAMMELGARD. I am not sure of what their so-called metered injection is. I am not familiar with the details of it.

Mr. CARTER. I believe I am correct in stating that the fuel-injection system is used on a Volkswagen. I think at this point it should certainly be considered from the point of conserving our gasoline supply as well as more efficiently burning the gasoline that is put into that car.

Mr. GAMMELGARD. Texaco has been working for many years on the so-called Texaco stratified charge engine which, as I understand it, in its current state of development does employ the fuel-injection principle.

Mr. CARTER. Do you think it would result in decreased consumption of gasoline and we could conserve our gasoline in this way?

Mr. GAMMELGARD. It would have that tendency.

Mr. CARTER. We certainly need to look to this closely. It is important to the needs of our country that we do consider our supply of gasoline and that we use it wisely. I have seen very little intent or purpose upon the part of the automotive industry to reduce the amount of gasoline that is consumed by automobiles in our country. I know it is possible, we know that it is possible, because we see that every producer of foreign makes of automobiles produces cars which use less gasoline than ours do. In a sense, it makes it almost impossible for the people of this country to buy anything but gasoline hogs and that is what some of these cars actually are. There have been charges of collusion, I regret to say, between the automotive industry and the gasoline industry, oil industry, and I regret these things because it just should not be. We have to adopt a different attitude and way of looking at things.

I notice on the last page you say that we should take a new look at this and we have to weigh the social advantages, or something to that effect, and the economic advantages or disadvantages, is that correct?

Mr. GAMMELGARD. I think we should take a good hard look at the cost to the public, because I think eventually the public will bear the cost of these improved-emission vehicles and see whether that last 5- or 10-percent reduction in emissions really comes through with a commensurate benefit to the quality of the air of the country. I really believe that, Dr. Carter. You get to the point of the law of diminishing return on anything you are trying to remove from any kind of an engineering system, and that last few percent, unless it is necessary for the protection of public health or welfare, I think we can overkill or overexpand to get it.

I think it should be examined to see whether it is really justified.

I would like to call your attention to figure 3.1 in the National Academy report. I think it is a rather interesting figure. It shows for three different pollutants in exhaust emissions—hydrocarbons, carbon monoxide, and nitrogen oxides—what the 90-percent reductions from the 1970 levels really mean because they are superimposed on 59-percent and 62-percent reductions already achieved in the 1970 model year cars. The additional 90 percent of the balance results in a 97-percent reduction in hydrocarbons and a 96-percent reduction in carbon monoxide, compared to an uncontrolled car.

I am just saying possibly it would be better economics for the country and for the people of the country to look at what an 85-percent reduction from an uncontrolled car would cost, what would a 90-percent reduction cost, and what would be the corresponding benefits to the atmosphere, to the air.

Mr. CARTER. Certainly I realize there is an economic factor here and perhaps we should weigh it, as you say, and we should also consider these things, but then we know that the emissions from automobiles do cause much trouble, much disease, much sickness. It has

been proven over and over again, and in fact, at tests run out at the National Institutes of Health, it is my understanding that inhalation of hydrocarbons with a virus has produced cancer. It is absolutely necessary for us to reduce the amount of hydrocarbons and/or other noxious emissions to the point where they won't adversely affect the health of our country.

Mr. GAMMELGARD. API has long taken the stand that anything that needs to be done to protect the health of the people of the United States from air or water pollution should be done irrespective of the costs of doing it.

Mr. CARTER. You have made that statement, but here you bring it up again and say we should reconsider or think again about the social versus the economic effect. That is a little doubling up.

Thank you, Mr. Chairman.

Mr. GAMMELGARD. Could I respond to one statement Dr. Carter made? It was not in the form of a question, but you referred to possible collusion between the oil and the automobile industries. If I could have a minute, I would like to respond to that.

Mr. CARTER. I would like to hear you.

Mr. GAMMELGARD. I have been in the oil business since 1934. I have seen over those years no sign whatever, and I was in the top management of a major company, of any collusion between the two industries in trying to drive up the gallons used in a car or to lower mileage. I really don't believe it has existed. I think that, whenever some oil company comes out and offers a slightly improved gasoline that will permit a higher compression ratio, Detroit will jump on it and the others will have to come up to it. And in some instances Detroit will lead and the oil companies will have to provide the fuel to satisfy their customers.

Mr. CARTER. With all due respect for you, Mr. Gammelgard, and my kind feelings and everything, I hope you are not telling me that our industry could not have built cars which will use less gasoline than they do today. There is no question in my mind as a car owner of many years but that they do produce cars that as we go on use more and more gas when they could have done better in this field. Whether that is the result of your friendship with them, I would not say, and I don't say that at all, but I know that they could have done better and they should do better now.

Why in the face of a gasoline shortage in this country they have not done something about it, I don't know the reason, but it has a lot to do with the future defense of this country of ours. I think the automotive industry certainly should be condemned in this area.

Mr. GAMMELGARD. I think we do have to conserve our energy resources in this country better than we have in the past. I will agree with you. I personally feel, and I have felt this for many years, rightly or wrongly, the American public has been responsible largely for the larger cars because of our relatively high standard of living and our low cost of gasoline.

Mr. CARTER. If that is true, why are so many of these small cars being sold today? The motor industry in our country today has provoked that. They are actually forcing our people to buy foreign-made cars.

Mr. GAMMELGARD. I think we went through that about 15 or 18 years ago when there was quite a trend toward compact cars in this country. We made predictions that they were going to take over 30 percent of the market in a few years; but, as I saw the picture unfold, the public wanted air conditioning, power brakes, and so on. Now, perhaps the increasing cost of cars and fuel is going to make the public relook at this, which is indicated by what you said that they are buying more of these small cars that can get 25 miles to the gallon.

Mr. CARTER. You are a very able witness. Thank you.

Mr. GAMMELGARD. Thank you, Dr. Carter.

Mr. ROGERS. Mr. Hastings?

Mr. HASTINGS. Thank you, Mr. Chairman; and, thank you, Mr. Gammelgard.

If I understand what has happened so far today with the automobile people testifying that they cannot meet the 1975 standards and requesting a suspension of a year, and indicating that the most viable hope they have of meeting those standards at any time is by the use of the catalytic converter, and the oil industry apparently through your able spokesmanship indicating that the social and economic factor is to create the lead-free fuel which if totally necessary might be prohibitive, and then seemingly to suggest that what we really ought to do is reanalyze the goals that were set in the Clean Air Act and then perhaps change those goals—is that what you are saying?

Mr. GAMMELGARD. Essentially, yes. Air quality is the name of the game. Air quality should be the pivot around which the other actions take place. If it takes a $400, $500, or $600 additional cost for the car and if it takes 5 or 10 cents additional cost per gallon of fuel to get acceptable standards of air quality, I think we should do that.

I think, however, we should be scientific about this, and with the economy struggling with a $25-billion deficit in 1 year, we should not spend money needlessly. If we can get to these air quality standards in a cheaper manner on the first cost of the car, the operating cost of the car, the maintenance cost of it and the fuel costs, and the economy of mileage and so forth, then we should take a look at that rather than accepting absolute goals of 97-, 95-, and 93-percent reductions from an uncontrolled car as being an absolute bible that we must go by regardless of what it costs.

Mr. HASTINGS. Do you think those goals are realistic?

Mr. GAMMELGARD. I think they are too tight. This is my personal feeling. I am expressing a personal opinion here. I don't believe with the mass-produced automobile and the advantages you get from mass production, you can get the 97-, 96-, and 93-percent reductions over a 50,000-mile life of a car.

I don't believe it is within reason.

Mr. HASTINGS. What is your reaction to the National Academy's recommendation which seems to indicate as I read it that there should be Federal action to assure wide variability, and so forth? I assume you have read the report.

Mr. GAMMELGARD. Yes, sir.

Mr. HASTINGS. They seem to concur with the manufacturers on this fuel. Is that your interpretation of what they say?

Mr. GAMMELGARD. What I got out of reading the report, it essentially said they thought there was a possibility—they didn't say

probability—a possibility that the 1975 emission standards for hydrocarbons and carbon monoxides had a chance of being attained.

I believe they also said that the other part of this—the NO_x—that they did not know of any technology to reach the 93-percent reduction in nitrogen oxides, that there was no technology today to do that. I look at this as part of a package and not just two sitting off here and one here—these three are all legal requirements.

From an engineering viewpoint, when you are trying to reduce hydrocarbons and carbon monoxide you are essentially doing the same thing and you will come down on both simultaneously. But you are working against the reduction of nitrogen oxides. They tend to increase as you tend to drive down the hydrocarbons and the carbon monoxide. You are working at cross purposes. This is why the systems Detroit thinks have a chance of success call for an oxidizing catalyst to oxidize the CO into CO_2 and oxidize the hydrocarbons into water vapor and CO_2, and a reducing catalyst to convert the oxides of nitrogen into oxygen and nitrogen.

The other is a reducing catalyst. You oxidize in one chamber and you reduce in another chamber.

Mr. HASTINGS. You say this is the Detroit point of view?

Mr. GAMMELGARD. It is my view from an engineering point of view. I think Detroit would agree. I don't see—and maybe tomorrow some catalyst manufacturer will come out with a catalyst that does both—but from a chemical-reactions viewpoint I don't see how you can conduct a reducing and an oxidizing reaction in the same chamber with the same catalyst.

Mr. HASTINGS. You accept the recommendations of the National Academy in relation to the necessity for Federal action to assure wide availability of lead-free fuel?

Mr. GAMMELGARD. Yes.

Mr. HASTINGS. You do accept that?

Mr. GAMMELGARD. Yes, sir.

Mr. HASTINGS. What action should we take, then?

Mr. GAMMELGARD. I think Detroit should continue, as I believe they are doing now, in an all-out effort to try to attain the goals. I don't think they should be let off the hook as far as trying to attain them. While this is being done it seems to me that reason dictates that we should be taking another look at the proposition—are these extreme, drastic reductions feasible and are they necessary?

Mr. HASTINGS. That is my question. What Federal action should we take to assure the wide availability of lead-free fuel? That is my question. You said you agreed with that concept recommended by the National Academy.

Mr. GAMMELGARD. I really don't think you have to take any action to assure that there will be a lead-free fuel available. There are a number of them on the market right now.

Mr. HASTINGS. Why did the National Academy make that recommendation?

Mr. GAMMELGARD. I think they feel it will require lead-free fuel to operate these advanced-concept systems satisfactorily. Therefore, the Government must assure that they will be available. I believe, Mr. Hastings, EPA right now is just about ready to come out with some regulations which will call for a lead-free grade of gasoline being

available by the sumer of 1974. Then I think there will be some kind of a schedule for the other grades like the 94- and the 100-octane grade with a lead stepdown. That is the action the Government is taking. I think it follows the Ragonne panel's report of about 2 or 3 years ago, to the Commerce Department's Technical Advisory Board. The panel recommended one grade of lead-free gasoline be available by the summer of 1974.

Mr. HASTINGS. Are those goals possible by 1974?

Mr. GAMMELGARD. Yes, sir.

Mr. HASTINGS. Also mentioned is controlling the amount of catalyst deactivators. That leads you to where?

Mr. GAMMELGARD. It leads us to a problem of some of the additives put in gasoline. We have some phosphorus-containing additives now which control spark plug misfiring and hot spots on the side of the cylinders, and we also have some detergent-type additives to keep the induction system clean that contain phosphorus.

If phosphorus is a problem in catalyst poisoning, there will have to be a limit established on the amount of phosphorus that is permissible in fuel and the industry will have to devise other means of doing these jobs with other noncatalyst deactivating or poisoning means.

Mr. HASTINGS. These goals are not that easily attainable as I understand from your suggestion.

Mr. GAMMELGARD. They are not easily attainable, but they are attainable.

Mr. HASTINGS. Since we are certainly going to have to take some action, we should certainly seek your advice, not necessarily your concurrence.

Mr. GAMMELGARD. I believe the proposed regulations that EPA is just about to put out will call for limits on phosphorus and will probably deal with the problem of sulphur, and so forth.

Mr. HASTINGS. I might say as a final comment I wonder how you are going to devise a vehicle to meet some of these requirements. I understand it is, of course, easier to solve some of the various problems involving the fuels.

Mr. GAMMELGARD. I believe if you have a lead-free system you can change the configuration of the fuel nozzle at the service station to, say, a triangular shape and then put a triangular shape fill pipe on the cars that require the nonleaded fuel. The only way you would get around that at the service station would be for the deliberate use of a gadget like a funnel where the attendant is deliberately voiding safeguards against getting the wrong gasoline in the right tank.

Mr. HASTINGS. Thank you very much.

Mr. ROGERS. As I understand it, you are saying the oil industry can take the lead out or whatever is necessary within the time element.

Mr. GAMMELGARD. There is no question about it.

Mr. ROGERS. So far as the oil industry is concerned, the requirements that might be set upon them by the 1970 Clean Air Act basically causes no problem?

Mr. GAMMELGARD. I think that is a fair statement.

Mr. ROGERS. So the bill, as far as the oil industry is concerned, needs no changing?

Mr. GAMMELGARD. It means changes, Mr. Chairman, in that we will have to revise our processing in our plants to accomplish this which we are now in the process of doing.

Mr. ROGERS. I understand that, but no change in the law so far as the oil industry is concerned, so it involves whether the automobile industry can meet the requirements of the law. Of course, they have tied you in by saying they cannot do it unless you do something.

Now, has the oil industry ever tried to encourage the automobile industry to put in smaller engines to use, as Dr. Carter said, the fuel-injection system?

Mr. GAMMELGARD. Not that I know of.

Mr. ROGERS. They put some pressure on you to take the lead out of gasoline. Why doesn't the oil industry make some suggestions and go out and do a little research? Do you not think that is a good idea to conserve our resources, our fast-dropping reserves?

Mr. GAMMELGARD. I think this is one of the most serious problems facing our Nation right now—our energy resources—and I think something has to give.

Mr. ROGERS. You might do a little research on how the injection-fuel system would work to conserve gas. It might be a little detrimental to you, but I imagine there is plenty to sell anyhow, and you have plenty of markets there.

Mr. GAMMELGARD. We have problems with supplying it.

Mr. ROGERS. Just spread out your market, as Dr. Carter says, a little longer.

Mr. GAMMELGARD. Texaco has developed a stratified charge fuel-injection system. They are working with at least one automaker to see what this system can do.

Mr. ROGERS. You bring in the cost factor of taking lead out. Would it require charging just 1 cent more?

Mr. GAMMELGARD. Typically, I think that is about it. I stopped the other night to check and I think there was a 1-cent or 2-cent difference.

Mr. ROGERS. If they take the lead out, it increases the life of the muffler, almost double they tell us, spark plugs, and the engine itself is cleaner so maybe it is a savings rather than a cost.

What is our status? How much nonleaded gas are we producing now—what percentage of our production?

Mr. GAMMELGARD. I would hesitate to give a figure. I would rather deal in word terms. I think the amount of no-lead gasoline being sold is very hard to determine. I know of one company on the west coast whose regular grade is low-lead, half a gram or less, and they are selling roughly 40 percent of their total volume that way. There are other companies elsewhere in the country that are selling low-lead fuel, major companies, and then there are some selling a no-lead fuel.

I think in the no-lead fuel grade for the lower octane regulars that the percentage sold is pretty small. I think there is one outstanding example, however, of a large company that has been selling 100-octane premium no-lead fuel and have been very successful in selling it to the public in part of their market.

Mr. ROGERS. Any figures you are to submit for the subcommittee would be helpful to give us a breakdown on that.

Mr. GAMMELGARD. I will try to get something for the subcommittee on that. It will be difficult.

(Mr. Gammelgard subsequently informed the committee that the specific information was not available.)

Mr. ROGERS. I know New York has put out a bid and they have gotten a contract for more than $12 million for experimental cars; they have had no difficulty with their vehicles and they have had no basic problems in their vehicles.

Suppose we simply reguire a 25,000-mile performance instead of a 50,000-mile performance and if you average and if we get the nonleaded fuel, it is my understanding from the National Academy of Sciences that we could be expected to meet the standards in 1975.

Mr. GAMMELGARD. I would think cutting the 50,000 requirement to 25,000 might quadruple your chances of success. It is not just a 2-to-1 ratio at all. Reaching a 25,000-mile life might be attainable with a number of catalysts. Reaching a 50,000-mile life might not be attainable by any of them. If this can be done at a reasonable cost, it seems to me 25,000 or even 20,000 is far more in the ball park than 50,000. I do not expect my spark plugs to last 50,000 miles.

Mr. ROGERS. It seems to me, if we could get an arrangement whereby they could save a good bit of money on a change of styling, that savings could be passed on and allocated to mufflers. Maybe you might be entitled to the second one to make sure you get the 50,000-mile clean car and have the right to go in and have that changed as a part of the buying of the car. I do not know why that could not be done, and we reach our standards. This is not very difficult. So, there are a lot of opportunities here to meet the standard and to meet the law. I think the oil industry is responding, and I am glad to hear you say you can take out the lead.

We appreciate your being here. Are there any other questions? We are grateful to you and we may be back to you for additional information or we might want some of your member companies to come in so we can discuss some of the measures that you cannot.

Thank you so much.

This concludes our hearings this afternoon, and we will hold our hearings tomorrow in this room at 10 o'clock.

The subcommittee is adjourned.

(The subcommittee adjourned at 2:45 p.m., to reconvene at 10 a.m., Thursday, January 27, 1972.)

CLEAN AIR ACT OVERSIGHT

THURSDAY, JANUARY 27, 1972

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON PUBLIC HEALTH AND ENVIRONMENT,
COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE,
Washington, D.C.

The subcommittee met at 10 a.m., pursuant to notice, in room 2141, Rayburn House Office Building, Hon. Paul G. Rogers (chairman) presiding.

Mr. ROGERS. The subcommittee will come to order, please.

We are continuing hearings on oversight of the Clean Air Act, Environmental Protection Agency.

The National Academy of Sciences testified yesterday and the Environmental Protection Agency will testify tomorrow.

Our first witness this morning is our distinguished colleague, the Honorable Victor V. Veysey from California. We are happy to have you with us.

STATEMENT OF HON. VICTOR V. VEYSEY, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF CALIFORNIA; ACCOMPANIED BY HON. JOHN H. ROUSSELOT, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF CALIFORNIA

Mr. VEYSEY. Thank you very much, Mr. Chairman and members of the committee. I appreciate the opportunity to appear before the committee.

I want to point out that, when I first learned that this subcommittee was going to undertake hearings on the matter before us today, I immediately presented a request to be able to appear before the committee.

Mr. ROGERS. That is correct.

Mr. VEYSEY. I appreciate the opportunity to do it.

My plan was to have here with me at this time Congressman Richard Hanna and Congressman John Rousselot of California, who were participants in our air pollution conference recently held at the Western White House at San Clemente.

Unfortunately, due to the circumstances of scheduling, they happen to have important committee matters before them at this time and may or may not be here today, but they would like to join, I think, in a later appearance before the committee.

Mr. ROGERS. That will certainly be acceptable, or if they desire to submit a statement, that will be acceptable as well.

Mr. VEYSEY. I have a short statement which I would like to give you at this time.

No single problem today is more critical to the health and well-being of all of us than is air pollution, especially when we consider the impact on future generations. The significance of air pollution is magnified many times over in my home district. In Riverside, Calif., in the last 2 years we have suffered from 410 smog-saturated days—410 days when the air pollution level was above that point which our air pollution control district has determined is injurious to human health. We have a severe shortage of doctors in Riverside today, yet because of the pollution level we have been totally unsuccessful in attracting new ones. They just won't live there. Indeed, they recommend to many of their patients with respiratory problems that they move elsewhere. This situation gives Riverside the dubious distinction of having the most serious smog problem in California and in the Nation. It also designates me as the Congressman with the most serious smog problem in the Nation, and that is precisely why I am here today.

Riverside is not a highly industrialized city. Much of our air pollution—and experts say as much as 80 to 85 percent—comes from the many motor vehicles operated many miles away in Los Angeles and Orange Counties.

California has had the earliest, and perhaps the worst, experience with automotive-created air pollution. It has been a matter of concern, of research, of regulatory activity by local and State government in California. Indeed, the record should show that California led the way to the understanding of photochemical air pollution and bravely pushed forward for control of mobile emitters long before there was much concern in Washington about the problem.

Mr. Chairman, we in southern California cannot wait for automakers and Federal regulatory agencies to move on a collision course toward arbitrary standards and emission levels. We cannot sit back while legislators and Government executives argue over statistics and standards which scientists cannot agree upon.

Quite clearly, our lives and the lives of our children depend on our finding the shortest possible route to effective control of air pollution. And that route, I have become convinced, may require reexamination of the legislation we have on the books today.

Two weeks ago, with the technical and logistical assistance of the University of California and the Statewide Air Pollution Research Center located in Riverside, I sponsored a first-of-its-kind conference at the Western White House in San Clemente. Our intention was to bring together from across the Nation those individuals most directly involved in, and concerned with, overcoming the technical roadblocks to solving our air pollution problem.

Our first goal was to provide a forum for frank and candid discussions between scientists, Government executives, industrialists, technicians, and elected officials—specifically, elected officials, both State and Federal, in the southern California smog bowl. Our second goal was to determine, for the first time ever, exactly where all parties could agree, where and why they disagree, and how we can resolve those disagreements. And our third goal was and is to chart the shortest and most efficient course to effective air pollution control.

In sponsoring the conference, I wanted facts—not publicity; candor—not glamour; consensus—not confusion; and results—not newspaper headlines.

We in Southern California must solve the politics of pollution or, frankly, we will have to move out. That, in short, is what the National Motor Vehicle Air Pollution Conference was all about.

Though detailed reports on the conference are still being developed and refined today, I can report to this committee some of our initial impressions.

First, our Federal clean air laws are seriously in need of reevaluation; specifically, the Federal Air Quality Standards and the Federal Emission Standards for motor vehicles. As an example, one of the most glaring questions concerns the prescribed 90-percent, across-the-board reduction by 1975 and 1976 in all auto emissions—nitrous oxides, carbon monoxide, and hydrocarbons. Ninety percent is a good round number, but is a purely arbitrary figure not necessarily related to the health of people.

Recent research tells us that NO_x is a far more serious danger to health than CO. Furthermore, there is strong evidence that industry could reduce NO_x emissions by 90 percent or even more by 1975 if we give a little on the CO standards. The independently derived California standards incorporate this important health concept.

On a related front, there is a real danger that 1975–76 automobiles, designed to meet the 90-percent, across-the-board reduction may be seriously unsafe. I don't mean that they wouldn't go fast enough. I mean their performance may be cut back so stringently that they are severe hazards to the safety of the occupants.

I would recall most graphically the statement of one of the representatives of a motor car company who said he has been driving one of the pilot models designed to the new standards. Because of problems with its performance he regarded it as too unsafe to permit his wife to drive that car.

Secondly, for the first time, all interests involved in the conference agreed that health should be the overriding consideration in the establishment of air pollution standards and emission controls.

Previously, much publicity has been generated on behalf of so-called technically feasible standards—standards which completely ignore the relative effects of various air pollutants on health. This basic agreement among the leaders of science, industry, and government, that health is paramount, is a real breakthrough, in my judgment.

Thirdly, a massive effort must be undertaken to step up development of alternatives to the gasoline internal combustion engine. Automakers today are pouring every research resource they have into bolt-on accessories, in a crash attempt to meet 1975–76 standards, with doubtful chance that those standards can be met. Meanwhile, there is evidence that Detroit has the capability to develop a gas turbine engine which would meet in the near future all of the necessary standards. The problem is one of manpower and money for development. And at the current level of research, there won't be a marketable gas turbine engine until 1980 or later.

Fourth, and the most relevant immediate answer to cutting back on air pollution is our consensus that a full-scale effort to encourage fleet vehicles to use gaseous fuels would cut air pollution by 10 percent in the Los Angeles basin. Natural gas and propane have already been used successfully by the General Services Administration as well as in various tests by the State of California.

A 10-percent reduction in pollutants, while certainly not a complete solution, would have a profound effect. And I know of no other possible way to lop off that much dirty air with one simple effort.

I would urge consideration of incentives to encourage fleet owners to make the changeover. Factory options of gaseous fuel systems would greatly decrease the cost. I am talking about taxicabs, delivery trucks, business fleets, to name a few, as well as all Government agency fleets. Here is a real chance to make progress.

Mr. Chairman, at this time I would like to have recorded in this hearing record a copy of the agenda of the National Motor Vehicle Air Pollution Conference. I feel it will shed additional light on the nature and significance of our conference.

Mr. ROGERS. Certainly that will be made part of the record following your statement.

Mr. VEYSEY. I would also like to call the attention of the committee to the need for a different kind of adjustment to the Clean Air Act.

In 1967 this committee passed the Air Quality Act, which was the most significant piece of air pollution legislation on the books up to that time. Many of the specific provisions of the 1967 act were based on emission standards that had been enforced in California years before. This committee recognized California's contribution and also saw the value of testing new emission standards in a State large enough to make special modifications economically feasible. Through the efforts of Congressman John Moss and the then Senator George Murphy, the committee gave California the right to set its own auto emission standards as long as they were more stringent than applicable Federal standards and consistent with them. This provision was expressly continued in the Clean Air Act of 1970.

California has taken advantage of the act to enact the strongest auto emission standards in the Nation. Recently, however, with the preemption of the Clean Air Act of 1970, the Environmental Protection Agency has been inclined to ignore the intent of Congress and to challenge California's right to set its own emission standards and methods of testing. When confronted with the language of the statute and the committee report, EPA back down, but the threat of further obstruction remains.

Before the EPA relented, I introduced H.R. 9884 to clarify California's right to set its own standards. This bill has the active support of the California Air Resources Board, the Governor's office, the California attorney general, the assembly transportation committee, the Los Angeles County air pollution district, the Los Angeles County Board of Supervisors, and 17 of my colleagues in the House from California. I urge this committee to take this opportunity to settle this important question once and for all by approving H.R. 9884 as soon as possible.

Thank you again, Mr. Chairman, for this opportunity to testify. I will be happy to answer any questions. Copies of my statement are available along with copies of the conference agenda.

(The conference agenda referred to follows:)

AGENDA—NATIONAL MOTOR VEHICLE AIR POLLUTION CONFERENCE

WESTERN WHITE HOUSE, SAN CLEMENTE, JANUARY 13–14, 1972

Thursday, January 13—Technical Sessions

9:00–9:30 a.m. Press Availability—Western White House
9:00–9:30 a.m. Registration and coffee—Western White House
9:30–9:45 a.m. Introductory Remarks—Congressman Victor V. Veysey and Dr. James N. Pitts, Jr.
9:45–12:00 noon *Moderator.*—Assemblyman Craig Biddle—"Discussion of the air quality standards"
12:00–12:45 p.m. Lunch—Catered at the Western White House
12:45–1:15 p.m. Conducted Tour of the Western White House
1:15–3:00 p.m. *Moderator.*—Assemblyman Pete Schabarum—"Discussion of exhaust emission standards, their enforcement, and alternate fuel systems"
3:00–3:15 p.m. Coffee break
3:15–5:00 p.m. Continuation of afternoon session
5:00–6:00 p.m. Press Conference—San Clemente Inn (Aquamarine Room)
6:00–6:45 p.m. "Attitude Adjustment" Hour—San Clemente Inn
7:00–8:30 p.m. Dinner—San Clemente Inn
8:30 p.m. Keynote Address—Lieutenant-Governor Ed Reinecke

Friday, January 14—Legislative and Society Options

8:30–9:00 a.m. Registration and coffee—Western White House
8:30–9:00 a.m. Press Availability—Western White House
9:00–9:10 a.m. Introductory Remarks—Congressman Victor V. Veysey
9:10–9:40 a.m. Summary and Conclusions from Thursday's Technical Sessions—Assemblymen Craig Biddle and Pete Schaberum
9:40–10:40 a.m. *Moderator.*—Congressman Richard Hanna—"Discussion of air quality standards and exhaust emission standards for existing and future motor vehicles"
10:40–10:50 a.m. Coffee break
10:50–12:00 noon Continuation of morning session
12:00–12:45 p.m. Lunch—Catered at the Western White House
12:45–1:15 p.m. Conducted Tour of the Western White House
1:15–4:00 p.m. *Moderator.*—Congressman Victor V. Veysey—"Consideration of scientific, technical, and legislative options for further coordinated efforts in air pollution control"
4:00–5:00 p.m. Press Conference—San Clemente Inn (Aquamarine Room)
4:00 Adjourn

AGENDA FOR DISCUSSIONS

Thursday, January 13—Technical sessions

9:45 a.m.-12:00 noon. *Moderator.*—Assemblyman Craig Biddle—"Discussion of the air quality standards".

1:15 p.m.-5:00 p.m. *Moderator.*—Assemblyman Peter Schabarum—"Discussion of exhaust emission standards, their enforcement, and alternate fuel systems".

Friday, January 14—Legislative and societal options

9:40 a.m.-12:00 noon. *Moderator.*—Congressman Richard Hanna—"Discussion of air quality standards and exhaust emission standards for existing and future motor vehicles".

1:15 p.m.-4:00 p.m. *Moderator.*—Congressman Victor V. Veysey—"Consideration of scientific, technical, and legislative options for further coordinated efforts in air pollution control".

THURSDAY MORNING—ASSEMBLYMAN CRAIG BIDDLE—DISCUSSION OF THE AIR QUALITY STANDARDS

Air quality standards and health-effects criteria

Should our air quality standards be related to health-effects criteria?
Should they be tempered by technology and feasibility?

Improved epidemiological studies

How can better epidemiological studies be designed?
Who should perform these?
Who will provide the necessary funding?

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Implication for air quality standards, Clean Air Amendments of 1970

How best do we approach the problem of obtaining more definitive date to meet the provision for reevaluation of air quality standards in the Clean Air Amendments of 1970?

Do we currently have adequate instrumentation to meet these requirements? If not, what can be done to remedy the situation?

Aldehydes and other oxygenated hydrocarbons

At present, are levels of aldehydes and other oxygenated hydrocarbons sufficiently significant as primary and secondary pollutants to be measured?

Should some standard be set for them? In the future, is the concentration of aldehydes and other oxygenated hydrocarbons likely to increase as a result of the controls applied to automobiles?

What methods are available for measurements of aldehydes and other oxygenated hydrocarbons—(a) at ambient concentrations, and (b) as they are emitted by the automobile? Are these methods adequate? If not, should a special program be funded to generate new methods and the required instrumentation?

Measurement of NO_2, CO, and hydrocarbons

What methods are available for measurement of ambient NO_2, CO, and hydrocarbons?

Is the instrumentation adequate for all of them? If not, are present efforts sufficient, or is a new impetus in terms of time and funding necessary?

THURSDAY AFTERNOON—ASSEMBLYMAN PETE SCHABARUM—DISCUSSION OF EXHAUST EMISSION STANDARDS, THEIR ENFORCEMENT, AND ALTERNATE FUEL SYSTEMS

Relationship between air quality standards and emission standards

Should there be a relationship between air quality standards and emission standards?

Is the emission standard formula enacted by the Clean Air Amendments of 1970 meaningful? [The 1975 emission standards represent a 90% reduction in the 1971–72 emissions.]

Automobile emission testing

What is the relationship among assembly line, mandatory, and random testing?

Is the necessary technology available for effective assembly line testing.

Is the test cycle currently used to measure emissions a realistic representation of driving habits?

Do we have sufficient trained personnel to implement an effective mandatory testing program?

What approach should be used in training personnel to make both the emission controls and vehicle performance acceptable?

Alternative fuel sources

Considering that large portions of natural gas resources now available are used for space heating, do we have enough natural gas and liquified petroleum gas (LPG) available for use in both power plants and automobiles in high pollution areas, such as the Los Angeles Basin? [The Federal Power Commission has for space heating, do we have enough natural gas and liquefied petroleum gas reserves.]

If not, is the manufacture of the synthetic equivalent of natural gas a feasible supplementary source?

If the use of LPG and natural gas effective in reducing emissions? What are the trade-offs (if any), modifications, or costs involved in converting automobiles to use these fuels? Is national redistribution of natural gas feasible and/or desirable?

Lead "in" gasoline—Lead "out" of gasoline

Does lead from automobile exhaust pose a serious health hazard?

Is the information sufficient to give a definitive answer to this question?

If not, what programs should be initiated to resolve this situation?

Does the removal of lead from gasoline necessitate a higher aromatic content to maintain the octane rating?

Is a high-octane gasoline necessary?

Using present knowledge, what effect does an increased aromatic content have on photochemical reactivity?

Are there health implications associated with increased aromatic content—e.g., production of carcinogenic species?

Is further research required to clarify these areas?

FRIDAY MORNING—CONGRESSMAN RICHARD HANNA—DISCUSSION OF FAIR QUALITY STANDARDS AND EXHAUST EMISSIONS STANDARDS FOR EXISTING AND FUTURE MOTOR VEHICLES

Relationship of Air Quality Standards and Emissions Standards

Does the current Federal formula for determining the 1975 emissions standards represent a meaningful relationship between air quality standards and emissions standards (90% reduction of the 1971–72 emissions)?

If not, what are the alternative approaches?

Emissions Controls and Vehicle Performance: Alternative Power Sources for Automobiles

In designing the reciprocating internal combustion engine to meet the 1975–76 emissions standards, what sacrifice in performance is incurred?

Are sufficient time and money being spent on alternatives to the internal combustion engine?

Are the gas turbine and electric-powered vehicles feasible alternatives?

Is further legislation desirable to promote their employment for currently feasible uses?

Reevaluation of Air Quality Standards

In the reevaluation of air quality standards provided by the Clean Air Amendments of 1970, should changes be made which affect such items as the relative emphasis given to the stringent reduction of CO, which may make the control of NO_x more difficulty?

Attainment of the 1975–76 Air Quality Standards

Is further legislation required to meet the 1975–76 air quality standards?

If so, what areas require attention?

What is the role of the Federal Government in helping the state meet these standards?

FRIDAY AFTERNOON—CONGRESSMAN VICTOR V. VEYSEY—DISCUSSION AND CONSIDERATION OF SCIENTIFIC, TECHNICAL, AND LEGISLATIVE OPTIONS FOR FUTHER COORDINATED EFFORTS IN AIR POLLUTION CONTROL

Progress in Air Quality Improvement

Are measures which effect small increments in air quality improvement worthwhile?

Should the public be informed that the effects of such single measures are unlikely to be visible?

Societal Options

Assuming the air quality standards are not going to be met by existing technology, what societal options should be pursued to alter life-style patterns to reduce air pollution?

Is a reduction in the dependence of the individual on the automobile desirable? If so, how best can it be effected? Should there be a limit on both the population and its distribution in areas of high air pollution potential? If so, how can it be carried out?

Implementing Societal Options

Should societal options such as car pooling and gas rationing be implemented in an effort to come as close as possible to meeting the air quality standards?

If so, by whom—the State and/or the Federal Government? What time schedule is involved?

Long-Term Approaches to Air Pollution Reduction

What steps should be taken to insure a cleaner mode of individual transportation for the long term? Is a mass transit system, which is both cost-effective and time-effective, feasible and desirable? How can such a system be implemented?

Provision of sufficient Alternative Fuel Sources

Is the Federal Government willing to launch a stepped-up campaign to provide severely polluted areas of the country with sufficient alternative fuel supplies—e.g., natural gas and LPG? This may involve such measures as national redistribution of available supplies and/or manufacture of the synthetic equivalent of natural gas. Are further data needed to clarify the latter statement?

Communications Among Legislators, Industry, and the Scientific Community

Are sufficient channels regarding air pollution available to insure adequate communication and information exchange among legislators, industry, government, and the universities? How are highly controversial issues, such as lead pollution, best resolved?

Mr. ROGERS. Thank you very much for your statement. We appreciate your being here to give the committee the benefit of your thinking.

Congressman Carter?

Mr. CARTER. Certainly, I want to thank the distinguished gentleman for his presentation.

Did you state that 80 to 85 percent of the pollution in your area was caused by automobiles; is that correct?

Mr. VEYSEY. That is correct. That is the figure that is commonly accepted in that region of California because of the geographical situation, and the high use of motor vehicles. Most of our air pollution is from motor vehicle exhaust.

Mr. CARTER. You stated, also, that there were 410 days of high pollution. In what period of time?

Mr. VEYSEY. In the past 2 years.

Mr. CARTER. And 1 year as much as 200 days?

Mr. VEYSEY. In excess of 200 days. I think it may be close to 250 days in 1 year.

Mr. CARTER. People with chest diseases are having to leave your area or are advised to do so?

Mr. VEYSEY. Yes; in the case of a very close friend of mine, who has a young son with an asthmatic condition, his doctor advised him to move away. He just couldn't make it under those air conditions so they moved to northern California.

Mr. CARTER. I agree with your statement and I certainly want to cooperate with you to develop legislation which will make your area more comfortable.

Thank you.

Mr. VEYSEY. It needs to be. It is most important that out of this conference came the agreement by all those participating that health considerations are paramount and they must be underlying any emission standards that we set.

Mr. CARTER. Yesterday I had a man who testified that we should take another look at this and weigh the economic factors with the social values or health values again, but actually such a danger to health might not continue to exist.

Mr. VEYSEY. I think we moved on the right track in setting health-related standards of air quality. I think that is pretty clear. We could argue over whether the evidence should be improved and whether further research would show something new. I know EPA intends to revise those standards as new information becomes available.

But there is only a most tenuous relationship between those air quality standards and the motor vehicle emission standards which we are going to apply in 1975 and 1976. That relationship is simply to make an across-the-board, 90-percent reduction in all of the components of vehicular smog.

I don't think that is based on scientific or health-related information.

Mr. CARTER. The legislation we passed in 1968 has not helped your area too much.

Mr. VEYSEY. The California standards are more strict than any the Federal Government has been attempting to enforce. In 1975 and 1976, we have a new situation because of the 90-percent reduction of emissions. It just seems to me that 80-percent across the board does not fit the physical facts of life.

Maybe it should be 95 percent on one component and 83 on another. This I could believe, but 90 percent across the board does not seem to me to be consistent with the physical facts.

Mr. CARTER. I certainly thank you for what you said.

Thank you, Mr. Chairman.

Mr. ROGERS. Mr. Hastings.

Mr. HASTINGS. Thank you, Mr. Chairman, and I commend the gentleman from California for his testimony on this most serious problem.

I would like to direct a little bit of attention to that meeting that you had at San Clemente mainly because of a newspaper story this morning in the Washington Post indicated that there was possibly collusion with the White House in calling the automobile manufacturers to that meeting, and I think the record should be wholly clarified.

Would you tell us who actually scheduled the meeting at San Clemente?

Mr. VEYSEY. I appreciate the opportunity to do that.

While I read the Washington Post, I don't always agree that their statements are totally correct.

Mr. HASTINGS. You are not alone.

Mr. VEYSEY. This meeting came about due to the circumstance which I related today: that Riverside is perhaps the most smoggy city due to automotive emissions of any in the Nation, and, that California has been a leader in trying to do something about this and that California has centered its research activity—all of the scientists who are working on this problem—at the air pollution research center at the University of California at Riverside.

Six months ago we held a preliminary, very small conference on the campus of the university between some of the scientists working in the field and some of the State and Federal legislators also working in the field to try to get some communication.

While that was successful in a modest way, it was evident that there are many other elements in our society that must be involved.

It was clear that the manufacturers of the hardware, the motor vehicles and of the fuel that is burned in those motor vehicles, must be involved as well as Federal regulatory agencies.

So at that time we decided to put together a conference. I guess our timing was significant because it just happened to coincide with a period in time when there is a good deal of discussion about what motor manufacturers are going to do or not going to do by 1975 and what they may request of the EPA.

I organized the conference with the technical advice and assistance of the University of California and the air pollution research center there.

They provided the scientific backup for what we were trying to do and much technical assistance.

Now let me explain the circumstance of it being held in the Western White House. The Western White House is made available for con-

ference purposes for all sorts of groups during those periods of time when it is not in use by the President or some of his top people.

It is operated by the General Services Administration and there have been thousands of people there in hundreds of different groups holding conferences.

Any conference given there does not have the endorsement of the White House or any participation from them at all in its composition or its determinations.

Mr. HASTINGS. On that point, the Post said "sanctioned by the White House."

Mr. VEYSEY. There is no sanction of the White House other than they gave us permission to use that facility—which would otherwise be vacant—to hold such a meeting.

They neither endorsed nor criticized what we were doing.

Mr. HASTINGS. Would that be the same as holding it at the Eastern White House?

Mr. VEYSEY. I don't think it would be quite the same.

Mr. HASTINGS. It is important. This is a serious problem, and perhaps any suggestion in the papers that the White House endorses certain automotive standards would shed light on anything.

Mr. VEYSEY. I would say that is not correct, not in this case, at all.

Mr. HASTINGS. Our colleague and our distinguished chairman said we have the right to know what can be done to attain goals and certainly we all share that view.

Thank you, Mr. Chairman.

Mr. ROGERS. We appreciate your being here to give us this background.

Who determined who would come to the meeting?

Mr. VEYSEY. I made the final decisions on who would be invited. Of course, individuals invited did not necessarily respond affirmatively, but we were limited in the number that could participate, due to the physical circumstances, to an outside of 45 or perhaps 50 people.

There is included in the materials which have been submitted to the committee a list of those participants in the conference.

We included the major motor car manufacturers, the major oil producers, those who are doing research on fuels and oils. We included a group of State legislators who have been most active in California in moving to better standards for vehicular emissions and a group of California Congressmen in the area immediately affected and immediately surrounding that district.

Mr. ROGERS. Did you discuss with administration officials this conference?

Mr. VEYSEY. We wrote a letter to them asking for permission to use the Western White House jointly with the university. This permission was granted and that was the extent of the exchange.

Of course, the EPA was there, the General Services Administration was there. We had a representative from the Justice Department to be sure there was no charge of collusion or anything like that.

Mr. ROGERS. Was this made clear in your invitation to the oil companies that Justice would participate?

Mr. VEYSEY. Yes.

Mr. ROGERS. And that the meeting would be held at the Western White House when the invitations went out?

Mr. VEYSEY. Yes; I think I have a packet here which includes the invitations.

Mr. ROGERS. You might like to submit it for the record.

Mr. VEYSEY. Yes, that information is in the first sentence of the invitation.

(Testimony resumes on p. 260.)

(The following material consisting of (*a*) copy of Mr. Veysey's letter to the President's Marine Corps Aide requesting permission to conduct the conference in the Western White House; (*b*) sample letter inviting attendance to the conference, plus list of invitees; (*c*) sample confirmation letter to those accepting; (*d*) list of those who actually attended; (*e*) copy of Mr. Veysey's opening remarks to the conferees, was submitted for the record:)

CONGRESS OF THE UNITED STATES,
HOUSE OF REPRESENTATIVES,
Washington, D.C., November 6, 1971.

Maj. JOHN V. BRENNAN, USMC,
Marine Corps Aide to the President, The White House,
Washington, D.C.

DEAR MAJOR BRENNAN: Would it be possible to obtain the Western White House in January 1972 for the purpose of conducting an Air Pollution Conference to be sponsored jointly by me and the University of California at Riverside?

The Conference would be one of national importance, with officials from the Environmental Protection Agency and the presidents of major auto and oil companies in attendance.

We would prefer to hold it either on a Monday or a Friday. Our first preference would be Friday, January 14, but we would be happy to have it on January 10, 24, or 28.

If any of these dates can be approved, would you please notify us by telephone as early as possible to facilitate our planning.

Sincerely,

VICTOR V. VEYSEY,
Member of Congress.

CONGRESS OF THE UNITED STATES,
HOUSE OF REPRESENTATIVES,
Washington, D.C., December 13, 1971.

Project: Pollution Conference.

Mr. H. ROBERT SCHAERBAUGH,
President, Sun Oil,
Philadelphia, Pa.

DEAR MR. SCHAERBAUGH: On January 13–14, 1972, a National Motor Vehicle Air Pollution Conference will be held at the Western White House, San Clemente, California, under the *co-sponsorship of myself and the University of California (Riverside)*.

The purpose will be to assemble the chief administrative officers and their key technical advisors from EPA, the automotive and petroleum industries, state and local control agencies, and researchers from the University of California *to devise a mutually acceptable strategy for reducing air pollution from existing automobiles.*

A list of the invitees is attached. The technical advisors will meet the first day, and under the leadership of the scientific team from the nine-campus Statewide Air Pollution Research Center, sort out those areas upon which there is general agreement and ascertain where further research and experimentation are needed.

On the second day, administrators and policy makers from industry, government, and control agencies (plus a few technical advisors) will confer to formulate a political strategy for most effectively reducing motor vehicle pollution.

After each meeting press conferences will be held, but the press will not be permitted to attend the working sessions and all discussions will be off the

record. Attendance in the Western White House Conference Room is physically limited to forty people at any one time.

Although the *Conference will be California-oriented*, it will have *national significance* because of the sheer size of the Golden State and its air pollution problem—particularly in the Los Angeles basin. The Conference will doubtless be the most important such one held next year, and your contribution to the discussions as President of Sun Oil would be invaluable.

Accordingly, we respectfully invite you to attend the all-day session on January 14, or if you are unable, your top administrative policy-making officer. In addition, we would like your key technical advisor to attend the January 13 session at the Western White House and to be available on January 14 for consultation and/or further seminar discussion in the nearby San Clemente Inn. Further details on the Conference agenda, site, and participants will be sent at a later date.

May we have the favor of an early reply?

Sincerely yours,

VICTOR V. VEYSEY,
Member of Congress.

INVITEES TO THE NATIONAL MOTOR VEHICLE AIR POLLUTION CONFERENCE, WESTERN WHITE HOUSE, SAN CLEMENTE, CALIF., JANUARY 13–14, 1972

Industry (President and Technical Advisor):
- General Motors
- Ford Motor Company
- Chrysler Corporation
- American Motors
- Esso Research
- Chevron Research
- DuPont Chemical
- Union Oil Company
- American Automobile Assoc.
- Western Oil & Gas Assoc.
- Sun Oil Company
- Auto Manufacturers Assoc.
- Pacific Lighting Service Co.
- Petrolane, Inc.
- Auto Club of Southern Calif.

Government:
- Lt. Gov. Ed Reinecke
- Congressman Victor V. Veysey
- Congressman Chet Holifield
- Congressman Jerry Pettis
- Congressman John Schmitz
- Congressman Richard Hanna
- Congressman Bob Mathias
- State Senator Gordon Cologne
- State Senator William Coombs
- Assemblyman Jerry Lewis
- Assemblyman Pete Schabarum
- Assemblyman John Quimby

EPA:
- Mr. William Ruckelshaus, Administrator

EPA—Continued
- Mr. Stanley Greenfield
- Mr. Harry Kramer
- Mr. Debart Barth

General Services Administration: Mr. Robert E. White, Motor Equipment Research & Tech Div.

Control Agencies:
- Mr. Milton Feldstein, Bay Area Pollution Control Dist.
- Mr. Robert L. Chass, Los Angeles County Air Pollution Dist.

Air Resources Board:
- Dr. Arie Haagen-Smit
- Dr. John Maga
- Mr. Frank Bonamassa

University of California:
- Dr. Ivan Hinderacker—Chancellor UCR
- Prof. James N. Pitts, Jr.
- O. Clifton Taylor
- John Behar
- E. R. Stephens
- E. A. Schuck
- Alan Lloyd
- R. L. Perrine
- G. Scott Samuelson
- Rovert Sawyer
- T. Timothy Crocker

Justice Department: Mr. Bruce Wilson, Dep. Asst. Atty. Genl.

National Science Foundation: William D. McElroy, Director

CONGRESS OF THE UNITED STATES,
HOUSE OF REPRESENTATIVES,
Washington, D.C., December 29, 1971.

Re air pollution conference.

Mr. H. ROBERT SCHARBAUGH,
President, Sun Oil,
Philadelphia, Pa.

DEAR MR. SCHARBAUGH: We are delighted that you will attend the National Motor Vehicle Air Pollution Conference at the Western White House in San Clemente on January 13–14, 1972.

To clarify the purpose of this unique conference, it is to bring together key people in the industry and government with concerned legislators to explore the possibility of further coordinating and implementing current control strategies in public and private enterprise so that air pollution from motor vehicles can be more rapidly reduced in the short term and the delivery of the "clean car" more readily attained in the mid-1970's.

The function of the University of California faculty in attendance will be to provide a neutral, technical resource for all participants of the conference. Naturally, the University and its faculty cannot be involved with political strategy or policy decisions arising from the talks.

As you will note from the enclosed agenda, the conference is divided into two sessions: Thursday, Technical Discussions; and Friday, Legislative and Societal Options. Since the Western White House will accommodate but forty people at a time, we invite you as primarily a policy making representative to participate on Friday, January 14.

However, a keynote address will be given the night before by Lt. Governor Ed Reinecke in the San Clemente Inn. His address will be preceded by cocktails and dinner beginning at 6:30 p.m., Thursday, January 13. We would very much like to have you attend this function if at all possible.

Individual attendees will be expected to bear all costs (transportation, housing, car rentals, etc.) other than the luncheons at the Western White House and dinner Thursday evening at the Inn.

Please complete and return the enclosed Registration Form as soon as possible. We look forward to seeing you at the Western White House.

Sincerely yours,

VICTOR V. VEYSEY,
Member of Congress.

TECHNICAL AND POLICYMAKING ATTENDEES AT THE NATIONAL MOTOR VEHICLE AIR POLLUTION CONFERENCE, WESTERN WHITE HOUSE, SAN CLEMENTE, CALIF., JANUARY 13–14, 1972 [1]

(Name, title, affiliation, and address)

Adamson, Mr. John F., Vice President—Engineering, American Motors Corporation, 14250 Plymouth Road, Detroit, Michigan 48232.

Bachman, Mr. William B., president, American Automobile Association, 1712 G Street, N.W., Washington, DC 20006.

Behar, Dr. Joseph V., Assistant Research Chemist, Statewide Air Pollution Research Center, University of California, Riverside, CA 92502.

Biddle, Mr. W. Craig, Assemblyman, 74th District, California State Assembly, State Capitol, Sacramento, CA 95814.

Bintz, Mr. Louis J. Manager, Automobile Engineering Dept., Automobile Club of Southern California, 2601 South Figueroa Street, Los Angeles, CA 90007.

Bonamassa, Mr. Frank, Supervising Engineer, California Air Resources Board, 434 South San Pedro Street, Los Angeles, CA 90013.

Bowditch, Dr. F. W., Director, Automotive Emission Control, General Motors Corporation, Environmental Activities Staff, General Motors Technical Center, Warren, Michigan.

Bradley, Dr. William E., Vice President of Research, Union Oil Company of California, P.O. Box 76, Brea, CA 92621.

Brooks, Dr. Douglas L., Special Assistant to the Director, National Science Foundation, Room 549, 1800 G Street, N.W., Washington, DC 20550.

Burton, Dr. George, Chief, Pulmonary Division, Loma Linda University, School of Medicine, Loma Linda, CA 92354.

Campion, Dr. Raymond J., Products Research Division, Esso Research and Engineering Co., P.O. Box 51, Linden, NJ 07036.

Chass, Mr. Robert L., Air Pollution Control Officer, Air Pollution Control District, County of Los Angeles, 434 South San Pedro Street, Los Angeles, CA 90013.

Cleghorn, Mr. Robert B., Technical Advisor, Western Oil and Gas Association, Standard Oil Co. of California, 605 W. Olympic Blvd., Los Angeles, CA 90015.

Cologne, Mr. Gordon, Senator, California State Senate, State Capitol, Sacramento, CA 95814.

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[1] This conference was requested and sponsored by Congressman Victor V. Veysey, in cooperation with the Statewide Air Pollution Research Center, University of California, Riverside.

Corbeil, Mr. Reine J., Manager of Dual Fuel Systems, Inc. R&D, Pacific Lighting Service Company, 720 West Eighth Street, Los Angeles, CA 90017.
Crocker, Dr. T. Timothy, Professor and Chairman, Dept. of Community & Environmental Medicine, University of California, Irvine, CA 92664.
Currie, Mr. Malcolm R., Vice President for Research, Beckman Instruments, Inc., 2500 Harboe Blvd., Fullerton, CA 92632.
Davidson, Mr. David G., President, Kern Co. Refinery, Independent Refiners' Association, Kern County Refinery, Inc., 612 South Flower Street, Suite 421, Los Angeles, CA 90017.
Deeter, Mr. Wendell F., Fuels Specialist, Atlantic Richfield Company, 515 South Flower Street, Los Angeles, CA 90071.
Diggs, Dr. Donald R., Marketing Manager, Petroleum Chemicals Division, E. I. Du Pont De Nemours & Company, 1007 Market Street, Wilmington, Delaware 19898.
Eastin, Mr. Maurice R., Special Consultant to the Administrator, Environmental Protection Agency, Waterside Mall, 401 M Street, S.W., Room 3910-G, Washington, DC 20460.
Fuller, Mr. Jack D., Air Conservation Group, Ethyl Corporation, Russ Bldg., 235 Montgomery Street, San Francisco, CA 94104.
Galler, Mr. Sidney, Deputy Assistant for Environmental Affairs, U.S. Department of Commerce, Main Commerce Building, 14th & Constitution, Washington, DC 20330.
Gardner, Dr. David P., Vice President, Public Service, Programs & University Dean of University Extension, University of California, 650 University Hall, Berkeley, CA 94720.
Goldschmidt, Mr. Peter, Special Assistant for Governmental Relations, University of California, Washington Office, 1310 19th Street, N.W., Washington, DC 20036.
Hanna, Mr. Richard, Member of Congress, U.S. House of Representatives, 213 Cannon Building, Washington, DC.
Hartley, Mr. Fred, President, Union Oil Company of California, P.O. Box 7600, Los Angeles, CA 90051.
Havenner, Mr. Joseph E., Executive Vice President, Automobile Club of Southern California, 2601 South Figueroa Street, Los Angeles, CA 90007.
Hernacki, Mr. Raymond P., Assistant Chief, Los Angeles Office, Antitrust Division, U.S. Department of Justice, 6241 Glade, L-318, Woodland Hills, CA 91364.
Hesselberg, Mr. H. E., Vice President for Air Conservation, Ethyl Corporation, 1600 West Eight Mile Road, Ferndale, Michigan 48220.
Hinderaker, Dr. Ivan, Chancellor, University of California, Riverside, CA 92502.
Hoagland, Mr. Charles E., Western Representative, Automobile Manufacturers Association, Inc., 927 Tenth Street, Suite 302, Sacramento, CA 95814.
Hoffman, Dr. William D., Technical Director, Products Division, Atlantic Richfield Company, 600 Fifth Avenue, New York, NY 10020.
Hutchison, Mr. Dale, Chief, Research Section, California Air Resources Board, 1025 P Street, Sacramento, CA 95814.
Jensen, Mr. Donald A., Director, Automotive Emissions Office, Ford Motor Company, American Road, Dearborn, Michigan 48121.
Lacy, Mr. George A., Chief Engineer, Vehicle Emissions Control, Chrysler Corporation, P.O. Box 1118, Detroit, Michigan 48231.
Lasage, Mr. James, Vice President in Charge of Government Relations, Gulf Oil Company, P.O. Box 54064, Terminal Annex, Los Angeles, CA 90054.
Laubach, Mr. Thomas, Director, Engine Fuel Services, Petrolane, Incorporated, 1600 East Hill Street, Long Beach, CA 90806.
Leffland, Dr. K. William, Associate Director, University of Southern California, School of Public Administration, University Park, Los Angeles, CA 90007.
Lewis, Mr. Ben H., Mayor of Riverside, City Hall, 7th and Orange Streets, Riverside, CA 92501.
Lewis, Mr. Jerry, Assemblyman, California State Assembly, State Capitol, Sacramento, CA 95814.
Lloyd, Dr. Alan C., Assistant Research Chemist, Statewide Air Pollution Research Center, University of California, Riverside, CA 92502.
Maga, Mr. John, Executive Officer, California Air Resources Board, 1025 P Street, Sacramento, CA 95814.
McCandless, Mr. Al, Chairman, Riverside County Board of Supervisors, Courthouse, 4050 Main Street, Riverside, CA 92501.

McDuffie, Mr. Malcolm, President, Mohawk Petroleum, Independent Refiners' Association, Mohawk Petroleum Corporation, 550 South Flower Street, Los Angeles, CA 90017.
Morrison, Mr. Harry, Vice President and General Manager, Western Oil and Gas Association, 609 South Grand Avenue, Los Angeles, CA 90017.
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Mrs. Terry Jones
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Miss Susan McClure
Mrs. Mae Minnich
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Mr. Arthur E. Sutton (Chancellor's Office)

STATEMENT BY CONGRESSMAN VICTOR V. VEYSEY, CHAIRMAN, NATIONAL MOTOR VEHICLE AIR POLLUTION CONFERENCE, WESTERN WHITE HOUSE, SAN CLEMENTE, CALIFORNIA—JANUARY 13, 1972

The problem of air pollution today touches the life and physical well being of virtually every American. Few of us can escape the effects of smog, in one form or another, on our lives. The Los Angeles Basin, for technological, geographical, and meteorological reasons, is particularly subject to the devastation of smog. For this reason, this site was selected for this initial conference. I am hopeful that this may be the first of a series of National Air Pollution Conferences focusing on the problem of the motor vehicle and its fuel.

This conference, bringing together representatives of industry, science, Federal and State agencies, and members of the State Legislature and the Congress, is an effort to spur us along a little faster toward a national strategy that will reduce the crisis we now face from air pollution and its effects on our society. I appreciate the technical and scientific assistance of the University of California and its Statewide Air Pollution Research Center in working with us on this event.

It is a closed conference, in part because of limited space and in part because communication is encouraged when honest differences of opinion can be aired in such an environment. We will expect to summarize the discussions each day for the news media. It is my hope that from these discussions a climate of good will can be fostered among the participants, leading to some direct, coordinated attack on this problem that so crucially affects us all. We will be working within the context of existing State and Federal laws, searching for real improvement prior to 1976, and looking on to 1980 after that.

I think the major story here today is the willingness of individuals, representing a wide diversity of economic and political interests, to come together to work for the common good. This is a most encouraging sign. I am pleased to have had a small part in making it possible.

Mr. ROGERS. I think all of us commend any member of Congress who has anything to do with doing something about clean air. Certainly we are not wanting to get into that at all.

Certainly you are right and we commend you for your effort.

The only thing I am concerned about is this was given the impression that this was closely connected with the White House with an invitation going out to the Western White House. Many in the east don't know they use that Western White House as Mr. Hastings said because we don't use the Eastern White House quite that way.

This was one of my concerns that this was given a sanction where people may not have understood just how that operates.

Mr. VEYSEY. I think we made that pretty clear in the invitation. Also, whenever inquiries were directed, we made that entirely clear.

I don't think anyone was there under a misapprehension at all.

Mr. ROGERS. Were there any costs involved and who paid for the costs?

Mr. VEYSEY. They did not charge us any rent for the facilities. The only costs involved were for two lunches and one dinner and a reception which was served there. I, out of funds available to me, bore the costs,

Mr. ROGERS. They were your own funds?

Mr. VEYSEY. Yes, and the university helped share in the dinner expenses.

Mr. ROGERS. And everybody paid their own transportation.

Mr. VEYSEY. Everybody was on his own time, his own transportation, and his own lodging.

Mr. ROGERS. I understood from General Motors yesterday there were recommendations. What they were referring to as recommendations——

Mr. VEYSEY. I don't know what was said yesterday, but there were no resolutions proposed, voted on, or adopted or even considered by the group.

It was a frank and open discussion which we are still in the process of attempting to summarize. That summary is now in the process of being circulated to the participants for their suggestions and corrections as to whether we stated the situation correctly.

Then, that will be revised and I will certainly be glad to make that available to the committee. I think it is important information for you.

Mr. ROGERS. We would welcome any suggestions you have.

(Testimony resumes on p. 265.)

(The following summary of discussions was received for the record:)

SUMMARY OF DISCUSSIONS AT THE NATIONAL MOTOR VEHICLE AIR POLLUTION CONFERENCE, WESTERN WHITE HOUSE, SAN CLEMENTE, CALIF.—JANUARY 13–14, 1972

AIR QUALITY STANDARDS

General agreement was reached that air quality standards should continue to be related to health effects, although some participants viewed aesthetic effects as having a greater impact on the public. Programs designed to satisfy the health-related standards may or may not contribute rapidly and substantially to the improvement of certain aesthetic effects, such as visibility. Participants concurred that the present standards are based upon data over which various experts disagree, and further short- and long-term epidemiological studies are urgently required. In the interim, it is acceptable to follow the example of the Federal Drug Administration and use the results from experiments with animals to aid in the formulation of aid quality standards.

Representatives of the automotive industry, the Los Angeles Air Pollution Control District, and the California Air Resources Board favored the California Air Quality Standards, but the Environmental Protection Agency (EPA) representatives disputed that the California standards are more realistic and technologically feasible than the federal standards. However, most participants agreed that the California standards were satisfactory, both on medical grounds and on the time periods over which the pollutant concentrations were average.

EMISSION STANDARDS

General consensus was reached among the representatives of the automobile manufacturers that it would be virtually impossible for them to reach the 1975–76 Federal Emission Standards, operating on current ground rules. They felt that the following provisions would facilitate the meeting of the federal standards:

1. A reasonable maintenance requirement for control devices would have to be enacted to ensure that, for example, catalysts are working.
2. Unleaded gasoline would be available in sufficient quantities.
3. The averaging concept for vehicle emission certification would be necessary rather than the requirement that *every* car be tested and required to pass the emission standards.

The automobile industry representatives stated that attainment of the California Emission Standards is more reasible, provided the industry is allowed to make this its goal. All changes which require major tooling-up operations must be recognized by April-June, 1972.

Most of the participants felt that too much emphasis had been placed on the validity of a *precise* number for the emission standard of a particular pollutant, in view of the uncertainties involved in the derivation of emission standards from air quality standards. They suggested that the currently available data were adequate to support values somewhere between the California and federal emission standards.

The necessity of requiring a 90% reduction from the 1970–71 levels of all three pollutants—NO_x, CO, and HC—in exhaust emissions by 1975 was open to serious question. The majority opinion supported the possible adoption of a CO standard somewhere between the California value of 24 gm/mi and the federal standard of

3.4 gm/mi: perhaps ~17gm/mi. They felt that the California standard for CO was adequate to protect the health and welfare of the people. Such a move would have significant benefits for both the public and the automobile manufacturers. It would facilitate the attainment of the NO_x emission standard; this, in turn, would lead to an improvement in air quality sooner, since according to current knowledge, NO_x plays a far greater role in photochemical smog formation than does CO. (Little or no evidence was presented to support a relaxation in the federal standards for HC and NO_x.)

LEAD IN GASOLINE

Possible adverse health effects and the poisoning of catalysts used in certain emission control devices constitute the two major reasons for eliminating lead from gasoline.

Agreement was reached that a grade of unleaded gasoline should be made generally available to insure the effectiveness of catalytic devices which would probably be employed to meet future emission standards.

A number of areas of disagreement emerged. Of these, the most significant are the possible health effects of atmospheric lead and the result of lead removal on exhaust particulates, aldehydes, and aromatic hydrocarbons. The problem of lead from leaded gasoline as a health hazard is not that clinical poisoning can be attributed to lead from this source; rather, it is a dearth of knowledge of the long term effects of exposure to low levels of tetraethyl lead, absorbed by inhalation.

It was pointed out that the EPA will soon be publishing regulations on lead in gasoline; these will include a provision for general availability of unleaded gasoline.

AUTOMOBILE EMISSION TESTING

Whereas the automobile manufacturers have accommodated reasonably well to the new federal constant volume sampling (CVS) of measuring emissions, the control officers are faced with a dilemma in correlating the data obtained when using the old and new test procedures. The new federally adopted test cycle was based, in part, on the previous experience of the Air Resources Board. It was noted, however, that the last one-third of the California test cycle (which represents the high-speed portion of the cycle) was omitted. This omission could be critical in relating test cycles to real driving habits in the Los Angeles basin.

Comments from both the automobile industry and the EPA indicated that the original intent of AB 1,[1] i.e., 100% assembly line testing of HC, CO, and NO_x emissions from all new automobiles sold in California—as passed in the legislature, would probably not be satisfied. This has several implications, including the fact that it would preclude a surveillance program involving mandatory and random testing of emissions from each individual car, since it would be impossible to know the emission levels of each automobile when it left the factory. The concept of "averaging" and the "functional" testing of key components involved in the control systems for reducing pollution were suggested, primarily by the auto industry, as being more realistic. The EPA is preparing its own guidelines with respect to assembly line testing, and these are to be available shortly.

ALTERNATIVE FUEL SOURCES

Natural gas (primarily CNG) and propane (LPG) have been used successfully by the General Services Administration (GSA) in fleets of automobiles used for rental purposes. The GSA reports both operational cost savings in this fleet, as compared to gasoline-fueled cars, as well as a significant reduction in exhaust emissions.

However, several problems associated with the use of CNG or LPG fuel were discussed. First, present supplies would not allow the immediate conversion of every car; however, by about 1974, other sources of natural gas are expected to become available. Second, the manufacturing cost of natural gas may be significantly higher than that required to produce the necessary equivalent gasoline. Also, the advantage that natural gas and LPG are not taxed will expire in 1975. Third, some loss in power when using natural gas fuel has been noted; in addition, no complete product analysis of the exhaust emissions has been performed. Fourth, storage tanks take considerable space, particularly for CNG.

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[1] 1970 California bill authorized by Assemblyman Craig Biddle.

MODIFICATIONS AND ALTERNATIVES TO THE INTERNAL COMBUSTION ENGINE

It was generally agreed that the modifications to the internal combustion engine and its exhaust system required to meet the 1975–76 Federal Emission Standards would have a significant detrimental effect on the durability and performance of the automobile. However, the possibility of a feasible alternative to the internal combustion engine being available to meet the 1975 emission standards was considered extremely remote. Looking at the long term, most participants who were qualified to pass judgment thought the gas turbine engine was the most attractive alternative to the internal combustion engine.

In the meantime, it was generally felt that careful consideration should be given to the possibility of conversion to dual fuel systems, even though retrofit conversion to natural gas or LPG costs over $400 on an individual basis. However, mass production and factory installation on new cars would reduce costs substantially and provide other benefits.

SOCIETAL OPTIONS

The following suggestions were raised as possible societal options:

1. Retrofit emission controls for all used cars.
2. Conversion of all pre-1966 cars to gaseous fuels.
3. Car pooling.
4. Gas rationing.
5. Mandatory inspection.
6. Four-day workweek and staggered working hours.
7. Public transportation and restricted travel in congested areas.

It was the consensus of all concerned that the impact of such societal options upon the public, as well as their effectiveness in improving the atmosphere, should be carefully considered. It was felt to be particularly important that the public be well informed of the technological, social and economic trade-offs and personal sacrifices involved in implementing these options.

AREAS FOR IMMEDIATE ACTION

The following, either directly or indirectly, emerged as areas upon which initial or additional work should be urgently focused. (No significance should be attached to the order in which these are presented.)

HEALTH EFFECTS

A critical reevaluation should be undertaken of the medical, epidemiological, and technical data upon which the present air quality standards are based.

Further research should be initiated into health effects, with particular emphasis on the health implications of chronic exposure to prevailing levels of pollutants in ambient air.

There is a critical need to elucidate the relationship between instantaneous maxima of pollutants and the longer-term averages used to define "health warning" or "emergency" situations. Control officers need to be able to predict the likely concentration of a pollutant and the time period for which this concentration exists to protect the "health risk" segments of the public; currently, no good correlation exists between such values and the peak maxima normally recorded.

AIR QUALITY STANDARDS AND EMISSIONS STANDARDS

The technical data from which emission standards were derived from the air quality standards should be carefully reexamined and reevaluated.

There is an urgent need for both short-term and long-term research into the atmospheric chemistry and physics of polluted atmospheres, which should be specifically designed to further elucidate the complex relationship existing between emisions and the quality of ambient air.

A definitive look should be taken at the effects of aldehydes and other oxygenated hydrocarbons on emission levels as a result of controls applied to automobiles. Based on this study, the possibility of a standard for aldehydes and other oxygenated hydrocarbon should be considered.

The role of aldehydes (particularly formaldehyde) and other oxygenated hydrocarbons in photochemical smog—both its generation and effects—should be fully explored.

The exact relationship between the emission data obtaind by using the old test cycle, as compared to that by using the current test cycle, needs urgent evaluation. The whole concept of a realistic test-driving cycle should be examined.

INSTRUMENTATION

More reliable and convenient instrumentation for determining NO and NO_2 in ambient air should be developed. Particularly in the case of NO_2, there is no simple, reliable instrument available to measure the concentration of this species in photochemical smog.

A convenient, reliable, and accurate method for the measurement of aldehydes and other oxygenated hydrocarbons in ambient air requires development.

EDUCATION

It is imperative that students, legislators and the public be educated in all aspects of the air pollution problem and the measures suggested for its alleviation.

The public should be made aware of the total impact of control measures and of the exact cost to them—both financially and otherwise—of possible societal and technical options.

TECHNICAL OPTIONS

The possibility of using gaseous fuels, especially for older cars and fleet vehicles, should receive immediate attention. Testimony indicated that converison of fleets to gaseous fuels is one of the few immediate changes which would improve air quality by as much as 10 percent in the Los Angeles basin. Vehicle manufacturers should be encouraged to provide factory options for use of gaseous fuels.

A comprehensive evaluation of the possible long-term alternatives to the internal combustion engine should be undertaken. The status and possibilities of the gas turbine in particular shsould be ascertained.

Technical information should be compiled and criteria developed to serve as a basis for minimum performance standards to accompany minimum emission standards for pollutants.

LEGISLATION

The members of the California Legislature and the California Delegation to Congress should:

1. Explore the possibility of requesting a critical valuation of the Federal Air Quality Standards and the Federal Emission Standards for motor vehicles.
2. Explore the trade-offs in the use of gaseous fuels—e.g., CNG, LNG, and LPG—in critical air pollution areas, particularly for fleet vehicles and possibly for private cars.
3. Explore the possibility of legislation specifying minimum performance standards to accompany minimum emission standards of pollutants, the objective being to insure a "safe," drivable, useful car which is a low emitter.
4. Explore the possibility of legislation which would insure critical evaluation of gas turbine engines as power sources for motor vehicles by the late 1970's. They would be evaluated in terms of performance characteristics, as well as low-pollution capabilities.

COMPARISON OF NEW FEDERAL CALIFORNIA AIR QUALITY STANDARDS

Substance	Federal standard		California standards
	Primary	Secondary	
SO_2	0.03 annual 0.14 p.p.m./24 hrs	0.02 annual 0.10 p.p.m./24 hrs.; 0.5 p.p.m./3 hrs.	0.04 p.p.m./24 hrs.; 0.5 p.p.m./1 hr.
Part	75 u.g./m.³ annual; 260 u.g./m.³ 24 hrs.	60 u.g./M.³ annual; 150 u.g./m.³ 24 hrs.	60 u.g./m.³ annual; 100 u.g./m.³ 24 hrs.
Co	9.0 p.p.m./8 hrs.; 35 p.p.m./1 hr.	9.0 p.p.m./8 hrs.; 35 p.p.m./1 hr.	10 p.p.m./12 hrs.; 40 p.m. 1 hr.
Oxidant	0.08 p.p.m./1 hr	0.08 p.p.m./1 hr	0.10 p.p.m./1 hr.
NO_2	0.05 p.p.m. (annual)	0.05 p.p.m. (annual)	0.25 p.p.m./1 hr.
HC (less methane)	0.24 p.p.m., 6–9 a.m	0.24 p.p.m., 6–9 a.m	

AIR POLLUTION EMISSION STANDARDS FOR LIGHT-DUTY VEHICLES

[In grams per mile]

	Federal	California		Federal	California
1973:			1975:		
HC	3.4	3.2	HC	4.1	1.0
CO	39.0	39.0	CO	3.4	24.0
NO_x	3.0	3.0	NO_x	3.1	1.5
1974:			1976:		
HC	3.4	3.2	HC	.4	1.0
CO	39.0	39.0	CO	3.4	24.0
NO_x	3.0	2.0	NO_x	.4	1.5

Mr. VEYSEY. I assure you there were never any resolutions and it was not our intent to take votes or come to agreements on resolutions.

Mr. ROGERS. Just so the record is clear, it might be well for you to put for us in the record the expense and whether any of this was paid for by the Government.

Mr. VEYSEY. None whatsoever, except for the expense of the Western White House which would be ongoing whether it would be used or not. The meals were catered and brought in.

(The following expenses of conference were received for the record:)

EXPENSES OF MOTOR VEHICLE AIR POLLUTION CONFERENCE, SAN CLEMENTE, CALIF., JAN. 13-14, 1972

Item	Cost	Congressman Veysey	University of California (Riverside)	
			Public affairs	Research center
Western White House	None			
Lunches, Jan. 13, 14	$674.75	$337.38		$337.37
Dinner, Jan. 13	804.75	402.37		402.38
Coffee and doughnuts	36.00	36.00		
Name tags	12.63	12.63		
Breakfast meetings	24.38	24.38		
Coffee and rolls for press room	24.00	24.00		
Rental for press room, San Clemente Inn	83.15	83.15		
Long-distance phone	1.87	1.87		
Hospitality hour, Jan. 13, 14	432.00	232.00	$200.00	
Typewriters, press room	44.00		44.00	
Telephones, press room	68.00		68.00	
Total	2,205.53	1,153.78	312.00	739.75

Note: All transportation costs to and from the conference, lodging, and other expenses were borne by the individual participants.

Mr. ROGERS. I understood from a letter which I will make part of the record this morning, written by a Mr. Harry Morrison, vice president and general manager of the Western Oil and Gas Association, that the general feeling of the meeting he said was unquestionably the consensus that no constructive progress in solving the automobile exhaust emission problem could be made so long as arbitrary reduction in auto emission standards continue in the present statute and unless recognition of the necessity for normal maintenance is included in the 50,000 mile maintenance.

I got the impression from your statement that you shared that feeling.

Mr. VEYSEY. The letter you referred to reached my office this morning. I don't know what quirk that is of the U.S. mail but it was dated January 25, mailed airmail, but reached me only this morning.

However, it was in the hands of a reporter by noon yesterday, I guess, from this committee—I don't know where else.

Mr. ROGERS. I don't mind telling you where I got it. I had a visit by Mr. Fred L. Hartley, head of Union Oil Co., who said he had this, shared its opinion and had no objection to its being made part of the record.

Mr. VEYSEY. That is fine. I was a little in the dark when the letter was addressed to me and I heard about it through other circumstances.

Mr. ROGERS. This was handed to me personally by the party who was there, as I understood.

Mr. VEYSEY. I see his name listed as one of the recipients of a copy of it.

Mr. ROGERS. I don't think there is any secret about how it got here. I just wondered if that was your feeling from the testimony you gave. Did you share that?

Mr. VEYSEY. The letter represents, if you read it carefully, Mr. Chairman, and I am sure you will, it represents his suggestion to me and to others as to what he thinks ought to happen.

Mr. Morrison is the writer of this letter. These are his conclusions and suggestions and not necessarily mine.

Mr. ROGERS. He said it was unquestionably the consensus of the meeting there were no contrary views as to standards.

Mr. VEYSEY. I would disagree.

Mr. ROGERS. I thought you felt in your statement you also felt there should be a modification of what you call arbitrary standards.

Mr. VEYSEY. I think what I called for is a reexamination of the basis of those standards. It seems to me that they are arbitrary right across the board. They might well be toughened in some directions and backed off in other directions to match the physical facts that we are working with rather than the arbitrary 80 percent across the board.

Mr. ROGERS. I am not trying to pin you down. I just wondered if you shared that general feeling.

Mr. VEYSEY. I do not share the statement that no progress can be made. That is his statement, not mine.

Mr. ROGERS. But you do feel——

Mr. VEYSEY. I do feel——

Mr. ROGERS. Reexamination of the 1967 law.

Mr. VEYSEY. That is right, reexamination of the health-related basis of those emission standards is what I am calling for.

Mr. ROGERS. Also, he makes the statement and I presume you were the chairman——

Mr. VEYSEY. I chaired portions of it, Congressman Hanna shared a portion.

Mr. ROGERS. I was wondering if he was referring to you when he said:

> In fact, at one point in the meeting, the chairman described the situation of the 90-percent reduction most clearly when he said the arbitrary aspects of the bill had resulted in "overkill."

Was that your statement?

Mr. VEYSEY. That might well be my reaction to the carbon monoxide standards.

Mr. ROGERS. This says the 90-percent reduction which is what you are talking about as being arbitrary.

Mr. VEYSEY. Across the board, that is correct.

Mr. ROGERS. Let me just ask this: I notice in your statement today you say:

> We in Southern California cannot wait for automakers and Federal regulation agencies to move on a collision course toward arbitrary standards and emission levels. We cannot sit back while legislators and Government executives argue over statistics and standards which scientists cannot agree upon.

I am not sure exactly what that means. I wonder if you might just comment on it and what action should be taken.

Mr. VEYSEY. I am referring really, Mr. Chairman, to the difference between the California emission standards and the Federal emission standards. There are some significant differences.

Mr. ROGERS. In fact, I think the Federal standards get rougher in the latter part, California led the way for the rougher one first.

Mr. VEYSEY. We had been earlier in our impact.

Mr. ROGERS. That is why we gave you an exemption and let you continue to still lead.

Mr. VEYSEY. We want to protect that opportunity to do so because we have had some experience and we have a unique problem.

Mr. ROGERS. A great experience.

Mr. VEYSEY. We have pushed for earlier achievement of some of these standards and it seems to me that the differences between the California and the Federal emission standards should be carefully examined.

I think, as I described to Congressman Carter, that there is only a most tenuous relationship between the air quality standards which are health-related clearly and the auto emission standards by this 90 percent lop-off measure. I think we may be depriving ourselves of an opportunity to get to clean air at the earliest possible chance by going that route, so I want to have a reexamination of the basis for it.

Mr. ROGERS. I am not sure, however, how I relate that to the fact that if we don't press for standards to be met, we therefore can reach better results. I am not sure I follow that exactly.

Mr. VEYSEY. What we want is clean air. We all agree on that. We want a healthful situation.

Now, the most damaging of these pollutants is the oxides of nitrogen, in my judgment.

Mr. ROGERS. I think health authorities would also say carbon monoxide is very harmful.

Mr. VEYSEY. Carbon monoxide is a poisonous gas and it could kill you, but it does not have the photochemical reactivity that really is at the heart of the problem that comes from our vehicular emissions in California.

I think we need to direct our attention very strongly to the oxides of nitrogen and perhaps we are counterproductive in going at the same time as strongly in the control of carbon monoxide.

Mr. ROGERS. I was interested in your statement. You did not feel these were health related, the reduction.

Mr. VEYSEY. Yes.

Mr. ROGERS. Have you had an opportunity to review the Senate report on page 25 where it gives an explanation of the health relation to the standards?

Mr. VEYSEY. I don't know what is on page 25 of the report, Mr. Chairman, but I understand the relationship is drawn through a paper or a calculation which is known as Barth et al., and is an attempt to make a relationship between the auto emission standards and the air quality standards.

I think even the Barth et al., report does not say 90 percent across the board. I am not at all sure that there aren't some assumptions made in that derivation that would stand some very critical examination. It was done with very sketchy information, probably.

Mr. ROGERS. I think it is pretty well stated here. They state what the ambient standard is necessary to protect public health in parts per million, the photochemical oxides in parts per million.

Mr. VEYSEY. You are talking about air quality standards.

Mr. ROGERS. Ambient air standards.

Mr. VEYSEY. I agree there.

Mr. ROGERS. Then they relate that to the actual standard, and it is also what the administration has set as its goal for 1980 for those standards.

Mr. VEYSEY. I think that is a tenuous relationship that needs to be examined.

Mr. ROGERS. What information do you have, aside from this study, showing this is not correct?

Mr. VEYSEY. I think the scientists have differed pretty widely on this.

Mr. ROGERS. We are delighted to have our colleague, Congressman Rousselot join us at the table. We are just going into some of the problems on air pollution.

Mr. VEYSEY. I feel that the scientists at the air pollution research center at Riverside do not necessarily agree that is the relationship. I think they are saying to us it ought to be examined in more depth and detail.

Mr. ROGERS. Did they present any scientific paper on that?

Mr. VEYSEY. No, I think it should be looked into by this committee.

Mr. ROGERS. We will look into it. To say on the record there is no basis for health standards and ambient standards because this is clearly set forth by the efforts of Congress.

We appreciate your appearance here and we would be pleased to have whatever recommendations your group would have.

Would you like to say anything, Mr. Rousselot?

Mr. ROUSSELOT. Thank you, Mr. Chairman. I don't think I can contribute any more than Congressman Veysey has already done. The point he makes does need emphasis. The University of California at Riverside has a very extensive research facility and had been groping with this problem for a long time. They feel this relationship between the two areas needs to be reexamined and this was discussed, I am sure, as was pointed out at the recent conference we had at the Western White House on this particular issue.

If this committee could consider a reevaluation of the relationship, I think it is important.

Now, nobody in California or on our California congressional delegation is more conscious of this problem. We want a real solution and we want results especially the members in southern California. We want to do it in a way that produces results and not just a lot of theory.

Mr. ROGERS. I commend you. The reports came out from this meeting asking for relaxation of the 1970 law. I thought we ought to have this very clear.

Mr. VEYSEY. Mr. Chairman, I don't know what reports you are referring to—

Mr. ROGERS. In the New York Times.

Mr. VEYSEY. Different individuals participating in the meeting were interviewed by the press on various occasions and reacted probably differently than Congressman Rousselot and I might have as to what the consensus was. I think what we really called for was a real new look at this question by Congress.

Mr. ROGERS. For instance, here is one of your agenda items, "How are highly controversial issues such as lead pollution best resolved?"

Well, the Congress has made that determination basically—take the lead out—and I think the agency has made that determination. What concerns me is some underlying feeling here that maybe we ought not to do this sort of thing. I know it is controversial to oil companies, but I think to most people they feel there is a health basis there. For the prevention of pollution from any catalyst the lead has to come out and there was the testimony and the oil people are willing to do it.

The oil people testified yesterday they can meet the requirement and they will meet it and they do not need any change in the law.

Mr. VEYSEY. We had some discussion on the question of lead. There are still two sides to the argument as to whether lead in gasoline coming out of motor vehicle exhausts is going to kill anybody. It hasn't apparently but maybe it will some time.

Mr. ROGERS. I am sure you know of the studies in New York, in the tunnels and with the lead that was found in their bodies.

Mr. VEYSEY. Those studies have been duplicated in many places and we find there is a buildup in the environment of lead but as far as I know, no clinical studies of physical damage to health resulting from that.

Mr. ROGERS. I think we know the obvious danger in lead poisoning.

Mr. VEYSEY. We know lead will kill people. There is no question about that. I relate the lead question much more to the importance of getting all of the lead out of the gasoline so that catalytic purifiers can be used in achieving these standards in 1975 or 1976 or whenever because I think that is maybe one of the real ways of getting to clean air.

As long as there is lead in gasoline, somebody is going to put leaded gasoline through that engine and catalysts simply will not be working.

Mr. ROUSSELOT. It does not have a long-range ability to cope with that.

Mr. ROGERS. I think the automobile companies now are projecting that we move into this entire area.

Mr. ROUSSELOT. We should.

Mr. ROGERS. We have the problem of old cars that need some for awhile.

Mr. VEYSEY. One of the problems of achieving the standards in 1975 and 1976 is the fact that we won't be that far along in getting all of the lead out of gasoline so that no one has confidence to move to catalytic purifiers.

Mr. ROGERS. The oil industry testified they could do it by 1974 so that would answer it.

Mr. VEYSEY. I have a personal feeling that maybe it does not. I think as long as there is leaded gasoline around, somebody is going to put it through that engine and that catalyst is killed.

Mr. ROGERS. Maybe they are just talking about changing the nozzle and the entrance to the cars.

Mr. VEYSEY. Unfortunately, Mr. Chairman, it is my judgment that people are pretty ingenious in doing things on their own.

Mr. ROGERS. I think for the most part they are not going to want to go out and buy another catalyst.

Mr. VEYSEY. They won't even be aware it is nonfunctional. The car runs fine.

Mr. ROGERS. The EPA is now looking at the inspection plans of the State. This would be one way of doing it; 1975 and 1976 are a little ways away.

I am sure you are, too, aware that the National Academy of Sciences has said if EPA allows averaging, testing with gasolines with the lead pollutants out and if we have a catalyst change every 25,000 miles, manufacturers can meet the standards. You don't need any changes in the law. We can clear it up. I am just concerned that there was a movement getting started to try to weaken what we are doing on a national scale here.

I was particularly concerned not knowing what you said that the White House really did not have any input in it when it was held at the Western White House, particularly.

Mr. VEYSEY. Let me assure you again, if there is a movement started, and I don't know if there is or is not, the White House had no input into the conference.

Mr. ROGERS. Although members of the administration agencies were there and this was given approval by the Justice Department.

Mr. VEYSEY. They laid down the guidelines as to what the manufacturers could and could not do. They did not approve the conference or anything of that sort.

Let me say that the only movement that I can see is an effort to try to get to clean air faster.

Mr. ROGERS. I don't know how you can do that if you don't say you don't have to get lead out if it is too much of a problem.

Mr. ROUSSELOT. I think you misinterpreted.

Mr. VEYSEY. When I was in the State legislature in California I supported and worked for legislation to get all of the lead out of gasoline in California by 1974 and I think that is what we ought to be doing so that leaded gasoline won't be destroying the catalysts. That paves the way to get something done.

Mr. ROUSSELOT. I think another thing should be corrected, Mr. Chairman. There is no attempt on our part to weaken anything. We are tired of a lot of conversation and rhetoric and not getting results. It was clearly discussed at this conference what the results would be.

Will we be producing the kind of emissions we are talking about, or is it guesswork? What are the medical values that need to be evaluated? What is the true medical evaluation of work at the danger point? The medical people say that is not totally known yet.

They have it in some areas. In the Lincoln Tunnel obviously, because it is a controlled atmosphere to a great degree, but we are not talking about the Lincoln Tunnel in southern California.

I don't care what the New York Times said because I don't think they get a lot of things accurate, so let's make that clear, too.

What you saw in the New York Times does not necessarily represent what happened at the conference, so I think that should be made clear.

We did have quite an argument with the man there from the New York Times. He could not get a lot of things straight, in my opinion, so please don't base your judgments on that article.

Mr. ROGERS. I won't, of course, and you have given us these assurances. Although the press was not at the meetings they were briefed.

Mr. ROUSSELOT. They had three press conferences a day——

Mr. ROGERS. I said I understood they were briefed but did not attend the conference.

Mr. VEYSEY. I made that decision myself so there could be a free exchange.

Mr. ROGERS. I understand. I was concerned about a statement in a letter from a man who was there, at least this was his impression. You may not agree with it.

He said:

> It was unquestionably the consensus that no constructive progress in solving the automotive exhaust emission problem could be made, one, so long as arbitrary reduction in auto emission standards continue in the present statute.

Mr. ROUSSELOT. That was at the 90-percent figure—in certain instances but not all.

In other words, the 90-percent concept should not be automatically applied across the board in all items.

Mr. ROGERS. In order to meet the goal—it does not meet the goal——

Mr. ROUSSELOT. To get the result.

Mr. ROGERS. Even 90 percent does not get the result because we are trying to get 100 percent if possible and it may not be possible. I don't know.

I think this spreads on the record things we were concerned with and we appreciate your taking time to come to the committee.

We would be pleased to receive your final determinations after you get them together.

Mr. VEYSEY. Thank you, Mr. Chairman. We will do that as soon as they have been examined by the participants and corrected in whatever way they desire.

Thank you very much.

Mr. ROGERS. Thank you very much.

I might also put in the record at this point a resolution the board of supervisors, county of Los Angeles, have sent to Members of Congress saying in effect that they do not want any delay in implementation of the exhaust emission control standards and do not endorse a change in the present law.

(The resolution referred to follows:)

BOARD OF SUPERVISORS,
COUNTY OF LOS ANGELES,
Los Angeles, January 24, 1972.

To each Member, U.S. Congress:

DEAR SIR: At its meeting held January 20, 1972, on motion of Supervisor Kenneth Hahn, the Board of Supervisors of the County of Los Angeles, sitting as the Air Pollution Control Board, adopted the attached resolution.

Very truly yours,

JAMES S. MIZE,
Executive Director.

RESOLUTION

On motion of Supervisor Hahn, unanimously carried, the following resolution was adopted:

Whereas, air pollution has been defiling the environment of Los Angeles County for more than 25 years and still lingers as a most urgent and sensitive problem; and

Whereas, the Board of Supervisors is responsible for the health and welfare of over seven million residents of Los Angeles County; and

Whereas, medical science has accumulated epidemiological, experimental, and clinical evidence that levels of air pollution in Los Angeles County affect significantly the breathing of normal subjects during high exposure periods and constitute a hazard to the health and welfare of the people in the County; and

Whereas, the Los Angeles County Medical Association has affirmed repeatedly that air pollution constitutes a hazard to the health of persons living in this County and, because of air pollution, a comprehensive School and Health Smog Warning System has been implemented by this Board of Supervisors, in accordance with the county medical association's recommendations, to protect the health of the students and people of this County; and

Whereas, the Federal air quality standards are exceeded for nitrogen dioxide and hydrocarbons in Los Angeles County, and the standard for photochemical oxidant is exceeded on 250 days per year (and every day in the summertime), and in addition the standards for carbon monoxide are exceeded on 200 days per year; and

Whereas, virtually the only contaminants for which air quality standards are often exceeded are those emitted by motor vehicles, or created by photochemical reactions of contaminants emitted by motor vehicles; and

Whereas, these motor vehicle emissions will prevent Los Angeles County from complying with the Federal air quality standards by 1975, as required by the Clean Air Act; and

Whereas, further delays in compliance with 1975 vehicular emission standards will delay still further the date when compliance with the air quality standards can be attained; and

Whereas, such further delay will subject the residents of Los Angeles County to additional exposure to these harmful contaminants; and

Whereas, this Board of Supervisors as the Air Pollution Control Board of the Los Angeles County Air Pollution Control District has enacted and enforced the most stringent Rules and Regulations for stationary sources in effect anywhere in the world; and

Whereas, local agencies have no jurisdiction over control of vehicular emissions and are restricted to control of stationary sources; and

Whereas, emissions from stationary sources under this program are now more than 80% controlled; and

Whereas, emissions from motor vehicles contribute more than 90% of the total pollution in this county and constitute its only inadequately controlled source of emissions; and

Whereas, this Board of Supervisors has, since 1953, by repeated communications, strongly informed and constantly reminded the automobile manufacturers of the urgent need to control motor vehicle emissions at the earliest possible date; and

Whereas, the automobile manufacturers, through procrastination, agreement, and other dilatory tactics, have failed and refused to comply with emission standards except when they were forced to do so; and

Whereas, the Committee on Motor Vehicle Emissions of the National Academy of Sciences has recommended to the Environmental Protection Agency that enforcement of the requirements of the Clean Air Act for 1975 vehicles be deferred until 1976,

Now, Therefore, Be It Resolved that the recommendation of the Committee on Motor Vehicle Emissions of the National Academy of Sciences should be rejected, and that any request by any automobile manufacturer for a one-year suspension of the 1975 Vehicle Emission Standards under the Clean Air Act be denied by the Administrator of the Environmental Protection Agency; and

Be It Further Resolved that any program, procedure, or attempt to delay effective control of exhaust emissions from motor vehicles is unacceptable to the County of Los Angeles; and

Be It Further Resolved that copies of this resolution shall be sent to the President, each member of Congress from California, and to the Administrator of the Environmental Protection Agency.

STATE OF CALIFORNIA
County of Los Angeles, ss:

I, James S. Mize, Executive Officer-Clerk of the Board of Supervisors of the County of Los Angeles, do hereby certify that the foregoing is a full, true and correct copy of the original Minute Entry (No. 4) of an action taken January 20, 1972, by the Board of Supervisors of the County of Los Angeles, and ex officio the governing body of all other special assessment and taxing districts, agencies, and authorities, for which said Board so acts, by the following vote:

Ayes: Supervisors Hahn, Debs, Chace, Dorn
Noes: None
Absent: Supervisor Bonelli

In Witness Whereof, I have hereunto set my hand and affixed the seal of the County of Los Angeles this 20th day of January, 1972

JAMES S. MIZE,
Executive Officer-Clerk of the Board of Supervisors of the County of Los Angeles.

Mr. ROGERS. Our next witness is Mr. D. A. Jensen, director, Automotive Emissions Office, Ford Motor Co., the American Road, Dearborn, Mich.

Mr. Jensen, we are very pleased to welcome you back again. We remember before when we went into writing the Clean Air Act of 1970 and you were very helpful then.

We welcome you and we will be pleased to receive your statement.

STATEMENT OF DONALD A. JENSEN, DIRECTOR, AUTOMOTIVE EMISSIONS OFFICE, FORD MOTOR CO.; ACCOMPANIED BY JAMES M. MacNEE, OFFICE OF GENERAL COUNSEL

Mr. JENSEN. Thank you, Mr. Chairman and gentlemen.

I am Donald A. Jensen, director, Automotive Emissions Office, Ford Motor Co.

In response to your request, I would like to offer comments with regard to implementation of those provisions of the Clean Air Amendments of 1970 which deal with motor vehicles. I will discuss primarily what we have done in carrying out the provisions of the act, and where we stand with regard to meeting the 1975 and 1976 vehicle emission standards as reported periodically to EPA. Through these comments, I believe your subcommittee will be able to gain insight on the manner in which we have attempted to carry out the provisions of the act to date.

By way of background, and to establish our historical position on the subject, I would first like to review briefly the previous testimony which Ford has given on the clean air amendments. On December 9, 1969, and on April 14, 1970, we testified before this subcommittee, then headed by Mr. Jarman, and on March 25, 1970, and on August 26, 1970, we were represented in discussions with the U.S. Senate. Throughout these hearings we consistently supported extension of the Clean Air Act; however, we also expressed concern or objection to several points. For example, we thought it was inappropriate to set specific emission reduction figures in the law, we felt there was insufficient technical evidence to support the stringency which was called for, and we believed that inadequate recognition had been given for lead time requirements. I might add that we still feel this way.

On December 31, 1970, the President signed the proposed amendments and they became law. They became law for us at Ford Motor Co. not only in a legal sense, but also from the standpoint of company

policy and dedication. Mr. Henry Ford II has stated this policy, along with his commitment for an all out program to meet the law, if at all possible, on a number of occasions.

To indicate to you that Mr. Ford's words were not empty, I would like to mention, as we have stated in earlier testimony to the EPA, that during calendar 1971—the first year under the Clean Air Amendments of 1970—Ford Motor Co., anticipating spending $132 million in the pursuit of controlling motor vehicle emissions, involving some 3,000 engineers, scientists, and technicians. And this does not include the additional millions of dollars spent last year in the continuing pollution control programs at our manufacturing plants.

Out of this effort has come a great deal of progress directed toward meeting the standards which EPA has set for 1975 and 1976 model vehicles. We have reported regularly to EPA, as well as appraising other organizations such as the National Academy of Sciences, of our continuing progress. To indicate the degree of detail in which we have reported, I have here copies of the material which we have submitted to EPA which we are making available to the committee. On April 5, 1971, we informed Mr. Ruckelshaus that Ford was proceeding with a major research and development effort to meet the 1975–76 emission requirements of the Act and described in detail our various programs. Then testimony was given before Mr. Ruckelshaus on May 6, 1971, and was supplemented with explanatory letters on May 13, 1971 and May 20, 1971. In another submission to EPA on October 18, 1971, we provided further detail on our progress. The extent of this work, and the significant results obtained, I submit, is testimony to our good faith efforts to meet the requirements of the statute. You may wish to have have these documents entered into the record of this hearing.

Mr. ROGERS. I think we will accept them for the files of the subcommittee.

Mr. JENSEN. Thank you, Mr. Chairman.

Mr. JENSEN. Let me summarize the more significant accomplishments of our emissions control research so far, to give you a better idea of the type and amount of work which has been done. A great deal has already been achieved, and some very encouraging developments have been made, however a great deal remains to be done.

We have identified four separate emission control systems which appear to be viable and are potential candidates for meeting 1975 and/or 1976 standards. Actually, a few experimental installations already have met the emission standard values at low mileage—I repeat, at low mileage—but none have achieved the 50,000-mile requirements of the law. As I will explain, however, they are still a long way from the point where we could put any of them into production. Let me describe each of four candidate systems, and tell you just where we stand on each of them. Drawings of each system are attached at the end of this statement.

Our first system is a combination of all of the advanced emission control components which we have been developing, both through our cooperative Inter-Industry Emission Control—IIEC—program and through our own research programs, over the past several years. This package, which is shown in Figure 1, has been dubbed the "kitchen sink" system by our engineers since it incorporates almost everything we feel will assist in reducing emissions.

1975 EMISSION SYSTEM

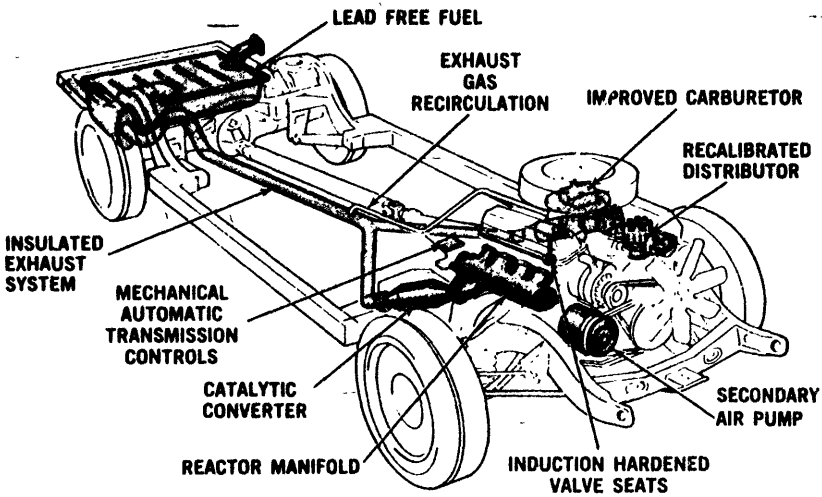

FIGURE 1

NOTE: THE 1976 (76-1) EMISSION SYSTEM WILL USE 1975 SYSTEM COMPONENTS BUT WILL BE TOTALLY RECALIBRATED FOR NOx REDUCTIONS.

It uses a combination of manifold thermal reactors for fast warm-up efficiency and noble metal catalytic converters for supplemental control during warmed up operation, plus exhaust gas recirculation—EGR—for reduction of oxides of nitrogen.

These three major devices—reactors, catalysts and EGR—are the new emission control devices on this system. Besides these items, this system also includes the following:

1. Secondary air supply pump, tubes and valves.
2. Improved carburetion or fuel injection.
3. Improved spark timing control.
4. Recalibrated distributor.
5. Insulated exhaust system.
6. Internal engine design modications:
   (*a*) Induction hardened valve seats
   (*b*) Modified compression ratio and surface-volume ratio
   (*c*) Modified valve timing.
7. Evaporative emission controls.
8. Revised transmission shift controls.
9. Overtemperature protection (for catalyst)
10. Vehicle insulation and heat shielding.
11. Vehicle component changes to package emission controls.
12. Closed crankcase ventilation system.
13. Lead-free fuel.

In spite of our best efforts, and the amount and complexity of the control hardware which has been added, we have not yet met the 1975 required emission levels with this system, with the specified durability. At low mileages, we are able to meet the 1975 emission standard values, but only on certain engines.

Major problems with this system, in addition to unsatisfactory low mileage emissions on certain engines, are excessive deterioration of system efficiency, high exhaust system temperature, and protection of the vehicle interior and chassis components from the high temperature of reactors and catalysts. In addition, there are problems of high system cost, degraded vehicle performance, proof fuel economy, and poor vehicle driveability.

As you know, the National Academy of Sciences issued a significant report to the Congress and to EPA on January 1, 1972, dealing with motor vehicle emissions. The findings of the eminent engineers, scientists, and educators who prepared this report are in basic agreement with our above findings relative to meeting 1975 requirements. They reported that no manufacturer has the technology necessary to meet 1975 emission standards for light duty vehicles, although they might be able to if certain allowances and provisions were made. The Academy also confirmed the vehicle operating penalties of performance, fuel economy, and driveability that will accompany the proposed 1975 control systems.

Regarding system cost, the Academy estimated that the 1975 requirements would increase the sticker price by about $288 over 1970 vehicles, or about $214 over 1973 vehicles. Also, they reported that a 3- to 12-percent increase in fuel comnsumption and increased maintenance costs could be expected.

Now let me review the various alternate control systems we are investigating in an effort to meet 1976 emission requirements. Our first alternate approach for 1976—system 76–1—is actually the above 1975 system, but with more of the same. In other words, the EGR rates are increased significantly, to obtain needed NO_x reduction, and higher catalyst efficiency is needed. Problems with this system are also similar to those I mentioned earlier, only they are somewhat more severe.

The second aproach directed toward meeting 1976 requirements—76–2—is essentially a dual-bed catalyst system which features an oxides of nitrogen NO_x catalyst. We are working on two versions of this concept. One of these—figure 2—includes the use of thermal reactors, for fast warmup, pelleted dual-catalysts, and EGR. The second version—figure 3—includes monolithic dual catalysts, EGR, and low-thermal inertial exhaust manifolds. The major problems which we have at this time with our 76–2 systems are:

1. Excessive deterioration of HC, CO, and NO_x catalyst activity.
2. Failure to meet our low-mileage emission objectives. These objectives are more stringent than the standards in order to allow for expected deterioration of the system with mileage.
3. Catalyst overtemperature protection.

1976–2A CONCEPT EMISSION PACKAGE
REACTOR-EGR-CATALYST SYSTEM

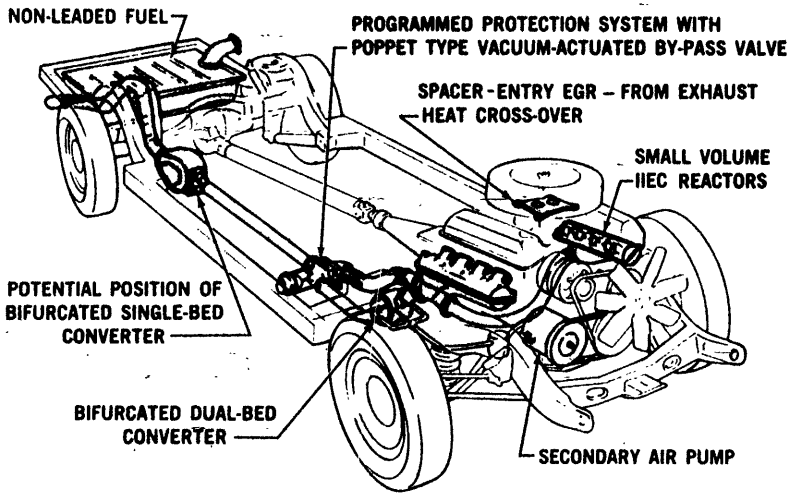

FIGURE 2

1976-2B CONCEPT EMISSION PACKAGE
EGR & MONOLITHIC DUAL CATALYST
MAJOR HARDWARE COMPONENTS

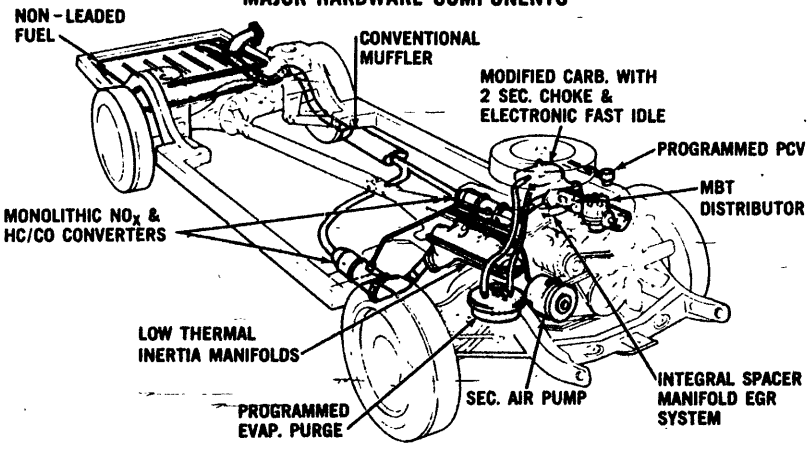

FIGURE 3

SYSTEM 76-3 STRATIFIED CHARGE INTERNAL COMBUSTION ENGINE-PROCO

INCLUDED – BUT NOT SHOWN:

- EXHAUST GAS RECIRCULATION
- LARGE VOLUME, LOW THERMAL INERTIA, INSULATED EXHAUST MANIFOLD
- PLATINUM HC/CO CATALYST
- NONLEADED FUEL

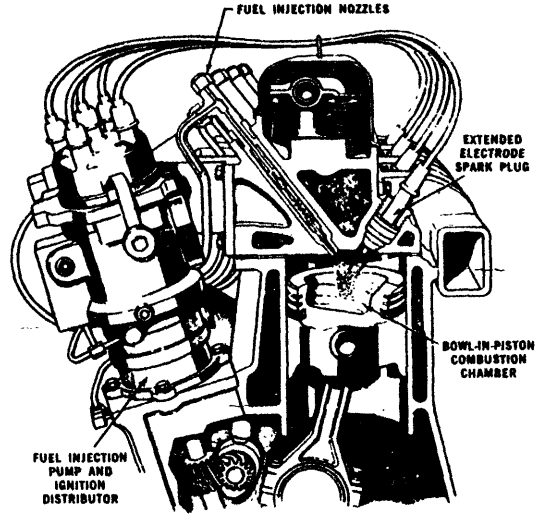

FIGURE 4

Our third approach—76–3—is most often referred to as the Ford Proco engine. The name "Proco" comes from programed combustion. The engine is essentially a stratified-charge, fuel-injection, internal-combustion, spark-ignited piston engine. It features a high-pressure mechanical fuel injection system with special injectors, a bowl-in-piston combustion chamber, long-reach spark plugs, plus EGR, a large volume, low-thermal inertia insulated exhaust manifold, and a noble metal catalyst.

Ford actually has been working on stratified-charge engines for over 15 years, with the original objective of improved fuel economy. Over the last 2 years we have been working with the U.S. Army in an effort to use this principle to reduce emissions. These efforts led to the development of a small, four-cylinder engine for the Army military utility transport truck, MUTT, which has shown very encouraging preliminary, low-mileage results. Our work on the Proco engine received wide and unexpected attention as the result of a September 24, 1971, news release by the Environmental Protection Agency stating that the engine had potential for meeting the 1975–76 clean air standards and was "the cleanest engine we have ever tested." EPA's release followed a statement by President Nixon, in his Economic Club of Detroit appearance on September 23, that EPA Chief, William Ruckelshaus—

> Working with industry in the Detroit area, will have an announcement in the next few days with regard to a new engine that in preliminary tests meets the very strict standards of the Clean Air Act.

The majority of our test data has been obtained with the 141-cubic-inch displacement, four-cylinder Proco engine in an Army M–151—

MUTT—vehicle. Although our engineering objectives have not been met, the emission results are encouraging. In order to verify the potential of this system and to prepare more typical vehicles for further development work, a 141-cubic-inch displacement Proco engine has been installed in a Capri vehicle and a 351-cubic-inch displacement V–8 engine has been converted to the Proco principle for installation and test in a Torino vehicle. These installations are currently being evaluated.

Current engineering research and development efforts on Proco are aimed at identifying and resolving durability problems, in addition to evaluation of the Torino and Capri vehicles mentioned above. It should be noted that even though the MUTT vehicle is a hand-built prototype and it was retuned by these engineers during the 14 EPA tests, our engineering objectives—these low-mileage objectives—have not been met. In addition, this engine is very dependent on HC/CO catalyst efficiency in order to obtain required low HC and CO emission levels for 50,000 miles. The number and complexity of the remaining unresolved items of the Proco, not to mention the special manufacturing problems involved, make it clear that this engine cannot be considered for 1975, and 1976 also appears very unlikely. Also, our catalyst system development program results will obviously determine, to a great extent, Proco engine emission potential.

We presented a technical paper on this engine and to the Society of Automotive Engineers at their Engineering Congress earlier this month in Detroit and you may wish to have this paper incorporated in the records of this hearing.

Mr. ROGERS. Yes, we would like very much to have this paper incorporated in the records of this hearing.

It will be inserted into the record following your statement.

Mr. JENSEN. Our fourth 1976 candidate system—76–4—is shown in figure 5 and is referred to as "Lean Burn." This concept is essentially a relatively conventional spark ignition, mixture cycle engine that is designated to operate with the high EGR rates plus lean fuel-air ratios. The objective is to maximize NO_x control with minimal fuel economy loss and acceptable driveability.

A low thermal inertia exhaust manifold and a great deal of HC/CO catalytic conversion are required with this system to control these pollutants, especially HC. Currently, a number of 351-cubic-inch displacement V–8 engines have been built to "Lean Burn" design specifications, and test results are somewhat encouraging, although engineering objectives have not been met. These results, much like the Proco engine results, have been obtained with hand-built precision hardware and they incorporate features, such as a manually controlled EGR system, which are not suitable for production or for customer use.

We are continuing a very active program on the 76–4 system aimed at reduction of the HC emission levels. In addition, automatic EGR and choke systems are being developed, thermal reactor effectiveness is being investigated, and octane requirements are being lowered. Basic system features can be applied to 1976 production vehicles if future comparative tests indicate they will get us closer to the 1976 regulations.

SYSTEM 76-4 (LEAN BURN)

INCLUDED – BUT NOT SHOWN:

- EXHAUST GAS RECIRCULATION
- LOW THERMAL INERTIA EXHAUST MANIFOLD
- SECONDARY AIR INJECTION
- PLATINUM HC/CO CATALYST
- NONLEADED FUEL

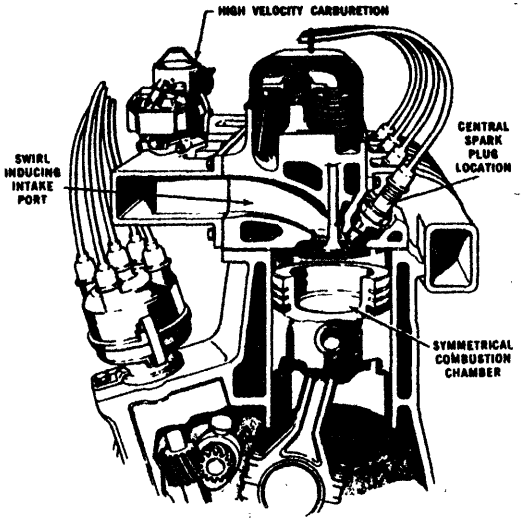

FIGURE 5

Our four 1976 potential systems, in summary, have shown encouraging progress as a result of our continuing research; however, none has shown the required degree of emission control after any extended durability running, even with the most carefully adjusted experimental installations. The very low standard for NO_x in 1976, in combination with the stringent 1975 carryover standards for HC and CO, present a formidable technological challenge which we have not yet been able to solve. The National Academy of Sciences, in their recent report, also concluded that the technology was not currently available to meet the 1976 standards.

I would also like to mention that our advanced emissions research is definitely not limited to the internal combustion engine. We have very active research and development programs underway on gas turbine engines, Rankine—vapor—cycle engines, and on high efficiency batteries and electric vehicle components. Lower priority studies have also been made on other alternate power sources. Although these various alternates each have certain desirable features which appear to have very interesting long-range potential, we have concluded unequivocally that none has the potential of being available for use in 1975 or 1976 production vehicles.

Incidentally, the National Academy of Sciences came to the same general conclusion regarding alternate power sources.

I hope this brief summary of our advanced emission control systems has given you an insight into the difficulty of the task which we face. More importantly, however, I hope I have conveyed to you two impressions. First, that we have made an all-out effort to meet the goals set in the statute, and, second, that these goals have been met only by a very few, highly experimental vehicles, at low mileages. As you

know, we are required to meet the emission standards for 50,000 miles of operation.

The net result of our efforts to date has made it abundantly clear that we will not be able to meet the specified requirements for 1975 models. The chairman of our board of directors indicated at a press conference on January 6, 1972, that we had no choice but to ask for an extension of time and on January 24, 1972, we formally notified EPA of our intention to file such a request.

Because of our production lead time, we must have our engineering work wrapped up sufficiently to allow us to make firm financial commitments for manufacturing facilities, tooling, and manpower no later than July 1, 1972. This decision date is necessary to insure our 1975 model car assembly line production date of August 1, 1974. There is no feasible way of completing the necessary engineering and durability verification work in time to meet the July 1, 1972, deadline.

We are now in the process of preparing our request for a 1-year delay in the 1975 model year standards. Actually, based on the time which the statute allows for review of the administrator's decision, we may already be late in making our reqeust for delay of 1975 standards, in order to meet our July 1, 1972, deadline.

We hope that the added year provided by the statute, if it is granted, will be sufficient to enable us to meet the requirement of a 90-percent reduction from 1970–71 emission levels. If it does, we think it will have been well worth the delay since the added research and development time would hopefully allow us to do a better job, not only of meeting the emission target, but of producing a better car in terms of improved driveability, reliability, and perhaps lower cost. Further, the effect on the atmosphere from such a delay would be only very slight, as verified by the National Academy of Sciences.

Again, in line with our earlier pledge, if the administrator does see fit to grant us the extra year that the law permits him to give, we pledge that we will continue to do our utmost to try to meet the requirements contained in the statute.

Thank you for this opportunity to express our views on this important matter.

(Testimony resumes on p. 305.)

(The Proco SAE paper referred to follows:)

SOCIETY OF AUTOMOTIVE ENGINEERS, INC.
TWO PENNSYLVANIA PLAZA, NEW YORK, N.Y. 10001

Exhaust Emission Control by the Ford Programmed Combustion Process-PROCO

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INTRODUCTION

Today there is little argument about the need for low-pollution powerplant systems for cars and trucks. There is a wide range of opinion, however, as to what a low-pollution powerplant system should be like. There are those who condemn the reciprocating piston engine outright and contend that cyclic combustion will never attain good combustion control and produce sufficiently pollution-free power. Instead, they demand development of continuous combustion powerplants such as gas turbines and steam engines. Another school of thought contends that the present engine does an excellent job of providing for flexible vehicle propulsion and that pollution cleanup must be done in the exhaust system. The Programmed Combustion (PROCO) concept represents a middle ground approach to the pollution cleanup problem. It is based on the present reciprocating piston engine, which has been established as a very durable mechanism, excellently suited for the high efficiency conversion of thermal-to-mechanical energy in conventionally lubricated cast iron and aluminum machinery.

In essence the PROCO engine is the second generation Ford Combustion Process (FCP) engine. The first generation (1) was developed to give significant fuel economy improvement with maximum power equal to that of a carbureted engine. Emission characteristics of the first generation engine, although quite good, were far short of long range objectives. Subsequent development has been aimed at minimizing exhaust emissions with minimum fuel economy loss. Exhaust emission reduction has been achieved basically by the introduction of air throttling and exhaust gas recirculation and by slight modification of other combustion control parameters. The resultant combustion process, although stratified in the strict sense of the word, is quite different from what is commonly known as "stratified charge combustion." The name "Programmed Combustion" is intended to convey this difference.

Research and development of this process has been carried out since 1956 with Ford Motor Company funds. During 1968, under the sponsorship of U.S. Army Tank-Automotive Command (USTACOM) the Ford Combustion Process was applied to the L-141 engine of the 1/4 ton military truck with the objective of significantly improving the fuel economy of the vehicle. Development of the L-141 engine for low emissions was jointly sponsored from 1969 by USTACOM and the Environmental Protection Agency (EPA) and its predecessor the Health, Education and Welfare Department of the United States. Process development and its application to passenger cars continues under Ford Motor Company sponsorship.

In order to convey basic information about the process as well as to document its present status, data for this paper were selected from different engines and from different stages of development. For this reason, complete data correlations between single-cylinder engines, multi-cylinder engines, and vehicles are lacking. It is hoped that, in the not too distant future, the process development will reach a level where full and thorough documentation will be practical and possible.

(1) Numbers in parenthesis indicate reference material listed at the end of the pape

ABSTRACT

The Ford Stratified Charge Combustion Process (FCP) which utilizes direct fuel injection has been further developed for reduced exhaust emissions. With air throttling, exhaust gas recirculation, low thermal inertia exhaust manifold and a noble metal catalyst, low gaseous emissions have been achieved at low mileage on a 1/4 ton military utility truck with acceptable fuel economy and driveability. Dynamometer and vehicle emission data and details of the fuel injection and air-fuel ratio control system are described.

In this paper single cylinder emission data are shown to indicate the relationships between PROCO engine variables and emissions; the fuel injection and control systems necessary for fully automatic multicylinder operation is described; and multicylinder dynamometer and vehicle emission data and operating experiences are presented.

COMBUSTION SYSTEM LAYOUT AND OPERATION

Figures 1 and 2 show cross sections of two experimental PROCO engines, one with a flat and the other with a dished combustion chamber surface on the cylinder head.

The first important element in the combustion control system is the intake port, which is shaped to impart a swirl around the cylinder bore axis. Bench-measured air flow and swirl rpm data of a typical

BORE:	3.875
STROKE:	3.00
COMP. RATIO:	11:1

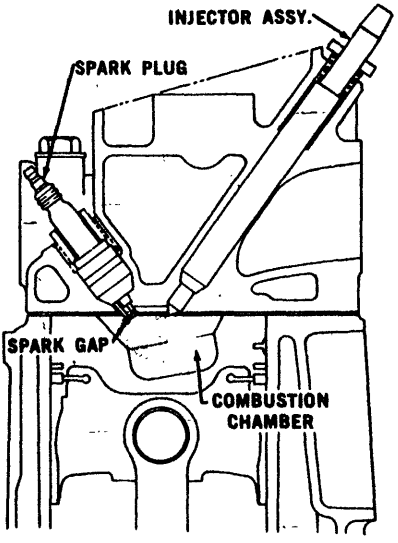

Figure 1 — L-141 PROCO Engine Cross Section

BORE:	4.00
STROKE:	3.50
COMP. RATIO:	11:1
C.I.D. / CYL:	44

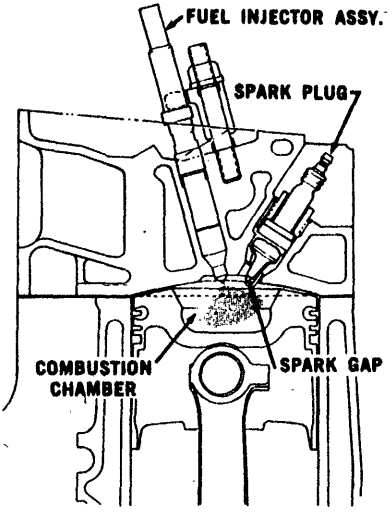

Figure 2 — 351-CID PROCO Engine Cross Section

PROCO port are shown on Figure 3. The swirl rpm in the engine is about 3-5 times the crankshaft speed. This swirl rate is significantly higher than found in conventional engines.

At part-load the intake air is throttled to maintain about 15.5:1 air-fuel ratio and 12-18% of the exhaust gas is recirculated into the intake system. The swirling charge is compressed at 11:1 compression ratio into a cup-shaped combustion chamber situated concentrically in the piston with about 65% squish area. Fuel is injected during the compression stroke. The injector, located near the center of the cylinder bore, provides a soft, low-penetrating, wide-angle, conical spray which results in a rich mixture at the center, surrounded by a leaner mixture and excess air. The spark plug, with its gap located either near the bore centerline or just above the spray, ignites the charge near top dead center. Combustion progresses rapidly in the rich mixture, then spreads out into the leaner regions. Flame travel is promoted by the intake swirl and the

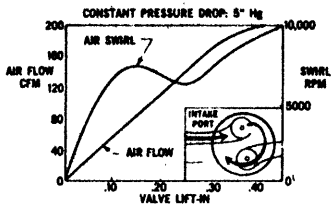

Figure 3 — Airflow and Swirl Data of a Typical PROCO Intake Port

toroidal mixture movement imparted by the squish action. As the piston travels down and the swirling charge expands from the piston cup into the cylinder space, air motion tends to homogenize the mixture and promote nearly complete combustion during the expansion stroke.

EMISSION CONTROL IN THE PROGRAMMED COMBUSTION ENGINE

Nitric oxide (NO) formation in the PROCO engine is controlled entirely inside the engine, whereas hydrocarbon (HC) and carbon monoxide (CO) control is accomplished in the engine as well as in the exhaust system.

Three factors play important roles in controlling NO formation in piston engines: peak cycle temperature, exposure time at high temperature, and oxygen availability. Theoretical NO formation as a function of temperature in perfectly mixed combustion products is shown in Figure 4. (2) The curve suggests that a very significant reduction in NO formation can be obtained by a relatively modest reduction in temperature. The effect of exposure time to high temperature is shown on Figure 5. (3) The curves indicate that, in terms of crank rotation, substantial time is necessary for NO to reach equilibrium, particularly at lower temperatures. Thus, shortened exposure time at high temperature can reduce NO emissions by stopping the NO formation reaction at a concentration level much below the theoretical equilibrium concentration. Oxygen availability also affects NO formation. Figure 6 (4) shows theoretical equilibrium NO concentration as a function of equivalence ratio. The constant temperature curves reflect oxygen concentration effect; whereas, the curve of adiabatic flame temperature on the lean side shows the combined effect of changing flame temperature due to dilution with air and the inceased oxygen availability with increased dilution.

This bell-shaped curve also indicates a sharp drop of NO concentration on the rich side, which is due to the combined effects of lack of oxygen behind the flame front and to internal cooling by the excess fuel.

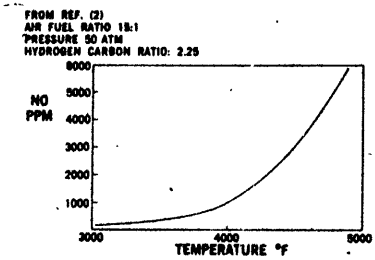

Figure 4 — NO at Equilibrium Vs. Temperature in Homogenous Combustion Products

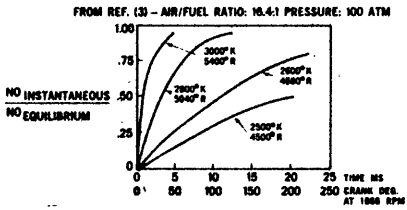

Figure 5 — N_2+O_2 Kinetic Progression for Different Temperatures in Homogeneous Combustion Products

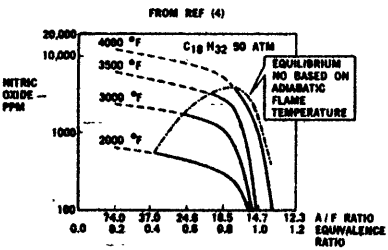

Figure 6 — Equilibrium NO Concentration Vs. Air-Fuel Ratio in Homogeneous Combustion Products

In the PROCO engine, combustion is initiated in a central rich mixture zone. This mixture fraction plays a dominant role in NO formation because it is subjected to the highest temperature for a relatively long period. The excess fuel in this zone reduces the peak temperature and assures an oxygen-free environment behind the flame front. These factors result in significantly reduced NO formation.

Exhaust gas recirculation (EGR) is also applied in the PROCO engine for NO reduction. Its beneficial effect is due to the lowering of flame temperature in the presence of additional inert gas in the combustion chamber. The rich mixture in the vicinity of the spark gap at the time of flame initiation enables the PROCO engine to fire overall lean mixtures with high EGR rates. After flame initiation, fast and near-complete combustion is maintained even with high EGR rates by virtue of the high swirl rate and the high squish action. The fast combustion rate also allows the use of late ignition timing without its associated phenomena of heavy loss of efficiency and poor driveability due to excessive cylinder pressure variations. Delaying most of the combustion until the early part of the expansion stroke extracts work from the gas while heat is being released, resulting in lower peak temperature and substantially shorter exposure time at high temperatures. Late ignition timing, of course, represents a shift from constant volume combustion towards constant pressure combustion. The lower efficiency of constant pressure combustion is compensated by the higher compression ratio of the PROCO engine.

Hydrocarbon emission control in the PROCO engine is effected primarily by injecting the fuel late in the compression stroke in the form of a low-penetrating spray and with an overall air-fuel ratio of about 15.5:1. The late timing of the fuel injection and the low penetration of the spray prevents filling the crevices of the combustion chamber with fuel air mixtures; instead, there is a fuel-free air "lining" in the chamber during the early part of the combustion. The result is reduced wall quenching of the mixture, which is one of the major factors of HC emission from carbureted engines.

The significance of the 15.5:1 overall air-fuel ratio lies in the fact that it assures sufficient oxygen for secondary oxidation without providing additional oxygen for NO formation.

Carbon monoxide concentration at 15.5:1 air-fuel ratio in a premixed-charge engine is .10 mole percent. In a PROCO engine with 15.5:1 air-fuel ratio the CO concentration is between .15 and 1.5 mole percent, depending on a number of variables. The higher CO concentration indicates the existence of rich initial combustion. Although unsubstantiated, it seems quite certain that during the early part of combustion much higher CO concentrations exist in the center region of the chamber. The second, lean-phase burning, however, significantly reduces the originally very high CO concentration but not to the low level obtained with leaner than stoichiometric premixed-charge combustion.

EXHAUST EMISSION CHARACTERISTICS OF A SINGLE-CYLINDER PROCO ENGINE

Exhaust emission characteristics of the PROCO process can be conveniently studied and at least partially developed on a single-cylinder engine. Table 1 shows the specifications and Figure 2 shows a cross section of the 44-CID single-cylinder engine used in these tests.

Emission data from the engine are presented as specific mass emissions (GM/OIHP-HR) because, unlike concentrations (PPM or mole percent) a minimum value in this unit truly signifies lowest emissions. To aid in placing GM/OIHP-HR emission values in proper perspective for those who are accustomed to the concentration values, Figure 7 was prepared. It shows the conversion of GM/OIHP-HR to PPM or mole percent for 15:1 air-fuel ratio and .400 LBS/OIHP-HR indicated specific fuel consumption (ISFC).

One of the key features of the PROCO concept is that the mixture is highly stratified at the beginning of combustion. The effect of this charge stratification on emissions can be assessed from Figure 8. The data shown were obtained by operating the PROCO engine with fuel injection and, for comparison, with a carbureted mixture. In both cases, the overall air-fuel ratio was 18:1 and EGR was not used. The curves show that in this engine the stratified fuel introduction results in a significant decrease in both NO_X and HC emissions and a slight increase in CO emissions.

TABLE 1
SINGLE CYLINDER TECHNICAL DATA

WAUKESHA CFR 48 CRANKCASE

BORE	4.00 IN.
STROKE	3.50 IN.
DISPLACEMENT	44 C.I.D.
COMPRESSION RATIO	11:1
PISTON SQUISH AREA	65%
FUEL INJECTION PUMP	AMERICAN BOSCH APE-1B SINGLE PLUNGER PUMP
INJECTOR	FORD - EXPERIMENTAL
IGNITION SYSTEM	FORD - TRANSISTORIZED

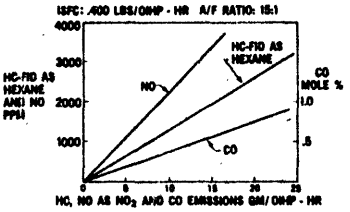

Figure 7 — Correlation Chart for Emission Units

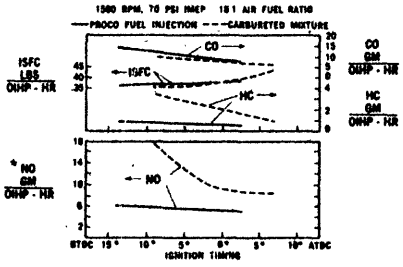

Figure 8 — Comparison of Stratified Vs. Premixed Combustion in PROCO Engine

Exhaust emissions of the PROCO engine can be influenced by a number of combustion control variables affecting emission control mechanisms, both inside the engine and in the exhaust system. Figures 9-12 show how exhaust emissions at 1500 rpm 70 psi IMEP are affected by injection and ignition timing, overall air-fuel ratio, and exhaust gas recirculation. At this load with 15% EGR the exhaust temperature in the single cylinder engine is low enough to eliminate significant thermal oxidation in the exhaust system. Therefore, the effects of the variables on emissions mostly reflect events taking place inside the cylinder. The effect of load, piston squish area and spark retard on emissions across the load range is shown in Figures 13 and 14. The effect of variables on emission concentration affords an insight into the emission formation mechanism of the PROCO engine.

Nitric Oxide Emissions

Overall NO emissions are influenced by conditions prevailing in the first, rich-combustion phase. Adjustments causing richer first-phase combustion such as injection timing retard (Figure 9) and richer, or more correctly, less-lean overall air-fuel ratio (Figure 11) tend to reduce NO formation. The effect of ignition timing on NO emissions (Figure 10) is similar to that in mixture-cycle engines. Retarded timing is beneficial, but beyond a point the deterioration in engine efficiency limits the amount of NO emission improvement achievable with ignition timing retard. Figure 14 indicates that ignition timing retard from 5.5° BTDC to TDC is effective at the higher loads but ineffective at the light load point.

Exhaust recirculation has a very strong influence on NO emissions (Figure 12) because the extra inert diluent gas reduces flame temperature without increasing oxygen availability. It is interesting to note that when EGR is added at 18:1 overall air-fuel ratio, the NO formation significantly decreases with both mixture-cycle and PROCO engines. However, when air is used as the diluent, the NO decreases with mixture-cycle combustion but slowly increases with PROCO

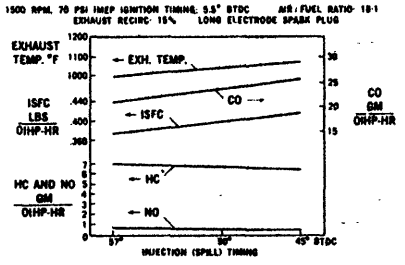

Figure 9 — Injection Timing Effects at One Load Point

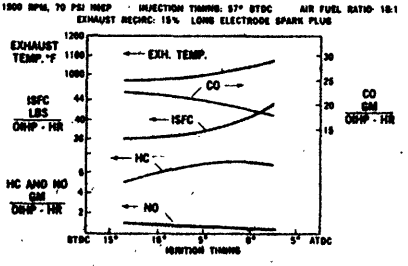

Figure 10 — Ignition Timing Effects at One Load Point

* *NO* $\frac{GM}{OIHP \cdot HR}$ *values are computed with* NO_2 *molecular weight.*

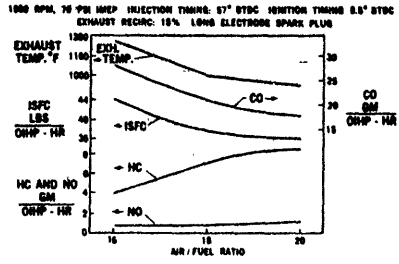

Figure 11 — Air-Fuel Ratio Effects at One Load Point

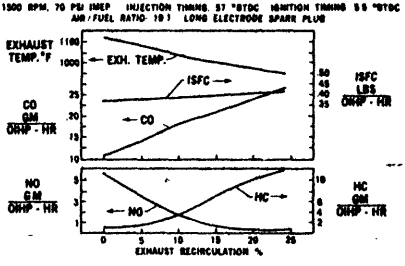

Figure 12 — Exhaust Recirculation Effects at One Load Point

(Figure 11). The reason for this latter result is the fact that the first phase combustion zone, where most of the NO formation occurs, is much richer than 16:1 air-fuel ratio. An overall leaning out of the charge with air will, in reality, reduce the richness of the first phase combustion, thereby increasing the NO formation.

As Figure 13 shows, increased squish area under identical injection and ignition timings results in higher NO emissions and better fuel economy. This is due to faster and more thorough mixing and faster combustion. However, with a 5.5° ignition timing retard, the NO emission decreases and the fuel economy increases to the level measured with the lower squish area piston (Figure 14). This indicates that when compensated by ignition timing adjustment, squish area changes in this range do not change the NO emission-fuel economy relationship.

Hydrocarbon Emissions

The effect of combustion control variables on HC emissions appears to indicate that the significant factors in HC emission formation are mid-air quenching of the flame, incomplete combustion in the bulk gas, and wall quenching.

Injection timing (Figure 9) influences HC emissions through its effect on fuel residence time between injection and ignition. Long residence time allows more fuel dispersion, leading to higher HC emissions. Very short residence time (late injection), however, increases unburnt HC's because insufficient mixing and evaporation within the mixture cloud occurs, resulting in incomplete combustion. This condition is not shown on Figure 9 because with late injection timing, the engine does not tolerate 15% EGR.

The effect of ignition timing on HC emissions shows an interesting diversity from the premixed-combustion process. As Figure 10 shows, retarded ignition timing increases HC emissions, due to the longer fuel residence time. Beyond a certain ignition timing retard, however, HC emission does not increase, probably due to the higher temperature in the expansion and exhaust strokes which promotes internal oxidation. Ignition timing effect on HC emissions can also be seen in Figure 14, where 5.5° retard (from 5.5° BTC to TDC) was applied across the load range with a 75% squish piston. At light load, the ignition retard increases HC emissions, whereas at higher loads it decreases HC emissions. The likely explanation is that, at light load, the dominating HC emission control factor is the residence time between injection and ignition, whereas at heavier loads, the increase in temperature due to later ignition timing has the prevailing influence.

The overall air-fuel ratio also very strongly influences HC emissions (Figure 11). As the excess air in the cylinder increases, fractions of the mixture become excessively lean for sustaining flame propagation, resulting in increased mid-air quenching.

The squish area change, shown in Figure 12, shows unique effects on HC emissions. At light load, increased squish reduces HC emissions, whereas at heavier load, increased squish increases HC emissions. This correlation suggests that at light load the higher squish area causes more thorough combustion, resulting in reduced HC and CO emissions. At heavier loads, nearly complete combustion is achieved even with the lower squish area piston. The increased turbulence of the higher squish action probably results in increased wall quenching, which freezes the oxidation reactions and leads to higher HC and CO emission. These trends suggest that, at light load, unique stratified charge conditions prevail, whereas at heavier loads, the trends become more similar to those observed in premixed-charge engines.

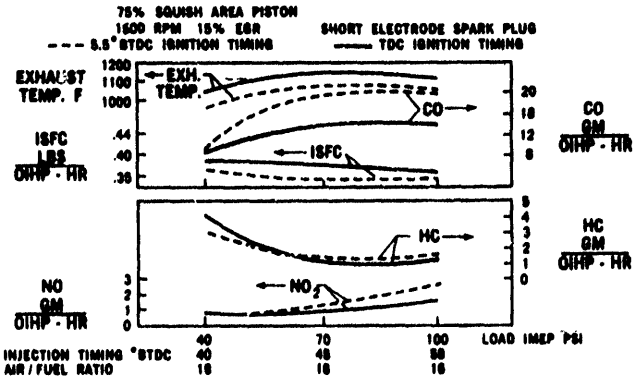

Figure 13 — Squish Area Effects Across the Part-Load Range

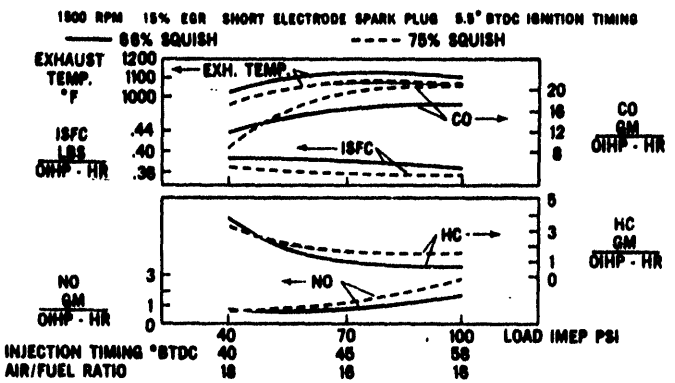

Figure 14 — Ignition Timing Effects Across the Part-Load Range

Carbon Monoxide Emissions

CO emissions are also influenced by fuel residence time, as are the HC emissions, but the trend is reversed. Injection timing retard (Figure 9) and ignition timing advance (Figure 10) increase CO emissions because the shorter fuel residence time results in richer conditions in the primary combustion zone. Increased overall air-fuel ratio (Figure 11), on the other hand, reduces CO emissions, primarily by leaning out the rich phase of the combustion. Exhaust gas recirculation (Figure 12) retards the reaction rate by its cooling (ballast gas) effect. Thus, CO oxidation will be less complete during the second, or lean-combustion phase. Increased squish area reduces CO emissions at light load and increases it at heavier loads (Figure 13).

Exhaust Smoke

During the single cylinder experiments, exhaust smoke was measured with a Hartridge type diesel smoke meter. In general, the smoke numbers are low,

0.5 - 3.0% opacity as compared to 5-50% in the exhaust of a diesel engine. Conditions which increase the richness of the first phase combustion tend to increase burning from a droplet rather than a premixed phase and hence increase smoke. Higher smoke concentration also results from higher EGR rate, higher load, and reduced fuel residence time prior to ignition. Higher squish action was found to give significant improvement in smoke at identical NO level. The higher squish area piston promotes fuel mixing and evaporation, resulting in less fuel burning from droplet phase.

Exhaust Recirculation Tolerance

A very significant aspect in the adjustment of combustion control parameters is their effect on EGR tolerance and, in a broader sense, their effect on the safety margin to misfire. Of all the variables tested, EGR was found to be the most effective means for NO emission reduction. Therefore, combustion control adjustments must be selected to provide for misfire-free operation at high EGR rates. Unfortunately, the three most effective measures which increase EGR tolerance, i.e. injection timing advance, increased squish action, and leaner air-fuel ratio (Figures 9, 13 and 11) also increase NO emissions. Because of this, higher EGR rates are required for the same NO emission control. In addition, these measures also increase HC emissions. These conflicting requirements complicate the optimization of adjustments necessary for minimum overall emissions, particularly when cold starts, transient conditions, and catalytic oxidation are also considered. However, experiments conducted with different spark gap locations indicated that EGR tolerance can be significantly improved by optimizing the spark gap location.

During the earlier stratified charge experiments, a variety of spark plug gap locations were evaluated. For good overall operation, particularly under light loads and very lean operation, a long electrode spark plug with a "center of the spray" gap location was found to be best (see Figure 15). With air throttling and exhaust gas recirculation in the PROCO engine, it appeared that the mixture at the center of the spray is richer than desirable for flame initiation. After a number of tests, a new, short-electrode spark plug evolved with a gap location shown in Figure 15. Figure 16 shows the comparison of engine operating characteristics with the two different spark plugs at one load point. Under high EGR conditions, the cyclic cylinder pressure variations of the engine are significantly less with the short-electrode spark plug, the EGR tolerance is better, the HC and CO emissions and the ISFC are lower. On the negative side, there is a slight increase in NO emission, but this can be compensated by a slightly higher EGR rate and/or by ignition timing

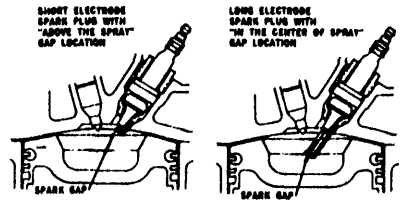

Figure 15 — Two Different Spark Gap Locations

retard. Similar trends were observed between the two spark gap locations at other loads and speeds except at idle where cyclic pressure variation and misfire tendency increased. It appears that in the power producing operating range the short-electrode spark plug ignites the charge at a location more favorable for flame initiation and consistent fast combustion, which, in turn, leads to lower HC and higher NO emissions. CO emission reduction with the short-electrode spark plug might be due to the richest portion of the charge burning just a little later in the cycle when slightly more dispersion and evaporation have taken place. HC and CO emission reduction with the short-electrode plug might also be due to elimination of electrode interference with the spray.

An overall evaluation of the exhaust emission characteristics of the single-cylinder PROCO engine indicates that NO emissions can be lowered to a level approaching long range emission objectives. These very low NO emission levels are achieved at the expense of significant HC and CO emission penalties and with adjustments near the misfire limit of the engine. The HC and CO emissions, particularly with adjustments conducive to low NO emissions, are much higher than required of a "clean" engine; hence, there is a need for external oxidation in the exhaust. Related experiments were conducted on automatically controlled multicylinder engines in vehicles. Before discussing multicylinder results, a review of the major design features of the PROCO fuel injection and control system utilized on multicylinder engines is presented.

FUEL INJECTOR AND CONTROL SYSTEM

Injection Pump — Ignition Distributor Unit

The most significant consideration in the design of the PROCO fuel injection system is the injection

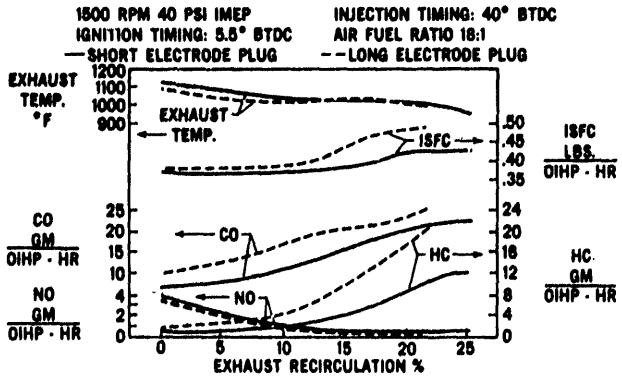

Figure 16 — Spark Gap Location Effects Vs. EGR

timing requirement. In order to provide for good operation in the broad speed and load range of an automotive engine, the injection timing must be advanced by about 50 crank degrees as a function of load and about 40 crank degrees as a function of engine speed. Conventionally, injection timing advance is accomplished by phase-shifting the main shaft of the fuel injection pump. For large phase-shift angles, this method would require bulky servo-operated mechanisms. The solution chosen here is based on providing for a very long duration upstroke for the individual plungers and, by spill control, utilizing a later or earlier portion of the plunger stroke. A fuel injection pump based on this concept was designed in the early 1960's for the Ford Stratified Charge Process (FTP) and described in reference (1). Several refinements have been developed over the years and, for improved control, the ignition distributor has been combined with the pump. In 1968, American Bosch of ARMA Corporation was requested to redesign the Ford experimental prototype unit as a first step towards developing a production prototype. Figure 17 shows the cross section of the redesigned unit. In this design individual plungers, one for each cylinder, are actuated by a face cam. Downward movement of the plungers is effected by the supply pressure communicating to the plunger top through radial fill-spill holes. During upstroke the fuel displaced by the plunger spills back to the fill chamber until the metering helix, rotating in the central bore, closes the fill-spill hole. At this point, the fuel begins to flow through a retraction-type delivery valve towards the injectors. The end of injection is effected by the metering helix reopening the fill-spill hole. Vertical displacement of the metering sleeve changes the duration of the spill port closure and thus the quantity of fuel injected.

A multipurpose centrifugal governor and the ignition distributor are integrally incorporated above the injection pump. The air-fuel ratio control mechanism, which correlates fuel delivery to the manifold pressure is mounted on the side of the governor housing. Fuel to the injection pump is supplied at 28 psi by an electrically driven pump.

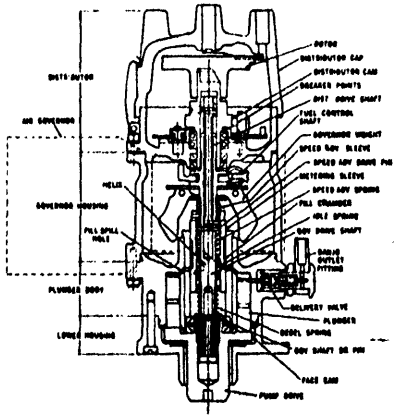

Figure 17 — PROCO Injection Pump Ignition Distributor Unit

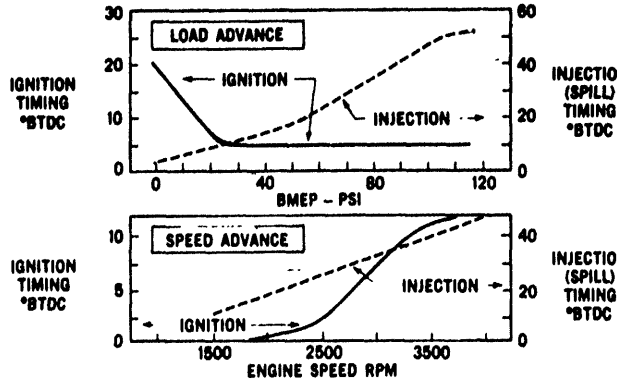

Figure 18 — Injection and Ignition Timing Schedule

Injection and Ignition Timing Mechanism

Figure 18 shows a set of typical injection and ignition timing schedules derived from multicylinder tests. Internal components of the injection pump-ignition distributor unit can be designed to provide for this type of timing schedule.

Injection timing as a function of injected fuel quantity is controlled by the shape of the metering helix formed on the metering sleeve. During part-load operation, a moderate rate of timing advance is provided, with increasing fuel quantity. For maximum engine output, optimum air utilization is needed and is achieved by early injection of the fuel. Injection timing as a function of engine speed is provided by the centrifugal governor causing a phase shift of the metering sleeve.

Ignition timing speed advance is also provided by the centrifugal governor inducing a phase shift of the distributor drive shaft. Ignition timing change as a function of fuel delivery is effected by the vertical movement of the distributor drive shaft. This vertical movement is correlated to the vertical movement of the fuel metering sleeve.

Air-fuel Ratio Control System

The PROCO injection system utilizes a compound control system consisting of a speed-density air-fuel ratio control mechanism for part-load operation and a mechanical enrichment system for maximum power. A speed-density-controlled mechanical fuel injection system requires that the fuel delivery versus speed characteristics of the injection pump match the air flow versus speed characteristics of the engine, and that the fuel control shaft be positioned at various loads as a function of the absolute intake manifold pressures. Temperature compensation would also be required for theoretically correct control, but it is not applied on the PROCO system at this time.

The air flow characteristics of the 141-CID four-cylinder PROCO engine are shown in Figure 19. The injected fuel quantity requirements on the basis of 15.5:1 A/F ratio are shown in Figure 20. These curves indicate that, at light loads, constant fuel delivery versus speed is required; whereas, at heavier load, the fuel delivery must be slightly lower with increasing speed. Fuel delivery with a constant-velocity, plunger actuating face cam rises slightly with speed, basically due to two major factors:

- Plunger and metering sleeve leakage, which are less dominant as speed increases.
- Advanced pressure build-up and delayed pressure blowdown at the fill-spill port, which are more dominant as speed increases.

To counteract these effects and to achieve the desired fuel delivery characteristics, shown on Figure 20, a fuel delivery tailoring technique is applied, based on the three-way interaction of the injection timing speed and load advance and a specially designed, non-constant velocity, face cam.

The control shaft of the fuel injection pump is positioned as a function of the absolute manifold pressure by an aneroid capsule actuated mechanism, which

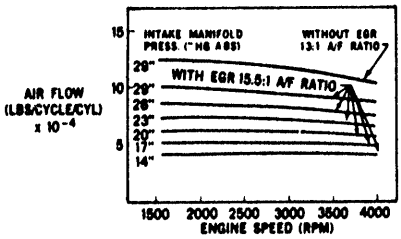

Figure 19 — Air Flow Vs. Engine Speed of the L-141 PROCO Engine

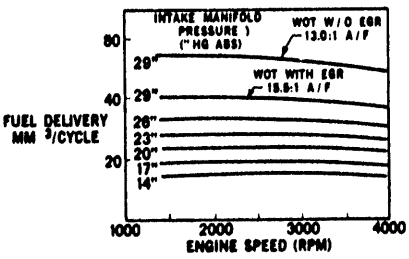

Figure 20 — Fuel Delivery Requirement Vs. Engine Speed of the L-141 PROCO Engine

facilitates selection of any desired fuel delivery versus absolute manifold pressure characteristic. To obtain maximum power output, the EGR must be closed to allow maximum air flow to enter the engine and the fuel delivery must be increased. These functions are accomplished mechanically by the accelerator linkage. This air-fuel ratio control system is altitude-compensated in the entire speed and load range.

The PROCO control mechanism also provides for independent idle air-fuel ratio adjustment and for complete fuel cutoff during deceleration. These functions are performed by the mechanical idle governor and a vacuum-actuated diaphragm system.

Air Throttle and EGR Control System

Air throttling and exhaust gas recirculation control are provided by the intake charge control mechanism, which is actuated by the accelerator pedal. For two-thirds of the accelerator pedal movement the air throttle valve is gradually opened to WOT position and the EGR valve is kept in the open position. During the last one-third travel the mechanism closes the EGR shut-off valve and increases the fuel delivery.

Exhaust gas for recirculation is taken from the exhaust manifold and routed through an engine coolant heat exchanger to the intake charge control mechanism. The recirculated exhaust gas enters the intake system through a large orifice at a point above the air throttle valve and also through a smaller orifice below the air throttle valve. The large orifice provides for an EGR rate slightly increasing with mass flow rate, whereas the small orifice delivers an EGR rate sharply decreasing with increased manifold pressure. The required EGR rate over the load and speed range is adjusted by proper selection of the two orifices.

Fuel Injectors

The experimental fuel injector used in the PROCO engine, shown in Figure 21, is identical to the one developed for the Ford Stratified Charge Process engines. The basic element of the injector is an outwardly opening poppet valve suspended on a concentrically positioned double-hook coil spring. This frictionless guidance coupled with the oscillatory nature of the poppet valve results in a constant vibration of about 2000 - 4000 cps during injection. The vibration plays a very important role in reducing the spray penetration and improving fuel atomization. Because of the valve vibration, sufficient atomization can be achieved with only 250 - 350 psi opening pressure.

MULTICYLINDER DYNAMOMETER TEST RESULTS

Most of the multicylinder PROCO engine experiments to date were carried out on the 141-CID engine of the M-151, ¼ ton military utility truck. This engine was converted to stratified charge operation during 1968 under a contract from the U.S. Army Tank-Automotive Command. In 1969 the emphasis of development in this program shifted from fuel economy improvement to emission reduction. Consequently, the second engine built in this program and partially funded by the Environmental Protection Agency underwent dynamometer tests to reduce emissions with air throttling, EGR, injection, and ignition timing changes. Exhaust emissions of this engine are shown in Figures 22, 23 and 24. These data were obtained with automatic injection and ignition timing but with manual air-fuel ratio and EGR rate adjustment. The adjustments were selected to minimize the NO emissions with as little HC and CO emission and fuel economy penalty as possible. No catalyst was used in the dynamometer tests.

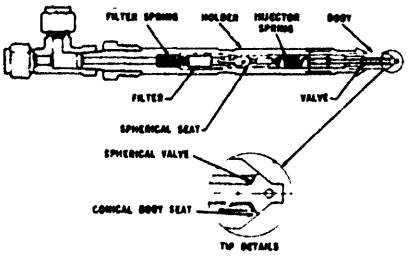

Figure 21 — The PROCO Experimental Fuel Injector

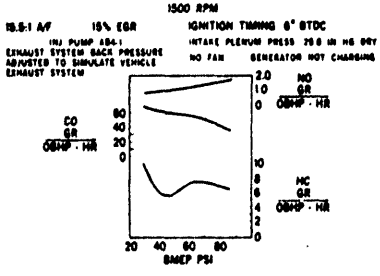

Figure 22 — Exhaust Emissions of the L-141 PROCO Engine at Part Loads, 1500 RPM

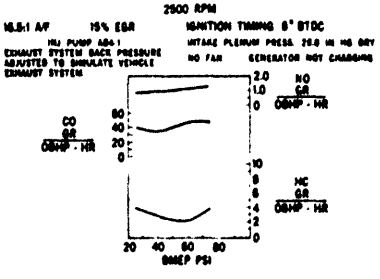

Figure 23 — Exhaust Emissions of the L-141 PROCO Engine at Part Loads, 2500 RPM

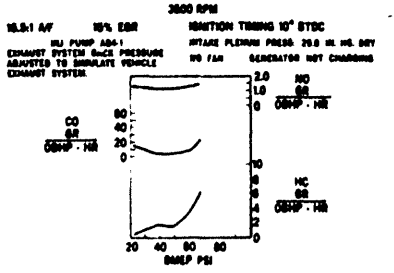

Figure 24 — Exhaust Emissions of the L-141 Engine at Part Loads, 3600 RPM

The fuel economy of the L-141 PROCO engine with the above described adjustments is shown in Figures 25, 26, and 27. These data indicate that the change from the "best economy" stratified charge mode of operation to the PROCO mode of operation entails significant loss in fuel economy. On the other hand, fuel economy of the PROCO engine on the average is about the same as that of the standard carbureted engine. The maximum torque is obtained from the PROCO engine by closing the EGR valve and increasing the fuel flow to about 13:1 air-fuel ratio. Fuel economy curves shown in Figures 25, 26, and 27 include these maximum torque points. Maximum torque and power of the PROCO engine and of the standard carbureted engines are shown in Figure 28. As the data indicate, the peak torque of the PROCO engine is 5 percent higher and the horsepower at 4000 RPM is 25 percent higher than that measured on the reference standard carbureted engine. This torque and BHP improvement is due partially to the higher compression ratio of the PROCO engine and partially to the design of the intake system of the carbureted engine, which is tailored for steep torque rise and stable low speed operation; hence its high speed output is modest.

VEHICLE EMISSION TEST RESULTS

Emission tests were run on an M-151 ¼ ton military utility truck equipped with the 141-CID PROCO engine. Table 2 shows engine and vehicle specification data. The fuel injection pump on this vehicle was an earlier model with a vacuum sensing air-fuel ratio control mechanism instead of the absolute pressure sensing system described earlier. The accelerator linkage of this vehicle was set up in such a manner as to prevent EGR shut off and fuel enrichment. Without this curtailment, the driver would depress the pedal

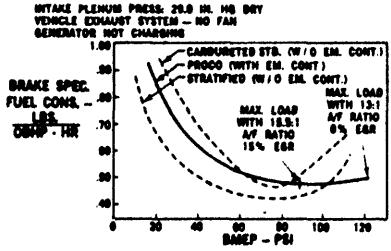

Figure 25 — Fuel Economy of L-141 Engines at Part Loads, 1500 RPM

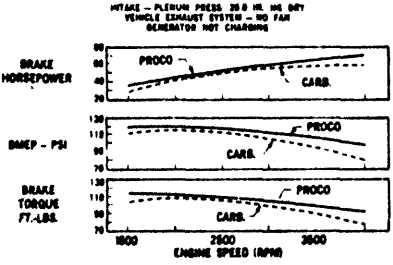

Figure 28 — Maximum Power Output of L-141 Carbureted and PROCO Engines

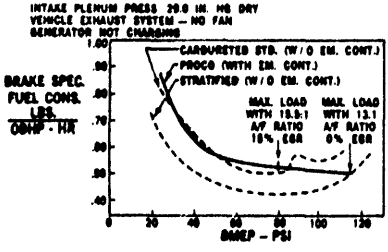

Figure 26 — Fuel Economy of L-141 Engines at Part Loads, 2500 RPM

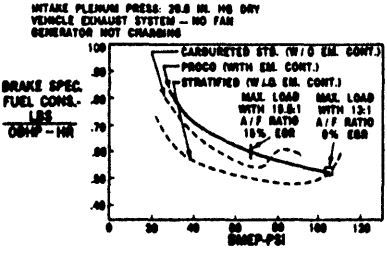

Figure 27 — Fuel Economy of L-141 Engines at Part Loads, 3500 RPM

far enough to close the EGR system several times during the LA-4 S-3 emission test in order to keep up with the required acceleration rates. With constantly open EGR system the vehicle operates with a derated setting. This power limitation results in a maximum of 7 MPH lag during the 192 to 215 sec. portion of the emission test and a lesser lag during the 452 to 470 sec. portion of the emission test. The derated setting is utilized temporarily to facilitate an assessment of the NOx emission potential of the engine with a constantly open EGR system. It is estimated that a 20-25 percent larger engine would provide enough power for the required accelerations with full EGR. Thus, with a larger engine, it is believed that EGR system closing and fuel enrichment could be allowed without influencing the emission test results significantly.

Emission data from this vehicle are shown in Table 3. For comparison, vehicle emission data are also shown with a "best economy" stratified charge engine and with a standard carbureted engine. The data indicate that with the specified derated adjustment, this PROCO engine-vehicle system at zero mileage produces gaseous emissions that are comparable to the 1976 Federal standards, and the fuel economy of the vehicle during the emission test is about 20 percent better than that of the standard carbureted, non-emission controlled, vehicle. This "zero mile" emission level was achieved with carefully controlled adjustments derived from a long series of optimization tests. Because of the high EGR rate (14-16%) the engine operates close to its misfire limit with occasional misfires noticeable at idle and sometimes at high speed/high load.

The fuel economy gain of the PROCO engine over the carbureted L-141 engine may not be considered typical for passenger car applications because, for the sake of good "off-the-road" driveability with a manual

TABLE 2
VEHICLE SPECIFICATIONS

M-151 ¼ TON UTILITY TRUCK

CURB WEIGHT	2713 LBS.
WHEELBASE	85.0 IN.
TRANSMISSION	STANDARD
SPEEDS	4
REAR AXLE	4.86:1
ENGINE	L-141, 4 CYL. PROCO
DISPLACEMENT	141 C.I.D.
COMP. RATIO	11:1
FUEL INJECTION SYSTEM	FORD-PROCO EXPERIMENTAL
AIR / FUEL RATIO CONTROL	SPEED-VACUUM SYSTEM
IGNITION SYSTEM	FORD TRANSISTORIZED
SPARK PLUGS	EXPERIMENTAL SHORT ELECTRODE
EGR SYSTEM	FIXED ORIFICE (WATER COOLED)
EXHAUST MANIFOLD	LOW INERTIA, INSULATED
CATALYST	ENGLEHART PTX-6 NOBLE METAL
FUEL	LEAD STERILE TEST FUEL 91 RON

TABLE 3
VEHICLE EMISSION DATA

CVS/CH TEST PROCEDURE

VEHICLE	GR/MI			MPG (1)	NO. OF TESTS	TEST
	HC	CO	NO	ECONOMY	AVERAGED	FACILITY
CARBURETED	4.55	41.80	4.40	17.2	3	FORD
PROCO — W / O CATALYST	2.60	13.45	.32	21.7	1	FORD
PROCO — WITH CATALYST	.35	1.01	.35	21.3 (2)	4	FORD
PROCO — WITH CATALYST	.37	.93	.33	NOT MEASURED	14	EPA

1972 CVS TEST PROCEDURE

CARBUR. — W / O EM CONT.	5.65	46.24	4.47	16.6	3	FORD
STRATIFIED — BEST ECONOMY	4.96	7.75	3.85	23.8	2	FORD
PROCO — W / O CATALYST	3.10	13.75	.33	21.2	1	FORD
PROCO — WITH CATALYST	.54	1.18	.37	19.6	4	FORD

(1) FUEL ECONOMY COMPUTED FROM THE MASS EMISSION DATA
(2) 20.4 MPG MEASURED WITH A BURETTE

TABLE 4
CVS / C-H TEST INDIVIDUAL SAMPLE BAG DATA

BAG	HC-GRAMS	CO-GRAMS	NO_X-GRAMS	MILES
	TRANSIENT PHASE — COLD START			
1	3.489	3.482	1.45	3.6
	STABILIZED PHASE			
2	.603	.036	1.246	3.9
	TRANSIENT PHASE — HOT START			
3	.92	.037	1.336	3.6

transmission, the carbureted L-141 engine is adjusted with richer carburetion than is customary for passenger cars.

To gain insight into emission formation during the emission test, the quantity of pollutants in each of the three phases of the emission test procedure was computed and listed on Table 4. It is readily apparent that the HC and CO emissions in the cold start, transient phase are several times higher than in the hot start, transient phase. The reason for this, of course, is that HC emissions are inherently higher from a cold engine, and, even more important, the catalyst does not oxidize the HC and CO emissions very efficiently during the first minute of the cold start test. However, during the hot start portion of the test the catalyst works well right from the start because it is still quite warm. The NO_x emissions are hardly influenced by cold or hot starting of the engine because engine temperature has only a minor effect on NO formation, and the EGR system is constantly open.

More emission formation and emission control details are revealed by the continuous CO_2, HC, CO, NO and O_2 concentration traces recorded during the emission test. To obtain these traces, the exhaust gas was sampled before the catalyst, and in another test it was sampled after the catalyst, and from the diluted CVS gas stream. The concentration traces of the cold and hot start transient phase of the test are reproduced in Figures 29 to 33. Hot start traces were plotted over the cold start traces to facilitate the evaluation of the effect of cold start.

The emission traces indicate that the engine starts up with leaner than stoichiometric air-fuel ratio and holds this air-fuel ratio throughout the entire transient phase of the test and also during the stabilized phase not shown here.

The pre-catalyst CO concentration range is .5-1.5 percent, with the heavier concentration occurring at higher loads. The catalyst begins CO oxidation after 20-30 seconds of operation. From about 50 seconds on, the post-catalyst CO concentration level is negligible. It is significant to observe that during longer cruises, the pre-catalyst CO concentration becomes gradually lower. This phenomenon indicates an increasing amount of thermal oxidation in the insulated exhaust manifold upstream of the catalyst.

The pre-catalyst HC concentration is quite high at start-up: 500-2000 ppm. During the first cruise, the level is down to about 300 ppm and during the high speed cruise it becomes as low as 30 ppm. This low HC emission level also indicates thermal oxidation in the exhaust manifold. At low engine speeds and loads, however, the exhaust temperature becomes too low to effect large scale thermal oxidation, even with a fully warmed-up engine.

The post-catalyst HC concentration becomes very low after about 60-80 seconds. However, there are a number of sharp HC emission spikes even after full warm-up. These spikes occur at gear shift points and occasionally also at decelerations, indicating that this HC concentration increase is associated with the fuel cut-off or with the onset of fuel injection after the cut-off. In terms of mass emissions, the significance of these HC concentration spikes is minor.

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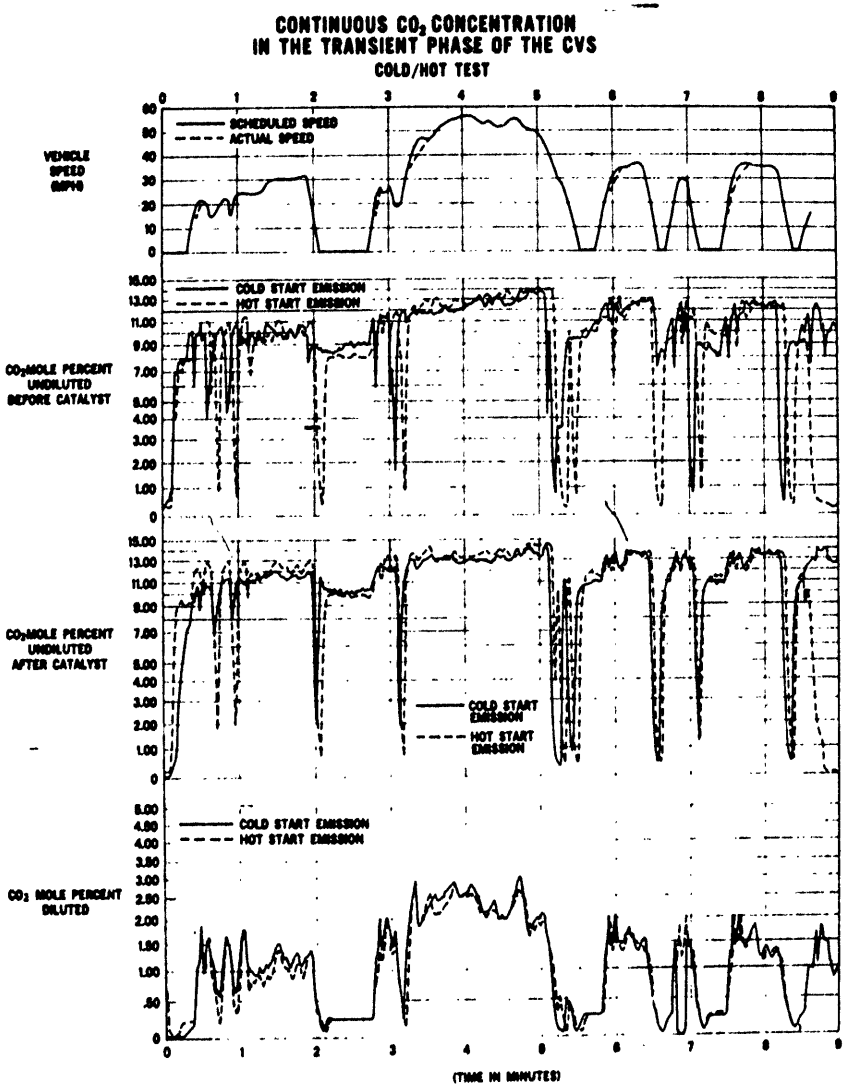

Figure 29 — Continuous CO_2 Concentration in the Transient Phase of the CVS Cold/Hot Test

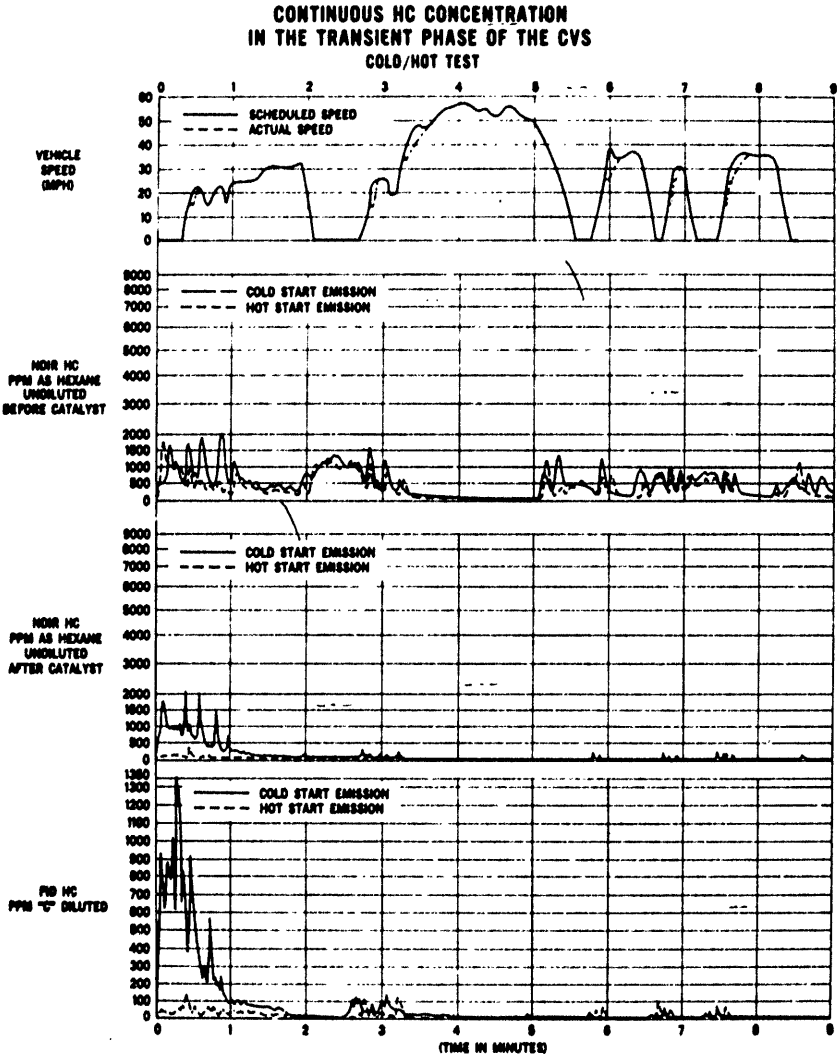

Figure 30 — Continuous HC Concentration in the Transient Phase of the CVS Cold/Hot Test

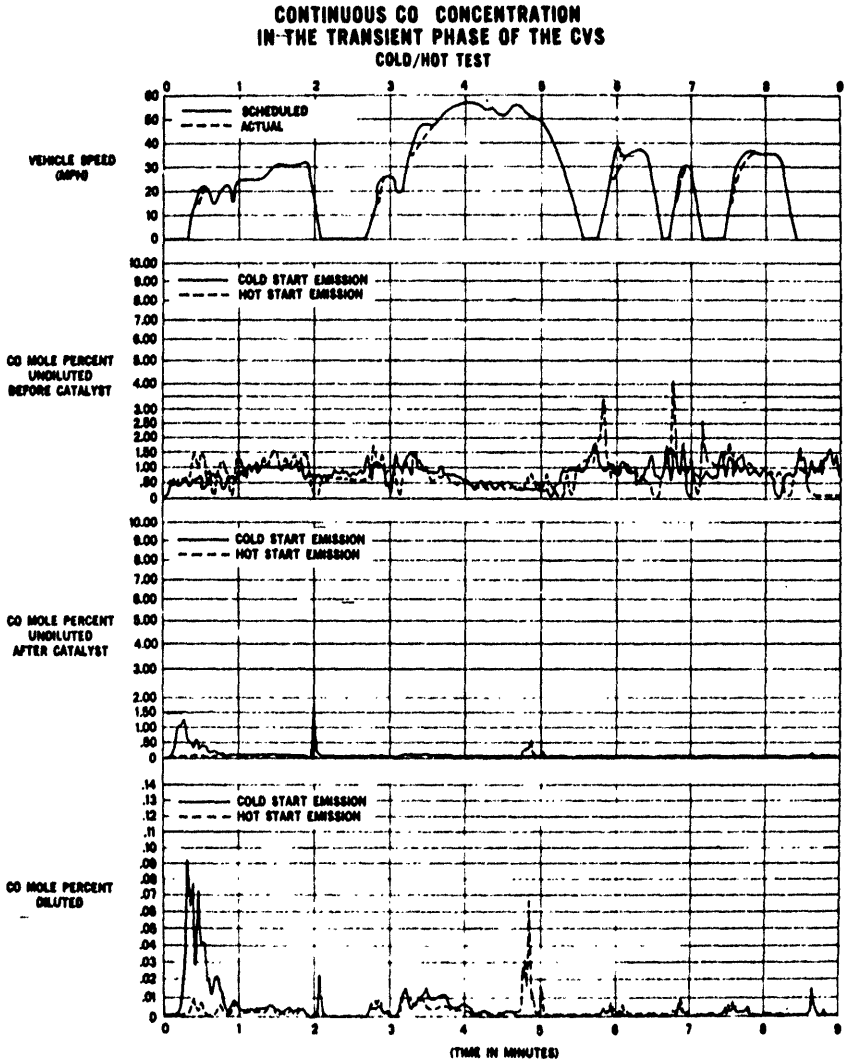

Figure 31 — Continuous CO Concentration in the Transient Phase of the CVS Cold/Hot Test

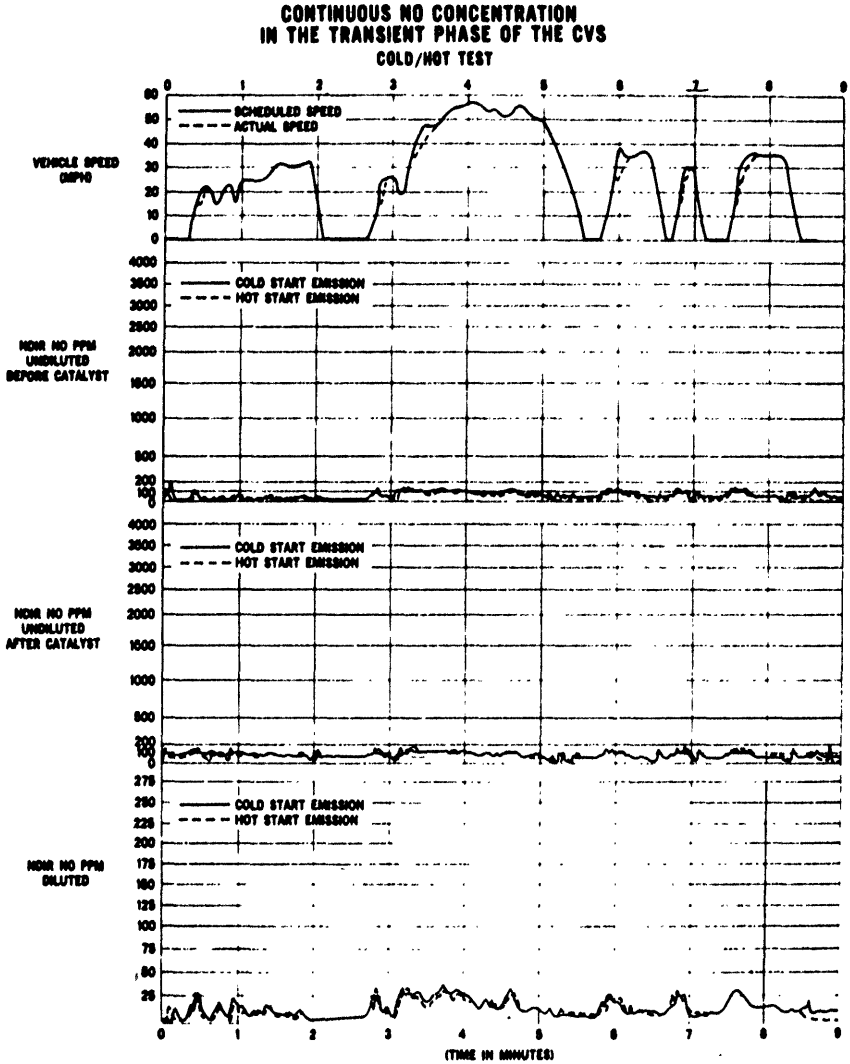

Figure 32 — Continuous NO Concentration in the Transient Phase of the CVS Cold/Hot Test

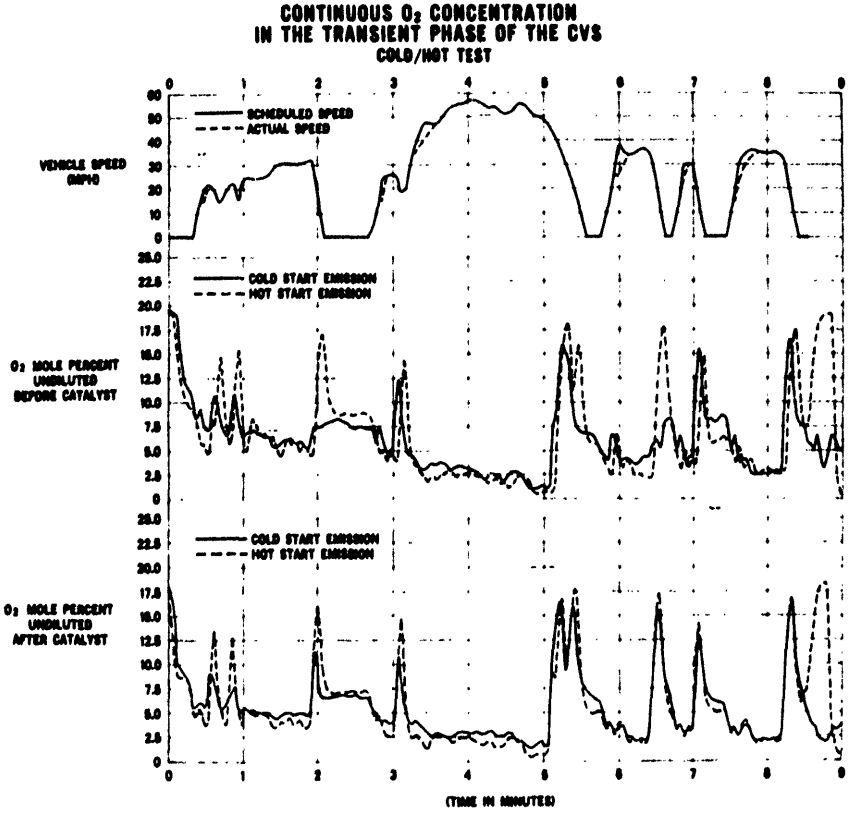

Figure 33 — Continuous O_2 Concentration in the Transient Phase of the CVS Cold/Hot Test

The NO emission concentrations vary from 50 to 150 ppm throughout the test and are influenced mostly by engine loading. A sharp rise in NO concentration occurs at the onset of injection after fuel cutoff. This can be attributed to the fact that, during fuel cutoff operation, the EGR system delivers clean air to the engine and thus, at the onset of injection, the engine operates with undiluted air for a few cycles. The post-catalyst NO emission level appears to be nearly the same as the pre-catalyst level. The diluted, mass, NO emission trace indicates that NO emission accumulates roughly porportional with the CO_2 mass emission, which is a measure of the mass fuel flow rate.

The O_2 concentration trace indicates a minimum of 1.0-2.0 mole percent after the catalyst. Sharp O_2 concentration increase indicates fuel cutoff.

OVERALL VEHICLE OPERATION

For full evaluation of a new type of engine it is necessary to run a large number of evaluation tests

such as road fuel economy under various driving conditions, acceleration, driveability, cold and hot weather starting, high altitude performance, durability testing and others. From the emissions point of view, emission deterioration testing is of great importance. So far none of these tests have been run at low emission calibration. During the emission development tests, however, some operating experience was gained with the engine and this experience is summarized below.

Under moderate and warm ambient temperatures the engine starts in 1-4 seconds. Cold start tests were conducted only on an earlier model L-141 FCP engine and only to 10° below zero. In these tests successful starts were achieved repeatedly, both with and without auxiliary manifold fuel spray.

Informal evaluation of the low emission vehicle indicates good driveability right after startup. There is no engine stumbling, even at very low speeds with zero manifold vacuum and full EGR. However, the acceleration performance of the vehicle is impaired by the derated adjustment, and the idle quality is not quite satisfactory with the short-electrode spark plugs.

Basic engine (pistons, valves, bearings, etc.) durability problems were not encountered during 600 dynamometer test hours and 4000 vehicle test miles. In the fuel injection pump, however, the top of the face cam and the bottom of the plunger showed signs of wear when spherical plunger bottoms were used, which ride on the face cam with point contact. Recently, the plunger bottom geometry was changed to a cylindrical surface, which provides for a line contact and much lower stresses.

The fuel injectors require good durability because both engine operation and emission control depend on good injector performance. All the injectors in the program were carefully built by highly skilled tool makers and technicians. The assembled injectors were subjected to a few hours of laboratory break-in before they were tested for spray quality. Out of twenty injectors, about 14-18 would pass the final test. With a few exceptions these injectors performed satisfactorily in the development work without requiring maintenance. A satisfactory answer to the injector durability question can be derived only on the basis of actual customer-type durability testing.

The durability of one key component, the spark plug, is known to be relatively short. The erosion rate of the gap is faster than normal due to the high ignition energy supplied by the transistorized ignition system and due to the relatively high electrode temperature. Measures are available to reduce electrode temperature by design and material changes in the spark plug but these measures have not been tested in PROCO engines. Reduction of ignition energy requirement would also be helpful. However, lower ignition energy requires lower EGR rates to avoid misfire, and of course, reduced EGR rates result in higher NO_x emissions.

The durability of the catalyst is also unknown. One catalyst performed satisfactorily during the development work, but after 1500 miles it failed mechanically due to inadequate mechanical support of the honeycomb structure. In later designs, more substantial support was provided but adequate test time has not been accumulated on these models. The deterioration of catalytic efficiency with extended mileage should also be determined under the specific operating environment of the engine-vehicle system.

In addition to the durability of individual components, the functional performance of the entire system must be carefully evaluated over a long period of customer type operation.

SUMMARY

Test data and experience with the 141-CID PROCO experimental engine indicate:

- The PROCO system affords some unique methods of emission control on piston engines.
- On the 141-CID experimental engine very low NOx emission levels have been achieved at low mileage, but when adjustments are set for very low NOx emissions the engine becomes prone to occasional misfire.
- HC and CO emission control to very low test levels requires combustion control optimization, plus an oxidizing catalyst, and possibly a low thermal inertia exhaust manifold.
- Emission control measures incorporated on the engine significantly reduce the fuel economy from that potentially obtainable with stratification, but the fuel economy of the low emission L-141 PROCO engine still compares favorably with that of the L-141 standard, carbureted engine.
- Vehicle driveability is good with low emission type adjustments.
- Hardware durability and emission deterioration characteristics of the PROCO engine system are yet to be proven.
- A number of design features of the experimental hardware are considered not feasible for volume production. Development of production-feasible design solutions has begun.
- Manufacturing and adjustment tolerances of the engine and its components have not been established,

but appear to be sufficiently different from current practice to require development before production feasibility can be established.

- Emission control technology for large engines in "full-size" vehicles is presently being developed but the emission-control potential in such applications has not been established yet.
- Based on the evaluation of results described above, Ford Motor Company selected the PROCO process as one of four possible alternatives to develop in its efforts to meet the stringent emission standards promulgated in the 1970 December amendments to the Clean Air Act.

Present efforts are directed towards the following objectives:

- Further refinement of the combustion process.
- Development of PROCO system technology for V-8 engines and full size vehicles.
- Durability tests and development.
- Tolerance requirement studies.
- Development of production-feasible solutions for all components and for the overall concept.

ACKNOWLEDGEMENT

Many people have contributed to this project since its conception. The authors wish to specially acknowledge the contribution of the following personnel:

Mr. I. N. Bishop, Department Manager, Internal Emission Control, Engine and Foundry who initiated the stratified charge experiments about 14 years ago; and Messrs: Laszlo Hideg, J. A. Robison, Richard Mosher, W. K. Ojala, R. C. VanBeylen, and many others from Product Development.

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4. Design Factors That Affect Diesel Emissions, Roger C. Bascom, et. al. SAE 710484

Mr. ROGERS. Thank you very much for your statement. It has been most helpful and we appreciate what Ford Motor Co. has been doing to date.

Mr. KYROS. If I understand correctly from the testimony yesterday and today, sir, these four facts seem to come out: First, you don't think you can complete the reduction to 90 percent by 1975 with the CO and hydrocarbons.

Mr. JENSEN. I agree.

Mr. KYROS. Second, to even try to meet the costs, car prices would go up roughly $200 to $300.

Mr. JENSEN. I have quoted National Academy figures.

Mr. KYROS. Third, there may be 3 to 12 percent increased gas consumption.

Mr. JENSEN. Yes; if I may, I would like to comment on that for just a second.

The National Academy figures were 3 to 12 percent. At Ford Motor Co. our direction has been, by management policy, to achieve the standards specified in the law, and then try to gain back any loss in fuel economy or driveability.

For example, we reported in January of last year our best emission control system had a 27-percent loss in fuel economy. This year we have reduced that loss to 10 percent on the same system. Our goal, obviously, is, by the time any of these systems get into production, to make the fuel penalty go away.

Mr. KYROS. The first problem is not being able to meet the situation economically; second, the costs of autos; third, gasoline consumption, and the fourth point you made is, given the added year you have some reasonable belief that you will come out with a device.

Mr. JENSEN. Yes, sir.

Mr. KYROS. On what do you base your belief that ultimately in 1976 the added year will permit you to develop a better device?

Mr. JENSEN. There are two basic problems and I probably will be oversimplifying. First, we have to have better durability so the customer won't have to continually maintain these control systems. This is a goal we have to achieve.

Second, we have to get better mass production experience on some of the components. Right today, for example, there is not a single catalyst manufacturer who is mass producing a catalyst unit.

The idea of installing catalysts within 1 year on the assembly line when vehicles are coming off that line at the rate of one per minute just terrifies us.

You would recognize that usually we put an innovation on only one of our product lines in order to gain experience.

On this type of installation we would ordinarily like to work into some mass production and get some experimental fleets going. At Ford we had wanted to put catalysts in California on 1974 models. This is no longer possible based on the present legal interpretations given by EPA. The desirable practice of which I am talking would provide data on durability and experience.

Mr. KYROS. In an attempt to get the device in the last year, if you get the suspension of the requirements for a year, you have talked about the difficulties in having a decision by July 1, 1972, because your

assembly lines and subcontractors must be set up 2 or 3 years ahead. Is that another parameter?

Mr. JENSEN. No, I have to back up again.

At the present time we are running 52 cars at Ford Motor Co. for 50,000 miles for 1973 models and we started these last fall, the fall of 1971. We have to start testing in the fall of 1973 for our 1975 models.

So, we really have 1 year—actually a year and 3 months—starting in the fall of 1973 to get production samples available to put on those cars to start Government testing.

We must run these 50,000 miles, Congressman Kyros, at low-speed urban driving rates because the urban areas are where the air pollution is located. It takes a long time to run 50,000 miles.

So, the testing plus the production lead time results in the necessity for a July 1, 1972, date for Government discussion.

Mr. KYROS. When you make all of these judgments you have talked about this morning, do you consider at all the effects of any research by the oil industry on your own planning?

What about their research in terms of gasoline?

Mr. JENSEN. In 1967, Congressman, Ford Motor Co., first with Mobil and then later with five other oil companies, joined together in emission research. Later four foreign automobile manufacturers joined us in the interindustry emission control program to try to match up the best hardware from the automobile companies with the best fuel from the oil companies so we could build what we defined as a "smog-free" car.

For this reason, I think, that perhaps, more than our competitors, we have worked very closely with the oil companies to try to achieve a mating of the fuel and hardware which we think is essential to reaching the goals specified by Congress.

Mr. KYROS. In other words, you considered what they are going to be doing at the same time?

Mr. JENSEN. In fact, we are working with them today. We started with a 3-year program, it has been extended twice and we are still working with the hardware and the fuel in combination to assure that we all come out at the same goal of a clean car.

Mr. KYROS. If you are able to state you cannot reach a 90 percent of HO and CO in 1975, what figure will you have reached from 1970?

Will it be 85 percent, 80 percent, 88 percent?

Mr. JENSEN. It will depend in part, as you might suspect from testimony that was given yesterday and the National Academy report with which you are familiar, on the kind of ground rules which are spelled out by EPA.

Under the present interpretation of the law, I would assume we could come very close, perhaps to 85 percent control from an uncontrolled vehicle or at least in that general range.

What we have not done, and this perhaps is an omission on our part—we do not have a fleet running to meet an intermediate goal. We have gone "all out" to meet requirements specified in the law for 1975.

We eventually will have to back off from our goal to the best achievable system. We don't know what that is and that is why I am being vague in my response.

Mr. KYROS. What in particular was in the report by the National Academy of Sciences to the Environmental Protection Agency?

On page 47, figure 7–2, they show curves plotting the CO emissions against the years. They showed both by the 1975 standard and the 1-year suspension, the incremental difference at a superficial glance looks very, very tiny, and the difference between what present controls are and what you would achieve, is significant.

If they can plot curves like these and say you can reach the 90-percent figure, it seems to me you should be prepared to tell us how closely you can come to the 90 percent.

Mr. JENSEN. I agree with you, Congressman, and certainly when the EPA has public hearings this will have to come out.

As you are probably aware, on January 7 we received some guidelines from the EPA which are complex and lengthy. We are assembling the data on that now. We are planning to start fleets of cars in early February at Ford to try to get some feel for this because obviously it has to be made part of the public record in that proceeding.

Mr. KYROS. Thank you very much.

Mr. ROGERS. Dr. Carter?

Mr. CARTER. Mr. Jensen, have you experimented with different types of engines other than your Proco engine?

Mr. JENSEN. Yes, sir; we are in mass production now on turbine engines. I think we are the first automobile manufacturer to go into mass production. We opened an engine plant in Toledo last August and are producing turbine engines for industrial uses and will perhaps put these into heavy trucks or buses in the next few years as we get all of the problems resolved.

We also have some other enterprises in different types of engine propulsion.

If you are interested in specific questions, Dr. Carter, I will be glad to answer them.

Mr. CARTER. Do you think the emissions from a turbine engine will be more easily controlled?

Mr. JENSEN. We are seeking to control three contaminants: Carbon monoxide, hydrocarbons, and oxides of nitrogen. We have to work toward goals on all three emissions which would be acceptable for a passenger vehicle. For example, we must control the oxides of nitrogen. We must get that down to the levels specified in the law for 1976 and certainly to those levels specified in the present regulations which are effective for 1973 models. Second, we are attempting to find ceramic material which can withstand high temperatures.

Both of these problems will have to be resolved. Yes, the oxides of nitrogen contaminants are excessive since this contaminant is formed because of high temperatures. We have yet to control oxides of nitrogen in the turbine. We have not yet done this, and I don't think anyone has. There is however an awful lot of work going into this effort because we think it is of great importance.

Mr. CARTER. What about the Rankine vapor-cycle engine?

Mr. JENSEN. I assume you are referring to a steam engine. Let me give you some background. If you put engineers on a project, you have to get a group that is really fired up to believe that their engine is going to replace the internal combustion engine and every other automobile power system that we now see on the roads.

We have that type of a group of dedicated people on turbines. We have that type of a group of dedicated people on electric cars. We

did not happen to have that same dedication in-house at Ford in respect to the steam car.

Therefore, we have made an arrangement with Thermal Electron Corp. of Waltham, Mass., which makes smaller steam engines commercially. We have given them several million dollars for research and development.

That company is convinced that steam is going to be the car of the future. Our cooperative project is well underway and we are working with them now to develop a workable steam car so we can take a look at it.

Mr. CARTER. What about the Lear steam turbine?

Mr. JENSEN. We have no formal relationship with Mr. Lear. We do keep in touch with him as well as the Paxby Corp. in southern California. They also work with steam cars. We thought Thermal Electron had the most know-how because they were in the commercial business of building steam engines. Certainly they had the most enthusiasm for success as far as we could see. We are now tied up with them for this ongoing program.

Mr. CARTER. You don't have too many pollution problems with the steam turbine cars, do you?

Mr. JENSEN. It is awfully hard to measure comparable emission levels because the only tests have been on warmed-up automobiles. If you have a warmed-up internal combustion engine, the levels are very low, too.

We do think the steam car has very low emission potential.

Mr. CARTER. Are you familiar with the Wankel?

Mr. JENSEN. Yes; Ford of Germany signed a contract about 2 months ago with NSU so we could work on the Wankel. We think it has potential for smaller vehicles but not necessarily for emission purposes.

The present Japanese models have thermal reactors on them. We feel from what we have seen that Wankel engines require the same kind of control devices that we are now contemplating for the internal combustion engines.

Mr. CARTER. I notice that your Proco car has a fuel injection system. Do you have that on your other cars?

Mr. JENSEN. Yes, sir; we feel for 1975 we have to have either vastly improved and different kinds of carburetion or fuel injection. We are working on both systems.

On the Proco system, we are working with American Bosch to obtain production samples to see if there is a potential for suitable mass production.

As I recall, the last time American Bosch delivered 20 samples, we checked and found that 16 would give us the tolerances we needed in Proco. We are of course very interested however in working with fuel injection very closely.

Mr. CARTER. What cars that you produce now have the fuel injection system?

Mr. JENSEN. We have none in production at the present time with fuel injection.

Mr. CARTER. Is this more economical of gasoline, the fuel injection system?

Mr. JENSEN. You can apply it in various ways. Up until the present, fuel injection has been mostly used for racing and high-performance engines.

We are now researching fuel injection systems which control to a smaller tolerance level which will enable us to work for favorable emission levels.

Mr. CARTER. What about the fuel injection on the Mercedes?

Mr. JENSEN. I understand they have a fuel injection model. I understand Volkswagen has it in one of their models.

Mr. CARTER. Don't all of those models use fuel injection?

Mr. JENSEN. No; as far as I know, they have a combination of carburetion and fuel injection depending on the models. You would almost have to ask them.

Mr. CARTER. Isn't fuel injection standard on most foreign-made cars and at a great saving of gasoline to the customer?

Mr. JENSEN. Dr. Carter, let's check and find out. We are in the import car business, too, at Ford Motor Co. and we are using carburetion on our imports.

(Testimony resumes on p. 316.)

(The following information was received for the record:)

FUEL INJECTION SYSTEMS AVAILABLE IN FOREIGN IMPORT VEHICLES

We at Ford have never found that the use of fuel injection provided a great saving of gasoline. We have found that with the exception of fuel injection being offered on some Volkswagen models it is only available on a few foreign import vehicles all of which are the more expensive, high performance sport models. Attached is a list of 1971 foreign import vehicle specifications which show the vehicles using fuel injection (see column heading "Carburetion"—FI denotes fuel injection.) [1]

[1] 1971 Import Buyer's Guide.

SPECIFICATIONS

Model	Engine Type	Location	Bore & Stroke mm	—ENGINE— Displacement cu. in.	cc	BHP @ RPM	Torque @ RPM	Comp. Ratio	Carburetion	Trans.
ALFA ROMEO										
1750 Berlina	IL4, dohc	Front	80x88 5	108	1779	135 @ 5500	137 @ 2900	9 0:1	Spica FI	5-spd
1750 Spider Veloce	IL4, dohc	Front	80x88 5	108	1779	135 @ 5500	137 @ 2900	9 0:1	Spica FI	5-spd.
1750 GTV	IL4, dohc	Front	80x88 5	108	1779	135 @ 5500	137 @ 2900	9.0:1	Spica FI	5-spd
ASTON MARTIN										
DBS V-8	V-8, dohc	Front	100x85	326	5340	Not Spec.	Not Spec.	9.0:1	Bosch FI	5-spd
AUDI										
Super 90	IL4, ohv	Front	8 5x84.4	107	1760	100 @ 5200	116 @ 3000	10.2:1	1 Solex 32TDIT	4 spd
100 LS	IL4, ohv	Front	8 5x84.4	107	1760	115 @ 5500	120 @ 3200	10.2:1	1 Solex 32TDIT	4-spd
BENTLEY										
T Series	V-8, ohv	Front	104.1x99.1	412	6740	Not Spec.	Not Spec.	9.0:1	2 SU HD8	Auto.
BMW										
1600	IL-4, sohc	Front	84.0x71.0	96	1600	96 @ 5800	91 @ 3000	8.6:1	1 Solex 38 PDSI	4-Spd
2002	IL-4, sohc	Front	89 0x80.0	121.3	2000	113 @ 5800	115.7 @ 3000	8.5:1	1 Solex 40 PDSI	4-Spd.
2500	IL-4, sohc	Front	86.0x72.0	152.2	2500	170 @ 6000	115.4 @ 3700	9.0:1	2 Zenith 35/40 INAT	4-Spd.
2800	IL-6, sohc	Front	86.0x80 0	170.1	2788	192 @ 6000	173.6 @ 3700	9.0:1	2 Zenith 35/40 INAT	4-Spd
2800-CS	IL-4, sohc	Front	86 0x80 0	170.1	2788	192 @ 6000	173 6 @ 3700	9 0:1	2 Zenith 35/40 INAT	4-Spd.
CITROEN										
D-Special	IL-4, ohv	Front	86.0x85.5	121.1	1985	91 @ 5750	106 @ 3000	8.0:1	1 Solex 34 PBIC	4-Spd.
D-21 Wagon	IL-4, ohv	Front	90.0x85.5	132.7	2175	117 @ 5750	128 @ 3000	8.75:1	1 Weber DDE	4-Spd.
DS-21 (and Pallas)	IL-4, ohv	Front	90.0x85.5	132.7	2175	117 @ 5750	128 @ 3000	8.8:1	1 Weber DDE	4-Spd.
Mehari	HO 2	Front	70x70	36.7	602	33 @ 7000	31 @ 4000	8.5:1	1 Solex	4-Spd.
DATSUN										
1200	IL-4, ohv	Front	73.0x70.0	71.5	1171	69 @ 6000	70 @ 3600	9.0:1	1 Hitachi	4-Spd.
510	IL-4, sohc	Front	83.0x73.3	97.3	1595	96 @ 5600	100 @ 3600	8.5:1	1 Hitachi	4-Spd.
240-Z	IL-6, sohc	Front	83.0x73.3	146	2393	150 @ 6000	148 @ 4400	9.0.1	2 Hitachi	4-Spd.
DE TOMASO										
Pantera	V-8, ohv	Mid	102.0x89.0	351	5763	285 @ 5400	370 @ 3400	10.7:1	1 Autolite D10F-EA	4-Spd.
FERRARI										
Dino 246-GT	V-6, dohc	Mid	92.5x60.0	148	2418	25 @ 7600	192 @ 5500	9.0:1	3 Weber DCNF-6	5-Spd.
365 GTB/4	V-12, dohc	Front	81x71	267.8	4390	390 @ 7500	365 @ 5500	9.3:1	6 Weber 40 DCN	5-Spd.
365 GT 2+2	V-12, sohc	Front	81x71	267.8	4390	320 @ 6600	267 @ 5000	8.8:1	3 Weber 40 DFI	5-Spd.
FIAT										
850 Sedan	IL-4, ohv	Rear	65.0x64.0	49.8	817	40 @ 530	43 @ 3400	8.8:1	1 Weber 30 ICF	4-Spd
850 Coupe	IL-4, ohv	Rear	65.0x68.0	55.1	903	58 @ 6500	51 @ 4000	9.5:1	1 Weber 30 DCT 1	4-Spd.
850 Spider	IL-4, ohv	Rear	65 0x68.0	55.1	903	58 @ 6500	51 @ 4000	9.5:1	1 Weber 30 DCT 1	4-Spd
850 Racer	IL-4, ohv	Rear	65.0x68.0	55.1	903	58 @ 6500	51 @ 4000	9.5:1	1 Weber 30 DCT 1	4-spd.
124 Sports 1438	IL-4, dohc	Front	80.0x71.5	87.9	1438	96 @ 6500	82 @ 4000	8.5:1	1 Weber 26/34 DCF	5-spd.
124 Sports 1600	IL-4, dohc	Front	80.0x80.0		1608	104 @ 6000	94 @ 4200	8.5:1	1 Weber 26/39 DCF	5-spd.
FORD										
Capri 1600	IL-4, ohv	Front	81.0x77.6	97.5	1599	,75 @ 5000	96 @ 3000	8.4:1	1 Autolite	4-Spd.
Capri 2000	IL-4, sohc	Front	91.0x77.0	122	1993	100 @ 5600	120 @ 3600	8.6:1	1 Weber 32/36 DFAV	4-Spd.

—CHASSIS—					—DIMENSIONS—						
Suspension Front	Suspension Rear	Brakes Front	Brakes Rear	Steering	Wheel-base	Track ins. Front	Track ins. Rear	Length OA (ins.)	Width OA (ins.)	Height (ins.)	Weight (lbs.)
Ind. Coil	Live Coil	Disc	Disc	Recirc. Ball	101.2	52.1	50.2	172.8	61.6	56.3	2440
Ind. Coil	Live Coil	Disc	Disc	Recirc. Ball	88.6	52.1	50.1	161.1	64.4	50.8	2290
Ind. Coil	Live Coil	Disc	Disc	Recirc. Ball	92.5	51.6	50.0	160.6	62.2	51.8	2290
Ind. Coil	De Dion Coil	Disc	Disc	Rack & Pinion	102.8	59.0	59.0	180.5	72.0	52.2	3800
Ind. Coil	Beam Tors	Disc	Drum	Rack & Pinion	98.0	52.8	52.0	173.8	64.0	57.2	2235
Ind. Coil	Beam Tors	Disc	Drum	Rack & Pinion	105.3	56.0	56.1	182.6	68.1	56.2	2435
Ind. Coil	Ind. Coil	Disc	Disc	Recirc. Ball	119.5	57.5	57.5	203.5	71.0	59.8	4900 (sedan) 4760 (coupe) 4700 (conv.)
Ind.	Ind.	Disc	Drum	ZF worm & roller	98.5	52.3	52.3	166.5	62.0	55.5	2028
Ind.	Ind.	Disc	Drum	ZF worm & roller	98.5	52.3	52.3	166.5	62.0	55.5	2080
Ind.	Ind.	Disc	Disc	ZF worm & roller	106.0	56.9	57.6	185.0	68.9	57.1	2866
Ind.	Ind.	Disc	Disc	ZF worm & roller	106.0	56.9	57.6	185.0	68.9	57.1	2954
Ind.	Ind.	Disc	Drum	ZF worm & roller	103.3	56.9	55.2	183.0	65.6	53.8	2811
Ind.	Ind.	Disc	Drum	Rack & Pinion	123.0	39.1	51.2	190.5	70.5	58.0	2855
Ind.	Ind.	Disc	Drum	Rack & Pinion	123.0	59.0	51.0	196.5	70.5	58.0	2950
Ind.	Ind.	Disc	Drum	Rack & Pinion	123.0	59.0	51.0	190.5	70.5	58.0	2855
Ind.	Ind.	Drum	Drum	Rack & Pinion	106.0			138.9	60.2	60.0	1177
Ind. Coil	Live Leaf	Disc	Drum	Recirc. Ball	90.6	48.8	49.0	152.0	59.6	53.1	1609
Ind.	Ind.	Disc	Drum	Recirc. Ball	95.3	50.4	50.4	162.2	61.4	55.1	2130
Ind.	Ind.	Disc	Drum	Rack & Pinion	89.9	53.3	53.0	161.3	63.6	49.1	2238
Ind.	Ind.	Disc	Disc	Rack & Pinion	98.4	57.0	58.0	167.0	67.0	43.4	2860
Ind.	Ind.	Disc	Disc	Rack & Pinion	88.2	56.1	55.1	163.4	66.9	43.9	2500
Ind.	Ind.	Disc	Disc	Worm & Gear	94.6	56.7	56.0	170	69.4	47.0	2425
Ind.	Ind.	Disc	Disc	Worm & Gear	104.0	56.6	57.8	196.2	70.5	53.0	3570
Ind.	Ind.	Drum	Drum	Screw & Sector	79.8	45.0	47.7	140.0	57.0	54.0	1475
Ind.	Ind.	Disc	Drum	Screw & Sector	79.8	45.6	47.7	143.7	59.0	51.2	1580
Ind.	Ind.	Disc	Drum	Screw & Sector	79.8	45.6	47.7	148.9	59.0	48.0	1640
Ind.	Ind.	Disc	Drum	Screw & Sector	79.8	45.6	97.7	148.9	59.0	48.0	1640
Ind. Coil	Live Coil	Disc	Disc	Worm & roller	89.8	53.0	51.8	162.3	63.0	49.0	2100
Ind. Coil	Live Coil	Disc	Disc	Worm & roller	89.8	53.0	51.8	158.3	63.0	49.0	2100
Ind. Coil	Live Leaf	Disc	Drum	Rack & Pinion	100.8	53.0	52.0	167.8	64.8	52.0	2135
Ind. Coil	Live Leaf	Disc	Drum	Rack & Pinion	100.8	53.0	52.0	167.8	64.8	52.0	2185

Model	Engine Type	Location	Bore & Stroke mm	Displacement cu. in.	Displacement cc	BHP @ RPM	Torque @ RPM	Comp. Ratio	Carburetion	Trans.
			—ENGINE—							
HONDA										
600	IL-2, sohc	Front	74.0x69.6	36.5	598	36 @ 6000	32 @ 4000	8.6:1	1 Keihin	4-Spd.
JAGUAR										
E Type	IL-6, dohc	Front	92.1x106.0	258	4235	245 @ 5500	263 @ 3000	9.0:1	2 Stromberg 175 CD 2SE	4-Spd.
E Type 2+2	IL-6, dohc	Front	92.1x106.0	258	4235	245 @ 5500	263 @ 3000	9.0:1	2 Stromberg 175 CD 2SE	4-Spd.
XJ6	IL-6, dohc	Front	92.1x106.0	258	4235	245 @ 5500	263 @ 3000	9.0:1	2 Stromberg 175 CD 2SE	Auto.
JENSEN										
Interceptor	V-8, ohv	Front	108.0x86.0	383	6276	330 @ 4600	425 @ 2800	10.0:1	1 Carter AVS 47325	Auto.
LAMBORGHINI										
Miura S	V-12, dohc	Central, Trans.	82x62	240	3929	370 DIN @ 7000	300 @ 5000	10.0:1	4 Weber 40IDA-3C	5-Spd.
Espada	V-12, dohc	Front	82x62	240	3929	350 DIN @ 7000	275 @ 4500	10.7:1	6 Weber 40DCOE	5-Spd.
Jarama	V-12, dohc	Front	82x62	240	3929	350 DIN @ 7000	275 @ 4500	10.7:1	6 Weber 40DCOE	5-Spd.
Urraco	V-8, sohc	Central, Trans.	86x53	150	2462	220 DIN @ 7800	166 @ 5700	10.5:1	4 Weber 40IDF-I	5-Spd.
LOTUS										
Europa S2	IL-4, ohv	Mid	77.0x84.0	95.5	1565	87 @ 5750	87 @ 4000	8.6:1	1 Weber 32 DAR	4-Spd.
Elan S4	IL-4, dohc	Front	82.5x72.7	95.1	1588	110 @ 6000	104 @ 4500	9.5:1	2 Stromberg 175 CD 2SE	4-Spd.
MASERATI										
Ghibli	V-8 dohc	Front	94.0x85.0	288	4719	330 @ 5500	325 @ 4000	8.8:1	4 Weber 40 DCNL5	5-Spd.
Indy	V-8 dohc	Front	94.0x85.0	288	4719	330 @ 5500	325 @ 4000	8.8:1	4 Weber 40 DCNL5	5-Spd.
MERCEDES-BENZ										
220	IL-4, sohc	Front	87.0x92.4	134	2197	116 @ 5200	142 @ 3000	9.0:1	2 Solex 36/40 PDSI	4-Spd.
220 Diesel	IL-4, sohc	Front	87.0x92.4	134	2197	65 @ 4200	96 @ 2400	21.0:1	Bosch F.I.	4-Spd.
250	IL-6, sohc	Front	86.5x78.8	170	2778	157 @ 5400	181 @ 3800	9.0:1	2 Zenith 35/40 INAT	Auto.
280 S	IL-6, sohc	Front	86.5x78.8	170	2778	157 @ 5400	181 @ 3800	9.0:1	2 Zenith 35-40 INAT	Auto.
280 SE & SEL	IL-6, sohc	Front	86.5x78.8	170	2778	180 @ 5750	193 @ 4500	9.5:1	Bosch F.I.	Auto.
280 SL	IL-6, sohc	Front	86.5x78.8	170	2778	180 @ 5750	193 @ 4500	9.5:1	Bosch F.I.	4-Spd.
280 SE Coupe & Conv.	V-8, sohc	Front	92.0x65.8	214	3499	230 @ 6050	231 @ 4200	9.5:1	Bosch F.I.	Auto.
300 SEL 3.5	V-8, sohc	Front	92.0x65.8	214	3499	230 @ 6050	231 @ 4200	9.5:1	Bosch F.I.	Auto.
300 SEL 6.3	V-8, sohc	Front	103.0x95.0	386	6329	300 @ 4100	434 @ 3000	8.1:1	Bosch F.I.	Auto.
600	V-8, sohc	Front	103.0x95.0	386	6329	300 @ 4100	434 @ 3000	8.1:1	Bosch F.I.	Auto.
MG										
Midget Mk III	IL4, ohv	Front	71.0x81.0	77.8	1275	62 @ 6000	72 @ 3000	8.8:1	2 SU HS 2	4-spd.
MGB	IL4, ohv	Front	80.3x89.0	110	1789	92 @ 5400	110 @ 3000	8.8:1	2 SU HS 4	4-spd.
MGB GT	IL4, ohv	Front	80.3x89.0	110	1789	92 @ 5400	110 @ 3000	8.8:1	2 SU HS 4	4-spd.
MORGAN										
Plus 8	V-8, ohv	Front	88.9x71.1	215	3528	184 @ 5200	226 @ 3000	10.5:1	2 SU HS 6	4-spd.
OPEL										
Kadett	IL4, ohv	Front	75.0x61.0	66.8	1078	56 @ 5800	55 @ 4400	8.0:1	1 Solex 30 PDSI	4-spd.
1900	IL4, sohc	Front	93.0x69.8	116	1897	90 @ 5200	111 @ 3400	8.0:1	1 Solex 32 DIDTA-4	4-spd.
1900 Rallye	IL4, sohc	Front	93.0x69.8	116	1897	90 @ 5200	111 @ 3400	8.0:1	1 Solex 32 DIDTA-4	4-spd.
GT	IL4, sohc	Front	93.0x69.8	116	1897	90 @ 5200	111 @ 3400	8.0:1	1 Solex 32 DIDTA-4	4-spd.
PEUGEOT										
304	IL4, sohc	Front	75.0x71.0	78.5	1288	70 @ 6100	74 @ 3750	8.8:1	1 Solex PBISA-4	4-spd.
504	IL4, ohv	Front	88.0x81.0	120	1971	98 @ 5800	124 @ 3000	8.4:1	1 Solex 32/35 BEIEA	4-spd.

—CHASSIS—					—DIMENSIONS—						
Suspension Front	Suspension Rear	Brakes Front	Brakes Rear	Steering	Wheel-base	Track Ins. Front	Track Ins. Rear	Length OA (Ins.)	Width OA (Ins.)	Height (Ins.)	Weight (lbs.)
Ind. Coil	Beam Leaf	Disc	Drum	Rack & Pinion	78.7	46 1	44.3	125.0	52 5	52.4	1355
Ind. Tors.	Ind. Coil	Disc	Disc	Rack & Pinion	98.0	50 0	50.0	175.3	65.2	48.1	3020
Ind. Coil	Ind. Coil	Disc	Disc	Rack & Pinion	104.7	50.0	50.0	188.1	65.2	50.1	3320
Ind. Tors.	Ind. Coil	Disc	Disc	Rack & Pinion	108 8	58 0	58.6	189.5	69.6	52.8	3720
Ind. Coil	Live Leaf	Disc	Disc	Rack & Pinion	103.0	55.3	56.5	188.0	69.9	53 0	3695
Ind.	Ind.	Disc	Disc	Rack & Pinion	98 4	55.5	55 5	171.6	69.2	41.5	3000
Ind.	Ind.	Disc	Disc	Rack & Pinion	104.3	58 6	58.6	185.0	71.6	46 8	3262
Ind.	Ind.	Disc	Disc	Rack & Pinion	93.6	58 6	58.6	176.5	73 2	46 8	2821
Ind.	Ind.	Disc	Disc	Rack & Pinion	96.5	57.5	57.5	167.3	69.2	43.9	2600
Ind. Coil	Ind. Coil	Disc	Drum	Rack & Pinion	91.0	53.0	53.0	157	64	42.5	1460
Ind. Coil	Ind. Coil	Disc	Disc	Rack & Pinion	84.0	47.1	48.4	145	56	45.2	1630
Live Leaf	Ind. Coil	Disc	Disc	Recirc. Ball	100.4	56.7	55.4	180.7	70.9	45.7	3365
Live Leaf	Ind. Coil	Disc	Disc	Recirc. Ball	102.3	58.2	53.5	186.6	69.2	48.0	3465
Ind. Coil	Ind. Coil	Disc	Disc	Recirc. Ball	108.3	56.8	56.7	184.5	69.7	56.7	3070
Ind. Coil	Ind. Coil	Disc	Disc	Recirc. Ball	108.3	56.8	56.7	184.5	69.7	56.7	3150
Ind. Coil	Ind. Coil	Disc	Disc	Recirc. Ball	108.3	56.8	56.7	184.5	70.5	54.9	3180
Ind. Coil	Ind. Coil	Disc	Disc	Recirc. Ball	108.3	58.4	58.5	192.9	71.3	56.7	3370
Ind. Coil	Ind. Coil	Disc	Disc	Recirc. Ball	112.2	58.4	58.5	196.8	71.3	56.7	3425
Ind. Coil	Ind. Coil	Disc	Disc	Recirc. Ball	94.5	58.4	58.5	168.7	69.3	52.0	3110
Ind. Coil	Ind. Coil	Disc	Disc	Recirc. Ball	108.3	58.4	58.7	193.1	72.6	55.3	3700
Ind. Coil	Ind. Coil	Disc	Disc	Recirc. Ball	112.2	58.4	58.5	196 8	71.3	56.7	3840
Ind. Coil	Ind. Coil	Disc	Disc	Recirc. Ball	112.2	58.7	58.5	196.8	71.3	56.7	4070
Ind. Coil	Ind. Coil	Disc	Disc	Recirc. Ball	153.5	62.5	62.2	246.0	76.8	59.0	6030
Ind. Coil	Live Leaf	Disc	Drum	Rack & Pinion	80.0	46.3	44.8	137.6	54.9	49.8	1560
Ind. Coil	Live Leaf	Disc	Drum	Rack & Pinion	91.0	49.3	49.3	152.7	59.9	49.4	2220
Ind. Coil	Live Leaf	Disc	Drum	Rack & Pinion	91.0	49.3	49.3	152.7	59.9	49.4	2220
Ind. Coil	Live Leaf	Disc	Drum	Cam & Peg	98.0	49.0	51.0	152.0	58.0	49.0	2005
Ind. Coil	Ind. Leaf	Drum	Drum	Rack & Pinion	95.1	49.3	50.2	161 6	63.5	54.4	1755
Ind. Coil	Ind. Coil	Disc	Drum	Rack & Pinion	95.7	52.4	52.0	164.6	64.3	54.5	2125
Ind. Coil	Ind. Coil	Disc	Drum	Rack & Pinion	95.7	52.4	52.0	171.0	64.3	53.3	2175
Live Leaf	Ind. Leaf	Disc	Drum	Rack & Pinion	95.7	49.4	50.6	161.9	62.2	48.2	2110
Ind. Coil	Ind. Coil	Disc	Drum	Rack & Pinion	101.9	52.0	49.6	163.0	61.8	55.4	1920
Ind. Coil	Ind. Coil	Disc	Drum	Rack & Pinion	108.0	56.5	53.5	177.0	66.5	57.5	2695

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Model	Engine Type	Location	Bore & Stroke mm	—ENGINE— Displacement cu. in.	cc	BHP @ RPM	Torque @ RPM	Comp. Ratio	Carburetion	Trans.
PORSCHE										
914	H 4, ohv	Mid	90.0x66.0	102	1679	85 @ 4900	103 @ 2800	8.2:1	Bosch F.I.	5-spd
914/6	H 6 sohc	Mid	80.0x66.0	122	1991	125 @ 5800	131 @ 4200	8.6:1	2 Weber 40 IDT	5-spd.
911-T	H 6 sohc	Rear	84.0x66.0	134	2195	142 @ 5800	148 @ 4200	8.6:1	2 Zenith 40 TIN	5-spd
911-E	H 6 sohc	Rear	84.0x66.0	134	2195	175 @ 6200	160 @ 4500	9.1:1	Bosch F.I.	5-spd
911-S	H 6 sohc	Rear	84.0x66.0	134	2195	200 @ 6500	164 @ 5200	9.8:1	Bosch F.I.	5-spd
RENAULT										
10	In 4, ohv	Rear	73.0x77.0	78.6	1289	56 @ 4600	70 @ 2300	8.5:1	1 Solex 26/32 DIDSA-10	4-spd
10 Automatic	In 4, ohv	Rear	70.0x72.0	67.6	1108	48 @ 4600	57 @ 3000	8.5:1	1 Solex 26/32 DIDSA-10	Auto
16	In 4, ohv	Front	77.0x84.0	95.5	1565	70 @ 5200	86 @ 2500	8.6:1	1 Solex 26/32 DIDSA-8	4-spd
16 Automatic	In 4, ohv	Front	77.0x89.0	95.5	1565	70 @ 5200	86 @ 2500	8.6:1	1 Solex 26/32 DIDSA-8	Elc. Auto
ROLLS ROYCE										
Silver Shadow	V-8, ohv	Front	104.1x99.1	412	6740	N.A.	N.A.	9.0:1	2 SU HD 8	Auto
ROVER										
2000 Auto	IL4, sohc	Front	3.37x3.37	120.8	1978	99 @ 5000	121 @ 3600	9.0:1	1 SU HSG	3-spd.
2000 TC	IL4, sohc	Front	3.37x3.37	120.8	1978	124 @ 5500	132 @ 4000	10.0:1	2 SU HS8	4-spd
3500 S	V-8, ohv	Front	3.50x2.80	215.0	3528	184 @ 5200	226 @ 3000	10.5:1	2 SU HS6	3-spd.
Land-Rover	IL4, ohv	Front	3.56x3.50	139.5		77 @ 4250	124 @ 2500	7.0:1	1 Zenith IVE	4-spd.
Range Rover	V-8, ohv	Front	3.50x2.80	215.0	3528	156 @ 5000	205 @ 3000	8.0:1	2 Zenith-Stromberg CD25	4-spd.
SAAB										
96 Sedan	V-4, ohv	Front	90.0x58.9	104	1698	73 @ 5500	87 @ 2700	8.0:1	1V Autolite	4-spd.
96 Wagon	V-4, ohv	Front	90.0x58.9	104	1698	73 @ 5500	87 @ 2700	8.0:1	1V Autolite	4-spd.
99E Sedan	IL4, sohc	Front	83.5x78.0	104	1709	95 @ 5500	98 @ 3000	9.0:1	F.I.	4-spd.
Sonett	V-4, ohv	Front	90.0x58.9	104	1698	73 @ 5500	87 @ 2700	8.0:1	1V Autolite	4-spd.
SIMCA										
1204	IL4, ohv	Front	74.0x70.0	73.4	1204	62 @ 5800	65 @ 3400	8.8:1	1 Solex 32 BISA	4-spd.
TOYOTA										
Corolla 1200	IL4, sohv	Front	75x66	71.1	1858	73 @ 6000	74.2 @ 3800	9.0:1	1-2V	4-spd.
Corona MK II	IL4, ohv	Front	86x80	113	1858	108 @ 5500	117 @ 3600	9.0:1	1 AISAN	4-spd.
Crown	IL6, sohc	Front	75x85	138	2253	115 @ 5200	127 @ 3000	8.8:1	1 AISAN	4 spd.
TRIUMPH										
Spitfire MK III	IL4, ohv	Front	73.7x76	79.1	1296	68 @ 5500	72 @ 3000	9.0:1	2 SU HS 2	4-spd.
GT 6+	IL6, ohv	Front	74.7x76	122	1998	95 @ 4700	117 @ 3400	9.2:1	2 Stromberg 150 CP	4-spd.
TR-6	IL6, ohv	Front	74.7x95	152	2498	104 @ 4500	142 @ 3000	8.5:1	2 Stromberg 175 COSE	4-spd.
VOLKSWAGEN										
Beetle	HO-4, ohv	Rear	85.5x69	96.66	1584	60 @ 4400	81.7 @ 3000	7.5:1	1 Solex	4-spd.
Super Beetle	HO-4, ohv	Rear	85.5x69	96.66	1584	60 @ 4400	81.7 @ 3000	7.5:1	1 Solex	4-spd.
Karmann Ghia Coupe	HO-4, ohv	Rear	85.5x69	96.66	1584	60 @ 4400	81.7 @ 3000	7.5:1	1 Solex	4-spd.
VW Convertible	HO-4, ohv	Rear	85.5x69	96.66	1584	60 @ 4400	81.7 @ 3000	7.5:1	1 Solex	4-spd.
9-Seat Station Wgn.	HO-4, ohv	Rear	85.5x69	96.66	1584	60 @ 4400	81.7 @ 3000	7.5:1	1 Solex	4-spd.
Delivery Van	HO-4, ohv	Rear	85.5x69	96.66	1584	60 @ 4400	81.7 @ 3000	7.5:1	1 Solex	4-spd.
Type III	HO-4, ohv	Rear	85.5x69	96.66	1584	65 @ 4600	86.8 @ 2800	7.7:1	Bosch F.I.	4-spd.
Squareback Sedan	HO-4, ohv	Rear	85.5x69	96.66	1584	65 @ 4600	86.8 @ 2800	7.7:1	Bosch F.I.	4-spd.
411 Four Door	HO-4, ohv	Rear	90x66	102.5	1679	85 @ 5000	99.4 @ 3500	8.2:1	Bosch F.I.	4-spd
411 Three Door	HO-4, ohv	Rear	90x66	102.5	1679	85 @ 5000	99.4 @ 3500	8.2:1	Bosch F.I.	4-spd.
VOLVO										
142, 144, 145	IL4, ohv	Front	88.9x80.0	121	1986	118 @ 5800	123 @ 3500	9.3:1	2 SU HIF	4-spd.
164	IL6, ohv	Front	88.9x80.0	182	2982	145 @ 5500	163 @ 3000	9.3:1	2 Zenith-Stromberg 175 CD 2 SE	4-spd
1800	IL4, ohv	Front	88.9x80.0	121	1986	130 @ 6000	133 @ 3500	10.5:1	Bosch F.I.	4-spd

—CHASSIS—					—DIMENSIONS—						
Suspension Front	Suspension Rear	Brakes Front	Brakes Rear	Steering	Wheel-base	Track Ins. Front	Track Ins. Rear	Length OA (Ins.)	Width OA (Ins.)	Height (Ins.)	Weight (lbs.)
Ind. Tors	Ind. Coil	Disc	Disc	Rack & Pinion	96.4	52.6	54.1	156.9	65.0	48.0	2085
Ind. Tors	Ind. Coil	Disc	Disc	Rack & Pinion	96.4	53.6	54.4	156.9	65.0	48.0	2195
Ind. Tors	Ind. Tors	Disc	Disc	Rack & Pinion	89.2	53.6	52.8	163.9	63.4	52.0	2395
Ind. Tors	Ind. Tors	Disc	Disc	Rack & Pinion	89.2	53.6	52.8	163.9	63.4	52.0	2395
Ind. Tors	Ind. Tors	Disc	Disc	Rack & Pinion	89.2	53.8	53.0	163.9	63.4	52.0	2390
Ind. Coil	Ind. Coil	Disc	Disc	Rack & Pinion	89.0	49.0	48.0	167.0	60.0	55.0	1905
Ind. Coil	Ind. Coil	Disc	Disc	Rack & Pinion	89.0	49.0	48.0	167.0	60.0	55.0	1840
Ind. Tors	Ind. Tors	Disc	Drum	Rack & Pinion	105.6	52.8	50.9	168.4	64.9	57.3	2770
Ind. Tors	Ind. Tors	Disc	Drum	Rack & Pinion	105.6	52.8	50.9	168.4	64.9	57.3	2365
Ind. Coil	Ind. Coil	Disc	Disc	Recirc. Ball	119.5	57.5	57.5	203.5	71.0	59.0	4690
Ind.	De Dion	Disc	Disc	Worm & Roller	103.	53.37	52.5	178.5	60.0	54.75	2793
Ind.	De Dion	Disc	Disc	Worm & Roller	103.0	53.37	52.5	178.5	60.0	54.75	2827
Ind.	De Dion	Disc	Disc	Cam & Roller	103.37	53.37	51.75	181.0	66.0	56.25	3184
Live Axle	Live Axle	Drum	Drum	Worm & Nut	88.0	51.5	51.5	142.3	64.0	77.5	2900
Live Axle	Live Axle	Disc	Disc	Recirc. Ball	100.0	N.A.	N.A.	176.0	N.A.	N.A.	3800
Ind. Coil	Beam Coil	Disc	Drum	Rack & Pinion	98.3	48.0	48.0	165.4	62.2	58.0	2000
Ind. Coil	Beam Coil	Disc	Drum	Rack & Pinion	98.3	48.0	48.0	169.3	62.2	58.0	2100
Ind. Coil	Beam Coil	Disc	Disc	Rack & Pinion	97.4	54.7	54.7	171.4	66.0	57.0	2360
Ind. Coil	Beam Coil	Disc	Drum	Rack & Pinion	84.6	48.5	48.5	154.0	59.0	47.0	1765
Ind. Tors	Ind. Tors	Disc	Drum	Rack & Pinion	99.2	53.8	51.6	155.3	62.0	57.4	2090
Ind. Coil	Ind. Coil	Disc	Drum	Recirc. Ball	91.9	49.4	49.0	161.4	59.3	54.1	1725-1805
Ind. Coil	Live Leaf	Disc	Drum	Recirc. Ball	98.8	52.2	52.0	170.5	63.4	55.3	2410
Ind. Coil	Live Leaf	Disc	Drum	Recirc. Ball	105.9	53.9	53.9	184.6	66.5	57.7	2930
Ind. Coil	Ind. Leaf	Disc	Drum	Rack & Pinion	83.0	49.0	48.0	147.0	57.0	47.0	1680
Ind. Coil	Ind. Leaf	Disc	Drum	Rack & Pinion	83.0	49.0	49.0	147.0	57.0	47.0	1975
Ind. Coil	Ind. Leaf	Disc	Drum	Rack & Pinion	88.0	50.2	49.8	156.0	58.0	50.0	2360
Ind. Tors	Ind. Tors	Drum	Drum	Worm & Roller	94.5	51.6	53.3	158.6	61.0	59.1	1807
Ind. Coil	Ind. Tors	Drum	Drum	Worm & Roller	95.3	54.3	53.3	161.8	62.4	59.1	1918
Ind. Tors	Ind. Tors	Disc	Drum	Worm & Roller	94.5	51.6	53.3	163.0	64.3	52.0	1918
Ind. Tors	Ind. Tors	Disc	Drum	Worm & Roller	94.5	51.6	53.3	158.6	61.0	59.1	1807
Ind. Tors	Ind. Tors	Disc	Drum	Worm & Roller	94.5	54.6	56.6	174.0	69.5	76.4	2888
Ind. Tors	Ind. Tors	Disc	Drum	Worm & Roller	94.5	54.6	56.6	174.0	69.5	76.4	2567
Ind. Tors	Ind. Tors	Disc	Drum	Worm &	94.5	51.6	53.0	170.9	63.2	57.9	2226
Ind. Tors	Ind. Tors	Disc	Drum	Worm & Roller	94.5	51.6	53.0	170.9	63.2	57.9	2282
Ind. Coil	Ind. Coil	Disc	Drum	Recirc. Ball	98.4	54.7	52.8	179.2	64.9	58.5	2425
Ind. Coil	Ind. Coil	Disc	Drum	Recirc. Ball	98.4	54.7	52.8	179.2	64.9	58.5	2469
Ind. Coil	Live Coil	Disc	Disc	Worm & Roller	103.1	53.1	53.1	182.7	68.3	56.7	2515
Ind. Coil	Live Coil	Disc	Disc	Worm & Roller	106.3	53.1	53.1	185.6	68.3	56.7	2940
Ind. Coil	Live Coil	Disc	Disc	Worm & Roller	96.5	51.6	51.6	171.3	66.9	50.4	2535

Mr. CARTER. I know that some of those cars you stated do have fuel injection systems. It is my understanding they are much more economical users of gasoline, and I am one who believe very much that we should certainly produce cars of that nature.

By producing cars which use gasoline so heavily, we have absolutely, in a sense, forced our people to buy foreign-made cars.

Of course, lately, we are entering that field and we are competing now and I am glad to see that. Of course, we have to think of the future, too, in the use of gasoline continuously.

Mr. JENSEN. I am not an expert on the extent of natural resources that are available. We have people in our company who are looking down the road to the future. I am in the emission field. It will be delegated talk to the people involved in our company in that work and submit information for the record.

Mr. CARTER. I would certainly like to see an evaluation of that since large motor companies, such as Ford, should be forward-looking. It we become dependent on foreign nations for petroleum we will be in a very, very sad position.

Mr. JENSEN. We will be glad to try to supply you with some information on that subject.

Mr. CARTER. Thank you.

(Testimony resumes on p. 320.)

(The following information was received for the record:)

STATEMENT IN RESPECT TO WORLD PETROLEUM RESERVES

"Future Petroleum Provinces of the United States," by the National Petroleum Council, Washington, D.C., July 1970, may be the source of the statement in the hearing in respect to very limited future supplies of petroleum. This is only indirectly relevant to the question of the world supply, since it addresses specifically the reserves in the United States and it does not consider other sources of hydrocarbons such as oil shale, tar sands, solid hydrocarbons, and coal. Some of the people familiar with this study, such as Mr. L. A. McReynolds, Director, Petroleum Products and Environmental Conservation, Phillips Petroleum Company, and Dr. C. E. Moser, Director of Research Planning, Fuels, Texaco, Inc., have indicated that these other resources are probably huge compared to those of liquid crude petroleum; but the National Petroleum Council did not include them since the practicality of their future recovery depended on Government policies and environmental considerations which cannot be assessed at the present time.

Moreover, it is generally accepted that the petroleum resources in the United States are only a small fraction of the total world reserves. For instance, of the known recoverable petroleum reserves only approximately sixteen percent are in the United States (U.S. Office of Science and Technology, 1965, "Energy R&D and National Progress," Washington, D.C., U.S. Government Printing Office). It appears that the United States' fraction may be even lower if one included also the probable but as yet undiscovered reserves and also petroleum which may lie beneath the ocean floor beyond the continental shelves. Therefore, it is clear that the ultimate petroleum potential of the world, including alternate sources of hydrocarbons, must be at least one order of magnitude greater than the estimate of the National Petroleum Council for the United States of 432 billion barrels (see attachment). On the basis of most estimates of future energy consumption (see, for instance, "Energy R&D and National Progress," *loc. cit.*), on a worldwide basis, the petroleum resources together with resources of other fossil fuels easily convertible into liquid hydrocarbons should suffice at least until the middle of the next century.

This view represents the consensus of numerous studies which have been summarized recently by V. E. McKelvey ("Mineral Resource Estimates and Public Policy," *American Scientist*, vol. 60, no. 1, pp. 32–40, January-February 1972). A much more pessimistic outlook may be gained on careless reading of another recent study by the National Petroleum Council ("U.S. Energy Outlook, An Initial Appraisal, 1971–1985," Washington, D.C., July 1971). This is due in

part to a consideration of the resources and needs of the United States alone, rather than of the total world. Secondly, this study assumes no changes in Government economic and environmental policies. It is claimed that changes in these policies would be required to make it economically feasible to utilize a good fraction of the United States resources. Mr. L. A. McReynolds, (see above) indicates that a second study by the National Petroleum Council, to be published in July 1972, will show that with some modest modifications in Government policies the prospects for availability of petroleum in the United States would remain quite favorable for a relatively long time, probably into the next century. Probably the statement at the Congressional "Oversight Hearings" was misinterpreted. Various studies have indicated not that the world has only a ten-year supply of petroleum, but rather that with present economic and political conditions the United States will be subjected to a severe petroleum shortage within ten years.

SUMMARY OF FORECAST PETROLEUM AVAILABILITY IN THE UNITED STATES[1]

Year	Forecast rate of demand (million barrels per day)	Equivalent (million barrels per year)	Estimated production[2] balance (million barrels)
1970	14.7	5,365.5	346,000
1971			340,635
1972			335,269
1973			329,904
1974			324,538
1975	18.5	6,752.5	317,786
1976			311,033
1977			304,281
1978			297,528
1979			290,776
1980	22.7	8,285.5	282,490
1981			274,205
1982			265,919
1983			257,634
1984			249,345
1985	26.4	9,636.0	(3)

[1] From National Petroleum Council, "Future Petroleum Provinces of the United States," Washington, D.C., July 1970, and "U.S. Energy Outlook," vol. 1, Washington, D.C., July 1971.
[2] Based on National Petroleum Council 1970 estimate of future production of crude oil only; does not include vast reserves of oil shale or tar sands or liquid petroleum products from coal or other solid hydrocarbons.
[3] 26 years' supply remaining at 1985 rate of demand, or until 2011.

[From "Future Petroleum Provinces of the United States," National Petroleum Council, Washington, D.C., July 1970]

Summary and Conclusions

In this study the entire United States, including the continental shelf and slope, was examined by experienced petroleum geologists in the search for areas with petroleum potential, however remote. The petroleum geology of the chosen areas was described in the detail considered adequate, or in the detail permitted by available data.

One hundred and forty-one geologists participated in the project, 11 of whom coordinated the study in the 11 regions (Figure 1). The report contains an enormous amount of unpublished pertinent data, all directed to appraisal of the Nation's petroleum resources. The potential of each region was assessed qualitatively, and in part quantitatively. The completeness of the report and the ideas and opinions expressed should provoke alternate ideas and opinions leading to more exploratory activity and more discoveries.

The more important observations are as follows.

The prospective basinal area of the United States covers approximately 3.2 million square miles; 1.8 million onshore, 0.9 million continental shelf, and 0.5 million continental slope. Alaska alone covers 940 thousand square miles; 85 thousand onshore, 580 thousand continental Shelf, and 275 thousand continental slope.

Estimated cubic miles of sedimentary rock above basement[1] or 30.000 feet total 6.0 million; 3.4 million onshore, 1.6 million continental shelf, and 1.0 million continental slope. The totals for Alaska alone are 1.4 million cubic miles; 0.2 million onshore, 0.8 million continental shelf, and 0.4 million continental slope.

In addition, large structurally complex areas of thick sedimentary rocks bor-

dering parts of the basinal areas, and some scattered smaller areas, are considered to be prospective but of secondary importance.

None of the 11 regions has been adequately explored. Extensions to old fields and discovery of new fields at conventional depths and deeper are forecast for all regions. The Atlantic, Florida, and Alaska continental shelves, and the entire continental slope, barely have been touched by drilling, and other prospective areas and depths on land and the continental shelf remain largely unexplored. Many high-potential areas are indicated by the geology and extent of exploration, particularly in parts of Alaska, California, Colorado, Louisiana, Mississippi, Montana, New Mexico, North Dakota, Oklahoma, Texas, Utah, and Wyoming. The future of the area east of the Mississippi River and north of the Gulf Coast province is particularly dependent on deeper discoveries in the older Paleozoic rocks, prospects of which are considered to be favorable. A high percentage of the new petroleum confidently foreseen on land will be found in stratigraphic, combination stratigraphic and structural, and complex structural traps.

Estimates of potential crude oil reserves of the basinal area only, and exclusive of known reserves, range from 227 ("probable" and "possible") to 436 (including "speculative") billion barrels of oil-in-place or from 59 to 112 percent of end of 1968 estimates of proved oil-in-place. The potential probably exceeds the medium estimate of 332 billion barrels of oil-in-place.

Estimates of potential recovery of crude oil range from 74 to 141 billion barrels, averaging 107 billion barrels at known rates of recovery of the oil-in-place; from 96 to 185 billion barrels, averaging 140 billion barrels at a recovery rate of 42 percent; and from 136 to 262 billion barrels, averaging 199 billion barrels at a recovery rat eof 60 percent.

Estimates of potential natural gas reserves of the entire country furnished by the Potential Gas Committee range from 595 ("probable" and "possible") to 1,227 trillion cubic feet (including "speculative") or from 94 to 194 percent of end of 1968 estimates of ultimate recovery of known fields. The potential probability exceeds the median estimate of 911 trillion cubic feet.

The ultimate petroleum potential of the United States including known reserves and past production, and assuming median estimates of potential and 60 percent recovery of 720 billion barrels of oil-in-place, may exceed 432 billion barrels of crude oil, 1,543 trillion cubic feet of natural gas, and 49 billion barrels of natural gas liquids. The amounts that *will* be discovered are not ventured, but if discovered and produced, future production of crude oil would be 346 billion barrels (4.0 times past production); future production of natural gas would be 1,195 trillion cubic feet (3.6 times past production); and future production of natural gas liquids would be 38 billion barrels (3.5 times past production).

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[1] Basement is defined as an underlying complex of unattractive rocks beneath the sedimentary sequence.

The trend in the last decade of devoting a declining percentage of producing revenue to finding and developing production of crude oil and natural gas has resulted in a drastic decline in exploratory and development drilling which together with deemphasis of the onshore of the conterminous United States is inimical to the development of the country's enormous petroleum resources.

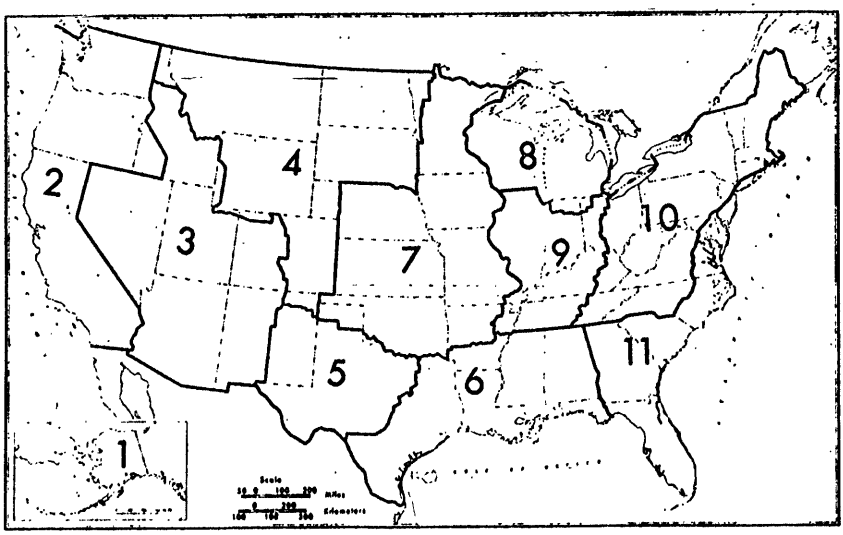

FIGURE 1.—Regional Boundaries (Reg. 1—Alaska and Hawaii; Reg. 2—Pacific Coast States; Reg. 3—Western Rocky Mountains; Reg. 4—Eastern Rocky Mountains; Reg. 5—West Texas and Eastern New Mexico; Reg. 6—Western Gulf Basin; Reg. 7—Midcontinent; Reg. 8—Michigan Basin; Reg. 9—Eastern Interior; Reg. 10—Appalachians; Reg. 11—Eastern Gulf and Atlantic Coast)

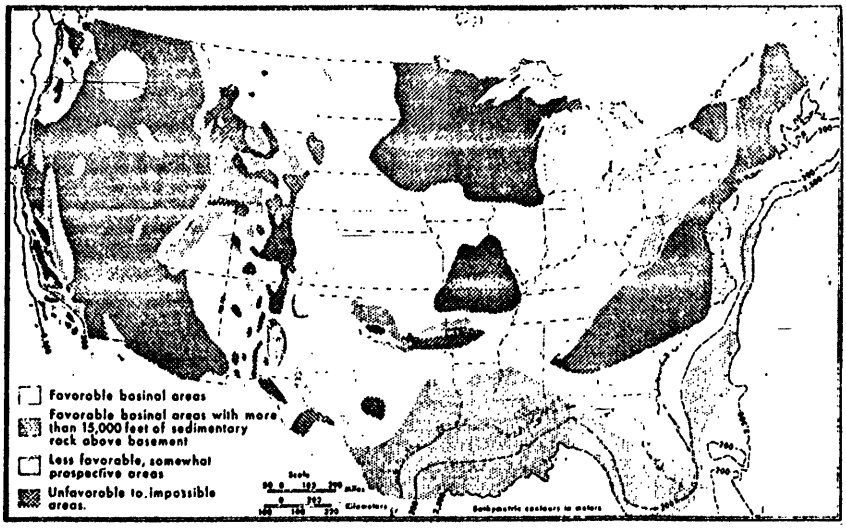

FIGURE 2.—Prospective Areas of Conterminous United States

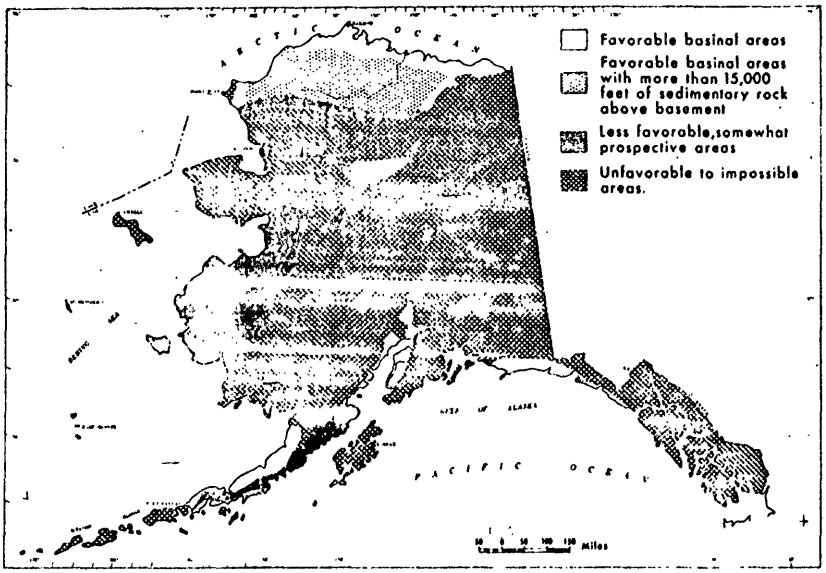

FIGURE 3.—Prospective Areas of Alaska

Mr. ROGERS. Mr. Hastings?

Mr. HASTINGS. Does each of those vehicles depend upon catalytic fuel?

Mr. JENSEN. Yes, sir.

Mr. HASTINGS. What is the most promising of the four approaches that Ford Motor Co. has taken, in your judgment?

Mr. JENSEN. The lowest emission levels that we have achieved are on the last two I mentioned—the program combustion engine and the lean-burn. Both of these at low mileage meet the 1976 requirements.

Mr. HASTINGS. Could they be attained by 1975 or 1976? Would that also be true?

Mr. JENSEN. We have more production problems to work out on those two than we do on the first two.

Mr. HASTINGS. Although they may be the most promising, they may be further down the line in meeting the required dates for emission control?

Mr. JENSEN. Exactly.

Mr. HASTINGS. I am not sure I know where that leads us.

Mr. JENSEN. We are faced with the same quandary.

Mr. HASTINGS. Does Ford Motor Co. share with General Motors the opinion that the fuel companies will have to make some drastic revisions in fuel to meet these standards? General Motors has so testified that high volatility of fuel will be required to meet a standard by 1975 if they get the 1-year suspension.

Do you join in that?

Mr. JENSEN. No, sir, it must be tied into some special General Motors hardware. We are running all of our test cars on commonly available lead-free fuel, not any special type of fuel with special volatility.

Mr. HASTINGS. Ford Motor Co. is saying they will hopefully improve their standard to meet the standard by 1976 but not 1975.

Mr. JENSEN. Yes, sir.

Mr. HASTINGS. On this question of Proco, do you share the feelings that Congress should reevaluate that across-the-board?

Mr. JENSEN. Yes, sir, I think, as you know, there is a tremendous amount of research going into health effects of air pollution because of the general public concern.

Congress has appropriated money to obtain facts in this field and so have many State governments. I think there is an obligation for all of us whether its the legislature, industry, or the administration, to continually reevaluate new research information as it becomes available to see if we are doing the proper thing for the public welfare and the public health.

Incidentally I attended the meeting which Congressman Veysey discussed, and I did not think that there was a general consensus that present standards were completely arbitrary.

At least, as one participant, I did not gain that impression.

Mr. HASTINGS. I have not read this letter from the oil company, but you do not join the writer in indicating that there was a consensus?

Mr. JENSEN. No, sir, as I just indicated, I think there should be a continuing reevaluation. As new research becomes available, we should continue to look at it, but that does not mean that we should say no progress is being made. By the way, I have not seen the letter either.

Mr. HASTINGS. In line with the San Clemente conference, since you were there in attendance, was there any misapprehension on your part that it was called by the University of California and Mr. Veysey and not in fact the White House and the administration?

Mr. JENSEN. I checked and found there was no connection. I talked with Dr. Jim Pitts who is head of the Air Pollution Research Center at the University of California at Riverside. If there were problems he clarified the matter for me.

We are professional colleagues and we are in periodic conversation. I cannot speak for the others in attendance, but certainly I was not confused because of the place where the meeting was held.

Mr. HASTINGS. Thank you very much, Mr. Jensen.

I have no further questions.

Mr. ROGERS. Dr. Carter?

Mr. CARTER. I just want to compliment the gentleman on his presentation. I think it was quite scholarly.

I know Ford picks highly intelligent people to appear here and I congratulate him again on his statement.

Mr. ROGERS. Do you know if any recommendations came out of the meeting in California that you attended?

Mr. JENSEN. No, sir.

Mr. ROGERS. Were there any determinations of basic findings?

Mr. JENSEN. The University of California, Mr. Chairman, had about 10 or 12 young staff people and I presumed they were graduate students. They wrote down what they thought either was a consensus or the pros and cons. There are controversial issues as you pointed out.

That text in rough draft form was circularized. I sent my copy back, I think, the day before yesterday. I did not agree with some of the

items that they summarized as being a consensus. As I recall, however, there were no specific recommendations.

Mr. ROGERS. Do you have a copy of that?

Mr. JENSEN. I can certainly make one available.

Mr. ROGERS. That would be helpful for the record.

(See "Summary of discussions at the Motor Vehicle Air Pollution Conference, Western White House, San Clemente, Calif.—January 13–14, 1972," p. 261, this hearing.)

Mr. ROGERS. I also presume you were there when the chairman was talking about the Clean Air Act and categorized it as resulting in "over-kill".

Mr. JENSEN. There was a discussion on the part of the California technical people who were there—the air pollution control official from Los Angeles—the Southern Automobile Club executive vice president and general manager—about the "over-kill" on carbon monoxide.

I don't know if it was Mr. Veysey or one of the State legislators that talked about the "over-kill," but my recollection of that type of phraseology was specifically addressed to carbon monoxide.

The California standards for carbon monoxide for 1975 which they adopted September 15 of 1971 called for 24 grams per mile as the standard for carbon monoxide in California. The 90 percent reduction specified in the Clean Air Amendments of 1970 call for 3.4 grams per mile, so you can see there is a wide difference.

The Los Angeles air pollution control officer stated to this group that he felt they could get clean air with no health problems in California with the California standards rather than the Federal standards. This "over-kill" phrase grew out of that kind of statement with respect to carbon monoxide.

Mr. ROGERS. Were you advised that the Justice Department would permit such a meeting before you attended?

Mr. JENSEN. We were very much concerned about this, so our office of general counsel contacted the Justice Department to assure that they would be represented.

I have J. M. MacNee III, from our office of general counsel who, I think, contacted the Justice Department.

Mr. ROGERS. Tell us quickly on that. Identify yourself, please.

Mr. MACNEE. My name is James MacNee, Mr. Chairman, of Ford's office of general counsel. Actually, I called a lawyer in Chicago and asked him to call Mr. Hernacke, the individual who Mr. Veysey indicated would represent the Antitrust Division.

I did so because Mr. Hernacke formerly served with the Chicago office of the Antitrust Division.

We wanted to be sure the Antitrust Division would be there in something more than an observer capacity. The phone call was made to assure ourselves that Mr. Hernacke would in fact intervene if any thing appeared to him to be amiss. We received such an assurance.

Mr. JENSEN. He made an opening statement. He never intervened while I was there, but he made a very cogent opening statement about the ground rules in respect to exchange of technical information.

Mr. ROGERS. Did they discuss anything about getting the lead out or the oil companies entering that discussion?

Mr. JENSEN. Yes, sir, the item you mentioned was on the agenda. Du Pont and Ethyl were there and they engaged in a discussion about what available data would show.

I don't think there was any conclusion on that part of the discussion.

Mr. ROGERS. So far as you know, there are no basic conclusions from the meeting at all?

Mr. JENSEN. That is correct.

Mr. ROGERS. It was just a get-together.

Mr. JENSEN. There was a great deal of public technical information discussed. The conflicting points of view were brought out during the exchanges but certainly there were no conclusions reached. The summaries would indicate two sides to many of the questions as I just pointed out.

Mr. ROGERS. Was there any discussion as to how you can actually meet the 1975 standards or just ways why you could not?

Mr. JENSEN. There is a certain prejudice in favor of its own standards in any State government as you recognize, Mr. Chairman. The State officials asked the car companies, "Do you think the California standards are more attainable than the Federal standards?"

Mr. ROGERS. They are weaker.

Mr. JENSEN. The obvious answer I would have to give, or anyone from the automobile companies would have to submit would be in the affirmative.

Mr. ROGERS. This is what I thought was the intent of the meeting not to go with the roughest standards and I can understand that.

I notice you say you spent about $130 million in this past year on air pollution?

Mr. JENSEN. Yes, sir.

Mr. ROGERS. What is your budgeted item for this year?

Mr. JENSEN. If I could, I would prefer to submit that for the record primarily because we are pulling it together now for the suspension hearing at EPA.

(The following statement was received for the record:)

This information is now being developed and audited for presentation to EPA at their request. When it is forwarded to them we will forward the correct information to this committee.

Mr. ROGERS. It would be more or less, basically.

Mr. JENSEN. It is bound to be more. We testified before this committee in 1969 that our research and development effort on emissions was approximately $38 million. In 1970 we told you it was approximately $68 million. Today I mentioned $132 million for 1971. Every year the amount increases.

Mr. ROGERS. That is interesting because General Motors is going down. They had $300 million and went down to $225 million this year.

I wondered if that was the pattern in the industry.

Mr. JENSEN. It certainly has never happened at Ford.

Mr. ROGERS. I understood you to say you have 3,000 people working on it. Is that the equivalent or actually 3,000 people?

Mr. JENSEN. I think it is the equivalent. I had better answer that one later for the record. As you can tell, I am more of an emission expert than a finance expert.

Mr. ROGERS. I do not mean to pin you down. We would just like to have that information for the record.

(The following statement was received for the record:)

This information is also being developed and audited for presentation to EPA at their request. When it is forwarded to them we will forward the correct information to this committee.

Mr. ROGERS. Do you know the overall amount of business Ford does, about the range of it? You don't have to be exact.

Mr. JENSEN. Let me ask our lawyer.

Mr. MACNEE. Sales are approximately $14 billion.

Mr. ROGERS. What were profits?

Mr. MACNEE. I am sorry, I should know the answer, but I don't.

Mr. ROGERS. Would you let us have that, please?

(The following information was received for the record:)

FORD MOTOR COMPANY PROFITS FOR 1971

Profits for 1971 were $657 million.

Mr. ROGERS. What did you spend annually on style changes, would you say? Can you give us an estimate of that?

Mr. JENSEN. I can't now. I can see if the information is available.

Mr. ROGERS. Would you, please?

(The following statement was received for the record:)

I regret that the information requested is not available.

And how many men are assigned to this phase of the work.

I just read this past week the auto industry spends $1.7 billion on style changes. Would you think this is possible? That is all of the industry.

Mr. JENSEN. You are talking to someone who is completely ignorant on the subject.

Mr. MACNEE. I might add, Mr. Chairman, the so-called annual style changes are becoming less and less frequent, certainly at Ford Motor Co. To try to give you a figure on style changes would be most difficult.

Mr. ROGERS. I think your accountants can break that down very quickly for your stockholders.

Mr. MACNEE. We have to factor in the style changes and some of the style changes are necessitated and occasioned by such things as safety and damageability.

Mr. ROGERS. I realize safety might require it, and comfort, but if you could give us a figure, I would appreciate it. I think it was Life magazine that got that information somewhere. If Life can get it, maybe you can let the Congress have it.

There is a reason for this. It seems to me if we can get the industry to come to some agreement, perhaps we could pass a law to protect you so that no one would have to make a style change. I think the public would accept it if we could keep costs down.

If we could save $1 billion $700 million, all of that could be spent on emission control and safety standards.

We would appreciate a figure on that for the record.

Mr. ROGERS. What do you think is the most difficult problem—durability?

Mr. JENSEN. Durability has proven most difficult.

Mr. ROGERS. You have accomplished the 1975 goals in some of your testing vehicles?

Mr. JENSEN. 1975 and 1976, yes, sir; at low mileage points.

Mr. ROGERS. You have shown it can be done. It is a question now of how long you can maintain that; for instance, with your catalytic converter.

Mr. JENSEN. Yes, sir.

Mr. ROGERS. The Academy of Sciences says there is no problem up to 25,000 miles. One of the manufacturers of the catalytic converters said they could really make them last longer than that but they didn't want to warrant them longer than 25,000 miles.

Mr. JENSEN. That particular catalyst manufacturer, I assume it was Universal Oil Products, has given us new units. In fact, I called today to check on the current status.

They gave us four units yesterday afternoon. We will put them on test and take a look at them.

Mr. ROGERS. The Academy of Sciences says it is not that it cannot be met—it can be met if we average emissions of the polluting vehicle, if we do require the availability of fuel which would be lead-free and maybe a couple of other items which the oil industry says it can do in 1974 and if you would provide that the catalyst only has to have a life of 25,000 miles.

Now, under those conditions they have said this has been proved out. This is the National Academy of Science Report.

Mr. JENSEN. I recognize that. They said it is possible if these conditions were put into effect. You have indicated an accurate reflection of their statement.

We have not had that kind of success on all engines at 25,000 mile durability.

Obviously, the National Academy of Sciences would not misrepresent the case. From our experience I find their optimism hard to believe but maybe some of our competitors have had more sucess.

We are testing some 43 different catalysts at the present time and hopefully we will arrive at the same kind of conclusion which they did in the scientific report.

Mr. ROGERS. Let me ask you this: Do you guarantee any car that you make for 5 years or 50,000 miles?

Mr. JENSEN. No, sir.

Mr. ROGERS. Do you guarantee any parts to last 50,000 miles or 5 years?

Mr. JENSEN. May I refer to my attorney?

He writes those warranties.

Mr. MACNEE. No, sir; we do not.

Mr. ROGERS. Then I am wondering why we should require you to guarantee 50,000 miles on this.

Mr. MACNEE. We have asked the same question.

Mr. ROGERS. I think we can solve it by allowing you to provide two converters at the sale of the car, they get one in place and they get a certificate and they can go to any dealer at the end of 25,000 miles and so forth and make a requirement to have your dealer send them a little tag, come in and change it and we have solved the whole problem and can meet the standards.

Do you understand that?

Mr. MACNEE. I understand Mr. Jensen to say that our data does not support that assumption; the existence of an effective catalyst for 25,000 miles.

Mr. ROGERS. The National Academy of Sciences says that. If you don't have the data maybe we can talk to General Motors about that.

Maybe Justice will agree to let everybody send out a man to talk and send everybody around and let everybody have access.

You would not object to that type of approach, would you?

Mr. MacNee. No, sir.

Mr. Rogers. I think we are making progress.

I realize there are problems but I do think it is very encouraging and I think the National Academy of Sciences report is most encouraging where they say it can be done but the only problem is the durability item.

As long as we average the emissions and as long as we have the fuel and the fuel people told us yesterday they will produce whatever we need by 1974 and they don't need any change in law.

Now, we are going to have to get EPA up here and ask them to let you give two converters. If you cut down styling costs it won't cost the public anything so we may have the whole solution that you have brought to us right here.

I know you have been working and I think the auto industry should be commended for what they are doing now.

I am hopeful that something can be worked out so that we can go ahead and meet these standards. I know you would want to, too, and you would want to produce a product that you can stand by.

I stand on that position. I do think your testimony has been most helpful. I think you are really trying, and I think if we can get a couple of these small points resolved on durability we can move right ahead, and move into production soon—I would hope so.

But if you will furnish the necessary items for the record, it would be very helpful.

Thank you very much for your presence here today.

Would it be convenient for the other witnesses to come back at 2 p.m.?

Under those circumstances, since it is noon, the committee will stand recessed until 2 o'clock this afternoon.

(Whereupon, at 12 noon, the hearing was recessed to reconvene at 2 p.m. the same day.)

AFTER RECESS

(The subcommittee reconvened at 2 p.m., Hon. Peter N. Kyros presiding.)

Mr. Kyros. The Subcommittee on Public Health and Environment will come to order to continue our hearings on the oversight of the 1970 Clean Air Act.

Our next witness is Mr. Sydney L. Terry, vice president—safety and environmental relations, Chrysler Corp.

The committee welcomes you and we are pleased to have you before us.

STATEMENT OF SYDNEY L. TERRY, VICE PRESIDENT, SAFETY AND ENVIRONMENTAL RELATIONS, CHRYSLER CORP.; ACCOMPANIED BY CHARLES M. HEINEN, EXECUTIVE ENGINEER OF MATERIALS ENGINEERING

Mr. Terry. We are delighted to be here today and to have the opportunity to discuss the Clean Air Act of 1970 with you. We believe an oversight hearing at this time is particularly appropriate.

The past year has been one of feverish activity in all fields of air pollution research and control. Government, industry and the academic community have contributed a great deal of new information which was not available at the time the act was drafted. All this new data must now be considered if jointly we are to make the best possible recommendations to the American public for maintaining and improving the quality of our air.

As you may know, some of the most intensive work in the air pollution field has been in those areas which apply to the automobile and its control. Although it is impossible in a brief presentation to cover all of the data that have been developed by workers in the field, we would like to indicate a few of the more substantive findings that may apply to possible changes in the Clean Air Act. If you wish, we will answer questions on the facts or on our interpretations. We are, of course, as we always have been, very happy to work with specific technical arms of your committee and explore and discuss the details of those things which we will mention today.

There are four general areas that we feel need particular comment:

1. The new findings concerning atmospheric measurements and their correlation with the new information on health effects;
2. The results of our extensive experiments using available technology to meet the 1975–76 automobile emission standards;
3. The problems that we will face in implementing the durability and warranty provisions of the act and, importantly, the growing awareness of what the various approaches will mean to the average citizen; and
4. The general findings that the standards will have multibillion dollar effect on the economy.

Let us begin with the first point—the new findings on atmospheric measurements and the new data on health effects. As you know, we have made substantial progress in learning what is in the atmosphere in the past year. As recently as a year ago there were very few atmospheric measurement stations for the types of gaseous emissions that come from the automobile. During the past year, a lot of stations then under construction have been made operational by the various States and municipalities. As a result, we know more than when the act was originally drafted.

Some of the results which seem to be emerging universally are best summarized by the November 1971 report of the California Air Resources Board entitled Air Quality and Emissions, 1963–70. The Board states in the summary that air quality data from any one station in an air basin are not adequate to represent the basin as a whole. Similar results can be detected from observing the two- or threefold variations in data taken simultaneously at various stations in the New York City area.

The Coordinating Research Council report, CAPA 3–68 showed how very difficult it can be to determine ambient levels when it demonstrated that concentrations can vary by nearly 100 percent from one side of the street to another; and even at the same spot, recorded concentrations can vary substantially in a matter of minutes. This has very important implications to some of the assumptions that we have made in establishing emission values. What this means simply is that the recorded concentrations do not necessarily tell us the actual ambient levels.

To establish standards that protect the health and welfare, we have to know what effect present levels—whatever they might be—have on the general population. For example, as you may know, the primary effect of one pollutant, carbon monoxide, is to react with the blood to form carboxyhemoglobin, and reduce the body's oxygen supply. If the carboxyhemoglobin reaches too high a level, it obviously impairs a person's abilities and even threatens his life. Everyone has at least a carboxyhemoglobin level of about 0.7 percent—the result of the breakdown of the tissues in the body. Smokers have carboxyhemoglobin levels of 5 percent, which, of course, is over seven times the minimum or even more, because of the high concentration of carbon monoxide in cigar and cigarette smoke. Yet, as Dr. John Schulte of Ohio State once observed, they move about in the world without any visible impairment. It is interesting to note that the CO blood level of smokers goes down if they stop smoking even though they are in crowded downtown areas.

Right now, in another research study, which is also a CRC project, researchers are analyzing the carbon monoxide concentrations in the blood of 47,000 people to identify effects of exposure to ambient carbon monoxide. The readings are, of course, in terms of carboxyhemoglobin. Although all 47,000 have not yet been analyzed, Dr. Richard Stewart, the director of the project, reported in a speech in Miami on November 13, 1971, on over 21,000 results. The findings are shown on chart I, to which I invite your attention.

CHART I

NONSMOKERS—CARBOXYHEMOGLOBIN MEAN AND STANDARD DEVIATION FOR 14 CITIES

	Milwaukee No. 1	Detroit No. 2	Miami	District of Columbia	St. Louis	New York	Hawaii
Number of samples	603	596	282	839	675	931	517
Mean	1.30	1.34	1.38	1.39	1.40	1.43	1.45
Standard deviation	.60	.52	.69	.61	.45	.61	.56

	Milwaukee No. 2	Seattle	Detroit No. 1	San Francisco	New Orleans	Alaska	Chicago
Number of samples	225	600	615	664	161	105	417
Mean	1.51	1.56	1.58	1.65	1.72	1.75	1.88
Standard deviation	.80	.58	.69	.57	.59	.68	.61

As you can see, the findings are that people exposed to actual carbon monoxide in the atmosphere, as we find it today, do not accumulate more than 2 percent carboxyhemoglobin in their blood and that, of course, is well below the level of millions of smokers. It is also well below the level of any effect of any kind that any laboratory study has shown.

What this study tells us once again is that the person is exposed to a wide number of concentrations. Since readings vary greatly from station to station, there is no way of accurately measuring the true exposure by a single station. All this strongly supports the thought voiced by the California people that a characteristic of an atmosphere in a city has to be based on a number of measurements in that city. Unfortunately, at the time the ambient air quality standards were

proposed and the Clean Air Act was written, this information was not available.

As a result, the most conservative approach was to take the highest readings available at any single station, translate these into probable carboxyhemoglobin readings, and set the standard on this basis. It was the only gage we had. It now appears that this approach overstates the actual exposure risk—and by a considerable margin.

The information being developed by Dr. Stewart is very heartening in that it indicates that at the present time we have not raised the carbon monoxide level in the environment of our cities to the point at which any physical effect has been shown.

In light of this new data, perhaps we should look again at the earlier conclusion, based on spot experiments, that pollution levels in our cities were well in excess of levels that have an effect on human health.

In this connection, one of the very interesting results of the California report mentioned above and one which as you can tell imagine is very gratifying to us in the automobile industry, is that from 1965 there has been a continuing drop in carbon monoxide in both San Francisco and Los Angeles.

We predicted this. Because of our continuing improvement in new cars, the carbon monoxide level coming out of the new cars has substantially decreased. Also as new cars replace older cars the CO level decreases. So this was the prediction hoped for.

I am sure you have seen chart II but I invite you to look at it nevertheless. Chart II shows that emissions from automobiles are now decreasing at an increasing rate and even though further standards are not implemented which is an assumption made when this chart was drawn would continue to decrease until at least 1980.

Our analysis of these facts indicates that there is an adequate factor of safety as far as CO is concerned and that the factor is increasing steadily.

How these findings on the relationships between single station measurements and human effects are to be interpreted in connection with the other vehicle emissions is not yet clear. They are more complex because they react with each other to form secondary products, whereas CO does not. Studies are underway, and certainly some of the information on CO will apply. I am sure this is a subject you will want to carefully consider as you discuss any possible improvements in the Clean Air Act.

The second major area I would like to comment on concerns the results of experiments to meet the 1975–76 standards. As you know, this has been a year of great progress, but nevertheless disappointing in the field of control devices. Perhaps the best summary of the situation is found in the report of the National Academy of Sciences which was discussed with you yesterday. The Academy concluded that the technology necessary to meet the requirements of the clean air amendments for the 1975 model year light-duty motor vehicles is not available at this time. It went on to point out that if several major modifications in requirements were made, it might be possible for some of the larger manufacturers to meet the numbers.

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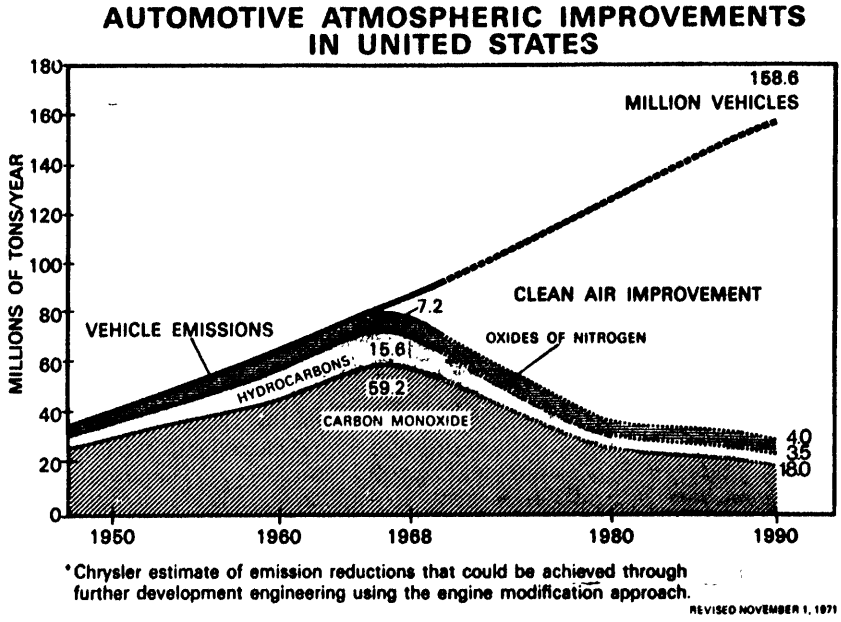


CHART II

We will address ourselves to these modifications a little bit further in the statement, but first let us review Chrysler's experience with the various systems. Because of the leadtime requirements, it was impossible within the framework of 1975–76 to pursue any other powerplant than the piston-type internal combustion engine, even if there were one that showed better promise of meeting the standards. This meant that our options were restricted to those things that could be done with that engine. I will not go into the timing charts, but the basis for our conclusions will be submitted to your committee for the record if you feel it is desirable.

Mr. KYROS. Without objection, you may do so.

(See "Timing of Technical Product Development Cycle," p. 340, this hearing.)

Mr. TERRY. The first approach, and the one that we have been following up to this time, is that of engine modifications.

Mr. KYROS. In the 1972 vehicles?

Mr. TERRY. We are talking about 1972 vehicles. Using engine modification approaches we have been able to reduce emissions of hydrocarbons by 80 percent, carbon monoxide by 70 percent, and oxides of nitrogen by 50 percent compared to an uncontrolled vehicle. We intensively examined what could be done by continuing to follow this approach. Our conclusion, after very considerable experimentation, was that we could not meet the standards for 1975–76 by this procedure. As you may recall, they require 97 percent reduction in hydrocarbons, 96 percent in carbon monoxide, and 90 percent in oxides of nitrogen compared with uncontrolled vehicles. Our best efforts

resulted in reductions of 88 percent, 83 percent, and 58 percent, respectively.

We next explored the possibilities of using a combination of catalyst and exhaust reactors in our laboratories. We found we could achieve the 97-percent reduction of hydrocarbons and 96 percent carbon monoxide with a fresh catalyst. Unfortunately, we have not found a catalyst which could maintain this performance for anywhere near the required period of time.

The problem became even more difficult when we tried to add the control of oxides of nitrogen. The reason was simply that the oxidation catalyst would be overheated as a result of the extra fuel which it had to handle.

In effect, the catalyst simply falls apart after a few thousand miles. Perhaps this statement requires some clarification.

On page 814 of a very excellent report prepared for the Environmental Protection Agency by the Aerospace Corp.—Aerospace Report No. TOR-0172(2787)-2—there is a figure, which is reproduced on our chart III—which explains the relationship of extra fuel to oxides of nitrogen control.

As you can see, increased control of oxides of nitrogen means increased fuel consumption.

The solid line on the chart shows that control of oxides of nitrogen at the level of 3 grams per mile involves only a low fuel economy penalty. As you increase the degree of control of oxides of nitrogen to get down to 1 gram of oxides of nitrogen per mile or less, the fuel economy penalty goes up to between 30 and 35 percent. In other words when you control oxides of nitrogen below 3 grams per mile, fuel consumption goes up very rapidly.

The dotted line on the chart starts at a much lower oxides of nitrogen value since it assumes the use of an oxides of nitrogen catalyst. In that case we start with less than 1 gram per mile of oxides of nitrogen. But again as we reduce the oxides of nitrogen emissions we sacrifice fuel economy. To get down to the level of 0.4 of a gram per mile required by the 1976 standard involves a fuel penalty of about 10 percent. So, using a NO_x catalyst we might get down to 0.4 gram per mile of NO_x at a penalty of 10 percent fuel economy. The problem with the method indicated by the dotted line is that we do not have a NO_x catalyst that works.

Mr. KYROS. Ten percent fuel economy means more fuel, does it?

Mr. TERRY. That is penalty compared to an uncontrolled vehicle.

Mr. KYROS. It will be necessary for us to take a short recess so we may answer a rollcall.

(Brief recess.)

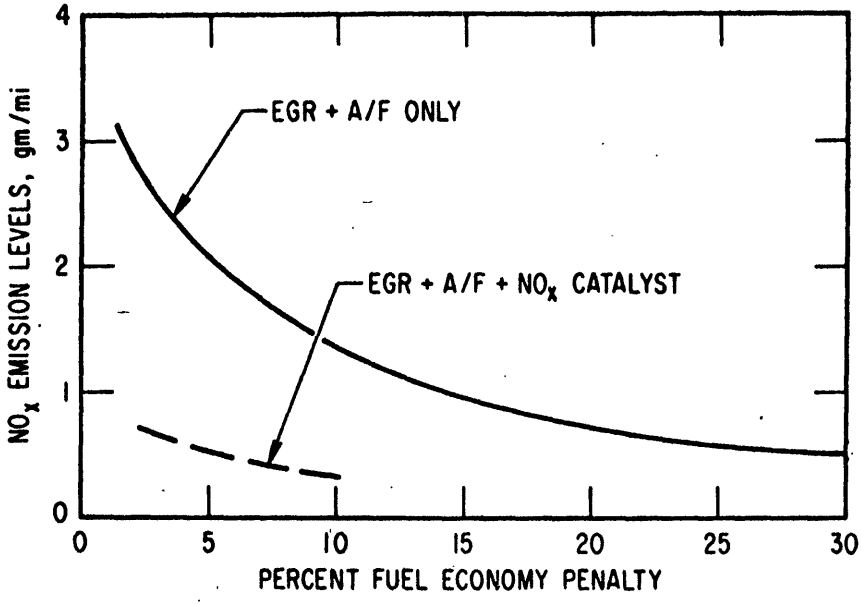
Mr. KYROS. The committee will come to order.

Mr. Terry, would you please continue with your testimony.

Mr. TERRY. We were discussing chart III and pointing out that fuel penalties are very substantial as we increase the control of oxides of nitrogen.

The EGR stands for exhaust gas recirculation and AFR stands for air fuel ratio.

FUEL ECONOMY PENALTY DUE TO NOx EMISSION REDUCTION



Aerospace Report No.
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CHART III

As the chart shows, fuel penalties can go up as high as 30 percent to control NO_x to an emission level of half a gram per mile NO_x. The standard calls for oxides of nitrogen control of 0.4 gram/mile in 1976. The reason the line is dotted is that we don't have a NO_x catalyst yet.

To go on with the prepared statement, you will notice at the bottom of the chart that a much more optimistic picture is painted for an oxide of nitrogen catalyst.

We, too, realized this from the output of a computerized engine model, and as a result we greatly increased our attempts to develop a catalyst.

To date we cannot report any spectacular success nor any great promise for this approach. However, because of its great potential for saving the customer large amounts on his fuel bill, it continues to be a very active project.

We also reexamined another approach which was orginally explored intensively by Chrysler over 10 years ago. In this approach we run the engine rich for oxides of nitrogen reductions, and then burn all of the extra fuel in what amounts to a furnace where the exhaust manifold is located. Here again we achieved numbers which would approach the standards. Unfortunately, it was impractical because the temperatures were so high. Even by using the most exotic materials, we could not provide adequate safeguards. However, we are also continuing to work on this approach.

Finally, there is a system which has a great deal of promise for very substantial reductions. This involves running the engine on a very lean mix. To be effective we need to be very precise in controlling engine timing, fuel handling, and distribution of the fuel mixture. We also need a far more advanced control of exhaust gas recirculation in order to reduce oxides of nitrogen.

To achieve these objectives—this much finer control—we are investtigating electronic controls where possible. You may perhaps have read of our electronic spark ignition which is the first production application of this work. This total electronics approach may be capable of major reductions with only moderate fuel penalties. But even here, we still need a great deal of work to make such a system a reality. Even though we feel that it cannot completely meet the 1975–76 standards, we are pursuing this approach because we believe it is the most practical system for achieving very good low control levels.

While we cannot meet 1975–76 Federal standards, we do feel there is a chance we can meet the California standards on the average by 1976 using this approach. As you know, California presently requires for 1975–76 a 95 percent reduction in hydrocarbons, an 80 percent reduction in carbon monoxide and a 75 percent reduction in oxides of nitrogen. This is all compared to an uncontrolled vehicle. While we do not now have this attainment in hand, we feel there is a reasonable chance of accomplishment after extensive development work.

I could go on to discuss in detail these and other systems we have considered, but I think that what I have said will illustrate the point that we have explored all available avenues. Each of the approaches has problems of control reliability, endurance, materials, or safety, or a combination of these. We are continuing to explore them all in an attempt to overcome these problems. We are leaving with your committee details of some of the other avenues we have explored and we will be glad to discuss at length with the staff members any of our findings.

Unfortunately, we just have not come up with an answer. We do not foresee the possibility of coming up with a completely satisfactory answer for 1975 for the Federal standards of that year and even less for the standards applicable to 1976.

The third major area I would like to comment on concerns the problems involved with the maintenance and warranty aspects of the 1975–76 requirements. As we understand it, our vehicles will be expected to operate at the levels specified in the act for a period of 50,000

miles. Presumably, the customer will have to provide normal maintenance. This is important not only for us as manufacturers, but also for Government and for the customer.

Our experience to date with the present catalysts will illustrate what I mean. Our studies indicate that they will have to be changed a minimum of two to three times over the 50,000 miles. The frequency of these changes will be affected by the type of driving and by the condition of the vehicle. In order to guarantee that the levels are being met, there will have to be mandatory vehicle inspection from time to time.

We are all becoming aware of what that involves.

First, we need the instruments and techniques to determine the condition of the vehicle in the field. Obviously, the techniques that we use in the laboratories at the present time, which involves a 13-hour procedure and about $150,000 for test stands, cannot be applied on a wholesale basis. We have already made some good progress in developing the instruments, but we have yet to establish an accurate test that lasts only a few minutes. The most promising development in this regard is the New Jersey test station which has just opened. Unfortunately, it has not been running long enough to find out whether it will be adequate for the purposes required.

Second, if the vehicle fails for some reason, it will have to go to a service station for repair or for catalyst replacement. Garages will need the same kind of instruments as the test stations.

What this means is that we will not simply need several thousand measurement units for inspection stations, we will need several hundred thousand for garages and repair stations. No one has yet started producing these instruments in anything near the required quantities.

If there were universal agreement that a particular catalyst could be used to meet the standards, perhaps a crash program could develop such outlets to handle such catalysts by the latter part of 1976. Unfortunately, there is no such agreement, because, as far as we know at the moment, there is no such catalyst.

We could go on detailing problems which might arise in the event that it is established that nothing less than a 20-minute cycle is adequate for establishing conformity of a given vehicle. That just piles additional complications on top of the inspection problem. The problem of building sufficient inspection stations in the required time is again a monumental task.

While no one of these problems may be insurmountable, given the time restrictions of the 1975–76 Clean Air Act the total combination comes close to being virtually unsolvable. I am hopeful the committee will explore the full implications of all this.

Now the Academy of Sciences states as a qualification:

> While there is no certainty that the new 1975 model year vehicle will meet the requirements of the act, the status of development and rate of progress make it possible that the larger manufacturers will be able to produce vehicles that will qualify provided that provisions are made for catalyst replacement and other maintenance, for averaging emissions of production vehicles, and for the general availability of fuel containing suitable low levels of catalysts poisons.

Let us address ourselves for the moment to what is meant by averaging production vehicles. In an average sample, emissions from some vehicles will be higher than the standards and some lower. If there

is to be universal enforcement, a level somewhat higher than that of the standards would have to be allowed for individual cars in the field. But this level cannot be established until we have some experience with a cross section of vehicles in general use. This has obvious implications for the whole question of warranty. You may wish to explore this subject.

Finally, the provision about the catalyst poison presumably refers to lead. However, some catalysts are poisoned by other materials in either the fuel or lubricants. Once the catalyst is established, the petroleum companies will have a massive task of reformulation of both fuels and lubricants and establishing an uncontaminated distribution network. The integration of this process with the requirements of the catalyst is not likely to be accomplished by 1975–76. So what I am saying is that in the past year we have come to understand more completely the complicated problems involved in meeting the 1975–76 standards.

The fourth piece of new information that has been brought to light since the act was passed is an accurate evaluation of the costs of controls and the degree to which these can be affected by even minor changes in the standards. Now I am not even going to comment on the enormous costs the manufacturers would have to bear in issuing and administering the warranty provisions of the act. Let us look just at the hardware and the cost to the consumer. The most recent evaluation of these costs can be found in the aerospace report cited above and in the Academy of Sciences' report. These estimates represent neither the highest nor the lowest. In fact, some of our own estimates run higher. But the estimates from these two independent agencies are similar and are very useful in our discussion today.

Assuming that any of the systems currently being proposed would work adequately, these sources indicate the 1975 requirements would result in a total additional cost of more than $300 over the base price of an uncontrolled vehicle. The 1976 requirements would probably add at least another $100 to this number. That amounts to a total increase of more than $400.

One of the most interesting and important aspects of this situation is that minor modifications in terms of percentage reductions, such as are proposed by California for 1975–76 would cut these costs in half.

Of even greater interest to the consumer is the fuel penalty from various levels of oxides of nitrogen control. In chart IV, taken from page 8–22 of the Aerospace report, we see this graphically. The difference in lifetime penalties, depending on the system used and the oxides of nitrogen level required, will vary from $200 for the California 1975–76 standard to upwards of $800 for the Clean Air Act standard. So that is over four times as much of the total cost in the life of the vehicle to the customer. When these costs are equated in terms of total population, it can be seen, as pointed out by the Aerospace report, that we are dealing with costs to the country on the order of $10 billion per year. As you gentlemen have apparently concluded, this requires most careful consideration.

In light of all the new data it is natural to ask if we should defer implementing some of the automotive provisions of the Clean Air Act. One of the important observations in the National Academy of Sciences report is that deferment of the date of compliance with the standards for a short period will have no substantial effect on air quality.

(Charts V and VI from their report show this effect.)

FUEL COST PENALTY

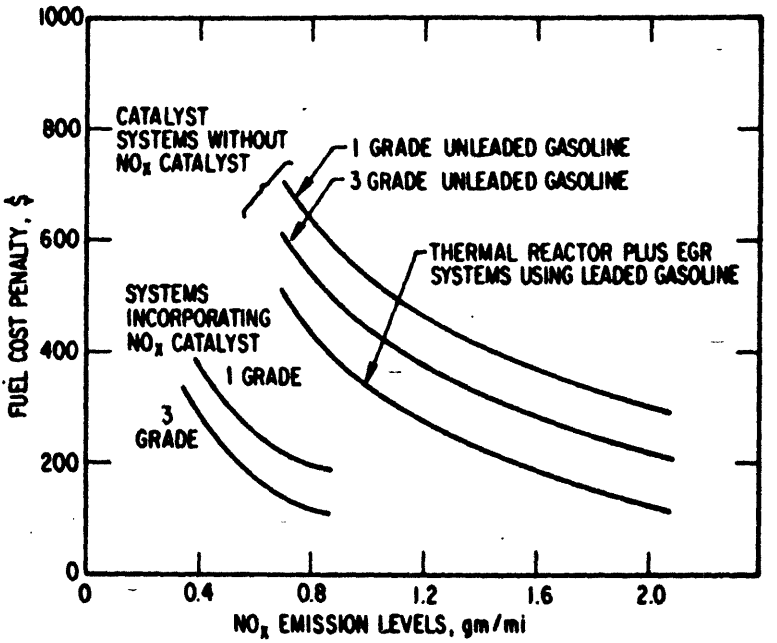

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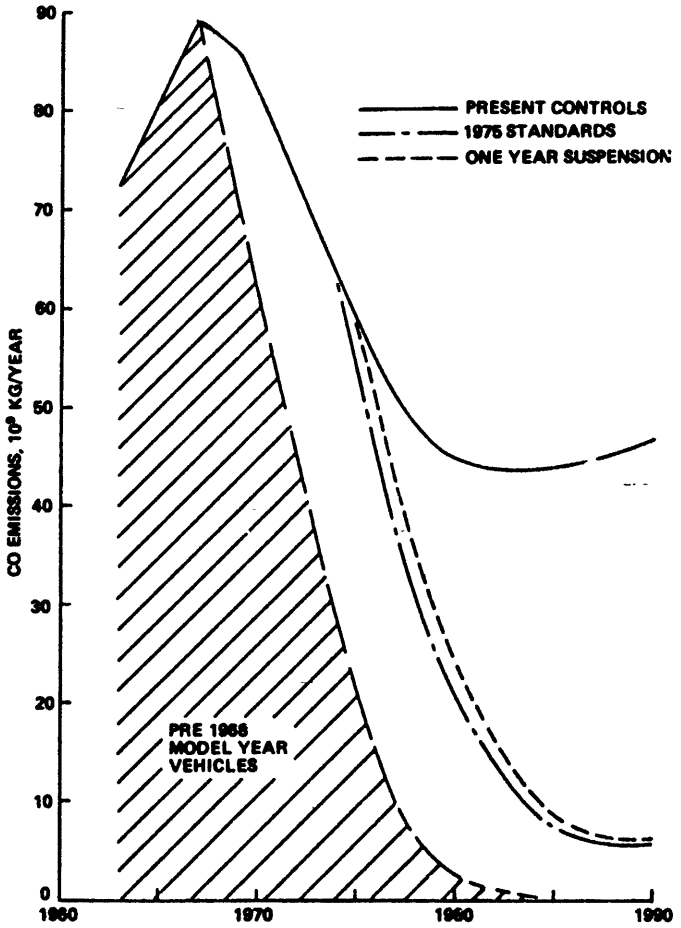
CHART IV

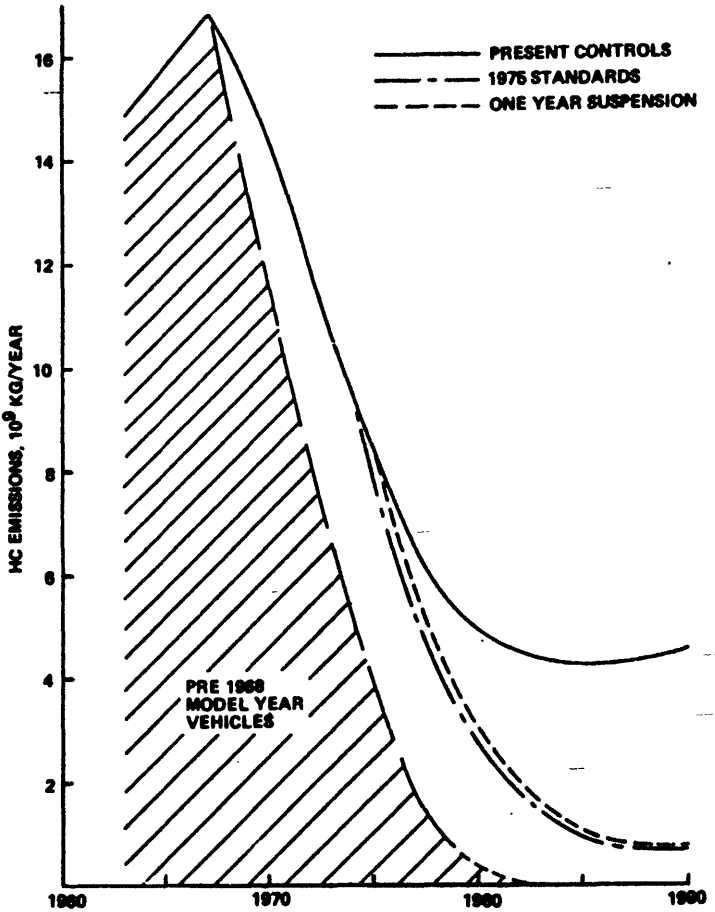
UNITED STATES NATIONWIDE CARBON MONOXIDE EMISSIONS



January 10, 1972
National Academy of Sciences
Contract No. 68-01-0402

CHART V

UNITED STATES NATIONWIDE HYDROCARBON EMISSIONS



January 10, 1972

National Academy of Sciences
Contract No. 68-01-0402

CHART VI

We wish that we had been able to come to this committee and say that that which was proposed a year ago has been accomplished and there are no problems. As you have heard, there are problems—serious problems that we have not solved yet. There is much new information that clearly indicates the necessity for evaluation of the present and future role of the automobile in the environment.

Specifically, we have learned more about the environment, the ambient levels of pollutants, and their effect on human health. We are discovering the effect may be less than originally feared, primarily because air measurements tend to overstate exposure.

We have no solution yet to the difficult control problems, though we have made considerable progress. We can substantially and economically reduce the already low emission levels.

We have come to recognize the enormously complicated problems involved in meeting the warranty provisions of the act.

And finally, several sources outside the industry have adequately identified the costs involved in meeting the standards. This information gives all of us a more accurate guide to use in deciding the best ways of allocating our national resources. Independent studies have also shown that even a small modification of the 1975–76 act could produce enormous savings for the Nation with no significant adverse effect on air quality.

I know that when we originally considered the Clean Air Act, there was a general feeling in many quarters that we were very close to achieving and even guaranteeing the large emission reductions the act required. Perhaps for this reason, the automobile was treated differently than any other source of pollution.

The act required specific reductions in automative emissions on a timetable. Unlike other sources, there was no requirement that the administrator consider technological feasibility or impact on the economy.

In the light of the new data developed not just by the industry, but by independent agencies, we think the time has come to reexamine this basic approach. In other words, since we are not as close to achieving our original objective as some were led to believe, we need to treat the automobile as we would any other source.

We must look at the total problem: the degree of control needed, the feasibility of control, the cost of control, and the overall impact on the American public. To assist in this kind of complete evaluation, we would suggest that the committee carefully consider asking an independent agency such as the National Academy of Sciences to evaluate all that is involved in controlling automotive emissions.

Such a study would include not only current information on the health hazards of automotive emissions but also current information on the effects ambient levels have on the general community.

It would consider not only the various means of controlling emissions, but also the effect the controls would have on ambient levels and general health. It really is a big systems problem.

Finally, the study would not only consider the technical feasibility of controls, but also the impact the controls would have on the Nation's limited national resources.

Authorizing a major evaluation of this kind is not postponing action—it is actually taking the kind of firm action needed to assure that the country will correctly control its air quality problems.

In review of public concern, the easy course might be to ignore the signals the new information raises, and insist on the 1975–76 standards no matter what the cost, no matter how impossible they might seem to be. But the easy course is not always the right course.

You may be sure that we at Chrysler Corp. will continue our intensive efforts to meet either the present standards or any modified standards that might be developed.

Beyond this, we assure you of the most wholehearted cooperation of the Chrysler Corp. should you authorize the type of comprehensive studies the Nation needs. We believe that a reevaluation of automobile emissions will give us what we all want: namely, good clean air with a minimum application of national resources. Even if this requires some additional time with intermediate levels of control, we believe the time will be well spent.

This concludes my statement, Mr. Chairman.

(Testimony resumes on p. 346.)

(The timing information referred to follows:)

TIMING OF TECHNICAL PRODUCT DEVELOPMENT CYCLE[1]

General industry history on technical projects of this magnitude, plus the total of Chrysler's research and engineering experience indicates strongly that the necessary work cannot be accomplished for full compliance with the 1970 Amended Clean Air Act, in volume production, in time for the 1975 model cars.

THE "FIXED-GOAL, FIXED-TIME" PROBLEM

The timing of stringent new standards is as critical as their level in determining practicality and cost to the public. Automobiles are highly complex, mass-produced vehicles. They are operated under widely varying conditions. An unsound design causes both higher cost and reduced reliability.

Chrysler's normal schedule for new product feature introduction provides 42 to 48 months from concept to production depending on the degree of complexity or uniqueness of the feature. This assumes, of course, that a feasible technology already exists, but where this is lacking, the program will be increased by whatever time it takes to develop that technology. Production lead time can be compressed but only to a certain extent, and even then, usually at a disproportionate cost.

For general descriptive purposes, large, complex, long-duration R&D programs sometimes are categorized as either the "fixed-resources/variable goals" type or the "variable-resources/fixed-goals" type. Yet, in this instance, neither classification fits the sizable R&D task faced by Chrysler Corporation in its effort to fulfill requirements of the 1970 Amended Clean Air Act.

Hence, with a fixed-goal, a fixed-time, and some finite upper limit of fixed resources, the outcome clearly is in doubt.

To single-out one over-riding factor: at this point, it appears that lack of sufficient time for a minimally adequate R&D program weighs heavily against success.

GENERAL PRACTICE

The stages through which scientific discoveries must pass in progressing to mass produced hardware applications are well-known to those who are closely familiar with the process of technological development. The sequential steps include:

[1] From "Progress Report: Technical Effort Aimed at Compliance With 1975–76 Emission Standards Established by December 1970 Clean Air Act"—Chrysler Corporation Response to Feb. 26, 1971, letter from W. D. Ruckelshaus, Administrator, Environmental Protection Agency.

- Research
- Invention
- Advance Engineering Development

- Design
- Testing
- Re-Design
- Testing
- Re-Design
- Pilot Production
- Design Refinement
- Volume Production

Development

Tooling

Time required for each of the successive phases is, of course, influenced by the amount and competence of resources applied. In addition to the scale of effort directed to the task, it is apparent that total time required from concept to volume production also is affected by magnitude and complexity of the development undertaken, as well as by the extent to which it attempts to go beyond the state-of-the-art in a given technology. The "size of the step" determines the effort an dtime required—as well as the likelihood of success.

The decision on when a technical development is "ready" for production is a judgment that assesses a blend of factors such as: functional performance, productibility, reliability, and cost.

In making this judgment, heavy weight is given to the *need* for the particular item. In the past, in the automobile industry, the "need" has been generated by customer preference and competitive marketing considerations. Currently, the need often is related to a requirement of compliance with a particular new Federal regulation.

But, whatever the source of pressure for creating a new technical development and bringing it into production—and even allowing for a sense of urgency that gains top priority for the project and makes it a so-called "crash program"—there still is a limit on the extent the development cycle can be telescoped. Beyond that point, further schedule compression, or omission of certain essential developmental steps does not succeed; but, instead, simply causes a pre-mature production commitment. The result is failure of hardward to perform its function . . . problems that show-up as operating malfunctions, unreliable devices, insufficient durability, and other kinds of difficulties in the field.

TIMING INFORMATION REPORTED BY NON-INDUSTRY SOURCES

"Morse Electric Car Panel".—As reported by the Secretary of Commerce, in "The Automobile and Air Pollution": "The Government and the public do not always appreciate the time delays associated with requirements for reliability and the high costs involved in the introduction of design changes at the productino level. Predictable dependability is an essential criterion for the mass produced automobile. This means that the complex system of interrelated parts needs to be carefully designed, tested, and evaluated prior to full-scale production. This problem of introducing a new pollution control device as the only modification to a single standard engine which has been used over several yearly models presents a considerably simpler problem . . ."

Arthur Young & Co.—Additional relevant comment on automotive research and development is found in the "Automotive Industrial Engineering Study" PB 176 326. This report was prepared by Arthur Young & Co., under contract from

the National Highway Safety Bureau. The report states: "Research and development, advanced engineering, invention . . . must be considered in proper perspective as a preliminary and essential step toward the more earth-bound elements of conceiving and producing a modern vehicle. A vehicle to be marketed must be made up of features, designs and units which can be produced within reasonable ranges of the existing state of the mechanical arts in the technical environment. To bring a design, invention, or feature to the point where 'applied engineering' can be effective is often a long and arduous process. This phase of development can cover from a few to many years before an idea or a concept has been sufficiently researched, tested, improved to be ready for mass application.

". . . These engineering projects in the Automotive Industry are typified by their high cost and long periods of gestation. For example, the energy absorbing or collapsible steering column made its public debut coincident with a rising interest in automobile safety. This may have been interpreted by some as indicating that it was a rapid result of the concurrent legislative and regulatory activity. In point of fact, possibly some six years of development had gone into this project and its emergence at this time was fortuitous . . .

"There may be some community of opinion that automotive manufacturers in general have a backlog of completed advanced engineering. Theoretically, these items would constitute off the shelf designs available for timely withdrawal into the design and production process. Such is not actually the case. While every manufacturer seeks to stay ahead of competition in innovative and inventive endeavors, competitive pressures militate for bringing new ideas and products to market as rapidly as possible . . ."

The Arthur Young Report identified eight phases for the transition of an automobile from an idea to a product. These phases are:

Product Conceptualization
Concept Development, Feasibility, Basic Assumptions
Body and Structural Development
Program Approval by Management
Detailed Engineering
Tooling Construction and Parts Procurement
Pilot Assembly
Production Changeover

Following are two timing charts taken from the Arthur Young report:

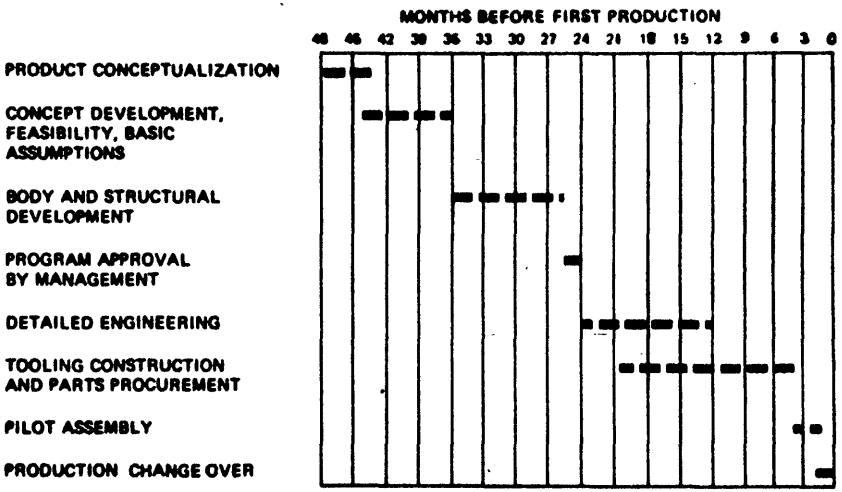


FIGURE 1.—Timetable for "representative normal automotive product development cycle"

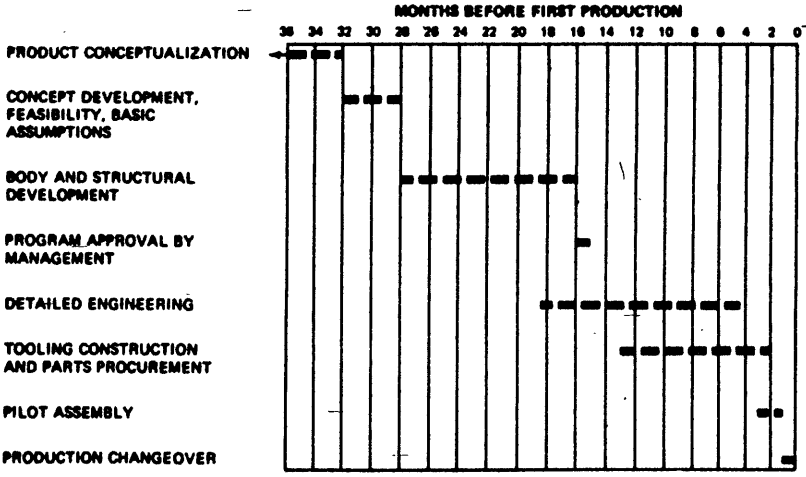


FIGURE 2.—Timetable for "representative accelerated cycle", performed on crash program basis

Booz, Allen & Hamilton, Incorporated. For further evidence that a substantial amount of research and development activity is needed to achieve feasible designs when the task is of the magnitude required for conformance with 1975 emissions regulations . . . and that a considerable amount of time is required to develop, test and tool such highly engineered components, reference also can be made to "Automotive Industrial Engineering Study". This report indicates that ". . . preproduction programs began about 3½ years or 42 months prior to the beginning of mass production . . ." The Booz, Allen & Hamilton Inc. document contains the timetable shown below.

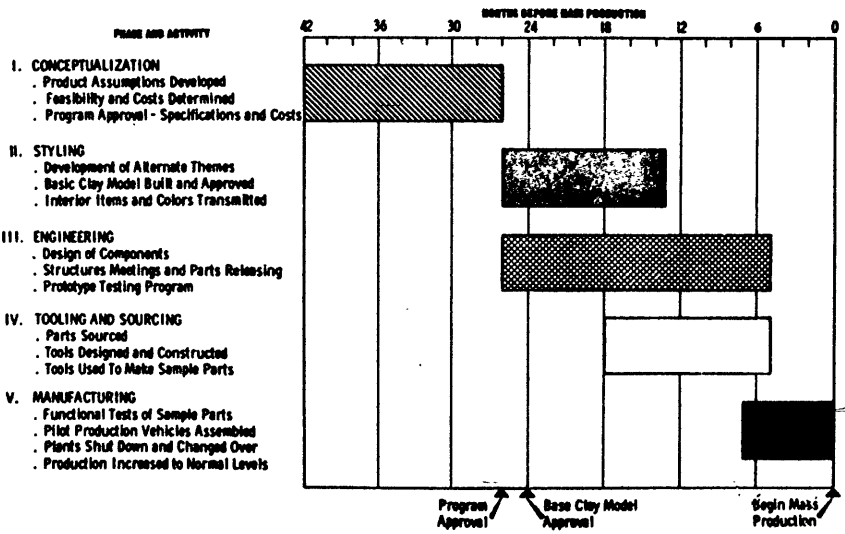


FIGURE 3.—Passenger Car Line Preproduction Program—Principal Phase and Activities. (It is important to note that a major new development is not "available" for commitment into this scheduled time-frame until it is proven technically sound. Thus, there usually have been some years of research and development activity applied to bring a given item along to a stage where its technical feasibility is determined and it can enter the generalized production program schedule depicted above.)

Battelle Memorial Institute.—In assessing time required for scientific and technical studies and experimentation needed to establish technical feasibility for basic approaches on which production hardware design can be based—it could be noted that five years was chosen as the time span for the "Federal Research and Development Plan for Air Pollution Control by Combustion Process Modification".[6] The report was prepared for Air Pollution Control Office Environmental Protection Agency. It recommends a five-year program of combustion R&D. The objective is to determine how combustion processes may be modified to reduce pollutant emissions. Information and knowledge would be the sole products of this basic five-year program.

CHRYSLER R/D PROJECT EXAMPLES

Chrysler Corporation has, of course, carried numerous technical projects from conception to production during its normal course of business over the years.

Some examples are cited below, to illustrate the point that a suitable period is needed for experimentation and development testing. Experience shows this minimum time to be on the order of several years to reach a feasibility stage where production design can even begin for a technical task entailing as much "reach" as required for conformance with the 1975 emission regulation.

Following are capsule descriptions of time frame in which some Chrysler developments have occurred:

Brake Lining.—Friction phenomena and friction materials still have an element of mystery in their function and therefore have more art in their development than most material areas. Thus, when Chrysler Corporation decided to manufacture its own brake lining for better performance, quality control, and sourcing reasons, the development was very fundamental and lengthy. Some pre-1947 lining materials were evaluated, but a formal research program began in 1947. Manufacturing process development was underway in 1958 . . . and the new brake linings were in production in 1961, for 1962 model compact cars.

Anti-Skid Brake.—Research on anti-skid brake systems began in 1957. A significant amount of hardware testing was done in 1966. Pilot production began in 1970, with Chrysler's adaptation of the Bendix system for the 1971 Imperial car. In 1971, the system will be installed on approximately 400 cars. In 1972, anti-skid brake production should reach about 800 units.

Automatic Transmission.—Start of this project was preceded by a five-year period in which Chrysler gained engineering and manufacturing experience with semi-automatic transmissions and such major components as fluid couplings, torque converters, and planetary gear sets. Automatic transmission development project began in 1951. The unit entered production in 1955. for use on the 1956 Imperial.

V–8 Engines.—In the years following World War II (1945–50), it was apparent to Chrysler that the large L-head, in-line straight 6- and 8-cylinder engines must be replaced with a more modern design for better performance, economy, reduced size, and lower weight. The specific design was not obvious and a broad development program was undertaken to establish basic factors.

In 1945, design studies were begun, leading to single cylinder testing in 1946. In 1950, production began on a new hemi-head V–8 engine for 1951 model cars.

Gas Turbine.—Following are dates of some key events in Chrysler Corporation's 23-year effort to develop an automotive gas turbine engine:

1948: Study resumed at end of Navy Aircraft Gas Turbine contract.

1953: 1st Complete Engine on test.

1957: 2nd Engine Design, incorporating experience to date.

1959: 3rd Engine Design, resized and updated.

1963: 4th Engine Design, dual regenerator arrangement (which became the industry "standard"). Chrysler Turbine Car, car designed for turbine and the launch of user evaluation program—50 cars.

1964: 5th Engine Design, laboratory testing of a more feasible production design.

1966: 50-car program ended.

1967: 6th Engine Design, second production arrangement using accessories driven from the output.

1971: Gas Turbine Burner study to evaluate emission control possibilities.

In retrospect, it is seen that time spans from project inception to production for the brake lining, anti-skid brake system, automatic transmission and V-8 engine were, respectively, 14, 14, 9, and 5 years . . . and the gas turbine (which is not yet in production) has had an incubation period of 23 years.

SCHEDULE SHOWS LACK OF R&D TIME

The foregoing coverage of general product program timing practices, plus pertinent information from outside sources and capsule summaries of actual Chrysler product developments prepares the way for direct assessment of adequacy of time available for conformance with the 1970 Amended Clean Air Act.

The lack of adequate time is shown by the following chart, Figure 4.

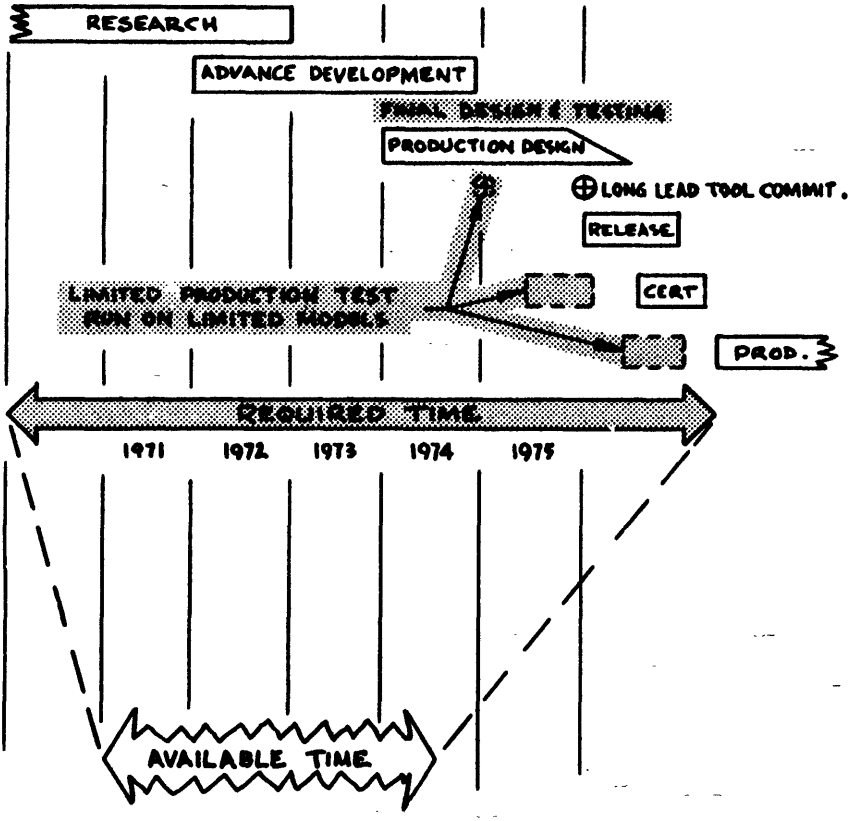


FIGURE 4.—Production Schedule Compression

Principal adverse effects caused by schedule time compression illustrated above are:

No time available for pilot production test on earlier model year.

Forced into design of hardware having low confidence level.

Risk of failure extremely high.

Cost of accelerated program disproportionate to results.

Forced to choose a program without satisfactory examination of alternates.

Some alternates discarded purely because of insufficient time.

Cost of product inordinately high because of no time to redesign on a value basis.

Note that "available time" in timetable to be applied for compliance with 1975 standards: (1) Is "missing" the several years of R&D needed to determine technical feasibility before production schedule commitment . . . and (2) Does not allow the several years needed for necessary rate of buildup from pilot production to volume production through a series of annual steps . . . to enable designs to be proven before they are placed in full production.

For a task of this magnitude and complexity, the last phase (prove-out of production designs, manufacturing facilities, and methods) is vitally important and time consuming.

TIMING PROBLEM DISCUSSION

To meet the 1975 model production target date (even on a highly compressed schedule)—technical feasibility of the design approach would have had to be known as of December 1970. Yet, even at this writing (March 1971) the technical feasibility has not been achieved as a basis for designing the new systems that will be needed.

Therefore, having noted that Chrysler believes there is insufficient R&D time for compliance with the 1970 Amended Clean Air Act, by 1975—one might ask: "How much more time would you need?"

The answer is that—while Chrysler Corporation is doing its best in a maximum effort—we don't think this will succeed in fully meeting the 1975–76 emission standards. Experience shows that invention cannot be legislated into existence, nor can legislation force the rate of technical progress beyond a certain maximum space. Despite the best motives of legislators and Chrysler's total commitment in an all-out effort to conform—it still appears impractical to set a fixed goal and specify an inadequate timetable for mass production of a vehicle that requires major new hardware whose technical feasibility is not established to an extent that would enable its entry into the initial block of lead time for scheduled progression into volume production.

Present indications are that it is virtually impossible to satisfy the specified level of standards by effectivity date stated in the Act. To have reasonable confidence in production designs, we must have at least two to three years to develop technology enabling technically sound vehicle designs. Also, it is apparent that there is a substantial amount of work (and time) involved in making the necessary changes in manufacturing facilities and practices.

Mr. KYROS. Thank you very much, Mr. Terry.

Before I ask Dr. Carter if he has any questions, I would like to state that on page 15 of your fine statement, you say that in view of public concern, the easy course might be to ignore the signals new information raises and insist on the 1975–76 standards no matter what the cost. You say the easiest course is not always the easiest.

It is my opinion Congress did not take any easy courses. I assume that is a bit of rhetoric in your statement which we can ignore and go on to the more factual information.

Mr. TERRY. We will strike that statement.

Mr. KYROS. Dr. Carter?

Mr. CARTER. Thank you, Mr. Chairman.

I am quite interested in your paper. What concentration of carbon monoxide is dangerous and can result in causing a man's death?

Mr. HEINEN. You have asked two questions. One might have an effect on health so let's try to answer them in turn. The lowest level that has been reported which possibly might produce a detectable effect was reported by Beard as 2⅕ percent carboxyhemoglobin which is roughly 12 or 13 parts per million.

That particular report has been challenged by the Air Force study team.

The next group really starts coming in about 5 percent carboxyhemoglobin which is something of the order of 25 parts per million continuous exposure for 8 hours.

Now you have to get somewhere up above 30 percent carboxyhemoglobin——

Mr. CARTER. Carbon monoxide mixed with hemoglobin produces carboxyhemoglobin?

Mr. HEINEN. In the lower levels about six parts per million carbon monoxide corresponds to about 1 percent of carboxy hemoglobin. If

you are in that atmosphere for 8 hours, that is what you stabilize at.

To cause death, a carbon monoxide concentration of over 500 parts per million range is involved. So we are not talking about anything that is anywhere near that level of any ambient that anyone could be exposed to.

We are talking about the first-level effects. There is general agreement that the first-level effect occurs at about 5 percent of carboxy hemoglobin which is about 25 to 30 parts per millon carbon monoxide.

The one exception to that is the Beard study. That study has been repeated by several people but no one was able to repeat the results. But as long as you have the results of that one study there, you want to be on the very safe side and you have to consider that.

Mr. CARTER. What did the Beard study show was the levels at which damage could occur?

Mr. HEINEN. The lowest level at which he had any effect was 50 parts per million carbon monoxide for 2 hours. Translated into 8 hours, that is assumed to be something of the order of 12 to 15.

Mr. CARTER. What was the level he advocated?

Mr. HEINEN. Beard, himself, did not advocate anything. He highly qualified his study because unfortunately his carboxylhemoglobin results went awry and he had no specific way of proving what his concentration was.

Mr. CARTER. I believe he recommended that the level not be higher than 9 parts per million for 8 hours.

This is the Senate hearings of September 7, 1970.

Mr. HEINEN. If it is in there, it is in there. But in private conversation he does not say that.

Mr. CARTER. The second part of my question I don't believe you have answered yet.

Mr. HEINEN. The lowest death level was about 500 parts per million.

Mr. CARTER. In terms of carbon monoxide in the ambient air, if you would have it that way—what is a level which could cause death, the lowest level.

Mr. HEINEN. 400 or 500 parts per million. It could go down as low as 200 parts per million depending on the conditions.

Mr. CARTER. I think it would be higher than that, actually. I would say 0.5 to 1 percent concentration would be one part per hundred——

Mr. HEINEN. I am stretching it somewhat.

Mr. CARTER. It would be in this area.

You have not said much about the control of hydrocarbons. Do you think you can control emissions of hydrocarbons according to, well, the present legislation which will take effect in 1975?

Mr. HEINEN. Could we control it?

Mr. CARTER. Yes.

Mr. HEINEN. We said in our statement that we could control hydrocarbons to that level with a fresh catalyst.

Mr. CARTER. You say you can construct such devices as are necessary and have them on the cars by 1975 to control hydrocarbons to the level of 0.41? And I believe that would be grams per mile.

Mr. HEINEN. Yes, sir; at the beginning of the life of a catalyst it will control to those levels. The question is the same one that was raised by Mr. Rogers this morning concerning the durability of the catalyst.

Our finding on catalyst ranges anywhere from 6,000 to 35,000 miles, depending on the type of driving.

Mr. CARTER. You could not do this on a durable vehicle?

Mr. HEINEN. I wish we could. Catalyst testing has been going on for a long time. We tried the catalyst approach in order to meet the first requirements in California. At that time catalysts seemed to be a prime candidate. But when we conducted durability tests the catalysts did not make it. The basic catalyst has not changed much since then.

Mr. TERRY. We have been able to control hydrocarbons alone down to the point four level with reactors, not using catalysts. If we don't have to worry about the other pollutants but when we have the whole combination to control, that becomes impractical.

Mr. CARTER. Which are the most difficult to control?

Mr. TERRY. Oxides of nitrogen without any question.

Mr. CARTER. If you did not have to worry about oxides of nitrogen, could you have a car developed to take care of hydrocarbons and carbon monoxide?

Mr. TERRY. If we know we didn't have to worry about oxides of nitrogen in the future, I believe we could meet the carbon monoxide and hydrocarbon levels of the 1975 standard.

Mr. CARTER. Since these mechanisms do not last and catalytic converters will have to be changed more than likely after a short time and I believe your paper indicates that, what do you think about having the price in the car for the installation of a converter when it becomes no longer useful or effective?

Mr. TERRY. Dr. Carter, we certainly cannot say that it cannot be done. It can be done. The unfortunate part is that we have not yet found the best catalyst for all the varying conditions under which cars have to operate. This is the kind of thing it takes time to develop.

Given the time I am sure we could set a price that would enable us to keep fresh catalysts in cars for a period of time.

We are still very much concerned about what would happen to the air when cars go past this warranty period. Old cars are causing much of our air pollution problem today. We are concerned about what would happen to these 1975 cars whenever they get beyond any guarantee period that has been set.

Mr. HEINEN. One of the truly difficult problems is, Dr. Carter, that the catalyst will run out of life at varying times depending on how you run the cars.

We have cars in which catalysts have failed at anywhere from 6,000 to 35,000 miles. We are trying to develop devices that will give us signals as to when the catalyst is gone. But those devices are almost as difficult to develop as the catalyst.

These are the problems we are facing. If, for example, you were to specify an average catalyst life of 15,000 miles and change it then whether it needs it or not, it might be possible to maintain the low emission levels.

This is the thing we are trying to get information on.

Mr. CARTER. I do think the automotive industry has made improvement in the past few years. I think I can tell that in comparing certain of our cities here with cities in Europe and also in Asia where older cars are used and I don't believe the countries over there have started in this area.

Mr. TERRY. There are figures in a number of cities which show the pollution levels are down. We are down to about a third of the level of the carbon monoxide that was measured in 1930 in some metropolitan areas such as the Chicago Loop and downtown New York City.

Mr. CARTER. It is still too bad if you are getting in a long row of cars going home at night and you smell it and you feel the effect of it.

The thing about it is that it is dangerous what you inhale, hydrocarbons in particular. I don't think that carbon monoxide actually in the concentration is going to cause the immediate effect that it does in higher concentrations causing coma or death, but it is dangerous to have so many cars and so many old cars so that we need to arrive at solutions.

Of course, the Congress wants to be understanding about it and given the time that is necessary, certainly we want it done as quickly as it can be done.

What do you think about also having in the cost of a car the price for having it taken up and torn into its component parts and recycled?

Mr. TERRY. That also can be done and I think we are all studying ways and means of doing that.

I know there have been some State actions on this.

Mr. CARTER. I think it is only commonsense that we do things like that. It is probably going to be a little expensive to begin with. I realize these mechanisms we are having to develop will be expensive, and I regret also that you state that there will be an increase in the cost of gas as a result of this.

I feel that your industry has been a little delinquent in developing motors that are saving gasoline.

Mr. TERRY. Dr. Carter, I would like to say in that connection that Chrysler has always maintained fuel economy as a primary objective when designing and developing cars.

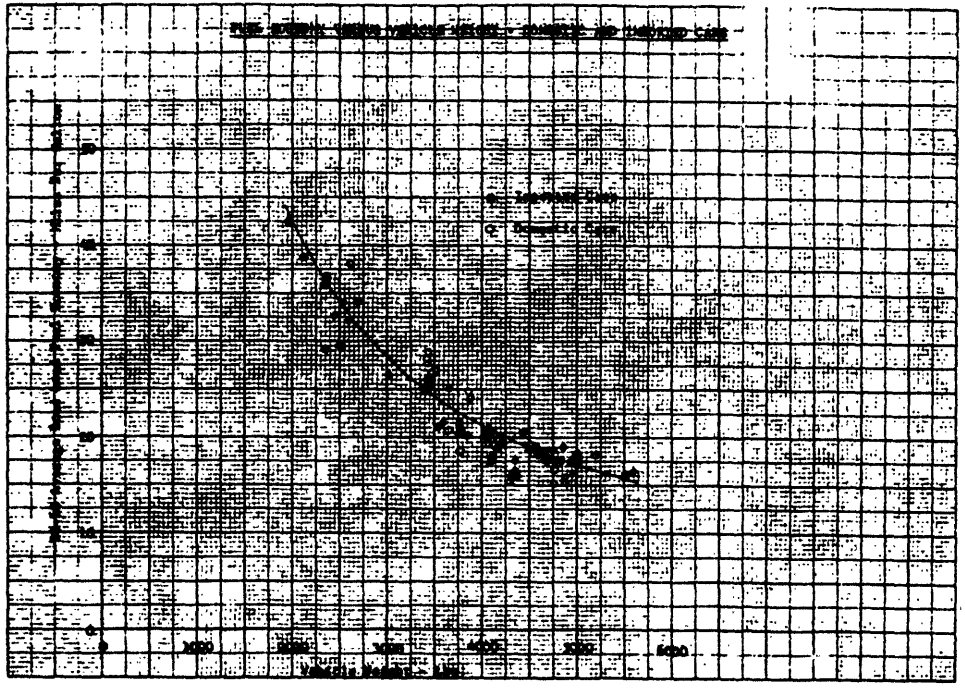
This is one reason why we were able to go to the engine modification approach originally. We already had efficient burning engines and good fuel economy and therefore by making adjustments and changes we were able to meet the original California emission standards.

Mr. CARTER. To get down to it, the European cars of comparable size——

Mr. TERRY. I think we meet them.

Mr. HEINEN. We would like to submit for the record comparable figures.

(The following graph was received for the record:)



NOTE - The graph shows the relationship between the average road load fuel economy from 20 to 60 mph and vehicle weight for various domestic and imported passenger cars. Data plotted are the results of fuel economy tests run at the Proving Grounds on 1971 model year Chrysler Corporation vehicles, competitive U. S. production vehicles, and late model foreign produced cars imported into the United States. These data indicate that the fuel economy level of imported cars are not substantially different than the fuel economy of domestic produced cars when vehicle weight is taken into account.

Mr. CARTER. This is a field in which I feel you have been delinquent because by having cars which consume so much gasoline you have opened the market for foreign imports which are causing you a lot of trouble and a lot of us a lot of worry.

Mr. TERRY. Believe me, we are perhaps even more concerned about the foreign imports cutting into our business than you, if that is possible.

Mr. CARTER. As an American automaker, yes, but people are going to get a good product as cheaply as they can get it. They will just do that.

I have touched on this before but we have to think about our known supply of petroleum, which is how long?

Mr. TERRY. I understand it is around 9 or 10 years.

Mr. CARTER. That is 1982.

Mr. TERRY. Twenty years ago we only had 10 or 15 years at that time, too. They keep discovering more oil reserves. And, of course, we have not even started to exploit the possibilities of coal and shale and so on.

Mr. CARTER. We have not even started and we have only 10 years. We had better make a start. Time is growing late.

Thank you, Mr. Terry.

Mr. KYROS. On pages 7 and 8 of your testimony, Mr. Terry, you indicate that your best efforts in the reduction of hydrocarbons would result in 88 percent reduction, in carbon monoxide 83, and 58 percent for oxides of nitrogen.

Do you mean, sir, you project by 1975 your best efforts to be that?

Mr. TERRY. No, sir; at that point in my testimony we were talking about using the engine modification approach and not going to these catalysts which we feel really are not the right thing to put in autos at their present stage of development.

What we are trying to do is answer the question which keeps coming up—if you don't put catalysts in your cars, what is the best you can do by 1975.

That is what that represents.

Mr. KYROS. Using catalysts or combinations, what do you estimate you will have reached by 1975 for hydrocarbons and carbon monoxide?

What is the percentage of reduction, if you have a figure?

Mr. TERRY. We can tell you this, Mr. Chairman: We have met the 1975 standards with individual cars, new experimental research cars.

Our concern is, however, that we cannot meet the standards consistently. We will build up an identical car to the one that just met the numbers and we may have twice as high a number, and we don't even know why. It may be partly because of the instrumentation, part of it because of the build-up tolerances, and so on.

We can meet the standards with individual vehicles. But we cannot say at this point that we would be able to meet them in mass production.

Also, the control methods that we use are such that we know we do not have durability. We do not know how good durability we do have because we have not run that many cars in durability tests under the wide variety of conditions they will be subjected to in the field.

From a development standpoint, we can get individual vehicles down below the emission values required for 1975. But we are a long way

from being able to say we can offer the emission control system in mass production and that it will last in service.

Mr. KYROS. For a car that would be in mass production, that is technologically feasible, what could you get it down to by 1975?

Do you have a sample of that kind of figure?

Mr. TERRY. I believe the engine modification approach is such that we are pretty sure we could get durability and not have the problems with maintenance that we would expect with some of these more sophisticated systems.

According to our testimony, reductions of 88 percent HC, 83 percent CO, and 58 percent NO_x represents what we think we could do with cars that would last and provide proper service and so on.

Mr. KYROS. What about the cost of cars like that?

Mr. TERRY. I would estimate we could do that for another $100 to $150 over what we now have.

Mr. KYROS. $150 over the uncontrolled vehicle?

Mr. TERRY. For $150 over the uncontrolled vehicle we might be able to do this.

Mr. KYROS. And this would not create the problem of having a catalyst which must be changed between 25,000 and 30,000 miles?

Mr. TERRY. That is right.

Mr. KYROS. Do I understand that Chrysler states they could get down to 88, and 83 percent, respectively, for the 1975 model on the HC and CO?

Mr. TERRY. Yes, sir.

Mr. KYROS. Did Chrysler file for a 1-year suspension?

Mr. TERRY. We have notified EPA that we will file.

Mr. KYROS. Just like the Ford Motor Co. and General Motors?

Mr. TERRY. Yes, sir.

Mr. KYROS. Even if you got the 1-year extension to 1976 of the provisions in the act, does that mean, sir, that you could go ahead and put in your engine modifications to give us 88 percent and 83 percent reductions respectively in HC and CO?

Mr. TERRY. Yes, sir, we can do that by 1975.

Mr. KYROS. Would you?

Mr. TERRY. I would say it would depend on how the regulations end up and the interpretation thereof and so on. That would be the first thing.

Mr. KYROS. Surely, you could not be put in a worst competitive situation than anyone else. It would be grossly unfair to have to add $100 to $150 to your price per car if no one else had to do it.

Mr. TERRY. I should make it clear that 88 percent reduction is a reduction compared to an uncontrolled vehicle.

Mr. KYROS. But the same thing is in the act.

Mr. TERRY. No. The act requires 90 percent from the 1970 levels which had already reduced hydrocarbons by 80 percent. So the level called for by the 1970 Clean Air Act amounts to 97 or 98 percent reduction of hydrocarbons.

So, really, it is only 88 compared to 97. The cost of percentage reduction of what remains goes up expotentially as you get down to the last little bit.

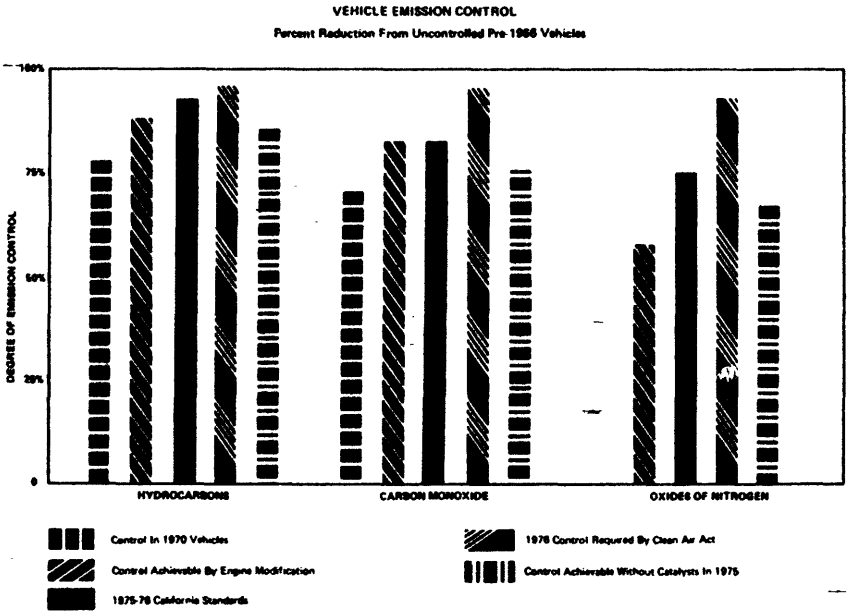
Mr. KYROS. Can you restate the terms of 88 and 83 in terms of the 1970 standards?

Do you have to multiply 88 by 97?

Mr. TERRY. We would achieve 88 percent reduction of hydrocarbons compared to 97 percent required by the act. We would get 83 percent reduction of CO compared to 97 percent required by the act and we would get 58 percent NO_x reduction compared to 90 percent required by the act in 1976.

Mr. KYROS. You confuse me.

(The following chart was received for the record:)



NOTE.—The percent reduction from uncontrolled pre-1966 vehicles, achieved by 1970 controlled vehicles, achieved by engine modification, required by California standards for 1975–75, required by the Clean Air Act for 1976 model vehicles, and the percent reduction achievable without catalysts in 1975.

Mr. KYROS. The act calls for 90 percent reduction of the 1970 controlled vehicle?

Mr. TERRY. Yes, sir.

Mr. KYROS. What would your best effort in reduction of hydrocarbons by 1975 be?

Mr. TERRY. Do you mean how much of a reduction would we get over the 1970 level?

Mr. KYROS. Uncontrolled, yes.

Mr. TERRY. It is about halfway, I guess.

Mr. HEINEN. We would be reducing about halfway.

Mr. TERRY. About 50 percent.

Mr. HEINEN. And we would be reducing oxides of nitrogen more than 50 percent.

Mr. KYROS. Do you mean with the hydrocarbons you have reached the 45 percent level?

Mr. TERRY. Cars coming down the line today—our Chrysler products—have reduced unburned hydrocarbons by 80 percent, so this would mean we would be going about half of the way toward the 97-percent reduction required by the act for an uncontrolled vehicle.

Mr. KYROS. If we can just stick to the act on the reduction, I want you to tell me what you would achieve by 1975 in terms of the act.

The act states that emissions of hydrocarbons and carbon monoxides during or after model year 1975 shall be reduced by 90 percent from those required in 1970 vehicles.

My question to you is, about what percentages will you reduce those required on the 1970 vehicles and what are your projections for 1975?

Mr. TERRY. It would be about 50 percent for hydrocarbons and about 40 percent carbon monoxide and 58 percent the total NO_x.

Mr. KYROS. Were you here earlier when Ford Motor Co. representatives testified. Their testimony was that they could reach an 85-percent reduction in hydrocarbons by 1975.

Am I incorrect in what I heard this morning?

Mr. TERRY. Mr. Chairman, I believe they were talking about using catalysts. All of their systems involve catalysts.

Mr. KYROS. Suppose we change some of the requirements. You will recall you cited from the National Academy of Sciences their statement that if the requirements were changed there might be a difference.

For example, suppose you could average emissions as you explained. Suppose that fuel containing a low level of catalyst poisons was made available to you in sufficient quantities by 1974.

That is not an irrational assumption. Suppose also that provisions were made for catalyst replacement and other maintenance. For example, you could issue a certificate and have the catalyst replaced at 20,000 or 25,000 miles.

Now, if you assume these propositions, would it not then be possible for you to try to meet these standards with catalysts?

Mr. TERRY. Yes, sir; we can try to meet the standards with catalysts and if it becomes necessary we certainly will do so.

We will do it that way. We don't think that meeting any standards with catalysts is a sound proposition from an engineering-technical point of view.

We know that the catalysts actually vary in length of life time over a wide ranging number of miles. Just saying bring the car in at 20,000 miles and we'll put in a new catalyst may still mean the customer has been running without control of his emissions for 17,000 miles without knowing it. In the process his car could be emitting a lot more pollutants than if he had a car that was a year or two older that didn't have a catalyst.

These are the things that really give us concern.

The state of the art is such that if we do put these devices in cars and we do have the kind of inspection stations or lack of them that we expect and we do have the maintenance representing the best we can do and the best the country can do in the time allotted, we are concerned the air might end up much worse than if we didn't put in the 1975 devices in the first place. This is because the use of sophisticated systems we are talking about, as we saw earlier, call for richer mixes so there is something to heat up the catalyst so it will work.

When you put the richer mixes through the exhaust, that is fine as long as the catalyst is working. But when the catalyst stops working, you have more emissions than you had before.

A little thing like a spark plug missing just for a very short time can also burn up a catalyst because it can overheat very, very quickly under those circumstances.

A spark plug missing, incidentally, increases your emissions of unburned hydrocarbons by as much as a factor of 10—just one mis-firing spark plug. So there are a great number of factors you don't normally think about when we talk about controlling emissions from cars.

Mr. KYROS. That is why we have you here today.

Universal Oil Co. stated that if the EPA were to accept the National Academy's recommendations to permit a catalyst change at 25,000 miles and to permit automotive field manufacturers—which is what I suggest to you—then achievement of the 1975 standards on schedule would be feasible, provided also the EPA takes timely action to assure availability of fuel.

Universal Oil Co. feels this is the most desirable course of action for the EPA to take.

There is an oil company that did follow the logic you explained to me and I respect what you said about missing spark plugs, but for heaven's sake, a spark plug could be missing in the car you set up, but we are assuming normal maintenance at all times, at least you have to, so how do you answer the suggestion that I made and also that Universal Oil Products Co. made?

Mr. TERRY. Universal Oil Products, with all due respect, is promoting catalysts. They are trying to sell catalysts to us. They perhaps take a more optimistic view of how well catalysts will actually operate in vehicles than we might take.

What we are concerned about, as I said, are the offbeat kinds of things that we do know happen to cars. And, it does not have to go on for very long to ruin a catalyst.

We are very, very much concerned that in the hands of the customers these catalysts will not last the result will be that we will end up not actually helping to get clean air.

That is the principal basis of our concern. At this point, we do not feel that catalysts are a good thing or practical thing to put into an automobile in volume production to be sold by the millions in this country.

Mr. KYROS. I think your testimony has been very informative.

Assuming that you get the added one year, how are you going to get a clean car?

I thought it would still be a combination of catalyst plus something else.

Mr. TERRY. I think that is a fair question, Mr. Chairman. I don't think from what we can see at this point in time that we would be able to meet the 1975 requirements with a satisfactory maintenance package and so on by 1976, either.

We would be able to come closer and do better. Perhaps we will discover some new catalysts. Perhaps in time some of these exhaust gas treatments may be able to be developed where they can be in our opinion practical.

However, as far as taking the auto out of the area where it can be said to be a major cause of the pollution problems, we believe that we have

done that already for all practical purposes as indicated by chart II.

Actually, we will be doing a lot better than chart II shows. But this shows that air pollution from cars is actually decreasing right now at an increasing rate and will continue to do so even though the total number of cars continues to increase on a straight line. Even if we don't do any more than we are doing right now, car emissions will continue to decrease until 1990 as new cars replace old cars.

We will know a lot more about these health problems and the effects of ambient air quality on health by 1980 or 1975 than we know now. We don't think it is advisable—from our standpoint anyway—to jump out of the frying pan into the fire with new devices that are not yet proved out and in which we have very little confidence for 1975 application.

Mr. KYROS. I understand from your statement that you are not sure the 1-year suspension will meet the standards set up by Congress last year.

Mr. TERRY. That is right, Mr. Chairman.

Mr. KYROS. That is pretty grim.

Mr. TERRY. I would like to say one other thing, Mr. Chairman: In our technical work we have to consider the 1976 requirements along with the 1975 requirements. As we have said, and as everybody else has said, meeting the 1975 requirements is feasible if you get the favorable administrative rulings listed in the NAS report and if you decide you are going to use a catalyst with all of the problems there.

The 1975 requirements could be met on this basis, but in the background we have the 1976 requirements which call for drastic reductions in NO_x. If we try to design systems that will meet the 1975 model requirements for hydrocarbons and CO, we end up with much more difficult problems to meet the 1976 model NO_x requirements. This is because of the incompatability between the types of control devices required to reduce hydrocarbons and carbon monoxide and the requirements of control devices to reduce oxides of nitrogen.

Mr. KYROS. You put something in a series with a converter. The catalyst picks up the HC and CO and with something in a series picks up the NO_x?

Mr. TERRY. It would be highly desirable if we could put a NO_x catalyst in service with the CO and HC controls and handle the temperature problems and so forth that I won't go into again now. Development of such a system that is durable and flexible enough to work under all operating conditions, is the desire and hope for reducing NO_x as well as HC and CO without there being the fuel economy penalties that we talked about earlier.

Mr. KYROS. I certainly appreciate your testimony as I am sure the entire committee will, and also your candor.

I think you are doing the best that you can. I just hope you will always remember that we, too, are doing the best we can, and that we do have complaints today in the United States in certain cities and certain urban areas.

We hear about pollution of all kinds.

Thank you very much, sir.

Our next witness at this time will be Mr. John F. Adamson, vice president—engineering and research, American Motors Corp.

The committee welcomes you today. I want to apologize for keeping you here all day long with all of the bells ringing and so on, and calling you to the stand so much.

STATEMENT OF JOHN F. ADAMSON, VICE PRESIDENT-ENGINEERING AND RESEARCH, AMERICAN MOTORS CORP.

Mr. ADAMSON. The testimony I will present today applies both to the passenger cars manufactured by American Motors, and the vehicles manufactured by Jeep Corp., its wholly-owned subsidiary.

At the outset, let me state that American Motors is diligently and conscientiously applying its resources and full technological capability to the effort of meeting future emissions standards as currently stipulated.

Even though every possible effort has been and is being made, American Motors Corp. and Jeep Corp. have not reached an engineering ability to comply with the emission control standard promulgated in the 1970 amendment of the Federal Clean Air Act and applicable to 1975 model car vehicles.

The fact that 1975 model motor vehicles must be in regular production in August 1974, and in view of the leadtime required after completion of our engineering, it is now evident that such engineering will not be completed in time to meet the required production schedule.

Our primary purpose for appearing today is to outline our efforts and clarify our position relative to meeting the 1975 standards, and we respectfully submit the following:

First, our extensive research and investigations have led us to the firm conclusion that the internal-combustion engine is the only powerplant that American Motors can produce which has any chance of meeting both consumer requirements and near-term emissions regulations. In fact, we presently see this as being true well beyond the 1975 model year.

American Motors has extensively investigated other forms of alternative propulsion such as electric, steam, natural gas, and turbine systems. These included inhouse building and testing of prototype systems as well as design studies, consultations and explorations with outside companies and individuals.

Such exploration confirmed that modification of the internal combustion engine was the only practical method for achieving reductions in pollutants within the allowable time span. This has been the basis of our primary experimental program, which included thorough investigations of many basic techniques to determine methods by which pollutant emissions of the ICE engine could be reduced.

Initial investigations were primarily pursued to define the potential that existed and the identification of problem areas that would have to be resolved.

Designs were prepared and tests conducted with thermal reactors of various sizes and configurations, with catalytic converters developed to reduce HC and CO concentrations, and with other converters intended to reduce HC, CO, and NO_x emissions. Concurrently, several methods of exhaust gas recirculation were explored, along with a variety of engine modifications including valve-train changes, carburetor revisions, ignition system modifications, and basic combustion chamber

concepts. In addition, we completed a lengthy series of tests to determine the effects that different transmission ratios, torque converters and axle ratios would have on emissions levels.

As a result of these tests, we established the major priority projects that we have pursued for potential 1975 release. These were catalytic converters for reduction of HC and CO; an exhaust gas recirculation device for control of NO_x; a refined system for controlling ignition timing responsive to temperature, speed and load; and certain detail engine changes primarily related to the valve, and induction systems.

Our experimental vehicles with modified internal combustion engines have been evaluated with both noble metal and nonnoble metal catalytic agents. One installation has completed 50,000 miles, and another is now at 30,000 miles. In both cars, excessive deterioration in control occurred, with resulting inability to meet required standards. Additional test vehicles, containing design refinements, are also operating, but results are not encouraging due to relatively rapid control loss.

It is impossible to list all the major problems that must be solved before we can have any hopes of meeting the 1975–76 regulations. For the purpose of this hearing, however, I would like to list a few of the major areas that require further explanation.

1. We must first achieve systems to meet the 1975 standards for HC and CO. These systems, however, must be capable of being integrated with a control system for meeting the 1976 NO_x standard since it would not be practical to tool a 1-year HC–CO control system. We recognize basic interaction characteristics of the currently known HC–CO and NO_x systems and the inherent problems that must be solved.

2. We must determine whether control devices used on these specially engineered and carefully tailored vehicles can be effectively transferred to our manufacturing processes, and whether such components can be produced and assembled by production-line workers.

3. Acceptable vehicle parameters relating to driveability, safety considerations, durability and reliability, et cetera, must be maintained when these new control devices are produced. We have not yet completed all needed investigations in these areas.

4. Still to be developed are necessary instrumentation and service techniques for maintenance of these very complex systems in the field. The eventual implementation of the performance warranty provisions of the Clean Air Act, as amended, requires careful in-depth studies and practical solutions for this problem.

5. The fuels available to the public and for which our current and future vehicles and control systems must be designed, are in a state of change, and there is uncertainty as to composition and performance characteristics. This variable must be stabilized to allow orderly and effective design of future control systems. The uncertainty that exists creates an unreasonable engineering burden that must be resolved before future emission standards can be effectively approached.

6. Another major area of concern to us is the fact that American Motors' 1975 model production will commence in early August 1974. The units needed for pollution control, as well as all other vehicle components affected by such devices, must be tooled and produced in quantity previous to the August 1974 date. Many such components are of the "long-lead" variety, which means that up to 24 months must

be allowed for design and procurement of the manufacturing tooling needed. Thus, the control system must be established, and engineering completed on all other vehicle components affected, by early summer of 1972. The 4–6 months that remain from the date of this statement are insufficient to complete the vast engineering program that will be needed.

In summary, time and lack of vital information and necessary technology are clearly against us in our efforts to meet the 1975 emissions standards. The body of knowledge we have developed in experimental programs is substantial, but we are still woefully short on answers in many key problem areas. We have gained greater knowledge and understanding of the problems involved, and, in time, this will help us find the solutions to many of the complex considerations. But the facts of our current situation make it obvious that we cannot get there on the basis of the time schedule prescribed.

You may be assured that American Motors will continue to apply the full force of its resources in doing what we can do to help achieve the national environmental objectives. We appreciate the opportunity to appear before this committee. Such fact-finding discussions are, I believe, very essential to continuing progress toward these important goals.

Thank you, Mr. Chairman.

Mr. KYROS. Thank you, Mr. Adamson.

Do I understand your company also has filed?

Mr. ADAMSON. We sent a letter of intent to Administrator Ruckelshaus on January 20, 1972.

Mr. KYROS. Requesting a 1-year extension?

Mr. ADAMSON. Yes, sir.

Mr. KYROS. Dr. Carter?

Mr. CARTER. I think you have made a good presentation. We have gone over this at length and I have no questions.

Mr. KYROS. Thank you, Dr. Carter.

I have just one question, Mr. Adamson.

If you did put in a device, have you computed or can you compute what reductions you would achieve under the act?

Can you give that in percentage figures, if possible?

Mr. ADAMSON. I don't believe I understand the question.

Mr. KYROS. Assume that the working under the act, you developed an emission control device and put it on your cars. What reduction would you achieve? The law calls for a 90-percent reduction of HC and CO. What reduction would you achieve by 1975?

Mr. ADAMSON. I cannot answer that, but I don't want to leave that statement without an explanation. Every one of the warm bodies and dollars that I can lay my hands on, are spending 100 percent of their time in two emission areas.

One is the finalization and compliance testing for 1973 models and the remainder of our abilities are going completely to a desperate effort to meet the 1975 standards.

We are not doing any work on interim hardware because I do not have any capability to pursue this third task.

Mr. KYROS. Even though you can't suggest a figure that you can reach, you do state with certainty you cannot reach the 90 percent for the HC and CO for 1975 and NO_x for 1976?

Mr. ADAMSON. Not in a drivable, mass-produced vehicle.

Mr. KYROS. What about the question I asked Mr. Terry previously. If you could use a 25,000- or 20,000-mile range with a certificate to change a catalyst, and if we had a nonpoisoning fuel, in that instance, what would happen?

Mr. ADAMSON. I think we would still, sir, have to do a great deal of further work for me to have any assurance that we would have a unit that would be durable and reliable through even a 25,000-mile period. I would need the same assurance that we could get a car that was drivable and brought forth a reasonable degree of customer satisfaction. Those, I think, are clearly unknowns.

Certainly, the things you mentioned that the National Academy of Sciences brought up, do help to bring the goal into a closer proximity but I am not able to sit here and say, "Yes, I am able to reach out and grab it."

Mr. KYROS. General Motors owns some percentage of American Motors nowadays?

Mr. ADAMSON. No, sir; we have a technical agreement with them for consultation.

Mr. KYROS. On emission controls?

Mr. ADAMSON. Yes, sir.

Mr. KYROS. So, you have some assistance from them in technology.

Mr. ADAMSON. Yes.

Mr. KYROS. Thank you very much, Mr. Adamson.

Our last witness today is Mr. Louis V. Lombardo. He is from the Center for Science in the Public Interest.

Mr. Lombardo, thank you for being so patient and welcome to the committee.

STATEMENT OF LOUIS V. LOMBARDO, CENTER FOR SCIENCE IN THE PUBLIC INTEREST; ACCOMPANIED BY JAMES SULLIVAN, CO-DIRECTOR AND FOUNDER

Mr. LOMBARDO. May I have along with me Dr. James Sullivan, a director and founder of the center.

Mr. KYROS. You are very welcome and we are happy to have you here with us.

Mr. LOMBARDO. Mr. Chairman, I would like to say that Dr. Sullivan is chairman of the Air Polution Advisory Committee for the Bureau of Air Pollution Control here in the District of Columbia.

Mr. KYROS. Is that a Federal agency?

Mr. SULLIVAN. The Bureau is part of the City Department of Environmental Services charged with air pollution and environmental problems.

It would be a Federal agency related to the District.

Mr. KYROS. You are a consultant to that agency?

Mr. SULLIVAN. I am chairman of the Air Pollution Advisory Committee. It is a committee of business, citizen, environmental organizations.

Mr. LOMBARDO. Mr. Chairman and members of the committee, my name is Louis V. Lombardo. For the past 6 years, I have worked in the Federal air pollution control program, I was technical aide to the Assistant Commissioner for Standards and Compliance and I specialized in motor vehicle emission control. I recently joined the

Center for Science in the Public Interest, a nonprofit, tax-exempt organization which was founded by several scientists, including Dr. Sullivan, who formerly worked for Ralph Nader.

Mr. KYROS. Why did you leave Mr. Nader?

Mr. LOMBARDO. I will let Dr. Sullivan answer that.

Mr. KYROS. Why did these scientists leave Mr. Nader?

Mr. SULLIVAN. There were no hard feelings or anything like that.

Mr. KYROS. Nobody suggested that.

Mr. SULLIVAN. Scientists need a visible example of other scientists who are working on public interest issues outside of Government or industry and inside Mr. Nader's organization scientists really did not get that visibility which I think is needed.

Mr. KYROS. That seems a logical reason.

Go ahead, Mr. Lombardo.

Mr. LOMBARDO. The center was founded for the purpose of performing public services in areas which demand scientific input but where few scientists can speak freely due to institutional commitments. Thank you for inviting me to discuss the implementation of Section 202 of the Clean Air Act Amendments of 1970 which govern the control of vehicle emissions from 1975 and later model year automobiles. The center has started Project CAVEAT—attachment A—, which stands for Clean Air Vehicle Assurance Team to work for full implementation of section 202. The first action of Project CAVEAT has been to sue Environmental Protection Agency Administrator, William Ruckelshaus, for promulgating 1975 hydrocarbon emission standards which fail to carry out the intent of Congress. The Center for Science in the Public Interest is a coplaintiff in the suit along with the Natural Resources Defense Council, Inc., NRDC, a public-interest law firm.

Project CAVEAT is supplying technical information for the suit—copy of the complaint is attachment B.

As you know the Clean Air Act Amendments of 1970 were intended to achieve air quality levels which would protect the public health. During 1970, the Congress was informed that the administration's 1980 automobile emission goals would achieve air quality levels protective of public health by 1990. The Congress then decided that as a national policy it was both reasonable and necessary to try to achieve air quality protective of public health by 1985. This decision was the basis for the following language used in section 202 of the act.

> The regulation (for 1975 vehicles * * * shall contain standards which require a reduction of at least 90 per centum from emission of * * * hydrocarbons allowable under the standards applicable to light duty vehicles and engines manufactured in model year of 1970 * * *.

You probably recall all too well the intensive opposition of the automobile industry to this congressional decision during passage of the 1970 Clean Air Act Amendments which included visits to Washington by Mr. Cole of GM, Mr. Iacocca of Ford, and others. You may also recall the November 17, 1970 letter from HEW Secretary Richardson endorsing the position of the automobile industry while the conferees were meeting to finalize the legislation.

These industry efforts were unsuccessful with Congress, but the pressures did not end. After enactment, the focus of industry pressure shifted to the executive branch where, unfortunately, receptive ears were found.

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A CHRONOLOGY OF MALIMPLEMENTATION OF THE ACT

1. In January 1971, right after enactment and before industry influence took root, the administration proposed ambient air quality standards, which were consistent with previous presentations to Congress, but which were criticized by environmentalists as having an insufficient margin of safety for protection of the public health. Such comments—attachments C and D—were filed by Ralph Nader's Center for the Study of Responsive Law and the Natural Resources Defense Council, and quietly ignored by EPA.

Mr. KYROS. Are you adding editorial comments as you go along?

Mr. LOMBARDO. Yes, sir.

Mr. KYROS. There is nothing wrong with that.

Mr. LOMBARDO. I can have it retyped and resubmitted formally.

Mr. KYROS. You may proceed and add things as you wish. You have been here all day and you are entitled to it.

Mr. LOMBARDO. By April 30, 1971, however, the administration had also heard industry comments—and these were heeded. Table I shows the results with respect to pollutants caused by motor vehicles. Changes were made to permit 28 percent higher air pollution levels for hydrocarbons and photochemical oxidants than had previously been expressed to the Congress during consideration of the 1970 amendments as necessary to protect the public health.

TABLE I.—AIR QUALITY GOALS FOR HEALTH PROTECTION

	Senate hearings July 1970	Standards as proposed January 1971	Standards as adopted June 1971	Degree of weakening between January and June (percent)
Carbon monoxide	10,000 μg./m.³ 8-hour average.	10,000 μg./m.³ 8-hour average.	10,000 μg./m.³ 8-hour average.	
		15,000 μg./m.³ 1-hour average.	40,000 μg./m.³ 1-hour average.	170
Hydrocarbons 6 to 9 a.m.	125 μg./m.³ 3-hour average.	125 μg./m.³ 3-hour average.	160 μg./m.³ 3-hour average.	28
Nitrogen dioxide	190 μg./m.³ 1-hour average.			
		250 μg./m.³ 24-hour average.	Standard dropped	(1)
		100 μg./m.³ annual average.	100 μg./m.³ annual average.	0
Photochemical oxidant	125 μg./m.³ 1-hour average.	125 μg./m.³ 1-hour average.	160 μg./m.³ 1-hour average.	28

[1] Total.

2. On February 26, 1971, less than 2 months after the President signed the Clean Air Act amendments, the Environmental Protection Agency proposed an emission standard of 0.46 grams per mile for 1975 and later model year vehicles. Attachment E, comments by Ralph Nader on the proposed standard of 0.46 grams per mile, summarized the failure of the Agency to carry out the will of Congress as follows:

The passage of the amendments was generally understood to accelerate the standards by five years, i.e. to leap-frog the proposed 1975 standards and to require compliance with the proposed 1980 standards by 1975. In view of these facts, it wou'd be unreasonable to infer, that after one of the major legislative battles of 1970, Congress intended to reduce the 1975 hydrocarbon standard by an infinitesimal amount (0.04) below the originally proposed level (from the originally understood levels of 0.5 to EPA's proposed level of 0.46).

The 1980 goal which was to have been brought forward to 1975 was 0.25 grams per vehicle mile of hydrocarbons as shown in table II.

TABLE II.—HYDROCARBON EMISSIONS IN GRAMS PER MILE ON THE 1972 (COLD START) TEST PROCEDURE

	Administration's interim 1975 goals	Administration's ultimate 1980 goal	Needed for health protection
What the Congress was told in 1970	0.50	0.25	[1] 0.14
	Administration's proposed 1975 standard	**Administration's adopted 1975 standard**	**Needed for health protection**
What was done in 1971	0.46	[2] 0.64	0.26

[1] Not in terms of the 1972 test procedure.
[2] Approximately.

Nader's comments and similar comments—attachment F—by David Hawkins, then with the Stern Community Law Firm, were not only ignored by the Agency, but flouted, as the Agency finally adopted still weaker standards.

3. On March 12, 1971, General Motors suggested the Agency change the cold start test procedures applicable to 1975 vehicles. The procedures originally called for testing a vehicle from a cold start to simulate the startup and morning commute of vehicles between 6 and 9 a.m. Historically, research has shown that this morning commute was the determinant in daily smog formation. GM suggested that during the day vehicles are started, on the average, about 4.5 times—not just once in the morning. Therefore, reasoned GM, a more accurate test procedure would simulate not just cold startups but cold starts and hot starts weighted or averaged together.

Photochemical smog, though it builds during the course of the day, is primarily the result of emissions generated between 6 and 9 a.m. by cars which are started cold after standing overnight and driven to work. Thus, emissions generated during the afternoon, evening, and nighttime hours are not pertinent to a control strategy which is concerned with the 6–9 a.m. emissions.

On July 2, 1971, without a prior Notice of Proposed Rulemaking, the Agency promulgated new test procedures which effectively incorporated GM's suggestion. The full significance of this change in the test procedure is presently being investigated by Project CAVEAT. Preliminary calculations from a limited data base, however, indicate that allowable emissions of hydrocarbons from 1975 vehicles will be about 0.64 grams per mile rather than 0.46 grams per mile as the Agency had proposed, and 0.26 grams per mile as Agency documents indicate is necessary to protect the public health.

Limitations on access to National Academy of Science data has hampered progress on developing a firmer number.

To make these grams per mile figures more understandable one can calculate very roughly that if the intent of Congress were carried out, 1975 model year automobiles would exhaust about 100 million pounds of hydrocarbons each year assuming, of course, they met the standards over the life of the vehicle. Under the regulations promulgated, however, the 1975 model year automobiles will emit 300 million

pounds of hydrocarbons during the first full year they are on the roads.

The industry, in addition to achieving the above chronology on governmental shifts, is proceeding to obtain further concessions. First, GM would like a change in the regulations which presently require each car to meet the standards. They suggest that some cars should be allowed to exceed the standard because some would be below the standard. The important thing, according to GM, is that the vehicles should meet the standard on the average. Beware the word "average." Both California officials and Federal officials know that averaging is yet another way to weaken the standards while appearing to maintain the same degree of stringency.

Second, the industry would like to be able to replace catalysts every 25,000 miles rather than every 50,000 miles as required. If this were permitted, the consumer would be saddled with yet another unnecessary expense. There is no inherent reason why catalysts cannot be made to last 50,000 miles and even beyond to the actual life of the car. Permitting catalyst replacement gives the auto companies an economic incentive to use catalysts which not only do not have good durability but also inherently do not have good catalytic activity, mechanical durability and resistance to heat and poisons.

The latest development has been General Motor's request for a 1-year suspension of the hydrocarbons and carbon monoxide emission standards for 1975 model year automobiles. I hope one effect of these hearings will be to stiffen the administration's posture in considering the 1-year suspension. GM's original request was denied on the grounds that it was a legally insufficient application for suspension. Our attorney, David Hawkins, suggested a question which might be asked of Mr. Ruckelshaus to determine the attitude of the Agency on this issue: Is the Administrator ready to subpena information from General Motors the day the complete suspension application is received?

Mr. KYROS. Are you asking this subcommittee this question? Mr. Ruckelshaus will be here tomorrow.

Mr. LOMBARDO. Our attorney suggested a question that might be asked of Mr. Ruckelshaus. We, of course, cannot ask that question, Mr. Chairman.

Another matter of concern which Mr. Ruckelshaus could resolve is the confidentiality of subpenaed or submitted application data. Mr. Hawkins has asked the Administrator in a letter dated January 21, 1972—attachment G—to adopt a policy that all data submitted by the applicant or subpenaed by the Agency be made availaible to the public. Perhaps he will announce his decision when he appears before you tomorrow.

The most alarming development, however, has been the recent meeting sponsored by Congressman Veysey of California. If the article from the New York Times—attachment H—is correct, it appears that the industry will be making a frontal attack for a repeal of the very provision of the law which we are trying to have enforced by the courts. The industry in effect is saying it will never meet standards necessary to protect the public health.

(The attachments to Mr. Lombardo's statement, referred to, follow:)

(Testimony resumes on p. 389.)

ATTACHMENT A

CENTER FOR SCIENCE IN THE PUBLIC INTEREST,
Washington, D.C.

PROJECT CAVEAT

CAVEAT: a Clean Air VEhicle Assurance Team to create a scientific counterforce to ever-present industry pressure for weaker pollution control standards.

THE PROBLEM

In 1970, history's most intensively fought legislative battle between environmentalists and the automobile industry was won by the public. Congress decided that to protect the public health it was necessary to write into law standards for 1975 model year automobiles requiring "a reduction of at least 90 per centum from emissions . . . allowable . . . in model year 1970." The subsequent regulations promulgated by EPA to implement this provision of the Act, however, do not require a 90 percent reduction of hydrocarbon (unburned gasoline) emissions. The adopted regulations permit more than twice as much hydrocarbon emissions as envisioned by Congress and necessary for the protection of the public health. The problem for the public and its only advocate, the environmentalists, is: How does the nation insure that the law will be met and the public health protected?

FACTS BEARING ON THE PROBLEM

1. Congress envisioned a standard of 0.22 grams per mile of hydrocarbon emissions from 1975 and later model year vehicles (as measured on the then new "closed cold" test procedure.) They correctly understood this standard to be necessary for protection of the public health. Yielding to industry pressure, EPA subsequently proposed an emission standard of 0.46 grams per mile hydrocarbons (also on the "closed cold" test procedure.) The Natural Resources Defense Council and the Center for the Study of Responsive Law protested, but industry pressure in the opposite direction was much stronger. EPA yielded still further to industry pressure and finally promulgated a standard supposedly comparable to 0.46 grams per mile but with a different numerical value of 0.41 grams per mile hydrocarbons. The new lower number looks like a more stringent standard but in reality is an even weaker standard because of a change in the measurement test procedure from a "cold" test to a "cold plus hot" test procedure.

2. The latter "cold plus Hot" test procedure further increases the amount of pollution permissible from 1975 vehicles. This can be understood by a comparison with the previous closed cold test procedure. The closed cold procedure collected and measured only the emissions generated during a cold start (a vehicle started from room temperature or "cold" generates far more emissions of hydrocarbons and carbon monoxide than a vehicle started from a fully warmed up or "hot condition." The new "cold plus hot" procedure also measures the high emissions generated during a cold start, but instead of stopping there and using these emissions as the measure of a vehicle's pollution characteristics, the new procedure goes on to measure the low emissions of a hot start and then average the two together to yield a lower measurement value. This average value of course creates the appearance that the vehicle emits less while actually permitting an increase in the mass (quantity) of allowable emissions. The averaged value will always be much less than the high (undiluted) cold start value.

3. The significance of "cold" versus "cold plus hot" measurements can be appreciated with an understanding of the photochemical smog phenomenon.

The phenomenon of photochemical smog results when hydrocarbons and oxides of nitrogen emitted into the atmosphere are baked by the radiant energy of sunlight for several hours. The emissions generated during the morning hours by millions of automobiles on a sunny day results in the corrosive photochemical smog which reaches a peak in the early afternoon hours. These emissions caused by morning commuters are primarily cold start emissions. Car which have been sitting dormant overnight are "cold" and the heaviest emissions are created during the morning startup. Thus, the aim historically has been to reduce cold start emissions to the point where there would not be enough chemicals in the atmosphere to support the photochemical reaction—the solution to the smog problem.

Prior to EPA's new regulation, during the entire twenty year history of motor vehicle pollution control efforts, standards were in terms of strictly cold start emissions. Hence the new EPA procedures, successfully pushed for by the auto-

mobile industry will control pollution to a far lesser degree than intended by Congress and not to the degree necessary to protect the public health.

4. Further efforts to erode the effectiveness of the 1970 Clean Air Act Amendments are also in progress by the automobile industry. EPA officials privately admit that they are about to allow 25,000 mile replacement of catalysts for 1975 model year vehicles rather than the 50,000 miles specified in the Clean Air Act and far less than the 100,000 miles needed by the public and originally sought by the Congress. EPA officials also have evinced a fatal wait-and-see approach toward the problem of assuring the durability and effectivness of 1975 emission control systems. That this is fatal can be seen from the fact that vehicles built by Detroit are now exceeding the standard after only 4,000 miles, rather than meeting the standards for 50,000 miles as required. Fatal also because it is now estimated that more than 10% of the annual deaths in New York City can be attributed to air pollution.

DISCUSSION

The above facts show that the industry is pushing its own interests in a repeat performance of its successful efforts in California. In 1959 the California legislature passed a law empowering the State health agency to set automobile emission standards to restore the degree of air quality which existed in Los Angeles in 1940—by 1970!

That this action by the California legislature to protect the public health was in vain can be seen from the following figures:

ESTIMATED EMISSIONS FROM MOTOR VEHICLES IN LOS ANGELES

[Tons per day]

	1940	1959	1970 [1]
Carbon monoxide	2,500	8,500	8,500
Hydrocarbons	600	1,800	1,500
Oxides of nitrogen	125	390	730
Total	3,225	10,690	[2] 10,730

[1] These estimated 1970 emissions are based upon the old open cycle test procedure and therefore substantially underestimate actual emissions by an undetermined factor which may be as high as 2.

[2] Or 22,000?

Note: The same evisceration of standards that went on in California during the 1960's is now, in the 1970's, proceeding apace at the Federal level. If it continues unabated we will find in 1984, when the Congress envisioned we both could and should have clean air, we will be breathing at best the same amount of poisons in the air as we do today.

So much for the facts of the problem and their implications. The question now becomes what can and should be done to rectify the problem.

Project CAVEAT will produce the scientific evidence necessary to force EPA to carry out its responsibilities under the Clean Air Act. CSPI is exploring legal methods to require EPA to enforce the law. The scientific community will be challenged by CSPI to examine EPA's actions and support efforts to obtain emission standards and test procedures capable of attaining the air quality levels necessary to protect the public health.

ATTACHMENT B

IN THE UNITED STATES DISTRICT COURT FOR THE DISTRICT OF COLUMBIA

Civil Action No. —

NATURAL RESOURCES DEFENSE COUNCIL, INC., 1600 Twentieth Street, N.W., Washington, D.C. 20009 and CENTER FOR SCIENCE IN THE PUBLIC INTEREST, 1346 Connecticut Avenue, N.W., Room 812, Washington, D.C. 20036, Plaintiffs, *v.* WILLIAM D. RUCKLESHAUS, Administrator, Environmental Protection Agency, Washington, D.C., Defendant.

COMPLAINT

(Mandamus: Declaratory Judgment)

1. This is a civil suit to require the Administrator of the Environmental Protection Agency (EPA) to promulgate regulations requiring a reduction, sufficient to comply with the mandate of Public Law 91-604, the Clean Air Amendments of 1970, in emissions of hydrocarbons from automobiles and automobile engines manufactured during or after model year 1975.

2. This Court has jurisdiction of this action under 5 U.S.C. §§ 701-706, 28 U.S.C. §§ 1331, 1337 (Commerce Regulation), 1343 (Civil Rights), 1361 (Mandamus), 2201-2202 (Declaratory Judgments), and section 304 of the Clean Air Act, as amended (sec. 12, Public Law 91-604, 84 Stat. 1706).

3. The amount in controversy, exclusive of interest, fees, and costs, exceeds ten thousand dollars.

4. Plaintiff Natural Resources Defense Council, Inc. (NRDC), is a nonprofit corporation organized under the laws of the State of New York, with offices at 36 West 44th Street, New York, New York, and 1600 Twentieth Street, N.W., Washington, D.C. NRDC is a national organization dedicated to the preservation and defense of the human environment and natural resources of the United States. NRDC's Board of Trustees is composed of lawyers, scientists, and other citizens interested in protecting the environment. Among NRDC's objectives are: (a) to provide a central, national focus for lawyers, scientists, and concerned citizens in an effort to make our courts and administrative agencies effective instruments of environmental protection; (b) to undertake environmental cases which have a potential for establishing widely applicable precedent or for saving or reclaiming some important aspect of our national endowment; (c) to provide legal advice and assistance, where appropriate, to conservation groups and environmental lawyers throughout the United States; and (d) to monitor the federal departments and regulatory agencies to ensure that the public interest in protecting the environment is fully considered in their administrative actions.

In carrying out the last of these objectives NRDC sponsors the Project on Clean Air, a national program to ensure effective federal and State enforcement of the Clean Air Amendments of 1970, and promotes the broadest and most informed public participation in preparation of State implementation plans under the Clean Air Amendments. The Project in consultation with the Scientists' Institute for Public Information, a national coalition of distinguished scientists across the country, has submitted public Comments on six separate EPA rule making proposals under the Clean Air Amendments. One of these Comments dealt specifically with the subject matter of this action and two other Comments concerned additional aspects of automotive emissions.

5. Plaintiff Center for Science in the Public Interest (CSPI) is a non-profit tax-exempt organization incorporated under the laws of the District of Columbia. CSPI is dedicated to providing unbiased scientific and technical information to the public and has focused particularly on environmental and consumer protection issues. Included in CSPI's activities relating to air pollution are a project to identify the major industrial sources of flourides air pollution throughout the United States, studies presented to EPA regarding the phasing out of lead in automotive fuels, and studies presented to the Federal Trade Commission regarding the posting of octane number on retail gasoline pumps. Dr. James B. Sullivan, a director of CSPI also serves as the Chairman of the Advisory Committee for Air Pollution Control in the District of Columbia.

6. Plaintiffs sue on their own behalf and as representatives of a class consisting of all persons in the United States who are or may be exposed to concentrations of hydrocarbons or photochemical oxidants in the ambient air at levels in excess of the primary or secondary national ambient air quality standards promulgated by EPA pursuant to the Clean Air Act, as amended (42 U.S.C. 1857 *et seq.*). As a result of defendant's acts and omissions alleged in this complaint, this class and each individual member thereof will continue to suffer exposure to above mentioned air pollutants at levels causing or contributing to the endangerment of public health or welfare in deprivation of rights, privileges, and immunities secured by the Constitution of the United States and the Clean Air Act, as amended.

7. Plaintiffs represent a class of persons so numerous that joinder of all is impracticable. They complain of acts and refusals to act on the part of defendants in ways which affect all members of their class similarly. There exist questions of law and fact common to each member of the class. The claims of the representative parties are typical of the claims of the class which they represent. The representative parties will fairly and adequately protect the interest of each member of the class represented.

8. Defendant William D. Ruckleshaus is Administrator of the Environmental Protection Agency. He is required by section 202 of the Clean Air Act, as amended by the Clean Air Amendments of 1970 (sec. 6, Public Law 91-604, 84 Stat. 1690) to promulgate regulations requiring the control of emissions of air pollutants from new motor vehicles and new motor vehicle engines.

GENERAL ALLEGATIONS

9. Section 109 of Title I of the Clean Air Act, as amended by the Clean Air Amendments of 1970, P.L. 91-604, 84 Stat. 1679 (hereafter the Clean Air Act) requires the Administrator to promulgate regulations establishing National Ambient Air Quality Standards (hereafter Air Quality Standards) for each air pollutant for which air quality criteria have been issued. Primary Air Quality Standards are required to be set at levels adequate to protect human health. Secondary Air Quality Standards are required to be set at levels adequate to protect the public welfare.

10. Title I, Section 110 of the Clean Air Act, (84 Stat. 1680) requires each State to prepare and submit to the Administrator for approval a plan which provides for the attainment within the State's boundaries of the Air Quality Standards prescribed by the Administrator.

11. Section 202 of the Clean Air Act requires the Administrator to prescribe standards for emissions from new motor vehicles. Emission standards are required for any air pollutant which "causes or contributes to, or is likely to cause or contribute to, air pollution which endangers the public health or welfare," (84 Stat. 1690). Section 202 of the Clean Air Act further requires the Administrator to prescribe standards for emissions of carbon monoxide (CO) and hydrocarbons (HC) from model year 1975 light duty motor vehicles (hereafter "automobiles"). These latter standards must be set at levels (a) which represent a reduction of at least 90 per centum from emissions allowable under the standards applicable to model year 1970 automobiles, and (b) which (without regard to steps such as automobile inspections or restriction on automobile use, taken by the States pursuant to Title I of the Clean Air Act to control automobile emissions) insure the attainment of the corresponding Primary Air Quality Standards established pursuant to Title I of the Clean Air Act. Thus, the Administrator is required to promulgate a standard for HC emissions from model year 1975 automobiles which is sufficiently stringent to insure that the Primary Air Quality Standards for HC and for Photochemical Oxidants will be met when all automobiles are in compliance with the standard.

12. On April 30, 1971, the Administrator established by regulation (36 Fed. Reg. 8186) Primary Air Quality Standards for HC and for Photochemical Oxidants as follows:

Pollutant	*Primary standard*
Photochemical Oxidants.	160 micrograms per cubic meter (0.08 p.p.m.)—maximum 1 hr. concentration not to be exceeded more than once per year.
Hydrocarbons	160 micrograms per cubic meter (0.24 p.p.m.)—maximum 3 hr. concentration (6 to 9 a.m.) not be exceeded more than once per year.

13. On July 2, 1971, the Administrator prescribed by regulation (36 Fed. Reg. 12657) the standard for exhaust emissions of HC from model year 1975 automobiles as follows:

$$HC = 0.41 \text{ grams per mile (gm./mi.)}$$

14. The standard of 0.41 gm./mi. for HC is too high to insure the attainment of the Primary Air Quality Standards for HC or for Photochemical Oxidants as required by section 202 of the Clean Air Act.

15. The failures as alleged in paragraphs 13 and 14 of the Administrator to perform acts and duties under the Clean Air Act which are not discretionary with the Administrator have caused plaintiffs and those they represent to suffer and to continue to suffer injury for which there is no adequate remedy at law.

16. On August 1, 1971 Plaintiff Natural Resources Defense Council, Inc. gave notice to the Administrator of its intention to bring this action pursuant to section 304 of the Clean Air Act (84 Stat. 1706).

PRAYER FOR RELIEF

A. Declaratory Judgment

Wherefore plaintiffs respectfully pray that:

17. This Court declare that the emission standard for HC for model year 1975 automobiles promulgated by the Administrator fails to achieve the automotive emission reductions mandated by § 202 of the Clean Air Act (84 Stat. 1690) and is, therefore, null and void.

B. Mandamus

Further, plaintiffs respectfully pray that:

18. This Court direct the Administrator to establish an emission standard for HC for model year 1975 automobiles consistent with the mandate of the Clean Air Act, as amended, 42 U.S.C. §§ 1857 *et seq.*

C. Costs

Further, plaintiffs respectfully pray that:

19. This Court award costs of litigation (including resasonable attorney and expert witness fees) to the Plaintiffs.

Finally, plaintiffs respectfully pray that:

20. This Court grant such other and further relief as shall be deemed necessary and proper.

Respectfully submitted.

DAVID G. HAWKINS,
EDWARD L. STROHBEHN, Jr.,
Attorneys for Plaintiffs.

ATTACHMENT C

CENTER FOR THE STUDY OF RESPONSIVE LAW,
Washington, D.C., March 15, 1971.

OFFICE OF THE ACTING COMMISSIONER,
Air Pollution Control Office, Environmental Protection Agency,
Rockville, Md.

DEAR COMMISSIONER: Enclosed please find comments (in triplicate) concerning the proposed primary and secondary ambient air quality standards (42 CFR 410) for your careful consideration.

Sincerely yours,

RALPH NADER.

COMMENTS CONCERNING PROPOSED PRIMARY AND SECONDARY AMBIENT AIR QUALITY STANDARDS (42 CFR 410)

GENERAL CONSIDERATIONS

Section 109 of the Clean Air Act (Public Law 91-640), as amended December 31, 1970, requires that the Administrator of the Environmental Protection Agency promulgate national primary ambient air quality standards based upon (1) the findings contained in the Air Quality Criteria documents regarding the adverse health effects of specific pollutants and (2) an allowance for an "adequate margin of safety" between the figures in the criteria documents and those proposed as standards.

The same section of the Act requires that national secondary ambient air quality standards shall be based upon the Criteria documents and that they shall protect the non-health related aspects of public welfare from any known or anticipated adverse effects of the various pollutants.

These guidelines grew out of a recognition by Congress of the limitations of the Air Quality Criteria documents. Generally, the proposed standards fail to reflect adequate attention on the part of the Administrator to these guidelines in the following ways:

1. Often they do not provide for an adequate margin of safety which is necessary because of the incomplete knowledge concerning the full extent of the hazards presented by various pollutants.

2. In some cases they overlook documented evidence of special dangers presented to particularly susceptible groups such as the very young, the aged or persons with illnesses.

The report of the Senate Committee on Public Works on the National Air Quality Standards Act of 1970 (91st Congress, Second Session, Report No. 91-1196) is quite explicit about the need to include adequate margins of safety in the air quality standards. The Report states, on p. 9:

> In setting such air quality standards the Secretary [now the Administrator] should consider and incorporate not only the results of research summarized in air quality criteria documents, but also the need for margins of safety. Margins of safety are essential to any health-related environmental standards if a reasonable degree of protection is to be provided against hazards which research has not yet identified.

The criteria documents themselves emphasize the limitations of their conclusions. Five of the six documents issued to date conclude with a paragraph which is identical or virtually identical to the following, excerpted from the Criteria document for nitrogen oxides (Chapter 11M):

> It is reasonable and prudent to conclude that, when promulgating ambient air quality standards, consideration should be given to requirements for margins of safety that would take into account possible effects on health, vegetation, and materials that might occur below the lowest of the above levels.[1]

The Senate report also made it clear that primary ambient air quality standards should be formulated with reference to members of the most susceptible groups. The report stated, on p. 10, that,

> * * * the Committee emphasizes that included among those persons whose health should be protected by the ambient standard are particularly sensitive citizens such as bronchial asthmatics and emphysematics who in the normal course of daily activity are exposed to ambient environment.

THE PROPOSED PRIMARY AIR QUALITY STANDARDS

> * * * in 1971, not one grain of dust, not one liter of gaseous pollution has yet been removed from the atmosphere of this Nation as a direct result of the 1967 air legislation. (Speech before the National Press Club, Washington, D.C., January 12, 1972 by William D. Ruckelshaus, Administrator, Environmental Protection Agency.)

It is suggested that unless the proposed standards are drastically revised, the same speech could be made in 1975 with reference to the 1970 Amendments to the Clean Air Act. Virtually all of the proposed standards are inconsistent with the guidelines and considerations outlined above. In addition, they fail to respond to the policy considerations outlined in the 1967 and 1970 air pollution legislation. Those pieces of legislation were intended to provide federal leadership in the establishment of air pollution control standards and clean-up plans. Therefore, it is ironic that the proposed standards very often represent a retreat from standards which have already been adopted by the states and submitted to the federal government for approval.

Sulfur oxides:[2] The proposed maximum 24 hour concentration of SO_x is 365 ug/m^3. This figure is on its face only slightly below the Air Quality Criteria for sulfur oxides. The Criteria document states, at Chapter 10B1d (with Errata sheet): "At concentrations rising from *300 ug/m^3 to 500 ug/m^3* [i.e. starting at 288 ug/m^3 when corrected to a reference temperature of 25° C] of sulfur dioxide (24-hour means), present for 3–4 days with low particulate levels, *increased hospital admissions* of older persons for respiratory disease may occur; *absenteeism* from work, particularly with older persons, may also occur." (Emphasis in original.) When a 24 hour maximum is calculated from the 4 day averaging time, using the Larsen model, the range in which effects could be possible is

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[1] One exception is the Criteria document for hydrocarbons. That report does not close with a version of the paragraph quoted above. The reason for this exception is not clear. However, since hydrocarbon pollution is a matter of public concern primarily because of the relationship between hydrocarbon levels and levels of photochemical oxidants, the omission is unimportant. The Criteria document for photochemical oxidants does close with a paragraph identical to the one quoted in the text.

[2] The proposed standard for sulfur oxide as it appears in the *Federal Register*, Vol. 36, No. 21, Jan. 30, 1971, indicates that all measurements of air quality are corrected to a reference temperature of 20° C and to a reference pressure of 760 mm of mercury. We were informed by a staff member of APCO in Durham that the temperature correction should have been 25° C. The Criteria document for SO_x utilizes numbers based on a reference temperature of 0° C. In order to convert the criteria level numbers comparable to the proposed standard, the following APCO formulation was utilized: at 25° C and 760 mm of Hg. 1 ppm SO_x=2618 ug/m^3.

369 to 443 ug/m³.[3] The proposed standard would permit ambient air levels of 365 ug/m³ for a 24 hour maximum; this allows an infinitesmal margin of safety of 4 ug/m³. The standard should be revised to provide a margin of safety that can appropriately be termed adequate.

The proposed annual arithmetic mean standard for SO_x is 80 ug/m³. The Criteria document (Chapter 10B1g) incidates that adverse health effects have been observed at concentrations of 97.5 ug/m³ (this figure corrected for new reference temperature; 105 ug/m³ at 0° C). The proposed standard appears to be uncomfortably close to the figure contained in the Criteria document at which an increased level of respiratory disease has been noted. In addition, the 80 ug/m³ standard [at 25° C] is more permissive than any standard proposed and/or adopted by 25 air quality control regions as of December 16, 1970. In a number of cases many states have already set standards which are nearly twice as stringent as the proposed federal level. This appears to be a diminution of the extremely modest federal leadership which has been exercised since 1967.

Particulates: The proposed annual geometric mean standard for partculates is 75 ug/m³. As is the case with SO_x, this proposed standard is only slightly below the health effect level cited in the Air Quality Criteria. That document states, at Chapter 12Bg (with Errata): "Where concentrations range from *80 ug/m³* to *100 ug/m³* for particulates (annual geometric means) with sulfation levels of about 0.3 ug/cm²-mo., *increased death rates* for persons over 50 years of age may occur." In addition the proposed standard is more permissive than the standards proposed and/or adopted in 16 air quality regions which had submitted their standards as of December 16, 1970.

Carbon monoxide: The proposed maximum 8 hour concentration for carbon monoxide is 10 mg/m³. The Criteria report states, at Chapter 10K: "An exposure of 8 or more hours to a carbon monoxide concentration of 12–7 mg/m³ (10–15 ppm) will produce a blood carboxyhemoglobin level of 2.0–2.5% in nonsmokers. This level of blood carboxyhemoglobin has been associated with adverse health effects as manifested by impaired time interval discrimination." Given these findings, concern for an adequate margin of safety would have led to proposing a more stringent standard for more susceptible groups such as victims of heart disease, smokers, and persons who suffer from respiratory illness.

Photochemical oxidants: The maximum 1 hour concentration for photochemical oxidants is 125 ug/m³. Here again the difference between the number contained in the criteria document and the proposed national standard is so small as to be insignificant. Inadequate consideration has been given to the need for a margin of safety in view of one of the major conclusions of the photochemical oxidant Air Quality Criteria document: "Under conditions prevailing in the areas where studies were conducted, adverse health effects, as shown by the impairment of performance of student athletes, occurred when the hourly average oxidant concentrations exceeded 130 ug/m³ [Chapter 10L]." The proposed standard is more permissive than the one hour maximum concentration standards for photochemical oxidants proposed and/or adopted in 18 out of 23 air quality regions as of November 16, 1970.

Hydrocarbons: The proposed maximum 3 hour concentration (6–9 a.m.) for hydrocarbons is 125 ug/m³. The Criteria document states that under certain meteorological conditions a 3 hour hydrocarbon concentration of 200 ug/m³ might produce an average ⅓ hour photochemical oxidant concentration of up to 200 ug/m³. The document indicates that measurements were confined to 200 ug/m³ because of instrumentation limitations. However, it goes on to read "If the functional relationship between the hydrocarbon and photochemical oxidant measurements were extended to include the lowest levels at which photochemical oxidant has been observed to adversely affect human health, the corresponding hydrocarbon concentration would be approximately 130 ug/m³ [Chapter 81 with Errata] * * *" The proposed standard provides an extremely slim margin of safety.

Nitrogen dioxide: The proposed 24 hour maximum is 250 ug/m³ and the proposed annual arithmetic mean is 100 ug/m³. The corresponding figures from the Criteria documents are 284 ug/m³ and 117 ug/m³ respectively [Chapter 11M]. The Criteria report for nitrogen oxides indicates that at these approximate

[3] Per R. J. Freeman, APCO, Durham, 2/16/71 chart of "Aerometric Relationships for Specific Sulfur Oxide Criteria Values."

levels an increased incidence of acute respiratory disease can be expected in family groups. Again, the adequacy of the margin of safety must be questioned.[4]

PROPOSED SECONDARY AMBIENT AIR QUALITY STANDARDS

The proposed primary ambient air standards provide unacceptable protection from potential adverse health effects and will therefore require revision in order to conform to the requirements of the Clean Air Act. The process of revision and re-evaluation will necessarily entail a corresponding revision of the proposed secondary standards, many of which seem to be set at levels which would generally be acceptable for use as primary standards.[5] But the levels are unacceptable as secondary standards. For instance, the proposed secondary standard (annual geometric mean) for particulates is 60 ug/m³. The Criteria document for particulates notes non-health related effects beginning precisely at the same point, *60 ug/m³*. The report states [Chapter 12B4] that "At concentrations ranging from *60 ug/m³* (annual geometric means, to *180* ug/m³. The Criteria document for particulates notes non-health related effects *ug/m³* for particulates (annual geometric means), in the presence of sulfur dioxide and moisture, corrosion of *steel and zinc* panels occurs at an accelerated rate." The proposed secondary ambient air standards for SO_x (national 24-hour concentration) is 260 ug/m³. The criteria report for SO_x states [Chapter 10B2] that "At a concentration of *285* ug/m³ [i.e. 262 ug/m³ when corrected for temperature] of sulfur dioxide, with comparable concentration of particulate matter in relative humidity of 50%, visibility may be reduced to about 5 miles."

For the four other pollutants, secondary standards have not been set at levels more stringent than the primary standards since "adverse welfare effects have not been observed at levels below the levels of the proposed primary standards" (*Federal Register*, Vol. 36, No. 21). This is totally inconsistent with Sec. 109 of the 1970 Clean Air Amendments which states that the Administrator of EPA should set secondary standards at levels that he judges are necessary to "protect the public welfare from any known or anticipated adverse effects" of a pollutant. [Emphasis added]

* * * * * * *

The proposed standards evidence a tendency on the part of the Administrator to consider the conclusions in the various Air Quality Criteria Reports as the final word concerning the dangers of air pollution. However, the Criteria reports were intended to summarize the best *available* studies of the effects of pollution. The reports do *not*—indeed they could not—document all of the potential effects. The Criteria are essentially compilations of those studies which already have been conducted and do not take account of effects which are not easily measured (e.g. genetic effects) or those for which data is incomplete.

The weight of increasing scientific evidence is that what we know about air pollution is only a fraction of what must be learned, and the trend of the evidence is that new findings will be even more troublesome than existing knowledge.

The Administrator's duty in this context is to exercise the greatest degree of administrative caution by revising the proposed standards to include wider margins of safety, and to take into account reasonably anticipated adverse effects of the various air pollutants.

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[4] In a Feb. 1, 1971, memo to the Director of the Division of Air Quality and Emission Data, J. B. Clements stated that "It is quite true * * * that the use of micrograms per cubic meter is difficult and on occasion is technically incorrect * * * It is my opinion that workers will continue to use volume per unit measurement by converting ug/m³ to ppm."

This appears to place an unnecessary and time consuming burden on workers in the field—and on citizens who may want to testify—that could easily be overcome by APCO's expressing standards in both ppm and ug/³, as is done in most of the Criteria documents. In that way, data on gaseous air pollutants would be more readily comparable and fewer errors might be made in converting figures.

[5] In fact, many regions had already proposed or set standards by December 1970 that are as stringent or more stringent than the Federally proposed *secondary* levels.

Number of regions proposing standards as stringent or more stringent than the federally proposed secondary levels

Standard:		
Sulfur oxides	17	[Annual arithmetic mean]
Particulates	8	[Annual geometric mean]
Carbon monoxide	8	[Maximum 8 hour concentration]
Photochemical oxidants	18	[Maximum 1 hour concentration]
Hydrocarbons	15	[Maximum 3 hour concentration]

ATTACHMENT D

COMMENTS ON THE PROPOSED NATIONAL PRIMARY AND SECONDARY AMBIENT AIR QUALITY STANDARDS (36 F.R. 1502, JAN. 30, 1971), SUBMITTED BY THE PROJECT ON CLEAN AIR OF THE NATURAL RESOURCES DEFENSE COUNCIL IN CONSULTATION WITH THE SCIENTISTS' INSTITUTE FOR PUBLIC INFORMATION—BY RICHARD E. AYRES, MARCH 16, 1971

The Clean Air Amendments of 1970 represent one of the strongest statements of public policy ever adopted by a Congress. Seldom does Congress express its desires so clearly and unequivocally, and with such force as it did in this Act. It is thus of the utmost importance that the administrative regulations promulgated under the Act, such as the national ambient air standards, implement embody the full force of the Congressional mandate. Although the proposed standards do go much further than might have been imagined a few years ago, they do not take full advantage of the authority to rid the air of pollution granted in the Act.

I. LEGISLATIVE MANDATE

To show how much further the standards should go requires an examination of the statute and its legislative history. The statutory section under which the proposed standards were promulgated, § 109(b) (1) and (2) of the Act. 42 U.S.C. § 1857 et seq., as amended (1970), requires that the Administrator of EPA set national "primary" ambient air standards which, "allowing an adequate margin of safety, are requisite to protect the public health;" and that "secondary" standards be promulgated sufficient to "protect the public welfare from any known or anticipated adverse effects associated with the presence of air pollutants in the ambient air."

Congress made it clear that these values were to prevail over considerations of cost and inconvenience, not to be balanced against them, as under previous pollution control legislation. In the Report accompanying the Senate bill, which is the major expression of Congressional intent regarding the Act as finally enacted, the Committee stated:

> The protection of public health * * * will require major action throughout the Nation. Many facilities will require major investments in new technology and new processes. Some facilities will need altered operatng procedures or a change of facilities. Some facilities may be closed.
>
> If the Nation is to continue to depend on individual use of motor vehicles, such vehicles must meet high standards * * * As much as seventy-five percent of the traffic may have to be restricted in certain large metropolitan areas if health standards are to be achieved within the time required by this bill. *Senate Committee on Public Works*, National Air Quality Standards Act of 1970, *S. Rep. No. 91-1196, 91st Cong., 2d Sess.* 2 (1970).

1. "Public health."—In adopting public health as the primary criterion for setting standards, Congress made quite clear that it meant this term to be construed broadly for the benefit of the people. The Senate Committee Report, accompanying the Senate bill (with the same standard), made clear that by protection of health the Act meant the safeguarding of all persons who are not so sick or young or otherwise susceptible as to require special artificial environments, even those who have diseases rendering them especially vulnerable to airborne pollutants:

> The Committee emphasizes that included among those persons whose health should be protected by the ambient standard are particularly sensitive citizens such as bronchial asthmatics and emphysematics who in the normal course of daily activity are exposed to the ambient environment. *Sen. Rept.* 10).

2. "Public Welfare."—Secondary standards were adopted to protect other values besides health from deterioration. Welfare was intended to be given the broadest possible reading:

> * * * effects on soils, water, vegetation, manmade materials, animals, wildlife, visibility, climate, and economic values. *Sen. Rept.* 11.

And in describing the research efforts to be undertaken to discover the effects of pollution on welfare value, the Committee said:

> The bill would provide for furtherance of knowledge on welfare effects, including effects on vegetation, animals, wildlife, buildings, structures, and materials. This research effort should extend into welfare effects and

aesthetics in their broadest definition, including the economy, visibility, weather, and climate. *Sen. Rept.* 7.

3. Compensation for Lack of Knowledge.—Congress recognized that to a considerable extent, it must legislate while the full effects of air pollution were only beginning to be understood, and at a time when air pollution effects were being discovered at ever lower levels of pollution. Thus the Act directs that error be made on the side of caution. Primary ambient standards are to be set so as to give an "adequate margin of safety." Secondary standards are to protect the public from "known or *anticipated*" effects [emphasis added]. Standards are to be reviewed regularly:

> The Committee believes that criteria and control technology documents should be periodically reviewed and re-issued to ensure currency. *Sen. Rept.* 9.

In short, the Act requires the Administrator to go further than merely to protect the health and welfare of the general public against presently known hazards. For the most part, the proposed standards would accomplish this goal. But the Act requires more. It requires that even the least tolerant groups in society, so long as they must expose themselves to the ambient air, must be protected against harm. And it adopts the most prudent position possible for dealing with our present dearth of knowledge: namely, that standards should provide a considerable margin beyond what is now known to be necessary to protect health and welfare, and that knowledge should be gained as rapidly as possible, and incorporated quickly into the national ambient air quality standards.

II. GENERAL COMMENTS

The ambient air standards ultimately promulgated by the Administrator will comprise an extremely important document—the basis from which federal and State enforcement will begin. Much of the detail which will govern the actual effect of the statute will be part of the federal implementation plan, and therefore should not appear in the standards document. But certain additional provisions should be included in the national air quality standards document to make it clear that the standards will be administered in the spirit which pervades the Act.

First, the regulations should explicitly provide for regular review and revision at stated intervals—perhaps yearly or even two years. Earlier review and revision should, of course, remain possible as soon as warranted by new information.

Congress recognized that much remained to be learned about the effects of pollution in particular about the effects of long term exposure to pollutants. In § 103 of the Act it provided funds to be spend for this purpose. The use of terms such as "anticipated effects" and "margin of safety" demonstrate Congress' fear that harmful effects might occur at concentrations well below those now considered dangerous. One of the clearest implications of the survey study by The Scientist's Institute accompanying these comments is that much more research must be done before we know the full price we pay for polluted air, and therefore that standards adopted now must be reviewed periodically as findings accumulate. Providing a definite review time, while it would not prevent earlier review, would help assure that the results of new studies were continuously integrated into the national ambient air standards.

Second, the regulations should explicitly note that the proposed standards are maxima, and do not license states to allow pollution of presently less polluted areas. A statement of this sort contained in the standards document would be a further step towards implementing the intent of Congress described by the Senate Report in its comments regarding the setting of national air quality standards:

> In areas where current pollution levels are already equal to, or better than, air quality goals, the Administrator should not approve any implementation plan which does not provide, to the maximum extent practicable, for the continued maintenance of such ambient air quality. *Sen. Rept.* 11.

In furtherance of this intent, the ambient air quality standards should explicitly state that because of the legislative history of the Act, in air quality regions where present levels of pollutants are lower than the national standards the present levels shall constitute the federal standards of ambient air quality for those regions.

Finally, the regulations should make explicit what is now only implicit in the manner of stating the standards: that these standards are to be observed regard-

less of meteorological conditions (such as inversions). Where inversions would cause a region to exceed the maximum concentration for any pollutant more than the "once per year" provided for in the standards, the standards should make it clear that emergency procedures, including temporary shutting down of manufacturing plants, traffic controls, or other measures provided for in implementation plans must be taken to ensure that the maxima are not exceeded. The standards should make it clear that they are not merely goals, but rather commands, which cannot legally be exceeded except during the period allowed by a duly authorized implementation plan and in compliance with the schedule contained in such a plan.

III. SPECIFIC COMMENTS

A. *Primary standards.*—According to the statute, primary standards must "protect the public health" and give an "adequate margin of safety." As the accompanying report of The Scientist's Committee suggests, for the purposes of the proposed standards, this statutory command appears to have been interpreted to mean that the highest allowable concentrations of each pollutant should be set at or slightly below the level shown by presently available research to produce adverse health consequences. It is doubtful whether such standards can meet the statutory mandate.

The Senate made it quite clear in Committee what they meant by protecting "health." They meant, as pointed out above, that the protection was to extend to the most sensitive groups (among those exposed to the ambient air) in the public. The Senate bill did not contain any provision for a "margin of safety." In the Conference version of the bill, the conferees added to the language of the Senate bill the proviso that ambient air standards should give an "adequate margin of safety." Thus the Act as passed means that any ambient air standard should provide an adequate margin of safety beyond the level necessary to protect the health of the most susceptible groups.

Of course, the levels of pollutants which produce adverse health effects in the most susceptible groups are in most cases not now known. In the absence of data about how much more susceptible groups such as asthmatics and emphysematics are, however, the intent of Congress throughout the act—to err on the side of health[1]—plus the requirement of a margin of safety, should dictate standards substantially more protective than the lowest levels known to be hazardous to less susceptible groups.

For these reasons, we suggest that, until enough research has been done to establish clearly what will be necessary to protect the more susceptible members of society, no standard should allow a concentration of any pollutant more than 75% of the concentration known to be harmful to the health of normal people. Of course, research should go forward immediately to determine what levels are hazardous to susceptible groups: neither industry nor the public should be penalized because of insufficient knowledge.

Primary standards—Other comments

(1) *Particulate matter standards.*—The standard for particulate matter does not include any standard concerning the size of particles which are permitted. As the attached Scientist's Institute paper points out, the harmful effect on health of particulate matter in the air depends heavily on the sizes of the particles. A standard which controls only the total mass or number of particles may fail to protect public health. Instead, the air quality standard should specify, perhaps by graph, an allowable frequency distribution of various sized particles as well as the maximum quantity of particulate matter allowed.

(2) *Sulfur dioxide standards.*—Any standard setting a maximum level of exposure, as the proposed standards do, only protects health adequately if the measuring time given in the standard is the same as the shortest period within which adverse effects on health have been documented. With respect to sulfur dioxide, damage to life functions has been shown to occur with as little as one hour of exposure. For this reason, the standard for sulfur dioxide should include a maximum one hour volume as well as the present twenty-four hour maximum and yearly mean.

[1] The Senate Report, for example, suggests that the "anticipated" as well as "known" health effects were to be considered in setting primary standards. S. Rept. 11. It is certainly proper to anticipate that adverse health effects will be found at lower levels among susceptible people than within the population at large.

The findings of Larsen, cited in the accompanying Scientist's Institute document, also raise serious general questions about the standard for sulfur dioxide. Larsen's work is one of the few attempts to estimate statistically the magnitude of the health hazard to humans from a pollutant. Larsen's study covered, of course, only two quite atypical cities—London and New York—but it does provide the basis for some reasoned estimate of the impact of sulfur dioxide. Using the proposed standards, The Scientists Institute has calculated, using Larsens equation, that the primary standards would permit 22 excess deaths in New York or London during an air episode in which pollution levels rose to the maximum 24 hour cogncentration permitted by the standards. Extrapolating from such calculations is very hazardous—no one knows whether Larsen's equation is accurate in smaller cities. Yet his data and conclusions raise serious questions about whether the once a year peak values, and even the yearly averages, for sulfur dioxide can be said to protect public health so long as the standards do not prevent "excess deaths" altogether.

B. *Secondary Standards.*—The Act requires that secondary standards be set so as to protect public welfare from all known or anticipated effects of pollutants. The word "welfare" was meant to include essentially all environmental values other than human health. The Senate Report, quoted above, made clear that under this part of the statute, it was expected that protection would be provided for "soils, water, vegetation. man-made materials, animals, wildlife, visibility, climate, and economic values," *Sen. Rept.* 11, and elsewhere included aesthetic values, buildings, climate and weather. *Sen. Rept.* 7.

The proposed secondary standards, like the proposed primary standards, appear to have been set at or slightly below the pollution level which has been demonstrated in existing literature to be harmful to one or more of the values listed. In the case of carbon monoxide, photochemical oxidants, hydrocarbons, and nitrogen dioxide, primary and secondary standards have been set at the same level, on the grounds that "adverse welfare effects have not been observed to occur at levels below the levels of the proposed primary standards." 36 *FR* 1502, (Jan. 30, 1971).

It is questionable whether this method of setting the standard satisfies the statute. To say that no adverse effects have been observed is not to say that none can be anticipated. Indeed, in the past, new research has almost always revealed harm at ever-decreasing concentrations of pollutants. In view of past history, and the relatively small amount of research so far done, the most reasonable anticipation to make would be that harm to welfare values occurs at concentrations lower than has theretofore been demonstrated.

The secondary standards also ignore synergism, which is known or suspected with good reason to occur with sulfur oxide and photochemical oxidants,[2] and with nitrogen oxides and sulfur dioxide or photochemical oxidants.[3] The results of research to date should be sufficient to make synergism a "known or *anticipated*" effect of air pollution, and appropriate adjustments downward in the concentrations allowed by the standards should be made.

3. *Photochemical oxidants.*—As the accompanying Scientists' Institute document relates, the secondary standard for photochemical standards has been set well above the level at which synergistic effects have been noted between ozone and various other pollutants.[4] Work with peanuts and tobacco plants by several experimenters has demonstrated effects at extremely low concentrations of these mixed pollutants.

In view of the studies cited there, the maximum allowable concentration of photochemical oxidants should be considerably reduced. The air quality standards cannot fulfill the statutory standard if they fail to protect against synergistic effects, since these are now either "known" or "anticipated."

IV. SUMMARY OF RECOMMENDATIONS

1. The national air quality standards should explicitly provide for review and revision at regular intervals—perhaps yearly or every two years—to assume that the results of new studies, especially of long-term effects, are continuously integrated into the air quality standards. This provision should not preclude

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[2] *The scientists' Institute for Public Information,* "The Proposed National Primary and Secondary Ambient Air Quality Standards: An Analysis," 10, 16, 4. [Hereinafter SIPI Rept.]

[3] Id. at 10, 16.

[4] SIPI Rept., 10–11.

earlier review and revision, but should set an outer limit to the time a standard may be put in effect without review. P. 5.

2. The aid quality standards should explicitly state that the values given are maxima, and that, because of the legislative history of the Act, in any air quality region which is presently less polluted, present levels shall constitute the federal standard which may not be exceeded. P. 6.

3. The national air quality standards should explicitly state that they are to be observed regardless of special meteorological conditions, subject only to exception during the period alowed by a duly authorized implementation plan and in compliance with the terms of the schedule for compliance contained in such plan. The regulations should state that emergency procedures provided for in implementation plans, such as shutting down plants, traffic controls, and other measures, must be taken where necessary to prevent exceeding the maxima. P. 7.

4. No primary air quality standard should exceed 75% of the concentration presently known to be harmful to the health of normal (i.e. non-specially susceptible) people. P. 6–7.

5. The primary air quality standard should specify (perhaps by graph) an allowable frequency distribution of various-sized particles as well as the maximum quantity of particulate matter allowed. P. 10.

6. The primary air quality standard for sulfur dioxide should include a maximum one hour concentration as well as the presently proposed twenty-four maximum and yearly mean. P. 10.

7. The primary air quality standard for sulfur dioxide should be re-evaluated in light of the findings of Larsen suggesting that 22 excess deaths could occur in New York during an episode in which concentrations of sulfur dioxide reached those allowed under the proposed eight-hour maximum, in light of the reasonable inferences these findings give rise to, and in light of the statutory command and safegard the "public health," "allowing an adequate margin of safety." P. 11.

8. The secondary air quality standards should be revised to provide greater protection, in view of the reasonably anticipated effects of the six major air pollutants, including known or anticipated the effects of synergism among certain of them. P. 12–13.

9. The secondary air quality standard for photochemical oxidants should be revised to provide greater protection, taking into account the available findings as to the harmful effects of ozone when mixed with other pollutants. P. 14.

ATTACHMENT E

Comments Concerning Proposed 1975 Emission Standards for Hydrocarbons (42 CFR Part 12021)

HYDROCARBONS

Section 202(b) of the Clean Air Act, as amended, (Public Law 91–604), requires, *inter alia*, that the Administrator promulgate "regulations * * * applicable to emissions of carbon monoxide and hydrocarbons from light duty vehicles and engines manufactured on or after model year 1975 [which] shall contain standards which require a reduction of at least 90 per centum from emissions of carbon monoxide and hydrocarbons allowable under this section applicable to light duty vehicles and engines manufactured in model year 1970." [1] The proposed 1975 standard for hydrocarbons (HC), announced on February 22, 1971, fails to comply with this legislative mandate. A new test procedure for measuring emissions from vehicles has been utilized in a manner which defeats the clear purpose of Section 202.

The Environmental Protection Agency (EPA) has anticipated criticism on this score and included the following explanation in its announcement of the proposed standard:

> The proposed standards are based on 130 tests on 1970 model year vehicles to determine the equivalency between the test procedure to be used beginning with the 1972 model year and the test procedure actually used for the 1970 model year. Based upon these tests, it was determined that the 1970 standards of 2.2 grams per vehicle mile hydrocarbons * * * [was] * * * equiv-

[1] 42 USC 1857 f–1, as amended by the Clean Air Amendments of 1970, 84 Stat. 1676, 1690, Public Law 91–604, Dec. 31, 1970.

alent to 4.6 grams per vehicle mile hydrocarbons * * * using the new test procedure. Therefore, a 90 per centum reduction using the new test procedure would produce the proposed standards set forth herein. It is emphasized that the higher numerical values reflect only the change in test procedure and not any decrease in stringency.[2]

Utilizing the new test procedure, EPA determined that HC emissions for cars meeting the 1970 standards are 4.6 gm/mi—rather than 2.2 gm/mi as measured by the test currently in use. A 90% reduction of 4.6 yields 0.46, the proposed 1975 HC standard.

However, neither the text of Section 202 nor any of the supporting legislative history indicate anything less than what the words of Section 202 clearly require: a 90 per cent reduction of the 1970 standard, without "equivalency" based upon the new test procedure. As will be shown below, Section 202 requires a 1975 HC standard more than twice as stringent as the EPA proposed standard—0.22 gm/mi. instead of 0.46 gm/mi.

THE MEANING OF "90 PER CENTUM" HYDROCARBON REDUCTION

Section 202(b) of the Clean Air Act represents a departure from the previous federal attempts to control automotive air pollution. By enacting this section, Congress clearly expressed its intention that "technological and economic feasibility" no longer act as a brake on standards-setting—as it had under the legislation which Section 202(b) superseded. This intention was expressed by quite specifically limiting the discretion which had been allowed the administrative agency under the earlier legislation. In introducing the concept Senator Edmund S. Muskie, the author of Section 202(b), told the Senate, "* * * we have learned that tests of economic and technological feasibility applied to these standards compromise the health of our people and lead to inadequate standards. It is clear that the long-range proposal for emission standards will only be adequate if the timetable is accelerated."[3]

At the time these words were spoken on the floor of the Senate on September 21, 1970, the "timetable" for emission control was apparent to all observers. Almost one year earlier, on November 20, 1969, at a meeting of the Environmental Quality Council, the Administration announced its interim (1975) and ultimate (1980) automotive emission goals. Representatives of the automobile industry attended this announcement and gave the goals their tacit support on the understanding that there would not be additional "harassing" emission standards set for intervening years. The goals proposed by the Administration were:

	1975	*1980*
Hydrocarbons	0.5	0.25
Carbon monoxide	11.0	4.7
Nitrogen oxides	.9	.4
Particulate matter	.1	.06

On September 17, 1970, the Senate Public Works Committee reported out a bill containing the language which was later to become Section 202(b). On the Senate floor, September 21, 1970, Senator Muskie explained the effect of the Section: ". . . the emission standards for carbon monoxide, hydrocarbons, and nitrogen dioxide which have been projected for 1980 must be met earlier. This bill would require that this be done by 1975."[4,5] Anyone hearing the Senator's words on September 21, 1970, would have concluded that the anticipated HC standard for 1975 would be about 0.25—*i. e.*, the original 1980 standard.

Announcements by the National Air Pollution Control Administration on July 15, 1970 led to the first public knowledge of the new test procedures to be applied beginning with the 1972 model year. A detailed press release issued on the same day indicates that the Senate had no knowledge that the new test procedure would affect the numerical value of the standards (when it enacted Section 202).[6] NAPCA's press release explained that the new system revealed that mass emissions for uncontrolled (pre-1968) vehicles were actually greater

[2] *Federal Register*, Vol. 36, No. 39, Feb. 26, 1971.
[3] *Congressional Record*, S16090. Sept. 21, 1970.
[4] As finally enacted by Congress, the law requires that the originally proposed 1980 standards for nitrogen dioxide be met by 1976 instead of 1975.
[5] *Ibid.*, S16091.
[6] *HEW News*, July 15, 1970.

than had been believed. While the present test method indicated uncontrolled HC emissions of 11.2 gm/mile, the 1972 test revealed emissions of 14.6 gm/mile.

This underestimate had naturally carried over to controlled vehicles. NAPCA found that the 1970 HC standard of 2.2 gm/mile had achieved only a 69% reduction, instead of the intended 80% reduction.[7] In other words, the new test procedure showed that HC emissions for 1970 model year cars are 4.6 gm/mile instead of 2.2. NAPCA explained its new findings and proposed standards as follows:

> *Publication of 1975 model year exhaust standards*
>
> On February 10, 1970, the Secretary of Health, Education, and Welfare announced the Department's intention to propose more stringent exhaust standards for hydrocarbons and carbon monoxide to be effective with the 1975 model year. The proposed regulations carry out that intent. The proposed new standards will be 0.5 grams per vehicle mile for hydrocarbons * * * *Compliance with these standards will be determined using the proposed new procedures.* (Emphasis added)

This statement was issued on July 15, 1970.

Therefore at the time the Senate amendments were adopted—on September 22, 1970, NAPCA had already announced the new test procedures and indicated that they would not result in a more permissive HC number for 1975. The general understanding was that, without any change in the law, the HC standard for 1975 was to be 0.5 gm/mile (the same figure that had been proposed at the 1969 meeting of the Council on Environmental Quality) with compliance determined by using the proposed new procedures. The passage of the Senate amendments—later adopted by the House—was generally understood as adoption of Senator Muskie's plan to accelerate the standards by five years, i.e. to leapfrog the proposed 1975 standards and to require compliance with the proposed 1980 standards by 1975. In view of these facts, it would be unreasonable to infer that after one of the major legislative battles of 1970, Congress intended to reduce the 1975 HC standard by an infinitesimal amount (0.04) below the originally-proposed level (from the originally understood level of 0.5 to EPA's proposed level of 0.46).

In addition, it is important to note the reason for the adoption of the new test procedure. In its July 15, 1970 announcement, NAPCA explained that the new test would be more efficient "because more of the gases are sampled, because the driving cycle is more realistic, and because the new instruments are more accurate."[8] The inadequacy of the old test—and the auto industry's consequent poor performance in emission control—is now the basis for relieving the industry from its full responsibility to reduce pollution. This ironic result is clearly inconsistent with the legislative history of Section 202.

The Senate Report is the most explicit piece of legislative history on this subject and there is no reason to assume that the Report meant anything less than what was clearly stated.

In its discussion of the meaning of the "90 per centum reduction" language, the Report clearly indicates an intention that the originally-proposed 1980 standards for three of the major auto pollutants should be moved up to 1975. In its discussion of these pollutants, the Report says:[9]

> A. To achieve the public health ambient standard would require emission controls placed on automobiles permitting emissions of only *5 grams per mile [of carbon monoxide], a figure which represents the 1980 emission requirement as proposed by the Administration.*
>
> * * * * * * *
>
> B. To achieve such ambient standard [for photochemical oxidants, of which hydrocarbon is a chemical precursor] would require *a reduction of hydrocarbon emissions from automobiles from the 1970 standard of 2.2 gm/mile of an emission level of 0.2 gm/mile. This last figure is the approximate*

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[7] Of course, even the new percentage of "control" overstates the case since the figures are hypothetical for cars actually in use. NAPCA tested only a handful of prototype vehicles for certification purposes and has acknowledged many times that the failure rate for cars actually in use is enormous.

[8] *Ibid.*

[9] National Air Quality Standards Act of 1970, Senate Report No. 91–1196, 91st Congress, 2nd Session, p. 25. The Conference Report said of Section 202: "The conference substitute follows substantially the Senate amendments * * * Carbon monoxide and hydrocarbon emissions from light duty vehicles for 1975 model year and thereafter are t be reduced at least 90 per centum over 1970 standards * * *." (Conference Report, "Clean Air Amendments of 1970," House of Representatives, 91st Congress, 2d Session, Report No. 91–1783, December 1970, p. 49.)

equivalent of the proposed 1980 emission standard.

C. To achieve the health standards would require a *reduction from the proposed 1973 emission standard of 2.0 gm/mile [of nitrogen oxides] to an emissions requirement for automobiles of 0.45 gm/mile, or approximately the proposed 1980 standards.*

Section B of the Report excerpt indicates a 1975 standard approximately equivalent to the 1980 standard of 0.25 and makes no mention of the standards being adjusted in the light of the new test procedures. In fact since the NAPCA announcement of July 15, 1970 had indicated that the new test procedures would not affect the originally-proposed 1975 standards, there is every reason to believe that the Senate, and ultimately the House (which made no independent inquiry into Section 202) believed that the new HC standard under Section 202 would be about 0.25 grams per mile, utilizing the test procedures.

It is important to note that the Congressional decision to accelerate the 1980 standards to 1975 was not an arbitrary one. Rather it was based on the results of scientific research done by the National Air Pollution Control Administration. The Senate Report states that "[f]nformation provided that Committee by the Administration indicated that, under the existing new vehicle emission control program * * * it would be 1990 before the ambient levels of motor vehicle related pollutants would be brought down to the level necessary to protect the health of persons." [10] The Report goes on to indicate that this conclusion was based upon a paper by Delbert S. Barth, Director of the Bureau of Criteria and Standards, National Air Pollution Control Administration.[11] The Barth paper computed automobile emission goals based upon desired levels of air quality. The conclusion for hydrocarbon emission goals was that, assuming a 1980 target date, the desired standard would be 0.14 gm/mile, a figure which is even more stringent than the Administration's goal of 0.25 gm/mile. The discrepancy between these two figures may or may not be important, depending upon the importance of the fact that reduced emissions would come five years earlier than anticipated. However, NAPCA's finding that 1970 vehicles have not achieved the intended degree of control makes it all the more imperative that the EPA standard be as close to the Barth number (0.14 gm/mi.) as is possible under the law.

It is clear from the response of the automobile industry to news of the impending Senate Public Works Committee's action that the industry understood that the "90 per centum" language would mean a 1975 hydrocarbon standard of about 0.25. For example, on August 27, 1970, Thomas C. Mann of the Automobile Manufacturers Association complained to the Secretary of HEW about the information provided to the Committee.

> * * * This bill in its present form proposes a drastic reduction in auto emission levels for 1975 as compared with the already stringent HEW goals for 1975 * * *.
>
> It is our understanding that the information from HEW contained in this document was reported in a paper entitled "Federal Motor Vehicle Emission Goals for CO, HC and NOx based on Desired Air Quality Levels" which I understand was used in a presentation by D. S. Barth, J. C. Romanovsky and E. A. Schuck of your Durham office at a June 16, 1970 annual meeting in St. Louis of the Air Pollution Control Association. It was made manifestly clear in the paper that the measurements, math models, data analysis, and conclusions are of a developmental or a preliminary nature and not intended to be construed as final or adequate for establishing legal standards.
>
> It is also our understanding that the information supplied by HEW staff is currently being evaluated by NAPCA and should not be considered definitive or official until after review and the required publications in the *Federal Register.*
>
> We are concerned that major legislative proposals concerning emissions standards embodying serious social and economic consequences are based on technical information supplied by HEW staff which has not received the rigorous technical scrutiny customary in HEW. We respectfully request that you personally review the material supplied by your department to Senate staff and, if you share our views concerning the nature of the data, that you promptly inform Senator Muskie.

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[10] Senate Report, p. 25.

[11] Delbert S. Barth, "Federal Motor Vehicle Emission Goals for CO, HC and NOx Based on Desired Air Quality Levels," *Air Pollution Control Association Journal*, Vol. 20, No. 8, August, 1970.

On September 2, 1970, Acting Secretary of HEW, John G. Veneman sent a reply to the AMA. The reply reaffirmed the need for standards as stringent as the Administration's ultimate 1980 goals and agreed that the degree of control called for in the bill was consistent with the Administration's 1980 emission levels:

> — * * * The paper entitled "Federal Vehicle Emission Goals for CO, HC, and NOx Based on Desired Air Quality Levels," prepared and presented by personnel of the National Air Pollution Control Administration, is intended to show, within the limits of existing data, the relationship between motor vehicle emission reductions and improvements in air quality. More specifically, it seeks to demonstrate that further reductions in such emissions, beyond those we have proposed for 1975, will be necessary, and that the order of magnitude of the needed reductions is consistent with the goals we previously announced for 1980.

During the Congressional debates concerning the 90 percent reduction, Mr. L. A. Iacocca, now President of the Ford Motor Company, emerged as one of the industry's leading spokesman against the impending legislation. A pamphlet discussing the automotive sections of the Clean Air Act amendments was issued from his office on September 9, 1970. The figures and arguments employed by Mr. Iacocca in his attempt to defeat the "90 percentum" provision are quite revealing. He said, "[t]hese proposed standards [the original HEW 1975 standards] *using the Federal government's present test procedures, would reduce* hydrocarbon exhaust emissions by 98 percent from pre-control level. . . . These latest proposed standards [Section 202] would result in exhaust emission reductions from pre-1968 levels of 95 percent in hydrocarbons." (Emphasis added.) [12] Mr. Iacocca anticipated that, despite the fact a new test would be applied beginning with model-year 1972, the percentage reduction required by Section 202 was to be applied against the 1970 standards without "equivalency"—*i.e.*, Mr. Iacocca anticipated an HC standard of about 0.25.

Mr. Iacocca's pamphlet does not indicate formulas used to arrive at the 95% (original HEW) and 98% (Section 202) reductions. However, it is clear that the 95% reduction was derived as follows:

$$\frac{11.2^{*}-0.5^{**}\times 100}{11.2}=95.6\%$$

*Old uncontrolled figure.
**Originally proposed 1975 standard.

The 98% reduction figure was based on either the old uncontrolled figure (11.2) or the uncontrolled figure announced on July 15, 1970, *but the anticipated standard could only have been the originally proposed 1980 figure (0.25)*:

1. Old uncontrolled basis:

$$\frac{11.2-0.25[1980]\times 100}{11.2}=97.8\% \text{ (98\% rounded)}$$

2. July 15, 1970 basis:

$$\frac{14.6-0.25[1980]\times 100}{14.6}=98.3\% \text{ (98\% rounded)}$$

These calculations indicate that at least one major auto industry spokesman anticipated a 1975 HC standard of 0.25 when Section 202 was enacted into law.

CONCLUSION

The intention of Section 202 was to mandate a 1975 HC standard approximately equivalent to the originally proposed 1980 standard of 0.25. For purposes of legislative draftsmanship Section 202 employed the "90 percentum" language rather than adopting a specific number standard. Literally applied, Section 202 requires a 1975 standard of .22gm./mi. There is no evidence that Congress anticipated that the use of a new test would alter the 1975 standard. On the contrary, all information available to the Senate, where the section was drafted and fully explored, indicated that the new test procedure would not result in the "adjusted" 1975 HC number now proposed by EPA. The final standard for HC should be .22 gm/mi.

[12] Statement by L. A. Iacocca, Executive Vice President, Ford Motor Company, Dearborn, Michigan, September 9, 1970, "Concerning Pending Senate Changes to the Clean Air Act."

ATTACHMENT F

STERN COMMUNITY LAW FIRM,
Washington, D.C., April 27, 1971.

Re: 45 CFR Part 1201—1975 Emission Standards For Hydrocarbons and Carbon Monoxide Applicable to Light-Duty Vehicles (Published at Federal Register, Vol. 36, No. 39, p. 3528—Friday, February 26, 1971).

Attention: Air Pollution Control Office
Mr. WILLIAM D. RUCKELSHAUS,
Administrator, Environmental Protection Agency
Rockville, Md.

DEAR MR. RUCKELSHAUS: The following comments are submitted on behalf of the undersigned and on behalf of other individuals and groups similarly affected.

THE PROPOSED 1975 EMISSION STANDARDS VIOLATE SECTION 202 (b) (1) (A) OF THE CLEAN AIR ACT [1]

A. Section 202(b) (1) (A) must be interpreted consistently with the basic intent of the Clean Air Amendments of 1970.

The basic goal of the Clean Air Amendments of 1970 is to insure the achievement within the next five years of a level of air quality that will have no adverse effects on the health of persons in the United States.[2] In bringing the bill which became, substantially unchanged, Public Law 91-604, before the Senate, Senator Muskie stated, "Our responsibility is to establish what the public interest requires to protect the health of persons." [3] Senator Spong stated, "Under the pending bill the Secretary [now Administrator] would set standards on the basis of the degree of control necessary to insure health-related ambient air quality levels." [4] Section 109 of the Act requires the promulgation of national primary ambient air quality standards sufficient to protect the public health. Section 110 requires each State to develop implementation plans which provide for the attainment of the primary standards within three years of the plan's approval. Section 202(b) is an integral part of the national primary ambient air quality standards programs. It will function as a federally-preempted component of each State's implementation plan. Thus the standards set under Section 202(b) must be compatible with the attainment of the national ambient air quality standards.

B. The basic intent of section 202(b) (1) (A) was to mandate that emission standards for automobiles of 1975 subsequent model years be set at a level capable of achieving ambient air quality protective of the health of persons.

Section 202(b) (1) (A) speaks in terms of a mandatory "reduction of at least 90 per centum" from emissions allowable under 1970 standards. This formula is an attempt to communicate in a compact, comprehensible form the mandate that emissions from automobiles be reduced by model year 1975 to a level permitting the achievement of health-related ambient air quality. The section has its source in communications between the staff of the Subcommittee on Air and Water Pollution of the Senate Committee on Public Works and the National Air Pollution Control Administration (NAPCA).[5] The Subcommittee staff requested NAPCA to provide it with data identifying ambient air standards for motor vehicle related pollutants and determining the automobile emission levels necessary to achieve these standards.[6] The staff summarized the information provided by NAPCA as follows:

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[1] 42 USC 1857 f-1, as amended by the Clean Air Amendments of 1970, 84 Stat. 1676, 1690, Public Law 91-604. December 31, 1970.

[2] See Cong. Record, S16090, Sept. 21, 1970. (Statement of Senator Edmund Muskie).

[3] *Ibid.*, S16091.

[4] *Ibid.*, S16109. (Statement of Senator William B. Spong, Jr.)

[5] See Letter of August 27, 1970 from Thomas C. Mann, President Automobile Manufacturers Association, Inc., to Elliot L. Richardson, Secretary of Health, Education, and Welfare, printed in Appendix to Air Pollution 1970, Hearings before the Subcommittee on Air and Water Pollution of the Committee on Public Works, United States Senate, 91st Cong. 2d Sess., p. 1576. (Hereinafter cited Air Pollution—1970.)

[6] See Staff Memorandum "Automobile Emissions Control and Achievement of the Ambient Air Standard necessary to protect health." Printed in Air Pollution—1970, p. 1576.

JUNE 11, 1970.

From: Staff

Subject: Automobile Emissions Control and Achievement of the Ambient Air Standard necessary to protect health.

Communications were held with the National Air Pollution Control Administration for the purpose of determining how long it would take to achieve a national ambient air standard related to health, with particular emphasis on the relationship of automobile emissions to the achievement of such standard. Automobiles contribute three particular pollutants in great quantities (a) carbon monoxide, (b) photochemical oxidants (hydrocarbons), and (c) oxides or nitrogen.

A. The *ambient standard* necessary to protect the public health from *carbon monoxide is 8–10 p.p.m.* This compares to *existing ambient air in Chicago, for instance, of 44 p.p.m.* The 1976 Federal emission standard for automobiles for carbon monoxide is 23 gm./mile. To achieve the public health ambient standard would require emission controls placed on automobiles permitting emissions of only 5 grams per mile; a figure that represents the 1980 emission requirement as proposed by the Administration. In order to achieve sufficient replacement of automobiles with autos having the emission controls meeting 1980 standards it will take an estimated ten years. Therefore on assumption of present programs it will be 1990 before carbon monoxide levels will be brought down to the public health ambient standard. This is premised, it must be emphasized, on reliance exclusively on automobile emission controls and reliance upon proposed levels of controls and their rate of application.

B. The ambient air health standard for photochemical oxidants (hydrocarbons) is 0.06 p.p.m. To achieve such ambient standard would require a reduction of hydrocarbon emissions from automobiles from the 1970 standard of 2.2 gm./mile to an emission level of 0.2 gm./mile to an emission level of 0.2 gm./mile. This last figure is the approximate equivalent of the proposed 1980 emission standard. With the replacement factor and again relying exclusively on emission control it would be 1990 before the ambient health standard could be achieved.

C. The ambient health standard for NO_x is anticipated to be about 0.10 p.p.m. This compares with an ambient condition found in most metropolitan of 50.0 to 60.0 p.p.m. To achieve the health standard would require a reduction from the proposed 1973 emission standard of 3.0 grams per mile to an emissions requirement for automobiles of 0.45 grams per mile, or approximately the proposed 1980 standard. The replacement factor would again, if reliance is placed only upon emission control of this character, result in ambient health standards not being met until 1990.[7]

Essentially the same information was reprinted in the Report of the Senate Committee on Public Works to accompany S. 4358 (which set forth the concept of "90% reduction" eventually enacted as Section 202(b)(1)(A)).[8]

NAPCA further provided a summary document focussing on reductions in automobile emissions which would insure air quality protective of health. This document stated;[9]

The National Air Pollution Control Administration has estimated that new motor vehicles must achieve a minimum reduction of emissions from a no-control baseline (pre-1968 models) of the following orders of magnitude to insure attainment of health-related air quality levels:

	Percent
Carbon monoxide	92.5
Nitrogen oxides	93.6
Hydrocarbons	99.0

These reductions were derived in a paper by Dr. D. S. Barth, et al., of NAPCA,[10] presented in June 1970, at the annual meeting of the Air Pollution Control Association and available to the Senate Committee on Public Works and the entire Congress.

Most importantly, pursuant to a request from Senator John Sherman Cooper's staff, NAPCA provided the following table:[11]

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[7] *Id.*

[8] National Air Quality Standards Act of 1970, Senate Report No. 91–1196, 91st Cong., 2d Sess., p. 25.

[9] *Ibid.*, 25–27.

[10] D. S. Barth, et al., "Federal Motor Vehicle Emission Goals for Carbon Monoxide, Hydrocarbons, and Nitrogen Oxides Based on Desired Air Quality Levels." Reprinted at Air Pollution—1970, p. 1639.

[11] Cong. Record, S16113, Sept. 21, 1970.

AUTO EMISSIONS

[All figures in grams per mile]

	Hydrocarbons, new test	Carbon monoxide, new test	Nitric oxides, old test	Particulate matter, old test
Uncontrolled	14.6	116.3	4.0	0.4
1970 standard	2.9	37.0		
Proposed 1975 standard	.5	11.0	.9	.1
Proposed 1980 standard	.25	4.7	.4	.03
Bill language (90 percent reduction of 1970 or uncontrolled)	.29	3.7	.4	.04

This table was understood to reaffirm earlier NAPCA statements that a "90% reduction from allowable emissions for 1970" would enable the achievement of health-related air quality when all vehicles were so controlled. The table identified in concrete terms the standards that would be set under the bill language of a "90% reduction." That the Senate Subcommittee on Air and Water Pollution and the full Committee on Public Works relied on this table is evident in the remarks of Senator Cooper as he read the table into the Congressional Record:

> Mr. COOPER. Mr. President, I know there is wide interest in the emission standards for automobiles required by the bill developed by the committee. During consideration in subcommittee and the full committee, we referred to a summary table of automobile emissions, which contains the figures in grams per mile comparing uncontrolled emissions, the 1970 standard, the proposed 1975 standard under present law, the 1980 goal put forward by the administration, and the level proposed in the bill. I ask unanimous consent that the table be printed in the Record for the information of Members, because I am sure that these facts will be referred to during the debate.[12]

The printing of the table in the Record brought it to the attention of the full Congress.

The proposed 1980 emission standard referred to in the Subcommittee staff memo and the table inserted by Senator Cooper are the "HEW ultimate goals for vehicle emissions" first articulated in an Environmental Quality Council meeting of November 20, 1969,[13] made public in February, 1970, and conveyed to Senator Muskie and the full Senate Public Works Committee in Spring, 1970.[14] These goals indicated that the achievement of health-related ambient air quality depended on the reduction of automobile emissions to the following levels:

	Grams per mile
Hydrocarbons	0.25
Carbon monoxide	4.7
Nitrogen oxides	.4
Particulate matter	.03

The understanding of the Senate Public Works Committee and of the Congress which enacted the reported bill was that the Administration's proposed 1980 emission goals represented a reduction in the level of automobile emissions sufficient to achieve ambient air quality with no adverse health effects due to vehicle-related pollutants. The Committee felt that these health-related standards should be applied earlier than the Administration date of 1980: "On the basis of information and hearings in 1964, 1965, 1967, and 1970, the committee concluded that 1975 would be the earliest possible date for application of the proposed standards."[15] This intent was recognized by Secretary of Health, Education, and Welfare, Elliot Richardson.[16]

In addition to statements in the Senate Committee Report and the Air Pollution—1970 Subcommittee Hearings referred to above, the legislators re-

[12] *Ibid.*, S16112.

[13] See Letter of September 2, 1970, from Acting Secretary of Health, Education, and Welfare, John G. Veneman to Thomas C. Mann, President, Automobile Manufacturers Association, Inc. Reprinted at Air Pollution—1970, p. 1596.

[14] Air Pollution—1970, pp. 361–62.

[15] *Supra* note 8, p. 27.

[16] "The Senate bill would require * * * that certain automobile emissions be reduced by 90 percent from the 1970 levels by 1975.

* * * The objective of these provisions is to accelerate substantially the current timetable for controlling automobile emissions. The Senate bill does this by making effective in 1975 the standards administratively projected to take effect no later than 1980." Letter of November 17, 1970, from Secretary of Health, Education, and Welfare, Elliot Richardson to Senator Jennings Randolph, Chairman, Senate Committee on Public Works.

peated numerous times in the Congressional Record that the 1975 standards were formulated with the achievement of health-related ambient air quality as their focus. "We are saying in this bill that this is what the public health requires. We are saying to the country, this is what the automobile ought to be measured against." [17] "We are the only ones who can say to the automobile industry, and make it stick, 'The public health requires this.' That is what this bill says, and nothing more." [18] This intention was alternatively referred to as pushing forward the 1980 proposed goals:

> In order to maintain those standards set under title I—standards which are necessary to protect the public health and which must be met in the next 5 years—the emissions standards for carbon monoxide, hydrocarbons, and nitrogen oxides which have been projected for 1980 must be met earlier. This bill would require that this be done by 1975.[19]

All the above material makes it abundantly clear that the primary question the legislators were concerned with when drafting Section 202 (b)(1)(A) was "How low must auto emissions be set in order to achieve health-related ambient air quality?" A subsidiary question was "How best to phrase the statutory language to guarantee the desired result?" As Senator Cooper's insertion into the Record [20] makes clear the table provided by NAPCA gave the legislators reason to believe that the "at least 90 percent reduction" formula was adequate to insure that 1975 model year automobiles would emit pollutants below levels sufficient to generate adverse health effects in the ambient air.

C. The proposed 1975 emission standards for hydrocarbons and carbon monoxide will not permit the achievement of health-related ambient air quality and are above the levels that congress intended be set pursuant to section 202 (b) (1) (A).

The proposed exhaust emission standards of 0.46 grams per mile of Hydrocarbons (HC) and 4.7 grams per mile of Carbon Monoxide (CO) are not low enough to insure achievement of health-related ambient air quality. The prediction methodology endorsed by HEW,[21] the former parent agency of NAPCA (predecessor of APCO), is detailed in a paper by Dr. D.S. Barth et al. of APCO which the Senate Public Works Committee referred to and relied on in drafting Section 202(b)(1)(A).[22]

> The paper entitled "Federal Motor Vehicle Emission Goals, for CO, HC, and NO_x Based on Desired Air Quality Levels," prepared and presented by personnel of the National Air Pollution Control Administration, is intended to show, within the limits of existing data, the relationship between motor vehicle emission reductions and improvements in air quality. More specifically, it seeks to demonstrate that further reductions in such emissions, beyond those we have proposed for 1975, will be necessary, and that the order of magnitude of the needed reductions is consistent with the goals we previously announced for 1980.
>
> The methods employed in analyzing the data are widely used in calculating emission reductions needed to insure attainment of given air quality levels. It appears to me that the paper makes responsible and constructive use of such data and methods as a means of determining what the Nation must do in order to reduce the threat of air pollution in years to come, particularly in view of the alternative, which is to postpone making projections and decisions for several years in order to produce more definitive data from which more precise conclusions could be drawn.[23]

Investigations currently active in APCO and the Environmental Protection Agency (EPA) indicate that it is not clear whether the proposed standard for CO is low enough to insure attainment of the desired air quality and that the standard for HC is definitely too high to permit the achievement of health-related photochemical oxidants levels. EPA General Counsel and assistant administrator for standards and enforcement, John R. Quarles, and his staff have been briefed to this effect within the past week. Since the ambient levels of CO and Photochemical Oxidants stipulated in the Barth paper as consistent with desired

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[17] Cong. Record, S16094, Sept. 21, 1970, (Statement of Senator Muskie.)

[18] *Ibid.*, S16095. See also S16091, S16109.

[19] *Ibid.*, S16091. See also S16094–95; S16109; S16221; S16223; S20598; S20600; S20608.

[20] See notes 11 and 12 *supra* and accompanying text.

[21] See Letter, *supra* note 13.

[22] See Air Pollution—1970, p. 1576. See also statement of Senator Robert P. Griffin, Sept. 22, 1970, Cong. Rec. S16222.

[23] Letter, *supra* note 13. For the text of the paper (Hereinafter Barth paper) see Air Pollution—1970, p. 1639.

air quality are substantial identical to the proposed National Primary Ambient Air Quality Standards for these contaminants,[24] the proposed emission standards violate Sections 109 and 110 as well as Section 202 of the Clean Air Act. They are inconsistent with the attainment of these Ambient Air Quality Standards.

The proposed NC and CO emission standards are above the levels which would be set under the "90 percent reduction" formulation according to the table provided by NAPCA to the Senate Public Works Committee. This table, which the Committee relied on and which was brought to the attention of the full Congress by Senator Cooper, stated that the levels which would be set under the bill language of an "at least 90 percent reduction" were 0.29 grams per mile for HC and 3.7 grams per mile for CO.[25] These figures were based on the new "closed-cycle" procedure which is the basis of the proposed exhaust emission standards. This table, which demonstrated the relatively close relationship between standards to be set by the bill language and the proposed "ultimate" federal 1980 standards served to assure the committee that the 90 percent reduction formulation was adequate to achieve health-related ambient air quality. The proposed standard for HC at 0.46 grams per mile is nearly double the projected 1980 federal goal of 0.25 grams per mile.

D. The proposed 1975 emission standards for hydrocarbons and carbon monoxide must be revised to comply with the intent of Congress.

As elaborated above the primary intent of Congress in passing Section 202(b)(1)(A) was to mandate that beginning with model year 1975, automobiles would not emit levels of HC and CO which were incompatible with the attainment of ambient air quality protective of the health of persons. Congress was informed that the "90 percent reduction" language was adequate to convey its intent. To the extent that the "90 percent reduction" formula is not adequate, EPA must apply the statutory language, "reduction of *at least* 90 per centum" [26] (emphasis added) in a manner that complies with the congressional intent of setting 1975 automobile emission standards compatible with health-related ambient air quality. Since the Congress proceeded on the assumption that a "90 percent reduction" produced standards of 0.29 grams per mile for HC and 3.7 grams per mile for CO, the 1975 standards for HC and CO must be at least that low. To the extent that standards of even lower levels are determined to be necessary to insure the achievement of health-related ambient air quality, standards at such lower levels must be promulgated.

There is no inconsistency between the language of Section 202(b)(1)(A) and the intent of Congress. The language specifies a reduction of *at least* 90 per centum from emissions allowable under 1970 standards. The intent of Congress was that the standards for 1975 model year automobiles be low enough to permit the attainment of ambient air quality protective of the health of persons.

Respectfully submitted,

DAVID G. HAWKINS,
Member of N.Y. Bar.

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[24] Compare Barth paper at Air Pollution—1970, p. 1643 to proposed 42 CFR Sections 410.8 and 410.9, 36 Fed. Reg. 1503, Jan. 30, 1971.
[25] See notes 11 and 12 *supra*, and accompanying text.
[26] Section 202 (b) (1) (A), note 1 *supra*.

ATTACHMENT G

NATURAL RESOURCE DEFENSE COUNCIL, INC.,
Washington, D.C., January 21, 1972.

WILLIAM D. RUCKELSHAUS,
Administrator, Environmental Protection Agency,
Washington, D.C.

DEAR MR. RUCKELSHAUS: We have received a copy of your letter of January 19, 1972 rejecting the January 12 request by General Motors Corporation for a one-year suspension of the hydrocarbon and carbon monoxide emission standards for model year 1975 automobiles.

The Project on Clean Air of the Natural Resources Defense Council is in complete agreement with your position that the January 12th letter from General Motors does not constitute an "application" within the meaning Section 202(b)(5)(A) of the Clean Air Act. Quite clearly since members of the public must prepare for a hearing and the Administrator must make a decision within 60 days of

the filing of an application, the Act requires that the applicant must present all the documentation he intends to submit in support of his request at the time he files his application.

Furthermore, and not covered by your letter, should an applicant wish to submit additional data to the Administrator following the initial filing of a suspension application, he should be permitted to do so only by filing a supplement application which filing would provide an additional 60 days for the Administrator to make his decision.

We are also concerned with two related matters discussed in EPA's Suspension Request Guidelines of January 1, 1971. First, on which of the four determinations does the applicant bear the burden of proof? Second, to what extent is the Administrator required or permitted to disclose to the public the documentation submitted by the applicant in support of his suspension request?

We are of the opinion that the burden of proof on determinations (i), (ii), (iii), and in part of (iv) rests with the applicant. Regarding determination (iv), we feel that the applicant bears the burden of proof that "the study and investigation of the National Academy of Sciences * * * has not indicated that technology, processes, or other alternatives are available * * * to meet the 1975 emission standards. The Suspension Request Guidelines say no more than "The applicant has the burden of affirmatively establishing the second and third of the four criteria required by the Act * * *." Your letter of January 19, 1972 to General Motors also identifies only determinations (ii) and (iii) as the findings on which the applicant clearly has the burden. Potential applicants may infer from these communications that they do not have the burden of proof on determination (i) and the NAS study portion of (iv). We therefore urge you to communicate immediately to potential applicants that the burden of proof rests with them on these latter determinations as well. This is necessary to avoid possible claims of reliance by applicants submitting applications which speak to determinations (ii) and (iii) only.

You state in your January 19, 1972 letter that "To fully comply with the law's public hearing requirement the public must have adequate and timely access to the factual foundation for the applicant's case * * *." To insure that this general policy (which we fully support) is adhered to during any suspension proceeding, *all* data submitted or referred to by an applicant in support of his application must be made available to the public. Congress, in requiring a public hearing, granted citizens not only the right to be heard but also the right to be fully informed of the applicant's grounds for relief. These rights may not be diluted by withholding the factual basis of the applicant's case from the public. Information submitted by the applicant pursuant to Sections 202(b)(5)(A) and (D) of the Clean Air Act is not subject to the restrictions on disclosure found in Sections 114, 208, and 307 of the Act. Even if such restrictions were considered applicable, the Administrator is empowered to disclose otherwise confidential information "when relevant in any proceeding under the Act." The suspension procedures of Sections 202(b)(5)(A) and (D) constitute such a proceeding and the data submitted should be disclosed.

Part III of EPA's Suspension Request Guidelines implies that the applicant has some limited right to confidential treatment of information submitted by him in support of his application. We urge you to abandon this position by announcing publicly your determination that any suspension proceeding under Section 202(b)(5) is a "proceeding under this Act," that any information relied upon by an applicant in support of a suspension request is presumptively relevant, and that, therefore, all such information will be made available to the public. While the Administrator is authorized (but not required) by Section 307 of the Act to treat certain *subpoenaed* information as confidential, the Administrator does not have any such power to withhold information volunteered by an applicant in the 202(b)(5) suspension proceeding.

From a practical standpoint if EPA grants confidential treatment to some information relied upon by the applicant, the public's rights at the hearing will be effectively destroyed. Under the Guidelines as now written an applicant need only request confidential treatment for the bulk of his application and EPA attorneys will be forced to spend days and perhaps weeks arguing the validity of the claim with the applicant's technicians and counsel. In the meantime, the 60 day decision period and with it the time permitted the public to prepare for the hearing will be running. The Guidelines do not indicate whether an applicant will be given notice of a determination of non-confidentiality of information he has voluntarily submitted, in advance of disclosure of that information. However, the

Guidelines provided a 30 day notice of non-confidentiality prior to disclosure of information subpoenaed from a person pursuant to Section 307 of the Act. Such a notice provision is obviously inconsistent with the public hearing requirement of Section 202, no matter what type of information, volunteered or subpoenaed, it applies to. Under this system a claim of confidentiality automatically insures concealment from the public for a period of 30 days plus the time needed for EPA to determine the validity of the claim. The 60 day period for a decision on the suspension request will be no more than half exhausted before even non-confidential information reaches the public. Assuming that the public hearing had not already been held, the information would be of little use to the public for lack of adequate time to analyze it prior to the hearing.

A simple and just resolution of this dilemma is provided by disclosing all information, both submitted and subpoenaed. Congress intended that any applicant requesting a suspension prove his case to the public, not just to experts in back rooms. If the Natural Resources Defense Council is denied access to any such information, or if such information is provided only after undue delay, we are prepared to challenge, in court if necessary, the legal sufficiency of any public hearings scheduled for the applicant's suspension request.

In your letter of January 19, 1972 to General Motors you indicate your conviction that the Clean Air Act requires that the public be fully informed regarding the grounds for an applicant's request. The Act authorizes you to disclose all such information. We urge you to announce your intention to use this authority.

I am enclosing a copy of a letter this date to the major automotive manufacturers communicating the views expressed above.

Sincerely,

DAVID G. HAWKINS.

ATTACHMENT H

[From the New York Times, Sunday, Jan. 16, 1972]

AUTO MAKERS BACKED ON POLLUTION-ACT PLEA

SAN CLEMENTE, Calif., Jan. 15—A Congressional effort to modify portions of the Clean Air Act of 1970 took root yesterday at a Western White House conference after the automobile industry warned that it could not meet the Government's "unrealistic" standards for reducing exhaust emissions.

The automobile makers—Ford, General Motors, Chrysler and American Motors—said they had serious doubts whether they could comply with the emissions standards even if granted a one-year extension of the Government's 1975 deadline. They are preparing to request such an extension, probably within the next month.

Representative Victor V. Veysey, Republican of California, who organized the two-day, closed-door meeting of 55 industry, government and scientific representatives, announced that the California delegation in Congress would ask for an immediate "new look" at the emissions standards contained in the 1970 act.

The proposed re-examination of the law would deal particularly with its requirement for a 90 per cent reduction in exhaust emissions, especially hydrocarbon and nitrogen oxides. New medical data would be collected and evaluated to determine whether the prescribed levels of emission were essential to public health.

Mr. Veysey said that there had been no quarrel during the conference with the pure air requirements set up in the 1970 act.

"But we do need to know urgently whether there is a sound and valid relationship between those clean air standards and what we are asking the automobile industry to do and what we are asking the public to pay," he said.

"The public is wholly unaware of the true situation. We're in a real bad fix. We are not going to achieve the Federal emissions standards by 1975 or 1976—that's quite clear from our discussions here—but the public doesn't know this and will be in for a shock when it learns the price it must pay for a new car built to the Government's current emissions standards and when they learn how that car's performance is reduced and what the added cost of fuel and operation will be."

John F. Adamson of American Motors said that to conform to the Federal emissions requirements would mean a trade-off of highway safety.

Driveability would be poor with frequent stalling," he said. "I would not let my wife drive one of the test models we're now working with."

F. W. Bowditch of General Motors said that if the industry was compelled to adhere to the Federal standards some small economy cars would have to be abandoned.

Donald A. Jensen of Ford's automotive emissions office said that even with an extra year of grace it is doubtful that the Government requirements could be met unless some relaxations were granted.

The automobile manufacturers' statement that they cannot meet the 1975 deadline was challenged by Eric O. Stork of Environmental Protection Agency.

"We are not yet convinced that the industry cannot meet the Federal requirements by 1975," he said, adding that the agency itself does not intend to put forward any proposals for relaxing those standards.

If the automobile makers request a one-year extension of the deadline, public hearings will be held. Interim standards will be established should such an extension be granted.

The automobile makers stress that some kind of decision, either to extend the deadline or relax the current standards, must be reached by April, or, as one of them put it, "we will be in big trouble because we are now only 26 months away from starting to build the 1975 models."

Oil industry representatives at the conference joined in warning of the sharply higher costs that the motorist would be asked to pay for meeting the Government standards.

"The public will have to pay one hell of a price," said Fred Hartley, president of the Union Oil Company, "in the cost of a new car, in the cost of maintaining it, and in the cost of fuel."

Mr. LOMBARDO. Mr. Chairman, with your permission, Dr. Sullivan would like to make a very brief statement on the implications of the nonimplementation of the Clean Air Act Provision.

Mr. KYROS. Go ahead, Dr. Sullivan.

Mr. SULLIVAN. I will keep my remarks to 1 minute.

Mr. KYROS. You don't have to.

STATEMENT OF JAMES SULLIVAN

Mr. SULLIVAN. I could go on for hours.

I would like to indicate what the implication will be on the whole clean air program if Detroit fails to supply a clean car. I speak from my experience with the District of Columbia Air Quality program, but I think it is a problem that exists around the country.

I have visited various cities and I have heard the same complaint.

Let me give you a figure that demonstrates what the problem is: We need a 55 percent reduction in hydrocarbons and carbon monoxide in the District to meet the standards dictated by the 1970 act.

In the District, for hydrocarbons and carbon monoxide we need over three-fifths of that reduction to be supplied by Detroit. That is, out of the 55 percent reduction we need for carbon monoxide we are relying on Detroit to supply 36 out of the 55 percent of that reduction and for hydrocarbons 35 percent. For oxides of nitrogen we need a 7.4 percent reduction and we are counting on Detroit to give one-third of that or 2.5 percent.

Mr. KYROS. Does that mean 60 percent of HC and CO in the city are automobile-generated?

Mr. SULLIVAN. No, in fact, it is a lot more automotive-caused. The latest study I have here from the Bureau of Air Pollution Control indicates that 80 or 85 percent of the total of air pollutants is automotive-produced in the District.

We don't have much industry here. About 98 percent of carbon monoxide is caused by automotive pollution. What I am saying is that we need a 55 percent reduction in present air quality levels to hit the 1970 air quality levels.

In other words, we have to cut them in half.

Of that half that we have to reduce it, we are counting on Detroit to give us 60 percent. We can only provide 40 percent from the District.

Let me just tell you a little bit about what our 40 percent will entail.

The District's implementation plan was prepared by the Bureau of Air Pollution Control and TRW Systems Group—it is basically a first draft. The second draft is now being prepared by the District Government and will be out and submitted to EPA by January 30—which is the deadline.

In the plan that will be submitted this weekend, we are calling for a ban on parking in the downtown areas and that a high tax be placed on governmental and private parking lots to dissuade commuters to drive to work and to convince them the bus is the best way to travel. These are severe measures.

Mr. KYROS. Even before the subway is installed.

Mr. SULLIVAN. Yes. This is an idea of the difficulties we are up against. A short talk with District officials will show you that they are at wit's end to come up with solutions to air pollution.

Another recommendation that we made but that I don't think will be implemented is a moratorium on freeway construction. That is a very controversial issue, as you know.

The point is that we are taking severe measures to reduce air pollution in the District.

If Detroit does not come through with a clean car, the District is not going to make the clean air standards.

This is not just a District problem. Other cities around the country are making the same statements that it is going to be very close. Without Detroit's contribution there is no hope. If you will just pardon the pun, we will just be spinning our wheels.

Mr. KYROS. Thank you very much, Doctor. Thank you very much, gentlemen, for very enlightening information.

I am sure the committee will consider it along with other material that has gone into the record today.

Dr. Carter?

Mr. CARTER. Thank you, Mr. Chairman.

You formerly worked for EPA?

Mr. LOMBARDO. That is correct.

Mr. CARTER. Were you exiled?

Mr. LOMBARDO. I was fired for being absent without leave for 9 days. I believe the dates were October 18 through the 27.

Mr. CARTER. You were transferred out of Washington, were you not?

Mr. LOMBARDO. Yes, they transferred my position to Ypsilanti, Mich.

Mr. CARTER. Do you feel the automotive industry can make a catalytic converter which will last for 50,000 miles?

Mr. LOMBARDO. Certainly. I don't see any reason why they can't be designed to operate effectively for 100,000 miles.

Mr. CARTER. Can you make one if you were given the materials?

Mr. LOMBARDO. I would have to hark back to your feeling that the automobile industry has been delinquent in some areas. I cannot make

one, but I don't have the resources of the automobile industry at my disposal, either.

Basically, this feeling of delinquency that you detected, I have been recognizing for the past 6 years. The automobile industry has been saying the kinds of things they have said here today for essentially 20 years. As can be seen from an examination of the testimony given by the automobile industry in California throughout the 1950's and the 1960's.

Mr. CARTER. They did meet their 1970 standards, didn't they?

Mr. LOMBARDO. If you are talking about the prototype vehicles, with a company engineer in the trunk, that were tested at Ypsilanti, yes. If you are talking about the vehicles that are supposed to meet the standards for 50,000 miles, in the hands of the public, they certainly did not.

Mr. CARTER. Of course, they did not check all of them. They did not check as the law requires.

Mr. LOMBARDO. Spot checks show vehicles in the hands of the public are exceeding the standards after roughly 4,000 miles.

Mr. CARTER. Do you have information to back that up?

Mr. LOMBARDO. Reams of it.

Mr. CARTER. Reams, of it?

Mr. LOMBARDO. Yes, sir.

Mr. CARTER. Of tests made on cars.

Mr. LOMBARDO. Yes, sir; the California surveillance data amounts to tests of some 20,000 to 30,000 cars.

Mr. CARTER. Could you tell us average mileage at which these tests were taken?

Mr. LOMBARDO. This committee was very upset last year at the finding that the cars were exceeding the standards roughly after only 4,000 miles. You may recall the Hertz Rent-a-Car study and the California surveillance data were both cited at that time.

Mr. CARTER. Some of them exceeding the levels as much as 63 percent.

Mr. LOMBARDO. That is right.

Mr. CARTER. Do you think the automotive industry could meet all of these requirements by 1975; is that correct?

Mr. LOMBARDO. Absolutely. There is not a doubt in my mind.

Mr. KYROS. What has the Academy of Sciences done in this case?

Mr. LOMBARDO. For one thing, they talked only to the automobile industry, but the National Academy did say it could be done. I think the National Academy report was, first of all, very, very conservative, and, secondly, very narrowly researched.

I think there were time constraints but I think they were very narrow in seeking information. I don't think they aggressively sought the views and information that could have been provided by the suppliers to the automobile industry of fuel injection systems, catalysts, and other engine components capable of controlling emissions.

Mr. CARTER. In a sense, you think they did a snow job; is that correct?

Mr. LOMBARDO. I don't think I want to say flatly that I think that the National Academy did a snow job. I would say that I have my suspicions because I asked the Academy for data and they just would not release it.

Basically I was first refused data on the grounds that the data was proprietary information. I said I was not interested in proprietary data but was interested in just the raw data that was used in the report.

I suggested the Academy cover up or code the company names. Just say it is vehicle A, B, C, D, or whatever. I just wanted the raw data.

When they agreed a coding system could protect the proprietariness of the data, they shifted and said permission would still have to be obtained from the committee.

Mr. CARTER. I would certainly hope they have not intentionally covered up.

Mr. LOMBARDO. May I just finish this anecdote and let me see what your judgment is. I would appreciate it.

They went back to the committee to obtain permission and subsequently I was verbally informed that it was the decision of the Vehicle Emissions Committee that no data other than the published data would be granted.

Furthermore, I was told it was the policy of the National Academy itself that no data other than the data in published reports could be released—with one exception. Interested scholars would be granted access to the archives to review the data--after a time lapse of 50 years.

I said I probably would not be here and I certainly would not be interested at that time. So, they have effectively refused any data other than that which has been published.

Mr. CARTER. I appreciate what you have had to say.

Mr. LOMBARDO. Dr. Carter, I would like to comment on a couple of things you put your finger on this morning and that I feel are very important.

One is this concept of recycling. We really do have to get into that area. We have to design into new products the concept of the recycling of our resources because there is just not an unlimited supply of resources.

Mr. CARTER. I certainly agree.

Mr. LOMBARDO. The second thing I was very much impressed with was your recognition of the need for fuel injection systems because of the improved fuel economy they produce.

Fuel injection systems provide a way of conserving resources, improving American products, and reducing air pollution as well. We just have got to go in that direction.

I was very, very pleased to hear you ask Ford for an analysis of what fuel injection systems would do in terms of conservation of fuel resources. I hope you will actually get from the industry a very thorough report on your question.

It is needed; as a Nation we need that kind of an analysis. I was very pleased to hear you ask those questions.

Mr. CARTER. Thank you, sir.

Thank you, Mr. Chairman.

Mr. KYROS. Mr. Lombardo, do you remember the discussion with the National Academy of Sciences with Mr. Ginzton? Were you here the other day when the figures were discussed about changing the 1970 requirements on hydrocarbons from 4.6 to 2.2?

Mr. LOMBARDO. I was not here, Mr. Chairman, but I can speak to the question. I just don't know what Dr. Ginzton said.

Mr. KYROS. Dr. Ginzton said the two procedures in terms of what happens to the car on the road were actually equivalent. It sounded as though there were a lessening of the standards, although Dr. Ginzton seemed to feel there was not.

Mr. LOMBARDO. I suggest that he consult his staff man who is Professor John, chairman of the staff. Dr. John and I had a discussion about this.

Basically, in terms of 1970 model vehicles, Dr. Ginzton is correct. A 1970 model vehicle tested on both procedures, show that the 4.1 grams per mile on the 1975 test procedure is roughly equivalent to 4.6 grams per mile on the 1972 test procedure. The problem of the weakening of the standards with regard to 1975 stems from the fact that the equivalency does not hold in 1975. The equivalency only holds for 1970 vehicles.

If one takes a 1970 vehicle and tests it from a cold start and then a hot start and uses the proper formulas, fine, 4.1 is roughly equivalent to 4.6. However, in 1975 there will be an entirely different technology. We are talking about catalysts, fuel injection systems, a whole variety of devices or systems to control emissions making the 1975 cars what we call sensitive to the cold-hot ratio, so the equivalency which holds for 1970 vehicles does not hold when applied to 1975 vehicles, and the effect of incorporating that equivalency as applicable to 1975 vehicles is to weaken the standards roughly by another third.

Mr. KYROS. The staff member you refer to is James E. A. John, the executive director of the Division of Motor Vehicle Emissions. You think he bears out what you just said?

Mr. LOMBARDO. Whether he will bear out the conclusion that the standards have been weakened, I don't know. I don't think he will put it in those words. He does agree that a different technology will be used in 1975 and that the technology does affect the emission levels and the cold-hot ratio. I don't know if he will go so far as to say the standards have been weakened. I really don't know how to judge what the NAS is doing, whether they are being objective or whether they are actually trying to hide something, I don't know.

Mr. KYROS. The National Academy of Sciences is trying to hide something?

Mr. LOMBARDO. We asked for and were denied background information on their report. Our attorney is looking into the Freedom of Information Act. The question is, Is the NAS an agency of Government subject to the act?

Mr. KYROS. You said on page 6 of your testimony, "Secondly, the industry would like to be able to replace catalysts every 25,000 miles rather than every 50,000 miles as required. If this were permitted the consumer would be saddled with yet another unnecessary expense. There is no inherent reason why catalysts can't be made to last 50,000 miles and beyond to the actual life of the car."

There was considerable testimony from the manufacturers that they do not have such a well developed catalyst. I don't see why auto manufacturers would try to hold back in developing a catalyst. Is there something that I miss here? What would be their reason?

Mr. LOMBARDO. They have dragged their feet now for 20 years and they are not about to change.

Mr. KYROS. I cannot damn everyone in the past who says, I failed to do something. We just passed the act, and the cost will be passed on

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to the consumer in any event. You and I are going to pay for cleaning up the air.

Mr. LOMBARDO. A reasonable cost is fine.

Mr. KYROS. Why should they hold back, then?

Mr. LOMBARDO. There are certain costs. For example, you would not mind paying, let's say, $20 or $30 for a very sturdy front bumper. You would not mind that nor would any other consumer. However, paying $20 or $30 for a bumper that is very flimsy and curved so the first time you park you either dent your car or the car in front of you. That puts dollars into the pockets of the automobile industry.

Mr. KYROS. Exactly.

Mr. LOMBARDO. It robs the consumer, of course. That is where the dollars come from.

Mr. KYROS. But that is not analogous to an emission catalyst.

Mr. LOMBARDO. Certainly it is.

Mr. KYROS. How is it analogous?

Mr. LOMBARDO. If the automobile industry could have catalysts replaced every 25,000 miles they would be making a profit every time that the individual has to come in to buy a catalyst.

Mr. KYROS. The testimony this morning was that they couldn't quite develop a catalyst that would run to 50,000 miles, and therefore, the problem of meeting the standards of the act as presently set up. Both the chairman and I have pursued the question of a catalyst to 25,000 miles, with a certificate to get past the warranty question, and gas that does not poison the catalyst. We could then perhaps try to meet the standards of the act. Some of the manufacturers said we could possibly do this, which I think, frankly, is not unreasonable.

I am interested in seeing that we come as close as possible to meeting the standards we have set. I also appreciate your concern that the standards are not rigorous enough.

Mr. LOMBARDO. That is right.

Mr. KYROS. That is a very fierce statement we have to consider. Catalysts involve all of us. As a public service and in terms of clean air, there should not have to be a profit markup on a catalyst.

Mr. SULLIVAN. I don't think Mr. Lombardo is trying to say that is the only reason. The economics of the auto industry are complicated and we don't pretend to be economic experts.

I would say that would be a proper question of the auto industry rather than us. There is a terrible black cloud hanging over Detroit. Besides the cloud of air pollution hanging over Detroit there is a cloud of pessimism and failure that seems to permeate thinking in that city and those are the people of whom to ask those questions.

Mr. KYROS. I have asked them all day and I will ask Mr. Ruckelshaus.

Your testimony is most interesting and provocative.

The statement is made here, "There is no inherent reason why catalysts can't be made to last 50,000 miles and beyond to the actual life of the car."

If that is no, we should put the car to the test and you also should be able to back up that statement.

Mr. SULLIVAN. There are two issues involved. I think the issue of putting a 25,000 mile catalyst is a different issue.

Now, there are no automobiles with catalysts that are working on large scales. We know that. I think in 1960 if you asked President

Kennedy or anybody else involved in initiating the moon program if we were going to make it to the moon, they would say it is virtually impossible, it is unlikely, we don't think so—the same words we hear today. I don't think we would have been on the moon last year.

Auto pollution control devices are a technological development that I think can be planned. I think that is what we are trying to say, not that we can prove it can be done.

To prove that it can be done is quite a complicated matter. Technology does not quite work that way.

Mr. LOMBARDO. During the hearings on the Clean Air Act Amendments of 1970, many manufacturers of catalysts submitted data showing durability up to 80,000 miles on lead-free gasoline. I believe there was even one close to 90,000 miles.

Mr. KYROS. Universal Oil Co. still feels you can make one that goes up to 25,000 miles.

Mr. LOMBARDO. Basically, they are drooling. If they have the opportunity to sell catalysts every 25,000 miles instead of every 100,000 miles, what do you think they are going to say? It is just like the automobile industry.

The automobile industry is trying to produce 10 million cars right now. If the automobile industry could force us to become a Nation of three-car families instead of two-car families they would be ecstatic. Where we would put them, and whether we would choke in their effluents, are other matters.

Mr. KYROS. Wasn't it Ford who said they are beginning to put money into other transit systems?

Mr. LOMBARDO. That is the old standard strategy of getting in on the ground floor of the inevitable and trying to shift Government policy to the industry's own ends.

Mr. KYROS. I have finished my questions.

From the public interest, your statement has been informative. The committee will have the value of studying it and we will certainly take the opportunity to look it over much more fully before we see Mr. Ruckelshaus tomorrow morning. If you have something else to add, however, go ahead, gentlemen.

Mr. LOMBARDO. Mr. Chairman, I appreciate what you say about wanting to look at the auto industry's record from the 1970 Act forward and not their previous record, but I think past is prologue. We are very much concerned that there has not been any change in the tactics or strategy of the automobile industry, and the facts show us that the industry is pushing its own interests in a repeat performance of its successful efforts in California.

May I just remind the committee that in 1959, the California Legislature passed a law empowering the State health agency to set automobile emission standards to restore the degree of air quality which existed in Los Angeles in 1940, which was quite clean—by 1970. You know as well as I do that the intent of that law has not been fulfilled.

The will of the California Legislature as expressed in 1959 has not been carried out. The question is: Will the will of the Congress as expressed in 1970 be carried out by 1985? Will we have air quality protective of public health by 1985 or will there be another public interest individual sitting before another august body in 1985 again saying the past is prologue?

Mr. KYROS. Is it your judgment that under no conditions should EPA be granted an extension of 1 year as requested by the industry for meeting the hydrocarbon and carbon monoxide standard?

Mr. LOMBARDO. Absolutely, suspension should be denied. Furthermore EPA should tighten its standards to the levels intended by Congress.

Mr. KYROS. And the standards, as you pointed out in your statement, were less than those Congress enacted?

Mr. LOMBARDO. Yes, and one last point, and that is this: The automobile industry, the oil industry, the suppliers to these industries have enormous resources: information, information gathering capability, scientists, public relations people, television advertising time at their command. These tremendous resources you may recall were utilized even as you were considering the Clean Air Amendments of 1970. Recall the television announcements repeatedly saying the industry was concerned with air pollution and was already doing much to control it.

We in the public interest movement just do not have such resources. I believe it is up to the Congress, and to citizens like us to organize an effective public interest force.

Mr. KYROS. Don't say that so despondently. I don't think you ought to worry too much.

Mr. LOMBARDO. We hope not.

Mr. KYROS. Thank you very much.

The hearings will be adjourned until 10 o'clock tomorrow morning.

(Whereupon, at 4:45 p.m. the subcommittee adjourned, to reconvene at 10 a.m., Friday, January 28, 1971.)

CLEAN AIR ACT OVERSIGHT

FRIDAY, JANUARY 28, 1972

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON PUBLIC HEALTH AND ENVIRONMENT,
COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE,
Washington, D.C.

The subcommittee met at 10 a.m., pursuant to notice, in room 2141, Rayburn House Office Building, Hon. Paul G. Rogers (chairman) presiding.

Mr. ROGERS. The subcommittee will come to order, please.

We are continuing our hearings on oversight of the Clean Air Act.

We are very pleased to have as our first witness this morning one of our distinguished colleagues who has been very interested in the whole question of air pollution, from California, the Honorable Richard T. Hanna.

We welcome you to the committee and appreciate your presence here today.

STATEMENT OF HON. RICHARD T. HANNA, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF CALIFORNIA

Mr. HANNA. Thank you, Mr. Chairman.

As one of the members of the House, may I express my gratitude and satisfaction with the great concern and the great contribution that this subcommittee has made to this important subject matter.

I was in the State legislature as a representative in 1959 when California started on its first large legislative approach to this great problem.

The problem has yet to be solved. I have been continually interested in this subject matter because it is a political necessity in my area.

It is a problem which is so evident that it is an everyday occurrence in our State.

I think we are one of the few areas where there have actually been ball games called off not on account of rain but on account of smog. This shows some of the dimension of the problem in our area.

It did seem to me when I was asked by the university and by Mr. Veysey to join in on a conference that would eradicate some of the isolation that has been plaguing our approach to this problem in which the key people in government, industry, and science were talking to themselves but not to each other; that it seemed a worthy thing to get them all together at one conference where they could speak to each other.

I recall that I opened my remarks at that Conference, saying that, "I did not come here to find a foe to fight; but to find a friend who could help."

I think that was the spirit of the conference.

The image of the Conference I now learn is somewhat at variance with what I thought was the reality and the actual event itself. There are no things that happen in politics that do not have political dimensions and certainly this conference had those.

The chairman was not of my party. The keynote speaker, the Lieutenant Governor of California, is not of my party. The Western White House, at the moment, is not occupied by a member of my party.

So, politics were a part of the conference.

However, I think that it is fair to say that the Western White House, having been brought into the area in which I serve, is looked upon as a new dimension in facilities because it has been utilized by a number of people for all kinds of conferences of which this was only one.

The problem that we are talking about, gentlemen, recognizes no partisanship. Where justice falleth like the gentle rain from Heaven, smog falls not so gently but it falls on all below. I think it is our concerted desire to see that we have a law which is effective.

What we talked about at that conference is not how to reduce our approach but how to make more effective the application of law.

We attempted—and I thought we were actually stressing the scientific contributions and a discussion on what were the available scientific facts.

I have, Mr. Chairman, a summary made by Dr. Pitts, who was the head scientist from the University of California at this meeting, and I would ask that it be made a part of the record at this point.

Mr. ROGERS. Without objection, it is so ordered.

(The summary was previously submitted for the record and is printed on p. 261 of this hearing. The summary is entitled "Summary of Discussions at the National Motor Vehicle Air Pollution Conference, Western White House, San Clemente, Calif.—January 13–14, 1972.")

Mr. HANNA. I would also like to draw your attention to the fact that we talked about not only the scentific problems of trying to bring down all of the factors in the ambient air at one time at one standard, but we also talked about what are the social options that could help cure air pollution.

We talked about gas rationing, conversion of pre-1966 cars to solid gas fuels, mandatory inspection, increased public transportation and increased travel, and so on.

We were talking about what I think is the hallmark of all legislation and that is how to achieve in the public interest the most effective application of the laws that the various legislative bodies have been enacting on the subject of air pollution.

I think if we don't exercise oversight as well as initiate legislation, we are not really doing our full chore in protecting the interest of the people who have elected us to office.

I will be glad to answer any questions that you gentlemen care to pose, and I again commend this committee, because it is taking an aggressive, effective attitude and I am sure you feel the way I do about the problem we face.

Mr. ROGERS. Thank you.

We appreciate your presence here. Congressman Veysey was here yesterday as well as Congressman Rousselot to spread on the record the fact that the conference was not to lessen the effect of the 1970 law. Some of the impressions from some of the participants in a letter particularly would give one the impression that the use of this 1970 law was an overkill with some suggestions that the standards are arbitrary and have no relationship to health and a few things like this, which sounded to me like the laying of a foundation for a drive to change the law or to see that it was not necessarily enforced in that regard.

That is why we were pleased to have each of you come and give us a proper interpretation of your feeling about the conference.

Mr. HANNA. May I make a couple of clarifying remarks on that score?

Mr. ROGERS. Certainly.

Mr. HANNA. We had a meeting at the university at Riverside to talk about the format of the conference. One of the points that was specifically brought up was whether we should move toward some kind of resolution or some statements of accord.

I specifically recall and I specifically made the point myself that I felt that the conference should not move in that direction, and it was with 100-percent accord that we went into the conference saying we would not come out with any specific resolutions.

Having said that, let me make another point clear. Whenever you are discussing this subject, since we do have adversary postures in regard to various interests, people are going to take whatever information is developed and try to make it fit into the ammunition, the armament of their side of the question, and I think we would be naive not to expect that and perhaps that has been done, but I can guarantee you what I said about the format was precisely that format and it was conducted accordingly.

Mr. ROGERS. I think this is reassuring and we are very grateful for your presence here to spread this on the record.

Mr. Nelsen?

Mr. NELSEN. Mr. Chairman, I noted the reference to the chairman not being of your party. Who was the chairman?

Mr. HANNA. It was Mr. Veysey.

Mr. NELSEN. I was going over the list of the people on the committee and it seems almost totally balanced.

Mr. HANNA. Not all of the Democrats who were invited were able to attend.

Mr. NELSEN. They didn't come?

Mr. HANNA. I said they were unable to attend so the load of things fell to myself but I figure they picked out a rather large man to carry the load.

Mr. NELSEN. Mr. Hanna, you will do a good job regardless of the weight or the size of the load, I can assure you.

I want to thank the gentleman. I have no further questions, but I want to mention the fact that having served on the conference committee and having worked with engines and motors all of my life, I found that many of the men on the committee didn't know a valve guide from a bearing insert.

My big concern from the beginning was: Can an internal combustion engine be cleaned up with a gadget on a sparkplug when using the wrong fuel? I think we are going to look to a different engine design if it can be found if we are going to have an exhaust fume that will be clean and acceptable and in the public interest.

But let me say thank you, Mr. Hanna. You are always pleasant to listen to and always a friendly gentleman to meet.

Mr. HANNA. You are always most kind.

Let me say expert information is most important. However, the person using it need not be an expert. As a lawyer, I once had to defend a bank robber, but would you believe I have never robbed a bank. We do have available information and I think we should seek it and use it.

Mr. KYROS. Mr. Hanna, I welcome you to the committee, and I was glad to hear your remarks.

I would like to clarify a remark made by Mr. Veysey, one of our colleagues, yesterday:

> I can report to this committee some of our initial impressions.

He said:

> First our Federal clean air laws are seriously in need of revaluation, specifically, the Federal Air Quality Standard and the Federal Emission Standards for Motor Vehicles. As an example, one of the most glaring questions concerns the prescribed 90 percent across the board reduction by 1975 and 1976 in all auto omissions—nitrous oxides, carbon monoxide, and hydrocarbons. Ninety percent is a good round number, but is a purely arbitrary figure not necessarily related to the health of the people.

I take exception to that because I think this is precisely the issue Chairman Rogers and every member of this committee must meet.

I would hope that you and the rest of the members of that conference will await any prejudgment on the 90-percent figure until we have all the facts.

Mr. HANNA. I think that is only the right and appropriate stance to take.

I have a great respect for the scientific minds and the scientific abilities. I don't think we should get in cement in any way.

I think what we are after is an effective program which by performance will show what we have done legislatively toward solving the people's problem of health in the air and that is where the final test will lie regardless of where the argument waxes and wanes.

Mr. ROGERS. Dr. Carter?

Mr. CARTER. In answer to the statement the gentleman from Maine propounded, I would have to say Congressman Veysey, as I understood him yesterday, was referring to the lack of correlation between requirements of the law with regard to concentration of noxious substances and the concentration of those substances in the ambient air.

I believe that is correct.

Mr. HANNA. Yes, sir.

Mr. CARTER. And, of course, they should be correlated and, of course, those standards for ambient air should be such that they do not affect the public health.

Thank you, Mr. Chairman.

Mr. ROGERS. Let me say this before you leave; I might as well put in an oar. If you read the Senate report, you will find there is a relationship from the health features of ambient air to what is required to

be reached by 1980, and this goes along in trying to reach those goals of 1980 by saying we are getting 90 percent.

I am sure you probably know that the National Academy of Sciences said this is possible if three things occur: If we have the fuel with the lead out—and the oil industry testified they can do this by 1974; second, if they use a testing item where they average the emission; and third, if they don't require the durability of the device of 50,000 miles.

The Academy of Sciences say they can meet it at 25,000 miles so if you provide the company two instead of one catalyst device, we have reached it.

I think our conclusions came that we all want to improve and if we can improve at 90 percent, then we do. I think it probably is not realistic at this time to say they have to have 50,000 miles. They don't guarantee any other part for 50,000 miles.

Mr. HANNA. It seems clear, Mr. Chairman, the scientific information in this field is moving as dramatically as it is in any other field of science and certainly this committee, this Congress or any Member of it, would not want to isolate himself from the knowledge and make it applicable in the most effective way in whatever legislation we pass.

Mr. ROGERS. Thank you, and we appreciate very much your being here and for your interest in cleaning up air.

Thank you so much.

Our next witness is the Honorable William D. Ruckelshaus, Administrator of the Environmental Protection Agency.

Mr. Ruckelshaus, the committee welcomes you and any of your colleagues that you desire to have with you, and would you identify them for the record, please?

STATEMENT OF HON. WILLIAM D. RUCKELSHAUS, ADMINISTRATOR, ENVIRONMENTAL PROTECTION AGENCY; ACCOMPANIED BY ERIC STORK, DIRECTOR, MOBILE RESOURCES POLLUTION CONTROL PROGRAM; JOHN MIDDLETON, DEPUTY ASSISTANT ADMINISTRATOR FOR AIR PROGRAMS; AND GARY BAISE, CONGRESSIONAL LIAISON OFFICE

Mr. RUCKELSHAUS. Thank you, Mr. Chairman.

I have with me today Mr. Erie Stork, on my left, who is director of our mobile resources pollution-control program.

Mr. ROGERS. We welcome you, Mr. Stork.

Mr. RUCKELSHAUS. Dr. John T. Middleton, deputy assistant administrator for air programs, and Mr. Gary Baise, in charge of our congressional liaison office.

Mr. ROGERS. We have known Dr. Middleton for many years. We welcome you and we appreciate your assuming a position of political nonpartisanship.

Mr. RUCKELSHAUS. The Environmental Protection Agency is pleased to have the opportunity of appearing before this distinguished committee to report our progress in implementing the provisions of the 1970 amendments to the Clean Air Act.

With the leadership of this committee, Congress provided us with a bold new plan in the Nation's battle to improve its air environment with the 1970 Clean Air Act amendments. The amendments call upon

EPA and the States to establish and enforce standards and regulations that will within the next few years significantly reduce air pollution levels throughout the country. Today we would like to discuss with you some of the accomplishments we have made and the problems we have faced since enactment of the amendments almost 13 months ago.

The 1970 amendments directs EPA to establish national ambient air quality standards; standards of performance for new stationary sources; national emission standards for hazardous air pollutants; national motor vehicle emission standards; and aircraft emission standards. They call upon the States to develop plans of implementation designed to achieve the national ambient air quality standards, and they impose a rigorous time schedule for accomplishment.

NATIONAL AMBIENT AIR QUALITY STANDARDS

Our ambient air quality standard-setting action began 30 days after enactment of the amendments with publication of proposed air quality standards designed to protect public health and welfare from the adverse effects of six common air pollutants—sulfur oxides, particulate matter, carbon monoxide, photochemical oxidants, nitrogen oxides, and hydrocarbons. After we invited and received public comment, the standards were promulgated on April 30. We would like to submit a copy of the standards for the record, Mr. Chairman.

Mr. ROGERS. Without objection, they will be made a part of the record following your statement.

(See attachment 1: Federal Register, vol. 36, No. 84, Friday, April 30, 1971, title 42—Public Health, ch. IV—Environmental Protection Agency, part 410—National Primary and Secondary Ambient Air Quality Standards, printed on p. 409, this hearing.)

Mr. RUCKELSHAUS. Once standards have been promulgated, the States are required by the act to prepare and submit, within 9 months, implementation plans designed to achieve and maintain them.

Mr. ROGERS. That would mean the end of this month, January?

Mr. RUCKELSHAUS. That is right, Mr. Chairman.

We believe it would be helpful to point out briefly some of the essential ingredients of an acceptable implementation plan. States must formulate control strategies which provide for a sufficient degree of control for attainment and maintenance of standards; adopt rules and regulations with specific time schedules to carry out the control strategies; develop special plans to prevent air pollution emergencies; establish adequate enforcement authority and procedures; and institute an air quality monitoring network. In some areas of the country, it should be noted that the States, in all likelihood, will have to institute transportation controls. This will be necessary to achieve compliance primarily with the carbon monoxide and photochemical oxidant national ambient air quality standards. Such controls may include periodic inspection of motor vehicle emission-control systems and limitations on motor vehicle usage.

EPA has given top priority to the efforts of the States to develop implementation plans within the 9-month deadline. We believe that these plans are crucial for the success of the control efforts, and for that reason we have provided the States with extensive financial, technical, and manpower assistance. A $12.7 million increase in grants

was awarded to State and local control programs in fiscal year 1972, bringing our total budget for this activity up to $42.9 million. For fiscal year 1973 we are planning an approximately $8 million increase for this activity.

Contracts were entered into with 10 firms to supply the States, at no cost to them, with needed technical services, such as aid in formulating and evaluating control strategies and assistance in conducting emission inventories. With respect to manpower assistance, approximately 100 employees located in EPA's regional offices and our technical center in North Carolina, devoted their full-time energies to aiding the States in developing their plans. In addition, we currently have assigned 135 Federal employees to the States.

State implementation plans are due at EPA on January 31. We anticipate receiving plans from every State. Of course, we will not be in a position to determine if they are adequate to achieve and maintain the primary standards by the statutory deadline of mid-1975 until we have had the opportunity to review them. We are hopeful that, by and large, they will be adequate. We do know that the overwhelming majority of the States have made a sincere and concentrated effort.

STANDARDS OF PERFORMANCE FOR NEW STATIONARY SOURCES

On December 23, EPA promulgated new source performance standards for five major stationary sources of air pollution—fossil-fuel-fired steam generators, incinerators, cement plants, and sulfuric and nitric acid operations.

Again, we would like to make a copy of these standards available for the record.

Mr. ROGERS. Without objection, they may be made a part of the record following your statement.

(See attachment 2: Federal Register, vol. 36, No. 247, Thursday, Dec. 23, 1971, title 40—Protection of Environment, ch. I—Environmental Protection Agency, subch. C—air programs, pt. 60—Standards of Performance for New Stationary Sources, printed on p. 425, this hearing.)

Mr. RUCKELSHAUS. These standards are designed to require the application of the best adequately demonstrated control techniques considering cost on new facilities. This year we anticipate promulgating additional new source performance standards. Industrial activities to be covered include petroleum refineries, asphalt batching plants, iron and steel mills, secondary lead smelters, and brass and bronze refining operations.

NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS

Hazardous emission standards covering new and existing major sources of asbestos, beryllium, and mercury were proposed by EPA on December 3. Under section 112 of the act, we are required to hold public hearings before these standards can be promulgated. The first of two scheduled hearings was conducted in New York last week.

A summary of this hearing has been prepared and we request that this also be made part of the record.

Mr. ROGERS. Without objection, it may be made a part of the record following your statement.

(See "Summary of public hearing on EPA's proposed national emission standards for hazardous air pollutants—Customs Court House, 1 Federal Plaza, New York, N.Y.—January 18, 1972, p. 445, this hearing.)

Mr. RUCKELSHAUS. The second hearing will be conducted on February 15 in Los Angeles.

MOTOR VEHICLE EMISSIONS

In 1965, Congress enacted the National Motor Vehicle Emission Standards Act which provided us with the authority to set and enforce, administratively, national standards limiting emissions from new motor vehicles. The first standards promulgated under this act became effective with the 1968 model year. In an effort to greatly accelerate reductions in motor vehicle pollution, the Congress, as part of the 1970 clean air amendments, legislatively mandated emission standards beginning with the 1975 model year. These standards for light-duty vehicles required, by 1975, a 90-percent reduction in hydrocarbon and carbon monoxide emissions from those allowed from 1970 vehicles, and by 1976, a 90-percent reduction in nitrogen oxide emissions from those measured from 1971 model vehicles.

We have promulgated final regulations by which cars will be judged for their compliance with the 1970 amendments.

Major provisions include:

1. Standards for carbon monoxide and hydrocarbons beginning with the 1975 model year. These would limit emissions to 3.4 grams of carbon monoxide and 0.41 grams of hydrocarbons per vehicle mile. By comparison, allowable emissions from 1970 automobiles were 34 grams of carbon monoxide and 4.1 grams of hydrocarbons per vehicle mile.

2. Emissions from 1971 cars that are not equipped with nitrogen oxides control systems are four grams per vehicle mile. A new exhaust emission standard for nitrogen oxides which will limit emissions to three grams per vehicle mile is applicable beginning with cars of the 1973 model year. A further reduction in the nitrogen oxides will limit emissions to four-tenths grams per vehicle mile beginning with the 1976 model year.

3. Changes in the present EPA testing procedure, beginning with the 1975 model year, which will more accurately reflect the driving experience of the motor vehicle population in major urban areas. The existing test procedure represents only the emissions from the first trip of the day while the new procedure represents an average of the emissions from all of the trips taken in a day.

We request that these standards and test procedures be made a part of the record.

Mr. ROGERS. Without objection, it is so ordered.

(See attachment 4: Federal Register, vol. 36, No. 128, Friday, July 2, 1971, title 45—Public Welfare, ch. VII—Environmental Protection Agency, part 1201—Control of Air Pollution From New Motor Vehicles and New Motor Vehicle Engines, Oxides of Nitrogen Exhaust Emission Standard and Test Procedures, printed on p. 446, this hearing.)

Mr. RUCKELSHAUS. Within the last few weeks, public interest has been focused on the ability of the automobile manufacturers to com-

ply with the 1975 hydrocarbon and carbon monoxide standards. Under the act, if a manufacturer feels compliance with the 1975 standards cannot be achieved, he may request EPA, after January 1, 1972, to grant a 1-year suspension of the standards.

We think it would be helpful to briefly enumerate the conditions required by section 202(c) of the act for a suspension. Before EPA can grant a suspension, we must determine that:

1. It is essential to the public interest or public health and welfare;
2. All good faith efforts have been made to comply with the standards;
3. The applicant establishes that the means of complying with the standards are not available or have not been available for a sufficient period of time;
4. The National Academy of Sciences' investigations and any other information available to us do not indicate that the technology is available for compliance.

Once an application meeting the statutory requirements has been received, we are further directed by section 202(c) to conduct a public hearing on such an application and within 60 days to issue a decision.

On January 1, the National Academy of Sciences' filed its first semiannual report on the technological feasibility of meeting the 1975 standards. The report indicated that, "There is no certainty today that any 1975 model year vehicles will meet the requirements of the act." The report further states, "It is possible that larger manufacturers will be able to produce vehicles that will qualify, provided that provisions are made for catalyst replacement and other maintenance, for averaging emissions of production vehicles, and for the general availability of fuel containing suitably low levels of catalyst poisons."

As this committee is well aware, General Motors wrote us on January 12 indicating they wished a suspension of the standards for their 1975 vehicles. In our January 19 reply to them, we stated that EPA would have to be supplied with data indicating that all good faith efforts have been made, and that the technology will not be available or has not been available long enough to comply with standards.

We request this correspondence be made a part of the record.

Mr. ROGERS. Without objection, it is so ordered.

(See attachment 5: letter dated January 12, 1972, from E. S. Starkman, vice president, General Motors Corp., to W. D. Ruckelshaus, Administrator, EPA, and letter dated January 19, 1972, from Mr. Ruckelshaus to Mr. Starkman, p. 459, this hearing.)

Mr. RUCKELSHAUS. There are two basic factors concerning compliance with the 1975 standards that we would like to bring to the attention of the committee. First, it is our position that if one manufacturer can comply with the standards, then EPA is unable to grant any other manufacturer a suspension. To read the provision any other way would have the effect of penalizing the manufacturer who meets the standard. Second, we are independently assessing available control technology, alternative systems, and leadtime necessary for production of 1975 model vehicles.

The matter of granting or denying a suspension in this very complex area is one that, in our opinion, should be the subject of great national debate. Toward this end, we are requiring suspension applicants to make public their supporting evidence at the time of application so

that the public can be well prepared at any suspension hearing. We intend to lay before the Congress and the public all information available to us on this matter.

REGULATION OF FUELS

Section 211 of the act authorizes EPA to establish regulations to control the use of motor vehicle fuel additives. We are currently in the process of designing proposed regulations which would have the effect of making available to the motoring public one grade of nonleaded gasoline by mid-1974. As soon as these regulations are proposed we will forward a copy of them to the committee.

AIRCRAFT EMISSION STANDARDS

Turning now to aircraft emissions, Secretaries Finch and Volpe in January 1970 entered into a voluntary agreement with the major airlines to reduce smoke emissions from certain jet aircraft. The agreement provided that at each major engine overhaul a smokeless combustor would be installed on the engine. We are pleased to report that compliance with the agreement is proceeding on schedule. As of December 31, 1971, smokeless combustors had been installed on approximately 70 percent of all of the commercial jet aircraft engines covered by the agreement.

With respect to setting aircraft standards, section 231 directs EPA to commence a study, within 90 days of enactment, to determine the extent to which aircraft emissions affect air quality in air quality control regions and the technological feasibility of controlling such emissions. The study was to be completed and a report published within 180 days. However, the time allowed has proven inadequate to make a full assessment of the impact of aircraft on air quality and the improvement in air quality that would result from various emission standards. We are in the process, however, of resolving this technical problem and are hopeful of publishing a report in the near future.

LITIGATION

The past year has witnessed litigation in three important areas: use of the emergency powers provision in imminent hazard cases, requirements covering new light duty vehicle certification, and challenges to air quality and new source performance standards.

Probably EPA's most publicized accomplishment in 1971 was its actions in dealing with the Birmingham air pollution episode. In this case, after local authorities unsuccessfully attempted to achieve significant voluntary curtailment of emissions from major sources, a small highly skilled staff of EPA and Justice Department officials requested and received from the Federal district court an order shutting down the pollution-producing operations at 23 plants, until the city's air quality returned to its normal levels. Clearly, this is an example of the benefits of a strong legislative provision, and determined and efficient implementation. We have available for the record a copy of our petition and the temporary restraining order issued by the court.

Mr. ROGERS. I might say I think we have that in our records. (See

p. 53, this hearing.) We think the agency did an outstanding job in applying that emergency provision.

We were very pleased with your actions and we think the public was quite pleased with that action.

Mr. RUCKELSHAUS. Thank you, Mr. Chairman.

Then there would be no need to submit that for the record?

Mr. ROGERS. That is correct.

Mr. RUCKELSHAUS. Late in the summer, we became aware that the Ford Motor Co. was shipping to dealers light duty vehicles which had not been certified as meeting emission standards. None of these vehicles had been sold to the motoring public, nevertheless the statute specifies as a prohibited act that new vehicles and engines cannot be introduced into commerce without a certificate of conformity with applicable standards. After a period of negotiation with the Ford Motor Co., the Justice Department entered into a consent decree with the company on December 1. This decree permanently enjoins the Ford Motor Co. from engaging in such practices and levies a fine of $10,000. We are making available for the record a copy of this decree.

Mr. ROGERS. Without objection, it will be made a part of the record.

(See attachment 6: *United States of America*, plaintiff v. *Ford Motor Company* and *Ford Marketing Corporation, etc.*, defendants—Civil No. 2405-71, U.S. District Court for the District of Columbia, p. 461, this hearing.)

Mr. RUCKELSHAUS. Of major concern to the Agency are pending and anticipated legal challenges to the standards we have promulgated. A challenge has been made to the national secondary ambient air quality standard for sulfur oxides on the grounds that it is to stringent. The 1975 emission standard for hydrocarbons has been challenged as not in compliance with the act. Also, it is our understanding the new source performance standards for sulfuric acid manufacturing operations are being challenged. We look upon these challenges positively. Judicial examination and testing can provide certainty and reliability in the standards. Again, we have available for the record a list of these cases.

Mr. ROGERS. They may be made a part of the record.

(See attachment 7: "List of cases challenging EPA standards," p. 464, this hearing.)

NOISE POLLUTION

Mr. RUCKELSHAUS. As mandated by title IV of the 1970 amendments, we have submitted a report to the President and the Congress regarding the causes, sources, and effects of noise pollution along with recommendations for its abatement and control. We have also held eight public hearings throughout the country on specific problems of noise control, pursuant to the title IV mandate. The complete transcripts of those hearings are available to the subcommittee for inclusion in the record, should you so desire.

Mr. ROGERS. I think we would prefer to have them for the committee's files.

Mr. RUCKELSHAUS. Both the report and the hearings point out the need for strong legislation in this area, as further reflected by our testimony before this subcommittee on June 16, 1971, on H.R. 5275

and others. We appreciate the subcommittee's own recognition of the need for noise control legislation through its referral of such legislation to the full committee on September 29, 1971. We hopefully anticipate action by the full committee and passage of noise legislation by the House in the near future.

EPA is attempting to implement the 1970 amendments as expeditiously as possible. We have yet to break the 4-minute mile, but we are coming close.

We would be pleased, Mr. Chairman, to answer any questions you or the committee might have.

(Testimony resumes on p. 464.)

(The attachments referred to in Mr. Ruckelshaus' statement follow:)

ATTACHMENT 1

Title 42—PUBLIC HEALTH

Chapter IV—Environmental Protection Agency

PART 410—NATIONAL PRIMARY AND SECONDARY AMBIENT AIR QUALITY STANDARDS

Notices of proposed rule-making published in the FEDERAL REGISTER on January 30, 1971 (36 F.R. 1502) and March 26, 1971 (36 F.R. 5867) set forth regulations prescribing national primary and secondary ambient air quality standards proposed for adoption as Part 410 of 42 CFR. Interested persons were afforded an opportunity to participate in the rule-making by submitting comments. Following review of the proposed standards and consideration of the comments, the standards have been revised as described below and are being promulgated today.

National primary ambient air quality standards are those which, in the judgment of the Administrator, based on the air quality criteria and allowing an adequate margin of safety, are requisite to protect the public health.

National secondary ambient air quality standards are those which, in the judgment of the Administrator, based on the air quality criteria, are requisite to protect the public welfare from any known or anticipated adverse effects associated with the presence of air pollutants in the ambient air.

The comments submitted to the Environmental Protection Agency reflect divergences of opinion among interested and informed persons as to the proper interpretation of available data on the public health and welfare effects of the six pollutants for which national ambient air quality standards are being established. A number of comments question the feasibility of implementing the proposed standards. Because the Clean Air Act, as amended, does not permit any factors other than health to be taken into account in setting the primary standards, no revisions were made on this basis. In reviewing the proposed standards, the Environmental Protection Agency limited its consideration to comments concerning the validity of the scientific basis of the standards.

Current scientific knowledge of the health and welfare hazards of these air pollutants is imperfect. To increase and improve this knowledge, the Environmental Protection Agency will continue to conduct and support relevant research. At the same time, the need for increased knowledge of the health and welfare effects of air pollution cannot justify failure to take action based on knowledge presently available. The Clean Air Act, as amended, requires promulgation at this time of national standards for six air pollutants on the basis of available data set forth in air quality criteria documents. Thus, the Administrator is required to make judgments as to the proper interpretation of presently available data and to establish national primary standards which include an adequate margin of safety to protect human health. Where the validity of available research data has been questioned, but not wholly refuted, the Administrator has in each case promulgated a national primary standard which includes a margin of safety adequate to protect the public health from adverse effects suggested by the available data.

The national primary standard for carbon monoxide, proposed on January 30, 1971, was based on evidence that low levels of carboxyhemoglobin in human blood may be associated with impairment of ability to discriminate time intervals. This evidence is reflected in "Air Quality Criteria for Carbon Monoxide" (35 F.R. 4768). In the comments, serious questions were raised about the soundness of this evidence. Extensive consideration was given to this matter. The conclusions reached were that the evidence regarding impaired time-interval discrimination had not been refuted and that a less restrictive national standard for carbon monoxide would therefore not provide the margin of safety which may be needed to protect the health of persons especially sensitive to the effects of elevated carboxyhemoglobin levels. The only change made in the national standards for carbon monoxide was a modification of the 1-hour value. The revised standard affords protection from the same low levels of blood carboxyhemoglobin as a result of short-term exposure. The national standards for carbon monoxide, as set forth below, are intended to protect against the occurrence of carboxyhemoglobin levels above 2 percent. It is the Administrator's judgment that attainment of the national standards for carbon monoxide will provide an adequate safety margin for protection of public health and will protect against known and anticipated adverse effects on public welfare.

National standards for photochemical oxidants have also been revised. The revised national primary standard of 160 $\mu g./m.^3$ (0.08 p.p.m.) is based on evidence of increased frequency of asthma attacks in some asthmatic subjects on days when estimated hourly average concentrations of photochemical oxidant reached 200 $\mu g./m.^3$ (0.10 p.p.m.). A number of comments raised serious questions about the validity of data used to suggest impairment of athletic performance at ambient oxidant concentrations. The revised primary standard includes a margin of safety which is substantially below the most likely threshold level suggested by this data. It is the Administrator's judgment that a primary standard of 160 $\mu g./m.^3$ (0.08 p.p.m.) as a 1-hour average will provide an adequate safety margin for protection of public health and will protect against known and anticipated adverse effects on public welfare.

National standards for hydrocarbons have been revised to make these standards consistent with the above modifications of the national standard for photochemical oxidants. Hydrocarbons are a precursor of photochemical oxidants. The sole purpose of prescribing a hydrocarbon standard is to control photochemical oxidants. Accordingly, the above-described revisions of the national standards for photochemical oxidants necessitated a corresponding revision of the hydrocarbon standards.

National standards for nitrogen dioxide have been revised to eliminate the proposed 24-hour average value. No adverse effects on public health or welfare have been associated with short-term exposure to nitrogen dioxide at levels which have been observed to occur in the ambient air. Attainment of the annual average will, in the Administrator's judgment, provide an adequate safety margin for protection of public health and will protect against known and anticipated adverse effects on public welfare.

Appendices A through F, which describe measurement methods, have been revised to clarify many technical points. As revised, each appendix describes a complete reference method for evaluating the ambient concentration of a pollutant for which national ambient air quality standards are being established.

Nine months after the date of publication of this notice, the States are required to submit to the Administrator, in accordance with section 110 of the Act, implementation plans for the attainment and maintenance of the national primary and secondary standards specified in this part. Requirements for the preparation, adoption, and submittal of implementation plans were published by the Administrator, as proposed rule-making, in the FEDERAL REGISTER on April 7, 1971 (36 F.R. 6680).

In consideration of the foregoing and in accordance with the statements in the notice of proposed rule-making, the national primary and secondary ambient air quality standards, Part 410, are hereby promulgated effective upon publication.

Dated: April 28, 1971.

WILLIAM D. RUCKELSHAUS,
Administrator.

A new Part 410 is added to Chapter IV, Title 42, Code of Federal Regulations as follows:

77-166 O - 72 - 27

Appendix A—Reference Method for the Determination of Sulfur Dioxide in the Atmosphere (Pararosaniline Method).
Appendix B—Reference Method for the Determination of Suspended Particulates in the Atmosphere (High Volume Method).
Appendix C—Reference Method for the Continuous Measurement of Carbon monoxide in the Atmosphere (Non-dispersive Infrared Spectrometry).
Appendix D—Reference Method for the Measurement of Photochemical Oxidants Corrected for Interferences Due to Nitrogen Oxide and Sulfur Dioxide.
Appendix E—Reference Method for the Determination of Hydrocarbons Corrected for Methane.
Appendix F—Reference Method for the Determination of Nitrogen Dioxide (24-Hour Sampling Method).

AUTHORITY: The provisions of this Part 410 issued under sec. 4, Public Law 91-604, Stat. 1679.

§ 410.1 Definitions.

(a) As used in this part, all terms not defined herein shall have the meaning given them by the Act.

(b) "Act" means the Clean Air Act, as amended (Public Law 91-604; 84 Stat. 1676).

(c) "Agency" means the Environmental Protection Agency.

(d) "Administrator" means the Administrator of the Environmental Protection Agency.

(e) "Ambient air" means that portion of the atmosphere, external to buildings, to which the general public has access.

(f) "Reference method" means a method of sampling and analyzing for an air pollutant, as described in an appendix to this part.

(g) "Equivalent method" means any method of sampling and analyzing for an air pollutant which can be demonstrated to the Administrator's satisfaction to have a consistent relationship to the reference method.

§ 410.2 Scope.

(a) National primary and secondary ambient air quality standards under section 109 of the Act are set forth in this part.

(b) National primary ambient air quality standards define levels of air quality which the Administrator judges are necessary, with an adequate margin of safety, to protect the public health. National secondary ambient air quality standards define levels of air quality which the Administrator judges necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant. Such standards are subject to revision, and additional primary and secondary standards may be promulgated as the Administrator deems necessary to protect the public health and welfare.

(c) The promulgation of national primary and secondary ambient air quality standards shall not be considered in any manner to allow significant deterioration of existing air quality in any portion of any State.

(d) The proposal, promulgation, or revision of national primary and secondary ambient air quality standards shall not prohibit any State from establishing ambient air quality standards for that State or any portion thereof which are more stringent than the national standards.

§ 410.3 Reference conditions.

All measurements of air quality are corrected to a reference temperature of 25° C. and to a reference pressure of 760 millimeters of mercury (1,013.2 millibars).

§ 410.4 National primary ambient air quality standards for sulfur oxides (sulfur dioxide).

The national primary ambient air quality standards for sulfur oxides, measured as sulfur dioxide by the reference method described in Appendix A to this part, or by an equivalent method, are:

(a) 80 micrograms per cubic meter (0.03 p.p.m.)—annual arithmetic mean.

(b) 365 micrograms per cubic meter (0.14 p.p.m.)—Maximum 24-hour concentration not to be exceeded more than once per year.

§ 410.5 National secondary ambient air quality standards for sulfur oxides (sulfur dioxide).

The national secondary ambient air quality standards for sulfur oxides, measured as sulfur dioxide by the reference method described in Appendix A to this part, or by an equivalent method, are:

(a) 60 micrograms per cubic meter (0.02 p.p.m.)—annual arithmetic mean.

(b) 260 micrograms per cubic meter (0.1. p.p.m.)—maximum 24-hour concentration not to be exceeded more than once per year, as a guide to be used in assessing implementation plans to achieve the annual standard.

(c) 1,300 micrograms per cubic meter (0.5 p.p.m.)—maximum 3-hour concentration not to be exceeded more than once per year.

§ 410.6 National primary ambient air quality standards for particulate matter.

The national primary ambient air quality standards for particulate matter, measured by the reference method described in Appendix B to this part, or by an equivalent method, are:

(a) 75 micrograms per cubic meter—annual geometric mean.

(b) 260 micrograms per cubic meter—maximum 24-hour concentration not to be exceeded more than once per year.

§ 410.7 National secondary ambient air quality standards for particulate matter.

The national secondary ambient air quality standards for particulate matter, measured by the reference method described in Appendix B to this part, or by an equivalent method, are:

(a) 60 micrograms per cubic meter—annual geometric mean, as a guide to be used in assessing implementation plans to achieve the 24-hour standard.

(b) 150 micrograms per cubic meter—maximum 24-hour concentration not to be exceeded more than once per year.

§ 410.8 National primary and secondary ambient air quality standards for carbon monoxide.

The national primary and secondary ambient air quality standards for carbon monoxide, measured by the reference method described in Appendix C to this part, or by an equivalent method, are:

(a) 10 milligrams per cubic meter (9 p.p.m.)—maximum 8-hour concentration not to be exceeded more than once per year.

(b) 40 milligrams per cubic meter (35 p.p.m.)—maximum 1-hour concentration not to be exceeded more than once per year.

§ 410.9 National primary and secondary ambient air quality standards for photochemical oxidants.

The national primary and secondary ambient air quality standard for photochemical oxidants, measured and corrected for interferences due to nitrogen oxides and sulfur dioxide by the reference method described in Appendix D to this part, or by an equivalent method, is: 160 micrograms per cubic meter (0.08 p.p.m.)—maximum 1-hour concentration not to be exceeded more than once per year.

§ 410.10 National primary and secondary ambient air quality standard for hydrocarbons.

The hydrocarbons standard is for use as a guide in devising implementation plans to achieve oxidant standards.

The national primary and secondary ambient air quality standard for hydrocarbons, measured and corrected for methane by the reference method described in Appendix E to this part, or by an equivalent method, is: 160 micrograms per cubic meter (0.24 p.p.m.)—maximum 3-hour concentration (6 to 9 a.m.) not to be exceeded more than once per year.

§ 410.11 National primary and secondary ambient air quality standard for nitrogen dioxide.

The national primary and secondary ambient air quality standard for nitrogen dioxide, measured by the reference method described in Appendix F to this part, or by an equivalent method, is: 100 micrograms per cubic meter (0.05 p.p.m.)—annual arithmetic mean.

APPENDIX A.—REFERENCE METHOD FOR THE DETERMINATION OF SULFUR DIOXIDE IN THE ATMOSPHERE (PARAROSANILINE METHOD)

1. *Principle and Applicability.* 1.1 Sulfur dioxide is absorbed from air in a solution of potassium tetrachloromercurate (TCM). A dichlorosulfitomercurate complex, which resists oxidation by the oxygen in the air, is formed (*1, 2*). Once formed, this complex is stable to strong oxidants (e.g., ozone, oxides of nitrogen). The complex is reacted with pararosaniline and formaldehyde to form intensely colored pararosaniline methyl sulfonic acid (*3*). The absorbance of the solution is measured spectrophotometrically.

1.2 The method is applicable to the measurement of sulfur dioxide in ambient air using sampling periods up to 24 hours.

2. *Range and Sensitivity.* 2.1 Concentrations of sulfur dioxide in the range of 25 to 1,050 $\mu g/m^3$ (0.01 to 0.40 p.p.m.) can be measured under the conditions given. One can measure concentrations below 25 $\mu g./m^3$ by sampling larger volumes of air, but only if the absorption efficiency of the particular system is first determined. Higher concentrations can be analyzed by using smaller gas samples, a larger collection volume, or a suitable aliquot of the collected sample. Beer's Law is followed through the working range from 0.03 to 1.0 absorbance units (0.8 to 27 $\mu g.$ of sulfite ion in 25 ml. final solution computed as SO_3).

2.2 The lower limit of detection of sulfur dioxide in 10 ml. TCM is 0.75 μg_{SO_2} (based on twice the standard deviation) representing a concentration of 25 $\mu g./m^3SO_2$ (0.01 p.p.m.) in an air sample of 30 liters.

3. *Interferences.* 3.1 The effects of the principal known interferences have been minimized or eliminated. Interferences by oxides of nitrogen are eliminated by sulfamic acid (*4, 5*), ozone by time-delay (*6*), and heavy metals by EDTA (ethylenediaminetetraacetic acid, disodium salt) and phosphoric acid (*4, 6*). At least 60 $\mu g.$ Fe (III), 10 $\mu g.$ Mn(II), and 10 $\mu g.$ Cr(III) in 10 ml. absorbing reagent can be tolerated in the procedure. No significant interference was found with 10 $\mu g.$ CU (II) and 22 $\mu g.$ V(V).

4. *Precision, Accuracy, and Stability.* 4.1 Relative standard deviation at the 95 percent confidence level is 4.6 percent for the analytical procedure using standard samples. (*3*)

4.2 After sample collection the solutions are relatively stable. At 22° C. losses of sulfur dioxide occur at the rate of 1 percent per day. When samples are stored at 5° C. for 30 days, no detectable losses of sulfur dioxide occur. The presence of EDTA enhances the stability of SO_2 in solution, and the rate of decay is independent of the concentration of SO_2. (*7*)

5. *Apparatus.*

5.1 *Sampling.*

5.1.1 *Absorber.* Absorbers normally used in air pollution sampling are acceptable for concentrations above 25 $\mu g./m^3$ (0.01 p.p.m.). An all-glass midget impinger, as shown in Figure A1, is recommended for 30-minute and 1-hour samples.

For 24-hour sampling, assemble an absorber from the following parts:

Polypropylene 3-port tube closures, special manufacture (available from Bel-Art Products, Pequannock, N.J.).

Glass impingers, 6 mm. tubing, 6 inches long, one end drawn to small diameter such that No. 79 jewelers will pass through, but No. 78 jewelers will not. (Other end fire polished.)

Polypropylene tubes, 164 by 32 mm. Nalgene or equal).

5.1.2 *Pump.* Capable of maintaining an air pressure differential greater than 0.7 atmosphere at the desired flow rate.

5.1.3 *Air Flowmeter or Critical Orifice.* A calibrated rotameter or critical orifice capable of measuring air flow within ±2 percent. For 30-minute sampling, a 22-gauge hypodermic needle 1 inch long may be used as a critical orifice to give a flow of about 1 liter/minute. For 1-hour sampling, a 22-gauge hypodermic needle five-eighths of an inch long may be used as a critical orifice to give a flow of about 0.5 liter/minute. For 24 hour sampling, a 27-gauge hypodermic needle three-eighths of an inch long may be used to give a flow of about 0.2 liter/minute. Use a membrane filter to protect the needle (Figure A1a).

6.2 *Analysis.*

6.2.1 *Spectrophotometer.* Suitable for measurement of absorbance at 548 nm. with an effective spectral band width of less than 15 nm. Reagent blank problems may occur with spectrophotometers having greater spectral band width. The wavelength calibration of the instrument should be verified. If transmittance is measured, this can be converted to absorbance:

$$A = \log_{10}(1/T)$$

6. *Reagents.*

6.1 *Sampling.*

6.1.1 *Distilled water.* Must be free from oxidants.

6.1.2 *Absorbing Reagent (0.04 M Potassium Tetrachloromercurate (TCM)).* Dissolve 10.86 g. mercuric chloride, 0.066 g. EDTA (thylenediaminetetraacetic acid, disodoum salt), and 6.0 g. potassium chloride in water and bring to mark in a 1,000-ml. volumetric flask. (Caution: highly poisonous. If spilled on skin, flush off with water immediately). The pH of this reagent should be approximately 4.0, but it has been shown that there is no appreciable difference in collection efficiency over the range of pH 5 to pH 3.(*7*) The absorbing reagent is normally stable for 6 months. If a precipitate forms, discard the reagent.

6.2 *Analysis.*

6.2.1 *Sulfamic Acid (0.8 percent).* Dissolve 0.6 g. sulfamic acid in 100 ml. distilled water. Prepare fresh daily.

6.2.2 *Formaldehyde (0.2 percent).* Dilute 5 ml. formaldehyde solution (36-38 percent) to 1,000 ml. with distilled water. Prepare daily.

6.2.3 *Stock Iodine Solution (0.1 N).* Place 12.7 g. iodine in a 250-ml. beaker; add 40 g. potassium iodide and 25 ml. water. Stir until all is dissolved, then dilute to 1,000 ml. with distilled water.

6.2.4 *Iodine Solution (0.01 N).* Prepare approximately 0.01 N iodine solution by diluting 50 ml. of stock solution to 500 ml. with distilled water.

6.2.5 *Starch Indicator Solution.* Triturate 0.4 g. soluble starch and 0.002 g. mercuric iodide (preservative) with a little water, and add the paste slowly to 200 ml. boiling water. Continue boiling until the solution is clear; cool, and transfer to a glass-stoppered bottle.

6.2.6 *Stock Sodium Thiosulfate Solution (0.1 N).* Prepare a stock solution by dissolving 25 g. sodium thiosulfate ($Na_2S_2O_3 \cdot 5H_2O$) in 1,000 ml. freshly boiled, cooled, distilled water and add 0.1 g sodium carbonate to the solution. Allow the solution to stand 1 day before standardising. To standardize, accurately weigh, to the nearest 0.1 mg., 1.5 g. primary standard potassium iodate dried at 180° C. and dilute to volume in a 500-ml. volumetric flask. To a 500-ml. iodine flask, pipet 50 ml. of iodate solution. Add 2 g. potassium iodide and 10 ml. of 1 N hydrochloric acid. Stopper the flask. After 5 minutes, titrate with stock thiosulfate solution to a pale yellow. Add 5 ml. starch indicator solution and continue the titration until the blue color disappears. Calculate the normality of the stock solution:

$$N = \frac{W}{M} \times 2.80$$

N = Normality of stock thiosulfate solution.

M = Volume of thiosulfate required, ml

W = Weight of potassium iodate, grams

$$2.80 = \frac{10^3(\text{conversion of g. to mg.}) \times 0.1\ (\text{fraction iodate used})}{35.67\ (\text{equivalent weight of potassium iodate})}$$

6.2.7 *Sodium Thiosulfate Titrant (0.01 N).* Dilute 100 ml. of the stock thiosulfate solution to 1,000 ml. with freshly boiled distilled water.

$$\text{Normality} = \text{Normality of stock solution} \times 0.100.$$

6.2.8 *Standardize Sulfite Solution for Preparation of Working Sulfite-TCM Solution.*[1] Dissolve 0.3 g. sodium metabisulfite ($Na_2S_2O_5$) or 0.40 g. sodium sulfite (Na_2SO_3) in 500 ml. of recently boiled, cooled, distilled water. (Sulfite solution is unstable; it is therefore important to use water of the highest purity to minimize this instability.) This solution contains the equivalent of 320 to 400 $\mu g./ml.$ of SO_2. The actual concentration of the solution is determined by adding excess iodine and back-titrating with standard sodium thiosulfate solution. To back-titrate, pipet 50 ml. of the 0.01 N iodine into each of two 500-ml. iodine flasks (A and B). To flask A (blank) add 25 ml. distilled water, and to flask B (sample) pipet 25 ml. sulfite solution. Stopper the flasks and allow to react for 5 minutes. Prepare the working sulfite-TCM Solution (6.2.9) at the same time iodine solution is added to the flasks. By means of a buret containing standardized 0.01 N thiosulfate, titrate each flask in turn to a pale yellow. Then add 5 ml. starch solution and continue the titration until the blue color disappears.

6.2.9 *Working Sulfite-TCM Solution.* Pipet accurately 2 ml. of the standard solution into a 100 ml volumetric flask and bring to mark with 0.04 M TCM. Calculate the concentration of sulfur dioxide in the working solution:

$$\mu g\ SO_2/ml. = \frac{(A - B)\ (N)\ (32{,}000)}{25} \cdot 25 \times 0.02$$

A = Volume thiosulfate for blank, ml.
B = Volume thiosulfate for sample, ml.
N = Normality of thiosulfate titrant.
32,000 = Milliequivalent wt. of SO_2, $\mu g.$
25 = Volume standard sulfite solution, ml.
0.02 = Dilution factor.

This solution is stable for 30 days if kept at 5° C. (refrigerator). If not kept at 5° C., prepare daily.

6.2.10 *Purified Pararosaniline Stock Solution (0.2 percent nominal).*

6.2.10.1 *Dye Specifications.* The pararosaniline dye must meet the following performance specifications: (1) the dye must have a wavelength of maximum absorbance at 540 nm. when assayed in a buffered solution of 0.1 M sodium acetate-acetic acid; (2) the absorbance of the reagent blank, which is temperature-sensitive (0.015 absorbance unit/°C), should not exceed 0.170 absorbance unit at 22° C. with a 1-cm. optical path length, when the blank is prepared according to the prescribed analytical procedure and to the specified concentration of the dye; (3) the calibration curve (Section 8.2.1) should have a slope of 0.030 ± 0.002 absorbance unit/$\mu g.$ SO_2 at this path length when the dye is pure and the sulfite solution is properly standardized.

6.2.10.2 *Preparation of Stock Solution.* A specially purified (99-100 percent pure) solution of pararosaniline, which meets the above specifications, is commercially available in the required 0.20 percent concentration (Harleco*). Alternatively, the dye may be purified, a stock solution prepared and then assayed according to the procedure of Scaringelli, et al. (*4*)

6.2.11 *Pararosaniline Reagent.* To a 250-ml. volumetric flask, add 20 ml. stock pararosaniline solution. Add an additional 0.2 ml. stock solution for each percent the stock

*Hartman-Leddon, 60th and Woodland Avenue, Philadelphia, PA 19143.

assays below 100 percent. Then add 25 ml. 3 M phosphoric acid and dilute to volume with distilled water. This reagent is stable for at least 9 months.

7. *Procedure.*

7.1 *Sampling.* Procedures are described for short-term (30 minutes and 1 hour) and for long-term (24 hours) sampling. One can select different combinations of sampling rate and time to meet special needs. Sample volumes should be adjusted, so that linearity is maintained between absorbance and concentration over the dynamic range.

7.1.1 *30-Minute and 1-Hour Samplings.* Insert a midget impinger into the sampling system, Figure A1. Add 10 ml. TCM solution to the impinger. Collect sample at 1 liter/minute for 30 minutes, or at 0.5 liter/minute for 1 hour, using either a rotameter, as shown in Figure A1, or a critical orifice, as shown in Figure A1a, to control flow. Shield the absorbing reagent from direct sunlight during and after sampling by covering the impinger with aluminum foil, to prevent deterioration. Determine the volume of air sampled by multiplying the flow rate by the time in minutes and record the atmospheric pressure and temperature. Remove and stopper the impinger. If the sample must be stored for more than a day before analysis, keep it at 5° C. in a refrigerator (see 4.2).

7.1.2 *24-Hour Sampling.* Place 50 ml. TCM solution in a large absorber and collect the sample at 0.2 liter/minute for 24 hours from midnight to midnight. Make sure no entrainment of solution results with the impinger. During collection and storage protect from direct sunlight. Determine the total air volume by multiplying the air flow rate by the time in minutes. The correction of 24-hour measurements for temperature and pressure is extremely difficult and is not ordinarily done. However, the accuracy of the measurement will be improved if meaningful corrections can be applied. If storage is necessary, refrigerate at 5° C. (see 4.2).

7.2 *Analysis.*

7.2.1 *Sample Preparation.* After collection, if a precipitate is observed in the sample, remove it by centrifugation.

7.2.1.1 *30-Minute and 1-Hour Samples.* Transfer the sample quantitatively to a 25-ml. volumetric flask; use about 3 ml. distilled water for rinsing. Delay analyses for 20 minutes to allow any ozone to decompose.

7.2.1.2 *24-Hour Sample.* Dilute the entire sample to 50 ml. with absorbing solution. Pipet 5 ml. of the sample into a 25-ml. volumetric flask for chemical analyses. Bring volume to 10 ml. with absorbing reagent. Delay analyses for 20 minutes to allow any ozone to decompose.

7.2.2 *Determination.* For each set of determinations prepare a reagent blank by adding 10 ml. unexposed TCM solution to a 25-ml. volumetric flask. Prepare a control solution by adding 2 ml. of working sulfite-TCM solution and 8 ml. TCM solution to a 25-ml. volumetric flask. To each flask containing either sample, control solution, or reagent blank, add 1 ml. 0.6 percent sulfamic acid and allow to react 10 minutes to destroy the nitrite from oxides of nitrogen. Accurately pipet in 2 ml. 0.2 percent formaldehyde solution, then 5 ml. pararosaniline solution. Start a laboratory timer that has been set for 30 minutes. Bring all flasks to volume with freshly boiled and cooled distilled water and mix thoroughly. After 30 minutes and before 60 minutes, determine the absorbances of the sample (denote as A_1), reagent blank (denote as A_2) and the control solution at 548 nm. using 1-cm. optical path length cells. Use distilled water, not the reagent blank, as the reference. (NOTE: This is important because of the color sensitivity of the reagent blank to temperature changes which can be induced in the cell compartment of a spectrophotometer.) Do not allow the colored solution to stand in the absorbance cells, because a film of dye may be deposited. Clean cells with alcohol after use. If the temperature of the determinations does not differ by more than 2° C. from the calibration temperature (8.2), the reagent blank should be within 0.03 absorbance unit of the y-intercept of the calibration curve (8.2). If the reagent blank differs by more than 0.03 absorbance unit from that found in the calibration curve, prepare a new curve.

7.2.3 *Absorbance Range.* If the absorbance of the sample solution ranges between 1.0 and 2.0, the sample can be diluted 1:1 with a portion of the reagent blank and read within a few minutes. Solutions with higher absorbance can be diluted up to sixfold with the reagent blank in order to obtain onscale readings within 10 percent of the true absorbance value.

8. *Calibration and Efficiencies.*

8.1 *Flowmeters and Hypodermic Needle.* Calibrate flowmeters and hypodermic needle (8) against a calibrated wet test meter.

8.2 *Calibration Curves.*

8.2.1 *Procedure with Sulfite Solution.* Accurately pipet graduated amounts of the working sulfite-TCM solution (6.2.9) (such as 0, 0.5, 1, 2, 3, and 4 ml.) into a series of 25-ml. volumetric flasks. Add sufficient TCM solution to each flask to bring the volume to approximately 10 ml. Then add the remaining reagents as described in 7.2.2. For maximum precision use a constant-temperature bath. The temperature of calibration must be maintained within ±1° C. and in the range of 20° to 30° C. The temperature of calibration and the temperature of analysis must be within 2 degrees. Plot the absorbance against the total concentration in $\mu g.$ SO_2 for the corresponding solution. The total $\mu g.$ SO_2 in solution equals the concentration of the standard (Section 6.2.9) in $\mu g.$ SO_2/ml. times the ml. sulfite solution added ($\mu g.$ SO_2= $\mu g.$/ml. SO_2× ml. added). A linear relationship should be obtained, and the y-intercept should be within 0.03 absorbance unit of the zero standard absorbance. For maximum precision determine the line of best fit using regression analysis by the method of least squares. Determine the slope of the line of best fit, calculate its reciprocal and denote as B_s. B_s is the calibration factor. (See Section 6.2.10.1 for specifications on the slope of the calibration curve). This calibration factor can be used for calculating results provided there are no radical changes in temperature or pH. At least one control sample containing a known concentration of SO_2 for each series of determinations, is recommended to insure the reliability of this factor.

8.2.2 *Procedure with SO_2 Permeation Tubes.*

8.2.2.1 *General Considerations.* Atmospheres containing accurately known amounts of sulfur dioxide at levels of interest can be prepared using permeation tubes. In the systems for generating these atmospheres, the permeation tube emits SO_2 gas at a known, low, constant rate, provided the temperature of the tube is held constant (±0.1° C.) and provided the tube has been accurately calibrated at the temperature of use. The SO_2 gas permeating from the tube is carried by a low flow of inert gas to a mixing chamber where it is accurately diluted with SO_2-free air to the level of interest and the sample taken. These systems are shown schematically in Figures A2 and A3 and have been described in detail by O'Keeffe and Ortman (9), Scaringelli, Frey, and Saltzman (10), and Scaringelli, O'Keeffe, Rosenberg, and Bell (11).

8.2.2.2 *Preparation of Standard Atmospheres.* Permeation tubes may be prepared or purchased. Scaringelli, O'Keeffe, Rosenberg, and Bell (11) give detailed, explicit directions for permeation tube calibration. Tubes with a certified permeation rate are available from the National Bureau of Standards. Tube permeation rates from 0.2 to 0.4 $\mu g.$/minute inert gas flows of about 50 ml./minute and dilution air flow rates from 1.1 to 15 liters/minutes conveniently give standard atmospheres containing desired levels of SO_2 (28 to 390 $\mu g./m.^3$; 0.01 to 0.15 p.p.m. SO_2). The concentration of SO_2 in any standard atmosphere can be calculated as follows:

$$C = \frac{P \times 10^6}{R_d + R_i}$$

Where:

C = Concentration of SO_2, $\mu g./m.^3$ at reference conditions.

P = Tube permeation rate, $\mu g.$/minute.

R_d = Flow rate of dilution air, liter/minute at reference conditions.

R_i = Flow rate of inert gas, liter/minute at reference conditions.

8.2.2.3 *Sampling and Preparation of Calibration Curve.* Prepare a series (usually six) of standard atmospheres containing SO_2 levels from 28 to 390 $\mu g.$ $SO_2/m.^3$. Sample each atmosphere using similar apparatus and taking exactly the same air volume as will be done in atmospheric sampling. Determine absorbances as directed in 7.2. Plot the concentration of SO_2 in $\mu g./m.^3$ (x-axis) against $A-A_2$ values (y-axis), draw the straight line of best fit and determine the slope. Alternatively, regression analysis by the method of least squares may be used to calculate the slope. Calculate the reciprocal of the slope and denote as B_s.

8.3 *Sampling Efficiency.* Collection efficiency is above 98 percent; efficiency may fall off, however, at concentrations below 28 $\mu g./m.^3$. (12, 13)

9. *Calculations.*

9.1 *Conversion of Volume.* Convert the volume of air sampled to the volume at reference conditions of 25° C. and 760 mm. Hg. (On 24-hour samples, this may not be possible.)

$$V_a = V \times \frac{P}{760} \times \frac{298}{t+273}$$

V_a = Volume of air at 25° C. and 760 mm. Hg, liters.

V = Volume of air sampled, liters.

P = Barometric pressure, mm. Hg.

t = Temperature of air sample, °C.

9.2 *Sulfur Dioxide Concentration.*

9.2.1 When sulfite solutions are used to prepare calibration curves, compute the concentration of sulfur dioxide in the sample:

$$\mu g.\ SO_2/m.^3 = \frac{(A-A_2)\ (10^6)\ (B_s)}{V_a} \times D$$

A = Sample absorbance.

A_2 = Reagent blank absorbance.

10^6 = Conversion of liters to cubic meters.

V_a = The sample corrected to 25° C. and 760 mm. Hg, liters.

B_s = Calibration factor, μg /absorbance unit.

D = Dilution factor.

For 30-minute and 1-hour samples, D=1.

For 24-hour samples, D=10.

9.2.2 When SO_2 gas standard atmospheres are used to prepare calibration curves, compute the sulfur dioxide in the sample by the following formula:

$$SO_2,\ \mu g./m.^3 = (A - A_2) \times B_s$$

A = Sample absorbance.

A_2 = Reagent blank absorbance.

B_s = (See 8.2.2.3).

9.2.3 *Conversion of $\mu g./m.^3$ to p.p.m.* = If desired, the concentration of sulfur dioxide

may be calculated as p.p.m. SO_2 at reference conditions as follows:

$$\text{p.p.m. } SO_2 = \mu g.\ SO_2/m.^3 \times 3.82 \times 10^{-4}$$

10. *References.*

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(13) Bostrom, C. E., "The Absorption of Sulfur Dioxide at Low Concentrations (p.p.m.) Studied by an Isotopic Tracer Method", *Intern. J. Air Water Poll. 9,* 33 (1965).

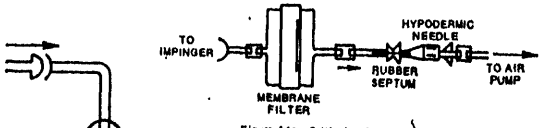

Figure A1a. Critical orifice flow control.

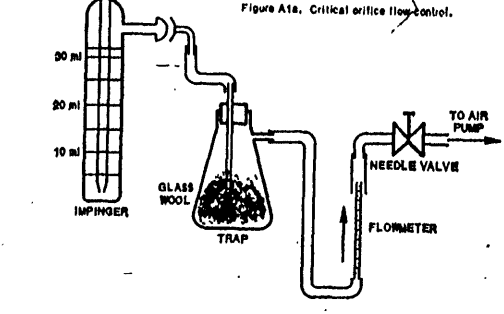

Figure A1. Sampling train.

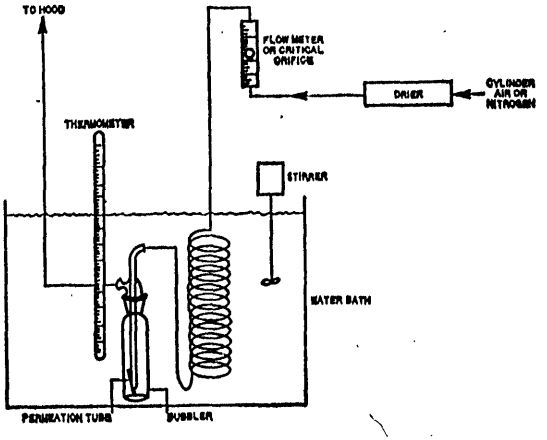

Figure A2. Apparatus for gravimetric calibration and field use.

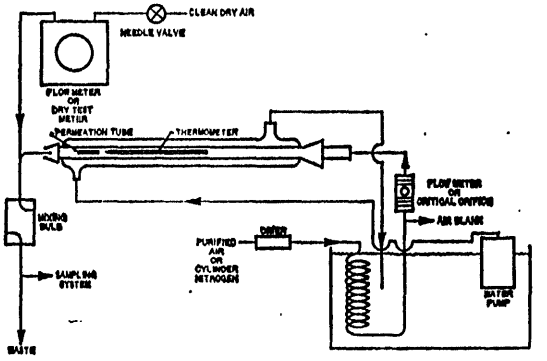

Figure A3. Permeation tube schematic for laboratory use.

APPENDIX B—REFERENCE METHOD FOR THE DETERMINATION OF SUSPENDED PARTICULATES IN THE ATMOSPHERE (HIGH VOLUME METHOD)

1. *Principle and Applicability.*

1.1 Air is drawn into a covered housing and through a filter by means of a high-flow-rate blower at a flow rate (1.18 to 1.70 m.³/min.; 40 to 60 ft.³/min.) that allows suspended particles having diameters of less than 100 μm. (Stokes equivalent diameter) to pass to the filter surface. (*1*) Particles within the size range of 100 to 0.1μm. diameter are ordinarily collected on glass fiber filters. The mass concentration of suspended particulates in the ambient air (μg./m.³) is computed by measuring the mass of collected particulates and the volume of air sampled.

1.2 This method is applicable to measurement of the mass concentration of suspended particulates in ambient air. The size of the sample collected is usually adequate for other analyses.

2. *Range and Sensitivity.*

2.1 When the sampler is operated at an average flow rate of 1.70 m.³/min. (60 ft.³/min.) for 24 hours, an adequate sample will be obtained even in an atmosphere having concentrations of suspended particulates as low as 1 μg./m.³. If particulate levels are unusually high, a satisfactory sample may be obtained in 8 to 8 hours or less. For determination of average concentrations of suspended particulates in ambient air, a standard sampling period of 24 hours is recommended.

2.2 Weights are determined to the nearest milligram, airflow rates are determined to the nearest 0.08 m.³/min. (1.0 ft.³/min.), times are determined to the nearest 2 minutes, and mass concentrations are reported to the nearest microgram per cubic meter.

3. *Interferences.*

3.1 Particulate matter that is oily, such as photochemical smog or wood smoke, may block the filter and cause a rapid drop in airflow at a nonuniform rate. Dense fog or high humidity can cause the filter to become too wet and severely reduce the airflow through the filter.

3.2 Glass-fiber filters are comparatively insensitive to changes in relative humidity, but collected particulates can be hygroscopic. (*2*)

4. *Precision, Accuracy, and Stability.*

4.1 Based upon collaborative testing, the relative standard deviation (coefficient of variation) for single analyst variation (repeatability of the method) is 8.0 percent. The corresponding value for multilaboratory variation (reproducibility of the method) is 9.7 percent. (*3*)

4.2 The accuracy with which the sampler measures the true average concentration depends upon the constancy of the airflow rate through the sampler. The airflow rate is affected by the concentration and the nature of the dust in the atmosphere. Under these conditions the error in the measured average concentration may be in excess of ±50 percent of the true average concentration, depending on the amount of reduction of airflow rate and on the variation of the mass concentration of dust with time during the 24-hour sampling period. (*4*)

5. *Apparatus.*

5.1 *Sampling.*

5.1.1 *Sampler.* The sampler consists of three units: (1) the faceplate and gasket, (2) the filter adapter assembly, and (3) the motor unit. Figure B1 shows an exploded view of these parts, their relationship to each other, and how they are assembled. The sampler must be capable of passing environmental air through a 406.5 cm.² (63 in.²) portion of a clean 20.3 by 25.4 cm. (8- by 10-in.) glass-fiber filter at a rate of at least 1.70 m.³/min. (60 ft.³/min.). The motor must be capable of continuous operation for 24-hour periods with input voltages ranging from 110 to 120 volts, 50–60 cycles alternating current and must have third-wire safety ground. The housing for the motor unit may be of any convenient construction so long as the unit remains airtight and leak-free. The life of the sampler motor can be extended by lowering the voltage by about 10 percent with a small "buck or boost" transformer between the sampler and power outlet.

5.1.2 *Sampler Shelter.* It is important that the sampler be properly installed in a suitable shelter. The shelter is subjected to extremes of temperature, humidity, and all types of air pollutants. For these reasons the materials of the shelter must be chosen carefully. Properly painted exterior plywood or heavy gauge aluminum serve well. The sampler must be mounted vertically in the shelter so that the glass-fiber filter is parallel with the ground. The shelter must be provided with a roof so that the filter is protected from precipitation and debris. The internal arrangement and configuration of a suitable shelter with a gable roof are shown in Figure B2. The clearance area between the main housing and the roof at its closest point should be 580.5 ± 102.5 cm.² (90 ± 20 in.²). The main housing should be rectangular, with dimensions of about 29 by 36 cm. (11½ by 14 in.).

5.1.3 *Rotameter.* Marked in arbitrary units, frequently 0 to 70, and capable of being calibrated. Other devices of at least comparable accuracy may be used.

5.1.4 *Orifice Calibration Unit.* Consisting of a metal tube 7.6 cm. (3 in.) ID and 15.5 cm. (6¼ in.) long with a static pressure tap 5.1 cm. (2 in.) from one end. See Figure B3. The tube end nearest the pressure tap is flanged to about 10.8 cm. (4¼ in.) OD with a male thread of the same size as the inlet end of the high-volume air sampler. A single metal plate 9.2 cm. (3⅝ in.) in diameter and 0.24 cm. (⅛ in.) thick with a central orifice 2.5 cm. (1½ in.) in diameter is held in place at the air inlet end with a female threaded ring. The other end of the tube is flanged to hold a loose female threaded coupling, which screws onto the inlet of the sampler. An 18-hole metal plate, an integral part of the unit, is positioned between the orifice and sampler to simulate the resistance of a clean glass-fiber filter. An orifice calibration unit is shown in Figure B3.

5.1.5 *Differential Manometer.* Capable of measuring to at least 40 cm. (16 in.) of water.

5.1.6 *Positive Displacement Meter.* Calibrated in cubic meters or cubic feet, to be used as a primary standard.

5.1.7 *Barometer.* Capable of measuring atmospheric pressure to the nearest mm.

5.2 *Analysis.*

5.2.1 *Filter Conditioning Environment.* Balance room or desiccator maintained at 18° to 35°C. and less than 50 percent relative humidity.

5.2.2 *Analytical Balance.* Equipped with a weighing chamber designed to handle unfolded 20.3 by 25.4 cm. (8- by 10-in.) filters and having a sensitivity of 0.1 mg.

5.2.3 *Light Source.* Frequently a table of the type used to view X-ray films.

5.2.4 *Numbering Device.* Capable of printing identification numbers on the filters.

6. *Reagents.*

6.1 *Filter Media.* Glass-fiber filters having a collection efficiency of at least 99 percent for particles of 0.3 μm. diameter, as measured by the DOP test, are suitable for the quantitative measurement of concentrations of suspended particulates. (3) Although some other medium, such as paper, may be desirable for some analyses. If a more detailed analysis is contemplated, care must be exercised to use filters that contain low background concentrations of the pollutant being investigated. Careful quality control is required to determine background values of these pollutants.

7. *Procedure.*

7.1 *Sampling.*

7.1.1 *Filter Preparation.* Expose each filter to the light source and inspect for pinholes, particles, or other imperfections. Filters with visible imperfections should not be used. A small brush is useful for removing particles. Equilibrate the filters in the filter conditioning environment for 24 hours. Weigh the filters to the nearest milligram; record tare weight and filter identification number. Do not bend or fold the filter before collection of the sample.

7.1.2 *Sample Collection.* Open the shelter, loosen the wing nuts, and remove the faceplate from the filter holder. Install a numbered, preweighed, glass-fiber filter in position (rough side up), replace the faceplate without disturbing the filter, and fasten securely. Undertightening will allow air leakage, overtightening will damage the sponge-rubber faceplate gasket. A very light application of talcum powder may be used on the sponge-rubber faceplate gasket to prevent the filter from sticking. During inclement weather the sampler may be removed to a protected area for filter change. Close the roof of the shelter, run the sampler for about 5 minutes, connect the rotameter to the nipple on the back of the sampler, and read the rotameter ball with rotameter in a vertical position. Estimate to the nearest whole number. If the ball is fluctuating rapidly, tip the rotameter and slowly straighten it until the ball gives a constant reading. Disconnect the rotameter from the nipple; record the initial rotameter reading and the starting time and date on the filter folder. (The rotameter should never be connected to the sampler except when the flow is being measured.) Sample for 24 hours from midnight to midnight and take a final rotameter reading. Record the final rotameter reading and ending time and date on the filter folder. Remove the faceplate as described above and carefully remove the filter from the holder, touching only the outer edges. Fold the filter lengthwise so that only surfaces with collected particulates are in contact, and place in a manila folder. Record on the folder the filter number, location, and any other factors, such as meteorological conditions or raising of nearby buildings, that might affect the results. If the sample is defective, void it at this time. In order to obtain a valid sample, the high-volume sampler must be operated with the same rotameter and tubing that were used during its calibration.

7.2 *Analysis.* Equilibrate the exposed filters for 24 hours in the filter conditioning environment, then reweigh. After they are weighed, the filters may be saved for detailed chemical analysis.

7.3 *Maintenance.*

7.3.1 *Sampler Motor.* Replace brushes before they are worn to the point where motor damage can occur.

7.3.2 *Faceplate Gasket.* Replace when the margins of samples are no longer sharp. The gasket may be sealed to the faceplate with rubber cement or double-sided adhesive tape.

7.3.3 *Rotameter.* Clean as required, using alcohol.

8. *Calibration.*

8.1 *Purpose.* Since only a small portion of the total air sampled passes through the rotameter during measurement, the rotameter must be calibrated against actual airflow with the orifice calibration unit. Before the orifice calibration unit can be used to calibrate the rotameter, the orifice calibration unit itself must be calibrated against the positive displacement primary standard.

8.1.1 *Orifice Calibration Unit.* Attach the orifice calibration unit to the intake end of the positive displacement primary standard and attach a high-volume motor blower unit to the exhaust end of the primary standard. Connect one end of a differential manometer to the differential pressure tap of the orifice calibration unit and leave the other end open to the atmosphere. Operate the high-volume motor blower unit so that a series of different, but constant, airflows (usually six) are obtained for definite time periods. Record the reading on the differential manometer at each airflow. The different constant airflows are obtained by placing a series of loadplates, one at a time, between the calibration unit and the primary standard. Placing the orifice before the inlet reduces the pressure at the inlet of the primary standard below atmosphere; therefore, a correction must be made for the increase in volume caused by this decreased inlet pressure. Attach one end of a second differential manometer to an inlet pressure tap of the primary standard and leave the other open to the atmosphere. During each of the constant airflow measurements made above, measure the true inlet pressure of the primary standard with this second differential manometer. Measure atmospheric pressure and temperature. Correct the measured air volume to true air volume as directed in 9.1.1, then obtain true airflow rate, Q, as directed in 9.1.2. Plot the differential manometer readings of the orifice unit versus Q.

8.1.2 *High-Volume Sampler.* Assemble a high-volume sampler with a clean filter in place and run for at least 5 minutes. Attach a rotameter, read the ball, adjust so that the ball reads 60, and seal the adjusting mechanism so that it cannot be changed easily. Shut off motor, remove the filter, and attach the orifice calibration unit in its place. Operate the high-volume sampler at a series of different, but constant, airflows (usually six). Record the reading of the differential manometer on the orifice calibration unit, and record the readings of the rotameter at each flow. Measure atmospheric pressure and temperature. Convert the differential manometer reading to $m.^3/min.$, Q, then plot rotameter reading versus Q.

8.1.3 *Correction for Differences in Pressure or Temperature.* See Addendum B.

9. *Calculations.*

9.1 *Calibration of Orifice.*

9.1.1 *True Air Volume.* Calculate the air volume measured by the positive displacement primary standard.

$$V_a = \frac{(P_b - P_m)}{P_b}(V_M)$$

V_a = True air volume at atmospheric pressure, $m.^3$

P_b = Barometric pressure, mm. Hg.

P_m = Pressure drop at inlet of primary standard, mm. Hg.

V_M = Volume measured by primary standard, $m.^3$

9.1.2 *Conversion Factors.*

Inches Hg. × 25.4 = mm. Hg.

Inches water × 73.48 × 10^{-4} = inches Hg.

Cubic feet air × 0.0284 = cubic meters air.

9.1.3 *True Airflow Rate.*

$$Q = \frac{V_a}{T}$$

Q = Flow rate, $m.^3/min.$

T = Time of flow, min.

9.2 *Sample Volume.*

9.2.1 *Volume Conversion.* Convert the initial and final rotameter readings to true airflow rate, Q, using calibration curve of 8.1.2.

9.2.2 *Calculate volume of air sampled*

$$V = \frac{Q_i Q_f}{2} \times T$$

V = Air volume sampled, $m.^3$

Q_i = Initial airflow rate, $m.^3/min.$

Q_f = Final airflow rate, $m.^3/min.$

T = Sampling time, min.

9.3 *Calculate mass concentration of suspended particulates*

$$S.P. = \frac{(W_f - W_i) \times 10^6}{V}$$

S.P. = Mass concentration of suspended particulates, $\mu g/m.^3$

W_i = Initial weight of filter, g.

W_f = Final weight of filter, g.

V = Air volume sampled, $m.^3$

10^6 = Conversion of g. to μg.

10. *References.*

(1) Robson, C. D., and Foster, K. E., "Evaluation of Air Particulate Sampling Equipment", *Am. Ind. Hyg. Assoc. J. 24*, 404 (1963).

(2) Tierney, G. P., and Conner, W. D., "Hygroscopic Effects on Weight Determinations of Particulates Collected on Glass-Fiber Filters", *Am. Ind. Hyg. Assoc. J. 28*, 363 (1967).

(3) Unpublished data based on a collaborative test involving 12 participants, conducted under the direction of the Methods Standardization Services Section of the National Air Pollution Control Administration, October, 1970.

(4) Harrison, W. E., Nader, J. S., and Fugman, F. S., "Constant Flow Regulators for High-Volume Air Sampler", *Am. Ind. Hyg. Assoc. J. 21*, 116-120 (1960).

(8) Pate, J. B., and Tabor, E. C., "Analytical Aspects of the Use of Glass-Fiber Filters for the Collection and Analysis of Atmospheric Particulate Matter", *Am. Ind. Hyg. Assoc. J.* 23, 144–150 (1962).

ADDENDA

A. *Alternative Equipment.*

A modification of the high-volume sampler incorporating a method for recording the actual airflow over the entire sampling period has been described, and is acceptable for measuring the concentration of suspended particulates (Henderson, J. S., Eighth Conference on Methods in Air Pollution and Industrial Hygiene Studies, 1967, Oakland, Calif.). This modification consists of an exhaust orifice meter assembly connected through a transducer to a system for continuously recording airflow on a circular chart. The volume of air sampled is calculated by the following equation:

$$V = Q \times T,$$

Q = Average sampling rate, m.³/min.
T = Sampling time, minutes.

The average sampling rate, Q, is determined from the recorder chart by estimation if the flow rate does not vary more than 0.11 m.³/min. (4 ft.³/min.) during the sampling period. If the flow rate does vary more than 0.11 m.³ (4 ft.³/min.) during the sampling period, read the flow rate from the chart at 2-hour intervals and take the average.

B. *Pressure and Temperature Corrections.*

If the pressure or temperature during high-volume sampler calibration is substantially different from the pressure or temperature during orifice calibration, a correction of the flow rate, Q_c, may be required. If the pressures differ by no more than 15 percent and the temperatures differ by no more than 100 percent (°C), the error in the uncorrected flow rate will be no more than 15 percent. If necessary, obtain the corrected flow rate as directed below. This correction applies only to orifice meters having a constant orifice coefficient. The coefficient for the calibrating orifice described in 5.1.4 has been shown experimentally to be constant over the normal operating range of the high-volume sampler (0.6 to 2.2 m.³/min.; 20 to 78 ft.³/min.). Calculate corrected flow rate:

$$Q_c = Q_1 \left[\frac{T_1 P_2}{T_2 P_1} \right]^{1/2}$$

Q_c = Corrected flow rate, m.³/min.
Q_1 = Flow rate during high-volume sampler calibration (Section 8.1.2), m.³/min.
T_1 = Absolute temperature during orifice unit calibration (Section 8.1.1), °K or °R.
P_1 = Barometric pressure during orifice unit calibration (Section 8.1.1), mm. Hg.
T_2 = Absolute temperature during high-volume sampler calibration (Section 8.1.2), °K or °R.
P_2 = Barometric pressure during high-volume sampler calibration (Section 8.1.2), mm. Hg.

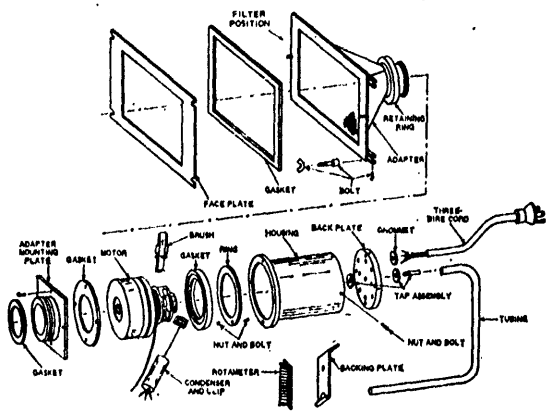

Figure B1. Exploded view of typical high-volume air sampler parts.

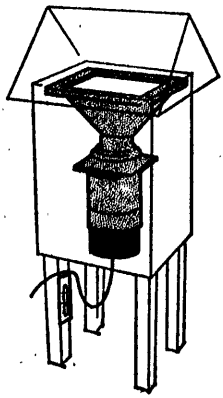

Figure B2. Assembled sampler and shelter.

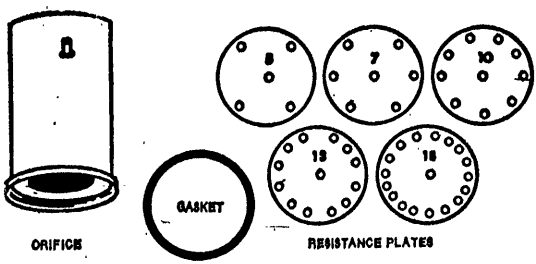

Figure B3. Orifice calibration unit.

APPENDIX C—REFERENCE METHOD FOR THE CONTINUOUS MEASUREMENT OF CARBON MONOXIDE IN THE ATMOSPHERE (NON-DISPERSIVE INFRARED SPECTROMETRY)

1. *Principle and Applicability.*

1.1 This method is based on the absorption of infrared radiation by carbon monoxide. Energy from a source emitting radiation in the infrared region is split into parallel beams and directed through reference and sample cells. Both beams pass into matched cells, each containing a selective detector and CO. The CO in the cells absorb infrared radiation only at its characteristic frequencies and the detector is sensitive to those frequencies. With a nonabsorbing gas in the reference cell, and with no CO in the sample cell, the signals from both detectors are balanced electronically. Any CO introduced into the sample cell will absorb radiation, which reduces the temperature and pressure in the detector cell and displaces a diaphram. This displacement is detected electronically and amplified to provide an output signal.

1.2 This method is applicable to the determination of carbon monoxide in ambient air, and to the analysis of gases under pressure.

2. *Range and Sensitivity.*

2.1 Instruments are available that measure in the range of 0 to 58 mg./m.³ (0–50 p.p.m.), which is the range most commonly used for urban atmospheric sampling. Most instruments measure in additional ranges.

2.2 Sensitivity is 1 percent of full-scale response per 0.6 mg. CO/m.³ (0.5 p.p.m.).

3. *Interferences.*

3.1 Interferences vary between individual instruments. The effect of carbon dioxide interference at normal concentrations is minimal. The primary interference is water vapor, and with no correction may give an interference equivalent to as high as 12 mg. CO/m.³ Water vapor interference can be minimized by (a) passing the air sample through silica gel or similar drying agents, (b) maintaining constant humidity in the sample and calibration gases by refrigeration, (c) saturating the air sample and calibration gases to maintain constant humidity or (d) using narrowband optical filters in combination with some of these measures.

3.2 Hydrocarbons at ambient levels do not ordinarily interfere.

4. *Precision, Accuracy, and Stability.*

4.1 Precision determined with calibration gases is ±0.5 percent full scale in the 0–58 mg./m.³ range.

4.2 Accuracy depends on instrument linearity and the absolute concentrations of the calibration gases. An accuracy of ±1 percent of full scale in the 0–58 mg./m.³ range can be obtained.

4.3 Variations in ambient room temperature can cause changes equivalent to as much as 0.5 mg. CO/m.³ per °C. This effect can be minimized by operating the analyzer in a temperature-controlled room. Pressure changes between span checks will cause changes in instrument response. Zero drift is usually less than ±1 percent of full scale per 24 hours, if cell temperature and pressure are maintained constant.

5. *Apparatus.*

5.1 *Carbon Monoxide Analyzer.* Commercially available instruments should be installed on location and demonstrated, preferably by the manufacturer, to meet or exceed manufacturers specifications and those described in this method.

5.2 *Sample Introduction System.* Pump, flow control valve, and flowmeter.

5.3 *Filter (In-line).* A filter with a porosity of 2 to 10 microns should be used to keep large particles from the sample cell.

5.4 *Moisture Control.* Refrigeration units are available with some commercial instruments for maintaining constant humidity. Drying tubes (with sufficient capacity to operate for 72 hours) containing indicating silica gel can be used. Other techniques that prevent the interference of moisture are satisfactory.

6. *Reagents.*

6.1 *Zero Gas.* Nitrogen or helium containing less than 0.1 mg. CO/m.³

6.2 *Calibration Gases.* Calibration gases corresponding to 10, 20, 40, and 80 percent of full scale are used. Gases must be provided with certification or guaranteed analysis of carbon monoxide content.

6.3 *Span Gas.* The calibration gas corresponding to 80 percent of full scale is used to span the instrument.

7. *Procedure.*

7.1 Calibrate the instrument as described in 8.1. All gases (sample, zero, calibration, and span) must be introduced into the entire analyzer system. Figure C1 shows a typical flow diagram. For specific operating instructions, refer to the manufacturer's manual.

8. *Calibration.*

8.1 *Calibration Curve.* Determine the linearity of the detector response at the operating flow rate and temperature. Prepare a calibration curve and check the curve furnished with the instrument. Introduce zero gas and set the zero control to indicate a recorder reading of zero. Introduce span gas and adjust the span control to indicate the proper value on the recorder scale (*e.g.* on 0-58 mg./m.³ scale, set the 46 mg./m.³ standard at 80 percent of the recorder chart). Recheck zero and span until adjustments are no longer necessary. Introduce intermediate calibration gases and plot the values obtained. If a smooth curve is not obtained, calibration gases may need replacement.

9. *Calculations.*

9.1 Determine the concentrations directly from the calibration curve. No calculations are necessary.

9.2 Carbon monoxide concentrations in mg./m.³ are converted to p.p.m. as follows:

$$\text{p.p.m. CO} = \text{mg. CO/m.}^3 \times 0.873$$

10. *Bibliography.*

The Intech NDIR-CO Analyzer by Frank McElroy. Presented at the 11th Methods Conference in Air Pollution, University of California, Berkeley, Calif., April 1, 1970.

Jacobs, M. B. et al., *J.A.P.C.A. 9, No. 3*, 110-114, August 1959.

MSA LIRA Infrared Gas and Liquid Analyzer Instruction Book, Mine Safety Appliances Co., Pittsburgh, Pa.

Beckman Instruction 1635B, Models 215A, 315A and 415A Infrared Analyzers, Beckman Instrument Company, Fullerton, Calif.

Continuous CO Monitoring System, Model A 5611, Intertech Corp., Princeton, N.J.

Bendix—UNOR Infrared Gas Analyzers, Ronceverte, W. Va.

APPENDIX

A. *Suggested Performance Specifications for NDIR Carbon Monoxide Analyzers:*

Range (minimum)	0-58 mg./m.³ (0-50 p.p.m.).
Output (minimum)	0-10, 100, 1,000, 5,000 mv. full scale.
Minimum detectable sensitivity.	0.6 mg./m.³ (0.5 p.p.m.).
Lag time (maximum)	15 seconds.
Time to 90 percent response (maximum).	30 seconds.
Rise time, 90 percent (maximum).	15 seconds.
Fall time, 90 percent (maximum).	15 seconds.
Zero drift (maximum)	2 percent/week, not to exceed 1 percent/24 hours.
Span drift (maximum)	2 percent/week, not to exceed 1 percent/24 hours.
Precision (minimum)	±0.5 percent.
Operational period (minimum).	2 days.
Noise (maximum)	±0.5 percent.
Interference equivalent (maximum).	1 percent of full scale.
Operating temperature range (minimum).	5-40° C.
Operating humidity range (minimum).	10-100 percent.
Linearity (maximum deviation).	1 percent of full scale.

B. *Suggested Definitions of Performance Specifications:*

Range—The minimum and maximum measurement limits.

Output—Electrical signal which is proportional to the measurement; intended for connection to readout or data processing devices. Usually expressed as millivolts or milliamps full scale at a given impedance.

Full Scale—The maximum measuring limit for a given range.

Minimum Detectable Sensitivity—The smallest amount of input concentration that can be detected at the concentration approaches zero.

Accuracy—The degree of agreement between a measured value and the true value; usually expressed as ± percent of full scale

Lag Time—The time interval from a step change in input concentration at the instrument inlet to the first corresponding change in the instrument output.

Time to 90 percent Response—The time interval from a step change in the input concentration at the instrument inlet to a reading of 90 percent of the ultimate recorded concentration.

Rise Time (90 percent)—The interval between initial response time and time to 90 percent response after a step increase in the inlet concentration.

Fall Time (90 percent)—The interval between initial response time and time to 90 percent response after a step decrease in the inlet concentration.

Zero Drift—The change in instrument output over a stated time period, usually 24 hours, of unadjusted continuous operation, when the input concentration is zero; usually expressed as percent full scale.

Span Drift—The change in instrument output over a stated time period, usually 24 hours, of unadjusted continuous operation, when the input concentration is a stated upscale value; usually expressed as percent full scale.

Precision—The degree of agreement between repeated measurements of the same concentration, expressed as the average deviation of the single results from the mean.

Operational Period—The period of time over which the instrument can be expected to operate unattended within specifications.

Noise—Spontaneous deviations from a mean output not caused by input concentration changes.

Interference—An undesired positive or negative output caused by a substance other than the one being measured.

Interference Equivalent—The portion of indicated input concentration due to the presence of an interferent.

Operating Temperature Range—The range of ambient temperatures over which the instrument will meet all performance specifications.

Operating Humidity Range—The range of ambient relative humidity over which the instrument will meet all performance specifications.

Linearity—The maximum deviation between an actual instrument reading and the reading predicted by a straight line drawn between upper and lower calibration points.

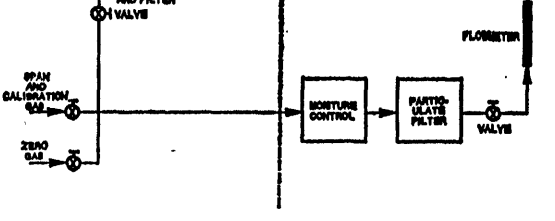

Figure C1. Carbon monoxide analyzer flow diagram.

APPENDIX D—REFERENCE METHOD FOR THE MEASUREMENT OF PHOTOCHEMICAL OXIDANTS CORRECTED FOR INTERFERENCES DUE TO NITROGEN OXIDES AND SULFUR DIOXIDE

1. *Principle and Applicability.*

1.1 Ambient air and ethylene are delivered simultaneously to a mixing zone where the ozone in the air reacts with the ethylene to emit light which is detected by a photomultiplier tube. The resulting photocurrent is amplified and is either read directly or displayed on a recorder.

1.2 The method is applicable to the continuous measurement of ozone in ambient air.

2. *Range and Sensitivity.*

2.1 The range is 9.8 μg. O_3/m.³ to greater than 1960 μg. O_3/m.³ (0.005 p.p.m. O_3 to greater than 1 p.p.m. O_3).

2.2 The sensitivity is 9.8 μg. O_3/m.³ (0.005 p.p.m. O_3).

3. *Interferences.*

3.1 Other oxidizing and reducing species normally found in ambient air do not interfere.

4. *Precision and Accuracy.*

4.1 The average deviation from the mean of repeated single measurements does not exceed 5 percent of the mean of the measurements.

4.2 The method is accurate within ±7 percent.

5. *Apparatus.*

5.1 *Detector Cell.* Figure D1 is a drawing of a typical detector cell showing flow paths of gases, the mixing zone, and placement of the photomultiplier tube. Other flow paths in which the air and ethylene streams meet

at a point near the photomultiplier tube are also allowable.

5.2 *Air Flowmeter.* A device capable of controlling air flows between 0-1.5 l/min.

5.3 *Ethylene Flowmeter.* A device capable of controlling ethylene flows between 0-50 ml /min. At any flow in this range, the device should be capable of maintaining constant flow rate within ±2 ml /min.

5.4 *Air Inlet Filter.* A Teflon filter capable of removing all particles greater than 5 microns in diameter.

5.5 *Photomultiplier Tube.* A high gain low dark current (not more than 1×10^{-9} ampere) photomultiplier tube having its maximum gain at about 430 nm. The following tubes are satisfactory: RCA 4507, RCA 8575, EMI 9750, EMI 9524, and EMI 9536.

5.6 *High Voltage Power Supply.* Capable of delivering up to 2,000 volts.

5.7 *Direct Current Amplifier.* Capable of full scale amplification of currents from 10^{-12} to 10^{-1} ampere; an electrometer is commonly used.

5.8 *Recorder.* Capable of full scale display of voltages from the DC amplifier. These voltages commonly are in the 1 millivolt to 1-volt range.

5.9 *Ozone Source and Dilution System.*—The ozone source consists of a quartz tube into which ozone-free air is introduced and then irradiated with a very stable low pressure mercury lamp. The level of irradiation is controlled by an adjustable aluminum sleeve which fits around the lamp. Ozone concentrations are varied by adjustment of this sleeve. At a fixed level of irradiation, ozone is produced at a constant rate. By carefully controlling the flow of air through the quartz tube, atmospheres are generated which contain constant concentrations of ozone. The levels of ozone in the test atmospheres are determined by the neutral buffered potassium iodide method (see section 8). This ozone source and dilution system is shown schematically in Figures D3 and D8, and has been described by Hodgeson, Stevens, and Martin.

5.10 *Apparatus for Calibration*

5.10.1 *Absorber.* All-glass impingers as shown in Figure D4 are recommended. The impingers may be purchased from most major glassware suppliers. Two absorbers in series are needed to insure complete collection of the sample.

5.10.2 *Air Pump.* Capable of drawing 1 liter/minute through the absorbers. The pump should be equipped with a needle valve on the inlet side to regulate flow.

5.10.3 *Thermometer.* With an accuracy of ±2° C.

5.10.4 *Barometer.* Accurate to the nearest mm. Hg.

5.10.5 *Flowmeter.* Calibrated metering device for measuring flow up to 1 liter/minute within ±2 percent. (For measuring flow through impingers.)

5.10.6 *Flowmeter.* For measuring airflow past the lamp; must be capable of measuring flows from 2 to 15 liters/minute within ±5 percent.

5.10.7 *Trap.* Containing glass wool to protect needle valve.

5.10.8 *Volumetric Flasks.* 25, 100, 500, 1,000 ml.

5.10.9 *Buret.* 50 ml.

5.10.10 *Pipets.* 0.5, 1, 2, 3, 4, 10, 25, and 50 ml. volumetric.

5.10.11 Erlenmeyer Flasks. 500 ml.

5.10.12 *Spectrophotometer.* Capable of measuring absorbance at 352 nm. Matched 1-cm. cells should be used.

6. *Reagents.*

6.1 *Ethylene.* C. P. grade (minimum).

6.2 *Cylinder Air.* Dry grade.

6.3 *Activated Charcoal Trap.* For filtering cylinder air.

6.4 *Purified Water.* Used for all reagents. To distilled or deionized water in an all-glass distillation apparatus, add a crystal of potassium permanganate and a crystal of barium hydroxide, and redistill.

6.5 *Absorbing Reagent.* Dissolve 13.6 g. potassium dihydrogen phosphate (KH_2PO_4), 14.2 g. anhydrous disodium hydrogen phosphate (Na_2HPO_4) or 35.8 g. dodecahydrate salt ($Na_2HPO_4 \cdot 12H_2O$), and 10.0 g. potassium iodide (KI) in purified water and dilute to 1,000 ml. The pH should be 6.8±0.2. The solution is stable for several weeks, if stored in a glass-stoppered amber bottle in a cool, dark place.

6.6 *Standard Arsenious Oxide Solution (0.05 N).* Use primary standard grade arsenious oxide (As_2O_3). Dry 1 hour at 105° C. immediately before using. Accurately weigh 2.4 g. arsenious oxide from a small glass-stoppered weighing bottle. Dissolve in 25 ml. 1 N sodium hydroxide in a flask or beaker on a steam bath. Add 25 ml. 1 N sulfuric acid. Cool, transfer quantitatively to a 1,000-ml. volumetric flask, and dilute to volume. Note: Solution must be neutral to litmus, not alkaline.

$$\text{Normality } As_2O_3 = \frac{\text{wt } As_2O_3 \text{ (g.)}}{49.46}$$

6.7 *Starch Indicator Solution (0.2 percent).* Triturate 0.4 g. soluble starch and approximately 2 mg. mercuric iodide (preservative) with a little water. Add the paste slowly to 200 ml. of boiling water. Continue boiling until the solution is clear, allow to cool, and transfer to a glass-stoppered bottle.

6.8 *Standard Iodine Solution (0.05 N).*

6.8.1 *Preparation.* Dissolve 5.0 g. potassium iodide (KI) and 2.2 g. resublimed iodine (I_2) in 10 ml. purified water. When the iodine dissolves, transfer the solution to a 500-ml. glass-stoppered volumetric flask. Dilute to mark with purified water and mix thoroughly. Keep solution in a dark brown glass-stoppered bottle away from light, and restandardize as necessary.

6.8.2 *Standardization.* Pipet accurately 30 ml. standard arsenious oxide solution into a 500-ml. Erlenmeyer flask. Acidify slightly with 1:10 sulfuric acid, neutralize with solid sodium bicarbonate, and add about 2 g. excess. Titrate with the standard iodine solution using 5 ml. starch solution as indicator. Saturate the solution with carbon dioxide near the end point by adding 1 ml. of 1:10 sulfuric acid. Continue the titration to the first appearance of a blue color which persists for 30 seconds.

$$\text{Normality } I_2 = \frac{\text{ml. } As_2O_3 \times \text{Normality } As_2O_3}{\text{ml. } I_2}$$

6.9 *Diluted Standard Iodine.* Immediately before use, pipet 1 ml. standard iodine solution into a 100-ml. volumetric flask and dilute to volume with absorbing reagent.

7. *Procedure.*

7.1 Instruments can be constructed from the components given here or may be purchased. If commercial instruments are used, follow the specific instructions given in the manufacturer's manual. Calibrate the instrument as directed in section 8. Introduce samples into the system under the same conditions of pressure and flow rate as are used in calibration. By proper adjustments of zero and span controls, direct reading of ozone concentration is possible.

8. *Calibration.*

8.1 *KI Calibration Curve.* Prepare a curve of absorbance of various iodine solutions against calculated ozone equivalents as follows:

8.1.1 Into a series of 25 ml. volumetric flasks, pipet 0.5, 1, 2, 3, and 4 ml. of diluted standard iodine solution (6.9). Dilute each to the mark with absorbing reagent. Mix thoroughly, and immediately read the absorbance of each at 352 nm. against unexposed absorbing reagent as the reference.

8.1.2 Calculate the concentration of the solutions as total µg. O_3 as follows:

$$\text{Total } \mu g. O_3 = (N)(96)(V_i)$$

N = Normality I_2 (see 6.8.2), meq./ml.

V_i = Volume of diluted standard I_2 added, ml. (0.5, 1, 2, 3, 4).

Plot absorbance versus total µg. O_3.

8.2 *Instrument Calibration.*

8.2.1 *Generation of Test Atmospheres.* Assemble the apparatus as shown in Figure D8. The ozone concentration produced by the generator can be varied by changing the position of the adjustable sleeve. For calibration of ambient air analyzers, the ozone source should be capable of producing ozone concentrations in the range 100 to 1,000 µg./m.³ (0.05 to 0.5 p.p.m.) at a flow rate of at least 5 liters per minute. At all times the airflow through the generator must be greater than the total flow required by the sampling systems.

8.2.2 *Sampling and Analyses of Test Atmospheres.* Assemble the KI sampling train as shown in Figure D4. Use ground-glass connections upstream from the impinger. Butt-to-butt connections with Tygon tubing may be used. The manifold distributing the test atmospheres must be sampled simultaneously by the KI sampling train and the instrument to be calibrated. Check assembled systems for leaks. Record the instrument response in nanoamperes at each concentration (usually six). Establish these concentrations by analysis, using the neutral buffered potassium iodide method as follows:

8.2.2.1 *Blank.* With ozone lamp off, flush the system for several minutes to remove residual ozone. Pipet 10 ml. absorbing reagent into each absorber. Draw air from the ozone-generating system through the sampling train at 0.2 to 1 liter/minute for 10 minutes. Immediately transfer the exposed solution to a clean 1-cm. cell. Determine the absorbance at 352 nm. against unexposed absorbing reagent as the reference. If the system blank gives an absorbance, continue flushing the ozone generation system until no absorbance is obtained.

8.2.2.2 *Test Atmospheres.* With the ozone lamp operating, equilibrate the system for about 10 minutes. Pipet 10 ml. of absorbing reagent into each absorber and collect samples for 10 minutes in the concentration range desired for calibration. Immediately transfer the solutions from the two absorbers to clean 1-cm. cells. Determine the absorbance of each at 352 nm. against unexposed absorbing reagent as the reference. Add the absorbances of the two solutions to obtain total absorbance. Read total µg. O_3 from the calibration curve (see 8.1). Calculate total volume of air sampled corrected to reference conditions of 25° C. and 760 mm. Hg. as follows:

$$V_a = V \times \frac{P}{760} \times \frac{298}{t+273} \times 10^{-3}$$

V_a = Volume of air at reference conditions, m.³

V = Volume of air at sampling conditions, liters.

P = Barometric pressure at sampling conditions, mm. Hg.

t = Temperature at sampling conditions, °C.

10^{-3} = Conversion of liters to m.³

Calculate ozone concentration in p.p.m. as follows:

$$\text{p.p.m. } O_3 = \frac{\mu g.\ O_3}{V_2} \times 5.10 \times 10^{-4}$$

8.2.3 *Instrument Calibration Curve.* Instrument response from the photomultiplier tube is ordinarily in current or voltage. Plot the current, or voltage if appropriate, (y-axis) for the test atmospheres against ozone concentration as determined by the neutral buffered potassium iodide method, in p.p.m. (x-axis).

9. *Calculations.*

9.1 If a recorder is used which has been properly zeroed and spanned, ozone concentrations can be read directly.

9.2 If the DC amplifier is read directly, the reading must be converted to ozone concentrations using the instrument calibration curve (8.2.3).

9.3 Conversion between p.p.m. and $\mu g./m.^3$ values for ozone can be made as follows:

$$\text{p.p.m. } O_3 = \frac{\mu g.\ O_3}{m.^3} \times 5.10 \times 10^{-4}$$

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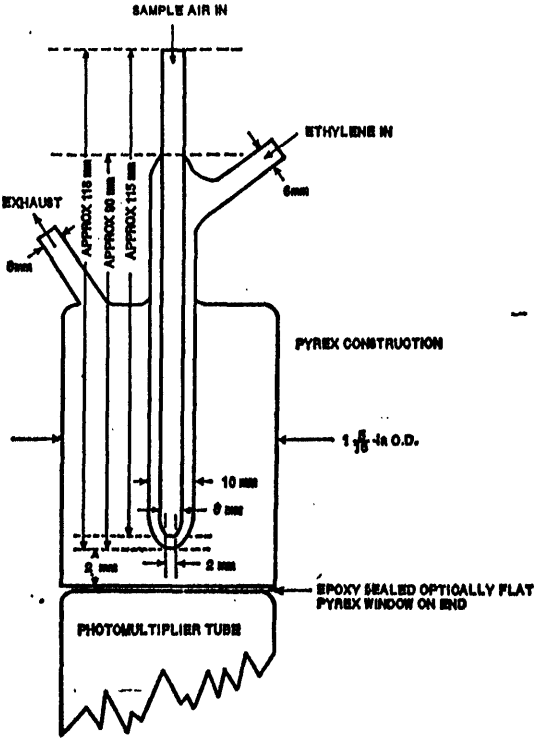

Figure D1. Detector cell.

APPENDIX E—REFERENCE METHOD FOR DETERMINATION OF HYDROCARBONS CORRECTED FOR METHANE

1. *Principle and Applicability.*

1.1 Measured volumes of air are delivered semicontinuously (4 to 12 times per hour) to a hydrogen flame ionization detector to measure its total hydrocarbon (THC) content. An aliquot of the same air sample is introduced into a stripper column which removes water, carbon dioxide, hydrocarbons other than methane, and carbon monoxide. Methane and carbon monoxide are passed quantitatively to a gas chromatographic column where they are separated. The methane is eluted first, and is passed unchanged through a catalytic reduction tube into the flame ionization detector. The carbon monoxide is eluted into the catalytic reduction tube where it is reduced to methane before passing through the flame ionization detector. Between analyses the stripper column is backflushed to prepare it for subsequent analysis. Hydrocarbon concentrations corrected for methane are determined by subtracting the methane value from the total hydrocarbon value.

Two modes of operation are possible: (1) A complete chromatographic analysis showing the continuous output from the detector for each sample injection; (2) The system is programed for automatic zero and span to display selected band widths of the chromatogram. The peak height is then used as the measure of the concentration. The former operation is referred to as the chromatographic or spectro mode and the latter as the barographic or "normal" mode depending on the make of analyzer.

1.2 The method is applicable to the semicontinuous measurement of hydrocarbons corrected for methane in ambient air. The carbon monoxide measurement, which is simultaneously obtained in this method, is not required in making measurements of hydrocarbons corrected for methane and will not be dealt with here.

2. *Range and Sensitivity.*

2.1 Instruments are available with various range combinations. For atmospheric analysis the THC range is 0–15.1 mg./m.^{3} (0–20 p.p.m.) carbon (as CH_4) and the methane range is 0–6.56 mg./m.^{3} (0–10 p.p.m.). For special applications, lower ranges are available and in these applications the range for THC is 0–1.51 mg./m.^{3} (0–2 p.p.m.) carbon (as CH_4) and for methane the range is 0–1.31 mg./m.^{3} (0–2 p.p.m.).

2.2 For the higher, atmospheric analysis ranges the sensitivity for THC is 0.066 mg./m.^{3} (0.1 p.p.m.) carbon (as CH_4) and for methane the sensitivity is 0.066 mg./m.^{3} (0.05 p.p.m.). For the lower, special analysis ranges the sensitivity is 0.016 mg./m.^{3} (0.020 p.p.m.) for each gas.

3. *Interferences.*

3.1 No interference in the methane measurement has been observed. The THC measurement typically includes all or a portion of what is generally classified as the air peak interference. This effect is minimized by proper plumbing arrangements or is negated electronically.

4. *Precision, Accuracy, and Stability.*

4.1 Precision determined with calibration gases is ±0.5 percent of full scale in the higher, atmospheric analysis ranges.

4.2 Accuracy is dependent on instrument linearity and absolute concentration of the calibration gases. An accuracy of 1 percent of full scale in the higher, atmospheric analysis ranges and 2 percent of full scale in the lower, special analysis ranges can be obtained.

4.3 Variations in ambient room temperature can cause changes in performance characteristics. This is due to shifts in oven temperature, flow rates, and pressure with ambient temperature change. The instrument should meet performance specifications with room temperature changes of ±5° C. Baseline drift is automatically corrected in the barographic mode.

5. *Apparatus.*

5.1 *Commercially Available THC, CH_4, and CO Analyzer.* Instruments should be installed on location and demonstrated, preferably by the manufacturer, or his representative, to meet or exceed manufacturer's specifications and those described in this method.

5.2 *Sample Introduction System.* Pump, flow control valves, automatic switching valves, and flowmeter.

5.3 *Filter (In-line).* A binder-free, glass-fiber filter with a porosity of 5 to 8 microns should be immediately downstream from the sample pump.

5.4 *Stripper or Precolumn.* Located outside of the oven at ambient temperature. The column should be repacked or replaced after the equivalent of 2 months of continuous operation.

5.5 *Oven.* For containing the analytical column and catalytic converter. The oven should be capable of maintaining an elevated temperature constant within ±0.5° C. The specific temperature varies with instrument manufacturer.

6. *Reagents.*

6.1 *Combustion Gas.* Air containing less than 1.3 mg./m.^{3} (2 p.p.m.) hydrocarbon as methane.

6.2 *Fuel.* Hydrogen or a mixture of hydrogen and inert gas containing less than 0.066 mg./m.^{3} (0.1 p.p.m.) hydrocarbons as methane.

6.3 *Carrier Gas.* Helium, nitrogen, air or hydrogen containing less than 0.066 mg./m.^{3} (0.1 p.p.m.) hydrocarbons as methane.

6.4 *Zero Gas.* Air containing less than 0.066 mg./m.^{3} (0.1 p.p.m.) total hydrocarbons as methane.

6.5 *Calibration Gases.* Gases needed for linearity checks (peak heights) are determined by the ranges used. Calibration gases corresponding to 10, 20, 40, and 80 percent of full scale are needed. Gases must be provided with certification or guaranteed analysis. Methane is used for both the total hydrocarbon measurement and methane measurement.

6.6 *Span Gas.* The calibration gas corresponding to 80 percent of full scale is used to span the instrument.

7. *Procedure.*

7.1 Calibrate the instrument as described in 8.1. Introduce sample into the system under the same conditions of pressure and flow rates as are used in calibration. (The pump is bypassed only when pressurized cylinder gases are used.) Figure E1 shows a typical flow diagram; for specific operating instructions refer to manufacturer's manual.

8. *Calibration.*

8.1 *Calibration Curve.* Determine the linearity of the system for THC and methane in the barographic mode by introducing zero gas and adjusting the respective zeroing controls to indicate a recorder reading of zero. Introduce the span gas and adjust the span control to indicate the proper value on the recorder scale. Recheck zero and span until adjustments are no longer necessary. Introduce intermediate calibration gases and plot the values obtained. If a smooth curve is not obtained, calibration gases may need replacement.

9. *Calculation.*

9.1 Determine concentrations of total hydrocarbons (as CH_4) and CH_4 directly from the calibration curves. No calculations are necessary.

9.2 Determine concentration of hydrocarbons corrected for methane by subtracting the methane concentration from the total hydrocarbon concentration.

9.3 Conversion between p.p.m. and mg./m.^{3} values for total hydrocarbons (as CH_4) methane and hydrocarbons corrected for methane are made as follows:

p.p.m. carbon (as CH_4) = [mg. carbon (as CH_4)/m.^{3}] × 1.55

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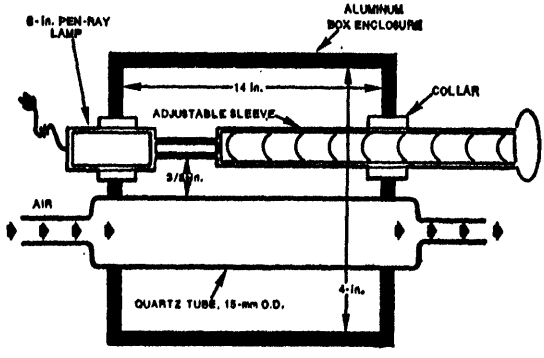

Figure D2. Ozone source.

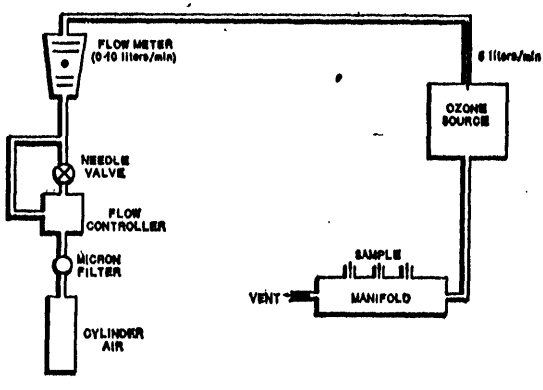

Figure D3. Ozone calibration air supply, source, and manifold system.

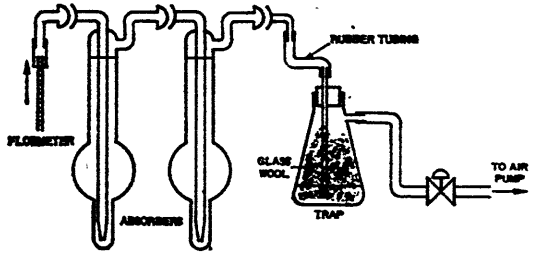

Figure D4. KI sampling train.

ADDENDA

A. *Suggested Performance Specifications for Atmospheric Analyzers for Hydrocarbons Corrected for Methane:*

Range (minimum)	0-5 p.p.m. THC.
Output (minimum)	0-5 p.p.m. CH4.
Minimum detectable sensitivity	0-10 mv. full scale.
Zero drift (maximum)	0.1 p.p.m. THC.
Span drift (maximum)	0.1 p.p.m. CH4.
Precision (minimum)	Not to exceed 1 percent/24 hours.
Operational period (minimum)	Not to exceed 1 percent/24 hours.
Operating temperature range (minimum)	±0.5 percent.
Operating humidity range (minimum)	3 days.
	5-40° C.
	10-100 percent.
Linearity (maximum)	1 percent of full scale.

B. *Suggested Definitions of Performance Specifications:*

Range—The minimum and maximum measurement limits.

Output—Electrical signal which is proportional to the measurement; intended for connection to readout or data processing devices. Usually expressed as millivolts or milliamps full scale at a given impedence.

Full Scale—The maximum measuring limit for a given range.

Minimum Detectable Sensitivity—The smallest amount of input concentration that can be detected as the concentration approaches zero.

Accuracy—The degree of agreement between a measured value and the true value; usually expressed as ± percent of full scale.

Lag Time—The time interval from a step change in input concentration at the instrument inlet to the first corresponding change in the instrument output.

Time to 90 Percent Response—The time interval from a step change in the input concentration at the instrument inlet to a reading of 90 percent of the ultimate recorded concentration.

Rise Time (90 percent)—The interval between initial response time and time to 90 percent response after a step decrease in the inlet concentration.

Zero Drift—The change in instrument output over a stated time period, usually 24 hours, of unadjusted continuous operation, when the input concentration is zero; usually expressed as percent full scale.

Span Drift—The change in instrument output over a stated time period, usually 24 hours, of unadjusted continuous operation, when the input concentration is a stated upscale value; usually expressed as percent full scale.

Precision—The degree of agreement between repeated measurements of the same concentration. It is expressed as the average deviation of the single results from the mean.

Operational Period—The period of time over which the instrument can be expected to operate unattended within specifications.

Noise—Spontaneous deviations from a mean output not caused by input concentration changes.

Interference—An undesired positive or negative output caused by a substance other than the one being measured.

Interference Equivalent—The portion of indicated input concentration due to the presence of an interferent.

Operating Temperature Range—The range of ambient temperature over which the instrument will meet all performance specifications.

Operating Humidity Range—The range of ambient relative humidity over which the instrument will meet all performance specifications.

Linearity—The maximum deviation between an actual instrument reading and the reading predicted by a straight line drawn between upper and lower calibration points.

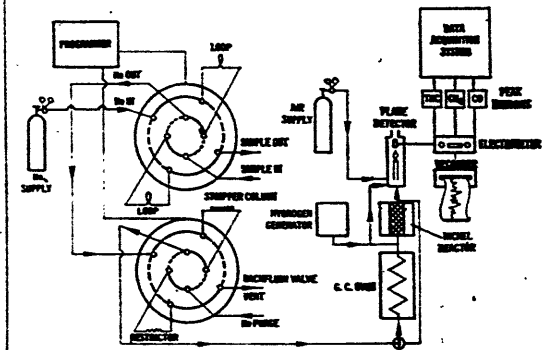

Figure E1. Typical flow diagram.

APPENDIX F—REFERENCE METHOD FOR THE DETERMINATION OF NITROGEN DIOXIDE IN THE ATMOSPHERE (24-HOUR SAMPLING METHOD)

1. *Principle and Applicability.*

1.1 Nitrogen dioxide is collected by bubbling air through a sodium hydroxide solution to form a stable solution of sodium nitrite. The nitrite ion produced during sampling is determined colorimetrically by reacting the exposed absorbing reagent with phosphoric acid, sulfanilamide, and N-1-naphthylethylenediamine dihydrochloride.

1.2 The method is applicable to collection of 24-hour samples in the field and subsequent analysis in the laboratory.

2. *Range and Sensitivity.*

2.1 The range of the analysis is 0.04 to 1.5 μg. NO_2/ml. With 50 ml. absorbing reagent and a sampling rate of 200 ml./min. for 24 hours, the range of the method is 20-740 μg./m.³ (0.01-0.4 p.p.m.) nitrogen dioxide.

2.2 A concentration of 0.04 μg. NO_2/ml. will produce an absorbance of 0.02 using 1-cm. cells.

3. *Interference.*

3.1 The interference of sulfur dioxide is eliminated by converting it to sulfuric acid with hydrogen peroxide before analysis. (*1*)

4. *Precision, Accuracy, and Stability.*

4.1 The relative standard deviations are 14.4 percent and 21.6 percent at nitrogen dioxide concentrations of 140 μg./m.³ (0.073 p.p.m.) and 200 μg./m.³ (0.108 p.p.m.), respectively, based on an automated analysis of

samples collected from a standard test atmosphere. Precision would probably be different when the analysis is performed manually.

4.2 No accuracy data are available.

4.3 Samples are stable for at least 6 weeks.

5. *Apparatus.*

5.1 *Sampling.* See Figure F1.

5.1.1 *Absorber.* Polypropylene tubes 164 x 32 mm., equipped with polypropylene two-port closures.* Rubber stoppers cause high and varying blank values and should not be used. A gas dispersion tube with a fritted end of porosity B (70–100 μm. maximum pore diameter) is used.

5.1.1.1 *Measurement of Maximum Pore Diameter of Frit.* Carefully clean the frit with dichromate-concentrated sulfuric acid cleaning solution and rinse well with distilled water. Insert through one hole of a two-hole rubber stopper and install in a test tube containing sufficient distilled water to cover the fritted portion. Attach a vacuum source to the other hole of the rubber stopper and measure the vacuum required to draw the first perceptible stream of air bubbles through the frit. Apply the following equation:

$$\text{maximum pore diameter, } \mu m. = \frac{50s}{P}$$

s = Surface tension of water in dynes/cm. at the test temperature (73 at 18° C., 72 at 25° C., and 71 at 31° C.).

P = Measured vacuum, mm. Hg.

5.1.2 *Probe.* Teflon, polypropylene, or glass tube with a polypropylene or glass funnel at the end and a membrane filter to protect the frit. Replace filter after collecting five samples, or more often as indicated by visual observation of the loading.

5.1.3 *Flow Control Device.* Calibrated 27-gauge hypodermic needle, three-eighths of an inch long to maintain a flow of approximately 0.2 liter/minute. The needle should be protected by a membrane filter. Change filter after collecting 10 samples.

5.1.4 *Air Pump.* Capable of maintaining a flow of 0.2 liter/minute through the absorber, and a vacuum of 0.7 atmosphere.

5.1.5 *Calibration Equipment.* Glass flowmeter for measuring airflows up to approximately 275 ml./min. within ±2 percent, stopwatch, and precision wet test meter (1 liter/revolution).

5.2 *Analysis.*

5.2.1 *Volumetric Flasks.* 50, 100, 200, 250, 500, 1,000 ml.

5.2.2 *Graduated Cylinder.* 1,000 ml.

5.2.3 *Pipets.* 1, 2, 5, 10, 15 ml. volumetric; 2 ml., graduated in 1/10 ml. intervals.

5.2.4 *Test Tube.*

5.2.5 *Spectrophotometer of Colorimeter.* Capable of measuring absorbance at 540 nm. Bandwidth is not critical.

6. *Reagents.*

6.1 *Sampling.*

6.1.1 *Absorbing Reagent.* Dissolve 4.0 g. sodium hydroxide in distilled water and dilute to 1,000 ml.

6.2 *Analysis.*

6.2.1 *Sulfanilamide.* Dissolve 20 g. sulfanilamide in 700 ml. distilled water. Add, with mixing, 50 ml. concentrated phosphoric acid (85 percent) and dilute to 1,000 ml. This solution is stable for a month if refrigerated.

6.2.2 *NEDA Solution.* Dissolve 0.5 g. N-1-naphthylethylenediamine dihydrochloride in distilled water. This solution is stable for a month if refrigerated and protected from light.

6.2.3 *Hydrogen Peroxide.* Dilute 0.3 ml. 30 percent hydrogen peroxide to 250 ml. with distilled water. This solution may be used for a month if protected from light.

6.2.4 *Standard Nitrite Solution.* Dissolve sufficient dessicated sodium nitrite ($NaNO_2$, assay of 97 percent or greater) and dilute with distilled water to 1,000 ml. so that a solution containing 1,000 μg. NO_2^-/ml. is obtained. The amount of $NaNO_2$ to use is calculated as follows:

$$G = \frac{1.500}{A} \times 100$$

G = Amount of $NaNO_2$, g.

1.500 = Gravimetric factor in converting NO_2 into $NaNO_2$.

A = Assay, percent.

7. *Procedure.*

7.1 *Sampling.* Assemble the sampling train as shown in Figure F1. Add 50 ml. absorbing reagent to the absorber. Disconnect funnel, insert calibrated flowmeter, and measure flow before sampling. If flow rate before sampling is less than 85 percent of needle calibration, check for leak or change filters as necessary. Remove flowmeter and replace funnel. Sample for 24 hours from midnight to midnight and measure flow at end of sampling period.

7.2 *Analysis.* Replace any water lost by evaporation during sampling. Pipet 10 ml. of the collected sample into a test tube. Add 1.0 ml. hydrogen peroxide solution, 10.0 ml. sulfanilamide solution, and 1.4 ml. NEDA solution with thorough mixing after the addition of each reagent. Prepare a blank in the same manner using 10 ml. absorbing reagent. After a 10-minute color-development interval, measure the absorbance at 540 nm. against the blank. Read μg. NO_2^-/ml. from standard curve (Section 8.3).

8. *Calibration and Efficiencies.*

8.1 *Sampling.*

8.1.1 *Calibration of Flowmeter.* Using a wet test meter and a stopwatch, determine the rates of air flow (ml./min.) through the flowmeter at several ball positions. Plot ball positions versus flow rates.

8.1.2 *Calibration of Hypodermic Needle.* Connect the calibrated flowmeter, the needle to be calibrated, and the source of vacuum in such a way that the direction of airflow through the needle is the same as in the sampling train. Read the position of the ball and determine flow rate in ml./min. from the calibration chart prepared in 8.1.1. Reject all needles not having flow rates of 190 to 210 ml./min. before sampling.

8.2 *Calibration Curve.* Dilute 5.0 ml. of the 1,000 μg. NO_2^-/ml. solution to 200 ml. with absorbing reagent. This solution contains 25 μg. NO_2^-/ml. Pipet 1, 2, 5, and 15 ml. of the 25 μg. NO_2^-/ml. solution into 50-, 50-, 100-, and 250-ml. volumetric flasks and dilute to the mark with absorbing reagent. The solutions contain 0.50, 1.00, 1.25, and 1.50 μg. NO_2^-/ml., respectively. Run standards as instructed in 7.2. Plot absorbance vs. μg. NO_2^-/ml.

8.3 *Efficiencies.* An overall average efficiency of 35 per cent was obtained from test atmospheres having nitrogen dioxide concentrations of 140 μg./m.³ and 200 μg./m.³ by automated analysis.(3)

9. *Calculation.*

9.1 *Sampling.*

9.1.1 Calculate volume of air sampled.

$$V = \frac{F_1 + F_2}{2} \times T \times 10^{-6}$$

V = Volume of air sampled, m.³

F_1 = Measured flow rate before sampling, ml./min.

F_2 = Measured flow rate after sampling, ml./min.

T = Time of sampling, min.

10^{-6} = Conversion of ml. to m.³

9.2 Calculate the concentration of nitrogen dioxide as μg. NO_2/m.³

$$\mu g.\ NO_2/m.^3 = \frac{(\mu g.\ NO_2^-/ml.) \times 50}{V \times 0.35} = \frac{(\mu g.\ NO_2^-/ml.) \times 143}{V}$$

50 = Volume of absorbing reagent used in sampling, ml.

V = Volume of air sampled, m.³

0.35 = Efficiency.

9.2.1 If desired, concentration of nitrogen dioxide may be calculated as p.p.m. NO_2.

$$p.p.m. = (\mu g.\ NO_2/m.^3) \times 5.33 \times 10^{-4}$$

10. *References.*

(1) Jacobs, M. B., and Hochheiser, S., "Continuous Sampling and Ultramicrodetermination of Nitrogen Dioxide in Air", *Anal. Chem.*, 30 426 (1958).

(2) Purdue, L. J., Dudley, J. E., Clements, J. B., and Thompson, R. J., "Studies in Air Sampling for Nitrogen Dioxide," I. A reinvestigation of the Jacobs-Hochheiser Reagent. In Preparation.

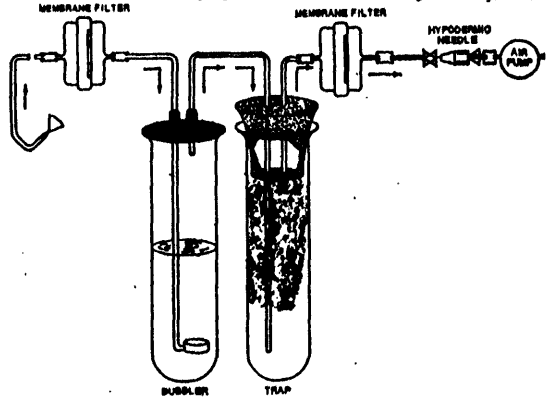

Figure F1. Sampling train.

[FR Doc.71-6142 Filed 4-29-71;8:51 am]

*Available from Bel-Art Products, Pequannock, N.J.

ATTACHMENT 2

Title 40—PROTECTION OF ENVIRONMENT

Chapter I—Environmental Protection Agency

SUBCHAPTER C—AIR PROGRAMS

PART 60—STANDARDS OF PERFORMANCE FOR NEW STATIONARY SOURCES

On August 17, 1971 (36 F.R. 15704) pursuant to section 111 of the Clean Air Act as amended, the Administrator proposed standards of performance for steam generators, portland cement plants, incinerators, nitric acid plants, and sulfuric acid plants. The proposed standards, applicable to sources the construction or modification of which was initiated after August 17, 1971, included emission limits for one or more of four pollutants (particulate matter, sulfur dioxide, nitrogen oxides, and sulfuric acid mist) for each source category. The proposal included requirements for performance testing, stack gas monitoring, record keeping and reporting, and procedures by which EPA will provide preconstruction review and determine the applicability of the standards to specific sources.

Interested parties were afforded an opportunity to participate in the rule making by submitting comments. A total of more than 200 interested parties, including Federal, State, and local agencies, citizens groups, and commercial and industrial organizations submitted comments. Following a review of the proposed regulations and consideration of the comments, the regulations, including the appendix, have been revised and are being promulgated today. The principal revisions are described below:

1. Particulate matter performance testing procedures have been revised to eliminate the requirement for impingers in the sampling train. Compliance will be based only on material collected in the dry filter and the probe preceding the filter. Emission limits have been adjusted as appropriate to reflect the change in test methods. The adjusted standards require the same degree of particulate control as the originally proposed standards.

2. Provisions have been added whereby alternative test methods can be used to determine compliance. Any person who proposes the use of an alternative method will be obliged to provide evidence that the alternative method is equivalent to the reference method.

3. The definition of modification, as it pertains to increases in production rate and changes of fuels, has been clarified. Increases in production rates up to design capacity will not be considered a modification nor will fuel switches if the equipment was originally designed to accommodate such fuels. These provisions will eliminate inequities where equipment had been put into partial operation prior to the proposal of the standards.

4. The definition of a new source was clarified to include construction which is completed within an organization as well as the more common situations where the facility is designed and constructed by a contractor.

5. The provisions regarding requests for EPA plan review and determination of construction or modification have been modified to emphasize that the submittal of such requests and attendant information is purely voluntary. Submittal of such a request will not bind the operator to supply further information; however, lack of sufficient information may prevent the Administrator from rendering an opinion. Further provisions have been added to the effect that information submitted voluntarily for such plan review or determination of applicability will be considered confidential, if the owner or operator requests such confidentiality.

6. Requirements for notifying the Administrator prior to commencing construction have been deleted. As proposed, the provision would have required notification prior to the signing of a contract for construction of a new source. Owners and operators still will be required to notify the Administrator 30 days prior to initial operation and to confirm the action within 15 days after startup.

7. Revisions were incorporated to permit compliance testing to be deferred up to 60 days after achieving the maximum production rate but no longer than 180 days after initial startup. The proposed regulation could have required testing within 60 days after startup but defined startup as the beginning of routine operation. Owners or operators will be required to notify the Administrator at least 10 days prior to compliance testing so that an EPA observer can be on hand. Procedures have been modified so that the equipment will have to be operated at maximum expected production rate, rather than rated capacity, during compliance tests.

8. The criteria for evaluating performance testing results have been simplified to eliminate the requirement that all values be within 35 percent of the average. Compliance will be based on the average of three repetitions conducted in the specified manner.

9. Provisions were added to require owners or operators of affected facilities to maintain records of compliance tests, monitoring equipment, pertinent analyses, feed rates, production rates, etc. for 2 years and to make such information available on request to the Administrator. Owners or operators will be required to summarize the recorded data daily and to convert recorded data into the applicable units of the standard.

10. Modifications were made to the visible emission standards for steam generators, cement plants, nitric acid plants, and sulfuric acid plants. The Ringelmann standards have been deleted; all limits will be based on opacity. In every case, the equivalent opacity will be at least as stringent as the proposed Ringelmann number. In addition, requirements have been altered for three of the source categories so that allowable emissions will be less than 10 percent opacity rather than 5 percent or less opacity. There were many comments that observers could not accurately evaluate emissions of 5 percent opacity. In addition, drafting errors in the proposed visible emission limits for cement kilns and steam generators were corrected. Steam generators will be limited to visible emissions not greater than 20 percent opacity and cement kilns to not greater than 10 percent opacity.

11. Specifications for monitoring devices were clarified, and directives for calibration were included. The instruments are to be calibrated at least once a day, or more often if specified by the manufacturer. Additional guidance on the selection and use of such instruments will be provided at a later date.

12. The requirement for sulfur dioxide monitoring at steam generators was deleted for those sources which will achieve the standard by burning low-sulfur fuel, provided that fuel analysis is conducted and recorded daily. American Society for Testing and Materials sampling techniques are specified for coal and fuel oil.

13. Provisions were added to the steam generator standards to cover those instances where mixed fuels are burned. Allowable emissions will be determined by prorating the heat input of each fuel; however, in the case of sulfur dioxide, the provisions allow operators the option of burning low-sulfur fuels (preferably natural gas) as a means of compliance.

14. Steam generators fired with lignite have been exempted from the nitrogen oxides limit. The revision was made in view of the lack of information on some types of lignite burning. When more information is developed, nitrogen oxides standards may be extended to lignite fired steam generators.

15. A provision was added to make it explicit that the sulfuric acid plant standards will not apply to acid mist plants. As stated in the background document, APTD 0711, which was issued at the time the proposed standards were published, the standards were not meant to apply to such operations, e.g., where sulfuric acid plants are used primarily to control sulfur dioxide or other sulfur compounds which would otherwise be vented into the atmosphere.

16. The regulation has been revised to provide that all materials submitted pursuant to these regulations will be directed to EPA's Office of General Enforcement.

17. Several other technical changes have also been made. States and interested parties are urged to make a careful reading of these regulations.

As required by section 111 of the Act, the standards of performance promulgated herein "reflect the degree of emission reduction which (taking into account the cost of achieving such reduction) the Administrator determines has been adequately demonstrated". The standards of performance are based on stationary source testing conducted by the Environmental Protection Agency and by contractors and on data derived from various other sources, including the available technical literature. In the comments on the proposed standards, many questions were raised as to cost and

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demonstrated capability of control systems to meet the standards. These comments have been evaluated and investigated, and it is the Administrator's judgment that emission control systems capable of meeting the standards have been adequately demonstrated and that the standards promulgated herein are achievable at reasonable costs.

The regulations establishing standards of performance for steam generators, incinerators, cement plants, nitric acid plants, and sulfuric acid plants are hereby promulgated effective on publication and apply to sources, the construction or modification of which was commenced after August 17, 1971.

Dated: December 16, 1971.

WILLIAM D. RUCKELSHAUS,
Administrator,
Environmental Protection Agency.

A new Part 60 is added to Chapter I, Title 40, Code of Federal Regulations, as follows:

AUTHORITY: The provisions of this Part 60 issued under sections 111, 114, Clean Air Act; Public Law 91-604, 84 Stat. 1713.

Subpart A—General Provisions

§ 60.1 Applicability.

The provisions of this part apply to the owner or operator of any stationary source, which contains an affected facility the construction or modification of which is commenced after the date of publication in this part of any proposed standard applicable to such facility.

§ 60.2 Definitions.

As used in this part, all terms not defined herein shall have the meaning given them in the Act:

(a) "Act" means the Clean Air Act (42 U.S.C. 1857 et seq., as amended by Public Law 91-604, 84 Stat. 1676).

(b) "Administrator" means the Administrator of the Environmental Protection Agency or his authorized representative.

(c) "Standard" means a standard of performance proposed or promulgated under this part.

(d) "Stationary source" means any building, structure, facility, or installation which emits or may emit any air pollutant.

(e) "Affected facility" means, with reference to a stationary source, any apparatus to which a standard is applicable.

(f) "Owner or operator" means any person who owns, leases, operates, controls, or supervises an affected facility or a stationary source of which an affected facility is a part.

(g) "Construction" means fabrication, erection, or installation of an affected facility.

(h) "Modification" means any physical change in, or change in the method of operation of, an affected facility which increases the amount of any air pollutant (to which a standard applies) emitted by such facility or which results in the emission of any air pollutant (to which a standard applies) not previously emitted, except that:

(1) Routine maintenance, repair, and replacement shall not be considered physical changes, and

(2) The following shall not be considered a change in the method of operation:

(i) An increase in the production rate, if such increase does not exceed the operating design capacity of the affected facility;

(ii) An increase in hours of operation;

(iii) Use of an alternative fuel or raw material if, prior to the date any standard under this part becomes applicable to such facility, as provided by § 60.1, the affected facility is designed to accommodate such alternative use.

(i) "Commenced" means that an owner or operator has undertaken a continuous program of construction or modification or that an owner or operator has entered into a binding agreement or contractual obligation to undertake and complete, within a reasonable time, a continuous program of construction or modification.

(j) "Opacity" means the degree to which emissions reduce the transmission of light and obscure the view of an object in the background.

(k) "Nitrogen oxides" means all oxides of nitrogen except nitrous oxide, as measured by test methods set forth in this part.

(l) "Standard of normal conditions" means 70° Fahrenheit (21.1° centigrade) and 29.92 in. Hg (760 mm. Hg).

(m) "Proportional sampling" means sampling at a rate that produces a constant ratio of sampling rate to stack gas flow rate.

(n) "Isokinetic sampling" means sampling in which the linear velocity of the gas entering the sampling nozzle is equal to that of the undisturbed gas stream at the sample point.

(o) "Startup" means the setting in operation of an affected facility for any purpose.

§ 60.3 Abbreviations.

The abbreviations used in this part have the following meanings in both capital and lower case:

B.t.u.—British thermal unit.
cal.—calorie(s).
c.f.m.—cubic feet per minute.
CO_2—carbon dioxide.
g.—gram(s).
gr.—grain(s).
mg.—milligram(s).
mm.—millimeter(s).
l.—liter(s).
nm.—nanometer(s), -10^{-9} meter.
μg.—microgram(s), 10^{-6} gram.
Hg.—mercury.
in.—inch.(es).
K—1,000.
lb.—pound(s).
ml.—milliliter(s).
No.—number.
%—percent.
NO—nitric oxide.
NO_2—nitrogen dioxide.
NO_x—nitrogen oxides.
N.c.m.—normal cubic meter.
s.c.f.—standard cubic feet.
SO_2—sulfur dioxide.
H_2SO_4—sulfuric acid.
SO_3—sulfur trioxide.

ft.³—cubic feet.
ft.²—square feet.
min.—minute(s).
hr.—hour(s).

§ 60.4 Address.

All applications, requests, submissions, and reports under this part shall be submitted in triplicate and addressed to the Environmental Protection Agency, Office of General Enforcement, Waterside Mall SW., Washington, DC 20460.

§ 60.5 Determination of construction or modification.

When requested to do so by an owner or operator, the Administrator will make a determination of whether actions taken or intended to be taken by such owner or operator constitute construction or modification or the commencement thereof within the meaning of this part.

§ 60.6 Review of plans.

(a) When requested to do so by an owner or operator, the Administrator will review plans for construction or modification for the purpose of providing technical advice to the owner or operator.

(b) (1) A separate request shall be submitted for each affected facility.

(2) Each request shall (i) identify the location of such affected facility, and (ii) be accompanied by technical information describing the proposed nature, size, design, and method of operation of such facility, including information on any equipment to be used for measurement or control of emissions.

(c) Neither a request for plans review nor advice furnished by the Administrator in response to such request shall (1) relieve an owner or operator of legal responsibility for compliance with any provision of this part or of any applicable State or local requirement, or (2) prevent the Administrator from implementing or enforcing any provision of this part or taking any other action authorized by the Act.

§ 60.7 Notification and record keeping.

(a) Any owner or operator subject to the provisions of this part shall furnish the Administrator written notification as follows:

(1) A notification of the anticipated date of initial startup of an affected facility not more than 60 days or less than 30 days prior to such date.

(2) A notification of the actual date of initial startup of an affected facility within 15 days after such date.

(b) Any owner or operator subject to the provisions of this part shall maintain for a period of 2 years a record of the occurrence and duration of any startup, shutdown, or malfunction in operation of any affected facility.

§ 60.8 Performance tests.

(a) Within 60 days after achieving the maximum production rate at which the affected facility will be operated, but not later than 180 days after initial startup of such facility and at such other times as may be required by the Administrator under section 114 of the Act, the owner or operator of such facility shall conduct performance test(s) and furnish the Administrator a written report of the results of such performance test(s).

(b) Performance tests shall be conducted and results reported in accordance with the test method set forth in this part or equivalent methods approved by the Administrator; or where the Administrator determines that emissions from the affected facility are not susceptible of being measured by such methods, the Administrator shall prescribe alternative test procedures for determining compliance with the requirements of this part.

(c) The owner or operator shall permit the Administrator to conduct performance tests at any reasonable time, shall cause the affected facility to be operated for purposes of such tests under such conditions as the Administrator shall specify based on representative performance of the affected facility, and shall make available to the Administrator such records as may be necessary to determine such performance.

(d) The owner or operator of an affected facility shall provide the Administrator 10 days prior notice of the performance test to afford the Administrator the opportunity to have an observer present.

(e) The owner or operator of an affected facility shall provide, or cause to be provided, performance testing facilities as follows:

(1) Sampling ports adequate for test methods applicable to such facility.

(2) Safe sampling platform(s).

(3) Safe access to sampling platform (s).

(4) Utilities for sampling and testing equipment.

(f) Each performance test shall consist of three repetitions of the applicable test method. For the purpose of determining compliance with an applicable standard of performance, the average of results of all repetitions shall apply.

§ 60.9 Availability of information.

(a) Emission data provided to, or otherwise obtained by, the Administrator in accordance with the provisions of this part shall be available to the public.

(b) Except as provided in paragraph (a) of this section, any records, reports, or information provided to, or otherwise obtained by, the Administrator in accordance with the provisions of this part shall be available to the public, except that (1) upon a showing satisfactory to the Administrator by any person that such records, reports, or information, or particular part thereof (other than emission data), if made public, would divulge methods or processes entitled to protection as trade secrets of such person, the Administrator shall consider such records, reports, or information, or particular part thereof, confidential in accordance with the purposes of section 1905 of title 18 of the United States Code, except that such records, reports, or information, or particular part thereof, may be disclosed to other officers, employees, or authorized representatives of the United States concerned with carrying out the provisions of the Act or when relevant in any proceeding under the Act; and (2) information received by the Administrator solely for the purposes of §§ 60.5 and 60.6 shall not be disclosed if it is identified by the owner or operator as being a trade secret or commercial or financial information which such owner or operator considers confidential.

§ 60.10 State authority.

The provisions of this part shall not be construed in any manner to preclude any State or political subdivision thereof from:

(a) Adopting and enforcing any emission standard or limitation applicable to an affected facility, provided that such emission standard or limitation is not less stringent than the standard applicable to such facility.

(b) Requiring the owner or operator of an affected facility to obtain permits, licenses, or approvals prior to initiating construction, modification, or operation of such facility.

Subpart D—Standards of Performance for Fossil-Fuel Fired Steam Generators

§ 60.40 Applicability and designation of *affected facility.*

The provisions of this subpart are applicable to each fossil fuel-fired steam generating unit of more than 250 million B.t.u. per hour heat input, which is the affected facility.

§ 60.41 Definitions.

As used in this subpart, all terms not defined herein shall have the meaning given them in the Act, and in Subpart A of this part.

(a) "Fossil fuel-fired steam generating unit" means a furnace or boiler used in the process of burning fossil fuel for the primary purpose of producing steam by heat transfer.

(b) "Fossil fuel" means natural gas, petroleum, coal and any form of solid, liquid, or gaseous fuel derived from such materials.

(c) "Particulate matter" means any finely divided liquid or solid material, other than uncombined water, as measured by Method 5.

§ 60.42 Standard for particulate matter.

On and after the date on which the performance test required to be conducted by § 60.8 is initiated no owner or operator subject to the provisions of this part shall discharge or cause the discharge into the atmosphere of particulate matter which is:

(a) In excess of 0.10 lb. per million B.t.u. heat input (0.18 g. per million cal.) maximum 2-hour average.

(b) Greater than 20 percent opacity, except that 40 percent opacity shall be permissible for not more than 2 minutes in any hour.

(c) Where the presence of uncombined water is the only reason for failure to meet the requirements of paragraph (b) of this section such failure shall not be a violation of this section.

§ 60.43 Standard for sulfur dioxide.

On and after the date on which the performance test required to be conducted by § 60.8 is initiated no owner or operator subject to the provisions of this part shall discharge or cause the discharge into the atmosphere of sulfur dioxide in excess of:

(a) 0.80 lb. per million B.t.u. heat input (1.4 g. per million cal.), maximum 2-hour average, when liquid fossil fuel is burned.

(b) 1.2 lbs. per million B.t.u. heat input (2.2 g. per million cal.), maximum 2-hour average, when solid fossil fuel is burned.

(c) Where different fossil fuels are burned simultaneously in any combination, the applicable standard shall be determined by proration. Compliance shall be determined using the following formula:

$$\frac{y(0.80)+z(1.2)}{x+y+z}$$

where:

x is the percent of total heat input derived from gaseous fossil fuel and,
y is the percent of total heat input derived from liquid fossil fuel and,
z is the percent of total heat input derived from solid fossil fuel.

§ 60.44 Standard for nitrogen oxides.

On and after the date on which the performance test required to be conducted by § 60.8 is initiated no owner or operator subject to the provisions of this part shall discharge or cause the discharge into the atmosphere of nitrogen oxides in excess of:

(a) 0.20 lb. per million B.t.u. heat input (0.36 g. per million cal.), maximum 2-hour average, expressed as NO_2, when gaseous fossil fuel is burned.

(b) 0.30 lb. per million B.t.u. heat input (0.54 g. per million cal.), maximum 2-hour average, expressed as NO_2, when liquid fossil fuel is burned.

(c) 0.70 lb. per million B.t.u. heat input (1.26 g. per million cal.), maximum 2-hour average, expressed as NO_2 when solid fossil fuel (except lignite) is burned.

(d) When different fossil fuels are burned simultaneously in any combination the applicable standard shall be determined by proration. Compliance shall be determined by using the following formula:

$$\frac{x(0.20)+y(0.30)+z(0.70)}{x+y+z}$$

where:

x is the percent of total heat input derived from gaseous fossil fuel and,
y is the percent of total heat input derived from liquid fossil fuel and,
z is the percent of total heat input derived from solid fossil fuel.

§ 60.45 Emission and fuel monitoring.

(a) There shall be installed, calibrated, maintained, and operated, in any fossil fuel-fired steam generating unit subject to the provisions of this part, emission monitoring instruments as follows:

(1) A photoelectric or other type smoke detector and recorder, except where gaseous fuel is the only fuel burned.

(2) An instrument for continuously monitoring and recording sulfur dioxide emissions, except where gaseous fuel is the only fuel burned, or where compliance is achieved through low sulfur fuels and representative sulfur analysis of fuels are conducted daily in accordance with paragraph (c) or (d) of this section.

(3) An instrument for continuously monitoring and recording emissions of nitrogen oxides.

(b) Instruments and sampling systems installed and used pursuant to this section shall be capable of monitoring emission levels within ±20 percent with a confidence level of 95 percent and shall be calibrated in accordance with the method(s) prescribed by the manufacturer(s) of such instruments; instruments shall be subjected to manufacturers recommended zero adjustment and calibration procedures at least once per 24-hour operating period unless the manufacturer(s) specifies or recommends calibration at shorter intervals, in which case such specifications or recommendations shall be followed. The applicable method specified in the appendix of this part shall be the reference method.

(c) The sulfur content of solid fuels, as burned, shall be determined in accordance with the following methods of the American Society for Testing and Materials.

(1) Mechanical sampling by Method D 2234-65.

(2) Sample preparation by Method D 2013-65.

(3) Sample analysis by Method D 271-68.

(d) The sulfur content of liquid fuels, as burned, shall be determined in accordance with the American Society for Testing and Materials Methods D 1551-68, or D 129-64, or D 1552-64.

(e) The rate of fuel burned for each fuel shall be measured daily or at shorter intervals and recorded. The heating value and ash content of fuels shall be ascertained at least once per week and recorded. Where the steam generating unit is used to generate electricity, the average electrical output and the minimum and maximum hourly generation rate shall be measured and recorded daily.

(f) The owner or operator of any fossil fuel-fired steam generating unit subject to the provisions of this part shall maintain a file of all measurements required by this part. Appropriate measurements shall be reduced to the units of the applicable standard daily, and summarized monthly. The record of any such measurement(s) and summary shall be retained for at least 2 years following the date of such measurements and summaries.

§ 60.46 Test methods and procedures.

(a) The provisions of this section are applicable to performance tests for determining emissions of particulate matter, sulfur dioxide, and nitrogen oxides from fossil fuel-fired steam generating units.

(b) All performance tests shall be conducted while the affected facility is operating at or above the maximum steam production rate at which such facility will be operated and while fuels or combinations of fuels representative of normal operation are being burned and under such other relevant conditions as the Administrator shall specify based on representative performance of the affected facility.

(c) Test methods set forth in the appendix to this part or equivalent methods approved by the Administrator shall be used as follows:

(1) For each repetition, the average concentration of particulate matter shall be determined by using Method 5. Traversing during sampling by Method 5 shall be according to Method 1. The minimum sampling time shall be 2 hours, and minimum sampling volume shall be 60 ft.³ corrected to standard conditions on a dry basis.

(2) For each repetition, the SO_2 concentration shall be determined by using Method 6. The sampling site shall be the same as for determining volumetric flow rate. The sampling point in the duct shall be at the centroid of the cross section if the cross sectional area is less than 50 ft.² or at a point no closer to the walls than 2 feet if the cross sectional area is 50 ft.² or more. The sample shall be extracted at a rate proportional to the gas velocity at the sampling point. The minimum sampling time shall be 20 min. and minimum sampling volume shall be 0.75 ft.³ corrected to standard conditions. Two samples shall constitute one repetition and shall be taken at 1-hour intervals.

(3) For each repetition the NO_x concentration shall be determined by using Method 7. The sampling site and point shall be the same as for SO_2. The sampling time shall be 2 hours, and four samples shall be taken at 30-minute intervals.

(4) The volumetric flow rate of the total effluent shall be determined by using Method 2 and traversing according to Method 1. Gas analysis shall be performed by Method 3, and moisture content shall be determined by the condenser technique of Method 5.

(d) Heat input, expressed in B.t.u. per hour, shall be determined during each 2-hour testing period by suitable fuel flow meters and shall be confirmed by a material balance over the steam generation system.

(e) For each repetition, emissions, expressed in lb./10⁶ B.t.u. shall be determined by dividing the emission rate in lb./hr. by the heat input. The emission rate shall be determined by the equation, lb./hr.$=Q_s \times c$ where, Q_s=volumetric flow rate of the total effluent in ft.³/hr. at standard conditions, dry basis, as determined in accordance with paragraph (c)(4) of this section.

(1) For particulate matter, c=particulate concentration in lb./ft.³, at determined in accordance with paragraph (c)(1) of this section, corrected to standard conditions, dry basis.

(2) For SO_2, c=SO_2 concentration in lb./ft.³, as determined in accordance with paragraph (c)(2) of this section, corrected to standard conditions, dry basis.

(3) For NO_x, c=NO_x concentration in lb./ft.³, as determined in accordance with paragraph (c)(3) of this section, corrected to standard conditions, dry basis.

Subpart E—Standards of Performance for Incinerators

§ 60.50 Applicability and designation of affected facility.

The provisions of this subpart are applicable to each incinerator of more than 50 tons per day charging rate, which is the affected facility.

§ 60.51 Definitions.

As used in this subpart, all terms not defined herein shall have the meaning given them in the Act and in Subpart A of this part.

(a) "Incinerator" means any furnace used in the process of burning solid waste for the primary purpose of reducing the volume of the waste by removing combustible matter.

(b) "Solid waste" means refuse, more than 50 percent of which is municipal type waste consisting of a mixture of paper, wood, yard wastes, food wastes, plastics, leather, rubber, and other combustibles, and noncombustible materials such as glass and rock.

(c) "Day" means 24 hours.

(d) "Particulate matter" means any finely divided liquid or solid material, other than uncombined water, as measured by Method 5.

§ 60.52 Standard for particulate matter.

On and after the date on which the performance test required to be conducted by § 60.8 is initiated, no owner or operator subject to the provisions of this part shall discharge or cause the discharge into the atmosphere of particulate matter which is in excess of 0.08 gr./s.c.f. (0.18 g./NM³) corrected to 12 percent CO_2, maximum 2-hour average.

§ 60.53 Monitoring of operations.

The owner or operator of any incinerator subject to the provisions of this part shall maintain a file of daily burning rates and hours of operation and any particulate emission measurements. The burning rates and hours of operation shall be summarized monthly. The record(s) and summary shall be retained for at least 2 years following the date of such records and summaries.

§ 60.54 Test methods and procedures.

(a) The provisions of this section are applicable to performance tests for determining emissions of particulate matter from incinerators.

(b) All performance tests shall be conducted while the affected facility is operating at or above the maximum refuse charging rate at which such facility will be operated and the solid waste burned shall be representative of normal operation and under such other relevant conditions as the Administrator shall specify based on representative performance of the affected facility.

(c) Test methods set forth in the appendix to this part or equivalent methods approved by the Administrator shall be used as follows:

(1) For each repetition, the average concentration of particulate matter shall be determined by using Method 5. Traversing during sampling by Method 5 shall be according to Method 1. The minimum sampling time shall be 2 hours and the minimum sampling volume shall be 60 ft.³ corrected to standard conditions on a dry basis.

(2) Gas analysis shall be performed using the integrated sample technique of Method 3, and moisture content shall be determined by the condenser technique of Method 5. If a wet scrubber is used, the gas analysis sample shall reflect flue gas conditions after the scrubber, allowing for the effect of carbon dioxide absorption.

(d) For each repetition particulate matter emissions, expressed in gr./s.c.f., shall be determined in accordance with paragraph (c)(1) of this section corrected to 12 percent CO_2, dry basis.

Subpart F—Standards of Performance for Portland Cement Plants

§ 60.60 Applicability and designation of affected facility.

The provisions of the subpart are applicable to the following affected facilities in portland cement plants: kiln, clinker cooler, raw mill system, finish mill system, raw mill dryer, raw material storage, clinker storage, finished product storage, conveyor transfer points, bagging and bulk loading and unloading systems.

§ 60.61 Definitions.

As used in this subpart, all terms not defined herein shall have the meaning given them in the Act and in Subpart A of this part.

(a) "Portland cement plant" means any facility manufacturing portland cement by either the wet or dry process.

(b) "Particulate matter" means any finely divided liquid or solid material, other than uncombined water, as measured by Method 5.

§ 60.62 Standard for particulate matter.

(a) On and after the date on which the performance test required to be conducted by § 60.8 is initiated no owner or operator subject to the provisions of this part shall discharge or cause the discharge into the atmosphere of particulate matter from the kiln which is:

(1) In excess of 0.30 lb. per ton of feed to the kiln (0.15 Kg. per metric ton), maximum 2-hour average.

(2) Greater than 10 percent opacity, except that where the presence of uncombined water is the only reason for failure to meet the requirements for this subparagraph, such failure shall not be a violation of this section.

(b) On and after the date on which the performance test required to be conducted by § 60.8 is initiated no owner or operator subject to the provisions of this part shall discharge or cause the discharge into the atmosphere of particulate matter from the clinker cooler which is:

(1) In excess of 0.10 lb. per ton of feed to the kiln (0.050 Kg. per metric ton) maximum 2-hour average.

(2) 10 percent opacity or greater.

(c) On and after the date on which the performance test required to be conducted by § 60.8 is initiated no owner or operator subject to the provisions of this part shall discharge or cause the discharge into the atmosphere of particulate matter from any affected facility other than the kiln and clinker cooler which is 10 percent opacity or greater.

§ 60.63 Monitoring of operations.

The owner or operator of any portland cement plant subject to the provisions of this part shall maintain a file of daily production rates and kiln feed rates and any particulate emission measurements. The production and feed rates shall be summarized monthly. The record(s) and summary shall be retained for at least 2 years following the date of such records and summaries.

§ 60.64 Test methods and procedures.

(a) The provisions of this section are applicable to performance tests for determining emissions of particulate matter from portland cement plant kilns and clinker coolers.

(b) All performance tests shall be conducted while the affected facility is operating at or above the maximum production rate at which such facility will be operated and under such other relevant conditions as the Administrator shall specify based on representative performance of the affected facility.

(c) Test methods set forth in the appendix to this part or equivalent methods approved by the Administrator shall be used as follows:

(1) For each repetition, the average concentration of particulate matter shall be determined by using Method 5. Traversing during sampling by Method 5 shall be according to Method 1. The minimum sampling time shall be 2 hours and the minimum sampling volume shall be 60 ft.³ corrected to standard conditions on a dry basis.

(2) The volumetric flow rate of the total effluent shall be determined by using Method 2 and traversing according to Method 1. Gas analysis shall be performed using the integrated sample technique of Method 3, and moisture content shall be determined by the condenser technique of Method 5.

(d) Total kiln feed (except fuels), expressed in tons per hour on a dry basis, shall be determined during each 2-hour testing period by suitable flow meters and shall be confirmed by a material balance over the production system.

(e) For each repetition, particulate matter emissions, expressed in lb./ton of kiln feed shall be determined by dividing the emission rate in lb./hr. by the kiln feed. The emission rate shall be determined by the equation, lb./hr.=$Q_s \times c$,

where Q_s=volumetric flow rate of the total effluent in ft.³/hr. at standard conditions, dry basis, as determined in accordance with paragraph (c)(2) of this section, and, c=particulate concentration in lb./ft.³, as determined in accordance with paragraph (c)(1) of this section, corrected to standard conditions, dry basis.

Subpart G—Standards of Performance for Nitric Acid Plants

§ 60.70 Applicability and designation of affected facility.

The provisions of this subpart are applicable to each nitric acid production unit, which is the affected facility.

§ 60.71 Definitions.

As used in this subpart, all terms not defined herein shall have the meaning given them in the Act and in Subpart A of this part.

(a) "Nitric acid production unit" means any facility producing weak nitric acid by either the pressure or atmospheric pressure process.

(b) "Weak nitric acid" means acid which is 30 to 70 percent in strength.

§ 60.72 Standard for nitrogen oxides.

On and after the date on which the performance test required to be conducted by § 60.8 is initiated no owner or operator subject to the provisions of this part shall discharge or cause the discharge into the atmosphere of nitrogen oxides which are:

(a) In excess of 3 lbs. per ton of acid produced (1.5 kg. per metric ton), maximum 2-hour average, expressed as NO_2.

(b) 10 percent opacity or greater.

§ 60.73 Emission monitoring.

(a) There shall be installed, calibrated, maintained, and operated, in any nitric acid production unit subject to the provisions of this subpart, an instrument for continuously monitoring and recording emissions of nitrogen oxides.

(b) The instrument and sampling system installed and used pursuant to this section shall be capable of monitoring emission levels within ±20 percent with a confidence level of 95 percent and shall be calibrated in accordance with the method(s) prescribed by the manufacturer(s) of such instrument, the instrument shall be subjected to manufacturers recommended zero adjustment and calibration procedures at least once per 24-hour operating period unless the manufacturer(s) specifies or recommends calibration at shorter intervals, in which case such specifications or recommendations shall be followed. The applicable method specified in the appendix of this part shall be the reference method.

(c) Production rate and hours of operation shall be recorded daily.

(d) The owner or operator of any nitric acid production unit subject to the provisions of this part shall maintain a file of all measurements required by this subpart. Appropriate measurements shall be reduced to the units of the standard daily and summarized monthly. The record of any such measurement and summary shall be retained for at least 2 years following the date of such measurements and summaries.

§ 60.74 Test methods and procedures.

(a) The provisions of this section are applicable to performance tests for determining emissions of nitrogen oxides from nitric acid production units.

(b) All performance tests shall be conducted while the affected facility is operating at or above the maximum acid production rate at which such facility will be operated and under such other relevant conditions as the Administrator shall specify based on representative performance of the affected facility.

(c) Test methods set forth in the appendix to this part or equivalent methods as approved by the Administrator shall be used as follows:

(1) For each repetition the NO_x concentration shall be determined by using Method 7. The sampling site shall be selected according to Method 1 and the sampling point shall be the centroid of the stack or duct. The sampling time shall be 2 hours and four samples shall be taken at 30-minute intervals.

(2) The volumetric flow rate of the total effluent shall be determined by using Method 2 and traversing according to Method 1. Gas analysis shall be performed by using the integrated sample technique of Method 3, and moisture content shall be determined by Method 4.

(d) Acid produced, expressed in tons per hour of 100 percent nitric acid, shall be determined during each 2-hour testing period by suitable flow meters and shall be confirmed by a material balance over the production system.

(e) For each repetition, nitrogen oxides emissions, expressed in lb./ton of 100 percent nitric acid, shall be determined by dividing the emission rate in lb./hr. by the acid produced. The emission rate shall be determined by the equation, lb./hr.=$Q_s \times c$, where Q_s=volumetric flow rate of the effluent in ft.³/hr. at standard conditions, dry basis, as determined in accordance with paragraph (c)(2) of this section, and c=NO_x concentration in lb./ft.³, as determined in accordance with paragraph (c)(1) of this section, corrected to standard conditions, dry basis.

Subpart H—Standards of Performance for Sulfuric Acid Plants

§ 60.80 Applicability and designation of affected facility.

The provisions of this subpart are applicable to each sulfuric acid production unit, which is the affected facility.

§ 60.81 Definitions.

As used in this subpart, all terms not defined herein shall have the meaning given them in the Act and in Subpart A of this part.

(a) "Sulfuric acid production unit" means any facility producing sulfuric acid by the contact process by burning elemental sulfur, alkylation acid, hydrogen sulfide, organic sulfides and mercaptans, or acid sludge, but does not include facilities where conversion to sulfuric acid is utilized primarily as a means of preventing emissions to the atmosphere of sulfur dioxide or other sulfur compounds.

(b) "Acid mist" means sulfuric acid mist, as measured by test methods set forth in this part.

§ 60.82 Standard for sulfur dioxide.

On and after the date on which the performance test required to be conducted by § 60.8 is initiated no owner or operator subject to the provisions of this part shall discharge or cause the discharge into the atmosphere of sulfur dioxide in excess of 4 lbs. per ton of acid produced (2 kg. per metric ton), maximum 2-hour average.

§ 60.83 Standard for acid mist.

On and after the date on which the performance test required to be conducted by § 60.8 is initiated no owner or operator subject to the provisions of this part shall discharge or cause the discharge into the atmosphere of acid mist which is:

(a) In excess of 0.15 lb. per ton of acid produced (0.075 kg. per metric ton), maximum 2-hour average, expressed as H_2SO_4.

(b) 10 percent opacity or greater.

§ 60.84 Emission monitoring.

(a) There shall be installed, calibrated, maintained, and operated, in any sulfuric acid production unit subject to the provisions of this subpart, an instrument for continuously monitoring and recording emissions of sulfur dioxide.

(b) The instrument and sampling system installed and used pursuant to this section shall be capable of monitoring emission levels within ±20 percent with a confidence level of 95 percent and shall be calibrated in accordance with the

method(s) prescribed by the manufacturer(s) of such instrument, the instrument shall be subject to manufacturers recommended zero adjustment calibration procedures at least once per 24-hour operating period unless the manufacturer(s) specified or recommends calibration at shorter intervals, in which case such specifications or recommendations shall be followed. The applicable method specified in the appendix of this part shall be the reference method.

(c) Production rate and hours of operation shall be recorded daily.

(d) The owner or operator of any sulfuric acid production unit subject to the provisions of this subpart shall maintain a file of all measurements required by this subpart. Appropriate measurements shall be reduced to the units of the applicable standard daily and summarized monthly. The record of any such measurement and summary shall be retained for at least 2 years following the date of such measurements and summaries.

§ 60.85 Test methods and procedures.

(a) The provisions of this section are applicable to performance tests for determining emissions of acid mist and sulfur dioxide from sulfuric acid production units.

(b) All performance tests shall be conducted while the affected facility is operating at or above the maximum acid production rate at which such facility will be operated and under such other relevant conditions as the Administrator shall specify based on representative performance of the affected facility.

(c) Test methods set forth in the appendix to this part or equivalent methods as approved by the Administrator shall be used as follows:

(1) For each repetition the acid mist and SO_2 concentrations shall be determined by using Method 8 and traversing according to Method 1. The minimum sampling time shall be 2 hours, and minimum sampling volume shall be 40 ft.³ corrected to standard conditions.

(2) The volumetric flow rate of the total effluent shall be determined by using Method 2 and traversing according to Method 1. Gas analysis shall be performed by using the integrated sample technique of Method 3. Moisture content can be considered to be zero.

(d) Acid produced, expressed in tons per hour of 100 percent sulfuric acid shall be determined during each 2-hour testing period by suitable flow meters and shall be confirmed by a material balance over the production system.

(e) For each repetition acid mist and sulfur dioxide emissions, expressed in lb./ton of 100 percent sulfuric acid shall be determined by dividing the emission rate in lb./hr. by the acid produced. The emission rate shall be determined by the equation, $lb./hr. = Q_s \times c$, where Q_s = volumetric flow rate of the effluent in ft.³/hr. at standard conditions, dry basis as determined in accordance with paragraph (c)(2) of this section, and c = acid mist and SO_2 concentrations in lb./ft.³ as determined in accordance with paragraph (c)(1) of this section, corrected to standard conditions, dry basis.

APPENDIX—TEST METHODS

METHOD 1—SAMPLE AND VELOCITY TRAVERSES FOR STATIONARY SOURCES

1. *Principle and Applicability.*

1.1 Principle. A sampling site and the number of traverse points are selected to aid in the extraction of a representative sample.

1.2 Applicability. This method should be applied only when specified by the test procedures for determining compliance with the New Source Performance Standards. Unless otherwise specified, this method is not intended to apply to gas streams other than those emitted directly to the atmosphere without further processing.

2. *Procedure.*

2.1 Selection of a sampling site and minimum number of traverse points.

2.1.1 Select a sampling site that is at least eight stack or duct diameters downstream and two diameters upstream from any flow disturbance such as a bend, expansion, contraction, or visible flame. For rectangular cross section, determine an equivalent diameter from the following equation:

$$\text{equivalent diameter} = 2\left(\frac{(\text{length})(\text{width})}{\text{length}+\text{width}}\right) \qquad \text{equation 1-1}$$

2.1.2 When the above sampling site criteria can be met, the minimum number of traverse points is twelve (12).

2.1.3 Some sampling situations render the above sampling site criteria impractical. When this is the case, choose a convenient sampling location and use Figure 1-1 to determine the minimum number of traverse points. Under no conditions should a sampling point be selected within 1 inch of the stack wall. To obtain the number of traverse points for stacks or ducts with a diameter less than 2 feet, multiply the number of points obtained from Figure 1-1 by 0.67.

2.1.4 To use Figure 1-1 first measure the distance from the chosen sampling location to the nearest upstream and downstream disturbances. Determine the corresponding number of traverse points for each distance from Figure 1-1. Select the higher of the two numbers of traverse points, or a greater value, such that for circular stacks the number is a multiple of 4, and for rectangular stacks the number follows the criteria of section 2.2.2.

2.2 Cross-sectional layout and location of traverse points.

2.2.1 For circular stacks locate the traverse points on at least two diameters according to Figure 1-2 and Table 1-1. The traverse axes shall divide the stack cross section into equal parts.

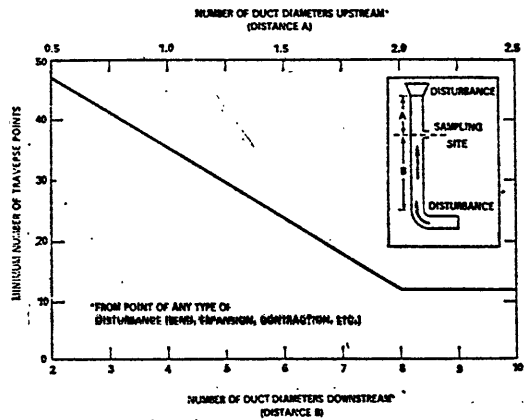

Figure 1-1. Minimum number of traverse points.

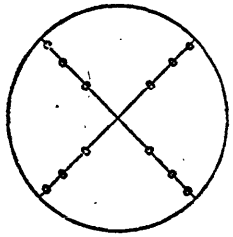

Figure 1-2. Cross section of circular stack divided into 12 equal areas, showing location of traverse points at centroid of each area.

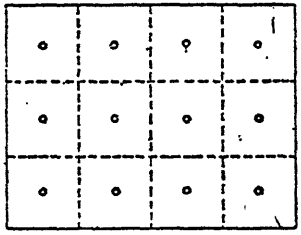

Figure 1-3. Cross section of rectangular stack divided into 12 equal areas, with traverse points at centroid of each area.

Table 1-1. Location of traverse points in circular stacks
(Percent of stack diameter from inside wall to traverse point)

Traverse point number on a diameter	Number of traverse points on a diameter											
	2	4	6	8	10	12	14	16	18	20	22	24
1	14.6	6.7	4.4	3.3	2.5	2.1	1.8	1.6	1.4	1.3	1.1	1.1
2	85.4	25.0	14.7	10.5	8.2	6.7	5.7	4.9	4.4	3.9	3.5	3.2
3		75.0	29.5	19.4	14.6	11.8	9.9	8.5	7.5	6.7	6.0	5.5
4		93.3	70.5	32.3	22.6	17.7	14.6	12.5	10.9	9.7	8.7	7.9
5			85.3	67.7	34.2	25.0	20.1	16.9	14.6	12.9	11.6	10.5
6			95.6	80.6	65.8	35.5	26.9	22.0	18.8	16.5	14.6	13.2
7				89.5	77.4	64.5	36.6	28.3	23.6	20.4	18.0	16.1
8				96.7	85.4	65.0	63.4	37.5	29.6	25.0	21.8	19.4
9					91.8	82.3	73.1	62.5	38.2	30.6	26.1	23.0
10					97.5	88.2	79.9	71.7	61.8	38.8	31.5	27.2
11						93.3	85.4	78.0	70.4	61.2	39.3	32.3
12						97.9	90.1	83.1	76.4	69.4	60.7	39.8
13							94.3	87.5	81.2	75.0	68.5	60.2
14							98.2	91.5	85.4	79.6	73.9	67.7
15								95.1	89.1	83.5	78.2	72.8
16								98.4	92.5	87.1	82.0	77.0
17									95.6	90.3	85.4	80.6
18									98.6	93.3	88.4	83.9
19										96.1	91.3	86.8
20										98.7	94.0	89.5
21											96.5	92.1
22											98.9	94.5
23												96.8
24												98.9

2.2.2 For rectangular stacks divide the cross section into as many equal rectangular areas as traverse points, such that the ratio of the length to the width of the elemental areas is between one and two. Locate the traverse points at the centroid of each equal area according to Figure 1-3.

3. *References.*

Determining Dust Concentration in a Gas Stream, ASME Performance Test Code #27, New York, N.Y., 1957.

Devorkin, Howard, et al., Air Pollution Source Testing Manual, Air Pollution Control District, Los Angeles, Calif. November 1963.

Methods for Determination of Velocity, Volume, Dust and Mist Content of Gases, Western Precipitation Division of Joy Manufacturing Co., Los Angeles, Calif. Bulletin WP-50, 1968.

Standard Method for Sampling Stacks for Particulate Matter, In: 1971 Book of ASTM Standards, Part 23, Philadelphia, Pa. 1971, ASTM Designation D-2928-71.

METHOD 2—DETERMINATION OF STACK GAS VELOCITY AND VOLUMETRIC FLOW RATE (TYPE S PITOT TUBE)

1. *Principle and applicability.*

1.1 Principle. Stack gas velocity is determined from the gas density and from measurement of the velocity head using a Type S (Stauscheibe or reverse type) pitot tube.

1.2 Applicability. This method should be applied only when specified by the test procedures for determining compliance with the New Source Performance Standards.

2. *Apparatus.*

2.1 Pitot tube—Type S (Figure 2-1), or equivalent, with a coefficient within ±5% over the working range.

2.2 Differential pressure gauge—Inclined manometer, or equivalent, to measure velocity head to within 10% of the minimum value.

2.3 Temperature gauge—Thermocouple or equivalent attached to the pitot tube to measure stack temperature to within 1.5% of the minimum absolute stack temperature.

2.4 Pressure gauge—Mercury-filled U-tube manometer, or equivalent, to measure stack pressure to within 0.1 in. Hg.

2.5 Barometer—To measure atmospheric pressure to within 0.1 in. Hg.

2.6 Gas analyzer—To analyze gas composition for determining molecular weight.

2.7 Pitot tube—Standard type, to calibrate Type S pitot tube.

3. *Procedure.*

3.1 Set up the apparatus as shown in Figure 2-1. Make sure all connections are tight and leak free. Measure the velocity head and temperature at the traverse points specified by Method 1.

3.2 Measure the static pressure in the stack.

3.3 Determine the stack gas molecular weight by gas analysis and appropriate calculations as indicated in Method 3.

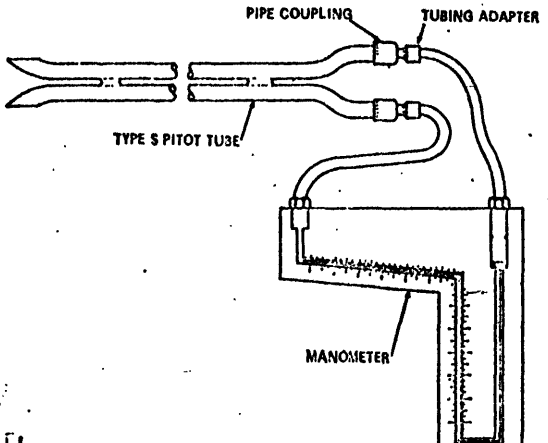

Figure 2-1. Pitot tube-manometer assembly.

4. *Calibration.*

4.1 To calibrate the pitot tube, measure the velocity head at some point in a flowing gas stream with both a Type S pitot tube and a standard type pitot tube with known coefficient. Calibration should be done in the laboratory and the velocity of the flowing gas stream should be varied over the normal working range. It is recommended that the calibration be repeated after use at each field site.

4.2 Calculate the pitot tube coefficient using equation 2-1.

$$C_{p_{std}} = C_{p_{std}}\sqrt{\frac{\Delta p_{std}}{\Delta p_{std}}} \quad \text{equation 2-1}$$

where:

$C_{p_{std}}$ = Pitot tube coefficient of Type S pitot tube.

$C_{p_{std}}$ = Pitot tube coefficient of standard type pitot tube (if unknown, use 0.99).

Δp_{std} = Velocity head measured by standard type pitot tube.

Δp_{std} = Velocity head measured by Type S pitot tube.

4.3 Compare the coefficients of the Type S pitot tube determined first with one leg and then the other pointed downstream. Use the pitot tube only if the two coefficients differ by no more than 0.01.

5. *Calculations.*

Use equation 2-2 to calculate the stack gas velocity.

$$(V_s)_{a.v.} = K_p C_p (\sqrt{\Delta p})_{a.v.} \sqrt{\frac{(T_s)_{a.v.}}{P_s M_s}}$$

Equation 2-2

where:

$(V_s)_{a.v.}$ = Stack gas velocity, feet per second (f.p.s.).

$K_p = 85.49 \frac{ft}{sec.}\left(\frac{lb.}{lb.\ mole \cdot {}^\circ R}\right)^{1/2}$ when these units are used.

C_p = Pitot tube coefficient, dimensionless.

$(T_s)_{a.v.}$ = Average absolute stack gas temperature, °R.

$(\sqrt{\Delta p})_{a.v.}$ = Average velocity head of stack gas, inches H_2O (see Fig. 2-2).

P_s = Absolute stack gas pressure, inches Hg.

M_s = Molecular weight of stack gas (wet basis), lb./lb.-mole.

$M_s = M_d(1 - B_{ws}) + 18B_{ws}$.

M_d = Dry molecular weight of stack gas (from Method 3).

B_{ws} = Proportion by volume of water vapor in the gas stream (from Method 4).

Figure 2-2 shows a sample recording sheet for velocity traverse data. Use the averages in the last two columns of Figure 2-2 to determine the average stack gas velocity from Equation 2-2.

Use Equation 2-3 to calculate the stack gas volumetric flow rate.

$$Q_s = 3600\,(1 - B_{ws})\,V_s A\left(\frac{T_{std}}{(T_s)_{a.v.}}\right)\left(\frac{P_s}{P_{std}}\right)$$

Equation 2-3

where:

Q_s = Volumetric flow rate, dry basis, standard conditions, ft³/hr.

A = Cross sectional area of stack, ft.²

T_{std} = Absolute temperature at standard conditions, 528° R.

P_{std} = Absolute pressure at standard conditions, 29.92 inches Hg.

6. *References.*

Mark, L. S., Mechanical Engineers' Handbook, McGraw-Hill Book Co., Inc., New York, N.Y., 1951.

Perry, J. H., Chemical Engineers' Handbook, McGraw-Hill Book Co., Inc., New York, N.Y., 1950.

Shigehara, R. T., W. F. Todd, and W. S. Smith, Significance of Errors in Stack Sampling Measurements. Paper presented at the Annual Meeting of the Air Pollution Control Association, St. Louis, Mo., June 14–19, 1970.

Standard Method for Sampling Stacks for Particulate Matter, In: 1971 Book of ASTM Standards, Part 23, Philadelphia, Pa., 1971, ASTM Designation D-2928-71.

Vennard, J. K., Elementary Fluid Mechanics, John Wiley & Sons, Inc., New York, N.Y., 1947.

PLANT_____

DATE_____

RUN NO._____

STACK DIAMETER, in._____

BAROMETRIC PRESSURE, in. Hg_____

STATIC PRESSURE IN STACK (P_g), in. Hg_____

OPERATORS_____

SCHEMATIC OF STACK CROSS SECTION

Traverse point number	Velocity head, in. H_2O	$\sqrt{\Delta_p}$	Stack Temperature (T_s), °F
	AVERAGE:		

Figure 2-2. Velocity traverse data.

METHOD 3—GAS ANALYSIS FOR CARBON DIOXIDE, EXCESS AIR, AND DRY MOLECULAR WEIGHT

1. *Principle and applicability.*

1.1 Principle. An integrated or grab gas sample is extracted from a sampling point and analyzed for its components using an Orsat analyzer.

1.2 Applicability. This method should be applied only when specified by the test procedures for determining compliance with the New Source Performance Standards. The test procedure will indicate whether a grab sample or an integrated sample is to be used.

2. *Apparatus.*

2.1 Grab sample (Figure 3-1).

2.1.1 Probe—Stainless steel or Pyrex[1] glass, equipped with a filter to remove particulate matter.

2.1.2 Pump—One-way squeeze bulb, or equivalent, to transport gas sample to analyzer.

[1] Trade name.

2.2 *Integrated sample (Figure 3-2).*

2.2.1 Probe—Stainless steel or Pyrex[1] glass, equipped with a filter to remove particulate matter.

2.2.2 Air-cooled condenser or equivalent—To remove any excess moisture.

2.2.3 Needle valve—To adjust flow rate.

2.2.4 Pump—Leak-free, diaphragm type, or equivalent, to pull gas.

2.2.5 Rate meter—To measure a flow range from 0 to 0.035 cfm.

2.2.6 Flexible bag—Tedlar,[1] or equivalent, with a capacity of 2 to 3 cu. ft. Leak test the bag in the laboratory before using.

2.2.7 Pitot tube—Type S, or equivalent, attached to the probe so that the sampling flow rate can be regulated proportional to the stack gas velocity when velocity is varying with time or a sample traverse is conducted.

2.3 *Analysis.*

2.3.1 Orsat analyzer, or equivalent.

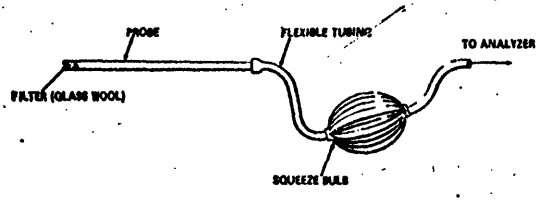

Figure 3-1. Grab-sampling train.

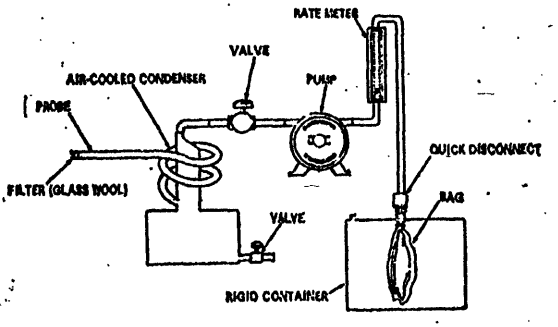

Figure 3-2. Integrated gas - sampling train.

3. *Procedure.*

3.1 Grab sampling.

3.1.1 Set up the equipment as shown in Figure 3-1, making sure all connections are leak-free. Place the probe in the stack at a sampling point and purge the sampling line.

3.1.2 Draw sample into the analyzer.

3.2 Integrated sampling.

3.2.1 Evacuate the flexible bag. Set up the equipment as shown in Figure 3-2 with the bag disconnected. Place the probe in the stack and purge the sampling line. Connect the bag, making sure that all connections are tight and that there are no leaks.

3.2.2 Sample at a rate proportional to the stack velocity.

3.3 Analysis.

3.3.1 Determine the CO_2, O_2, and CO concentrations as soon as possible. Make as many passes as are necessary to give constant readings. If more than ten passes are necessary, replace the absorbing solution.

3.3.2 For grab sampling, repeat the sampling and analysis until three consecutive samples vary no more than 0.5 percent by volume for each component being analyzed.

3.3.3 For integrated sampling, repeat the analysis of the sample until three consecutive analyses vary no more than 0.2 percent by volume for each component being analyzed.

4. *Calculations.*

4.1 Carbon dioxide. Average the three consecutive runs and report the result to the nearest 0.1% CO_2.

4.2 Excess air. Use Equation 3-1 to calculate excess air, and average the runs. Report the result to the nearest 0.1% excess air.

$$\%EA = \frac{(\%O_2) - 0.5(\%CO)}{0.264(\%N_2) - (\%O_2) + 0.5(\%CO)} \times 100 \quad \text{equation 3-1}$$

where:

$\%EA$ = Percent excess air.

$\%O_2$ = Percent oxygen by volume, dry basis.

$\%N_2$ = Percent nitrogen by volume, dry basis.

$\%CO$ = Percent carbon monoxide by volume, dry basis.

0.264 = Ratio of oxygen to nitrogen in air by volume.

4.3 Dry molecular weight. Use Equation 3-2 to calculate dry molecular weight and average the runs. Report the result to the nearest tenth.

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO) \quad \text{equation 3-2}$$

where:

M_d = Dry molecular weight, lb./lb-mole.

$\%CO_2$ = Percent carbon dioxide by volume, dry basis.

$\%O_2$ = Percent oxygen by volume, dry basis.

$\%N_2$ = Percent nitrogen by volume, dry basis.

0.44 = Molecular weight of carbon dioxide divided by 100.

0.32 = Molecular weight of oxygen divided by 100.

0.28 = Molecular weight of nitrogen and CO divided by 100.

5. *References.*

Altshuller, A. P., et al., Storage of Gases and Vapors in Plastic Bags, Int. J. Air & Water Pollution, 6:75-81, 1963.

Conner, William D., and J. S. Nader, Air Sampling with Plastic Bags, Journal of the American Industrial Hygiene Association, 25:291-297, May-June 1964.

Devorkin, Howard, et al., Air Pollution Source Testing Manual, Air Pollution Control District, Los Angeles, Calif., November 1963.

METHOD 4—DETERMINATION OF MOISTURE IN STACK GASES

1. *Principle and applicability.*

1.1 Principle. Moisture is removed from the gas stream, condensed, and determined volumetrically.

1.2 Applicability. This method is applicable for the determination of moisture in stack gas only when specified by test procedures for determining compliance with New Source Performance Standards. This method does not apply when liquid droplets are present in the gas stream[1] and the moisture is subsequently used in the determination of stack gas molecular weight.

Other methods such as drying tubes, wet bulb-dry bulb techniques, and volumetric condensation techniques may be used.

2. *Apparatus.*

2.1 Probe—Stainless steel or Pyrex[2] glass sufficiently heated to prevent condensation and equipped with a filter to remove particulate matter.

2.2 Impingers—Two midget impingers, each with 30 ml. capacity, or equivalent.

2.3 Ice bath container—To condense moisture in impingers.

2.4 Silica gel tube (optional)—To protect pump and dry gas meter.

2.5 Needle valve—To regulate gas flow rate.

2.6 Pump—Leak-free, diaphragm type, or equivalent, to pull gas through train.

2.7 Dry gas meter—To measure to within 1% of the total sample volume.

2.8 Rotameter—To measure a flow range from 0 to 0.1 c.f.m.

2.9 Graduated cylinder—25 ml.

2.10 Barometer—Sufficient to read to within 0.1 inch Hg.

2.11 Pitot tube—Type S, or equivalent, attached to probe so that the sampling flow rate can be regulated proportional to the stack gas velocity when velocity is varying with time or a sample traverse is conducted.

3. *Procedure.*

3.1 Place exactly 5 ml. distilled water in each impinger. Assemble the apparatus without the probe as shown in Figure 4-1. Leak check by plugging the inlet to the first impinger and drawing a vacuum. Insure that flow through the dry gas meter is less than 1% of the sampling rate.

3.2 Connect the probe and sample at a constant rate of 0.075 c.f.m. or at a rate proportional to the stack gas velocity. Continue sampling until the dry gas meter registers 1 cubic foot or until visible liquid droplets are carried over from the first impinger to the second. Record temperature, pressure, and dry gas meter readings as required by Figure 4-2.

3.3 After collecting the sample, measure the volume increase to the nearest 0.5 ml.

4. *Calculations.*

4.1 Volume of water vapor collected.

$$V_{wc} = \frac{(V_f - V_i)\rho_{H_2O} R T_{std}}{P_{std} M_{H_2O}} = 0.0474 \frac{ft^3}{ml}(V_f - V_i) \qquad \text{equation 4-1}$$

where:

V_{wc}=Volume of water vapor collected (standard conditions), cu. ft.

V_f=Final volume of impinger contents, ml.

V_i=Initial volume of impinger contents, ml.

R=Ideal gas constant, 21.83 inches Hg—cu. ft./lb. mole-°R.

ρ_{H_2O}=Density of water, 1 g./ml.

T_{std}=Absolute temperature at standard conditions, 520° R.

P_{std}=Absolute pressure at standard conditions, 29.92 inches Hg.

M_{H_2O}=Molecular weight of water, 18 lb./lb.-mole.

[1] If liquid droplets are present in the gas stream, assume the stream to be saturated, determine the average stack gas temperature by traversing according to Method 1, and use a psychrometric chart to obtain an approximation of the moisture percentage.

[2] Trade name.

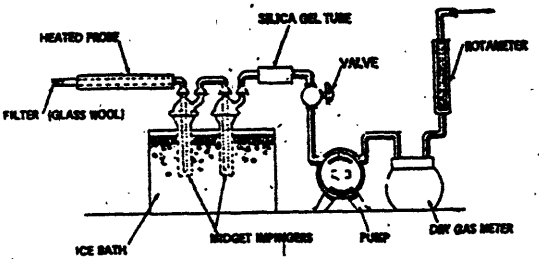

Figure 4-1. Moisture-sampling train.

LOCATION _____ COMMENTS

TEST _____

DATE _____

OPERATOR _____

BAROMETRIC PRESSURE _____

CLOCK TIME	GAS VOLUME THROUGH METER, (V_m), ft^3	ROTAMETER SETTING ft^3/min	METER TEMPERATURE, °F

Figure 4-2. Field moisture determination.

4.2 Gas volume.

$$V_{std} = V_m\left(\frac{P_m}{P_{std}}\right)\left(\frac{T_{std}}{T_m}\right) = 17.71\,\frac{°R}{in.\ Hg}\left(\frac{V_m P_m}{T_m}\right) \quad \text{equation 4-2}$$

where:

V_{std} = Dry gas volume through meter at standard conditions, cu. ft.

V_m = Dry gas volume measured by meter, cu. ft.

P_m = Barometric pressure at the dry gas meter, inches Hg.

P_{std} = Pressure at standard conditions, 29.92 inches Hg.

T_{std} = Absolute temperature at standard conditions, 520° R.

T_m = Absolute temperature at meter (°F + 460), °R.

4.3 Moisture content.

$$B_{ws} = \frac{V_{ws}}{V_{ws} + V_{std}} + B_{wm} = \frac{V_{ws}}{V_{ws} + V_{std}} + (0.025) \quad \text{equation 4-3}$$

where:

B_{ws} = Proportion by volume of water vapor in the gas stream, dimensionless.

V_{ws} = Volume of water vapor collected (standard conditions), cu. ft.

V_{std} = Dry gas volume through meter (standard conditions), cu. ft.

B_{wm} = Approximate volumetric proportion of water vapor in the gas stream leaving the impingers, 0.025.

5. *References.*

Air Pollution Engineering Manual, Danielson, J. A. (ed.), U.S. DHEW, PHS, National Center for Air Pollution Control, Cincinnati, Ohio, PHS Publication No. 999-AP-40, 1967.

Devorkin, Howard, et al., Air Pollution Source Testing Manual, Air Pollution Control District, Los Angeles, Calif., November 1963.

Methods for Determination of Velocity, Volume, Dust and Mist Content of Gases, Western Precipitation Division of Joy Manufacturing Co., Los Angeles, Calif., Bulletin WP-50, 1968.

METHOD 5—DETERMINATION OF PARTICULATE EMISSIONS FROM STATIONARY SOURCES

1. *Principle and applicability.*

1.1 Principle. Particulate matter is withdrawn isokinetically from the source and its weight is determined gravimetrically after removal of uncombined water.

1.2 Applicability. This method is applicable for the determination of particulate emissions from stationary sources only when specified by the test procedures for determining compliance with New Source Performance Standards.

2. *Apparatus.*

2.1 Sampling train. The design specifications of the particulate sampling train used by EPA (Figure 5-1) are described in APTD-0581. Commercial models of this train are available.

2.1.1 Nozzle—Stainless steel (316) with sharp, tapered leading edge.

2.1.2 Probe—*Pyrex*[1] glass with a heating system capable of maintaining a minimum gas temperature of 250° F. at the exit end during sampling to prevent condensation from occurring. When length limitations (greater than about 8 ft.) are encountered at temperatures less than 600° F., Inconloy 625[1], or equivalent, may be used. Probes for sampling gas streams at temperatures in excess of 600° F. must have been approved by the Administrator.

2.1.3 Pitot tube—Type S, or equivalent, attached to probe to monitor stack gas velocity.

[1] Trade name.

2.1.4 Filter Holder—*Pyrex*[1] glass with heating system capable of maintaining minimum temperature of 225° F.

2.1.5 Impingers / Condenser—Four impingers connected in series with glass ball joint fittings. The first, third, and fourth impingers are of the Greenburg-Smith design, modified by replacing the tip with a ½-inch ID glass tube extending to one-half inch from the bottom of the flask. The second impinger is of the Greenburg-Smith design with the standard tip. A condenser may be used in place of the impingers provided that the moisture content of the stack gas can still be determined.

2.1.6 Metering system—Vacuum gauge, leak-free pump, thermometers capable of measuring temperature to within 5° F., dry gas meter with 2% accuracy, and related equipment, or equivalent, as required to maintain an isokinetic sampling rate and to determine sample volume.

2.1.7 Barometer—To measure atmospheric pressure to ±0.1 inches Hg.

2.2 Sample recovery.

2.2.1 Probe brush—At least as long as probe.

2.2.2 Glass wash bottles—Two.

2.2.3 Glass sample storage containers.

2.2.4 Graduated cylinder—250 ml.

2.3 Analysis.

2.3.1 Glass weighing dishes.

2.3.2 Desiccator.

2.3.3 Analytical balance—To measure to ±0.1 mg.

2.3.4 Trip balance—500 g. capacity, to measure to ±0.05 g.

3. *Reagents.*

3.1 Sampling.

3.1.1 Filters—Glass fiber, MSA 1106 BH[1], or equivalent, numbered for identification and preweighed.

3.1.2 Silica gel—Indicating type, 6-16 mesh, dried at 175° C. (350° F.) for 2 hours.

3.1.3 Water.

3.1.4 Crushed ice.

3.2 Sample recovery.

3.2.1 Acetone—Reagent grade.

3.3 Analysis.

3.3.1 Water.

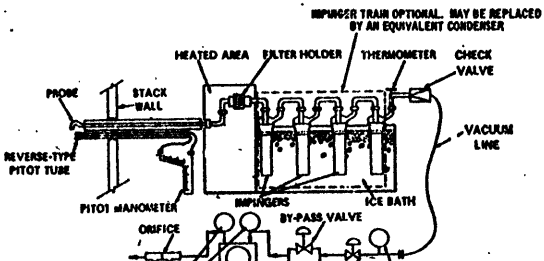

Figure 5-1. Particulate-sampling train.

3.3.2 Desiccant—Drierite,[2] indicating.

4. *Procedure.*

4.1 Sampling

4.1.1 After selecting the sampling site and the minimum number of sampling points, determine the stack pressure, temperature, moisture, and range of velocity head.

4.1.2 Preparation of collection train. Weigh to the nearest gram approximately 200 g. of silica gel. Label a filter of proper diameter, desiccate[2] for at least 24 hours and weigh to the nearest 0.5 mg. in a room where the relative humidity is less than 50%. Place 100 ml. of water in each of the first two impingers, leave the third impinger empty, and place approximately 200 g. of preweighed silica gel in the fourth impinger. Set up the train without the probe as in Figure 5-1. Leak check the sampling train at the sampling site by plugging up the inlet to the filter holder and pulling a 15 in. Hg vacuum. A leakage rate not in excess of 0.03 c.f.m. at a vacuum of 15 in. Hg is acceptable. Attach the probe and adjust the heater to provide a gas temperature of about 250° F. at the probe outlet. Turn on the filter heating system. Place crushed ice around the impingers. Add more ice during the run to keep the temperature of the gases leaving the last impinger as low as possible and preferably at 70° F., or less. Temperatures above 70° F. may result in damage to the dry gas meter from either moisture condensation or excessive heat.

4.1.3 Particulate train operation. For each run, record the data required on the example sheet shown in Figure 5-2. Take readings at each sampling point, at least every 5 minutes, and when significant changes in stack conditions necessitate additional adjustments in flow rate. To begin sampling, position the nozzle at the first traverse point with the tip pointing directly into the gas stream. Immediately start the pump and adjust the flow to isokinetic conditions. Sample for at least 5 minutes at each traverse point; sampling time must be the same for each point. Maintain isokinetic sampling throughout the sampling period. Nomographs are available which aid in the rapid adjustment of the sampling rate without other computations. APTD-0576 details the procedure for using these nomographs. Turn off the pump at the conclusion of each run and record the final readings. Remove the probe and nozzle from the stack and handle in accordance with the sample recovery process described in section 4.2.

[1] Trade name.

[2] Dry using Drierite[1] at 70° F. ± 10° F.

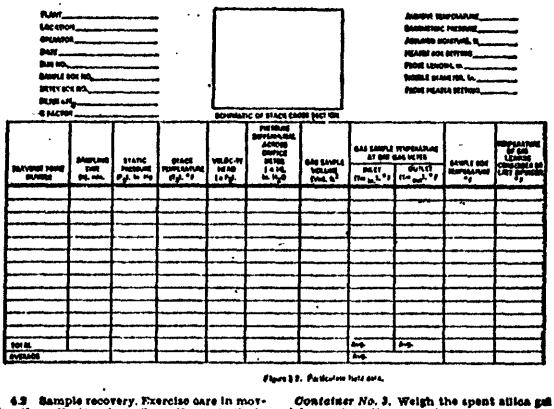

Figure 5-3. Particulate field data.

4.2 Sample recovery. Exercise care in moving the collection train from the test site to the sample recovery area to minimize the loss of collected sample or the gain of extraneous particulate matter. Set aside a portion of the acetone used in the sample recovery as a blank for analysis. Measure the volume of water from the first three impingers, then discard. Place the samples in containers as follows:

Container No. 1. Remove the filter from its holder, place in this container, and seal.

Container No. 2. Place loose particulate matter and acetone washings from all sample-exposed surfaces prior to the filter in this container and seal. Use a razor blade, brush, or rubber policeman to lose adhering particles.

Container No. 3. Transfer the silica gel from the fourth impinger to the original container and seal. Use a rubber policeman as an aid in removing silica gel from the impinger.

4.3 Analysis. Record the data required on the example sheet shown in Figure 5-3. Handle each sample container as follows:

Container No. 1. Transfer the filter and any loose particulate matter from the sample container to a tared glass weighing dish, desiccate, and dry to a constant weight. Report results to the nearest 0.5 mg.

Container No. 2. Transfer the acetone washings to a tared beaker and evaporate to dryness at ambient temperature and pressure. Desiccate and dry to a constant weight. Report results to the nearest 0.5 mg.

Container No. 3. Weigh the spent silica gel and report to the nearest gram.

5. *Calibration.*

Use methods and equipment which have been approved by the Administrator to calibrate the orifice meter, pitot tube, dry gas meter, and probe heater. Recalibrate after each test series.

6. *Calculations.*

6.1 Average dry gas meter temperature and average orifice pressure drop. See data sheet (Figure 5-2).

6.2 Dry gas volume. Correct the sample volume measured by the dry gas meter to standard conditions (70° F., 29.92 inches Hg) by using Equation 5-1.

$$V_{m_{std}} = V_m \left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right) = \left(17.71 \frac{°R}{in.\ Hg}\right) V_m \left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right)$$

equation 5-1

where:

$V_{m_{std}}$ = Volume of gas sample through the dry gas meter (standard conditions), cu. ft.

V_m = Volume of gas sample through the dry gas meter (meter conditions), cu. ft.

T_{std} = Absolute temperature at standard conditions, 530° R.

T_m = Average dry gas meter temperature, °R.

P_{bar} = Barometric pressure at the orifice meter, inches Hg.

ΔH = Average pressure drop across the orifice meter, inches H_2O.

13.6 = Specific gravity of mercury.

P_{std} = Absolute pressure at standard conditions, 29.92 inches Hg.

6.3 Volume of water vapor.

$$V_{w_{std}} = V_{lc}\left(\frac{\rho_{H_2O}}{M_{H_2O}}\right)\left(\frac{RT_{std}}{P_{std}}\right) = \left(0.0474 \frac{cu.\ ft.}{ml.}\right) V_{lc}$$

equation 5-2

where:

$V_{w_{std}}$ = Volume of water vapor in the gas sample (standard conditions), cu. ft.

V_{lc} = Total volume of liquid collected in impingers and silica gel (see Figure 5-3), ml.

ρ_{H_2O} = Density of water, 1 g./ml.

M_{H_2O} = Molecular weight of water, 18 lb./lb.-mole.

R = Ideal gas constant, 21.83 inches Hg—cu. ft./lb.-mole-°R.

T_{std} = Absolute temperature at standard conditions, 530° R.

P_{std} = Absolute pressure at standard conditions, 29.92 inches Hg.

6.4 Moisture content.

$$B_{wo} = \frac{V_{w_{std}}}{V_{m_{std}} + V_{w_{std}}}$$

equation 5-3

where:

B_{wo} = Proportion by volume of water vapor in the gas stream, dimensionless.

$V_{w_{std}}$ = Volume of water in the gas sample (standard conditions), cu. ft.

$V_{m_{std}}$ = Volume of gas sample through the dry gas meter (standard conditions), cu. ft.

6.5 Total particulate weight. Determine the total particulate catch from the sum of the weights on the analysis data sheet (Figure 5-3).

6.6 Concentration.

6.6.1 Concentration in gr./s.c.f.

$$c'_s = \left(0.0154 \frac{gr.}{mg.}\right)\left(\frac{M_n}{V_{m_{std}}}\right)$$

equation 5-4

where:

c'_s = Concentration of particulate matter in stack gas, gr./s.c.f., dry basis.

M_n = Total amount of particulate matter collected, mg.

$V_{m_{std}}$ = Volume of gas sample through dry gas meter (standard conditions), cu. ft.

PLANT _____

DATE _____

RUN NO. _____

CONTAINER NUMBER	WEIGHT OF PARTICULATE COLLECTED, mg		
	FINAL WEIGHT	TARE WEIGHT	WEIGHT GAIN
1			
2			
TOTAL			

	VOLUME OF LIQUID WATER COLLECTED	
	IMPINGER VOLUME, ml	SILICA GEL WEIGHT, g
FINAL		
INITIAL		
LIQUID COLLECTED		
TOTAL VOLUME COLLECTED		g* ml

CONVERT WEIGHT OF WATER TO VOLUME BY DIVIDING TOTAL WEIGHT INCREASE BY DENSITY OF WATER. (1 g ml):

$$\frac{\text{INCREASE, g}}{(1\ \text{g/ml})} = \text{VOLUME WATER, ml}$$

Figure 5-3. Analytical data.

6.6.2 Concentration in lb./cu. ft.

$$c_s = \frac{\left(\frac{1\ \text{lb.}}{453,600\ \text{mg.}}\right) M_n}{V_{m_{std}}} = 2.205 \times 10^{-6} \frac{M_n}{V_{m_{std}}} \qquad \text{equation 5-5}$$

where:

c_s = Concentration of particulate matter in stack gas, lb./s.d.f., dry basis.

453,600 = mg/lb.

M_n = Total amount of particulate matter collected, mg.

$V_{m_{std}}$ = Volume of gas sample through dry gas meter (standard conditions), cu. ft.

6.7 Isokinetic variation.

$$I = \frac{T_s\left[\frac{V_{lc}(\rho_{H_2O})R}{M_{H_2O}} + \frac{V_m}{T_m}\left(P_{bar} + \frac{\Delta H}{13.6}\right)\right]}{\theta V_s P_s A_n} \times 100$$

$$= \frac{\left(1.667\ \frac{\text{min.}}{\text{sec.}}\right)\left[\left(0.00267\ \frac{\text{in. Hg-cu. ft.}}{\text{ml-°R}}\right) V_{lc} + \frac{V_m}{T_m}\left(P_{bar} + \frac{\Delta H}{13.6}\right)\right]}{\theta V_s P_s A_n} \qquad \text{Equation 5-6}$$

where:

I = Percent of isokinetic sampling.

V_{lc} = Total volume of liquid collected in impingers and silica gel (see Fig. 5-3), ml.

ρ_{H_2O} = Density of water, 1 g/ml.

R = Ideal gas constant, 21.83 inches Hg-cu. ft./lb.-mole-°R.

M_{H_2O} = Molecular weight of water, 18 lb./lb.-mole.

V_m = Volume of gas sample through the dry gas meter (meter conditions), cu. ft.

T_m = Absolute average dry gas meter temperature (see Figure 5-3), °R.

P_{bar} = Barometric pressure at sampling site, inches Hg.

ΔH = Average pressure drop across the orifice (see Fig. 5-3), inches H_2O.

T_s = Absolute average stack gas temperature (see Fig. 5-3), °R.

θ = Total sampling time, min.

V_s = Stack gas velocity calculated by Method 2, Eq. 2-9, ft./sec.

P_s = Absolute stack gas pressure, inches Hg.

A_n = Cross-sectional area of nozzle, sq. ft.

6.8 Acceptable results. The following range sets the limit on acceptable isokinetic sampling results:

If $90\% \leq I \leq 110\%$, the results are acceptable, otherwise, reject the results and repeat the test.

7. References.

Addendum to Specifications for Incinerator Testing at Federal Facilities, PHS, NCAPC, Dec. 6, 1967.

Martin, Robert M., Construction Details of Isokinetic Source Sampling Equipment, Environmental Protection Agency, APTD-0581.

Rom, Jerome J., Maintenance, Calibration, and Operation of Isokinetic Source Sampling Equipment, Environmental Protection Agency, APTD-0576.

Smith, W. S., R. T. Shigehara, and W. F. Todd, A Method of Interpreting Stack Sampling Data, Paper presented at the 63d Annual Meeting of the Air Pollution Control Association, St. Louis, Mo., June 14-19, 1970.

Smith, W. S., et al., Stack Gas Sampling Improved and Simplified with New Equipment, APCA paper No. 67-119, 1967.

Specifications for Incinerator Testing at Federal Facilities, PHS, NCAPC, 1967.

METHOD 6—DETERMINATION OF SULFUR DIOXIDE EMISSIONS FROM STATIONARY SOURCES

1. *Principle and applicability.*

1.1 Principle. A gas sample is extracted from the sampling point in the stack. The acid mist, including sulfur trioxide, is separated from the sulfur dioxide. The sulfur dioxide fraction is measured by the barium-thorin titration method.

1.2 Applicability. This method is applicable for the determination of sulfur dioxide emissions from stationary sources only when specified by the test procedures for determining compliance with New Source Performance Standards.

2. *Apparatus.*

2.1 Sampling. See Figure 6-1.

2.1.1 Probe—Pyrex[1] glass, approximately 6 to 8 mm. ID, with a heating system to prevent condensation and a filtering medium to remove particulate matter including sulfuric acid mist.

2.1.2 Midget bubbler—One, with glass wool packed in top to prevent sulfuric acid mist carryover.

2.1.3 Glass wool.

2.1.4 Midget impingers—Three.

2.1.5 Drying tube—Packed with 6 to 16 mesh indicating-type silica gel, or equivalent, to dry the sample.

2.1.6 Valve—Needle valve, or equivalent, to adjust flow rate.

2.1.7 Pump—Leak-free, vacuum type.

2.1.8 Rate meter—Rotameter or equivalent, to measure a 0 to 10 a.c.f.h. flow range.

2.1.9 Dry gas meter—Sufficiently accurate to measure the sample volume within 1%.

2.1.10 Pitot tube—Type S, or equivalent.

[1] Trade names.

necessary only if a sample traverse is required, or if stack gas velocity varies with time.

2.2 Sample recovery.

2.2.1 Glass wash bottles—Two.

2.2.2 Polyethylene storage bottles—To store impinger samples.

2.3 Analysis.

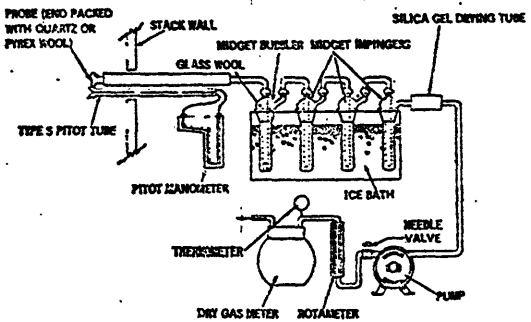

Figure 6-1. SO_2 sampling train.

2.3.1 Pipettes—Transfer type, 5 ml. and 10 ml. sizes (0.1 ml. divisions) and 25 ml. size (0.2 ml. divisions).

2.3.2 Volumetric flasks—50 ml., 100 ml., and 1,000 ml.

2.3.3 Burettes—5 ml. and 50 ml.

2.3.4 Erlenmeyer flask—125 ml.

3. *Reagents.*

3.1 Sampling.

3.1.1 Water—Deionized, distilled.

3.1.2 Isopropanol, 80%—Mix 80 ml. of isopropanol with 20 ml. of distilled water.

3.1.3 Hydrogen peroxide, 3%—dilute 100 ml. of 30% hydrogen peroxide to 1 liter with distilled water. Prepare fresh daily.

3.2 Sample recovery.

3.2.1 Water—Deionized, distilled.

3.2.2 Isopropanol, 80%.

3.3 Analysis.

3.3.1 Water—Deionized, distilled.

3.3.2 Isopropanol.

3.3.3 Thorin indicator—1-(o-arsonophenylazo)-2-naphthol-3,6-disulfonic acid, disodium salt (or equivalent). Dissolve 0.20 g. in 100 ml. distilled water.

3.3.4 Barium perchlorate (0.01 *N*)—Dissolve 1.95 gr. of barium perchlorate [$Ba(ClO_4)_2 \cdot 3H_2O$] in 200 ml. distilled water and dilute to 1 liter with isopropanol. Standardize with sulfuric acid. Barium chloride may be used.

3.3.5 Sulfuric acid standard (0.01 *N*)—Purchase or standardize to ±0.0002 *N* against 0.01N NaOH which has previously been standardized against potassium acid phthalate (primary standard grade).

4. *Procedure.*

4.1 Sampling.

4.1.1 Preparation of collection train. Pour 15 ml. of 80% isopropanol into the midget bubbler and 15 ml. of 3% hydrogen peroxide into each of the first two midget impingers. Leave the final midget impinger dry. Assemble the train as shown in Figure 6-1. Leak check the sampling train at the sampling site by plugging the probe inlet and pulling a 10 inches Hg vacuum. A leakage rate not in excess of 1% of the sampling rate is acceptable. Carefully release the probe inlet plug and turn off the pump. Place crushed ice around the impingers. Add more ice during the run to keep the temperature of the gases leaving the last impinger at 70° F. or less.

4.1.2 Sample collection. Adjust the sample flow rate proportional to the stack gas velocity. Take readings at least every five minutes and when significant changes in stack conditions necessitate additional adjustments in flow rate. To begin sampling, position the tip of the probe at the first sampling point and start the pump. Sample proportionally throughout the run. At the conclusion of each run, turn off the pump and record the final readings. Remove the probe from the stack and disconnect it from the train. Drain the ice bath and purge the remaining part of the train by drawing clean ambient air through the system for 15 minutes.

4.2 Sample recovery. Disconnect the impingers after purging. Discard the contents of the midget bubbler. Pour the contents of the midget impingers into a polyethylene shipment bottle. Rinse the three midget impingers and the connecting tubes with distilled water and add these washings to the same storage container.

4.3 Sample analysis. Transfer the contents of the storage container to a 50 ml. volumetric flask. Dilute to the mark with deionized, distilled water. Pipette a 10 ml. aliquot of this solution into a 125 ml. Erlenmeyer flask. Add 40 ml. of isopropanol and two to four drops of thorin indicator. Titrate to a pink endpoint using 0.01 *N* barium perchlorate. Run a blank with each series of samples.

5. *Calibration.*

5.1 Use standard methods and equipment which have been approved by the Administrator to calibrate the rotameter, pitot tube, dry gas meter, and probe heater.

5.2 Standardize the barium perchlorate against 20 ml. of standard sulfuric acid containing 100 ml. of isopropanol.

6. *Calculations.*

6.1 Dry gas volume. Correct the sample volume measured by the dry gas meter to standard conditions (70° F. and 29.92 inches Hg) by using equation 6-1.

$$V_{m_{std}} = V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar}}{P_{std}}\right) = 17.71\,\frac{°R}{in.\ Hg}\left(\frac{V_m P_{bar}}{T_m}\right) \quad \text{equation 6-1}$$

where:

$V_{m_{std}}$ = Volume of gas sample through the dry gas meter (standard conditions), cu. ft.

V_m = Volume of gas sample through the dry gas meter (meter conditions), cu. ft.

T_{std} = Absolute temperature at standard conditions, 530° R.

T_m = Average dry gas meter temperature, °R.

P_{bar} = Barometric pressure at the orifice meter, inches Hg.

P_{std} = Absolute pressure at standard conditions, 29.92 inches Hg.

6.2 Sulfur dioxide concentration.

$$C_{SO_2} = \left(7.05\times10^{-4}\,\frac{lb.\text{-}l.}{g.\text{-}ml.}\right)\frac{(V_t - V_{tb})N\left(\frac{V_{sol}}{V_a}\right)}{V_{m_{std}}} \quad \text{equation 6-2}$$

where:

C_{SO_2} = Concentration of sulfur dioxide at standard conditions, dry basis, lb./cu. ft.

7.05×10^{-4} = Conversion factor, including the number of grams per gram equivalent of sulfur dioxide (32 g./g.-eq.), 453.6 g./lb., and 1,000 ml./l., lb.-l./g.-ml.

V_t = Volume of barium perchlorate titrant used for the sample, ml.

V_{tb} = Volume of barium perchlorate titrant used for the blank, ml.

N = Normality of barium perchlorate titrant, g.-eq./l.

V_{sol} = Total solution volume of sulfur dioxide, 50 ml.

V_a = Volume of sample aliquot titrated, ml.

$V_{m_{std}}$ = Volume of gas sample through the dry gas meter (standard conditions), cu. ft., see Equation 6-1.

7. *References.*

Atmospheric Emissions from Sulfuric Acid Manufacturing Processes, U.S. DHEW, PHS, Division of Air Pollution, Public Health Service Publication No. 999-AP-13, Cincinnati, Ohio, 1965.

Corbett, P. F. The Determination of SO_2 and SO_3 in Flue Gases, Journal of the Institute of Fuel, 34:537-543, 1961.

Matty, R. E. and E. K. Diehl, Measuring Flue-Gas SO_2 and SO_3, Power 101:94-97, November, 1957.

Patton, W. F. and J. A. Brink, Jr., New Equipment and Techniques for Sampling Chemical Process Gases, J. Air Pollution Control Association, 13, 162 (1963).

METHOD 7—DETERMINATION OF NITROGEN OXIDE EMISSIONS FROM STATIONARY SOURCES

1. *Principle and applicability.*

1.1 Principle. A grab sample is collected in an evacuated flask containing a dilute sulfuric acid-hydrogen peroxide absorbing solution, and the nitrogen oxides, except

nitrous oxide, are measure colorimetrically using the phenoldisulfonic acid (PDS) procedure.

1.2 Applicability. This method is applicable for the measurement of nitrogen oxides from stationary sources only when specified by the test procedures for determining compliance with New Source Performance Standards.

2. *Apparatus.*

2.1 Sampling. See Figure 7-1.

2.1.1 Probe—Pyrex[1] glass, heated, with filter to remove particulate matter. Heating is unnecessary if the probe remains dry during the purging period.

2.1.2 Collection flask—Two-liter, Pyrex, round bottom with short neck and 24/40 standard taper opening, protected against implosion or breakage.

[1] Trade name.

2.1.3 Flask valve—T-bore stopcock connected to a 24/40 standard taper joint.

2.1.4 Temperature gauge—Dial-type thermometer, or equivalent, capable of measuring 2° F. intervals from 25° to 125° F.

2.1.5 Vacuum line—Tubing capable of withstanding a vacuum of 3 inches Hg absolute pressure, with "T" connection and T-bore stopcock, or equivalent.

2.1.6 Pressure gauge—U-tube manometer, 36 inches, with 0.1-inch divisions, or equivalent.

2.1.7 Pump—Capable of producing a vacuum of 3 inches Hg absolute pressure.

2.1.8 Squeeze bulb—One way.

2.2 Sample recovery.

2.2.1 Pipette or dropper.

2.2.2 Glass storage containers—Cushioned for shipping.

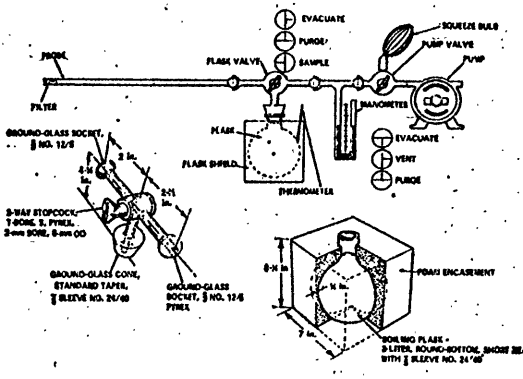

Figure 7-1. Sampling train, flask valve, and flask.

2.2.3 Glass wash bottle.

3.3 Analysis.

3.3.1 Steam bath.

3.3.2 Beakers or casseroles—250 ml., one for each sample and standard (blank).

3.3.3 Volumetric pipettes—1, 2, and 10 ml.

3.3.4 Transfer pipette—10 ml. with 0.1 ml. divisions.

3.3.5 Volumetric flask—100 ml., one for each sample, and 1,000 ml. for the standard (blank).

3.3.6 Spectrophotometer—To measure absorbance at 420 nm.

3.3.7 Graduated cylinder—100 ml. with 1.0 ml. divisions.

3.3.8 Analytical balance—To measure to 0.1 mg.

3. *Reagents.*

3.1 Sampling.

3.1.1 Absorbing solution—Add 2.8 ml. of concentrated H_2SO_4 to 1 liter of distilled water. Mix well and add 6 ml. of 3 percent hydrogen peroxide. Prepare a fresh solution weekly and do not expose to extreme heat or direct sunlight.

3.2 Sample recovery.

3.2.1 Sodium hydroxide (1*N*)—Dissolve 40 g. NaOH in distilled water and dilute to 1 liter.

3.2.2 Red litmus paper.

3.2.3 Water—Deionized, distilled.

3.3 Analysis.

3.3.1 Fuming sulfuric acid—15 to 18% by weight free sulfur trioxide.

3.3.2 Phenol—White solid reagent grade.

3.3.3 Sulfuric acid—Concentrated reagent grade.

3.3.4 Standard solution—Dissolve 0.5495 g. potassium nitrate (KNO_3) in distilled water and dilute to 1 liter. For the working standard solution, dilute 10 ml. of the resulting solution to 100 ml. with distilled water. One ml. of the working standard solution is equivalent to 25 µg. nitrogen dioxide.

3.3.5 Water—Deionized, distilled.

3.3.6 Phenoldisulfonic acid solution—Dissolve 25 g. of pure white phenol in 150 ml. concentrated sulfuric acid on a steam bath. Cool, add 75 ml. fuming sulfuric acid, and heat at 100° C. for 2 hours. Store in a dark, stoppered bottle.

4. *Procedure.*

4.1 Sampling.

4.1.1 Pipette 25 ml. of absorbing solution into a sample flask. Insert the flask valve stopper into the flask with the valve in the "purge" position. Assemble the sampling train as shown in Figure 7-1 and place the probe at the sampling point. Turn the flask valve and the pump valve to their "evacuate" positions. Evacuate the flask to at least 3 inches Hg absolute pressure. Turn the pump valve to its "vent" position and turn off the pump. Check the manometer for any fluctuation in the mercury level. If there is a visible change over the span of one minute, check for leaks. Record the initial volume, temperature, and barometric pressure. Turn the flask valve to its "purge" position, and then do the same with the pump valve. Purge the probe and the vacuum tube using the squeeze bulb. If condensation occurs in the probe and flask valve area, heat the probe and purge until the condensation disappears. Then turn the pump valve to its "vent" position. Turn the flask valve to its "sample" position and allow sample to enter the flask for about 15 seconds. After collecting the sample, turn the flask valve to its "purge" position and disconnect the flask from the sampling train. Shake the flask for 5 minutes.

4.2 Sample recovery.

4.2.1 Let the flask set for a minimum of 16 hours and then shake the contents for 2 minutes. Connect the flask to a mercury filled U-tube manometer, open the valve from the flask to the manometer, and record the flask pressure and temperature along with the barometric pressure. Transfer the flask contents to a container for shipment or to a 250 ml. beaker for analysis. Rinse the flask with two portions of distilled water (approximately 10 ml.) and add rinse water to the sample. For a blank use 25 ml. of absorbing solution and the same volume of distilled water as used in rinsing the flask. Prior to shipping or analysis, add sodium hydroxide (1*N*) dropwise into both the sample and the blank until alkaline to litmus paper (about 25 to 35 drops in each).

4.3 Analysis.

4.3.1 If the sample has been shipped in a container, transfer the contents to a 250 ml. beaker using a small amount of distilled water. Evaporate the solution to dryness on a steam bath and then cool. Add 2 ml. phenoldisulfonic acid solution to the dried residue and triturate thoroughly with a glass rod. Make sure the solution contacts all the residue. Add 1 ml. distilled water and four drops of concentrated sulfuric acid. Heat the solution on a steam bath for 3 minutes with occasional stirring. Cool, add 20 ml. distilled water, mix well by stirring, and add concentrated ammonium hydroxide dropwise with constant stirring until alkaline to litmus paper. Transfer the solution to a 100 ml. volumetric flask and wash the beaker three times with 4 to 5 ml. portions of distilled water. Dilute to the mark and mix thoroughly. If the sample contains solids, transfer a portion of the solution to a clean, dry centrifuge tube, and centrifuge, or filter a portion of the solution. Measure the absorbance of each sample at 420 nm. using the blank solution as a zero. Dilute the sample and the blank with a suitable amount of distilled water if absorbance falls outside the range of calibration.

5. *Calibration.*

5.1 Flask volume. Assemble the flask and flask valve and fill with water to the stopcock. Measure the volume of water to ±10 ml. Number and record the volume on the flask.

5.2 Spectrophotometer. Add 0.0 to 16.0 ml. of standard solution to a series of beakers. To each beaker add 25 ml. of absorbing solution and add sodium hydroxide (1*N*) dropwise until alkaline to litmus paper (about 25 to 35 drops). Follow the analysis procedure of section 4.3 to collect enough data to draw a calibration curve of concentration in µg. NO_2 per sample versus absorbance.

6. *Calculations.*

6.1 Sample volume.

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$$V_{sc}=\frac{T_{std}(V_f-V_s)}{P_{std}}\left(\frac{P_f}{T_f}-\frac{P_i}{T_i}\right)=\left(17.71\ \frac{°R}{in.\ H_g}\right)(V_f-25\ ml.)\left(\frac{P_f}{T_f}-\frac{P_i}{T_i}\right)\quad \text{Equation 7-1}$$

where:

V_{sc} = Sample volume at standard conditions (dry basis), ml.

T_{std} = Absolute temperature at standard conditions, 530° R.

P_{std} = Pressure at standard conditions, 29.92 inches Hg.

V_f = Volume of flask and valve, ml.

V_s = Volume of absorbing solution, 25 ml.

P_f = Final absolute pressure of flask, inches Hg.

P_i = Initial absolute pressure of flask, inches Hg.

T_f = Final absolute temperature of flask, °R.

T_i = Initial absolute temperature of flask, °R.

6.2 Sample concentration. Read $\mu g.\ NO_2$ for each sample from the plot of $\mu g.\ NO_2$ versus absorbance.

$$C=\left(\frac{m}{V_{sc}}\right)\left(\frac{1\ lb.}{cu.\ ft.}\right)\left(\frac{1}{1.6\times10^{-9}\ \frac{\mu g.}{ml.}}\right)=\left(6.2\times10^{-4}\ \frac{lb./s.c.f.}{\mu g./ml.}\right)\left(\frac{m}{V_{sc}}\right)\quad \text{equation 7-2}$$

where:

C = Concentration of NO_2 as NO_2 (dry basis), lb./s.c.f.

m = Mass of NO_2 in gas sample, $\mu g.$

V_{sc} = Sample volume at standard conditions (dry basis), ml.

7. *References.*

Standard Methods of Chemical Analysis. 6th ed. New York, D. Van Nostrand Co., Inc., 1962, vol. 1, p. 329-330.

Standard Method of Test for Oxides of Nitrogen in Gaseous Combustion Products (Phenoldisulfonic Acid Procedure), In: 1968 Book of ASTM Standards, Part 23, Philadelphia, Pa. 1968, ASTM Designation D-1608-60, p. 726-729.

Jacob, M. B., The Chemical Analysis of Air Pollutants, New York, N.Y., Interscience Publishers, Inc., 1960, vol. 10, p. 351-356.

METHOD 8—DETERMINATION OF SULFURIC ACID MIST AND SULFUR DIOXIDE EMISSIONS FROM STATIONARY SOURCES

1. *Principle and applicability.*

1.1 Principle. A gas sample is extracted from a sampling point in the stack and the acid mist including sulfur trioxide is separated from sulfur dioxide. Both fractions are measured separately by the barium-thorin titration method.

1.2 Applicability. This method is applicable to determination of sulfuric acid mist (including sulfur trioxide) and sulfur dioxide from stationary sources only when specified by the test procedures for determining compliance with the New Source Performance Standards.

2. *Apparatus.*

2.1 Sampling. See Figure 8-1. Many of the design specifications of this sampling train are described in APTD-0581.

2.1.1 Nozzle—Stainless steel (316) with sharp, tapered leading edge.

2.1.2 Probe—Pyrex[1] glass with a heating system to prevent visible condensation during sampling.

2.1.3 Pitot tube—Type S, or equivalent, attached to probe to monitor stack gas velocity.

2.1.4 Filter holder—Pyrex[1] glass.

2.1.5 Impingers—Four as shown in Figure 8-1. The first and third are of the Greenburg-Smith design with standard tip. The second and fourth are of the Greenburg-Smith design, modified by replacing the standard tip with a ½-inch ID glass tube extending to one-half inch from the bottom of the impinger flask. Similar collection systems, which have been approved by the Administrator, may be used.

2.1.6 Metering system—Vacuum gauge, leak-free pump, thermometers capable of measuring temperature to within 5° F., dry gas meter with 2% accuracy, and related equipment, or equivalent, as required to maintain an isokinetic sampling rate and to determine sample volume.

2.1.7 Barometer—To measure atmospheric pressure to ±0.1 inch Hg.

[1] Trade name.

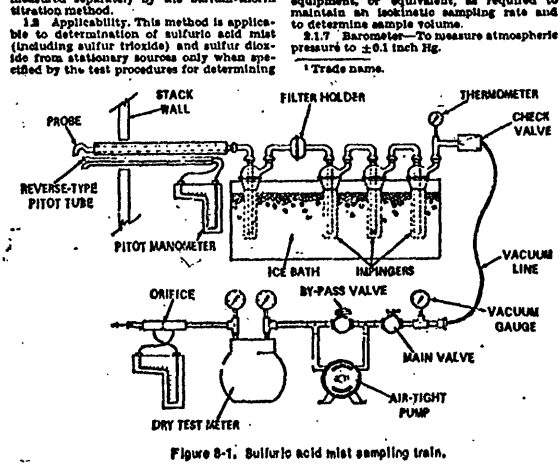


Figure 8-1. Sulfuric acid mist sampling train.

2.2 Sample recovery.

2.2.1 Wash bottles—Two.

2.2.2 Graduated cylinders—250 ml., 500 ml.

2.2.3 Glass sample storage containers.

2.2.4 Graduated cylinder—250 ml.

2.3 Analysis.

2.3.1 Pipette—25 ml., 100 ml.

2.3.2 Burette—50 ml.

2.3.3 Erlenmeyer flask—250 ml.

2.3.4 Graduated cylinder—100 ml.

2.3.5 Trip balance—300 g. capacity, to measure to ±0.05 g.

2.3.6 Dropping bottle—to add indicator solution.

3. *Reagents.*

3.1 Sampling.

3.1.1 Filters—Glass fiber, MSA type 1106 BH, or equivalent, of a suitable size to fit in the filter holder.

3.1.2 Silica gel—Indicating type, 6-16 mesh, dried at 175° C. (350° F.) for 2 hours.

3.1.3 Water—Deionized, distilled.

3.1.4 Isopropanol, 80%—Mix 800 ml. of isopropanol with 200 ml. of deionized, distilled water.

3.1.5 Hydrogen peroxide 3%—Dilute 100 ml. of 30% hydrogen peroxide to 1 liter with deionized, distilled water.

3.1.6 Crushed ice.

3.2 Sample recovery.

3.2.1 Water—Deionized, distilled.

3.2.2 Isopropanol, 80%.

3.3 Analysis.

3.3.1 Water—Deionized, distilled.

3.3.2 Isopropanol.

3.3.3 Thorin indicator—1-(o-arsonophenylazo)-2-naphthol-3, 6-disulfonic acid, disodium salt (or equivalent). Dissolve 0.20 g. in 100 ml. distilled water.

3.3.4 Barium perchlorate (0.01*N*)—Dissolve 1.95 g. of barium perchlorate [$Ba(ClO_4)_2 \cdot 2H_2O$] in 200 ml. distilled water and dilute to 1 liter with isopropanol. Standardize with sulfuric acid.

3.3.5 Sulfuric acid standard (0.01*N*)—Purchase or standardize to ±0.0002 *N* against 0.01 *N* NaOH which has previously been standardized against primary standard potassium acid phthalate.

4. *Procedure.*

4.1 Sampling.

4.1.1 After selecting the sampling site and the minimum number of sampling points, determine the stack pressure, temperature, moisture, and range of velocity head.

4.1.2 Preparation of collection train. Place 100 ml. of 80% isopropanol in the first impinger, 100 ml. of 3% hydrogen peroxide in both the second and third impingers, and about 200 g. of silica gel in the fourth impinger. Retain a portion of the reagents for use as blank solutions. Assemble the train without the probe as shown in Figure 8-1 with the filter between the first and second impingers. Leak check the sampling train at the sampling site by plugging the inlet to the first impinger and pulling a 15-inch Hg vacuum. A leakage rate not in excess of 0.02 c.f.m. at a vacuum of 15 inches Hg is acceptable. Attach the probe and turn on the probe heating system. Adjust the probe heater setting during sampling to prevent any visible condensation. Place crushed ice around the impingers. Add more ice during the run to keep the temperature of the gases leaving the last impinger at 70° F. or less.

4.1.3 Train operation. For each run, record the data required on the example sheet shown in Figure 8-2. Take readings at each sampling point at least every 5 minutes and when significant changes in stack conditions necessitate additional adjustments in flow rate. To begin sampling, position the nozzle at the first traverse point with the tip pointing directly into the gas stream. Start the pump and immediately adjust the flow to isokinetic conditions. Maintain isokinetic sampling throughout the sampling period. Nomographs are available which aid in the

rapid adjustment of the sampling rate without other computations. APTD-0576 details the procedure for using these nomographs. At the conclusion of each run, turn off the pump and record the final readings. Remove the probe from the stack and disconnect it from the train. Dump the ice bath and purge the remaining part of the train by drawing clean ambient air through the system for 15 minutes.

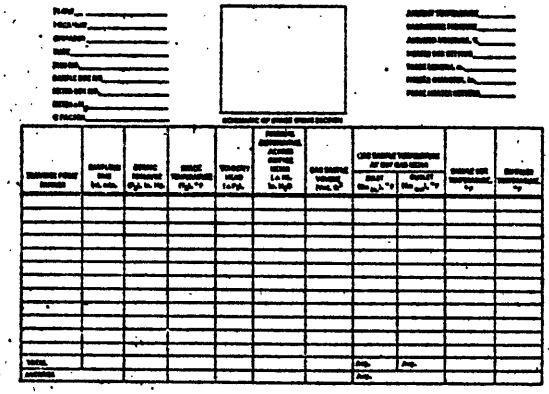


Figure 5-6. Field data.

4.3 Sample recovery.

4.3.1 Transfer the isopropanol from the first impinger to a 250 ml. graduated cylinder. Rinse the probe, first impinger, and all connecting glassware before the filter with 80% isopropanol. Add the rinse solution to the cylinder. Dilute to 250 ml. with 80% isopropanol. Add the filter to the solution, mix, and transfer to a suitable storage container. Transfer the solution from the second and third impingers to a 500 ml. graduated cylinder. Rinse all glassware between the filter and silica gel impinger with deionized, distilled water and add this rinse water to the cylinder. Dilute to a volume of 500 ml. with deionized, distilled water. Transfer the solution to a suitable storage container.

4.4 Analysis.

4.4.1 Shake the container holding isopropanol and the filter. If the filter breaks up, allow the fragments to settle for a few minutes before removing a sample. Pipette a 100 ml. aliquot of sample into a 250 ml. Erlenmeyer flask and add 2 to 4 drops of thorin indicator. Titrate the sample with barium perchlorate to a pink end point. Make sure to record volumes. Repeat the titration with a second aliquot of sample. Shake the container holding the contents of the second and third impingers. Pipette a 25 ml. aliquot of sample into a 250 ml. Erlenmeyer flask. Add 100 ml. of isopropanol and 2 to 4 drops of thorin indicator. Titrate the sample with barium perchlorate to a pink end point. Repeat the titration with a second aliquot of sample. Titrate the blanks in the same manner as the samples.

5. *Calibration.*

5.1 Use standard methods and equipment which have been approved by the Administrator to calibrate the orifice meter, pitot tube, dry gas meter, and probe heater.

5.2 Standardize the barium perchlorate with 25 ml. of standard sulfuric acid containing 100 ml. of isopropanol.

6. *Calculations.*

6.1 Dry gas volume. Correct the sample volume measured by the dry gas meter to standard conditions (70° F., 29.92 inches Hg) by using Equation 5-1.

$$V_{m_{std}} = V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar}+\frac{\Delta H}{13.6}}{P_{std}}\right) = \left(17.71\frac{°R}{in.\ Hg}\right)V_m\left(\frac{P_{bar}+\frac{\Delta H}{13.6}}{T_m}\right)$$

equation 5-1

where:

$V_{m_{std}}$ = Volume of gas sample through the dry gas meter (standard conditions), cu. ft.

V_m = Volume of gas sample through the dry gas meter (meter conditions), cu. ft.

T_{std} = Absolute temperature at standard conditions, 530° R.

T_m = Average dry gas meter temperature, °R.

P_{bar} = Barometric pressure at the orifice meter, inches Hg.

ΔH = Pressure drop across the orifice meter, inches H_2O.

13.6 = Specific gravity of mercury.

P_{std} = Absolute pressure at standard conditions, 29.92 inches Hg.

6.2 Sulfuric acid concentration.

$$C_{H_2SO_4} = \left(1.08\times10^{-4}\frac{lb.\text{-}l.}{g.\text{-}ml.}\right)\frac{(V_t - V_a)(N)\left(\frac{V_{soln}}{V_a}\right)}{V_{m_{std}}}$$

equation 5-2

$C_{H_2SO_4}$ = Concentration of sulfuric acid at standard conditions, dry basis, lb./cu. ft.

1.08×10^{-4} = Conversion factor including the number of grams per gram equivalent of sulfuric acid (49 g./g.-eq.), 453.6 g./lb., and 1,000 ml./l., lb.-l./g.-ml.

V_t = Volume of barium perchlorate titrant used for the sample, ml.

V_{tb} = Volume of barium perchlorate titrant used for the blank, ml.

N = Normality of barium perchlorate titrant, g.-eq./l.

V_{soln} = Total solution volume of sulfuric acid (first impinger and filter), ml.

V_a = Volume of sample aliquot titrated, ml.

$V_{m_{std}}$ = Volume of gas sample through the dry gas meter (standard conditions), cu. ft., see Equation 5-1.

6.3 Sulfur dioxide concentration.

$$C_{SO_2} = \left(7.05\times10^{-4}\frac{lb.\text{-}l.}{g.\text{-}ml.}\right)\frac{(V_t - V_a)(N)\left(\frac{V_{soln}}{V_a}\right)}{V_{m_{std}}}$$

equation 5-3

where:

C_{SO_2} = Concentration of sulfur dioxide at standard conditions, dry basis, lb./cu. ft.

7.05×10^{-4} = Conversion factor including the number of grams per gram equivalent of sulfur dioxide (32 g./g.-eq.), 453.6 g./lb., and 1,000 ml./l., lb.-l./g.-ml.

V_t = Volume of barium perchlorate titrant used for the sample, ml.

V_{tb} = Volume of barium perchlorate titrant used for the blank, ml.

N = Normality of barium perchlorate titrant, g.-eq./l.

V_{soln} = Total solution volume of sulfur dioxide (second and third impingers), ml.

V_a = Volume of sample aliquot titrated, ml.

$V_{m_{std}}$ = Volume of gas sample through the dry gas meter (standard conditions), cu. ft., see Equation 5-1.

7. *References.*

Atmospheric Emissions from Sulfuric Acid Manufacturing Processes. U.S. DHEW, PHS, Division of Air Pollution, Public Health Service Publication No. 999-AP-13, Cincinnati, Ohio, 1965.

Cooper, D. F., The Determination of SO_2 and SO_3 in Flue Gases, Journal of the Institute of Fuel, 34:237-242, 1961.

Martin, Robert M., Construction Details of Isokinetic Source Sampling Equipment, Environmental Protection Agency, Air Pollution Control Office Publication No. APTD-0581.

Patton, W. F., and J. A. Brink, Jr., New Equipment and Techniques for Sampling Chemical Process Gases, J. Air Pollution Control Assoc. 13, 162 (1963).

Rom, Jerome J., Maintenance, Calibration, and Operation of Isokinetic Source Sampling Equipment, Environmental Protection Agency, Air Pollution Control Office Publication No. APTD-0576.

Shell Development Co. Analytical Department, Determination of Sulfur Dioxide and Sulfur Trioxide in Stack Gases, Emeryville Method Series, 4516/59a.

METHOD 9—VISUAL DETERMINATION OF THE OPACITY OF EMISSIONS FROM STATIONARY SOURCES

1. *Principle and applicability.*

1.1 Principle. The relative opacity of an emission from a stationary source is determined visually by a qualified observer.

1.2 Applicability. This method is applicable for the determination of the relative opacity of visible emissions from stationary sources only when specified by test procedures for determining compliance with the New Source Performance Standards.

2. *Procedure.*

2.1 The qualified observer stands at approximately two stack heights, but not more than a quarter of a mile from the base of the stack with the sun to his back. From a vantage point perpendicular to the plume, the observer studies the point of greatest opacity in the plume. The data required in Figure 9-1 is recorded every 15 to 30 seconds to the nearest 5% opacity. A minimum of 25 readings is taken.

3. *Qualifications.*

3.1 To certify as an observer, a candidate must complete a smokereading course conducted by EPA, or equivalent; in order to certify the candidate must assign opacity readings in 5% increments to 25 different black plumes and 25 different white plumes, with an error not to exceed 15 percent on any one reading and an average error not to exceed 7.5 percent in each category. The smoke generator used to qualify the observers must be equipped with a calibrated smoke indicator or light transmission meter located in the source stack if the smoke generator is to determine the actual opacity of the emissions. All qualified observers must pass this test every 6 months in order to remain certified.

4. *Calculations.*

4.1 Determine the average opacity.

5. *References.*

Air Pollution Control District Rules and Regulations, Los Angeles County Air Pollution Control District, Chapter 2, Schedule 6, Regulation 4, Prohibition, Rule 50, 17 p.

Kudluk, Rudolf, Ringelmann Smoke Chart, U.S. Department of Interior, Bureau of Mines, Information Circular No. 8333, May 1967.

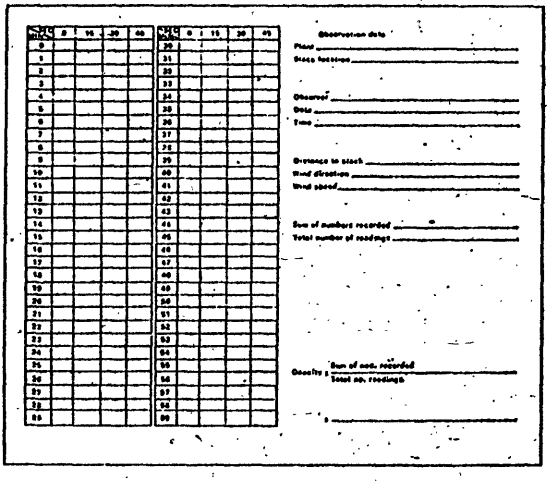


Figure 9-1. Field data.

[FR Doc.71-18624 Filed 12-22-71;8:45 am]

ATTACHMENT 3

SUMMARY OF PUBLIC HEARING ON EPA'S PROPOSED NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS—CUSTOMS COURT HOUSE, 1 FEDERAL PLAZA, NEW YORK, N.Y.—JANUARY 18, 1972

Johns-Manville Corporation acknowledged health hazards from asbestos and was sympathetic with the concept of controlling emissions. While the Corporation feels the general public is not presently endangered by asbestos in the ambient air, it agreed that it is prudent and feasible to control emissions to ensure that no problem develops in the near future. Therefore, the Corporation concurred with the proposed regulations, although some clarifications were suggested.

Dr. J. C. McDonald of McGill University, who testified both on his own behalf, and in conjunction with the Johns-Manville Corporation presentation, discussed the medical dangers of asbestos. While conceding the occupational dangers, he tended to dismiss the threat to the community at large. However, he agreed that it was prudent to identify and control major sources of asbestos.

Dr. Merrill Eisenbud of New York University, testifying on his own behalf, argued that beryllium is not hazardous in the sense of presently causing health problems but conceded that it is potentially toxic unless ambient levels are controlled. He felt that machine shops and brass foundries often handle only miniscule amounts of beryllium and that the applicability of standards to such sources was not justified on health grounds. He suggested, as a minimum, a one-year delay in the applicability of our standards to such sources. He also questioned the proposed emission measurement procedure.

Dr. Leonard Goldwater of Duke University, testifying on his own behalf, questioned the designation of mercury as hazardous although, under questioning, he acknowledged the potential danger from mercury. He said that he doubted the availability of measurement techniques (although he was talking about atmospheric measurements while the standard is an emission standard of much greater magnitude). He also criticized some of the studies which EPA cities as support for the Administrator's determination that mercury is hazardous. Arguing that at least some mercury compounds are detoxified as they enter food chains, he questioned the basis for the standard itself. He indicated that he did not oppose regulation of emissions of mercury "or any other potentially harmful substance" but only wanted a delay until more information could be obtained.

The New York City Department of Air Resources presented a short statement supporting the proposed standards and indicating their intention to submit data they have obtained on the three substances.

H. K. Porter Company, a manufacturer of brake linings and asbestos textiles, indicated that they could live with any reasonable standard and urged coordination between different Government agencies in setting and enforcing asbestos standards.

The statement of the Bureau of Air Quality Control of the Commonwealth of Massachusetts, which was submitted for the record rather than read, endorsed the designation of all three pollutants as hazardous. The statement suggested that EPA follow a philosophy in this area that any controllable exposure should be prohibited.

Thee Nassau County (N.Y.) Bureau of Air Pollution Control indicated concurrence in EPA's proposed standards and stated their intention to cooperate in the enforcement of the standards. The Bureau suggested expanding the mercury standard to include operations involving incineration of instruments containing mercury.

ATTACHMENT 4

Title 45—PUBLIC WELFARE

Chapter XII—Environmental Protection Agency

PART 1201—CONTROL OF AIR POLLUTION FROM NEW MOTOR VEHICLES AND NEW MOTOR VEHICLE ENGINES

Oxides of Nitrogen Exhaust Emission Standard and Test Procedures

On February 27, 1971, a notice of proposed rule making was published in the FEDERAL REGISTER (36 F.R. 3825) which set out the text of proposed amendments to the regulations in this part to provide for an oxides of nitrogen exhaust emission standard and test procedures to become applicable to new light duty vehicles beginning with the 1973 model year.

Pursuant to the above notice, a number of comments have been received from representatives of domestic and foreign manufacturers and from other interested parties. Due consideration has been given to all relevant matter presented and a number of amendments have been made to the regulations as proposed.

Changes have been made to the proposed regulations to provide for a better description of the NO_x converter, a method of determining the efficiency of the NO_x converter, and an NO_x background level correction factor. The special allowance for off-road utility vehicles had been extended to cover NO_x as well as hydrocarbons and carbon monoxide.

In addition, the final rule contains other amendments, largely technical and clarifying modifications.

The oxides of nitrogen exhaust emission standard, as proposed for the 1975 model year, is not included in these regulations but is included in the final rule for exhaust emission standards applicable to 1975 and later model years (proposed in 36 F.R. 3528 and 36 F.R. 9469).

The amendments to Part 1201 set forth below are hereby adopted effective on publication in the FEDERAL REGISTER (7-2-71) and are applicable to new light duty vehicles beginning with the 1973 model year.

The current regulations which appear at Part 1201 will remain in effect for the purpose of their applicability to earlier model year vehicles.

(Sec. 301(a), 81 Stat. 504; 42 U.S.C. 1857g(a), as amended by sec. 15(c)(2), Public Law 91-604, 84 Stat. 1713)

Dated: June 23, 1971.

WILLIAM D. RUCKELSHAUS,
Administrator.

Part 1201 of Chapter XII, Title 45 of the Code of Federal Regulations is amended as follows:

1. In § 1201.1 a new subparagraph is added as follows:

§ 1201.1 Definitions.

(a) * * *

(33) "Oxides of Nitrogen" means the sum of the nitric oxide and nitrogen dioxide contained in a gas sample as if the nitric oxide were in the form of nitrogen dioxide.

2. In § 1201.2 four new abbreviations are added as follows:

§ 1201.2 Abbreviations.

* * * * *

C.—Centigrade.
NO—Nitric Oxide.
NO_2—Nitrogen Dioxide.
NO_x—Oxides of Nitrogen.

* * * * *

3. In § 1201.21, paragraph (a) is revised to read as follows:

§ 1201.21 Standards for exhaust emissions.

(a) Exhaust emissions from 1973 and 1974 model year vehicles shall not exceed:

(1) Hydrocarbons—3.4 grams per vehicle mile.

(2) Carbon monoxide—39.0 grams per vehicle mile.

(3) Oxides of nitrogen—3.0 grams per vehicle mile.

* * * * *

4. In § 1201.70, paragraph (b) is revised to read as follows:

§ 1201.70 Introduction.

* * * * *

(b) The exhaust emission test is designed to determine hydrocarbon, carbon monoxide and oxides of nitrogen mass emissions while simulating an average trip in an urban area of 7.5 miles from a cold start. The test consists of engine startup and vehicle operation on a chassis dynamometer through a specified driving schedule, as described in Appendix A to this part. A proportional part of the diluted exhaust emissions is collected continuously, for subsequent analysis, using a constant volume (variable dilution) sampler.

* * * * *

5. In § 1201.74, paragraph (b)(1) is revised to read as follows:

§ 1201.74 Evaporative emission collection procedure.

* * * * *

(b) *Running loss test.* (1) The vehicle shall be placed on the dynamometer and the fuel tank thermocouple reconnected. The fuel temperature and the ambient air temperature shall be recorded at a chart speed of approximately 12 inches per hour (or equivalent record).

* * * * *

6. In § 1201.75, paragraph (b) is revised to read as follows:

§ 1201.75 Dynamometer driving schedule.

* * * * *

(b) A speed tolerance of ±2 m.p.h. and a time tolerance of ±1 second (or an algebraic combination of the two) from either the speed-time relationship prescribed in Appendix A or as printed on a driver's aid chart approved by the Administrator are acceptable. Speed tolerances greater than 2 m.p.h. (such as occur when shifting manual transmission vehicles) are acceptable provided they occur for less than 2 seconds on any one occasion. Speeds lower than those pre- vehicle is operated at maximum available power during such occurrences. Further, speed deviations from those prescribed due to stalling are acceptable provided the provisions of § 1201.80(f) are adhered to.

7. In § 1201.76, paragraph (a) is revised to read as follows:

§ 1201.76 Dynamometer procedure.

(a) The vehicle shall be tested from a cold start. Engine startup and operation over the driving schedule make a complete test run. Exhaust emissions are diluted with air to a constant volume and a portion is sampled continuously during the entire test run. The composite sample, collected in a bag, is analyzed for hydrocarbon, carbon monoxide, and oxides of nitrogen emissions. A parallel sample of the dilution air is similarly analyzed.

* * * * *

8. In § 1201.80, paragraphs (a) and (b)(1) are revised to read as follows:

§ 1201.80 Engine starting and restarting.

(a) The engine shall be started according to the manufacturer's recommended starting procedures. The initial 20-second-idle period shall begin when the engine starts.

(b) Choke operation:

(1) Vehicles equipped with automatic chokes shall be operated according to the manufacturer's operating or owner's manual including choke setting and "kick-down" from cold fast idle. If choke "kick-down" time is not specified, it shall be performed 13 seconds after the engine starts. The transmission shall be placed in gear 15 seconds after the engine is started. If necessary, braking may be employed to keep the drive wheels from turning.

* * * * *

9. Section 1201.81 is revised to read as follows:

§ 1201.81 Sampling and analytical systems (exhaust emissions).

(a) *Schematic drawings.* The following figures (Figs. 1a and 1b) are schematic drawings of the exhaust gas sampling and analytical systems which will be used for testing under the regulations

in this part. Additional components such as instruments, valves, solenoids, pumps, and switches may be used to provide additional information and coordinate the functions of the component systems.

In particular, the HC and CO instruments may be connected in series instead of in parallel.

(b) *Component description (exhaust gas sampling system).* The following components will be used in the exhaust gas sampling system for testing under the regulations in this part. See Figure 1a. Other types of constant volume samplers may be used if shown to yield equivalent results.

(1) A dilution air filter assembly consisting of a particulate (paper) filter to remove solid matter from the dilution air and thus increase the life of the charcoal filter; a charcoal filter to reduce and stabilize the background hydrocarbon level; and a second particulate filter to remove charcoal particles from the air stream. The filters shall be of sufficient capacity and the duct which carries the dilution air to the point where the exhaust gas is added shall be of sufficient size so that the pressure at the mixing point is less than 1 inch of water pressure below ambient when the constant volume sampler is operating at its maximum flow rate.

(2) A flexible, leak-tight connector and tube to the vehicle tailpipe. The flexible tubing shall be sized and connected in such a manner that the static pressure variations in the vehicle tailpipe(s) remain within ±1 inch of water of the static pressure variations measured during a dynamometer driving cycle with no connections to the tailpipe(s).

(3) A heating system to preheat the heat exchanger to within ±10° F. of its operating temperature before the test begins.

(4) A heat exchanger capable of limiting the gas mixture temperature variation during the entire test to ±10° F. as measured at a point immediately ahead of the positive displacement pump.

(5) A positive displacement pump to pump the dilute exhaust mixture. The pump capacity (300 to 350 c.f.m. is sufficient for testing most vehicles) shall be large enough to virtually eliminate water condensation in the system. See Appendix C for flow calibration techniques.

(6) Temperature sensor (T1) with an accuracy of ±2° F. to allow continuous recording of the temperatures of the dilute exhaust mixture entering the positive displacement pump. (see § 1201.83 (1)).

(7) Gauge (G1) with an accuracy of ±3 mm. Hg to measure the pressure depression of the dilute exhaust mixture entering the positive displacement pump, relative to atmospheric pressure.

(8) Gauge (G2) with an accuracy of ±3 mm. Hg to measure the pressure increase across the positive displacement pump.

(9) Sample probes (S1 and S2) pointed upstream to collect samples from the dilution air stream and the dilute exhaust mixture. Additional sample probes may be used, for example, to obtain continuous concentration traces of the dilute exhaust stream. In such case the sample flow rate, in standard cubic feet per test, must be added to the calculated dilute exhaust volume. The position of the sample probe in Figure 1a is pictorial only.

(10) Filters (F1 and F2) to remove particulate matter from dilution air and dilute exhaust samples prior to entering sample collection bags.

(11) Pumps (P1 and P2) to pump the dilution air and dilute exhaust into their respective sample collection bags.

(12) Flow control valves (N1 and N2) to regulate flows to sample collection bags, at constant flow rates. The minimum sample flow rate shall be 5 c.f.h.

(13) Flowmeters (FL1 and FL2) to insure, by visual observation, that constant flow rates are maintained throughout the test.

(14) Three-way solenoid valves (V1 and V2) to direct sample streams to either their respective bags or overboard.

(15) Quick-connect leak-tight fittings (C1 and C2), with automatic shutoff on bag side, to attach sample bags to sample system.

(16) Sample collection bags for dilution air and exhaust samples of sufficient capacity so as not to impede sample flow.

(17) A revolution counter to count the revolutions of the positive displacement pump while the test is in progress and samples are being collected.

(c) *Component description (exhaust gas analytical system).* The following components will be used in the exhaust gas analytical system for testing under the regulations in this part. The analytical system provides for the determination of hydrocarbon concentrations by flame ionization detector (FID) analysis, the determination of carbon monoxide concentrations by nondispersive infrared (NDIR) analysis and the determination of oxides of nitrogen concentration by chemiluminescence (C1) analysis in dilute exhaust samples. The chemiluminescence method of analysis requires that the nitrogen dioxide present in the sample be converted to nitric oxide before analysis. See Appendix E. Other types of analyzers may be used if shown to yield equivalent results and if approved in advance by the Administrator. See Figure 1b.

(1) Quick-connect leak-tight fitting (C3) to attach sample bags to analytical system.

(2) Filter (F3) to remove any residual particulate matter from the collected samples.

(3) Pump (P3) to transfer samples from the sample bags to the analyzers.

(4) Selector valves (V3, V4, and V5) for directing samples, span gases or zeroing gas to the analyzers.

(5) Flow control valves (N3, N4, N5, N6, N7, N8, N9, N10, and N11) to regulate the gas flow rates.

(6) Flowmeters (FL3, FL4, and FL5) to indicate gas flow rates.

(7) Manifold (M1) to collect the expelled gases from the analyzers.

(8) Pump (P4) to transfer expelled gases from the collection manifold to a vent external to the test room (optional).

(9) Analyzers to determine hydrocarbon, carbon monoxide and oxides of nitrogen concentrations.

(10) An oxides of nitrogen converter to convert any NO_2 present in the samples to NO before analysis.

(11) Selector valves (V6 and V7) to allow the sample, span, calibrating or zeroing gases to bypass the converter.

(12) Recorders (R1, R2, and R3) to provide permanent records of calibration, spanning and sample measurements.

10. Figures 1a and 1b of § 1201.81 are revised as follows:

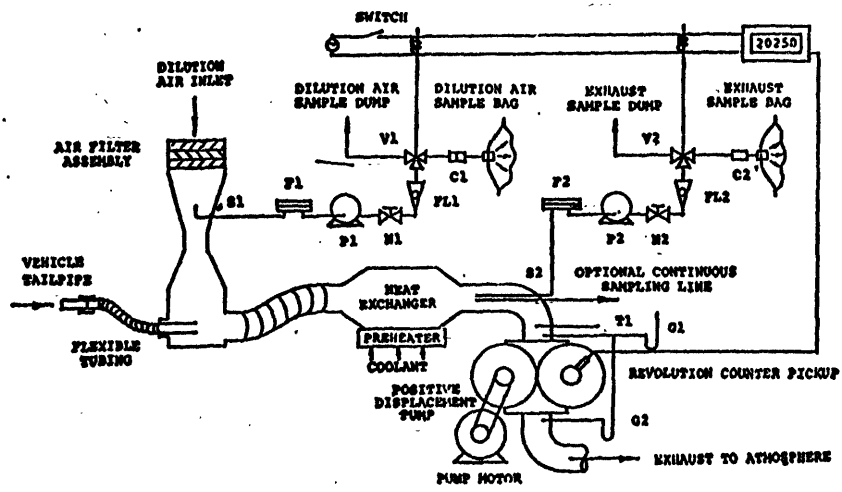


Figure 1a. Exhaust Gas Sampling System

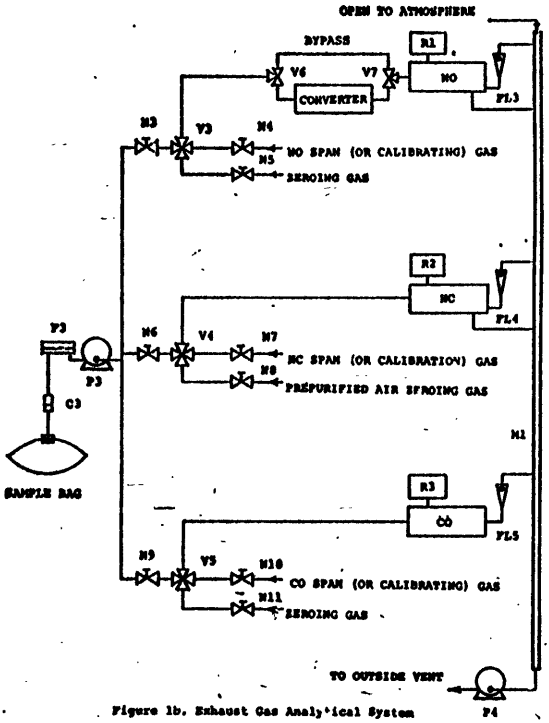


Figure 1b. Exhaust Gas Analytical System

§ 1201.83 [Amended]

11. In § 1201.83, the number "+5°" in paragraph (e) is revised to read "±5°".

12. Section 1201.84 is revised and a new Figure 1c is added as follows:

§ 1201.84 Analytical system calibration and sample handling.

(a) Calibrate the analytical assembly at least once every 30 days. Use the same flow rate as when analyzing samples.

(1) Adjust analyzers to optimize performance.

(2) Zero the hydrocarbon analyzer with zero grade air and the carbon monoxide and oxide of nitrogen analyzers with either zero grade air or nitrogen. The allowable zero gas impurity concentrations should not exceed 1 p.p.m. equivalent carbon response, 1 p.p.m. carbon monoxide, and 0.1 p.p.m. nitric oxide.

(3) Set the CO analyzer gain to give the desired range. Select desired attenuation scale of the HC analyzer and set the sample capillary flow rate, by adjusting the back pressure regulator, to give the desired range. Select the desired scale of the NO_x analyzer and adjust the phototube high voltage supply to give the desired range. The operating range of the analyzers shall be such that the analyzer deflection which indicates an emission level equivalent to the respective standard is in the upper two-thirds of the scale.

(4) Calibrate the HC analyzer with propane (air diluent) gases having nominal concentrations of 50 and 100 percent of full scale. Calibrate the CO analyzer with carbon monoxide (nitrogen diluent) gases having nominal concentrations equal to 10, 25, 40, 50, 60, 70, 85, and 100 percent of full scale. Calibrate the NO_x analyzer with nitric oxide (nitrogen diluent) gases having nominal concentrations equal to 50 and 100 percent of full scale. The actual concentrations should be known to within ±2 percent of the true values.

(5) Compare values obtained on the CO analyzer with previous calibration curves. Any significant change reflects some problem in the system. Locate and correct problem, and recalibrate. Use best judgment in selecting curves for data reduction.

(6) Check the NO_2 to NO converter efficiency by the following procedure:

(i) Fill a sample bag (one not previously used to collect exhaust gas samples) with air (or oxygen) and NO span gas in proportions which result in a mix in the operating range of the analyzer. Provide enough oxygen for substantial conversion of NO to NO_2.

(ii) Knead bag and immediately connect the bag to the sample inlet and alternately measure the NO and NO_x concentration at 1-minute intervals by alternately passing the sample through the converter and the bypass (close valves N6 and N9 to minimize pump down rate of bag). After several minutes of operation, the recording of NO and NO_x will resemble Figure 1c if the converter is efficient. Even though the amount of NO_2 increases with time, the total NO_x ($NO+NO_2$) remains constant. A decay of NO_x with time indicates the converter is not essentially 100 percent efficient and the cause should be determined before the instrument is used.

(iii) The converter efficiency should be checked at least once weekly and preferably once daily.

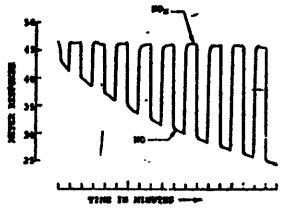


Figure 1c. Converter Efficiency Check Response

(b) HC, CO, and NO_x measurements: Allow a minimum of 30 minutes warmup for the HC analyzer and 2 hours for the CO and NO_x analyzers. (Power is normally left on infrared and chemiluminescence analyzers; but when not in use,

the chopper motor of the infrared analyzer is turned off and the phototube high voltage supply of the chemiluminescence analyzer is placed in the standby position.) The following sequence of operations should be performed in conjunction with each series of measurements:

(1) Zero the analyzers. Obtain a stable zero on each amplifier meter and recorder. Recheck after test.

(2) Introduce span gases and set the CO analyzer gain, the HC analyzer sample capillary flow rate and the NO_x analyzer high voltage supply to match the calibration curves. In order to avoid corrections, span and calibrate at the same flow rates used to analyze the test samples. Span gases should have concentrations equal to approximately 80 percent of full scale. If gain has shifted significantly on the CO analyzer, check tuning. If necessary, check calibration. Recheck after test. Show actual concentrations on chart.

(3) Check zeros; repeat the procedure in subparagraphs (1) and (2) of this paragraph if required.

(4) Check flow rates and pressures.

(5) Measure HC, CO, and NO_x concentrations of samples. Prevent moisture from condensing in the sample collection bag.

(6) Check zero and span points.

(c) For the purposes of this paragraph, the term "zero grade air" includes artificial "air" consisting of a blend of nitrogen and oxygen with oxygen concentrations between 18 and 21 mole percent.

13. Section 1201.86 is revised to read as follows:

§ 1201.86 Chart reading.

(a) Determine the HC, CO, and NO_x concentrations of the dilution air and dilute exhaust sample bags from the instrument deflection or recordings making use of appropriate calibration charts.

(b) Determine the average dilute exhaust mixture temperature from the temperature recorder trace if a recorder is used.

14. Section 1201.87 is revised to read as follows:

§ 1201.87 Calculations (exhaust emissions).

The final reported test results shall be computed by use of the following formulae:

(a) For light duty vehicles, excluding off-road utility vehicles:

(1) Hydrocarbon Mass:

$$HC_{mass} = V_{mix} \times Density_{HC} \times \frac{HC_{conc}}{1,000,000}$$

(2) Carbon Monoxide Mass:

$$CO_{mass} = V_{mix} \times Density_{CO} \times \frac{CO_{conc}}{100}$$

(3) Oxides of Nitrogen Mass:

$$NOx_{mass} = V_{mix} \times Density_{NO_2} \times \frac{NOx_{conc}}{1,000,000}$$

(b) For off-road utility vehicles:

(1) $HC_{mass} = V_{mix} \times Density_{HC} \times \frac{HC_{conc} \times 0.85}{1,000,000}$

(2) $CO_{mass} = V_{mix} \times Density_{CO} \times \frac{CO_{conc} \times 0.85}{100}$

(3) $NOx_{mass} = V_{mix} \times Density_{NO_2} \times \frac{NOx_{conc} \times 0.85 \times K_H}{1,000,000}$

(c) Meaning of symbols:

HC_{mass} = Hydrocarbon emissions, in grams per vehicle mile.

$Density_{HC}$ = Density of hydrocarbons in the exhaust gas, assuming an average carbon to hydrogen ratio of 1:1.85, in grams per cubic foot at 68° F. and 760 mm. Hg pressure (16.33 gm./cu. ft.).

HC_{conc} = Hydrocarbon concentration of the dilute exhaust sample, minus hydrocarbon concentration of the dilution air sample, in p.p.m. carbon equivalent i.e., equivalent propane × 3.

CO_{mass} = Carbon monoxide emissions, in grams per vehicle mile.

$Density_{CO}$ = Density of carbon monoxide in grams per cubic foot at 68° F. and 760 mm. Hg pressure (32.97 gm./cu. ft.).

CO_{conc} = Carbon monoxide concentration of the dilute exhaust sample minus the carbon monoxide concentration of the dilution air sample, in volume percent.

NOx_{mass} = Oxides of nitrogen emissions, in grams per vehicle mile.

$Density_{NO_2}$ = Density of oxides of nitrogen in the exhaust gas, assuming they are in the form of nitrogen dioxide, in grams per cubic foot at 68° F. and 760 mm. Hg pressure (84.16 gm./cu. ft.).

NOx_{conc} = Oxides of nitrogen concentration of the dilute exhaust sample minus the oxides of nitrogen concentration of the dilution air sample, in p.p.m.

V_{mix} = Total dilute exhaust volume in cubic feet per mile, corrected to standard conditions (528° R and 760 mm. Hg).

$$V_{mix} = K_1 \times V_o \times N \times \frac{P_p}{T_p}$$

where:

$$K_1 = \frac{528° R}{760 \text{ mm. Hg} \times 7.5 \text{ miles}} = 0.09333.$$

V_o = Volume of gas pumped by the positive displacement pump during the test while samples are being collected.

N = Number of revolutions of the positive displacement pump during the test while samples are being collected.

P_p = Absolute pressure of the dilute exhaust entering the positive displacement pump, in mm. Hg. i.e., barometric pressure minus the pressure depression below atmospheric of the mixture entering the positive displacement pump.

T_p = Average temperature of dilute exhaust entering positive displacement pump during test while samples are being collected, in degrees Rankine.

K_H = Humidity correction factor.

$$K_H = \frac{1}{1 - 0.0047 (H - 75)}$$

where:

H = Absolute humidity in grains of water per pound of dry air.

(d) Example calculation of mass emission values:

Assume $V_o = 0.5385$ cu. ft. per revolution; N = 20,350 revolutions; H = 65 grains per lb. of dry air; $P_p = 730$ mm. Hg; $T_p = 550°R$; $HC_{conc} = 100$ p.p.m. carbon equivalent; $CO_{conc} = 0.09\%$; and $NOx_{conc} = 70$ p.p.m.

Then:

$V_{mix} = (0.09333)\ (0.5385)\ (20,350)\ (730/550) = 650.8$ cu. ft. per mile.

$$K_H = \frac{1}{1 - 0.0047\ (65 - 75)} = 1.040.$$

(1) For a 1972 light-duty vehicle.

$$HC_{mass} = 650.8 \times 16.33 \times \frac{100}{1,000,000} = 1.72 \text{ grams per vehicle mile.}$$

$$NO_{mass} = 650.8 \times 84.16 \times \frac{70}{1,000,000} \times 1.040 = 2.08 \text{ grams per vehicle mile.}$$

(2) For a 1972 utility vehicle.

$$CO_{mass} = 650.8 \times 32.97 \times \frac{0.09 \times 0.85}{100} = 16.6 \text{ grams per vehicle mile.}$$

15. In § 1201.92, the second sentence of paragraph (c) (1) is revised. As amended, § 1201.92(c) (1) reads as follows:

§ 1201.92 Compliance with emission standards.

* * * * *

(c) * * *

(1) Separate emission deterioration factors shall be determined from the emissions results of the durability data vehicles for each engine-system combination. A separate factor shall be established for the combination for exhaust HC, exhaust CO, exhaust NO_x, and fuel evaporative HC.

* * * * *

16. A new appendix, Appendix E, is added as follows:

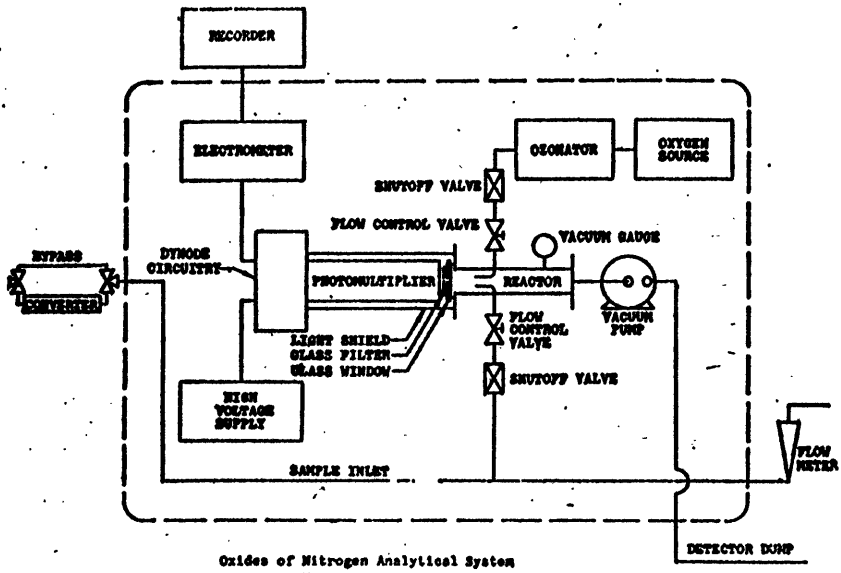
APPENDIX E—OXIDES OF NITROGEN ANALYTICAL SYSTEM

The chemiluminescence method utilizes the principle that nitric oxide (NO) reacts with ozone (O_3) to give nitrogen dioxide (NO_2) and oxygen (O_2). Approximately 10 percent of the NO_2 is electronically excited. The transition of excited NO_2 to the ground state yields a detectable light emission (600–800 nanometer region) at low pressures. The intensity of this emission is proportional to the mass flow rate of NO into the reactor. The light emission can be measured utilizing a photomultiplier tube and associated electronics.

The method also utilizes the principle that the thermal decomposition of NO_2 ($2NO_2 \rightarrow 2NO + O_2$) is complete at about 600° C. The rate of constant for the dissociation of NO_2 at 600° C. is approximately 10^6 (liters/mole-second). A 6-foot length of one-eighth inch outside diameter, 0.035 wall thickness, fawless stainless steel tubing resistance heated using a low voltage, high current power supply to a temperature of 650° C. (1200° F.) provides sufficient residence time at a sample flow rate of 700 cc. per minute (1.5 c.f.h.) for essentially complete conversion of nitrogen dioxide to nitric oxide. Other converter

designs may be used if shown to yield essentially 100 percent conversion of NO_2 to NO. The method permits continuous monitoring of NO_x concentrations over a wide range. Response time (2 to 4 seconds is typical) is primarily dependent on the mechanical pumping rate at the operating pressure of the reactor. The operating pressure of the reactor is generally less than 5 torr.

The following figure is a flow schematic illustrating one configuration of the major components required for the oxides of nitrogen analytical system.



Oxides of Nitrogen Analytical System

[FR Doc.71-9607 Filed 7-1-71;8:45 am]

PART 1201—CONTROL OF AIR POLLUTION FROM NEW MOTOR VEHICLES AND NEW MOTOR VEHICLE ENGINES

Exhaust Emission Standards Applicable to 1975 and Later Model Year Light Duty Vehicles

On February 26, 1971, a notice of proposed rule making was published (36 F.R. 3526) which set out the text of proposed amendments to the regulations in this part to provide for more stringent exhaust emission standards for hydrocarbons and carbon monoxide to become applicable to new light duty vehicles beginning with the 1975 model year. On May 28, 1971, a notice of proposed rule making was published (36 F.R. 9469) which proposed a more stringent exhaust emission standard for oxides of nitrogen to become applicable to such vehicles beginning with the 1976 model year.

Pursuant to the above notices, a number of comments have been received from representatives of domestic and foreign manufacturers and from other interested parties. Due consideration has been given to all relevant matter presented, and a number of amendments have been made to the regulations as proposed.

Based upon air quality data, the test procedures have been modified to include both hot and cold start tests which are then weighted to better represent emissions that should be measured to meet air quality requirements. In addition, some modifications have been made to the analytical system for carbon monoxide and a procedure has been established to determine and compensate for dilution air background levels. Further, since it is anticipated that lead-free gasoline will be generally available by July 1, 1974 (see the advance notice of proposed rule making on this subject in 36 F.R. 1486) the fuel specifications have been revised to provide for use of lead-free gasoline as a test fuel.

In addition, the final rule contains other amendments, largely technical and clarifying modifications. These regulations also include the oxides of nitrogen exhaust emission standard proposed for the 1976 model year in 36 F.R. 3526.

The amendments to Part 1201 set forth below are hereby adopted effective on publication in the FEDERAL REGISTER (7-2-71) and are applicable to new light duty vehicles beginning with the 1975 model year.

The current regulations which appear at Part 1201 will remain in effect for the purpose of their applicability to earlier model year vehicles.

(Sec. 6, Public Law 91-604; 84 Stat. 1690)

Dated: June 23, 1971.

WILLIAM D. RUCKELSHAUS,
Administrator.

Part 1201 of Chapter XII, Title 45 of the Code of Regulations is amended as follows:

1. In § 1201.1, paragraph (a)(2) is revised as follows:

§ 1201.1 Definitions.

(a) * * *

(2) "Model year" means the manufacturer's annual production period (as

determined by the Administrator) which includes January 1 of such calender year: *Provided*, That if the manufacturer has no annual production period, the term "model year" shall mean the calendar year.

* * * * *

2. Section 1201.21 is revised to read as follows:

§ 1201.21 Standards for exhaust emissions.

(a) Exhaust emissions from 1975 model year vehicles shall not exceed:

(1) Hydrocarbons—0.41 gram per vehicle mile.

(2) Carbon monoxide—3.4 grams per vehicle mile.

(3) Oxides of nitrogen—3.0 grams per vehicle mile.

(b) Exhaust emissions from 1976 and later model year vehicles shall not exceed:

(1) Hydrocarbons—0.41 gram per vehicle mile.

(2) Carbon monoxide—3.4 grams per vehicle mile.

(3) Oxides of nitrogen—0.4 gram per vehicle mile.

(c) The standards set forth in paragraphs (a) and (b) of this section refer to the exhaust emitted over a driving schedule as set forth in the applicable sections of "Test Procedures for Vehicle Exhaust and Fuel Evaporative Emissions (Gasoline Fueled Light Duty Vehicles)" of this part and measured and calculated in accordance with those procedures.

3. In § 1201.70, paragraphs (b) and (c)(2) are revised. As amended, § 1201.70 reads as follows:

§ 1201.70 Introduction.

* * * * *

(b) The exhaust emission test is designed to determine hydrocarbon, carbon monoxide, and oxides of nitrogen mass emissions while simulating an average trip in an urban area of 7.5 miles. The test consists of engine startups and vehicle operation on a chassis dynamometer through a specified driving schedule, as described in Appendix A to this part. A proportional part of the diluted exhaust emissions is collected continuously, for subsequent analysis, using a constant volume (variable dilution) sampler.

(c) * * *

(2) Running losses from the fuel tank and carburetor resulting from a simulated trip on a chassis dynamometer; and

* * * * *

4. Section 1201.71 is revised to read as follows:

§ 1201.71 Gasoline specifications.

(a) Fuel having the following specifications or substantially equivalent specifications approved by the Administrator, shall be used in exhaust and evaporative emission testing. The lead content and octane rating of the fuel shall be in the range recommended by the vehicle or engine manufacturer.

Item	ASTM designation	Specifications
Distillation range	D 86	
IBP, ° F		75-95
50 percent point, ° F		125-170
90 percent point, ° F		250-325
10 percent point, ° F		300-375
EP, ° F (max.)		415
Sulfur, wt. percent, max	D 1266	0.10
Phosphorous, theory		0.0
RVP, [1] lb	D 323	8.7-9.2
Hydrocarbon composition	D 1319	
Olefins, percent, max		10
Aromatics, percent, max		35
Saturate		Remainder

[1] For testing which is unrelated to fuel evaporative emission control, the specified range is 8.0-9.2.

(b) Fuels representative of commercial fuels which will generally be available through retail outlets shall be used in mileage accumulation. The lead content and octane rating of the fuel used shall be in the range recommended by the vehicle or engine manufacturer. The Reid Vapor Pressure of the fuel used shall be characteristic of the motor fuel during the season during which the mileage accumulation takes place.

(c) The specification range of the fuels to be used under paragraph (b) of this section shall be reported in accordance with § 1201.81(b)(3).

5. In § 1201.73, paragraph (c) is revised to read as follows:

§ 1201.73 Vehicle preconditioning (fuel evaporative emissions).

* * * * *

(c) The test vehicle shall be placed on the dynamometer and operated over a simulated trip, according to the applicable requirements and procedures of §§ 1201.75–1201.80 except that the engine need not be cold when starting the run on the dynamometer and only a single trip of 7.5 miles shall be run. During the run the ambient temperature shall be between 68° F. and 86° F.

* * * * *

6. In § 1201.76, paragraph (a) is revised and a new paragraph (i) is added. As amended § 1201.76 reads as follows:

§ 1201.76 Dynamometer procedure.

(a) The dynamometer run consists of two tests, a "cold" start test after a minimum 12-hour soak according to the provisions of §§ 1201.72–1201.74, and a "hot" start test with a 10-minute soak between the two tests. Engine startup, operation over the driving schedule, and engine shutdown make a complete cold start test. Engine startup and operation over the first 505 seconds of the driving schedule complete the hot start test. The exhaust emissions are diluted with air to a constant volume and a portion is sampled continuously during each test. The composite samples collected in bags are analyzed for hydrocarbons, carbon monoxide, carbon dioxide, and oxides of nitrogen. A parallel sample of the dilution air is similarly analyzed for hydrocarbon, carbon monoxide, and oxides of nitrogen.

* * * * *

(i) If the dynamometer has not been operated during the 2-hour period immediately preceding the test it shall be warmed up for 15 minutes by operating it at 30 m.p.h. using a nontest vehicle.

7. Section § 1201.81 is revised to read as follows:

§ 1201.81 Sampling and analytical system (exhaust emissions).

(a) *Schematic drawings.* The following figures (Figs. 1a and 1b) are schematic drawings of the exhaust gas sampling and analytical systems which will be used for testing under the regulations in this part. Additional components such as instruments, valves, solenoids, pumps, and switches may be used to provide additional information and coordinate the functions of the component systems.

(b) *Component description (exhaust gas sampling system).* The following components will be used in the exhaust gas sampling system for testing under the regulations in this part. See Figure 1a. Other types of constant volume samplers may be used if shown to yield equivalent results.

(1) A dilution air filter assembly consisting of a particulate (paper) filter to remove solid matter from the dilution air and thus increase the life of the charcoal filter; a, charcoal filter to reduce and stabilize the background hydrocarbon level; and a second particulate filter to remove charcoal particles from the air stream. The filters shall be of sufficient capacity and the duct which carries the dilution air to the point where the exhaust gas is added shall be of sufficient size so that the pressure at the mixing point is less than 1 inch of water pressure below ambient when the constant volume sampler is operating at its maximum flow rate.

(2) A flexible, leak-tight connector and tube to the vehicle tailpipe. The flexible tubing shall be sized and connected in such a manner that the static pressure variations in the vehicle tailpipe(s) remain within ±1 inch of water of the static pressure variations measured during a dynamometer driving cycle with no connections to the tailpipe(s).

(3) A heating system to preheat the heat exchanger to within ±10° F. of its operating temperature before the test begins.

(4) A heat exchanger capable of limiting the gas mixture temperature variation during the entire test to ±10° F. as measured at a point immediately ahead of the positive displacement pump.

(5) A positive displacement pump to pumpe dilute exhaust mixture. The pump capacity (300 to 350 c.f.m. is sufficient for testing most vehicles) shall be large enough to virtually eliminate water condensation in the system. See Appendix C for flow calibration techniques.

(6) Temperature sensor (T1) with an accuracy of ±2° F. to allow continuous recording of the temperature of the

dilute exhaust mixture entering the positive displacement pump. (See § 1201.83 (1).)

(7) Gauge (G1) with an accuracy of ±3 mm. Hg to measure the pressure depression of the dilute exhaust mixture entering the positive displacement pump, relative to atmospheric pressure.

(8) Gauge (G2) with an accuracy of ±3 mm. Hg to measure the pressure increase across the positive displacement pump.

(9) Sample probes (S1 and S2) pointed upstream to collect samples from the dilution air stream and the dilute exhaust mixture. Additional sample probes may be used, for example, to obtain continuous concentration traces of the dilute exhaust stream. In such case the sample flow rate, in standard cubic feet per test phase, must be added to the calculated dilute exhaust volume. The position of the sample probe in Figure 1a is pictorial only.

(10) Filters (F1 and F2) to remove particulate matter from dilution air and dilute exhaust samples prior to entering sample collection bags.

(11) Pumps (P1 and P2) to pump the dilution air and dilute exhaust into their respective sample collection bags.

(12) Flow control valves (N1 and N2) to regulate flows to sample collection bags, at constant flow rates. The minimum sample flow rate shall be 10 c.f.h.

(13) Flowmeters (FL1 and FL2) to insure, by visual observation, that constant flow rates are maintained throughout the test.

(14) Three-way solenoid valves (V1, V2, and V3) to direct sample streams to either their respective bags or overboard.

(15) Quick-connect leak-tight fittings (C1, C2, and C3), with automatic shut-off on bag side, to attach sample bags to sample system.

(16) Sample collection bags for dilution air and exhaust samples of sufficient capacity so as not to impede sample flow.

(17) Revolution counters to count the revolutions of the positive displacement pump while each test phase is in progress and samples are being collected.

(c) *Component description (exhaust gas analytical system).* The following components will be used in the exhaust gas analytical system for testing under the regulations in this part. The analytical system provides for the determination of hydrocarbon concentrations by flame ionization detector (FID) analysis, the determination of carbon monoxide and carbon dioxide concentrations by nondispersive infrared (NDIR) analysis and the determination of oxides of nitrogen concentrations by chemiluminescence (CL) analysis in dilute exhaust samples. The chemiluminescence method of analysis requires that the nitrogen dioxide present in the sample be converted to nitric oxide before analysis. See Appendix E. Other types of analyzers may be used if shown to yield equivalent results and if approved in advance by the Administrator. See Figure 1b.

(1) Quick-connect leak-tight fitting (C4) to attach sample bags to analytical system.

(2) Filter (F3) to remove any residual particulate matter from the collected sample.

(3) Pump (P3) to transfer samples from the sample bags to the analyzers.

(4) Selector valves (V4, V5, V6, V7, and V8) for directing samples, span gases or zeroing gases to the analyzers.

(5) Flow control valves (N3, N4, N5, N6, N7, N8, N9, N10, N11, N12, and N13) to regulate the gas flow rates.

(6) Flowmeters (FL3, FL4, and FL5) to indicate gas flow rates.

(7) Manifold (M1) to collect the expelled gases from the analyzers.

(8) Pump (P4) to transfer expelled gases from the collection manifold to a vent external to the test room (optional).

(9) Analyzers to determine hydrocarbon, carbon monoxide, carbon dioxide and oxides of nitrogen concentrations.

(10) An oxides of nitrogen converter to convert any NO_2 present in the samples to NO before analysis.

(11) Selector valves (V9 and V10) to allow the sample, span, calibrating or zeroing gases to bypass the converter.

(12) Water trap (T1) to partially remove water and a valve (V11) to allow the trap to be drained.

(13) Sample conditioning columns to remove remainder of water (WR1 and WR2 containing indicating $CaSO_4$) and carbon dioxide (CDR1 and CDR2 containing ascarite) from the CO analysis stream.

(14) Selector valves (V12 and V13) to permit switching from exhausted absorbing columns to fresh columns.

(15) Water bubbler (W1) to allow saturation of the CO_2 span gas to check efficiency of absorbing columns.

(16) Recorders (R1, R2, R3, and R4) to provide permanent records of calibration, spanning and sample measurements.

* * * * *

8. In § 1201.81, Figures 1a and 1b are revised as follows:

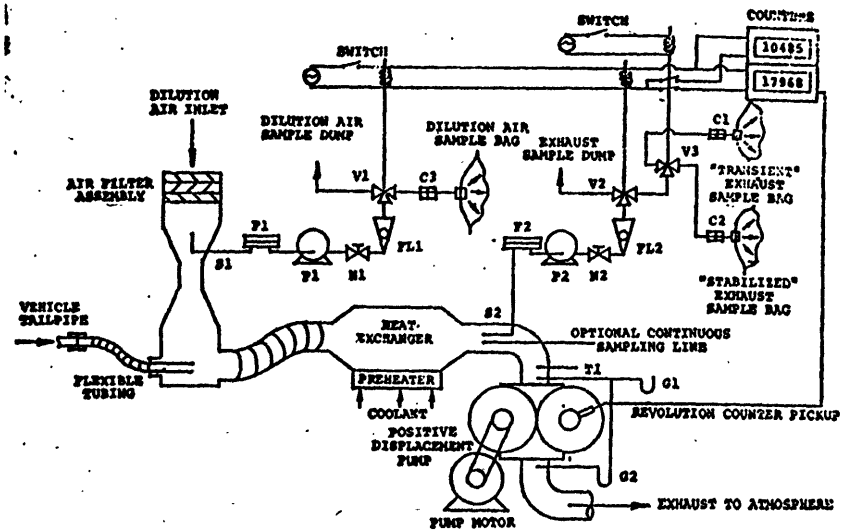


Figure 1a. Exhaust Gas Sampling System

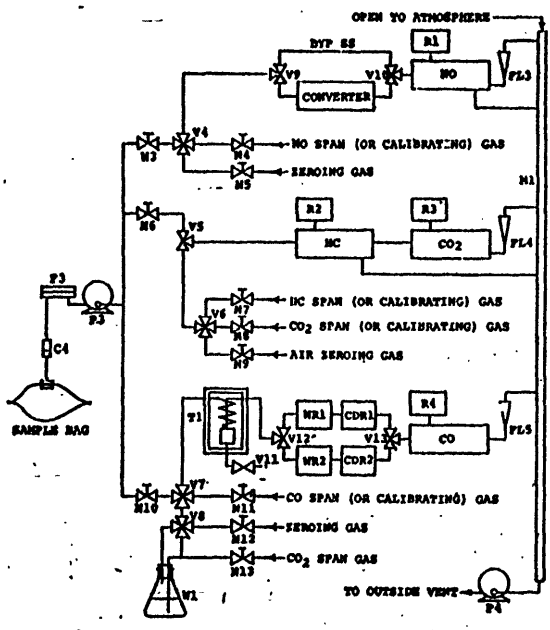


Figure 1b. Exhaust Gas Analytical System

9. In § 1201.83, a new paragraph (n) is added as follows:

§ 1201.83 Information to be recorded.

* * * * *

(n) The humidity of the dilution air.

* * * * *

10. Section 1201.84 is revised to read as follows:

§ 1201.84 Analytical system calibration and sample handling.

(a) Calibrate the analytical assembly at least once every 30 days. Use the same flow rate as when analyzing samples.

(1) Adjust analyzers to optimize performance.

(2) Zero the hydrocarbon analyzer with zero grade air and the carbon monoxide, carbon dioxide, and oxides of nitrogen analyzers with zero grade nitrogen. The allowable zero gas impurity concentrations should not exceed 1 p.p.m. equivalent carbon response, 1 p.p.m. carbon monoxide, 300 p.p.m. (0.03 mole percent) carbon dioxide, and 0.1 p.p.m. nitric oxide.

(3) Set the CO and CO_2 analyzer gains to give the desired ranges. Select the desired attenuation scale of the HC analyzer and set the sample capillary flow rate, by adjusting the back pressure regulator, to give the desired range. Select the desired scale of the NO_x analyzer and adjust the phototube high voltage supply to give the desired range.

(4) Calibrate the HC analyzer with propane (air diluent) gases having nominal concentrations equal to 50 and 100 percent of full scale. Calibrate the CO analyzer with carbon monoxide (nitrogen diluent) gases and the CO_2 analyzer with carbon dioxide (nitrogen diluent) gases having nominal concentrations equal to 10, 25, 40, 50, 60, 70, 85, and 100 percent of full scale. Calibrate the NO_x analyzer with nitric oxide (nitrogen diluent) gases having nominal concentrations equal to 50 and 100 percent of full scale. The actual concentrations should be known to within ±2 percent of the true values.

(5) Compare values obtained on the CO and CO_2 analyzers with previous calibration curves. Any significant change reflects some problem in the system. Locate and correct problem, and recalibrate. Use best judgment in selecting curves for data reduction.

(6) Check the NO_x to NO converter efficiency by the following procedure:

(i) Fill a new (not previously used to collect exhaust gas samples) sample bag with air (or oxygen) and NO span gas in proportions which result in a mix in the operating range of the analyzer. Provide enough oxygen for substantial conversion of NO to NO_2.

(ii) Knead bag and immediately connect the bag to the sample inlet and alternately measure the NO and NO_x concentration at 1-minute intervals by alternately passing the sample through the converter and the bypass (close valves N6 and N10 to minimize pump down rate of bag). After several minutes of operation, the recording of NO and NO_x will resemble Figure 1c if the converter is efficient. Even though the amount of NO_2 increases with time, the total NO_x ($NO+NO_2$) remains constant. A decay of NO_x with time indicates the converter is not essentially 100 percent efficient and the cause should be determined before the instrument is used.

(iii) The converter efficiency should be checked at least once weekly and preferably once daily.

(b) HC, CO, CO_2, and NO_x measurements: Allow a minimum of 30 minutes warmup for the HC analyzer and 2 hours for the CO, CO_2 and NO_x analyzers. (Power is normally left on infrared and chemiluminescence analyzers; but when not in use, the chopper motors of the infrared analyzers are turned off and the phototube high voltage supply of the chemiluminescence analyzer is placed in the standby position.) The following sequence of operations should be performed in conjunction with each series of measurements:

(1) Zero the analyzers. Obtain a stable zero on each amplifier meter and recorder. Recheck after tests.

(2) Introduce span gases and set the CO and CO_2 analyzer gains, the HC analyzer sample capillary flow rate and the NO_x analyzer high voltage supply to match the calibration curves. In order to avoid corrections, span and calibrate at the same flow rates used to analyze the test samples. Span gases should have concentrations equal to approximately 80 percent of full scale. If gain has shifted significantly on the CO or CO_2 analyzers, check tuning. If necessary, check calibration. Recheck after test. Show actual concentrations on chart.

(3) Check zeros; repeat the procedure in subparagraphs (1) and (2) of this paragraph if required.

(4) Check flow rates and pressures.

(5) Measure HC, CO, CO_2, and NO_x concentrations of samples. Care should be exercised to prevent moisture from condensing in the sample collection bag.

(6) Check zero and span points.

(c) For the purposes of this section, the term "zero grade air" includes artificial "air" consisting of a blend of nitrogen and oxygen with oxygen concentrations between 18 and 21 mole percent.

11. Section 1201.85 is revised to read as follows:

§ 1201.85 Dynamometer test runs.

(a) The vehicle shall be allowed to stand with the engine turned off for a period of not less than 12 hours before the cold start exhaust emission test, at an ambient temperature as specified in

§§ 1201.73 and 1201.74. The vehicle shall be stored prior to the emission tests in such a manner that precipitation (e.g. rain or dew) does not occur on the vehicle. The complete dynamometer test consists of a cold start drive of 7.5 miles and simulates a hot start drive of 7.5 miles. The vehicle is allowed to stand on the dynamometer during the 10-minute time period between the cold and hot start tests. The cold start test is divided into two periods. The first period, representing the cold start "transient" phase, terminates at the end of the deceleration which is scheduled to occur at 505 seconds of the driving schedule. The second period, representing the "stabilized" phase, consists of the remainder of the driving schedule including engine shutdown. The hot start test similarly consists of two periods. The first period, representing the hot start "transient" phase, terminates at the same point in the driving schedule as the first phase of the cold start test. The second period of the hot start test, "stabilized" phase, is assumed to be identical to the second period of the cold start test. Therefore, the hot start test terminates after the first period (505 seconds) is run. During the tests the ambient temperature shall be between 68° F. and 86° F.

(b) The following steps shall be taken for each test:

(1) Place drive wheels of vehicle on dynamometer without starting engine.

(2) Open the vehicle engine compartment cover and start the cooling fan.

(3) With the sample solenoid valves in the "dump" position connect evacuated sample collection bags to the two dilute exhaust sample connectors and the dilution air sample line connector.

(4) Start the positive displacement pump, the sample pumps and the temperature recorder. (The heat exchanger of the constant volume sampler should be preheated to its operating temperature before the test begins.)

(5) Adjust the sample flow rates to the desired flow rate (minimum of 10 c.f.h.) and set the revolution counters to zero.

(6) Attach the flexible exhaust tube to the vehicle tailpipe(s).

(7) Simultaneously start the revolution counter for the positive displacement pump, position the sample solenoid valves to direct the sample flows into the "transient" exhaust sample bag and the dilution air sample bag, and start cranking the engine.

(8) Fifteen seconds after the engine starts, place the transmission in gear.

(9) Twenty seconds after the engine starts, begin the initial vehicle acceleration of the driving schedule.

(10) Operate the vehicle according to the dynamometer driving schedule (§ 1201.75).

(11) At the end of the deceleration which is scheduled to occur at 505 seconds, simultaneously switch the dilute exhaust sample flow from the "transient" bag to the "stabilized" bag, switch off revolution counter No. 1 and start counter No. 2. Immediately disconnect the "transient" sample bag, transfer to the analytical system and process according to § 1201.84 as soon as practical and in no case longer than 10 minutes after the end of this portion of the test.

(12) Turn the engine off 2 seconds after the end of the last deceleration (at 1,369 seconds).

(13) Five seconds after the engine stops running, simultaneously turn off revolution counter No. 2 and position the sample solenoid valve to the "dump" position. Immediately disconnect the "stabilized" exhaust and dilution air sample bags, transfer to analytical system and process samples according to § 1201.84 as soon as practicable and in no case longer than 10 minutes after the end of this portion of the dynamometer test.

(14) Immediately after the end of the sample period, disconnect the exhaust tube from the tailpipe(s), turn off the cooling fan and close the engine compartment cover.

(15) Turn off the positive displacement pump.

(16) Repeat the steps in subparagraphs (2) through (10) of this paragraph for the hot start test except only one evacuated sample bag is required for sampling exhaust gas. The step in subparagraph (7) of this paragraph shall begin 9 and 11 minutes after the end of the sample period for the cold start test.

(17) At the end of the deceleration which is scheduled to occur at 505 seconds, simultaneously turn off the No. 1 revolution counter and position the sample solenoid valve to the "dump" position. (Engine shutdown is not part of the hot start test sample period.)

(18) Immediately disconnect the "transient" exhaust and dilution air sample bags, transfer to analytical system and process samples according to § 1201.84 as soon as practicable and in no case longer than 10 minutes after the end of this portion of the dynamometer test.

(19) Disconnect the exhaust tube from the vehicle tailpipe(s) and remove vehicle from dynamometer.

(20) Turn off the positive displacement pump.

12. Section 1201.86 is revised to read as follows:

§ 1201.86 Chart reading.

(a) Determine the HC, CO, CO_2 and NO_x concentrations of the dilution air and dilute exhaust sample bags from the instrument deflections or recordings making use of appropriate calibration charts.

(b) Determine the average dilute exhaust mixture temperatures from the temperature recorder trace if a recorder is used.

13. Section 1201.87 is revised to read as follows:

§ 1201.87 Calculations (exhaust emissions).

The final reported test results shall be computed by use of the following formulae:

(a) For light duty vehicles:

$$Y_{wm} = (0.43\ Y_{ci} + 0.57\ Y_{hi} + Y_s)/7.5$$

where:

Y_{wm} = Weighted mass emissions of each pollutant, i.e. HC, CO, or NO_x, in grams per vehicle mile.

Y_{ci} = Mass emissions as calculated from the "transient" phase of the cold start test, in grams per test phase.

Y_{hi} = Mass emissions as calculated from the "transient" phase of the hot start test, in grams per test phase.

Y_s = Mass emissions as calculated from the "stabilized" phase of the cold start test, in grams per test phase.

(b) The mass of each pollutant for each phase of both the cold start test and the hot start test is determined from the following:

(1) Hydrocarbon Mass:

$$HC_{mass} = V_{mix} \times Density_{HC} \times \frac{HC_{conc}}{1,000,000}$$

(2) Oxides of nitrogen Mass:

$$NO_{x_{mass}} = V_{mix} \times Density_{NO_x} \times \frac{NO_{x_{conc}}}{1,000,000} \times K_H$$

(3) Carbon monoxide Mass:

$$CO_{mass} = V_{mix} \times Density_{CO} \times \frac{CO_{conc}}{1,000,000}$$

(c) Meaning of symbols:

HC_{mass} = Hydrocarbon emissions, in grams per test phase.

$Density_{HC}$ = Density of hydrocarbons in the exhaust gas, assuming an average carbon to hydrogen ratio of 1:1.85, in grams per cubic foot at 68° F. and 760 mm. Hg pressure (16.33 gm cu. ft.).

HC_{conc} = Hydrocarbon concentration of the dilute exhaust sample corrected for background, in p.p.m. carbon equivalent, i.e. equivalent propane × 3.

$$HC_{conc} = HC_e - HC_d\ (1 - 1/DF)$$

where:

HC_e = Hydrocarbon concentration of the dilute exhaust sample as measured, in p.p.m. carbon equivalent.

HC_d = Hydrocarbon concentration of the dilution air as measured in p.p.m. carbon equivalent

$NO_{x_{mass}}$ = Oxides of nitrogen emissions, in grams per test phase.

$Density_{NO_x}$ = Density of oxides of nitrogen in the exhaust gas, assuming they are in the form of nitrogen dioxide, in grams per cubic foot at 68° F. and 760 mm. Hg pressure (54.10 gm cu. ft.).

$NO_{x_{conc}}$ = Oxides of nitrogen concentration of the dilute exhaust sample corrected for background, in p.p.m.

$$NO_{x_{conc}} = NO_{x_e} - NO_{x_d}\ (1 - 1/DF)$$

where:

NO_{x_e} = Oxides of nitrogen concentration of the dilute exhaust sample as measured, in p.p.m

NO_{x_d} = Oxides of nitrogen concentration of the dilution air as measured, in p.p.m.

CO_{mass} = Carbon monoxide emissions, in grams per test phase.

Density$_{CO}$ = Density of carbon monoxide in grams per cubic foot at 68° F. and 760 mm. Hg pressure (23.97 gm./cu. ft.).

CO_{cor} = Carbon monoxide concentration of the dilute exhaust sample corrected for background, water vapor and CO_2 extraction, in p.p.m.

$$CO_{cor} = CO_c - CO_d\ (1 - 1/DF)$$

where:

CO_c = Carbon monoxide concentration of the dilute exhaust sample volume corrected for water vapor and carbon dioxide extraction, in p.p.m. The calculation assumes the hydrogen = carbon ratio of the fuel is 1.85:1.

$$CO_c = (1 - 0.01925\ CO_{2_c} - 0.000323\ R)\ CO_{r_m}$$

where:

CO_{r_m} = Carbon monoxide concentration of the dilute exhaust sample as measured, in p.p.m.

CO_{2_c} = Carbon dioxide concentration of the dilute exhaust sample, in mole percent.

R = Relative humidity of the dilution air, in percent.

CO_d = Carbon monoxide concentration of the dilution air corrected for water vapor extraction, in p.p.m.

$$CO_d = (1 - 0.000323\ R)\ CO_{d_m}$$

where:

CO_{d_m} = Carbon monoxide concentration of the dilution air sample as measured, in p.p.m.

$$DF = \frac{13.4}{CO_{2_c} + (HC_c + CO_c) \times 10^{-4}}$$

V_{mix} = Total dilute exhaust volume in cubic feet per test phase corrected to standard conditions (528°R and 760 mm. Hg).

$$V_{mix} = V_s \times N\ (P_p/760\ \text{mm. Hg})\ (528°R/T_p)$$

where:

V_s = Volume of gas pumped by the positive displacement pump, in cubic cubic feet per revolution. This volume is dependent on the pressure differential across the positive displacement pump.

N = Number of revolutions of the positive displacement pump during the test phase while samples are being collected.

P_p = Absolute pressure of the dilute exhaust entering the positive displacement pump, in mm. HG, i.e. barometric pressure minus the pressure depression below atmospheric of the mixture entering the positive displacement pump.

T_p = Average temperature of dilute exhaust entering positive displacement pump during test while samples are being collected, in degrees Rankine.

K_H = Humidity correction factor.

$$K_H = \frac{1}{1 - 0.0047\ (H - 75)}$$

where:

H = Absolute humidity in grains of water per pound of dry air.

(d) Example calculation of mass emission values:

(1) For the "transient" phase of the cold start test assume $V_s = 0.29344$ cu. ft. per revolution; N = 10,485; R = 48 percent; H = 62 grains per pound of dry air; $P_p = 692$ mm. Hg; $T_p = 570°R$; $HC_c = 105.8$ p.p.m. carbon equivalent; $NO_{x_c} = 11.2$ p.p.m.; $CO_{r_m} = 206.6$ p.p.m.; $CO_{2_c} = 1.43$ percent; $HC_d = 12.1$ p.p.m.; $NO_{x_d} = 0.8$ p.p.m.; $CO_{d_m} = 15.3$ p.p.m.

Then:

$$V_{mix} = (0.29344)\ (10,485)\ (692/760)\ (528/570) = 2506.0 \text{ cu. ft. per test phase.}$$

$$K_H = \frac{1}{1 - 0.0047\ (62 - 75)} = 0.9424$$

$$CO_c = (1 - 0.01925\ (1.43) - 0.000323\ (48))\ 206.6 = 202.4 \text{ p.p.m.}$$

$$CO_d = (1 - 0.000323\ (48))\ 15.3 = 15.1 \text{ p.p.m.}$$

$$DF = \frac{13.4}{1.43 + (105.8 + 202.4) \times 10^{-4}} = 9.116$$

$$HC_{cor} = 105.8 - 12.1\ (1 - 1/9.116) = 95.03$$

$$HC_{mass} = (2595)\ (16.33)\ (95.03/1{,}000{,}000) = 4.027 \text{ grams per test phase.}$$

$$NO_{x_{cor}} = 11.2 - 0.8\ (1 - 1/9.116) = 10.49$$

$$NO_{x_{mass}} = (2595)\ (54.16)\ (10.49/1{,}000{,}000)\ (0.9424) = 1.269 \text{ grams per test phase.}$$

$$CO_{cor} = 202.4 - 15.3\ (1 - 1/9.116) = 279.8$$

$$CO_{mass} = (2595)\ (23.97)\ (279.8/1{,}000{,}000) = 23.94 \text{ grams per test phase.}$$

(2) For the "stabilized" portion of the cold start test assume that similar calculations resulted in $HC_{mass} = 0.62$ grams per test phase; $NO_{x_{mass}} = 1.27$ grams per test phase; and $CO_{mass} = 5.98$ grams per test phase.

(3) For the "transient" portion of the hot start test assume that similar calculations resulted in $HC_{mass} = 0.51$ grams per test phase; $NO_{x_{mass}} = 1.38$ grams per test phase; and $CO_{mass} = 5.01$ grams per test phase.

(4) For a 1975 light duty vehicle:

$$HC_{FTP} = ((0.43)\ (4.027) + (0.57)\ (0.51) + 0.62)\ /\ 7.5 = 0.352 \text{ gram per vehicle mile.}$$

$$NO_{x_{FTP}} = ((0.43)\ (1.269) + (0.57)\ (1.38) + 1.27)\ /\ 7.5 = 0.354 \text{ gram per vehicle mile.}$$

$$CO_{FTP} = ((0.43)\ (23.94) + (0.57)\ (5.01) + 5.98)\ /\ 7.5 = 2.55 \text{ grams per vehicle mile.}$$

[FR Doc.71-9306 Filed 7-1-71;8:45 am]

77-166 O - 72 - 30

Proposed Rule Making

ENVIRONMENTAL PROTECTION AGENCY

[45 CFR Part 1201]

CONTROL OF AIR POLLUTION FROM NEW MOTOR VEHICLES AND NEW MOTOR VEHICLE ENGINES

Proposed Standards and Test Procedures Applicable to 1973 and 1974 Light-Duty Vehicles

In conjunction with a review of comments on the proposed 1975 light-duty vehicle emission standards and test procedures (36 F.R. 3528 and 36 F.R. 9469), a study was made of air quality data to determine the proper hot-start-to-cold-start weighing for the test procedures.

It was determined that a weighing different from that reflected in the proposal would better represent emissions that should be measured to meet air quality requirements. Accordingly, the test procedures applicable to 1975 and subsequent model year vehicles, published in this issue of the FEDERAL REGISTER, are modified in this regard.

It appears desirable to make the revised 1975 test procedures applicable to earlier model years. However, because there may be objections regarding the leadtime involved in applying the revised procedures to the 1973 and 1974 model years, it would be inappropriate to make this change without providing an opportunity for comment. Therefore, the test procedures proposed for applicability to the 1973 and 1974 model years (36 F.R. 3525) are being adopted in this issue of the FEDERAL REGISTER without a change in hot-start-to-cold-start weighting.

Notice is hereby given that the Administrator is considering making the Federal test procedures promulgated for applicability to 1975 and later model years applicable to the 1973 and 1974 model years as well. The standards for those years would be adjusted as follows to reflect the same degree of stringency as the standards which have today been adopted for those years:

1. Hydrocarbons—3.0 grams per vehicle mile.
2. Carbon monoxide—28.0 grams per vehicle mile.
3. Oxides of Nitrogen—3.1 grams per vehicle mile.

Interested persons may submit written data, views, or arguments (in quadruplicate) in regard to the proposed regulations to the Administrator, Environmental Protection Agency, Attention: Office of Air Programs, Parklawn Building, 5600 Fishers Lane, Rockville, MD 20852. All relevant material received not later than 60 days after the publication of this notice will be considered. This notice of proposed rule making is issued under the authority of section 202, Public Law 91-604 (sec. 6, 84 Stat. 1690).

Dated: June 23, 1971.

WILLIAM D. RUCKELSHAUS,
Administrator.

[FR Doc.71-9609 Filed 7-1-71;8:45 am]

ATTACHMENT 5

GENERAL MOTORS CORPS.
ENVIRONMENTAL ACTIVITIES STAFF,
Warren, Mich., January 12, 1972.

Mr. W. D. RUCKELSHAUS,
Administrator, Environmental Protection Agency,
Washington, D.C.

DEAR MR. RUCKELSHAUS: As you know, Section 202(b)(5)(A) of the Clean Air Act, as amended, provided that after January 1, 1972 a vehicle manufacturer may apply for suspension of the 1975 model year hydrocarbon and carbon monoxide standards. General Motors would prefer to be in a position to make such a request, for our stated goal has been to take the car out of the air pollution problem at the earliest possible date. We have been, and continue to be, optimistic that the levels of vehicular emissions specified in the 1975 standards can be accomplished under certain conditions with approaches under development. We have also been successful in building experimental systems for vehicles which have met the 1975 emission levels, at low mileage. Nevertheless, we have not yet advanced to the point of assurance that these systems, when mass produced and used in normal customer service, could meet either the 1975 emission levels or necessary durability and reliability levels.

The most likely of the systems we have built involves a catalytic converter. In order to be certain that we could equip all 1975 model vehicles with appropriate emission control systems incorporating a catalytic converter, it would be necessary for us to commit ourselves immediately to a catalyst supplier. However, we are unable at this time to designate specific catalysts which will adequately accomplish these requirements for field application.

A further impediment to definition of a system to satisfy the 1975 standards is the importance in ultimate price to the consumer that the same system components become an integral part of that which will satify the 1976 requirements. We are, as yet, in the early stages of developing a system for 1976, but are still far short of that goal, even in a demonstration phase.

Beyond this, there are many unanswered questions which must be resolved before we can make final decisions on our system and its components. These include among others the potential problems and costs for the consumer in terms of component replacement, owner maintenance, fuel composition, reduced durability and safety. There are also problems related to other industries such as the oil and refining industry which must be resolved if a best, least-cost system is to be achieved. These factors are in addition to the establishment of vehicle certification and end-of-line testing procedures and standards.

Therefore, we have reluctantly come to the conclusion that it is necessary to request the suspension provided in Section 202(b)(5)(A), and this letter can be considered a formal request for suspension of the 1975 hydrocarbon and carbon monoxide standards for light duty vehicles and engines until the 1976 model year production. In addition, we are undertaking to organize the data to support this request. As you are aware, we have already provided a great deal of this information to EPA. We are endeavoring to assemble the material in a form for your purposes of evaluating this request.

General Motors makes this request as a consequence of insufficient technology to allow mass production of emission control systems for 1975 models which would meet the provisions of the Clean Air Act. However, we assure you that postponement of the 1975 vehicular emission requirements until the 1976 model year will result in no declination in our effort in this area. We will pursue with the utmost of diligence the goals which Congress has established.

We also request and wish to point out that any interim changes in emission level specification between 1973 and a one-year extension of the 1975 requirements would interfere seriously with our capability to accommodate the targeted emission levels. We, therefore, urgently request that no such interim changes be adopted. Particularly we make this request in view of the almost negligible impact that a one-year extension of 1973 standards will have on the atmosphere.

Very truly yours,

E. S. STARKMAN, *Vice President.*

* * *

ENVIRONMENTAL PROTECTION AGENCY,
Washington, D.C., January 19, 1972.

Mr. E. S. STARKMAN,
Vice President, General Motors Corps., General Motors Technical Center, Warren, Mich.

DEAR MR. STARKMAN: This is in reply to your letter of Junary 12, 1972, in which you request that the Administrator of the Environmental Protection Agency grant to General Motors a suspension of the 1975 emission standards for one year in accordance with Section 202(b)(5)(A) of the Clean Air Act, as amended. Your letter summarizes General Motors' reasons for requesting the extension in general terms. The letter also requests that no interim standards more stringent than the 1978 emission standards be set.

As you know, the Section 202(b)((5)(D) requires the Administrator to make four determinations favorable to the applicant in order to grant a one-year suspension of the standards. These are: (i) a determination that such suspension is essential to the public interest or the public health and welfare of the United States; (ii) a determination that all good faith efforts have been made to meet the standards for which suspension has been requested; (iii) a determination that the applicant has established that effective control technology, processes, opertaing methods, or other alternatives are not available, or have not been available for a sufficient period of time to achieve compliance prior to the effective date of such standards; and (iv) a determination that the study and investigation of the National Academy of Sciences conducted pursuant to Section 202(c) of Act, and other information available to the Administrator, has not indicated that technology, processes, or other alternatives are available to meet such standards.

The burden of proof on determinations (ii) and (iii) clearly rests on the party seeking suspension of the standards. Complete documentation of the applicant's efforts to comply is essential to any suspension of the standards, and this documentation can only come from the applicant. Your letter states that data to support your request is being assembled. Until this information is received, a complete assessment of General Motors' efforts to date is impossible, and the findings required by the law cannot be made. Since the Clean Air Act requires the Administrator to hold a public hearing and to render a final decision with respect to an application within 60 days, it is our judgment that a request for suspension must be documented before the application can be deemed to be complete and before the 60-day time period begins to run. A detailed indication of the type of documentation that is necessary has been provided to you in guidelines prepared by this Agency.

To fully comply with the law's public hearing requirement the public must have adequate and timely access to the factual foundation for the applicant's case with respect to determinations (ii) and (iii). Effective and responsible public participation at the hearing is clearly an important objective of the statutory procedure and can only be assured if the essential portions of an applicant's supporting data accompany the application and are available to the public. I want to stress at this time my strong belief that the public's right to participate responsibly in the proceedings looking toward the granting or denial of requests for suspension is not compatible with an attempt by any applicant to place major reliance on supporting data previously submitted by the applicant but not made public, unless such data is made public at the time of application.

For these reasons your January 12, 1972, letter cannot be considered to be a legally sufficient application for suspension until necessary documentation and supporting data is submitted. When a complete application is submitted by General Motors, the public hearing required by Section 202(b)(D) will be scheduled.

Sincerely yours,

WILLIAM D. RUCKELSHAUS, *Administrator.*

ATTACHMENT 6

UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF COLUMBIA

Civil No. 2405-71

UNITED STATES OF AMERICA, PLAINTIFF, *v.* FORD MOTOR CO. AND FORD MARKETING CORP., DEFENDANTS

COMPLAINT FOR INJUNCTIVE AND MONETARY RELIEF

The United States of America, by its undersigned attorneys, by authority of the Attorney General, and at the request of the Administrator of the Environmental Protection Agency, brings this suit against the defendants and alleges that:

I. This is a civil action for injunctive relief and for the imposition of a civil penalty against Ford Motor Company and Ford Marketing Corporation for violations of Section 208 of the Clean Air Act, as amended, 42 U.S.C. 1857f-2.

II. This Court has jurisdiction of the subject matter of this action pursuant to 28 U.S.C. 1345 and 42 U.S.C. 1857f-3.

III. Defendants, Ford Motor Company and Ford Marketing Corporation, are corporations organized and existing under the laws of the State of Delaware and are licensed to do business and are doing business in the District of Columbia.

IV. Defendant Ford Motor Company is a manufacturer and seller and defendant Ford Marketing Corporation is a seller of new motor vehicles and new motor vehicle engines for distribution in commerce.

V. Section 1857f-2 of Title 42 of the United States Code provides in pertinent part that:

(*a*) The following acts and the causing thereof are prohibited—

> (1) In the case of a manufacturer of new motor vehicles or new motor vehicles engines for distribution in commerce, the sale, or the offering for sale, or the introduction, or the delivery for introduction, into commerce . . . of any new motor vehicle or new motor vehicle engine, manufactured after the effective date of regulations under this part which are applicable to such vehicle or engine unless such vehicle or engine is covered by a certificate of conformity issued (and in effect) under regulations prescribed under this part * * *.

VI. The Regulations prescribed under 42 U.S.C. 1857f-1 and 42 U.S.C. 1857g were published in the Federal Register on November 10, 1970 (35 Fed. Reg. 17288), and became effective the same day.

VII. Upon information and belief, defandants, during the period commencing on or about July 16, 1971, and ending on or about September 24, 1971, introduced into commerce or delivered for introduction into commerce approximately 200,000 new motor vehicles that were not covered by certificates of conformity as required by 42 U.S.C. 1857f-5 and regulations issued pursuant thereto, thereby doing or permitting the doing of one or more of the acts prohibited by 203(a). Such vehicles were introduced into commerce or delivered for introduction into commerce on consignment under documents by which defendants retained title to such motor vehicles and under terms and conditions that did not permit the consignees to sell or otherwise dispose of such motor vehicles until they were certified by the Environmental Protection Agency and, where appropriate, reworked so that they were in all material respects of substantially the same construction as the test vehicles upon the basis of which the certificates of conformity were based.

VIII. The violations of introducing or delivering for introduction into commerce of uncertified motor vehicles consisted of the movement in interstate commerce, or the causing thereof, by defendants or one of them of uncertified motor vehicles.

IX. Injunctive relief to restrain violations is specifically provided by 42 U.S.C. 1857f-3. Plaintiff has no adequate remedy at law.

WHEREFORE, plaintiff prays:

1. For a judgment imposing a civil penalty, pursuant to 42 U.S.C. 1857f-4, on the defendants for each violation of 42 U.S.C. 1857f-2.
2. For a permanent injunction enjoining the defendants from violating 42 U.S.C. 1857f-2.
3. For such other relief as the Court may deem appropriate.

L. PATRICK GRAY III,
Assistant Attorney General.

E. GREY LEWIS,
Deputy Assistant Attorney General.

IRWIN GOLDBLOOM,
Attorney, Department of Justice,
Attorneys for Plaintiff.

UNITED STATES DISTRICT COURT FOR
THE DISTRICT OF COLUMBIA

Civil No. 2405-71

UNITED STATES OF AMERICA, PLAINTIFF, *v.* FORD MOTOR CO. AND FORD MARKETING CORP., DEFENDANTS.

STIPULATION

It is stipulated and agreed by and between the undersigned parties, by their respective attorneys, that:

(1) The Final Judgment attached hereto and filed herewith may be entered by the Court at any time after the expiration of thirty (30) days following the date of filing of this Stipulation without any further notice to any party or other proceedings, either upon the motion of any party or upon the Court's own motion, provided that the Plaintiff has not withdrawn its consent as provided herein;

(2) The Plaintiff may withdraw its consent hereto at any time within said period of thirty (30) days by serving notice thereof upon the defendents and filing said notice with the Court;

(3) In the event Plaintiff withdraws its consent hereto, this Stipulation shall be of no effect whatever in this or any other proceeding and the making of this Stipulation shall not in any manner prejudice any consenting party in any subsequent proceedings.

Dated:

FOR THE PLAINTIFF:

L. PATRICK GRAY, III,
Assistant Attorney General.
E. GREY LEWIS,
Deputy Assistant Attorney General.
IRWIN GOLDBLOOM,
Attorney, Department of Justice.

FOR THE DEFENDANTS:

WRIGHT TISDALE,
Attorney for Defendants.
HOWARD P. WILLENS.

UNITED STATES DISTRICT COURT FOR
THE DISTRICT OF COLUMBIA

Civil No. 2405-71

UNITED STATES OF AMERICA, PLAINTIFF, *v.* FORD MOTOR CO. AND FORD MARKETING CORP., DEFENDANTS.

ANSWER

Defendants Ford Motor Company and Ford Marketing Corporation ("defendants") answer the Complaint as follows:

First defense

The Complaint fails to state a claim against defendants upon which relief can be granted.

Second defense

Defendants admit the allegations of paragraphs I through VI of the Complaint and so much of paragraph VII thereof as allege that, during the period alleged, defendants shipped or caused the shipment on consignment of approximately 200,000 new motor vehicles that were not yet covered by certificates of conformity under the terms and conditions which prohibited the consignees from selling or otherwise disposing of such vehicles until they were certified by the Environmental Protection Agency and, where appropriate, reworked so that they were in all material respects of substantially the same construction as the test vehicles upon the basis of which the certificates of conformity ultimately were issued; but denies each and every other material allegation of the Complaint.

WHEREFORE, defendants pray judgment that the Complaint be dismissed.

HOWARD P. WILLENS,
Attorney for Defendants.

Of Counsel: Wilmer, Cutler & Pickering

UNITED STATES DISTRICT COURT FOR
THE DISTRICT OF COLUMBIA

Civil No. 2405-71

UNITED STATES OF AMERICA, PLAINTIFF, *v.* FORD MOTOR CO. AND FORD MARKETING CORP., DEFENDANTS.

ACCEPTANCE OF SERVICE

The undersigned defendants hereby acknowledge receipt of the complaint herein, waive service of process, and appear herein.

FORD MOTORING CO. and FORD MARKETING CORP.
By HOWARD P. WILLENS,
Attorney for Defendants.

UNITED STATES DISTRICT COURT FOR
THE DISTRICT OF COLUMBIA

Civil No. 2405-71

UNITED STATES OF AMERICA, PLAINTIFF, *v.* FORD MOTOR CO. AND FORD MARKETING CORP., DEFENDANTS.

FINAL JUDGMENT

The plaintiff having filed its complaint herein on December —, 1971, alleging violations of Section 203 of the Clean Air Act as amended, 42 U.S.C. 1857f-2, seeking injunctive and monetary relief on the basis of such allegations, and defendants having filed their answer denying certain allegations of the complaint, and the parties without trial having consented to the entry of this final judgment, it is by the Court this —— day of ———, 1972,

ORDERED, ADJUDGED AND DECREED as follows:

I. This Court has jurisdiction of the subject matter of this action and of the parties hereto. The complaint states claims for relief against the defendants under 28 U.S.C. 1345 and 42 U.S.C. 1857, *et seq.*

II. A. The word "Defendants" shall mean the defendant Ford Motor Company, a corporation organized and existing under the laws of the State of Delaware, having a principal place of business at Dearborn, Michigan, and defendant Ford Marketing Corporation, a corporation organized and existing under the laws of the State of Delaware, having a principal place of business at Dearborn, Michigan.

B. The word "subsidiary" shall mean a company in which fifty per cent (50%) or more of the voting securities is owned or controlled by the defendants or either of them and which is engaged in the sale or distribution in the United States of new motor vehicles manufactured in the United States.

C. Each of the words "new motor vehicle," "scale," "offering for sale," "introducing into, or delivering for introduction into commerce," "commerce," "ultimate purchaser," "State" and "model year" shall have the same meaning as that specified in Sections 213 and 302 of the Clean Air Act, as amended (42 U.S.C. 1857f-7), and in 35 Federal Register 17288-89 dated November 10, 1970.

III. The provisions of this Final Judgment shall apply to the defendants and to each of its or their domestic subsidiaries, successors and assigns.

IV. Defendants are permanently enjoined and restrained from introducing or delivering for introduction into commerce new motor vehicles unless they shall have received notice of certification of such vehicles by the Environmental Protection Agency pursuant to the Clean Air Act as amended, 42 U.S.C. 1857, *et seq.* and regulations issued pursuant thereto, which shall include but not be limited to interstate shipment of new motor vehicles to dealers or other consignees under documents by which title to such motor vehicles is retained by them and under terms and conditions that do not permit the consignees to sell or otherwise dispose of such new motor vehicles unless they shall have received notice of certification of such vehicles by the Environmental Protection Agency pursuant to the Clean Air Act as amended, 42 U.S.C. 1857, *et seq.* and regulations issued pursuant thereto.

V. Nothing in this Final Judgment shall be deemed to prohibit defendants from availing themselves of any right or benefit they may have pursuant to the Clean Air Act, as amended, any present or future Act of Congress, or any present or future regulation promulgated thereunder, including but not limited to 19 Code of Federal Regulations 12.73–12.80 and 34 Federal Register 18551–52 dated November 21, 1969.

VI. Defendants are ordered to pay the sum of Ten Thousand ($10,000) and no/100 Dollars to plaintiff as a civil penalty.

VII. This Final Judgment shall become effective upon entry hereof and shall be without prejudice to defendants' right to seek modification thereof if, at any time in the future, the Environmental Protection Agency (or other defendants' domestic competitors to do any of the acts prohibited by Section IV of this Final Judgment.

United States District Judge.

ATTACHMENT 7

LIST OF CASES CHALLENGING EPA STANDARDS

1. Secondary ambient air quality standard for sulfur oxides

Kennecott Copper Corporation—Petitioner v. EPA—Defendant U.S. Circuit Court of Appeals for the District of Columbia—Docket No. 71–1410

2. 1975 motor vehicle emission standard for hydrocarbons

Natural Resources Defense Counsel, Inc. and Center for Science in the Public Interest, Petitioner, v. William D. Ruckelshaus, Administrator, Defendant, U.S. District Court for the District of Columbia, Civil Action No. 2598–71

Mr. ROGERS. Thank you very much.

Mr. Kyros, do you have questions?

Mr. KYROS. Yes. Thank you, Mr. Chairman.

Mr. Ruckelshaus, with regard to the Birmingham pollution episode, Chairman Rogers did take several members of the committee down there and, frankly, for the first time I realized how extensive and tough your job is. In Birmingham, it was pretty obvious that the industrial people, although they meant well, had to lay off employees. The people were upset, but the U.S. attorney, who was a very young man, was willing to go ahead and shut down those plants for several days. It was an awful thing to have to let 50,000 or 60,000 men out of their jobs, but at the same time you had a duty to perform, and I think you did very well.

Mr. RUCKELSHAUS. Thank you, Mr. Kyros. It illustrates to me how the regional offices can respond to this kind of an emergency, because it was really done out of our Atlanta office in cooperation with our research center in Durham, N.C. Those men went down there and enforced the law, which is what we should be doing to protect the public health, and a major part of the credit belongs to them.

Mr. KYROS. There has been a lot of discussion about the conference out west. I see no reason why Congressmen should not consider constituents when looking into the clean air situation.

The New York Times on Sunday, January 16, 1972, carried the automobile manufacturers' statement that they cannot meet the 1975 deadline. This was challenged by Eric O. Stork of the EPA, who said that the Agency is not yet convinced the industry cannot meet the Federal requirements by 1975. He added that the Agency itself does not intend to put forward any proposals for relaxing those standards.

Does that mean that Mr. Stork believes that the 1975 standards can still be met?

Mr. RUCKELHAUS. He is fully capable of speaking for himself, but let me say that under the terms of the act it is my responsibility to make a judgment, after the submission of an application by the automobile companies that they cannot meet the standards, as to whether they have satisfied the criteria in the act.

Clearly, it would be premature for me or Mr. Stork to state whether they can or cannot until we go through the procedure required in the act. So, I think his statement is consistent with the terms of the statute, and he has my full support on the statement.

Mr. KYROS. Often when one is quoted in the newspapers it sounds as though a decision has been made, but he was just making a comment, probably a very frank one.

Have you or any other members of your staff had any meetings with the automobile industry directly?

Mr. RUCKELSHAUS. Shortly after I began this job, I had a single meeting with each of the presidents of the automobile companies for the purpose of telling them how I would like to communicate with them in this important area. I encouraged them to have full communication with the technical staff of the Environmental Protection Agency, but cautioned that I was in the position of having to regulate the automotive companies in a very important way.

So, the communications I would have to have with them would have to be fully public and spread on the public record, and there was no way in which I could personally meet with them without compromising in my opinion that which was spelled out in the Clean Air Act of 1970. We have had communications and the lines have been open between our technical people to gain an assessment of the progress that may or may not be made in attempting to achieve these standards.

Mr. KYROS. In carrying out the statute, you would have closed meetings with the automotive industry? I do not say that derogatorily.

Mr. RUCKELSHAUS. I don't know that I would call these closed meetings.

Mr. KYROS. Closed to the press and the public?

Mr. STORK. We have had a number of technical meetings with industry. Those meetings are open to anyone who wishes to attend. A stenographic record is made of those meetings. That does not mean that we do not have incidental conversations on various occasions. We may not have incidental conversation with individual people from individual companies. Obviously, those are not scheduled with court reporters, but for all meetings of any formality at all that we have had with industry, we have a stenographic transcript of the proceedings.

Mr. KYROS. Turning to public participation, how do you plan to proceed with the applications you have reached thus far with respect to the suspension of the automobile deadline?

Mr. RUCKELSHAUS. We have received one formal application from General Motors which we sent back pursuant to my statement with a letter stating that we felt that they had to provide with their application all the data and documentation to back up the claim that there should be an extension. We said that we intended to make this documentation and data available to the public when the application was filed so that when we had a public hearing, there would be opportunity for the public to make full comment on the back-up material that the automotive companies have supplied.

We have sent to all of the companies guidelines as to what we expect to be in an application.

We have a continuing problem over the question of trade secrets and the confidentiality of certain information. I am concerned about the matter because unless there is an opportunity for the public to review completely the basis on which we are trying to make a decision, it is very difficult for them to assess the wisdom of that decision. So, we are in the process of trying to amend the guidelines that we sent out to insure as full a disclosure of the information that backs up the company's application as possible.

Mr. KYROS. Have you published these guidelines?

Mr. RUCKELSHAUS. We have not officially published them. We would be pleased to furnish copies to the committee.

Mr. KYROS. First, will you make available the guidelines to the subcommittee for the record.

Mr. RUCKELSHAUS. Yes, we certainly will.

(Testimony resumes on p. 471.)

(The following information was received for the record:)

ENVIRONMENTAL PROTECTION AGENCY,
Washington, D.C., Jan. 28, 1972.

Re: 1975 Motor Vehicle Emission Standard Suspension Request Guidelines

GENTLEMEN: In a recent letter to the General Motors Corporation, in response to a suspension request, Mr. Ruckelshaus stated:

"The burden of proof on determinations (ii) and (iii) clearly rests on the party seeking suspension of the standards. Complete documentation of the applicant's efforts to comply is essential to any suspension of the standards, and this documentation can only come from the applicant. Your letter states that data to support your request is being assembled. Until this information is received, a complete assessment of General Motors' efforts to date is impossible, and the findings required by the law cannot be made. Since the Clean Air Act requires the Administrator to hold a public hearing and to render a final decision with respect to an application within 60 days, it is our judgment that a request for suspension must be documented before the application can be deemed to be complete and before the 60-day time period begins to run. A detailed indication of the type of documentation that is necessary has been provided to you in guidelines prepared by this Agency.

"To fully comply with the law's public hearing requirement the public must have adequate and timely access to the factual foundation for the applicant's case with respect to determinations (ii) and (iii). Effective and responsible public participation at the hearing is clearly an important objective of the statutory procedure and can only be assured if the essential portions of an applicant's supporting data accompany the application and are available to the public. I want to stress at this time my strong belief that the public's right to participate responsibly in proceedings looking toward the granting or denial of requests for suspension is not compatible with an attempt by any applicant to place major reliance on supporting data previously submitted by the applicant but not made public, unless such data is made public at the time of the application."

In keeping with the points made in Mr. Ruckelshaus' letter, the Suspension Request Guidelines provided to you recently are amended as follows:

On Page 1, under Section I. *Introduction*, the third paragraph is amended to read:

"In order to justify suspension of the 1975 emission standards, findings favorable to the applicant must be made by the Administrator on all four criteria. Consequently, it is incumbent upon the applicant to submit any information he considers relevant to each of the four criteria. In particular, the burden of affirmatively establishing the second and third criteria clearly rests on the applicant. To facilitate consideration of these two criteria, Guidelines are presented herein for use by any applicant requesting suspension."

On Page 2, under Section III. *Instructions*, the second paragraph is amended beginning with the last sentence to read:

"Regardless of the confidential nature of the information, however, the Administrator is authorized to make any such information available to officers, employees or authorized representatives of the United States concerned with carrying out the Clean Air Act, or when relevant in any proceeding under the Act. The process by which the Administrator arrives at his decision within 60 days from receipt of a suspension request is a proceeding under the Act. Hence, any information submitted by an applicant, whether or not such information constitutes a trade secret or a secret process within the meaning of § 307(a), may be disclosed to the public if the Administrator determines that such disclosure is necessary to satisfy the objectives of the Act."

The third and fourth paragraphs of Section III are deleted and a new paragraph is substituted therefor as follows:

"The public hearing requirement contained in § 202(b)(5)(D) of the Act cannot be fully satisfied unless interested members of the public have adequate and timely access to information which accompanies the application or which, if previously submitted, is referred to in the application or is otherwise relied upon by the applicant for support. Applicants should anticipate, therefore, that information disclosing or claimed to disclose a trade secret or secret process submitted with an application or relied upon for support by an applicant will be promptly reviewed and, in the absence of exceptional considerations, immediately placed in the Agency's public files. An applicant claiming exceptional considerations justifying confidential treatment of specific information shall identify and segregate such information and shall furnish a full statement of such justification."

Very truly yours,

JOHN R. QUARLES, Jr.,
Assistant Administrator for
Enforcement and General Counsel.

ENVIRONMENTAL PROTECTION AGENCY,
OFFICE OF ENFORCEMENT,
January, 1972.

For use by any automobile manufacturer who may wish to request suspension if the effective date of the 1975 hydrocarbon and carbon monoxide emission standards for light duty vehicles.

SUSPENSION REQUEST GUIDELINES

I. INTRODUCTION

The Clean Air Act, as amended, provides that at any time after January 1, 1972, any manufacturer may file with the Administrator an application requesting the suspension for one year of the effective date of HC and CO emission stnadards required for the 1975 model year. The Administrator does not have the authority to suspend the effective date of the statutory HC and CO emission standards for more than one year.

Within 60 days after receipt of the application for any such suspension, and after public hearing the Administrator is required by the Act to make a determination granting or refusing such suspension. The Act provides that the Administrator shall grant such suspension only if he determines that (1) such suspension is essential to the public interests or the public health and welfare of the United States, (2) all good faith efforts have been made to meet the established standards, (3) the applicant has established that effective control technology, proc-

ess, operating methods, or other alternatives are not available, or have not been available for a sufficient period of time to achieve compliance prior to the effective date of such standards, and (4) the study and investigation of the National Academy of Sciences and other information available to him has not indicated that technology, processes or other alternatives are available to meet such standards.

The applicant has the burden of affirmatively establishing the second and third of the four criteria required by the Act to justify suspension of the 1975 emission standards. To facilitate consideration of these two criteria, Guidelines are presented herein for us by any applicant requesting such suspension.

II. APPLICABILITY

Any manufacturer requesting suspension of the effective date of any 1975 emission standard, as provided for by Sec 202(b)(5)(A) of the Clean Air Act, as amended, should prepare his request as prescribed in these Guidelines.

A manufacturer is any person engaged in the manufacturing or assembling of new motor vehicles or new motor vehicle engines or importing of such vehicles or engines for sale, or who acts for and is under the control of any person in connection with the distribution of new motor vehicles or new motor vehicle engines, but shall not include any dealer with respect to new motor vehicle engines received by him in commerce.

III. INSTRUCTIONS

A suspension request shall contain separate responses to each section and sub-section of Part IV of these Guidelines. Applicant may add or expand any section to the extent he deems necessary to support his request. Applicant shall structure his responses to the Guidelines to reflect his specific plans, goals, and achievements and shall avoid generalizations and conclusions based on information not directly related to his effort. Applicant may incorporate any reports, records or information pertinent to the request that he has previously submitted to the Administrator. The Administrator may request information from an applicant in addition to that submitted in compliance with these Guidelines.

In connection with any determination to be made under § 202(b)(5) of the Clean Air Act, the Administrator is authorized under § 307(a), to require "the attendance and testimony of witnesses and the production of relevant papers, books, and documents . . ." Except for emission data so obtained, the Administrator is required to consider such information confidential under 18 U.S.C. 1905 upon "a showing satisfactory to the Administrator" that its disclosure would reveal trade secrets of secret processes of the manufacturer submitting the information. Regardless of the confidential nature of the information, however, the Administrator is authorized to make any such information available to officers, employees or authorized representatives of the United States concerned with carrying out the Clean Air Act, or when relevant in any proceeding under the Act.

Any person desiring confidential treatment of information obtained from said person under § 307(a) has the burden of making the "showing satisfactory to the Administrator" required by the Act. Applicant's submission of any item of information which he identifies as confidential, in that its disclosure would reveal trade secrets or secret processes, must set forth the reasons for so identifying the information, including any supportive scientific or technical data or legal authority. In any case in which the Agency determines that the information does not constitute a trade secret or secret process, the manufacturer who submitted it will be notified in writing at least 30 days prior to such intended disclosure.

Confidential treatment of information shall be limited to that portion of any submission demonstrated to be confidential within the meaning of the Act. Applicant has the burden of separating for confidential treatment that portion of any submission which qualifies for such treatment. Confidential pages shall be identified by markings to that effect on the top, bottom, front and back of each page.

Ten copies of the application shall be filed with the Administrator, Environmental Protection Agency, Attn: Office of General Enforcement, Room 3109, 4th & M Streets, S. W. Washington, D. C., 20460. Any questions concerning the Guidelines should be directed to the above office at AC 202-755-2530.

IV. APPLICATION

Section 1 shall not include any confidential information and shall:

(*a*) Identify the applicant and any other person engaged in the manufacture, distribution and sale of vehicles manufactured, distributed or sold by applicant.

(*b*) Contain a summary of the applicant's position and supporting arguments with respect to the second and third criteria set forth in Part I.

(*c*) Set forth the interim standards which the applicant believes should be established in lieu of the standard to which the application relates.

Section 2 shall contain applicant's statement of the total effort he has extended to achieve compliance with the established emissions standards for 1975. The statement shall present an overview of applicant's research, development, testing and enginering program(s) in the area of emission control. The statement shall discuss:

(*a*) The composition of the program(s) and shall be in sufficient detail to include the number and qualifications of professional personnel assigned to emission control activity, and the academic or functional disciplines involved, the type(s) and quantity of major items of laboratory equipment used (e.g., visible, ultra-violet and infra-red spectrophotometers), and the laboratory and testing facilities used. When equipment, projects, and personnel are only partially dedicated to the emission control activities applicant shall indicate the percentage portion of such equipment, projects, and personnel so dedicated.

(*b*) That portion of the program(s) carried out under contracts or agreements with other firms or ad hoc organizations.

(*c*) The accomplishments of the research, development, testing and engineering program(s) in terms of determination of feasible and non-feasible approaches to emission control, patents obtained or pending, and publications in technological journals.

Section 3 shall contain the applicant's detailed expression of his financial commitment to emission control research, development, testing and engineering activities.

(*a*) A project narrative shall be completed for each project or particular phase of a project in research, development, testing and engineering for the years 1967 through 1976. The project narrative shall include the following:

1. Project title, number or designation and date started or planned to start.
2. Project description, including objectives, scope, approach, phase and status. Phase refers to research, development, engineering testing or other areas of the emission control program. Project status shall indicate the percentage completion of the project and which phases of the program have been committed for the project and which phases are pending.
3. Description of the project's relationship to the total effort to meet the emission standards for the 1975 model year and relationship to or dependency upon other projects. The description shall include whether the project was originated because of the 1970 Amendment to the Clean Air Act, the original objectives of the project if they have changed since inception, the percent of direct cost attributed to the present project objectives, and the basis of the percentage attribution.

(*b*) Direct research, revelopment, testing and engineering cost will be summarized in this sub-section. These costs shall be presented as shown below—by type of expense and by year of expenditure, including projections for 1972 to 1976, if possible—for each project or project phase described in 3(a). Financial data presented in this sub-section must be consistent with the project narratives of 3(a), and should conform to the normal accounting year of the applicant, with designation of the fiscal year. Expense classifications may be expanded or contracted only if consistently applied and specifically indicated when a classification change has been made. The financial commitment for services supplied by outside organizations, i.e., those services financed by the applicant that can be directly related to his emission control program, will be reported in 3(b)(4). The following outline shall be used to report direct costs for each project identified in 3(a).

Project title
Actual costs—1967, 1968, 1969, 1970, 1971
Projected costs—1972, 1973, 1974, 1975, 1976
Direct project costs:
1. Salaries and wages
(A) Professionals
(B) Laboratory technicians
(C) Other technical and clerical
(D) Employee benefits
2. Chemicals and gases
3. Laboratory supplies
4. Outside services (identify)
5. Rental expenses
6. Eqipment purchases expense
7. Depreciation expense[1]
Other information:
8. Other direct costs (identify)
9. Total direct project costs
10. Number of personnel directly assigned to project at end of each year
(A) Professionals:
Full Time
Part Time
(B) Laboratory technicians
(C) Other technical and clerical

(*c*) Applicant shall indicate in this sub-section all other costs that may be allocated to the emission control projects reported in 3(a). Such costs are to be listed by year of expenditure, including projections for 1972 to 1976, if possible, along with a detailed description of the expenditure and the basis for allocation. The nature of these costs, (e.g., research and development administrative costs, employee benefits, utilities, depreciation of certain research and development facilities) makes it normally not practical to allocate the costs to each project.

(*d*) This sub-section shall contain a summary of emission control program costs for each year (67–76). Direct project costs of projects reported in 3(b) shall be totaled and added to the total other allocated costs from 3(c). This total shall be the total cost (past and projected) of research, development, testing and engineering by year as applied to emission control systems for light duty vehicles. Total company Research and Development cost by year and total domestic (U.S.) light-duty vehicle sales by year (67–76) shall also be presented in this sub-section.

Section 4 shall contain applicant's argument to establish that effective control technology, processes, operating methods or other alternatives are not available or have not been available for a sufficient period of time to achieve compliance prior to the effective date of such standards. The information requested in this section, if provided with sufficient support material and in sufficient detail, will be considered by the Administrator to the minimum required of the applicant to establish his inability to comply with the standards. Additional data and information should be submitted by the applicant as appropriate to support his argument. Applicant shall discuss:

(*a*) What emission control results have been achieved to date for the first choice system and all alternative systems considered for compliance in 1975. The discussion of each system will include the following topics: type of emission control system, sizes and numbers of vehicles tested, test procedure used, test procedure correlation with the 1975 Federal Test Procedure, vehicle mileage at test points, all test results on cars with high mileage, results in grams per mile, spread in the data, and any test data pertinent to changes in effectiveness of the control system as a function of changing ambient conditions (high altitude, high temperature or low temperature). In addition discuss why work is being done on the system or systems described, why these systems are considered superior to other approaches, and which, if any, systems have been developed by companies outside the automobile industry.

(*b*) Engineering goals for the emission levels to be achieved by low mileage engineering prototypes in order to achieve compliance with the 1975 emission standards, including assumption made to arrive at those goals; factors assumed to allow for production variations, prototype-to-production slippages, and deteri-

[1] Submit separate schedule indicating cost of buildings and/or equipment purchased and the respective asset life used to calculate depreciation.

oration; and change in production variations assumed to occur by 1975 model year production.

(c) Major problems associated with the most promising system investigated, including fuel consumption, reduced driveability, other performance penalties, and any safety, maintenance servicing, warranty, development (emission performance, durability and producibility), production tooling, and vendor problems.

(d) Plans for resolving the problems identified in c, including use of technology developed outside the company or outside the automobile industry, timetable for developing solutions, critical milestones for meeting this timetable, confidence placed in the schedule, areas of greatest uncertainty, probable or possible breakthrough(s) that would result in a significant reduction in lead time, and consequences of any shortcuts both to the company and to the potential vehicle user.

(e) Detailed lead time schedule for model year 1975 production, including crucial milestones, commitment and signoff dates, lead time requirements of vendors, and specific lead time schedules for those emission control system components which are most critical. Discuss how much less lead time would be required to produce a single model or nameplate that will comply, as contrasted to all current models or nameplates, and whether it is feasible to increase lead time by delaying MY 1975 production until calendar year 1975.

(f) The efforts that have been made to identify useful technology developed by other companies.

(g) The efforts, results, and conclusions relative to all alternative power systems considered.

(h) The interim standards which could be met in 1975, including assumptions used to arrive at the levels obtainable, emission control system to be used, the extra cost to the car buyer for such a system, and the associated increased annual operating cost. Such interim standards should reflect the greatest degree of emission control achievable by application of available technology.

Mr. KYROS. Were your guidelines subject to the usual rulemaking procedures allowing public comment before you publish them?

Mr. RUCKELSHAUS. No; they were not. We simply said, "this is what we think should be supplied." Since we sent out those guidelines, we have gotten communications from various public-interest organizations which have pointed out to me and to the members of my staff some of the difficulties that exist in these guidelines. They particularly alluded to the subject of confidentiality and trade secrets, and I must say they give me some pause as to whether our guidelines provide for sufficient disclosure of public information on which the public can make full comment. For that reason, we are giving serious consideration to amending those guidelines for a full disclosure.

Mr. KYROS. Mr. Ruckelshaus, did you and your staff draw up those guidelines before an application was made by General Motors for a deadline extension?

Mr. RUCKELSHAUS. They were drawn up before.

Mr. KYROS. Long before?

Mr. RUCKELSHAUS. They were distributed before, but not long before. It was about 2 weeks before we received GM's letter, so I think it would be fair to say that they did not really have the chance to assimilate that information fully before submitting their original letter.

Mr. KYROS. There have been allegations to that effect. Are the guidelines drawn up so that internal combustion or any other of the many engines fit them?

Mr. RUCKELSHAUS. Mr. Stork may be able to answer that.

Mr. STORK. The guidelines simply provide guidance to the manufacturer as to the type of information that the administrator needs to judge a suspension. They are neutral on the type of power system that is to be used to propel light vehicles by 1975.

Mr. KYROS. Late yesterday afternoon we had testimony from Mr. Lombardo of the Center for Public Interest. Among Mr. Lombardo's statements was his feelings that it was wrong to make a change in the cold start procedures applicable to the 1975 vehicles. He said that historically you should test the one cold start to simulate the start-up in the morning between 6 and 9 a.m. and General Motors suggested you make four and a half starts and average them throughout the day. Mr. Lombardo suggested this was not an accurate measure of testing that the EPA seemed to agree with. Would you comment on that, Mr. Ruckelshaus.

Mr. RUCKELSHAUS. Let me comment in general and then I think Mr. Stork can describe with greater clarity the reason we changed our testing procedure.

In the first place, Mr. Lombardo has raised this same question in a lawsuit against the Agency. As I said in my statement, I welcomed this because what we are trying to do clearly is comply with the law that Congress has passed and that is to reduce by 90 percent the emissions that have been showing up in the 1970 automobiles for, in this case, hydrocarbons. We are trying to comply with the law. The only way we can decide whether we are in fact complying with the law is based on the way we measure those pollutants coming out of the 1970 automobile, and that same measurement has to be applied to the 1975 automobiles to gage a 90-percent reduction. I think Mr. Stork can describe to you precisely why we made this change.

Mr. STORK. Mr. Kyros, first, I think we have to point out the statement historically has no basis in fact whatsoever. The self-weighting cold start procedure that is referred to in Mr. Lombardo's statement had been promulgated on November 10, 1970, as applicable to 1972-model-year cars. Prior to that time, a totally different test procedure was used which, in fact, did not measure the cold start at all adequately.

Emission testing is a very complicated and developing science. To make it as brief as possible, in developing the test procedure that is to be applied to 1975 cars, it was necessary for the EPA to look again very carefully at exactly how best to measure the emissions from cars in a way that is as representative a test as it is possible to get of what really causes smog. I can, if you desire, go into considerable detail, but I won't do that.

The point is, the revised test procedure is a more accurate representation of how cars are really operated, and how cars are really operated is what causes smog.

Mr. KYROS. Thank you very much. I want to commend you, Mr. Ruckelshaus, for your very candid views. I have assured myself that Congress has never legislated technology and feel that you have reached that same conclusion.

Mr. RUCKELSHAUS. That is right. There is a debate going on now regarding these standards and that is to the good. As long as those are the standards Congress asked us to implement, we are going to do everything we can to implement them.

Mr. ROGERS. Mr. Nelsen.

Mr. NELSEN. Mr. Ruckelshaus, may I join with my colleagues in thanking you for the very difficult job that you are doing and also for recognizing the tremendous obstacles that industry faces in meeting some of the standards we hope will be met.

I might comment that I am pleased that this environmental concern has developed. However, viewing many of the things that we discuss and the goals that we set, so many times there is an inclination to overlook the fact that it has taken years to get to the situation in which we find ourselves, and you cannot just overnight turn it around. We set a new goal and move toward it, and it takes some time to get the job done. I hope we will be patient and careful in our process in reaching that goal.

May I ask this question. We are changing our fuel design now to reach this goal, but what about the cars that are designed for a leaded gasoline and what will I have to do with my old 1965 Buick? Will I be able to buy fuel to run it or what will happen?

Mr. RUCKELSHAUS. We are in the process of developing proposals. We are giving consideration to the fact that there are automobiles that will still be on the road that have to have a high-octane fuel level in order to properly operate. So, what we are presently thinking of is making leadless fuel less available by 1974. We will have to have a schedule of phasing lead out of fuel over the next few years.

Clearly, one of the considerations that we have to bear in mind is the need of some of the older automobiles for higher octane fuel. If lead cannot be used to increase the octane level of the fuels, some other additive has to be used, and we have to be careful that those other additives do not get us into other problems. We are trying to address this whole spectrum, including lead itself, in considering the standards we hope to promulgate pretty soon.

Mr. NELSEN. As I recall, in the hearings, the major reason for the lead removal from fuels was the fact that if lead was contained in the fuels, the catalytic converter would be coated up in no time at all, and this was the major reason, and the emission was not as much a factor as was the fact that the catalytic converter would be coated and would be ineffective. Is that still the conclusion?

Mr. RUCKELSHAUS. It is our belief, Mr. Nelsen, that both reasons are important. No. 1, it is necessary in our opinion, to have a chance of meeting the 1975 standard, that a catalytic converter of some kind be used. At least that seems to be a consensus at this time. In order to protect that converter, leadless gasoline is needed.

By the same token, while the information is not without some ambiguity, we have sufficient concern over the health effects of lead in the ambient air that we believe it advisable also to regulate lead from this point of view also.

Under the act, we can regulate lead, as an additive to gasoline with the same section both on the grounds of its health effects and on the grounds of its need in order to meet the 90 percent reduction standards in the statute.

Mr. NELSEN. I seem to recall that in our hearings, whether it be in this particular area or drugs or any other area, we in our committee constantly attempt to encourage hearings, encourage communication so that those who are affected may exchange ideas, exchange the information necessary to move toward a goal. I feel that the Members of Congress who set up this meeting and who sponsored it—I am not acquainted with all of the facts, just having returned, Mr. Chairman—but I think a compliment is in order that communications have been established, that hearings are being held, and that there has been

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an exchange of information between industry and your agency. I want you to know that as far as I am concerned, you can never solve a problem unless you have communications with the people with whom you deal. I believe this effort should be complimented, not a feeling left that something is going on that should not go on because how can you solve a problem unless you have communications?

I want to say to you again, my compliments to you for the job you are doing. It is not an easy one, and we are with you all the way.

Mr. RUCKELSHAUS. Thank you, Mr. Nelsen.

Mr. ROGERS. Dr. Carter.

Mr. CARTER. Thank you, Mr. Chairman. I certainly want to compliment you on your presentation and the fine job you are doing.

I have no questions, Mr. Chairman.

Mr. ROGERS. Mr. Hastings.

Mr. HASTINGS. Thank you, Mr. Chairman.

I do not have anything bad to say about you after having heard everything that is good about your work. My colleagues have been complimenting you and your agency on the work you are doing. I was present in Birmingham, as the Chairman mentioned, where you used the emergency powers, and I was quite impressed. We are glad we wrote something in the bill that worked when it was called upon.

On the time-frame, you have 60 days after an application is received from the manufacturer; is that correct?

Mr. RUCKELSHAUS. That is right.

Mr. HASTINGS. The automobile manufacturers seemed to indicate by mid-1972, in order to tool up, some extension of time is necessary. Can we assume that this decision will be forthcoming?

Mr. RUCKELSHAUS. Again, without trying to predetermine when the decision will be made, one of the things we are presently looking into, and one of the things I mentioned in my opening statement, is this question of lead time—whether in fact the automobile companies need a decision by the middle of this year in order to be able to tool up in time for the 1975 model year.

Mr. HASTINGS. You are not necessarily accepting their statement?

Mr. RUCKELSHAUS It is an assumption which, like the other assumptions has to be proven, and that is one of the reasons we are looking into this question.

Mr. HASTINGS. I am glad to know you are questioning even the lead time. We have to accept their statements on face value. The NAS report seemed to indicate that by 1972 this decision would have to be made.

Mr. RUCKELSHAUS. I think that is right, Mr. Hastings, and I have asked our staff why we just assume this. Is this a correct assumption? We may have to ascertain independently whether it is true, in order for me to act in the public interest as I am supposed to under the act. For that reason, we are trying to investigate the question of whether in fact this lead time is necessary.

Mr. HASTINGS. That decision is not available at this time?

Mr. RUCKELSHAUS. I think it has to be part of the overall decision as to wether an extension of time would be granted.

Mr. HASTINGS. One other question. Repeatedly we hear from various segments both in the automobile industry and from the fuel people that the 90 percent reduction figure related to hydrocarbons and car-

bon monoxide is an arbitrary figure the way we wrote it and there should be a study instituted to perhaps reassess whether or not 90 percent is an accurate reflection and whether it is possible. Do you have any judgment on that?

Mr. RUCKELSHAUS. There are a lot of things I need to learn, but one is I do not want to accuse Congress of ever acting arbitrarily.

Mr. HASTINGS. That is very nice of you but both of us know better.

Mr. RUCKELSHAUS. I recognize from the Senate reports and other documentation where the 90 percent reduction figure came from. I do not believe it is totally illogical or arbitrary. I do believe, however, that this standard, like any standard, whether it is set by Congress or set by the administrative branch, should be constantly reviewed to see if it is in the public interest. I think the reviews going on relating to this standard are all to the good.

One of the things I have found in the year in this job, in setting standards, is that they are often being set without as much information as we would like ideally to have. I do not believe this means, however, that we do not act. It does mean that we have to make the best and wisest approximation that we can make. In setting that standard, we should not thereby say, "from now on that is it and we will never review what we have done." By the same token, I think in the 90 percent reduction standard, this review and debate that is going on is all to the good. That does not necessarily mean the standard is arbitrary. It is the best approximation that could be made at the time.

Mr. HASTINGS. You are saying somebody should take a look at it.

Mr. RUCKELSHAUS. Everybody is taking a look at it and that is all to the good.

Mr. HASTINGS. General Motors met with the oil companies and they said they could not meet the standards by 1976 unless there was a drastic change in the fuel and the fuel companies indicated economically this was not possible, looking at the question of high volatility.

Mr. STORK. We have not so far made a comprehensive study of the specific types of fuels that will be needed for 1975 automobiles. It is entirely appropriate for the automobile companies, who know far more about the technology that they intend to use, to make these studies. We are aware of the meetings General Motors has had with the oil companies. To my best knowledge, we have had no involvement in those meetings.

Mr. HASTINGS. We have the problem of the manufacturers saying they cannot meet the requirements and, in turn, we would have to ask the fuel companies to come up with a new type of fuel.

I would hope there would be a study made on this.

Mr. STORK. The series of meetings you are talking about is going on now. Some oil people have told me they are meeting with General Motors within the next week or two.

Mr. RUCKELSHAUS. It is something we could take into account in the suspension proceedings themselves but, again, like the no-lead fuel, the petroleum industry has traditionally tailored its fuels to the needs of the automotive companies. The question of whether it is possible to tailor the fuel to this particular kind of need that General Motors might have is one that I think we can resolve in suspension proceedings. It is my understanding that there is some division of opinion, between the automotive companies themselves as to whether this change is needed.

Mr. HASTINGS. I believe that is correct.

Thank you very much, Mr. Ruckelshaus. I wish you well in your work, and I have no other questions.

Mr. ROGERS. Mr. Ruckelshaus, I notice you stated one of the reports had not been made, but you would submit it as soon as possible. Which report was that?

Mr. RUCKELSHAUS. The aircraft emission standards report.

(The aircraft emission standards report requested was not available—to the committee at the time of printing.)

Mr. ROGERS. I think you own us a couple more reports of studies as well. Section 312 requires a study on economic impact. Has that study been completed?

Mr. RUCKELSHAUS. No, Mr. Chairman, it has not been. We expect to be submitting——

Mr. ROGERS. This was due January 10.

Mr. RUCKELSHAUS. It is due on January 10. What we are doing is reviewing the figures submitted under the 1973 budget, and we sent letters to the Speaker of the House and the President of the Senate and this committee, and we expect that the report can now be prepared by the end of February.

Mr. ROGERS. So we can expect that report by the end of February?

Mr. RUCKELSHAUS. That is right, Mr. Chairman.

("The Economics of Clean Air," an annual report of the Administrator of the Environmental Protection Agency to the Congress of the United States in compliance with Public Law 91-604, the Clean Air Amendments of 1970, was transmitted to the Speaker of the House of Representatives by the Administrator of EPA on February 29, 1972. The report was printed as Senate Document 92-67—March 1972. A copy of this document may be found in the committee's files.)

Mr. ROGERS. What about the report on progress and problems associated with the control of automobile exhaust and aircraft exhaust requirements, and so on, covered in section 313?

Mr. RUCKELSHAUS. This report, like the earlier one, is in the last stages of review. Again, we have notified the Speaker of the House and the President of the Senate of the delay, and we expect these to be available by the end of February.

Mr. ROGERS. Both of those reports will be submitted?

Mr. RUCKELSHAUS. Yes, sir.

("Progress in the Prevention and Control of Air Pollution," an annual report of the Administrator of the Environmental Protection Agency to the Congress of the United States in compliance with Public Law 91-604, the Clean Air Act of 1970, was transmitted to the Speaker of the House of Representatives by the Administrator of EPA on February 29, 1972. This report was printed as Senate Document 92-66—March 1972. A copy of this document may be found in the committee's files.)

Mr. ROGERS. The States must have plans and intentions in by the end of this month?

Mr. RUCKELSHAUS. That is right.

Mr. ROGERS. Have any already been submitted?

Mr. RUCKELSHAUS. Yes.

Mr. ROGERS. About how many?

Mr. RUCKELSHAUS. We now have six.

Mr. ROGERS. What States are those?

Mr. RUCKELSHAUS. Vermont, New Hampshire, Georgia, North Carolina, Iowa, and North Dakota.

Mr. ROGERS. Have there been any requests from any of the States?

Mr. RUCKELSHAUS. Yes; we have not granted extensions as such because we are not permitted to do so under the act. We have been working very closely with the States on these plans and if a State does not submit its plan on time, rather than cutting out the State completely, we hope to continually work with the State, and if the plan can be submitted even beyond the deadline, fine. If it is the State's own plan, we believe there is a better chance of its being implemented under the terms of the act than if we simply shunt them aside and develop the plan without their involvement at all.

Mr. ROGERS. I presume there is no penalty other than having you go in and plan it for them; is that correct?

Mr. RUCKELSHAUS. Under the terms of the act, if they do not get it in by the end of January, we start the plan. We have been working with them right along in trying to develop these plans.

Mr. ROGERS. I think that is good. Do any particular States seem extremely far behind?

Mr. MIDDLETON. No, other than some having been tardy in announcing that hearings will be held.

Mr. ROGERS. Are there any States which are not prepared at all for the public hearings which would be the final stage?

Mr. RUCKELSHAUS. Not to my knowledge.

Mr. ROGERS. Are there any plans from any State that you cannot anticipate being submitted within, say, the next 3 months?

Mr. BAISE. We expect to receive plans from all of the States.

Mr. MIDDLETON. There has been a close regional working relationship with the States.

Mr. ROGERS. I understand, and I think that is most commendable. Would you keep the committee advised and would you let us know what States do not submit plans as of the end of January?

Mr. RUCKELSHAUS. Certainly.

(The following statement was received for the record:)

By the end of February 1972 all the States had submitted plans.

Mr. ROGERS. As I understood it, you set out some plans and there have been some criticisms brought to your attention on some of the plans. I think on State plans it went over to the OMB for supposedly a perfunctory review, but when it came back, there were rather considerable changes. Could you comment on the changes that OMB evidently required you to make other than just reviewing what you had done? Could you let us know who the experts are in the OMB who are qualified?

Mr. RUCKELSHAUS. If I could get the list of those names, I will give it to you.

(The following information was received for the record:)

OMB'S RESPONSIBILITY FOR REVIEWING EPA'S GUIDELINES AND REGULATIONS

The Environmental Branch of the Natural Resources Programs Division is the group responsible at the Office of Management and Budget for reviewing the Environmental Protection Agency's guidelines and regulations. I believe it is important to point out that this group acts as a conduit in requesting and receiv-

ing comments from other Federal agencies. The procedure for the review is set out in Director Schultz's memorandum of October 5, 1971. (Memorandum follows.)

EXECUTIVE OFFICE OF THE PRESIDENT,
OFFICE OF MANAGEMENT AND BUDGET,
Washington, D.C., October 5, 1971.

MEMORANDUM FOR THE HEADS OF DEPARTMENTS AND AGENCIES

Subject: Agency regulations, standards, and guidelines pertaining to environmental quality, consumer protection, and occupational and public health and safety.

This memorandum is to establish a procedure for improving the interagency coordination of proposed agency regulations, standards, guidelines and similar materials pertaining to environmental quality, consumer protection, and occupational and public health and safety. This procedure will apply to all such materials proposed for issuance by any executive department or agency other than the regulatory boards or commissions listed in the attachment which could be expected to:

Have a significant impact on the policies, programs, and procedures of other agencies; or

Impose significant costs on, or negative benefits to, non-Federal sectors; or

Increase the demand for Federal funds for programs of Federal agencies which are beyond the funding levels provided for in the most recent budget requests submitted to the Congress.

To implement this procedure, agencies covered by this procedure are to submit to the Office of Management and Budget by October 25, 1971:

A schedule, classified where possible according to the above criteria, covering the ensuing year showing estimated dates of future announcements of all proposed and final regulations, standards, guidelines or similar matters in the subject areas shown above;

The name of an agency official who will be responsible for your agency's participation in the coordination process and who will serve as the primary contact point with the Office of Management and Budget and other agencies for all matters pertaining to this procedure.

Schedules described above should be updated monthly and submitted by the first of each month beginning December 1, 1971. Schedules should indicate whether the proposed actions are specifically required by statute and whether the scheduled announcement date is set by statute.

Proposed and final regulations, standards, guidelines, and similar actions meeting the criteria outlined above should be submitted to the Office of Management and Budget at least 30 days prior to their scheduled announcement. The regulations should be accompanied by a summary description indicating:

The principal objectives of the regulations, standards, guidelines, etc.;

Alternatives to the proposed actions that have been considered;

A comparison of the expected benefits or accomplishments and the costs (Federal and non-Federal) associated with the alternatives considered; and

The reasons for selecting the alternative that is proposed.

As a part of its role in the interagency coordination process, the Office of Management and Budget will receive copies of proposed regulations and similar materials from departments and agencies, distribute those materials to other agencies affected, collect comments and provide them to the agency proposing the regulations for its information.

A continuing effort will be needed to simplify the reporting and coordination procedures called for in this memorandum and to focus upon the most significant actions. It may be possible, for example, to eliminate certain categories of regulations, standards or guidelines that would otherwise be included in the criteria outlined above. In this regard, and in implementing the general provisions of this memorandum, agencies are to work with the OMB Assistant Directors and Program Divisions with which they normally deal on program and budget matters.

GEORGE P. SHULTZ,
Director.

Mr. ROGERS. What you are referring to are the guidelines to the States as to how we would expect them to implement the national ambient air quality standards. They have been made a part of the record, I think. They are called requirements for preparation, adoption, and submittal of implementation plans. There has been a good deal of confusion over the guidelines. There is no statutory requirement that we issue such guidelines as there is for national ambient air quality standards. When the guidelines were originally proposed by the Agency, a number of groups of all kinds in societies, States, industry, environmental groups, even other governmental agencies, complained about them. We instituted a review of these complaints and made several changes in the guidelines as originally proposed.

The essential basis of those changes was to provide more flexibility to the States to meet the national ambient air quality standards. There were no changes made in those guidelines which I did not approve.

The involvement of OMB in these guidelines and in our regulation, I think, has got to be made clear. They act as a reviewing or conduit agency for other governmental agencies to comment on our regulations and the regulations of any other agencies. We receive those comments, discuss them with OMB, but the final decision has to be mine. I cannot delegate that decision to anyone else, nor did I delegate that decision in issuing these guidelines.

Essentially, what the guidelines have done is, instead of saying "here is the way you are to meet the ambient air quality standards," we are saying "here is a range of options, not to be exclusive, by which you can meet these standards."

Mr. ROGERS. Would you let us have for the record your proposed guidelines before they went to OMB and then OMB's suggestions and then your final determination. Did your final determination vary any from OMB's?

(Testimony resumes on page 528.)

(The following material was submitted for the record:)

[Submitted to Office of Management and Budget from EPA, June 1971]

ENVIRONMENTAL PROTECTION AGENCY

[42 CFR Part 240]

PLANS FOR IMPLEMENTATION OF NATIONAL AMBIENT AIR QUALITY STANDARDS

Notice of Proposed Regulations for Preparation, Adoption, and Submittal of Implementation Plans

On or about April 30, 1971, pursuant to Section 109 of the Clean Air Act, as amended, the Administrator will promulgate national ambient air quality standards for sulfur oxides, particulate matter, carbon monoxide, photochemical oxidants, hydrocarbons, and nitrogen oxides. Within none months thereafter, each State is required by Section 110 the Act to adopt and submit to the Administrator a plan which provides for the implementation, maintenance, and enforcement of such national ambient air quality standards within each air quality control region (or portion thereof) within the State. An additional period of no longer than 18 months may be allowed for adoption and submittal of that portion of a plan relating to implementation of secondary ambient air quality standards. State plans must provide for attainment of national primary ambient air quality standards within three years after the date of the Admin-

istrator's approval of such plans, except that a two-year extension of this deadline may be granted by the Administrator upon application by a Governor if the application satisfies the requirements set forth in Section 110(e) of the Act. State plans must provide for attainment of national secondary ambient air quality standards within a reasonable time.

Within four months from the date on which State plans are required to be submitted, the Administrator must either approve or disapprove such plans or portions thereof. The regulations proposed herein contain the requirements to be met in preparing, adopting, and submitting implementation plans, and in requesting extensions of the time deadlines set forth in the Act. The proposal also sets forth the factors which the Administrator will take into consideration in reviewing State plans and evaluating requests for extensions.

It is recognized that States will require assistance from the Environmental Protection Agency in preparing implementation plans conforming to the requirements proposed herein. The Agency will furnish such assistance through its Regional Air Pollution Control Directors.

Interested persons may submit written comments on the proposed regulations in triplicate to the Office of the Associate Commissioner, Air Pollution Control Office, Environmental Protection Agency, 411 West Chapel Hill Street, Durham, North Carolina 27701. All relevant comments postmarked not later than 21 days after publication of this notice will be considered. The regulations, modified as the Administrator deems appropriate after consideration of comments, will be effective upon the date of their republication in the Federal Register.

This notice of proposed rulemaking is issued under the authority of Section 301(a) of the Clean Air Act (42 U.S.C. 1857g(a), as amended by Section 15(c)(2) of Pub. Law 91-604, 84 Stat. 1713).

_____,
Administrator, EPA.

A new Part 420 would be added to Chapter IV, Title 42, Code of Federal Regulations, as follows:

Part 420—Requirements for Preparation, Adoption, and Submission of Plans

Subpart A—General Provisions

Sec.

Subpart B—Plan Content and Requirements

Sec.

Subpart C—Extensions

Sec.

Subpart A

§ 420.01 Definitions

As used in this part, all terms not defined herein shall have the meaning given them in the Act:

(a) "Act" means the Clean Air Act (42 U.S.C. 1857–18571, as amended by Pub. Law 91–604, 84 Stat. 1676).

(b) "Administrator" means the Administrator of the Environmental Protection Agency.

(c) "Primary standard" means a national primary ambient air quality standard promulgated pursuant to Section 109 of the Act.

(d) "Secondary standard" means a national secondary ambient air quality standard promulgated pursuant to Section 109 of the Act.

(e) "National standard" means either a primary or a secondary standard.

(f) "Plan" means an implementation plan, under Section 110 of the Act, to attain and maintain a national standard.

(g) "Regional Director" means a Regional Air pollution control Director of the Environmental Protection Agency.

(h) "State agency" means the air pollution control agency primarily responsible for development and implementation of a plan under the Act.

(i) "Local agency" means any air pollution control agency, other than a State agency, which is charged with responsibility for carrying out part of a plan.

(j) "Region" means (1) an air quality control region designated by the Secretary of Health, Education, and Welfare or the Administrator (2) any area designated by a State as an air quality control region under (1) or (2) herein.

§ 420.02 Classification of regions

This section establishes a classification system to categorize regions for purposes of plan development and evaluation. The requirements of this Part vary according to the classification of each region, in order that the time and resources to be expended in developing the plan for that region, as well as the substantive content of that plan, will be commensurate with the complexity of the air pollution problem. The classification will be based upon measured ambient air quality, where known, or, where not known, estimated air quality in the area of maximum pollutant concentration. All regions will be classified by the Administrator after consultation with State governments. Each region will be classified separately with respect to each of the following pollutants: sulfur oxides, particulate matter, carbon monoxide, nitrogen dioxide, and photochemical oxidants.

(a) For sulfur oxides and particulate matter, each region will be classified into one of three categories, defined as Priority I, Priority II, or Priority III.

(1) (i) Ambient concentration limits (expressed as micrograms per cubic meter) which define the classification system for sulfur oxides and particulate matter are:

Pollutant		Priority I: Greater than	Priority II: From	Priority II: To	Priority III: Less than
Sulfur oxides	Annual arithmetic mean	100	60	100	60
	24-hour maximum	455	260	450	260
Particulate matter	Annual geometric mean	95	60	95	60
	24-hour maximum	325	150	325	150

(ii) The more restrictive classification will be chosen where there is a difference between the 34-hour maximum value and the annual average, e.g., if a region is Priority I with respect to an annual average and Priority II with respect to a 24-hour maximum value, the classification will be Priority I.

(2) The procedures which will be used to estimate air quality in regions where no measured data or inadequate data exist are described in Appendix A.

(b) For carbon monoxide, nitrogen dioxide, and photochemical oxidants, each region will be classified into one of two categories, defined as Priority I or Priority III.

(1) Ambient concentration limits which define the classification system are:

(i) Carbon monoxide: Priority I: Equal to or above 21 milligrams per cubic meter, one hour maximum, or 14 milligrams per cubic meter, eight hour maximum: Priority III: Below both of such values.

(ii) Nitrogen dioxide: Priority I: Equal to or above either of the primary standards; Priority III: Below both of the primary standards.

(iii) Photochemical oxidants: Priority I: Equal to or above 170 micrograms per cubic meter, one-hour maximum; Priority III: Below such value.

(2) In the absence of measured data to the contrary, classification with respect to carbon monoxide, photochemical oxidants and nitrogen dioxide will be based on the following estimate of the relationship between these pollutants and population: Any region containing a metropolitan area whose 1970 "urban place" population, as defined by the U.S. Bureau of Census, exceeds 200,000 will be classified as Priority I. All other regions will be classified as Priority III.

(3) Classifications with respect to hydrocarbons will be the same as the classifications with respect to photochemical oxidants.

§ 420.03 Public hearings

(a) Each State shall, prior to adoption of a plan and after reasonable notice thereof, conduct one or more public hearings on the plan. Separate hearings may be held for plans to implement primary and secondary standards.

(b) For purposes of this Part, "reasonable notice" shall be considered to be notice given at least twenty-one days prior to the date of the hearings. In the case of an interstate region, "reasonable notice" shall be considered to include notice to the State agency of any other State a portion of which is included in the region, and to any local agencies in such other's portion of the region.

(c) States shall prepare and retain, for submission to the Administrator upon his request, a record of the hearing(s). The record shall contain, as a minimum, a list of witnesses together with a summary of each presentation.

(d) Each State shall submit with its plan (1) a copy of the notice required by this section; and (2) a certification that the hearing was held in accordance with the notice.

§ 420.04 Submission of plans; preliminary review of plans

(a) Submission to the Administrator shall be accomplished by delivering five copies of the plan to the appropriate Regional Director and a letter to the Administrator notifying him of such action. Plans shall be adopted by each State and submitted to the Administrator by the Governor as follows:

(1) For any primary standard, within nine months after promulgation of such standard.

(2) For any secondary standard, within nine months after promulgation of such secondary standard or by such later date prescribed by the Administrator pursuant to Subpart C.

(b) Upon request of a State agency, the Administrator will provide preliminary review of a plan or portion thereof submitted in advance of the date such plan is due. Such requests shall be made in writing to the appropriate Regional Director, and shall be accompanied by five copies of the material for which review is sought. Such requests shall be made no later than 90 days prior ot the date on which a plan is required to be submitted. Requests for preliminary review shall not operate to relieve a State from the responsibility of adopting and submitting plans in accordance with prescribed due dates.

§ 420.05 Revisions

(a) The plan shall provide for its revision from time to time as may be necessary to take account of:

(1) revisions of national standards,

(2) the availability of improved or more expeditious methods of achieving such standards, or

(3) a finding by the Administrator that the plan is substantially inadequate to achieve or maintain the national standard which it implements.

(b) The plan shall be revised within 60 days following notification by the Administrator under paragraph (a) of this section, or by such later date prescribed by the Administrator after consultation with the State. Where required by the Administrator or the laws of the State, such revisions shall be adopted after reasonable notice and public hearings.

§ 420.06 Reports

(a) For the three-month period commencing with the approval of a plan by the Administrator, and for each three-month period thereafter, the State shall submit to the Administrator (through the Regional Director) a report on air quality data that includes data on pollutant concentrations; sampler types; sampling period; time interval and frequency of sampling; methods of collection and analysis; sampler locations; and elevation and height of sampling stations.

(b) For the six-month period commencing with the approval of a plan by the Administrator, and for each six-month period thereafter, the State shall submit to the Administrator (through the Regional Director) reports on progress toward carrying out the plan. Such reports shall include information on: compliance with time schedules and emission limitations included in the plan, enforcement activities, implementation of permit and registration systems, source tests and monitoring programs, emergency episode regulations, actions taken with respect to variances, progress in acquiring the resources provided for in the plan, and any difficulties which have delayed or may delay the State in carrying out the approved plan.

(c) The reports required by this section shall be submitted within 30 days after the end of the reporting period on forms which shall be prescribed by the Administrator.

§ 420.07 Approval of plans; applicable State plans

The Administrator shall approve any plan or portion thereof, or any revision of such plan or portion thereof if he determines that it meets the requirements of the Act. The approved plan or any portion thereof shall be the applicable State plan for purposes of the Clean Air Act. Changes or revisions in such plan shall not be considered part of the applicable State plan until such changes or revisions have been approved by the Administrator in accordance with this part.

Subpart B—Plan Content and requirements

§ 420.10 General requirements

(a) Each plan shall include such emission limitations and other measures as are necessary for attainment and maintenance of the national standards in each region within the State to which such plan applies. Plans for different regions within a State may be submitted in a single document or in separate documents.

(b) Plans implementing a primary standard shall provide for the attainment of such standard as expeditiously as practicable, but in no case, except as otherwise provided by Subpart C, later than three years after the date of the Administrator's approval of such plan.

(c) Plans implementing a secondary standard shall provide for the attainment of such standard within a reasonable time after the date of the Administrator's approval of such plan.

(d) The plan for each region shall have adequate provisions to insure that pollutant emissions within such region will not interfere with attainment and maintenance of the national standards in any portion of such region or in any other region.

(e) Each plan shall include, in accordance with the requirements more specifically set forth in this Subpart, separate sections setting forth:

(1) The legal authority to implement such plan.

(2) The emission limitations and other measures to be implemented in order to attain and maintain the national standards (which emission limitations and other measures, together with timetables for implementing such limitations and other measures, shall be referred to hereinafter as the "control strategy").

(3) The adequacy of the control strategy.

(4) Existing air quality and source emissions.

(5) Systems to be used for surveillance of air quality and emissions.

(6) Procedures and criteria for emergency action.

(7) The resources which are and will be made available for implementation of such plan.

(8) Provisions for intergovernmental cooperation in the formulation and implementation of such plan.

§ 420.11 Legal Authority

(a) The plan shall show that the State agency or agencies directly responsible for implementing the plan have legal authority to implement the plan, including authority to:

(1) Adopt emission standards and limitations and any other measures required by the plan as necessary for attainment and maintenance of national ambient air quality standards.

(2) Enforce applicable laws, regulations, and standards, including authority to seek injunctive relief.

(3) Abate pollutant emissions on an emergency basis to prevent substantial endangerment to public health, i.e., authority comparable to that available to the Environmental Protection Agency under Section 303 of the Clean Air Act, as amended.

(4) Establish and operate statewide system under which permits would be required for the construction and operation of new stationary sources of air pollution and the construction and operation of modifications to existing sources, including authority to prevent such construction, modification, or operation, and any other necessary land use control authority required by the plan.

(5) Obtain information necessary to determine whether air pollution sources are in compliance with applicable laws, regulations, and standards, including authority to require record keeping and to make inspections and conduct tests of air pollution sources.

(6) Require owners or operators of stationary sources to install, maintain, and use emission monitoring devices and to make periodic reports to the State on the nature and amounts of emissions from such stationary sources and to make such data available to the public as reported and as correlated with any applicable emission standards.

(7) Carry out a program of inspection and testing of motor vehicles to enforce compliance with applicable emission standards when necessary and practicable, and to impose other necessary controls on transportation provided for in the plan.

(b) The provisions of law or regulation which the State determines provide the authority required under this section shall be specifically identified, and copies of such laws or regulations shall be submitted with the plan.

(c) The plan shall show that the legal authorities specified in this section are available to the State agency or agencies directly responsible for implementing the plan at the time of submission of the plan.

§ 420.12 Control strategy: General

(a) In any region where measured or estimated ambient levels of a pollutant are above the levels specified by an applicable national standard, the plan shall include a control strategy which shall be shown to provide for the degree of emission reduction necessary for attainment and maintenance of such national standard, including the degree of emission reduction necessary to offset emission increases that can reasonably be expected to result from projected growth of population, industrial activity, motor vehicle traffic, or other factors that may cause or contribute to increased emissions.

(b) In any region where measured or estimated ambient levels of a pollutant are identical to, or below, the levels specified by an applicable secondary standard, the control strategy shall include procedures for preventing such ambient levels from exceeding such secondary standard. Regulations such as those described in section 1.1 of Appendix B will be deemed to fulfill this requirement.

§ 420.13 Control strategy: Sulfur Oxides and Particulate Matter

(a) In any region where emission reductions are necessary for attainment and maintenance of a primary standard, the control strategy shall provide for the application of such emission limitations or other measures as may be necessary to achieve such emission reductions, including, but not limited to, emission limitations or other measures such as those described in Appendix B.

(b) (1) In any region where application of emission limitations or other measures which are not more stringent than those described in Appendix B will result in attainment and maintenance of a secondary standard, "reasonable time" shall be three years or less, unless the State shows good cause why the application of such emission limitations or other measures should be postponed.

(2) Nothing in this Subpart shall be construed as requiring or encouraging the adoption or enforcement of emission limitations or other measures which will necessitate restrictions on the use or composition of fuel in stationary sources, except as necessary for attainment of primary standards.

(c) Example region:

(1) A control strategy which provides for the attainment and maintenance of a national standard in one region in a State will be deemed by the Administrator to be adequate for attainment and maintenance of such standard in any or all other regions of the State in which measured or estimated levels of the pollutant are lower than those in the region for which the control strategy was formulated, provided that such control strategy is sufficiently comprehensive to include adequate controls on sulfur oxides and particulate emissions from sources listed in Appendix C. Any region (i) for which the State formulates a control strategy which is applied to other regions or (ii) for which a control strategy is developed, without regard to whether such strategy is applied outside of the region, is referred to hereinafter as an "example region".

(2) The State shall obtain, through the Regional Director, the concurrence of the Administrator in the selection of an example region.

(d) Adequacy of control strategy

(1) The plan shall demonstrate that the control strategy for each national standard is adequate for attainment and maintenance of such standard in the example region(s) to which it applies. The adequacy of a control strategy shall be demonstrated by means of a proportional model or diffusion model.

(2) The proportional model shall be one in which the following equation is employed to calculate the degree of improvement in air quality needed for attainment of a national standard:

$$\frac{A-C}{A-B}\times 100 = \text{percent reduction needed}$$

Where:

A = Existing air quality at the location having the highest measured or estimated concentration in the region.

B = Background concentration.

C = National standard.

The plan shall show that application of the control strategy will result in the degree of emission reduction indicated to be necessary by the above calculation. The plan shall contain a summary of the computations used to determine the emission reductions that will result from application of the control strategy to each point source and group of area sources; such summary shall be included in a table similar to that presented in Appendix D. The detailed computations shall be retained and be made available for inspection by the Administrator.

(3) (i) If a diffusion model is used it shall be identified and described; provided, however, that if either of the two diffusion models described in the following publications is used, it need only be identified:

"Air Quality Implementation Planning Program (IPP)", Volume I, Operator's Manual, National Air Pollution Control Administration, Environmental Protection Agency, Washington, D.C., November 1970.

"Air Quality Display Model (AQDM)", National Air Pollution Control Administration, Department of Health, Education, and Welfare, Washington, D.C., November 1969.

(ii) The plan shall contain a summary of emission levels expected to result from application of the control strategy, which summary shall be included in a table similar to that presented in Appendix D.

(iii) The plan shall also show the air quality levels expected to result from application of the control strategy presented either in tabular form or as an isopleth map showing maximum pollutant concentrations and expected concentration gradients. Computer printouts of the input and output data associated with use of a diffusion model shall be retained and made available for inspection by the Administrator.

(4) Appendix B contains examples of emission limitations and other measures directly applicable or adaptable to point sources and area sources. This Subpart shall not be construed to require that such limitations or measures be applied solely to area sources or solely to point sources.

(e) Emissions data

(1) Each plan shall include the following data on emissions of sulfur oxides and particulate matter:

(i) For each example region in the State a detailed inventory of emissions from point sources and area sources in each county shall be summarized in a form similar to that shown in Appendix D, and the data described in Appendix E and Appendix F shall be retained and made available for inspection by the Administrator.

(ii) For all other regions, point-source and area-source data shall be submitted in summary form as shown in Appendix G, except that for regions classified as Priority III, only point-source data and any existing area-source data shall be submitted. Data shown in Appendices E and F shall be retained and made available for inspection by the Administrator.

(2) As used in this section, a "point source" is:

(i) Any stationary source causing emissions in excess of twenty-five (25) tons per year of any pollutant for which there is a national standard, or

(ii) Without regard to quantity of emissions, any source listed in Appendix C.

(3) As used in this section, an "area source" is any small residential, government, institutional, commercial, or industrial fuel combustion operation; on-site waste disposal facility; motor vehicles, aircraft, vessels, or other transportation facilities; or other miscellaneous sources such as those listed in Appendix D, as identified through inventory techniques similar to those described in: "A Rapid Survey Technique for Estimating Community Air Pollution Emissions," Public Health Service Publication No. 999-AP-29, October 1966.

(f) Air Quality Data.

Data showing existing air quality with respect to sulfur oxides and particulate matter shall be submitted for each example region. Actual measurements shall be used where available. If actual measurements are not available and cannot be made in time to be employed in the development of the control strategy, air quality may be estimated by the procedure described in Appendix A. Air quality data, whether measured or estimated, shall be submitted in the form shown in Appendix H.

§ 420.14 Control strategy: Carbon monoxide, hydrocarbons, photochemical oxidants, and nitrogen dioxide

(a) Priority I Regions

(1) Each plan for a region classified as Priority I shall include a control strategy which shall provide for the degree of emission reduction necessary for attainment and maintenance of the national standards after consideration of the emission reductions that will result from the application of Federal motor vehicle emission standards promulgated by the Administrator pursuant to Section 202 of the Act.

(2) Unless specific data are available for a region, a State shall assume that such Federal motor vehicle emission standards will result in the emission reductions shown in Appendix I. If specific data are used, such data must be submitted in the plan for such region.

(b) Priority III Regions. For a region classified as Priority III, a control strategy need include only procedures for preventing ambient levels of a pollutant from exceeding the applicable primary standard. Regulations such as those described in Section 1.1 of Appendix B will be deemed to fulfill this requirement.

(c) Control Strategy Development. In a region in which attainment and maintenance of a national standard will require emission reductions in addition to those which will result from application of the Federal motor vehicle emission standards, the control strategy shall provide for application of such emission limitations or other measures as may be necessary for attainment and maintenance of such national standard, including, but not limited to the following:

(1) Emission limitations or other measures such as those described in Appendix B.

(2) Emission limitations necessitating installation of emission control devices or systems on in-use motor vehicles, which limitations may be assumed to be capable of producing the emission reductions shown in Appendix I.

(3) Emission limitations necessitating conversion of motor vehicle fleets, including commercial and governmental fleets, to use liquified natural gas or liquified petroleum gas or other low-emission fuels or engines.

(4) Measures to reduce motor vehicle traffic, particularly rush-hour traffic, including measures such as commuter taxes, gasoline rationing, parking limitations, staggered working hours, or restrictions on motor vehicle idling time.

(5) Expansion or promotion of the use of mass transportation facilities through measures such as increases in frequency, convenience, and passenger-carrying capacity of mass transportation systems; subsidization of the costs of operating such systems; providing for special bus lanes on major streets and highways; or other incentives to efficient operation and use of such systems.

(6) At such time as they are determined by the Administrator to be feasible and practicable, programs for periodic inspection and testing of motor vehicle emission control systems.

(d) Adequacy of control strategy.

(1) The plan shall demonstrate that the control strategy included in each plan for a region classified as Priority I is adequate for attainment and maintenance of the national standard(s) to which such control strategy applies, by means of a proportional model or diffusion/photochemical model.

(i) With respect to control of carbon monoxide and nitrogen oxides, the proportional model to be used for purposes of this paragraph is described in Section 420.18(d)(2) of this Subpart provided, with respect to the national standards for nitrogen dioxide, it may be assumed that the degree of air quality improvement indicated to be necessary by the proportional model will be achieved by a corresponding degree of reduction of total nitrogen oxides emissions from stationary and mobile sources.

(ii) With respect to control of hydrocarbons and photochemical oxidants, it may be assumed that the degree of total hydrocarbon emission reduction necessary for attainment and maintenance of the primary standards for photochemical oxidants will also be adequate for attainment of the primary standard for hydrocarbons. The proportional model to be used to determine the necessary reduction is set forth in Appendix J.

(2) The plan shall show that the control strategy will result in the degree of emission reduction indicated to be necessary by the proportional model. The plan shall contain a summary of the computations used to determine the emission reductions that will result from application of the control strategy to each point source and each group of area sources. Such summary shall be included in a table similar to that presented in Appendix D. The detailed computations shall be retained by the State and made available for inspection by the Administrator.

(3) If a diffusion/photochemical model is used, the plan shall include a description of such model.

(e) Emission Data. Emission data on carbon monoxide, hydrocarbons, photochemical oxidants, and nitrogen oxides shall be submitted in accordance with the requirements in Section 420.18(e) of this Subpart.

(f) Air Quality Data. Data showing existing air quality levels shall be presented in accordance with this section:

(1) For Priority I regions, data on carbon monoxide, nitrogen dioxide, and photochemical oxidants shall, as a minimum, include the results of measurements made during the period July 1, 1971, through September 30, 1971, in accordance with the following procedures.

Pollutant	Sampling methods	Number of sites per region	Frequency of sampling
Carbon monoxide.....	Nondispersive infrared or equivalent [1]..	1	Continuous.
Nitrogen dioxide.....	24-hour (gas bubbler) method (Jacobs-Hochheiser) or equivalent.[2]	1	1 24-hour sample, once every 3 days.
Photochemical oxidants....	Neutral KI colorimetric (gas bubbler) or equivalent.[3]	1	Continuous if equipment is available; otherwise, 4 1-hour samples taken between 11 a.m. and 3 p.m. local time, 5 days per week.

[1] Equivalent methods are gas chromatographic and mercury replacement.
[2] Equivalent methods are continuous Saltsman and coulometric.
[3] Equivalent methods are chemiluminescence and coulometric.

(2) For Priority I regions, only available air quality data for hydrocarbons must be submitted.

(3) For Priority III regions, no air quality data for carbon monoxide, hydrocarbons, nitrogen oxides, and photochemical oxidants need be submitted.

(4) Air quality data required by this subparagraph shall be submitted in the form similar to that shown in Appendix H.

§ 420.15 Emergency action criteria and procedures.

Plans for Priority I and Priority II regions shall include criteria and procedures for initiating emission control actions commensurate with the severity of air pollution conditions in an emergency episode situation in accordance with the requirements of this section.

(a) Plans for Priority I and Priority II regions shall specify as episode criteria ambient pollutant concentrations at which control actions will be taken to reduce or prohibit emissions and shall provide for such actions to be taken when the specified concentrations are reached at any one monitoring site in the region. The control actions to be taken shall be identified by episode criteria level. Acceptable episode criteria and control actions are set forth in Appendix B.

(b) Plans for Priority I regions shall include the following elements:

(1) Episode surveillance system

(i) The air quality surveillance system in each such region shall include one or more air monitoring stations capable of providing data sufficiently rapidly to permit prompt identification of situations in which pollutant concentrations have reached, or are increasing toward, applicable episode criteria levels.

(ii) Each plan shall provide for daily acquisition of forecasts of atmospheric stagnation conditions and shall further provide that, during periods of atmospheric stagnation or any episode stage, such forecasts shall be updated at least every 12 hours.

(iii) Each plan shall provide for inspection of sources to ascertain compliance with applicable emission reduction requirements.

(2) Each plan shall include an emission reduction plan which shall include prescribed action for reduction of pollutant emissions at each episode criteria level. Such emission reduction plan shall include specific emission reduction action plans for each major source of pollution (100 tons per year, or more). An acceptable episode control regulation is set forth in Appendix B.

(3) Each plan shall provide for communications procedures for transmitting status reports and orders as to control actions to be taken during any episode stage, including procedures for contact with public officials, major emissions sources, public safety and emergency agencies, and news media. Such communications procedures shall be set forth in a manual which shall specify, in detail, how contacts are made and received at each episode criterial level.

(c) In the event that procedures meeting the requirements of paragraph (b) of this section have not been fully implemented by the prescribed date for submitting a plan, a description of procedures under consideration and a timetable for their implementation shall be submitted with the plan. Such timetable shall provide for full implementation of such procedures within one year after such prescribed date. A description of actions that will be taken to reduce emissions during episodes which occur during such one year period shall be included.

§ 420.16 Control Regulations

The control strategy included in the plan shall be adopted in the form of control regulations and copies shall be submitted with the plan, together with timetables for implementation and enforcement of such regulations. A plan con-

taining proposed control regulations does not satisfy requirements for plan content nor will it be construed a timely submission.

§ 420.17 Air Quality Surveillance

(a)(1) The plan shall provide for the establishment of an air quality surveillance system meeting, at a minimum, the following requirements:

Classification of region	Pollutant	Sampling method	Minimum number of air quality monitoring sites	Minimum frequency of sampling
A	Suspended particulates.	NASN high-volume	1 per 50,000 population up to 10 sites.	1 24-hour sample every 6 days.
		Tape sampler	1 per 250,000 population up to 8 sites.	Continuous.
	Sulfur dioxide.	Modified pararosaniline or equivalent.[1]	1 per 100,000 population up to 10 sites, and 1 per 250,000 population up to 8 sites.	1 24-hour sample every 6 days (gas bubbler).[2] Continuous.
	Carbon monoxide.	Nondispersive infrared or equivalent.[3]	1 per 250,000 population up to 8 sites.[4]	Do.
	Nitrogen dioxide.	24-hour sampling method (Jacobs-Hochheiser method) or equivalent.[5]	1 per 100,000 population up to 10 sites, and 1 per 250,000 population up to 8 sites.	1 24-hour sample every 6 days (gas bubbler).[2] Continuous.
	Oxidants	Neutral potassium iodide colorimetric or equivalent.[6]	do	Do.
B	Suspended particulates.	NASN high-volume	3	1 24-hour sample every 6 days.[2]
	Sulfur dioxide.	Modified pararosaniline	3	1 24-hour sample every 6 days (gas bubbler).[2]
C	Suspended particulates.	NASN high-volume	1	1 24-hour sample every 6 days.[2]
	Sulfur dioxide.	Modified pararosaniline	1	1 24-hour sample every 6 days (gas bubbler).[2]

[1] Equivalent continuous instruments are coulometric and flame photometric.
[2] Equivalent to 61 random samples per year.
[3] Equivalent methods are gas chromatographic technique and mercury replacement.
[4] In regions where multiple carbon monoxide monitoring sites are required, 1 should have mobile capabilities.
[5] Equivalent methods are continuous Saltzman and coulometric.
[6] Equivalent methods are chemiluminescence and coulometric.

(2) At least one sampling site must be located in the area of estimated maximum pollutant concentrations.

(b) The plan shall contain a description of the existing and proposed system, which shall set forth:

(1) The basis for the design of the surveillance system, selection of samplers, and sampling sites.

(2) The locations of the samplers by Universal Transverse Mercator (UTM) grid coordinates or the equivalent. Any National Air Sampling Network sampling site may be designated as a sampler location.

(3) The sampling schedules.

(4) The methods of sampling and analysis.

(5) The method of data handling and analysis procedures.

(6) The timetable for the installation of any additional equipment needed to complete the system.

(c) The plan shall provide that information regarding the establishment and operation of the network and the data resulting from its use will be available to the Administrator upon request.

(d) The plan shall provide for monitoring of air quality during emergency episodes. The stations selected for use during episodes must be capable of providing real-time validated air quality data.

§ 420.18 Review of new sources and modifications

(a) Each plan shall include a description of the procedures that will be used to implement the authority described in section 420.11(a)(4) of this Subpart, which procedure shall be adequate to enable the State agency to determine that construction and modification of stationary sources does not result in violations of applicable emission limitations or other regulations and does not interfere with attainment or maintenance of a national standard. Procedures such as those described in section 1.1 of Appendix B will be deemed to fulfill this requirement.

(b) Such procedures shall provide for the submission, by the owner or operator of a new stationary source, or existing source which is to be modified, of such

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information on location, design, construction, and operation of such source as may be necessary to permit the State agency to make the determination referred to in paragraph (a) of this section.

(c) Such procedures shall also include means of disapproving such construction or modification if it will result in a violation of applicable emission limitations or other regulations or will interfere with attainment or maintenance of a national standard.

(d) Such procedure shall provide that approval of any construction or modification shall not affect the responsibility of the owner or operator to comply with applicable emission limitations or other regulations.

§ 420.19 Source registration. Such plan shall contain a description of the procedures that will be used for registration of significant existing sources of pollutants for which there are national standards. Such procedure shall provide for the submission and periodic updating, by the owners or operators of such sources of information on the nature and amount of emissions from such sources and such other information as may be necessary to enable the State agency to determine whether such sources are in compliance with applicable emission limitations or other regulations. Procedures derived from those described in section 1.1 of Appendix B will be deemed to fulfill this requirement.

§ 420.20 Emissions surveillance. Each plan shall include a description of the procedures that will be used to monitor compliance with emission limitations and other regulations applicable to emission sources. Such procedures shall include:

(a) Periodic inspection of stationary sources at intervals not exceeding two years.

(b) A field investigation system for:

(1) Detecting, and initiating any necessary action to abate emissions from sources not otherwise known to the State agency.

(2) Investigating and taking any necessary action with respect to complaints.

(3) Enforcing regulations applicable to visible emissions.

(4) Conducting emission tests on point sources.

§ 420.21 Resources. The plan shall include a description of the resources available to the State agency and local agencies at the date of submission of the plan and of any additional resources needed to carry out the plan during the five year period following its submission. Such description, which shall be provided in a form similar to that in Appendix K, shall include projections of the extent to which resources will be acquired at one, three, and five year intervals.

§ 420.22 Intergovernmental cooperation

(a) For the purpose of assisting the development of a plan for any interstate region, the State agency responsible for implementing national standards in any portion of such an interstate region shall furnish any available data on emissions, air quality, and control strategy development, upon request, to any other State or local agency having such responsibility in any other portion of such interstate region.

(b) Each plan shall identify, by official title, local air pollution control agencies involved in the development of the plan as well as those which will participate in the implementation of the plan.

(c) Each plan shall provide that the State agency having primary responsibility for implementing national standards in any region, or portion thereof, will promptly transmit, to other State agencies having such responsibility in the same or other States, information on factors (e.g., construction of new industrial plants) which may significantly affect air quality in any other portion of such region or in any adjoining region.

Subpart C: Extensions

§ 420.30 Request for two-year extension

(a) The Governor of a State may, at the time of submission of a plan to implement a primary standard in a Priority I region, request the Administrator to extend, for a period not exceeding two years, the three-year period for attainment of the primary standard in such region.

(b) Any such request regarding an interstate region shall be submitted jointly with the requests of the Governors of all States in the region, or shall show that the Governor of each State in the region has been notified of such request.

(c) Any such request regarding attainment of a primary standard shall be submitted together with a plan providing for attainment of such primary stand-

ard not later than five years after the date of the Administrator's approval of such plan and shall show that it is more reasonable to provide for attainment of such primary standard within such five-year period than within a three-year period. Any plan so submitted shall reflect consideration of the emission reductions which can be achieved through application of measures such as those described in Appendix B and in section 420.14(c) of this Subpart.

(d) Any showing pursuant to paragraph (c) of this section shall include:

(1) A clear identification of emission sources or classes of moving sources which will be unable to comply with the requirements of such plan within a three-year period because the necessary technology or alternative methods of compliance will not be available soon enough to permit such compliance.

(2) A clear identification and justification of any assumptions made with respect to the time at which such needed technology or alternative methods of compliance will be available.

(3) A clear identification of the alternative means of attainment of such primary standard which were considered and an explanation of why such alternatives were rejected, or, if any such alternatives were adopted, of why such alternatives can more reasonably be implemented within such five-year period than within a three-year period.

(4) A showing that emission sources or classes of moving sources other than those referred to in subparagraph (1) of this paragraph will be required to comply, within such three-year period, with any applicable requirements of such plan.

(5) A clear identification of the interim control measures provided for in such plan with respect to emissions from such source(s).

§ 420.31 Request for 18-month extension

(a) Upon request of the State agency made in accordance with this section, the Administrator may, whenever he determines necessary, extend for a period not to exceed 18 months the deadline for submitting that portion of a plan that implements a secondary standard.

(b) Requests for such extensions will be given consideration only in the case of Priority I and Priority II regions.

(c) Requests for extensions of the deadline shall show that attainment of the secondary standards will require emission reductions exceeding those which can be achieved through the application of emission limitations identical or equivalent to those described in Appendix B.

(d) In addition to satisfying the other requirements of this Subpart, a request for extension of the deadline with respect to any portion of an interstate region shall be submitted jointly with requests for such extensions from all other States within the region, or shall show that all such States have been notified of such request.

(e) A request for extension of the deadline shall be submitted sufficiently early to permit development of a plan prior to the deadline in the event that such request is denied. Any such request shall contain the information necessary to permit the Administrator to determine whether such request satisfies the requirements of this section.

§ 420.32 Request for one-year postponement

(a) Pursuant to section 110(f) of the Act, the Governor of a State may request, with respect to any stationary source or class of moving sources, a postponement for not more than one year of the applicability of any requirement prescribed in a State plan approved by the Administrator under this Part.

(b) Any such request regarding sources located in an interstate region shall show that the Governor of each State in the region has been notified of such request.

(c) Any such request shall clearly identify the source(s) and requriement(s) which are the subject of such request.

(d) A public hearing will be held, before the Administrator or his designee, on any such request. No such hearing will be held earlier than one year in advance of the prescribed date for compliance with any such requirement(s).

(e) No such request shall operate to stay the applicability of the requirement(s) covered by such request.

(f) A State's determination to defer the applicability of any requirement of a plan with respect to such source(s) will not necessitate a request for postponement under this section unless such deferral will prevent attainment or maintenance of a national standard within the time prescribed by the Act or such additional time prescribed by the Administrator under section 420.30 of this Subpart, provided, however, that any such determination would constitute revision of an applicable State plan under section 420.07 of Subpart A.

APPENDIX A

Air Quality Estimation

Ambient pollutant levels may be estimated through the application of atmospheric diffusion models. These estimates are based primarily upon the emission densities, meteorology, and topography that prevails within a region. Two types of diffusion models may be used: (1) a model developed by Holzworth,[1] and subsequently modified, which estimates annual average concentrations on the basis of emissions uniformly distributed throughout a region; and (2) a diffusion model which predicts concentration resulting from point sources during particularly unfavorable meteorological conditions.

Holzworth model.—This model requires estimates of a region's average emission density, the "size" of the region, and the wind speed through the atmospheric mixing layer. Emission densities have been computed for all of the Standard Metropolitan Statistical Areas (SMSA) for both particulate matter and sulfur dioxide (SO_2) and can be readily estimated for other urbanized areas. Values of the wind speed in the mixing layer have been determined and published by Holzworth. The basic assumptions and technical modifications of Holzworth's procedures are found elsewhere[2]; however, a summary and description of how to use the procedure are presented here.

For discussion purposes let:

X = Estimated concentration, micrograms/cubic meter (ug/m^3)
u = wind speed through mixing layer, meters/second m/s)
Q = Emission density, micrograms/square meter-second (ug/m^2-s)
C = Urban size = 1/2 $\sqrt{\text{urban area}}$, kilometers (km.).

Figure 1 is a plot or "normalized concentration" $\left(\frac{Xu}{Q}\right)$ as a function of urban size and is defined to be the product of predicted concentration and wind speed divided by emission density. Concentrations are an increasing function of urban size and are directly proportional to emission density. The wind serves as a diluting agent and reduces expected pollutant concentrations.

As an example, the SMSA of Chicago is used to compute the expected concentration of SO_2 from 1967 emissions in the Chicago area. The urban area of Chicago for computational purposes is 2,500 square km. The urban size, as defined, is consequently 25 km. and thus from Figure 1:

$$\frac{Xu}{Q} = 230$$

For Chicago:

$$Q = 17.8 \ \frac{\text{ug/sec.}}{\text{meter}^2}$$

$$u = 7.3 \text{ meters/sec.}$$

and hence;

$$X = \frac{(230)\ (17.8)}{7.8} = 561 \text{ ug/m}^3$$

Using this procedure, concentration estimates for both SO_2 and particulate matter can be made on a regional basis. These predicted air quality concentrations may be used to establish region classifications.

Point source model.—A short-term diffusion model[3, 4] will be used to estimate the maximum ambient concentrations due to point source emissions. The model is composed of two portions and describe the maximum concentrations which may occur under two separate types of meteorological conditions. The first portion is stack height dependent and describes concentrations that may occur using a generalized atmospheric diffusion model.[4] The second portion of the model is one in which ambient concentrations are estimated on the basis of emissions from

[1] Holzworth, George Co., "Meteorological Potential for Urban Pollution in the Contiguous United States", Paper No. ME-206 presented at the Second International Clean Air Congress, Washington, D.C., December 1970.
[2] Fonsterstock, et. al., "The Development and Utilization of an Air Quality Index", APCA paper 69-73 presented at annual meeting of APCA, New York, N.Y., June 1969.
[3] Carpenter, S. B., et. al., "Principal Plume Dispersion Models—TVA Power Plants", APCA Paper No. 70-149 presented at annual meeting of APCA, St. Louis., Mo., June 1970.
[4] Gifford, Frank A., "The Problem of Forecasting Dispersion in the Lower Atmosphere", USAEC, Division of Technical Information Extension, Oak Ridge, Tenn., July 1961.

"tall stacks" during periods of low wind speeds and severe limitations on vertical mixing.

A joint consideration of these two models indicates that expected maximum concentrations are constant for physical stack heights which exceed 60 meters. A plot of 24-hour maximum concentration expected for various stack heights and emissions is given in Figure 2.

For example, at stack heights of 60 meters, SO_2 emission rates from a point source must exceed 100 metric tons/day for the primary standard for sulfur oxides to be exceeded. Mass emission rates are available for all significant sources of sulfur oxides and particulate matter in the country and will be used to aid in the regional classification for each pollutant.

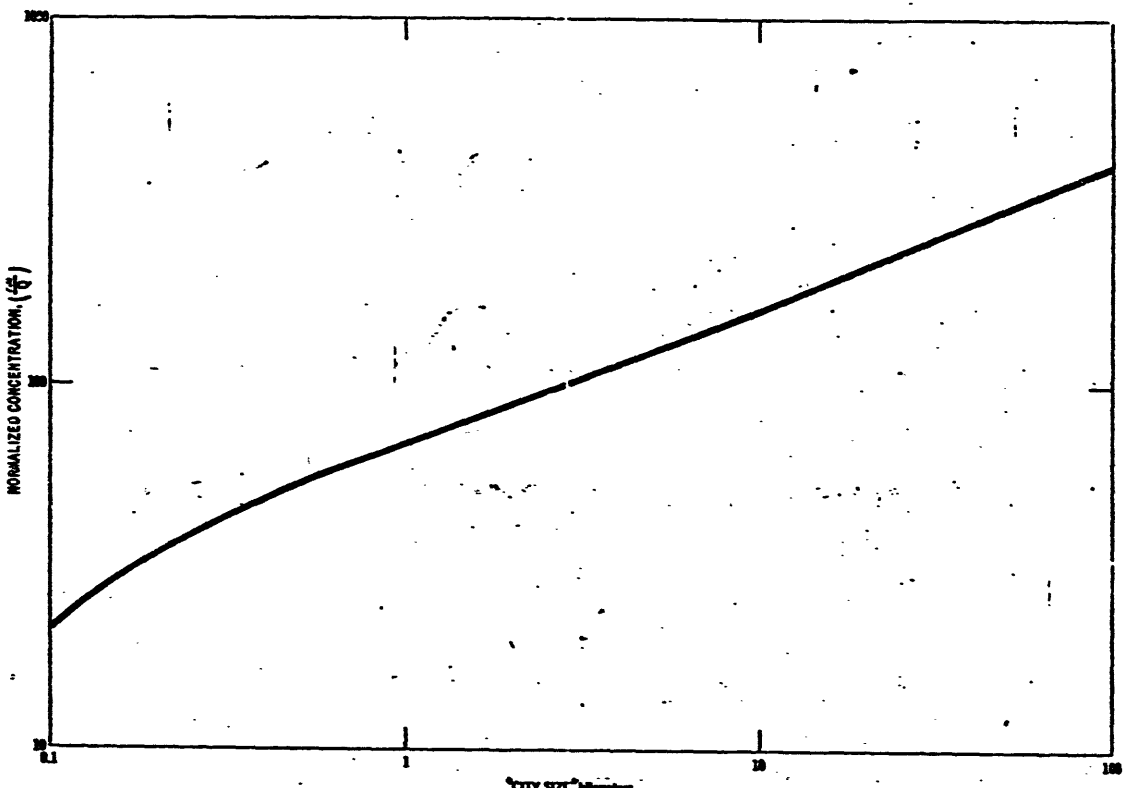

Figure 1.. Relationship of normalized pollutant concentration and city size.

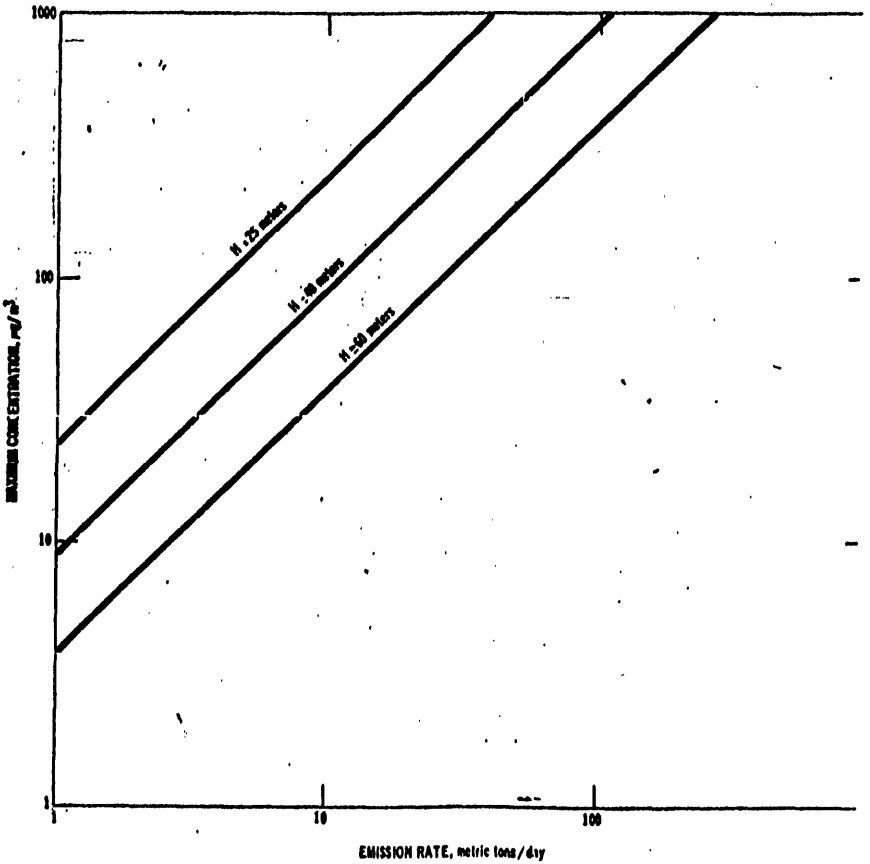

Figure 2. Relationship of emission rate, stack height, and estimated ground-level concentration.

APPENDIX B

AIR POLLUTION CONTROL REGULATIONS

These air pollution control regulations include examples of the administrative provisions and pollutant emission limitations a State may need for an approvable implementation plan. Part I contains general provisions regarding permits for new construction; emission monitoring, record-keeping, and reporting; prevention of air pollution emergencies; and timetables for compliance. Parts II through VII contain emission limitations applicable to sources of particulate matter, sulfur oxides, hydrocarbons, carbon monoxide, and nitrogen oxides.

Although these emission limitations contained herein are relatively stringent, they have, with some modification, been applied by various State and local jurisdictions. Notes have been added, where necessary, to explain the basis or application of the regulations. These emission limitations do not necessarily represent the ultimate in emission control.

I. GENERAL PROVISIONS

1.0 Definitions.

1.0.1 "Air contaminant" shall mean dust, fumes, mist, smoke, other particulate matter, vapor, gas, or any combination thereof.

1.0.2 "Air pollution" shall mean the presence in the outdoor atmosphere of one or more air contaminants in such quantities and duration as is or tends to be injurious to human health or welfare, animal or plant life, or property or interferes with the enjoyment of life or property.

1.0.3 "Director" shall mean the Director of the State Air Pollution Control Agency.

1.0.4 "Existing source" shall mean equipment, machines, devices, articles, contrivances, or installations which are in being on the effective date of these regulations; except that any existing equipment, machine, device, article, contrivance, or installation which is altered, replaced, or rebuilt after the effective date of these regulations shall be reclassified as "new source".

1.0.5 "Fuel-burning equipment" shall mean any furnace, boiler, apparatus, stack, and all appurtenances thereto, used in the process of burning fuel for the primary purpose of producing heat or power by indirect heat transfer.

1.0.6 "Fugitive dust" shall mean solid air-borne particulate matter emitted from any source other than a flue or stack.

1.0.7 "Multiple-Chamber Incinerator" shall mean any article, machine, equipment, contrivance, structure or part of a structure, used to dispose of combustible refuse by burning, consisting of three or more refractory lined combustion furnaces in series, physically separated by refractory walls, interconnected by gas passage ports or ducts and employing adequate design parameters necessary for maximum combustion of the material to be burned.

1.0.8 "New source" shall mean equipment, machines, devices, articles, contrivances, or installations built or installed on or after the effective date of these regulations, and installations existing at said stated time which are later altered, repaired, or rebuilt. Any equipment moved to another premise involving a change of address, or purchased and to be operated by a new owner, or when a new lessee desires to operate such equipment after the effective date of these regulations shall be considered a new source.

1.0.9 "Opacity" shall mean a state which renders material partially or wholly impervious to rays of light and causes obstruction of an observer's view.

1.0.10 "Open burning" shall mean the burning of any matter in such a manner that the products of combustion resulting from the burning are emitted directly into the ambient air without passing through an adequate stack, duct, or chimney.

1.0.11 "Particulate matter" shall mean any material, except where water in uncombined form, that is or has been airborne and exists as a liquid or a solid at standard conditions.

1.0.12 "Person" shall mean any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, agency, political subdivision of this State, any other State or political subdivision or agency thereof or any legal successor, representative, agent, or agency of the foregoing.

1.0.13 "Ringlemann Chart" shall mean the chart, published and described in the U.S. Bureau of Mines Information Circular 8333.

1.0.14 "Soiling Index" A measure of the soiling properties of suspended particles in air determined by drawing a measured volume of air through a known area of Whatman No. 4 filter paper for a measured period of time, expressed as COH's/1000 linear feet.

1.0.15 "Source" shall mean any property, real or personal, or person contributing to air pollution.

1.0.16 "Stack or chimney" shal meanany flue, conduit, or duct arranged to conduct emissions.

1.0.17 "Standard conditions" shall mean a dry gas temperature of 70 degrees fahrenheit and a gas pressure of 14.7 pounds per square inch absolute.

1.0.18 "Submerged Fill Pipe" any fill pipe the discharge opening of which is entirely submerged when the liquid level is 6 inches above the bottom of the tank; or when applied to a tank which is loaded from the side, shall mean any fill pipe the discharge opening of which is entirely submerged when the liquid level is two times the fill pipe diameter, in inches, above the bottom of the tank.

1.0.19 "Effluent Water Separator" any tank, box, sump, or other container in which any volatile organic compound floating on or entrained or contained in water entering such tank, box, sump, or other container is physically separated and removed from such water prior to outfall, drainage, or recovery of such water.

1.0.20 "Volatile Organic Compounds" any compound containing carbon and hydrogen or containing carbon and hydrogen in combination with any other element which has a vapor pressure of 1.5 pounds per square inch absolute or greater under actual storage conditions.

1.1 Permits.

1.1.1 General requirements:

(a) No person shall cause or permit the construction or modification of any new source without first obtaining an authority to construct or modify from the Director as to the location and design of such new source to comply with applicable rules and regulations and ambient air quality standards.

(b) The Director shall not approve such construction or modification unless the applicant demonstrates to the satisfaction of the Director that the new source can be expected to comply with the applicable rules and regulations.

1.1.2 Applications.

(a) Application for authority to construct or modify shall be made by the owner or operator of the new source on forms furnished by the Director. If the applicant is a partnership or group other than a corporation, the application shall be made by one individual who is a member of the group. If the applicant is a corporation, the application shall be made by an officer of the corporation.

(b) A separate application is required for each new source subject to rules and regulations. To aid in evaluating the new source, additional applications may be required by the Director.

(c) Each application shall be signed by the applicant. The signature of the applicant shall constitute an agreement that the applicant will assume responsibility for the construction, modification, or use of the new source concerned in accordance with the rules and regulations.

1.1.3 Information required:

(a) Each application for an authority to construct or modify shall be accompanied by two copies of complete data, siting information, plans descriptions, specifications and drawings to show how the proposed new source is designed and in what manner it will be operated and controlled.

(b) Any additional information, plans, specifications, evidence or documentation that the Director may require.

1.1.4 Standards for granting authority to construct or modify. No authority to construct or modify shall be granted unless the applicant shows to the satisfaction of the Director that:

(a) The new source is designed and will be constructed or modified to operate without causing a violation of the applicable rules and regulations.

(b) The new source is designed, built and equipped in accordance with the latest available control technology so as to reduce emissions to a minimum.

(c) The new source, as designed or modified, does not endanger maintenance or attainment of any applicable ambient air quality standard.

(d) The new source, if required by the Director, shall be provided with:

(1) Sampling ports of a size, number and location as the Director may require,

(2) Safe access to each port,

(3) Instrumentation to monitor and record emission data and,

(4) Any other sampling and testing facilities the Director may require.

1.1.5 Action on applications:

(a) The Director shall act, within a reasonable time, on an application for an authority to construct or modify, and shall notify the applicant in writing of his approval, conditional approval, or denial of the application.

(b) If an application is denied, the Director shall set forth his objections in the notice of denial.

(c) The applicant may submit answers and comments, in duplicate, to the Director's objections to the application.

(d) The Director will consider the applicant's answers and comments to his objections, and shall notify the applicant in writing of his approval or denial of the application.

(e) The Director shall not accept a further application unless the applicant has complied with the objections specified by the Director as his reasons for denial of the authority to construct or modify.

1.1.6 Conditional authority to construct or modify. The Director may grant a conditional authority to construct or modify if it appears likely from all of the information submitted that as a result of the conditions the new source will satisfy the requirements of 1.1.4 above.

1.1.7 Cancellation of authority to construct or modify:

(a) The Director may cancel an authority to construct or modify if the construction or modification is not begun within one year from the date of issuance, or if the work involved in the construction or modification is suspended for one year or more from the date of issuance.

(b) An applicant may secure an extension of the expiration date by written request to the Director stating the reasons for the request. Extensions may be granted for a period of not more than six months.

1.1.8 Permit to Operate.

(a) No person shall begin operation of a new source without notifying the Director at least 30 days prior to operation.

(b) No person shall cause or permit the operation of a new source for more than a sixty (60) day period without applying for a permit to operate from the Director.

(c) No person shall cause or permit the use or operation of existing sources of control apparatus without applying for a permit to operate from the Director within six months of the adopted date of these regulations or an approved control plan in accordance with Section 1.7 of these regulations.

(d) No owner or operator shall cause or permit the operation of a new or existing source if the Director denies or revokes a permit to operate.

1.1.9 Applications.

Applications for a permit to operate shall be made in accordance with 1.1.2 of this part.

1.1.10 Standards for granting permits.

No permit to operate shall be granted unless the applicant shows to the satisfaction of the Director that the new source satisfied the requirements of the applicable rules and regulations and has been constructed, installed, or modified in accordance with the requirements and conditions contained in the authority to construct or modify.

1.1.11 Performance Testing.

Before a permit to operate is granted, the applicant, if required by the Director, shall conduct performance tests, in accordance with methods approved by the Director with the tests being made at the expense of the applicant. The Director may monitor performance tests conducted by the applicant and may also conduct performance tests.

1.1.12 Action on Applications.

(a) Before acting on an application for a permit to operate the Director may require the applicant to furnish additional information, plans or specifications.

(b) The Director shall act within a 60 day period on an application for a permit to operate and shall notify the applicant, in writing of his approval, conditional approval or denial of the application.

(c) If an application is denied the procedures of 1.1.5 of this part shall apply.

1.1.13 Conditional Permit.

The holder of a permit to operate shall comply with the conditions contained in his permit as well as all applicable provisions of rules and regulations.

1.1.14 Suspension or revocation of Permit.

(a) The Director may suspend or revoke a permit to operate for willful or continued violation of rules and regulations.

(b) Suspension or revocation of a permit to operate shall become final 10 days after service of notice on the holder of the certificate.

(c) A permit to operate which has been revoked pursuant to these regulations shall be surrendered forthwith to the Director.

1.1.15 Transfer of Permit.

Any purported or attempted transfer of a permit to operate to another owner or from one location to another or from one new source to another automatically revokes the permit.

1.1.16 Reporting information.

No owner or operator shall cause or permit the operation of any new source without furnishing such performance tests results, information, and records as may be required by the Director in the applicable rules and regulations.

1.1.17 Exemptions.

An authority to construct and a permit to operate shall not be required for:

(a) The installation or alternation of an air contaminant detector, air contaminant recorder, combustion controller or combustion shutoff.

(b) Air Conditioning or ventilating systems not designed to remove air contaminant generated by or released from equipment.

(c) Fuel burning equipment, other than smoke house generators, which; uses gas as a fuel for space heating, air conditioning or heating water; or is used in a private dwelling or has a BTU input of not more than 350,000 BTU per hour; or is used for space heating other than boilers and hot air furnaces.

(d) Internal combustion engines.

(e) Laboratory equipment used exclusively for chemical or physical analyses.

(f) Other sources of minor significance specified by Director. Note: This suggested regulation specifies a complete permit system for application to new and existing sources. For existing sources, a simple registration is adequate although not as effective for enforcement purposes.

1.2 Monitoring, Records, Reporting.

1.2.1 The Director may require the owner or operator of any air contaminant source to install, use, and maintain such monitoring equipment; sample such emissions in accordance with methods as the Director shall prescribe; establish and maintain such records; and make such periodic emission reports as required in section 1.2.2.

1.2.2 Records and reports as the Director shall prescribe on air contaminants or fueld shall be recorded, compiled, and submitted on forms furnished by the Director. (The procedures below are examples of such requirements.)

(a) Emissions of particulate matter, sulfur dioxide, and oxides of nitrogen shall be expressed as follows: in pounds per hour and pounds per million BTU of heat input for fuel-burning equipment; in pounds per hour and pounds per 100 pounds of refuse burned for incinerators; and in pounds per hour and in pounds per hourly process weight or production rate or in terms of some other easily measured and meaningful process unit specified by the Director.

(b) Sulfur dioxide and oxides of nitrogen emission data shall be averaged over a 24 hour period and shall be summarized monthly. Daily averaged and monthly summaries shall be submitted to the Director biannually. Data should be calculated daily and available for inspection at any time.

(c) Particulate matter emissions shall be sampled and submitted biannually.

(d) Visible emissions shall be measured continuously and records kept indicating total minutes per day in which stack discharge effluent exceeds 20 percent capacity. Data should be summarized monthly and submitted monthly and submitted biannually. Current daily results shall be available for inspection at any time.

(e) The sulfur content of fuels, as burned, except natural gas, shall be determined in accordance with current recognized ASTM procedures. Daily and monthly averages shall be submitted biannually. Daily records shall be kept current and be available for inspection.

1.2.3 The following sources are subject to the provisions of this regulation: (The appropriate State Agency should either classify such sources by regulation or require reporting as a permit to operate condition).

1.3 Sampling and Testing Methods.

1.3.1 All tests shall be made and the results calculated in accordance with test procedures approved by the Director. All tests shall be made under the direction of persons qualified by training and/or experience in the field of air pollution control.

1.3.2 The Director may conduct tests of emissions of air contaminants from any source. Upon request of the Department the person responsible for the source to be tested shall provide necessary holes in stacks or ducts and such other safe and proper sampling and testing facilities, exclusive of instruments and sensing devices as may be necessary for proper determination of the emission of air contaminants.

1.4 Malfunction of Equipment; Reporting.

1.4.1 In the case of shutdown of air pollution control equipment for necessary scheduled maintenance, the intent to shut down such equipment shall be reported to the Director at least twenty-four (24) hours prior to the planned shutdown. Such prior notice shall include, but is not limited to the following:

(a) Identification of the specific facility to be taken out of service as well as its location and permit number.

(b) The expected length of time that the air pollution control equipment will be out of service.

(c) The nature and quantity of emissions of air contaminants likely to occur during the shutdown period.

(d) Measures such as the use of off-shift labor and equipment that will be taken to minimize the length of the shutdown period.

(e) The reasons that it would be impossible or impractical to shut down the source operation during the maintenance period.

1.4.2 In the event that any emission source, air pollution control equipment, or related facility breaks down in such a manner as to cause the emission of air contaminants in violation of this Article, the person responsible for such equipment shall immediately notify the Director of such failure or breakdown and provide a statement giving all pertinent facts, including the estimated duration of the breakdown. The Director shall be notified when the condition causing the failure or breakdown has been corrected and the equipment is again in operation.

1.5 Air Pollution Emergencies.

Notwithstanding any other provision of the air pollution control regulations, this episode regulation is designed to prevent the excessive buildup of air contaminants during air pollution episodes, thereby preventing the occurrence of an emergency due to the effects of these contaminants on the public health.

1.5.1 Episode Criteria.

Conditions justifying the proclamation of an air pollution alert, air pollution warning, or air pollution emergency shall be deemed to exist whenever the Director determines that the accumulation of air contaminants in any place is attaining or has attained levels which could, if such levels are sustained or exceeded, lead to a threat to the health of the public. In making this determination, the Director will be guided by the following criteria:

(a) "Air Pollution Forecast": An internal watch by the Department of Air Pollution Control shall be actuated by a National Weather Service advisory that Atmospheric Stagnation Advisory is in effect or the equivalent local forecast of stagnant atmospheric conditions. (b) "Alert": The Alert level is that concentration of pollutants at which first stage control actions is to begin. An Alert will be declared when any one of the following levels is reached:

SO_2—0.3 ppm, 24 hour average
Particulate—3.0 COHs, 24 hour average
SO_2 and Particulate combined—product of SO_2 ppm,
24 hour average and COHs equal to 0.2
CO—15 ppm, 8 hour average
Ox—0.1 ppm, 1 hour average
NO_2—0.6 ppm, 1 hour average
0.15 ppm, 24 hour average

and meterological conditions are such that this condition can be expected to continue for twelve (12) or more hours.

(c) "Warning": The Warning level indicates that air quality is continuing to degrade and that additional abatement actions are necessary. A Warning will be declared when *any one* of the following levels is reached:

SO_2—0.6 ppm, 24 hour average
Particulate—6.0 COHs, 24 hour average
Combined SO_2 and COHs, 24 hour average

SO_2 and COHs equal to 1.0
CO—30 ppm, 8 hour average
Ox—0.4 ppm, 1 hour average
NO_2—1.2 ppm, 1 hour average
0.3 ppm, 24 hou. average

and meterological conditions are such that this condition can be expected to continue for twelve (12) or more hours.

(d) "Emergency": The Emergency level is reached when the Warning level for a pollutant has been exceeded and (1) the concentrations of the pollutant are continuing to increase, or (2) the Director determines that, because of meteorological or other factors, the concentrations will continue to increase.

(e) "Termination": Once declared, any status reached by application of these criteria will remain in effect until the criteria for that level are no longer met. At such time the next lower status will be assumed.

1.5.2 Emission Reduction Plans.

(a) Air Pollution Alert—Any persons responsible for the operation of a source of air contamination as set forth in Table I shall take all Air Pollution Alert actions as required for such source of air contamination and shall particularly put into effect the preplanned strategy for an Air Pollution Alert.

(b) Air Pollution Warning—Any person responsible for the operation of a source of air contamination as set forth in Table II shall take all Air Pollution Warning actions as required for such source of air contamination and shall particularly put into effect the preplanned strategy for an Air Pollution Warning.

(c) Air Pollution Emergency—Any person responsible for the operation of a source of air contamination as described in Table III shall take all Air Pollution Emergency actions as required for such source of air contamination and shall particularly put into effect the preplanned strategy for an Air Pollution Emergency.

1.5.3 Preplanned Abatement Strategies.

(a) Any person responsible for the operation of a source of air contamination as set forth in Table I shall prepare preplanned strategies, consistent with good industrial practice and safe operation procedures, for reducing the emission of air contaminants into the outdoor atmosphere during periods of an Air Pollution Alert, Air Pollution Warning, and Air Pollution Emergency. Standby plans shall be designed to reduce or eliminate emissions of air contaminants into the outdoor atmosphere in accordance with the objectives set forth in Tables I-II which are made a part of this Section.

(b) Any person responsible for the operation of a source of air contamination not set forth under Section 4.1 shall, when requested by the Director in writing, prepare preplanned strategies consistent with good industrial practice and safe operating procedures, for reducing the emission of air contaminants into the outdoor atmosphere during periods of an Air Pollution Alert, Air Pollution Warnings, and Air Pollution Emergency. Standby plans shall be designed to reduce or eliminate emissions of air contaminants into the outdoor atmosphere in accordance with the objectives set forth in Tables I-III.

(c) Preplanned strategies as required under Sections 4.1 and 4.2 shall be in writing and show the source of air contamination, the approximate amount of reduction of contaminants and a brief description of the manner in which the reduction will be achieved during an Air Pollution Alert, Air Pollution Warning, and Air Pollution Emergency.

(d) During a condition of Air Pollution Alert, Air Pollution Warning, and Air Pollution Emergency, preplanned strategies as required by this Section shall be made available on the premises to any person authorized to enforce the provisions of the Air Pollution Control Regulations.

(e) Preplanned strategies as required by this Section shall be submitted to the Director upon request within thirty (30) days of the receipt of such request; such preplanned strategies shall be subject to review and approval by the Director. If, in the opinion of the Director, such standby plans do not effectively carry out the objectives as set forth in Tables I-III, the Director may disapprove said preplanned strategies, state its reason for disapproval and order the preparation of amended strategies within the time period specified in the order. Any person aggrieved by the order requiring the preparation of a revised strategy is entitled to a hearing. If the person responsible fails within the time period specified in the order to submit an amended preplanned strategy which in the opinion of the Director meets the said objectives, the Director may revise the standby plan to cause it to meet these objectives. Such revised strategies will thereafter be the preplanned strategy which the person responsible will put into effect upon the issuance of an appropriate order by the Director.

TABLE I.—ABATEMENT STRATEGIES EMISSION REDUCTION PLANS

ALERT LEVEL

PART A. GENERAL

1. There shall be no open burning by any persons of tree waste, vegetation, refuse, or debris in any form.
2. The use of incinerators for the disposal of any form of solid waste shall be limited to the hours between 12:00 noon and 4:00 p.m.
3. Persons operating fuel-burning equipment which requires boiler lancing or soot blowing shall perform such operations only between the hours of 12:00 noon and 4:00 p.m.
4. Persons operating motor vehicles should eliminate all unnecessary operations.

PART B. SOURCE CURTAILMENT

Any person responsible for the operation of a source of atmospheric contamination listed below shall take all required control actions for this Alert Level.

SOURCE OF CONTAMINATION	AIR POLLUTION ALERT
1. Coal or oil-fired electric power generating facilities.	a. Substantial reduction by utilization of fuels having low ash and sulfur content. b. Maximum utilization of mid-day (12:00 noon to 4:00 p.m.) atmospheric turbulence for boiler lancing and soot blowing. c. Substantial reduction by diverting electric power generation to facilities outside of Alert Area.
2. Coal and oil-fired process steam generating facilities.	a. Substantial reduction by utilization of fuels having low ash and sulfur content. b. Maximum utilization of mid-day (12:00 noon to 4:00 p.m.) atmospheric turbulence for boiler lancing and soot blowing. c. Substantial reduction of steam load demands consistent with continuing plant operations.
3. Manufacturing industries of the following classifications: Primary Metals Industry Petroleum Refining Operations Chemical Industries Mineral Processing Industries Paper and Allied Products Grain Industry	a. Substantial reduction of air contaminants from manufacturing operations by curtailing, postponing, or deferring production and all operations. b. Maximum reduction by deferring trade waste disposal operations which emit solid particles, gas vapors or malodorous substance. c. Maximum reduction of heat load demands for processing. d. Maximum utilization of mid-day (12:00 noon to 4:00 p.m.) atmospheric turbulence for boiler lancing or soot blowing.

TABLE II.—EMISSION REDUCTION PLANS

WARNING LEVEL

PART A. GENERAL

1. There shall be no open burning by any persons of tree waste, vegetation, refuse, or debris in any form.
2. The use of incinerators for the disposal of any form of solid waste or liquid waste shall be prohibited.
3. Persons operating fuel-burning equipment which requires boiler lancing or soot blowing shall perform such operations only between the hours of 12:00 noon and 4:00 p.m.
4. Persons operating motor vehicles must reduce operations by the use of car pools and increased use of public transportation and the elimination of unnecessary operation.

PART B. SOURCE CURTAILMENT

Any person responsible for the operation of a source of atmospheric contamination listed below shall take all required control actions for this Warning Level.

SOURCE OF AIR CONTAMINATION	AIR POLLUTION ALERT
1. Coal or oil-fired electric power generating facilities.	a. Maximum reduction by utilization of fuels having lowest ash and sulfur content. b. Maximum utilization of mid-day (12:00 noon to 4:00 p.m.) atmospheric turbulence for boiler lancing and soot blowing. c. Maximum reduction by diverting electric power generation to facilities outside of Warning Area.
2. Coal and oil-fired process steam generating facilities.	a. Maximum reduction by utilization of fuels having the lowest available ash and sulfur content. b. Maximum utilization of mid-day (12:00 noon to 4:00 p.m.) atmosphereic turbulence for boiler lancing and soot blowing. c. Making ready for use a plan of action to be taken if an emergency develops.
3. Manufacturing industries which require considerable lead time for shut-down including the following classifications. Petroleum Refining Chemical Industries Primary Metals Industries Glass Industries Paper and Allied Products	a. Maximum reduction of air contaminants from manufacturing operations by, if necessary, assuming reasonable economic hardship by postponing production and allied operation. b. Maximum reduction by deferring trade waste disposal operations which emit solid particles, gases, vapors or malodorous substances. c. Maximum reduction of heat load demands for processing. d. Maximum utilization of mid-day (12:00 noon to 4:00 p.m.) atmospheric turbulence for boiler lancing or soot blowing.

4. Manufacturing industries require relatively short lead times for shutdown including the following classifications. Primary Metals Industries Chemical Industries Mineral Processing Industries Grain Industry	a. Elimination of air contaminants from manufacturing operations by ceasing, curtailing, postponing, or deferring production and allied operations to the extent possible without causing injury to persons or damage to equipment. b. Elimination of air contaminants from trade waste disposal processes which emit solid particles, gases, vapors, or malodorous substances. c. Maximum reduction of heat load demands for processing. d. Maximum utilization of mid-day (12:00 noon to 4:00 p.m.) atmospheric turbulence for boiler lancing or soot blowing.

TABLE III.—EMISSION REDUCTION PLANS

Emergency Level

PART A. GENERAL

1. There shall be no open burning by any persons of tree waste, vegetation, refuse, or debris in any form.

2. The use of incinerators for the disposal of any form of solid or liquid waste shall be prohibited.

3. All places of employment described below shall immediately cease operations.

a. Mining and quarrying of non-metallic minerals.

b. All construction work except that which must proceed to avoid emergent physical harm.

c. All manufacturing establishments except those required to have in force an air pollution emergency plan.

d. Wholesale trade establishment; i.e., places of business primarily engaged in selling merchandise to retailers, to industrial, commercial, institutional or professional users, or to other wholesalers, or acting as agents in buying merchandise for or selling merchandise to such persons or companies.

e. All offices of local, county, and State government including authorities, joint meetings, and other public bodies excepting such agencies which are determined by the chief administrative officer of local, county, or State government, authorities, joint meetings and other public bodies to be vital for public safety and welfare and the enforcement of the provisions of this order.

f. All retail trade establishments except pharmacies and stores primarily engaged in the sale of food.

g. Banks, credit agencies other than banks, securities and commodities brokers, dealers, exchanges, and services; offices of insurance carriers, agents and brokers, real estate offices.

h. Wholesale and retail laundries, laundry services and cleaning and dyeing establishments; photographic studios; beauty shops, barber shops, shoe repair shops.

i. Advertising offices; consumer credit reporting, adjustment and collection agencies; duplicating, addressing, blueprinting; photocopying, mailing, mailing list and stenographic services; equipment rental services, commercial testing laboratories.

j. Automobile repair, automobile services, garages,

k. Establishments rendering amusement and recreation services including motion picture theaters.

l. Elementary and secondary schools, colleges, universities, professional schools, junior colleges, vocational schools, and public and private libraries.

4. All commercial and manufacturing establishments not included in this order will institute such actions as will result in maximum reduction of air contaminants from their operations by ceasing, curtailing, or postponing operations which emit air contaminants, to the extent possible without causing injury to persons or damage to equipment.

5. The use of motor vehicles is prohibited except in emergencies with the approval of local or State police.

PART B. SOURCE CURTAILMENT

Any person responsible for the operation of a source of atmospheric contamination listed below shall take all required control actions for this Emergency Level.

SOURCE OF AIR CONTAMINATION	AIR POLLUTION EMERGENCY
1. Coal or oil-fired electric power generating facilities.	a. Maximum reduction by utilization of fuels having lowest ash and sulfur content. b. Maximum utilization of mid-day (12:00 noon to 4:00 p.m.) atmospheric turbulence for boiler lancing or soot blowing. c. Maximum reduction by diverting electric power generation to facilities outside of Emergency Area.
2. Coal and oil-fired process steam generating facilities.	a. Maximum reduction by reducing heat and steam demands to absolute necessities consistent with preventing equipment damage. b. Maximum utilization of mid-day (12:00 noon to 4:00 p.m.) atmospheric turbulence for boiler lancing and soot blowing. c. Taking the action called for in the emergency plan.
3. Manufacturing industries of the following classifications. Primary Metals Industries Petroleum Refining Chemical Industries Mineral Processing Industries Grain Industry Paper and Allied Products	a. Elimination of air contaminants from manufacturing operations by ceasing, curtailing, postponing or deferring production and allied operations to the extent possible without causing injury to persons or damage to equipment. b. Elimination of air contaminants from trade waste disposal processes which emit solid particles, gases, vapors, or malodorous substances. c. Maximum reduction of heat load demands for processing. d. Maximum utilization of mid-day (12:00 noon to 4:00 p.m.) atmospheric turbulence for boiler lancing or soot blowing.

1.6 Prohibition of Air Pollution.

No person shall permit or cause air pollution, as defined in section 1.02 of this article.

1.70 Compliance Schedule.

Except as otherwise specified, compliance with the provisions of these regulations shall be according to the following time schedule.

1.7.1 New Source.

All new sources shall comply as of going into operation.

1.7.2 Existing Sources.

All existing sources not in compliance as of the effective date of these regulations shall be in compliance within six months of the effective date of these regulations unless the owner or person responsible for the operation of the installation shall have submitted to the Director in a form and manner satisfactory to him, a control plan and schedule for achieving compliance, such plan and schedule to contain a date on or before which full compliance will be attained, and such other information as the Director may require. If approved by the Director, such date will be the date on which the person shall comply. The Director may require persons submitting such a plan to submit subsequent periodic reports on progress in achieving compliance. In no event shall the control plan and schedule exceed three years from the adopted date of these regulations.

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1.8 Circumvention.

No person shall cause or permit the installation or use of any device or any means which, without resulting in reduction in the total amount of air contaminant emitted, conceals or dilutes an emission of air contaminant which would otherwise violate these regulations.

1.9 Severability.

If any provision of these regulations or the application thereof to any person or cirmumstances is held to be invalid, such invalidity shall not affect other provisions or application of any other part of these regulations which can be given effect without the invalid provisions or application, and to this end the provisions of these regulations and the various applications thereof are declared to be severable.

II. CONTROL OF OPEN BURNING AND INCINERATION

2.1 Open Burning.

No person shall ignite, cause to be ignited, permit to be ignited, or maintain any open fire except as follows:

2.1.1 Open fires for the cooking of food for human consumption on other than commercial premises.

2.1.2 Fires for recreational or ceremonial purposes.

2.1.3 Fires to abate a fire hazard, providing hazard is so declared by the fire department or fire district having jurisdiction.

2.1.4 Fires for prevention or control of disease or pests.

2.1.5 Fires for training personnel in the methods of fighting fires.

2.1.6 Fires for the disposal of dangerous materials, where there is no alternate method of disposal and burning is approved by the Director.

2.2 Incinerator Design and Operation.

2.2.1 No residential or commercial single-chamber incinerator shall be used for the burning of refuse for a period in excess of eighteen (18) months after the adopted date of this regulation.

2.2.2 All new incinerators and all existing incinerators within 18 months after adopted date of this regulation shall be multiple-chamber incinerators, provided that the Director may approve any other type of incinerator if it is demonstrated such design provides equivalent performance.

2.2.3 No person shall operate or cause or permit the operation of any incinerator at any time other than between the hours of 10:00 a.m. and 4:00 p.m. This restriction shall not apply to incinerators having refuse-burning capacity of five (5) tons per hour or more.

2.2.4 Incinerators shall be designed and operated in such manner as is necessary to prevent the emission of objectionable odors.

Note: Additional regulations prohibiting all domestic and commercial incineration may be feasible in some areas and necessary for attainment of national air quality standards.

III. CONTROL OF PARTICULATE EMISSIONS

3.1 Visible Emissions.

3.1.1 Visible emissions restrictions for stationary sources.

(a) No person shall discharge into the atmosphere from any single source of emission whatsoever any air contaminant of a shade or density equal to or darker than that designated as No. 1 on the Ringelmann Chart or 20 percent opacity.

(b) A person may discharge into the atmosphere from any single source of emission for a period or periods aggregating not more than three minutes in any sixty minutes air contaminants of a shade of density not darker than No. 3 on the Ringelmann Chart or 60 percent capacity.

3.1.2 Visible emission from motor vehicle.

(a) No person shall cause or permit the emission of visible air contaminants from gasoline-powered motor vehicles for longer than 5 consecutive seconds.

(b) No person shall cause or permit the emission of visible air contaminants from diesel-powered motor vehicles of a shade or density equal to or darker than that designated as No. 1 on the Ringelmann Chart or 20 percent opacity for longer than 5 consecutive seconds.

3.1.3 Uncombined water.

Where the presence of uncombined water is the only reason for failure of an emission to meet the requirements of this regulation, such sections shall not apply.

3.2 Fugitive Dust.

3.2.1 No person shall cause, suffer, allow, or permit any materials to be handled, transported, or stored; or a building, its appurtenances, or a road to be used, constructed, altered, repaired or demolished without taking reasonable precautions to prevent particulate matter from becoming airborne. Such reasonable precautions shall include, but not be limited to, the following:

(a) Use, where possible, water or chemicals for control of dust in the demolition of existing buildings or structures, construction operations, the grading of roads or the clearing of land;

(b) Application of asphalt, oil, water or suitable chemicals on dirt roads, materials stockpiles, and other surfaces which can create airborne dusts;

(c) Installation and use of hoods, fans and fabric filters to enclose and vent the handling of dusty materials. Adequate containment methods shall be employed during sandblasting or other similar operations;

(d) Covering, at all times when in motion, open bodied trucks transporting materials likely to become airborne;

(e) Conduct of agricultural practices such as tilling of land, application of fertilizers, etc. in such manner as to not create a nuisance to others residing in the area.

(f) The paving of roadways and their maintenance in a clean condition.

(g) The prompt removal of earth or other material from paved street which earth or other material has been transported thereto by trucking or earth moving equipment or erosion by water.

3.2.2 No person shall cause or permit the discharge of visible emissions beyond the lot line of the property on which the emissions originate.

3.2.3 When dust, fumes, gases, mist odorous matter, vapors, or any combination thereof escape from a building or equipment in such a manner and amount as to cause a nuisance or to violate any regulation, the Director may order that the building or equipment in which processing, handling and storage are done be tightly closed and ventilated in such a way that all air and gases and air or gas-borne material leaving the building or equipment are treated by removal or destruction of air contaminants before discharge to the open air.

3.3 Incineration.

3.3.1 No person shall cause or permit to be emitted into the open air from any incinerator, particulate matter in the exhaust gases to exceed 0.10 pounds per 100 pounds of refuse burned.

3.3.2 Emission tests shall be conducted at maximum burning capacity of the incinerator.

3.3.3 The burning capacity of an incinerator shall be the manufacturer's or designer's guaranteed maximum rate or such other rate as may be determined by the Director in accordance with good engineering practices. In case of conflict, the determination made by the Director shall govern.

3.3.4 For the purposes of this regulation, the total of the capacities of all furnaces within one system shall be considered as the incinerator capacity.

Note: This mass emission rate is about equivalent to a grain loading of 0.1 grains/SCF at 12 percent carbon dioxide. More restrictive requirements are feasible for large incinerators.

3.4 Fuel Burning Equipment.

3.4.1 No person shall cause or permit emission to the atmosphere from fuel burning equipment burning solid fuel of particulate matter in excess of 0.10 pounds per million BTU per hour.

3.4.2 No person shall cause or permit emission to the atmosphere, from oil-fired fuel burning equipment rated greater than or equal to 250 million BTU per hour heat input, of particulate matter in excess of 0.025 pounds per million BTU per hour.

3.4.3 For purposes of this regulation the heat input shall be the aggregate heat content of all fuels whose products of combustion pass through a stack or stacks. The heat input value used shall be the equipment manufacturer's or designer's guaranteed maximum input, whichever is greater. The total heat input of all fuel burning units on a plant or premises shall be used for determining the maximum allowable amount of particulate matter which may be emitted.

Note: Section 3.4.1 requires solid fuel burning equipment to remove about 99 percent of particulate matter generated by combustion of the average 10 percent ash coal. Section 3.4.2 requires removal of about 80 percent of particulate generated from combustion of high-ash residual fuel oil in large boilers. This can be accomplished by proper design and operation and use of small diameter cyclones and/or electrostatic precipitators or low-ash oil. Additional regulations prohibiting the combustion of solid fuels and/or residual fuel oil in small units may be feasible in some areas and necessary to achieve national air quality standards. For example, prohibition of hand-fired coal burning units is practiced in several areas.

3.5 Process Industries—General.

3.5.1 No person shall cause, suffer, allow, or permit the emission of particulate matter in any one hour from any source in excess of the amount shown in Table IV for the process weight rate allocated to such source or in excess of 0.03 grains per standard cubic foot of exhaust gas.

TABLE IV

Process weight rate Lb/Hr	*Rate of emission Lb/Hr*	*Process weight rate Lb/Hr*	*Rate of emission Lb/Hr*
100	0.551	6,000	8.56
200	0.877	7,000	9.49
400	1.40	8,000	10.4
600	1.85	9,000	11.2
800	2.22	12,000	13.6
1,000	2.58	16,000	16.5
1,500	3.39	18,000	17.9
2,000	4.10	20,000	19.2
2,500	4.76	30,000	25.2
3,000	5.38	40,000	30.5
3,500	5.96	50,000	35.4
4,000	6.52	60,000 or more	40.0
5,000	7.58		

3.5.2 Interpolation of the data in this table for process weight rates up to 6,000 lb/hr shall be accomplished by use of the equation $E=4.10^{P^{0.67}}$, E=rate of emission in lb/hr and P=Process weight rate in tons/hr.

3.5.3 Process weight per hour is the total weight of all materials introduced into any specific process that may cause any discharge of particular matter. Soild fuels charged will be considered as part of the process weight, but liquid and gaseous fuels and combustion air will not. For a cyclical or batch operation, the process weight per hour will be derived by dividing the total process weight by the number of hours in one complete operation from the beginning of any given process to the completion thereof, excluding any time during which the equipment is idle. For a continuous operation, the process weight per hour will be derived by dividing the process weight for a typical period of time.

3.5.4 Where the nature of any process or operation or the design of any equipment is such as to permit more than one interpretation of this regulation, the interpretation that results in the minimum value for allowable emission shall apply.

3.5.5 For purposes of the regulation, the total process weight from all similar process units at a plant or premises shall be used for determining the maximum allowable emission of particulate matter that passes through a stack or stacks.

Note: Specific regulations for large industrial sources are encouraged in order to more closely require use of the latest available control techniques. Consultation in developing such regulations is available from EPA upon request.

IV. CONTROL OF SULFUR COMPOUND EMISSIONS

4.1 Fuel Combustion.

4.1.1 No person shall burn, sell, or make available for sale burning in fuel burning equipment, any fuel containing in excess of —— percent sulfur by weight. NOTE: This language is intended for application to small area sources, where fuel substitution is the only practical control method.

4.1.2 No person operating power and steam generating facilities having a power generating capacity in excess of 25 megawatts or a heat input greater than 250 million Btu/hr shall emit in excess of [1]—— pounds of sulfur per million Btu of heat input per hour. NOTE: This language is intended for application to large

[1] It is not possible to make nationally applicable generalizations about attainable degrees of control of sulfur oxides emissions from combustion sources. Availability of low-sulfur fuels varies from one area to another. In some areas, severe restrictions on the sulfur content of fuels could have a significant impact on fuel-supply patterns; accordingly, where such restrictions are necessary for attainment of national ambient air standards, option of phased schedules of sulfur-in-fuel limitations is recommended. Stack gas cleaning is feasible at large industrial combustion sources and steam electric power plants. Technology now being demonstrated will allow 80 percent removal of sulfur oxides from combustion gases of most existing boilers. It is reasonable to expect that these processes will be improved in the near future and thus permit attainment of 90 percent or greater collection efficiency at a wide range of boilers.

fuel combustion sources, where installations of flue gas cleaning systems is feasible.

Alternative means of meeting requirements for the control of sulfur oxides emissions from fuel combustion sources include: Use of natural gas, distillate oil, low-sulfur coal, and low-sulfur residual oil; desulfurization of oil or coal; stack gas desulfurization; and restricted use, shutdown, or relocation of large existing sources.

In many areas of the country, regulations can be written requiring the following fuel characteristics: Distillate oil—0.1 percent sulfur; residual oil—0.3 percent sulfur; bituminous coal—0.7 percent sulfur. Because residual oil generally is obtained from overseas sources, its use ordinarily is restricted to areas accessible to water-borne transportation. There are limited tonnages of 0.7 percent sulfur coal available at the present time but only in certain areas of the country.

4.1.3 No person shall cause or permit the emission or combustion of any refinery process gas stream or any other process gas stream that contains H_2S in concentration greater than 10 grains per 100 cubic feet of gas without removal of the hydrogen sulfide in excess of this concentration.

4.2 Sulfuric Acid Plants.

4.2.1 No person should cause or permit sulfur dioxide tail gas emissions from sulfuric acid manufacturing plants to exceed 6.5 lb/ton of acid produced. The tail gas acid mist emissions are not to exceed 0.5 lb/ton of acid produced and the sulfur trioxide emissions are not to exceed 0.2 lb/ton of acid produced.

4.3 Sulfur Recovery Plants.

4.3.1 No person shall cause or permit the sulfur oxide emissions from a sulfur recovery plant to exceed 0.01 pounds per pound of sulfur processed.

Note: Processes are being offered commercially that are capable of meeting the above emission level for sulfur recovery plants. Approximately 99.5 percent of the sulfur processed must be recovered to meet this regulation.

4.4 Non-Ferrous Smelters

4.41 No person shall cause or permit emissions of sulfur oxides from primary non-ferrous smelters to exceed that set forth according to the following equations.

Copper Smelters: $Y=0.2X$

Zinc Smelters: $Y=0.564X^{0.85}$

Lead Smelters: $Y=0.98X^{0.77}$

Where X is the total sulfur fed to the smelter in lb/hr and Y is the allowable sulfur emission in lb/hr.

Note: This rule in effect, requires removal of about 90 percent of the input-sulfur to the smelter.

4.5 Sulfite Pulp Mills

4.5.1 No person shall cause or permit the total sulfite pulp mill sulfur oxide emissions from blow pits, washer vents, storage tanks, digester relief, recovery system, etc. to exceed 9.0 lb per air dried ton of pulp produced.

Note: This emission limit is being achieved with efficiently designed chemical recovery systems that are well integrated with the pulp mill and designed for maximum sulfur recovery.

V. CONTROL OF HYDROCARBON EMISSIONS FROM STATIONARY SOURCES

5.1 Storage of Volatile Organic Materials

5.1.1. No person shall place, store, or hold in any stationary tank reservoir or other container of more than 40,000 gallons capacity any volatile organic compounds unless such tank, reservoir, or other container is a pressure tank capable of maintaining working pressures sufficient at all times to prevent vapor or gas loss to the atmosphere or is designed, and equipped with one of the following vapor loss control devices:

(a) A floating roof, consisting of a pontoon type, double deck type roof or internal floating cover, which will rest on the surface of the liquid contents and be equipped with a closure seal or seals to close the space between the roof edge and tank wall. This control equipment shall not be permitted if the volatile organic compounds have a vapor pressure of 11.0 pounds per square inch absolute or greater under actual storage conditions. All tank gauging or sampling devices shall be gas-tight except when tank gauging or sampling is taking place.

(b) A vapor recovery system, consisting of a vapor gathering system capable of collecting the volatile organic compound vapors and gases discharged and a vapor disposal system capable of processing such volatile organic vapors and gases so as to prevent their emission to the atmosphere and with all tank gauging and sampling devices gas-tight except when gauging or sampling is taking place.

(c) Other equipmnt or means of equal efficiency for purposes of air pollution control as may be approved by the Director.

(d) No person shall place, store, or hold in any stationary storage vessel more than 250 gallons capacity any volatile organic compound unless such vessel is equipped with a permanent submerged fill pipe or is a pressure tank as described in Section 5.1.1. or is fitted with a vapor recovery system as described in Section 5.1.1(b).

5.2 Volatile Organic Materials Loading Facilities

5.2.1. No person shall load any volatile organic compounds into any tank, truck or trailer from any loading facility unless such loading facility is equipped with a vapor collection and disposal system or its equivalent, properly installed; in good working order; and in operation.

5.2.2. No person shall load any volatile organic compounds into any tank, truck, or trailer unless such loading facility is equipped with a loading arm with a vapor collection adaptor, pneumatic, hydraulic, or other mechanical means shall be provided to force a vapor-tight seal between the adaptor and the hatch. A means shall be provided to prevent liquid organic compounds drainage from the loading device when it is removed from the hatch of any tank, truck or trailer, or to accomplish complete drainage before such removal. When loading is effected through means other than hatches, all loading and vapor lines shall be equipped with fittings which make vapor-tight connections and which close automatically when disconnected.

5.3 Volatile Organic Compound Water Separation

5.3.1 No person shall use any compartment of any single or multiple compartment volatile organic compound water separation which compartment received effluent water containing 200 gallons a day or more of any equipment processing, refining, treating, storing, or handling volatile organic compounds unless such compartment is equipped with one of the following vapor loss control devices, properly installed, in good working order, and in operation:

(a) A container having all openings sealed and totally enclosing the liquid contents. All gauging and sampling devices shall be gas-tight except when gauging or sampling is taking place.

(b) A container equipped with a floating roof, consisting of a pontoon type, double deck type roof, or internal floating cover, which will rest on the surface of the contents and be equipped with a closure seal or seals to close the space between the roof edge and container wall. All gauging and sampling devices shall be gas-tight except when gauging or sampling is taking place.

(c) A container equipped with a vapor recovery system consisting of a vapor gathering system capable of collecting the hydrocarbon vapors and gases discharged and a vapor disposal system capable of processing such hydrocarbon vapors and gases so as to prevent their emission to the atmosphere and with all container gauging and sampling devices gastight except when gauging or sampling is taking place.

(d) A container having other equipment of equal efficiency for purposes of air pollution control as may be approved by the Director.

5.4 Pumps and Compressors

All pumps and compressors handling volatile organic compounds shall have mechanical seals or other equipment of equal efficiency for purposes of air pollution control as may be approved by the Director.

5.5 Waste Gas Disposal

5.5.1 No person shall emit a waste gas stream from an ethylene producing plant into the atmosphere unless the waste gas stream is properly burned at 1300° for 0.3 seconds or greater in a direct-flame afterburner equipped with an indicating pyrometer which is positioned in the working area at the operator's eye level or an equally effective catalytic vapor incinerator also with pyrometer.

5.5.2 No person shall emit hydrogen gases to the atmosphere from a vapor blowdown system unles these gases are burned by smokeless flares, or an equally effective control device as approved by the Director.

5.6 Organic Solvents

5.6.1 A person shall not discharge more than 15 pounds of organic materials into the atmosphere in any one day from any article, machine, equipment or other contrivance in which any organic solvent or any material containing organic solvent comes into contact with flame or is baked, heat-cured, or heat-polymerized, in the presence of oxygen.

5.6.2 A person shall not discharge more than 40 pounds of organic material into the atmosphere in any one day from any article, machine, equipment, or other contrivance used under conditions other than described in Section 5.6.1, for employing applying, evaporating or drying any photochemically reactive

solvent, as defined in Section 5.6.11, or material containing such solvent, unless all organic materials discharged from such article, machine, equipment or other contrivance have been reduced to not more than 40 pounds in any one day.

5.6.3 Any series of articles, machines, equipment or other contrivances designed for processing a continuously moving sheet, web, strip, or wire which is subjected to any combination of operations described in section 5.6.1 or 5.6.2 involving any photochemically reactive solvent, as defined in section 5.6.11, or material containing such solvent, shall be subject to compliance with section 5.6.2. Where only non-photochemically reactive solvents or material containing only non-photochemically reactive solvents are employed or applied, and where any portion or portions of said series of articles, machines, equipment, or other contrivances involves operations described in section 5.6.1, said portions shall be collectively subject to compliance with section 5.6.1.

5.6.4 Emissions of organic materials to the atmosphere from the clean-up with photochemically reactive solvents, as defined in section 5.6.11, of any article, machine, equipment, or other contrivance described in sections 5.6.1, 5.6.2, or 5.6.3, shall be included with the other emissions of organic materials from that article, machine, equipment, or other contrivance for determining compliance with this rule.

5.6.5 Emissions of organic materials to the atmosphere as a result of spontaneously continuing drying of products for the first 12 hours after their removal from any article, machine, equipment, or other contrivance described in sections 5.6.1, 5.6.2, or 5.6.3, shall be included with other emissions of organic materials from that article, machine, equipment, or other contrivance, for determining compliance with this rule.

5.6.6 Emissions of organic materials into the atmosphere required to be controlled by sections 5.6.1, 5.6.2, or 5.6.3, shall be reduced by:

(a) Incineration, provided that 90 percent or more of the carbon in the organic material being incinerated is oxidized to carbon dioxide, or

(b) Absorption, or

(c) Processing in a manner determined by the Director to be not less effective than (a) or (b) above.

5.6.7 A person incinerating, absorbing, or otherwise processing organic materials pursuant to this rule shall provide, properly, install, and maintain in calibration, in good working order and in operation, devices as specified in the authority to construct or the permit to operate, or as specified by the Director, for indicating temperatures, pressures, rates of flow, or other operating conditions necessary to determine the degree and effectiveness of air pollution control.

5.6.8 Any person using organic solvents or any materials containing organic solvents shall supply the Director, upon request and in the manner and form prescribed by him, written evidence of the chemical composition, physical properties, and amount consumed for each organic solvent used.

5.6.9 The provisions of this rule shall not apply to:

(a) The manufacture of organic solvents, or the transport or storage of organic solvents or materials containing organic solvents.

(b) The use of equipment for which other requirements are specified by 5.1, 5.2, 5.3, or which are exempt from air pollution control requirements by said rules.

(c) The spraying or other employment of insecticides, pesticides, or herbicides.

(d) The employment, application, evaporation, or drying of saturated halogenated hydrocarbon, or perchloroethylene.

5.6.10 For the purposes of this rule, organic solvents include diluents and thinners and are defined as organic materials which are liquids at standard conditions and which are used as dissolvers, viscosity reducers, or cleaning agents.

5.6.11 For the purposes of this rule, a photochemically reactive solvent is any solvent with an aggregate of more than 20 percent of its total volume composed of the chemical compounds classified below or which exceeds any of the following individual percentage composition limitations, referred to the total volume of solvent:

(a) A combination of hydrocarbons, alcohols, aldehydes, esters, ethers, or ketones having an olefinic or cyclo-olefinic type of unsaturation: 5 percent:

(b) A combination of aromatic compounds with either or more carbon atoms to the molecule except ethylbenzene: 8 percent;

(c) A combination of ethylbenzene, ketones having branched hydrocarbon structures, trichloroethylene or toluene: 20 percent.

Whenever any organic solvent or any constituent of an organic solvent may be classified from its chemical structure into more than one of the above groups of organic compounds, it shall be considered as a member of the most reactive

chemical group, that is, that group having the least allowable percent of the total volume of solvents.

5.6.12 For the purposes of this rule, organic materials are defined as chemical compounds of carbon excluding carbon monoxide, carbon dioxide, carbonic acid, etallic carbides, etallic carbonates, and ammonium carbonate.

5.7. Architectural Coatings

5.7.1 A person shall not sell or offer for sale for use in containers of one quart capacity or larger, any architectural coating containing photochemically reactive solvent, as defined in 5.6.11.

5.7.2 A person shall not employ, apply, evaporate, or dry any architectural coating, purchased in containers of one quart capacity or larger, containing photochemically reactive solvent, as defined, in 5.6.11.

5.7.3 A person shall not thin or dilute any architectural coating with a photochemically reactive solvent, as defined in 5.6.11.

5.7.4 For the purposes of this rule, an architectural coating is defined as a coating used for residential or commercial buildings and their appurtenances; or industrial buildings.

5.8 Disposal and Evaporation of Solvents.

A person shall not, during any one day, dispose of a total of more than 1½ gallons of any photochemically reactive solvent, as defined in 5.6.11, or of any material containing more than 1½ gallons of any such photochemically reactive solvent by any means which will permit the evaporation of such solvent into the atmosphere.

Note: These various rules on hydrocarbon emission control cover the principal stationary sources of hydrocarbon emissions. The type of rules needed in a particular region will depend on the nature of source distribution.

VI. CONTROL OF CARBON MONOXIDE EMISSIONS

6.1 Process Equipment.

No person shall emit the carbon monoxide gases generated during the operation of a grey iron cupola, blast furnace, or basic oxygen steel furnace unless they are burned at 1300° F for 0.3 seconds or greater in a direct flame afterburner or equivalent device equipped with an indicating pyrometer which is positioned in the working area at the operator's eye level.

6.2 No person shall emit carbon monoxide waste gas stream from any catalyst regeneration of a petroleum cracking system, petroleum fluid coker, or other petroleum process into the atmosphere, unless the waste gas stream is burned at 1300° F for 0.3 seconds or greater in a direct-flame afterburner or boiler equipped with an indicating pyrometer which is positioned in the working area at the operator's eye level.

Note: Carbon monoxide emitted from open burning and incineration is controlled by other regulations.

VII. CONTROL OF NITROGEN OXIDES EMISSIONS

7.1 Combustion Sources.

7.1.1 No person shall cause or permit emissions of nitrogen oxides from an oil or gas-fired boiler with a capacity of 250 million Btu/hr or more and completed before the effective date of this regulation in excess of 0.30 pounds per million Btu of heat input per hour.

7.1.2 No person shall cause or permit emissions of nitrogen oxides from a coal-fired boiler with a capacity of 250 million Btu per hour or more in excess of 0.9 pounds per million Btu of heat input per hour.

Note: The proposed requirement for oil and gas-fired plants is about equivalent to 200 ppm by volume at 3 percent oxygen. The requirement for coal-fired plants is about equivalent to 500 ppm by volume. These levels are expected to be achieved by design and operation changes in firing boilers.

7.2 Nitric Acid Manufacture.

No person shall cause or permit the emission of nitrogen oxides from nitric acid manufacturing plants in excess of 5.8 pounds per ton of acid produced.

APPENDIX C

Major Pollutant Sources

Chemical Process Industries:
Adipic Acid
Ammonia
Ammonium Nitrate
Carbon Black*
Charcoal*
Chlorine
Detergent and Soap*
Explosives (TNT and Nitrocellulose)*
Hydrofluoric Acid*
Nitric Acid
Paint and Varnish Manufacturing*
Phosphoric Acid*
Phthalic Anhydride
Plastics Manufacturing*
Printing Ink Manfacturing*
Sodium Carbonate*
Sulfuric Acid*
Synthetic Fibers
Synthetic Rubber
Terephthalic Acid

Food and Agricultural Industries:
Alfalfa Dehydrating*
Coffee Roasting*
Cotton Ginning*
Feed and Grain*
Fermentation Processes
Fertilizers*
Fish Meal Processing
Meat Smoke Houses*
Starch Manufacturing*
Sugar Cane Processing*

Metallurgical Industries—Primary Metals Industries:
Aluminum Ore Reduction*
Copper Smelters*
Ferroalloy Production*
Iron and Steel Mills*
Lead Smelters*
Metallurgical Coke Manufacturing*
Zinc*

Metallurgical Industries—Secondary Metals Industries:
Aluminum Operations*
Brass and Bronze Smelting*
Ferro Alloys*
Gray Iron Foundries*
Lead Smelting*
Magnesium Smelting*
Steel Foundries*
Zinc Processes*

Mineral Products Industries:
Asphalt Roofing*
Asphaltic Concrete Batching*
Bricks and Related Clay Refractories*
Calcium Carbide*
Castable Refractories*
Cement*
Ceramic and Clay Processes*
Clay and Fly Ash Sintering*
Coal Cleaning*
Concrete Batching*
Fiberglass Manufacturing*
Frit Manufacturing*
Glass Manufacturing*
Gypsum Manufacturing*
Lime Manufacturing*
Mineral Wool Manufacturing*
Paperboard Manufacturing*
Perlite Manufacturing*
Phosphate Rock Preparation*
Rock, Gravel, and Sand Quarrying and Processing*

Petroleum Refining and Petrochemical Operations.*
Wood Processing.*
Petroleum Storage (Storage tanks and bulk terminals).

Miscellaneous:
Steam Electric Power Plants*
Municipal or Equivalent Incinerators*
Open Burning Dumps*

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*Major sources of sulfur oxides and/or particulate matter.

APPENDIX D.

(POLLUTANT) EMISSIONS INVENTORY SUMMARY, (EXAMPLE REGIONS AND WHERE EMISSION LIMITATIONS ARE DEVELOPED)

_____AIR QUALITY CONTROL REGION—DATA REPRESENTATIVE OF CALENDAR YEAR——

[In tons per year]

Source, category	State A								State B[1]		
	County 1		.....		County N		State region total			Region total[1]	
	Existing emissions	Emissions achieved[2]	Existing emissions	Emissions achieved[2]	Existing emissions	Emissions achieved[2]	Existing emissions	Emissions achieved[2]	Ditto	Existing emissions	Emissions achieved[2]
I. Fuel combustion—stationary sources:											
A. Residential fuel:											
1. Anthracite coal:											
(a) Area sources											
(b) Point sources											
2. Bituminous coal:											
(a) Area sources											
(b) Point sources											
3. Distillate oil:											
(a) Area sources											
(b) Point sources											
4. Residual oil:											
(a) Area sources											
(b) Point sources											
5. Natural gas:											
(a) Area sources											
(b) Point sources											
6. Wood:											
(a) Area sources											
(b) Point sources											
7. Other (specify):											
(a) Area sources											
(b) Point sources											
8. Total											
B. Commercial and institutional fuel:											
1. Anthracite coal:											
(a) Area sources											
(b) Point sources											
2. Bituminous coal:											
(a) Area sources											
(b) Point sources											
3. Distillate oil:											
(a) Are sources											
(b) Point sources											

4. Residual oil:
   (a) Area sources
   (b) Point sources
5. Natural gas:
   (a) Area sources
   (b) Point sources
6. Wood:
   (a) Area sources
   (b) Point sources
7. Other (specify):
   (a) Area sources
   (b) Point sources
8. Total

C. Industrial fuel:
1. Anthracite coal:
   (a) Area sources
   (b) Point sources
2. Bituminous coal:
   (a) Area sources
   (b) Point sources
3. Coke:
   (a) Area sources
   (b) Point sources
4. Distillate oil:
   (a) Area sources
   (b) Point sources
5. Residual oil:
   (a) Area sources
   (b) Point sources
6. Natural gas:
   (a) Area sources
   (b) Point sources
7. Process gas:
   (a) Area sources
   (b) Point sources
8. Other (specify):
   (a) Area sources
   (b) Point sources
9. Total

D. Steam-electric powerplant fuel (point sources only):
1. Anthracite coal
2. Bituminous coal
3. Coke
4. Distillate oil

See footnotes at end of table.

(POLLUTANT) EMISSIONS INVENTORY SUMMARY, (EXAMPLE REGIONS AND WHERE EMISSION LIMITATIONS ARE DEVELOPED)

| _____ AIR QUALITY CONTROL REGION—DATA REPRESENTATIVE OF CALENDAR YEAR—Continued

[In tons per year]

Source, category	State A								State B[1]		
	County 1		.....		County N		State region total			Region total[1]	
	Existing emissions	Emissions achieved[2]	Existing emissions	Emissions achieved[2]	Existing emissions	Emissions achieved[2]	Existing emissions	Emissions achieved[2]	Ditto	Existing emissions	Emissions achieved[2]
5. Residual oil											
6. Natural gas											
7. Process gas											
8. Other (specify)											
9. Total											
E. Total, stationary fuel combustion											
II. Process losses:											
A. Area sources:[3]											
B. Point sources:											
1. Chemical process industries											
2. Food and agricultural industries											
3. Metallurgical industries											
4. Mineral products industries											
5. Petroleum refining and petrochemical operations											
6. Wood processing											
7. Petroleum storage											
C. Total, process losses											
III. Solid waste disposal:											
A. Incineration:											
1. Onsite:											
(a) Area sources											
(b) Point sources											
2. Municipal, etc.:											
(a) Area sources											
(b) Point sources											
B. Open burning											
1. Onsite:											
(a) Area sources											
(b) Point sources											
2. Dumps:											
(a) Area sources											
(b) Point sources											

Source, category	State A								State B[1]		
	County 1		.....		County N		State region total			Region total[1]	
	Existing emissions	Emissions achieved[2]	Existing emissions	Emissions achieved[2]	Existing emissions	Emissions achieved[2]	Existing emissions	Emissions achieved[2]	Ditto	Existing emissions	Emissions achieved[2]
C. Other (specify):											
1. Area sources											
2. Point sources											
D. Total, solid waste disposal											
IV. Transportation (area source only):											
A. Motor vehicles:											
1. Gasoline powered[4]											
2. Diesel powered											
B. Off-highway fuel usage											
C. Aircraft											
D. Railroads											
E. Vessels											
F. Gasoline handling evaporative losses[5]											
G. Other (specify)											
H. Total, transportation											
V. Miscellaneous (area sources only):											
A. Forest fires											
B. Structural fires											
C. Coal refuse burning											
D. Agricultural burning											
E. Other (specify)											
F. Total, miscellaneous											
VI. Grand totals:											
A. Area sources											
B. Point sources											
C. Total											

[1] Included only if interstate region.
[2] "Emissions achieved" with control regulations of implementation plans. Must be submitted in example regions and where emission limitations are developed.
[3] For hydrocarbons only, would include emissions for surface coating operations, dry cleaning, degreasing operations, etc., unless considered point sources.
[4] For hydrocarbons, would include vehicle evaporative losses.
[5] For hydrocarbons only, would include losses from filling tank trucks, service station tanks, and automobile tanks.

APPENDIX E

POINT SOURCE DATA

(Does not need to be submitted with implementation plan but must be available for inspection by the Administrator, EPA)

I. General Source Information
- A. Establishment name and address
- B. Person to contact on air pollution matters and telephone number
- C. Average number of employees
- D. Standard Industrial Classification (S.I.C.) Codes
- E. Land area at plant location, if available
- F. Operating Schedule
  1. Percent of annual production by season
  2. Days of week normally in operation
  3. Shifts or hours of day normally in operation
  4. Number of days per year in operation
- G. Year in which data are recorded
- H. Future activities, if available (e.g., addition of new or expansion of existing facilities, changes in production rate, installation of control equipment, phasing out of equipment, fuel change, etc.)
- I. Map or general layout of large complex plants showing locations of various facilities, if available.*

II. Fuel Combustion
- A. Number of boilers
- B. Type of fuel burning equipment for each boiler
- C. Rated and/or maximum capacity of each boiler, 10⁶ BTU/hr
- D. Types of fuel burned, quantities and characteristics
  1. Type of each fuel used and place of origin
  2. Maximum and average quantity per hour
  3. Quantity per year
  4. Sulfur content (as received), %
  5. Ash content (as received), %
  6. Heat content (as received), BTU/unit of measure
  7. Estimate of future usage, if available
- E. Percent used for space heating and process heat
- F. Air pollution control equipment (existing and proposed)
  1. Type
  2. Collection efficiency (design and actual), %
- G. Stack data
  1. List stacks by boilers served
  2. Location of stacks by grid coordinates (Universal Transverse Mercator, UTM, or equivalent) *
  3. Stack height, ft.
  4. Stack diameter (inside, top), ft.
  5. Exit gas temperature, ° F
  6. Exit gas velocity, fps

Emission data
1. Based on emission factors
2. Estimate of emissions by the source
3. Results of any stack tests conducted

III. Manufacturing Activities (Process Losses)
- A. Process name or description of each product
- B. Flow diagram of each process indicating equipment capacities
- C. Quantity of raw materials used and handled for each product, maximum quantity per hour, and average quantity per year
- D. Quantity of each product manufactured, maximum quantity per hour, and average quantity per year

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*Required only when diffusion modeling is utilized.

E. Description of annual, seasonal, monthly, weekly, and daily operating cycle including downtime for maintenance and repairs
F. Air pollution control equipment in use (existing and proposed)
    1. Type
    2. Collection efficiency (design and actual), percent.
G. Stack data
    1. List of stacks by equipment served
    2. Location of stacks by grid location (UTM or equivalent)*
    3. Stack height, ft.
    4. Stack diameter (inside, top), ft.
    5. Exit gas temperature, °F
    6. Exit gas velocity, fps
H. Emission data
    1. Based on emission factors
    2. Estimate of emissions by the source
    3. Results of any stack tests conducted

IV. Solid Waste Disposal
A. Amount and description of solid waste generated, quantity per year
B. Percent of total that is combustible
C. Method of disposal (on-site or off-site)
D. Description of on-site disposal method, if applicable (incineration, open burning, landfill, etc.) including maximum quantities disposed per hour and average quantities disposed per year and actual operating schedule
    1. Location of the source by a grid system (UTM or equivalent)*
    2. If method of disposal is by an incinerator, include the following information:
        (a) Auxiliary fuel used
        (b) Air pollution control equipment (existing and proposed):
            (1) Type
            (2) Collection efficiency (actual and design), %
        (c) Stack data:
            (1) List stacks by furnace served
            (2) Stack height, ft.
            (3) Stack diameter, (inside, top), ft.
            (4) Exit gas temperature, °F
            (5) Exit gas velocity, fps
            (6) Exit gas moisture content, % if available
    3. Emission data
        (a) Based on emission factors
        (b) Estimate of emissions by the source
        (c) Results of any stack tests conducted

*Required only when diffusion modeling is utilized.

APPENDIX F

Area Source Data*

(Does not need to be submitted with implementation plan but must be available for inspection by the Administrator, EPA)

Grid Coordinate (lower left-hand corner) ——— · ———, UTM or equivalent**

Average Stack Height of Sources ————***

I. Fuel Combustion—Stationary Sources (includes sulfur and ash content of fuels, if applicable)

A. Residential Fuel:

1. Anthracite Coal (plus type and size of unit)****—tons/year
2. Bituminous Coal (plus type and size of unit)—tons/year
3. Distillate Oil (plus type and size of unit)—10^6 gal/year
4. Residual Oil (plus type and size of unit)—10^6 gal/year
5. Natural Gas (plus type and size of unit)—10^6 cf/year
6. Wood—tons/year
7. Other—please specify

B. Commercial and Institutional Fuel:

1. Anthracite Coal (plus type and size of unit)—tons/year
2. Bituminous Coal (plus type and size of unit)—tons/year
3. Distillate Oil (plus type and size of unit)—10^6 gal/year
4. Residual Oil (plus type and size of unit)—10^6 gal/year
5. Natural Gas (plus type and size of unit)—10^6 cf/year
6. Wood—tons/year
7. Other—please specify

C. Industrial Fuel

1. Anthracite Coal (plus type and size of unit)—tons/year
2. Bituminous Coal (plus type and size of unit)—tons/year
3. Coke (plus type and size of unit)—tons/year
4. Distillate Oil (plus type and size of unit)—10^6 gal/year
5. Residual Oil (plus type and size of unit)—10^6 gal/year
6. Natural Gas (plus type and size of unit)—10^6 cf/year
7. Wood—tons/year
8. Other—please specify

II. Process Losses (hydrocarbons only)

A. Surface coating operations, dry cleaning, degreasing operations, etc., unless considered as point sources—appropriate basis for emission estimate

III. Solid Waste Disposal

A. On-site incineration (plus type of unit)—tons/year
B. Open burning—tons/year
C. Other—specify

IV. Transportation

A. Gasoline-powered motor vehicles—appropriate basis for emission estimate, including hydrocarbon evaporative losses
B. Diesel-powered motor vehicles—appropriate basis for emission estimate
C. Off-highway fuel usage—10^3 gal/year
D. Aircraft—number of flights per year per type of aircraft
E. Railroads—10^3 gal diesel oil/year

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*Emissions data for all source categories and subcategories listed below would be summarized in the implementation plans as is in Appendix D or G.

**Data would be required on a grid basis only when diffusion modeling is utilized. For proportional model technique, data must be available only on a county basis.

***Required only when diffusion modeling is utilized.

****Average type and size for each category. This is used as the basis for selection of average emission factor.

F. Vessels—10^3 gal oil/year, tons of coal/year, or tons of wood/year (includes sulfur and ash content of fuel, if applicable)
G. Gasoline handling evaporative losses—appropriate basis for hydrocarbon emission estimate from filling tank trucks, service station tanks, and automobile tanks
H. Other—specify

V. Miscellaneous
A. Forest fires—appropriate basis for emission estimate
B. Structural fires—appropriate basis for emission estimate
C. Coal refuse burning—appropriate basis for emission estimate
D. Agricultural burning—appropriate basis for emission estimate
E. Other—specify

APPENDIX G

(POLLUTANT) EMISSIONS INVENTORY SUMMARY, (REGIONS WHERE EMISSION LIMITATIONS ARE NOT DEVELOPED)

..... AIR QUALITY CONTROL REGION—DATA REPRESENTATIVE OF CALENDAR YEAR——

[In tons per year]

Source category	State A				State B [1]	Regional total [1 2]
	County 1 [2]	..... [2]	County N [2]	State region total [2]	Ditto	
I. Fuel combustion—stationary sources:						
A. Area sources [3]						
B. Point sources						
C. Total						
II. Process losses:						
A. Area sources [3 4]						
B. Point sources:						
1. Chemical process industries						
2. Food and agricultural industries						
3. Metallurgical industries						
4. Mineral products industries						
5. Petroleum refining and petrochemical operations						
6. Wood processing						
7. Petroleum storage						
C. Total						
III. Solid Waste Disposal:						
A. Area sources [3]						
B. Point sources						
C. Total						
IV. Transportation: (area sources only) [3 5]						
V. Miscellaneous: (area sources only) [3]						
VI. Grand totals:						
A. Area sources [3]						
B. Point sources						
C. Total						

[1] Included only if interstate region.
[2] Existing emissions.
[3] If not available, does not need to be submitted for priority III regions.
[4] For hydrocarbons only, would include emissions for surface coating operations, dry cleaning, degreasing operations, etc., unless considered point sources.
[5] For hydrocarbons would include vehicle evaporative losses and losses from filling tank trucks, service station tanks, and automobile tanks.

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APPENDIX H

AIR QUALITY DATA SUMMARY

Pollutant	Sampling site location [1]	Sampling interval (months)	Start date	End date	Number of samples	Maximum 1 hour	Maximum 3 hours, 6 to 9 a.m.	Maximum 8 hours	Maximum 24 hours	Annual arithmetic mean	Standard deviation	Annual Geo. mean	Geo. standard deviation
Particulate matter	X	X	X	X	X				X	X	X	X	X
Sulfur oxides (as SO_2)	X	X	X	X	X				X	X	X	X	X
Nitrogen dioxide	X	X	X	X	X				X	X	X	X	X
Photochemical oxidants	X	X	X	X	X	X				X	X	X	X
Carbon monoxide	X	X	X	X	X	X		X		X	X	X	X
Hydrocarbons	X	X	X	X	X		X			X	X	X	X

[1] UTM grid coordinate or equivalent.

Note: "X" is data or information required.

APPENDIX I

Projected Motor Vehicle Emissions

The assumptions listed below were made in calculating the projectd national urban emissions from motor vehicles as shown in Figures 1–3.

a. Emission factors are based on the new Federal test procedure (1), which has an average route speed of 18 miles per hour.

b. Emission control devices are assumed to just meet present and proposed standards when new, but deteriorate with age. Deterioration factors are adopted from data given in Reference 2.

c. Increases in urban vehicle-miles of travel for automobiles from Reference 3.

d. Distribution of automobiles by age from Reference 4.

e. Relative miles of travel for automobiles (i.e., new cars are driven more than older ones) from Reference 5.

f. Vehicle-mile projections for trucks from Reference 6.

g. Efficiency of retrofit devices is based on data reported by General Motors Corporation (7), Ford Motor Company (8), and Chrysler Corporation (9) for the retrofit kits supplied by each manufacturer. The Ford and Chrysler figures also include the effect of a tune-up. The following reduction figures are considered representative of emission reduction capabilities of retrofit devices:

HC—50%
CO—37%
NO_x—40%

Retrofit was considered only for pre-1968 automobiles. These devices were assumed to deteriorate in the same way as factory-installed control devices.

REFERENCES

1. *Federal Register*, Vol. 35, No. 219, Part II, November 10, 1970.

2. "Exhaust Emissions from Privately-Owned 1966–1968 California Automobiles—A Statistical Evaluation of Surveillance Data," Supplement to Progress Report No. 13 by Arthur J. Hocks, California Air Resources Board, Los Angeles, California, November 8, 1968.

3. Unpublished data, Department of Transportation, estimated 1990 vehicle-miles of travel.

4. *Automotive News*—1968 *Almanac Issue*, Slocum Publishing, Detroit, Michigan, April 29, 1969.

5. Bostich, T. A. and Greenhalgh, H. J. "Relationship of Passenger Car Age and Other Factors to Miles Driven." U.S. Department of Commerce, Bureau of Public Roads, Washington, D.C., January 1967.

6. Landsberg, H. H., Fischman, L. L., and Fisher, J. L., *Resources In America's Future*, Johns Hopkins Press, 1963.

7. The General Motors Used Car Emission Control, General Motors Corporation, December 1969.

8. McKee, P. E., "Preliminary Report—Ford, G.S.A. Used Car Emission Control Experiment" Ford Motor Company, April 1970.

9. "Used Car Control System Hot Cycle Emissions Before and After Installation," Chrysler Corporation.

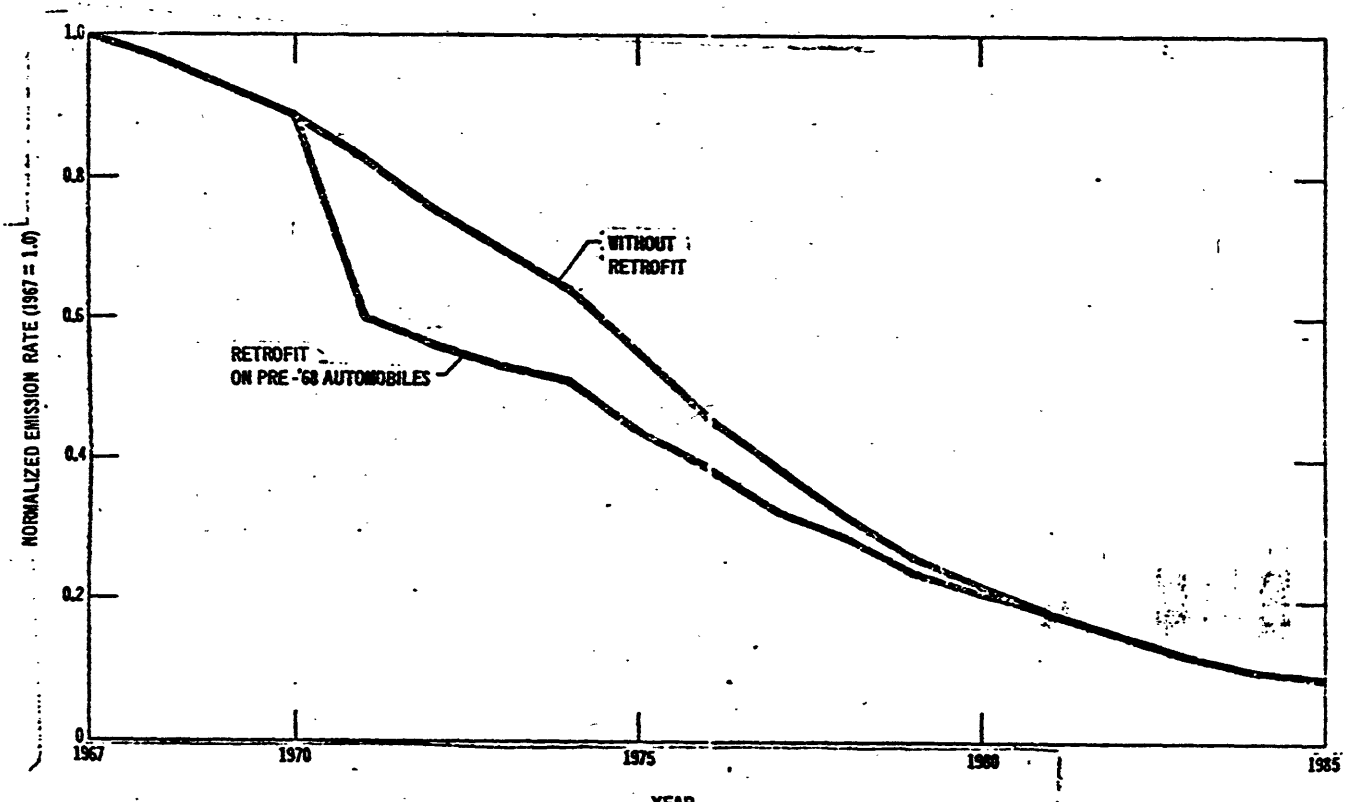


Figure 1. Projected national urban normalized hydrocarbon emissions.

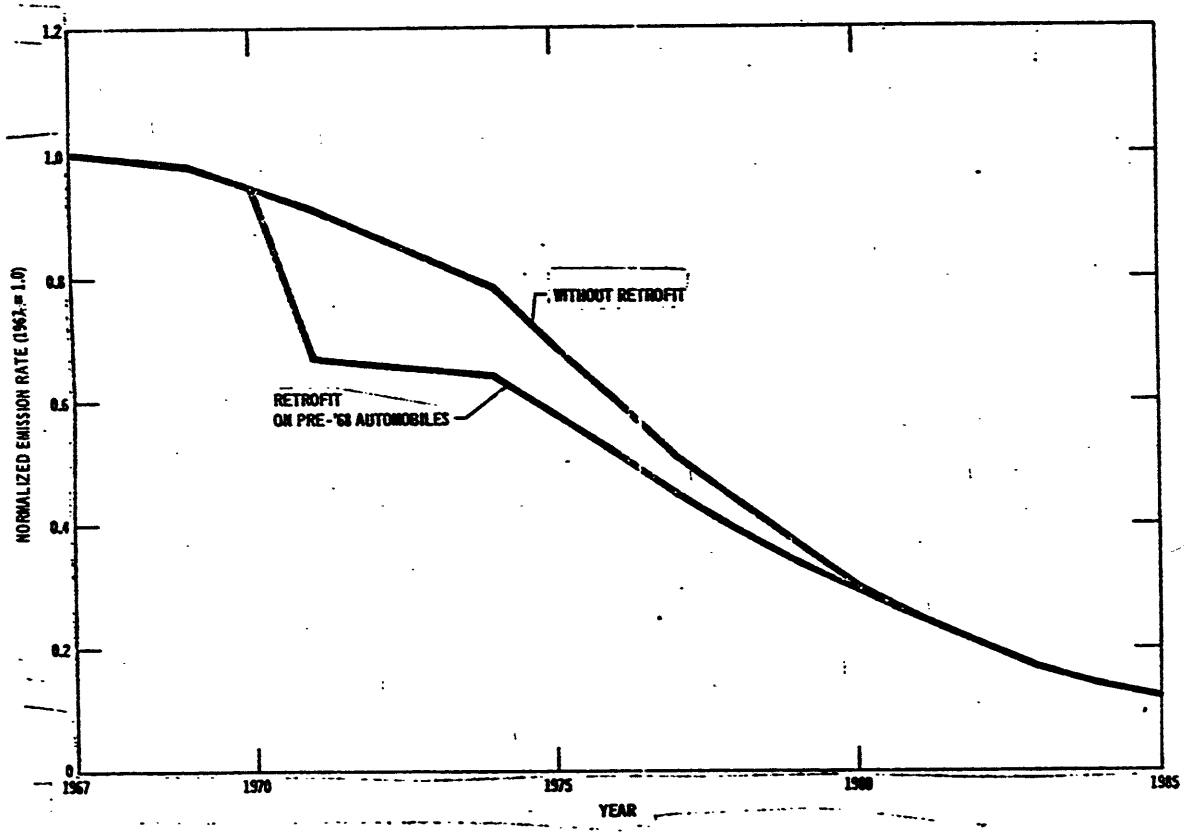
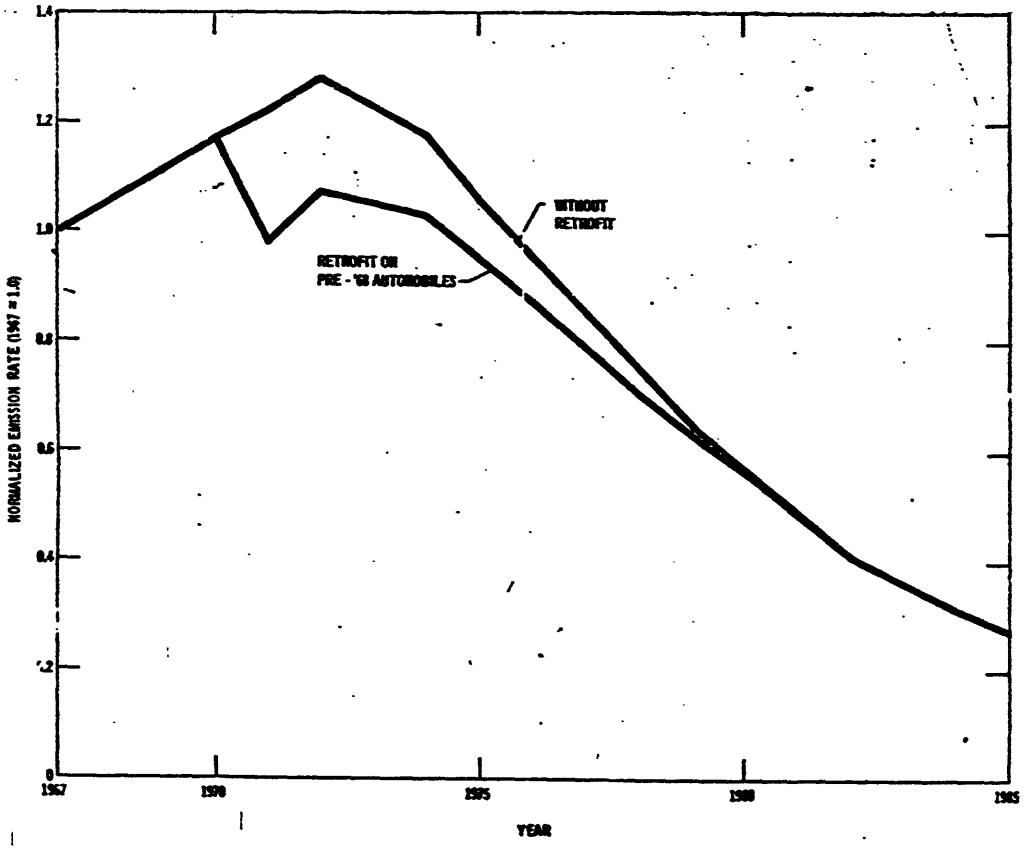


Figure 2. Projected national urban normalized carbon monoxide emissions.


1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
NORMALIZED EMISSION RATE (1967 = 1.0)
1967
1970
1975
1980
1985
YEAR
WITHOUT RETROFIT
RETROFIT ON PRE - '68 AUTOMOBILES

APPENDIX J

Required Hydrocarbon Emission Control as a Function of Oxidant Concentration

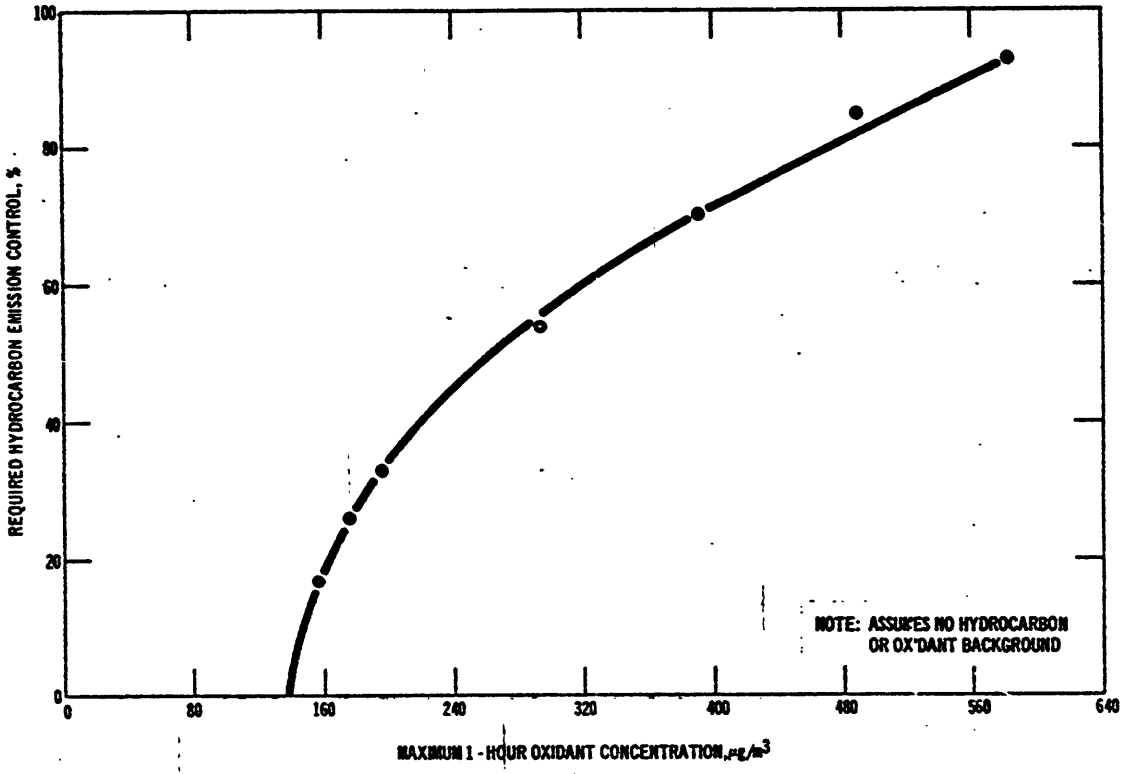


Figure 1. Required hydrocarbon emission control as a function of oxidant concentration.
REFERENCE: AIR QUALITY CRITERIA FOR NITROGEN OXIDES, ENVIRONMENTAL PROTECTION AGENCY, AIR POLLUTION CONTROL OFFICE, WASHINGTON, D.C., JANUARY 1971

APPENDIX K

CONTROL AGENCY FUNCTIONS

MAN-YEAR ESTIMATES BY FUNCTION FOR STATE OF _____ PORTION OF _____ AQCR

Function	Present		Year					
	State agency	Local agencies	State agency	Local agencies	State agency	Local agencies	State agency	Loca agencies
Enforcement services, subtotal								
Scheduled inspections								
Complaints and field patrol								
Engineering services, subtotal								
Permit system								
Emission estimates								
Source testing								
Reports, new legislation, etc								
Technical services, subtotal								
Operation of monitoring network								
Special studies								
Instrument calibration and maintenance								
Laboratory operations								
Data processing								
Management services, subtotal								
Policy, P/R, strategies, etc								
Staff training								
Administrative and clerical support								
Total								

FUND ESTIMATES FOR STATE OF ..... PORTION OF ..... AQCR

[In thousands of dollars]

	Present		Year					
	State agency	Local agencies	State agency	Local agencies	State agency	Local agencies	State agency	Loca agencies
Enforcement services:								
Operating funds								
Capital funds								
Contract funds								
Engineering services:								
Operating funds								
Capital funds								
Contract funds								
Technical services:								
Operating funds								
Capital funds								
Contract funds								
Management services:								
Operating funds								
Capital funds								
Contract funds								
Total operating funds								
Total capital funds								
Total contract funds								
Total funds								

Mr. RUCKELSHAUS. We can certainly make our original guidelines a part of the record. OMB did not really make any suggestions, but to the extent we have anybody's suggestions you are certainly entitled to them also.

Mr. ROGERS. Just OMB's.

Mr. RUCKELSHAUS. I do not know that they submitted any recommendations to us.

Mr. ROGERS. You do not have any correspondence on that at all?

Mr. MIDDLETON. We have some suggestions.

Mr. ROGERS. Let me suggest this is something we would like to go into. Section 101 requires inclusion of emission limitations.

I notice on page 3, you do not mention that. Maybe it is covered, is it?

Mr. RUCKELSHAUS. I am not sure I understand the question.

Mr. ROGERS. In the States' implementation plan which they must submit as to how they will implement the law, the law requires the inclusion of emission limitations in that plan. I do not see you mentioning that. Perhaps you overlooked it. Is that a requirement in your guidelines?

Mr. RUCKELSHAUS. The answer to your question, Mr. Chairman, is that we have told the State that while they may submit a strategy in which emission limitations are provided, if they can show that the standards can be met without emission limitations, then we will review the plan with that in mind.

Now, the vast majority of the plans that have been and are being submitted, do contain and will require emission limitations.

Mr. ROGERS. How will they know if they have to have emission limitations until something happens?

Mr. RUCKELSHAUS. In virtually all of the plans that we have now, there are emission limitations.

Mr. ROGERS. Why is that not a requirement since it was specifically stated in the law?

It is my understanding this was changed at OMB, that you had it in your suggested guideline but it came back from OMB and it was not in it. Maybe I am mistaken.

Mr. RUCKELSHAUS. It was simply amended to say that if a State could show they could meet the air quality standard without emission limitations, then there would not be such a requirement. Frankly, I do not know how they are going to do it, but if they can make such a showing——

Mr. ROGERS. I do not know how they could do it either. It seems to me there was a requirement, and I hope it is still a requirement because it is required in the law.

Mr. MIDDLETON. Mr. Ruckelshaus spoke to other opportunities to meet the standards. I think if you or your staff had the opportunity to look at the rules and regulations, which we will submit for the record, you will see under subpart A, 42.1 a description of what a control strategy is. I might just read that to clarify the point since it is one of concern to all of us. It says:

> Control strategy means a combination of measures designated to achieve the aggregate reduction of emissions necessary for attainment and maintenance of a national standard including but not limited to measures such as emission limitations. These are first on the list.

Mr. ROGERS. And I would think the most important.

Mr. MIDDLETON. That is why they appear first on the list.

Mr. ROGERS. I cannot conceive of any plan coming in where they do not have some thoughts, some plan, some method of eliminating emissions, because this is where we are beginning to start one.

Mr. RUCKELSHAUS. I have yet to see one which does not have any limitations.

Mr. ROGERS. I would hope you would not approve any plan that does not include that within their proposal.

Shouldn't each plan have that?

Mr. MIDDLETON. We would not want to stop progress if there is an innovative idea.

Mr. ROGERS. This does not stop any new ideas. It just says that if the new ideas do not work, we can stop the emissions.

Mr. MIDDLETON. The Administrator will have to approve the plan.

Mr. ROGERS. How are you going to effect anything or carry it out unless you know how to bring about a limitation of the emissions? Here we state it first in the law, and then it is left out of your guidelines.

Mr. RUCKELSHAUS. I do not think it is left out.

Mr. ROGERS. Then the intent is that they shall; is that correct?

Mr. RUCKELSHAUS. It is certainly so stated in the regulations.

Mr. ROGERS. If that is the clear understanding, fine, but I think that should be made clear, and I think the States should know that because certainly that was the intent of Congress and I am sure your intent in getting into it.

One of the things I was concerned about, you had public comment before and not after that OMB change. Is that true? There was no public comment after the OMB change came back?

Mr. RUCKELSHAUS. Those were the final regulations.

Mr. ROGERS. That is right, and they were changed after they were entered.

Also, what about your change in the language on the approval of the plan shall not be considered in any manner to allow significant deterioration of existing air quality in any portion of any State? Was this not changed by OMB? They cut that language from the published guidelines, did they not?

Mr. RUCKELSHAUS. Like all these other changes, Mr. Chairman, that was made by me.

Mr. ROGERS. It was in your original and it was not changed until it came back with the suggestion filed by OMB.

Mr. RUCKELSHAUS. There were suggestions made, and I think they were right for use not to put into the guidelines any nondegradation standard that went beyond the authority we were given under the statute. Our authority under the statute was to protect the ambient air quality and set standards that protect the public health and environment. For us to impose upon a State that any nondegradation standard be included in their plan went beyond our authority.

However, the States clearly have that authority to put that provision in there if they want to, and we have no authority to tell them to do otherwise.

Mr. ROGERS. What about the feeling by some that in the guidelines, after OMB reviewed them, the States were repeatedly discouraged from applying strict measures necessary to attain air quality standards to such areas where such measures are not absolutely necessary and they say nothing herein shall be construed to encourage strict standards.

Mr. RUCKELSHAUS. It also states pretty clearly in the guidelines that nothing herein precludes a State or political subdivision from adopt-

ing any measures or combination thereof to maintain air quality better than that required by national standards. That is a specific provision in the guidelines. What we are saying is we are neutral on that.

Mr. ROGERS. I think it is going beyond neutrality because there was a change in the approach from the way you first had it, and then after it came back from OMB.

Mr. RUCKELSHAUS. We were trying to carry out the will of the Congress in this bill, as I saw it, and that was to set standards which fully protected the public health and environment, which we did. If the States want to set stricter standards, that is up to them, and that is precisely what we are trying to say in these guidelines.

Mr. ROGERS. It just seems to me that the negative approach was not necessary. I think we need to encourage positive action rather than a negative action, and I think the way you first had them was preferable.

Mr. RUCKELSHAUS. The way we first had them, frankly, went beyond our authority given us under the act.

Mr. ROGERS. I disagree with you there. I think they were better the way you first had them.

Mr. RUCKELSHAUS. I do not see the authority in the act to condition approval by any nondegradation standard.

Mr. ROGERS. Nor do I see any provision in the law to discourage them from strict enforcement to bring about a clear act.

Mr. RUCKELSHAUS. Not only are we going to encourage strict enforcement by the State, but if they do not enforce it, we will move in. But I do not think that is a question in the guideline.

Mr. ROGERS. I do not think you need to state that—"Nothing herein shall be construed to encourage that." That is the actual wording.

Mr. RUCKELSHAUS. We also say nothing shall preclude them——

Mr. ROGERS. But you added this other part, but I will not pursue that any further.

I think OMB came in and I want to know who their experts are over there who are better than you. I think what you originally did was better. But I won't pursue it.

Mr. Nelsen.

Mr. NELSEN. We usually assume OMB moves more in the budget and management area. I did not know that they went beyond that in too many cases. Am I right or wrong in that? Is it budget they usually deal with?

Mr. RUCKELSHAUS. That is right, Mr. Nelsen. They also act as a conduit or clearinghouse for proposed legislation and, in the case of several agencies, for proposed regulations. This insures that all of the suggestions of other governmental agencies are taken into account by the agency which has the responsibility for issuing the standard or regulation. In this case, that is what they did. They are really nothing more than a conduit.

Mr. NELSEN. Many times someone will come before the committee asking x number of dollars and then along comes the Appropriations Committee and it recommends way below the authorization. Did the Appropriations Committee match the authorization level or how much lower were they?

Mr. RUCKELSHAUS. They did not in this case match the authorizations level. It is below. In fiscal year 1972——

Mr. ROGERS. While you are giving that, would you also give what you requested.

Mr. RUCKELSHAUS. I am sorry, I did not hear you.

Mr. ROGERS. Would you also give the requested funds.

Mr. RUCKELSHAUS. We received from the committee precisely what we requested. I did not mean to imply otherwise.

Mr. NELSEN. The money you requested we authorized, and the money that was appropriated——

Mr. RUCKELSHAUS. It may be easier to supply those figures for the record. I could give you the figures of what was actually appropriated. The authorizations are spread throughout the act.

Mr. NELSEN. The reason I ask the question, quite often OMB gets criticism because they may have made a dollar recommendation below what this committee may have authorized.

Then we also find on the other side of the process that the Appropriations Committee often appropriates less than we authorized. So, when we look at the total picture, I do not want to overlook the fact the Congress sometimes reduces dollar authorizations, and I think Budget also steps in at times.

It is my understanding that the cupboard is getting rather bare.

(The following information was received for the record:)

AUTHORIZATION AND APPROPRIATION FOR FISCAL YEAR 1972

The authorization for Fiscal year 1972 was $390 million; the Congress appropriated $143,015,000.

Mr. ROGERS. Mr. Kyros.

Mr. KYROS. Thank you, Mr. Chairman.

I would like to have you turn your attention for a moment to testimony we have had the last couple of days when you were not present. We had the automotive manufacturers and they gave some very cogent reasons for not being able to meet the standards for the 1975 and 1976 models. We also had the statement by the National Academy of Sciences that the requirements to meet the provisions of the Clean Air Act of 1975 were not available at this time.

I tried to get this question cleared up with the auto companies and they answered candidly but I am not sure it is clear on the record.

Assuming for purposes of discussion that it is justified to grant a suspension of 1 year, does that mean you are still going to require for the 1975 models something like 88 percent of the 90 or 85 or 80 or 75? What are you going to do?

Mr. RUCKELSHAUS. Under the terms of the act, that is part of the suspension proceeding. In order to suspend the 1975 deadline, we are required to set an interim 1975 standard that would be as close to the 90-percent reduction as we felt was technologically feasible, based on the evidence presently available.

Mr. KYROS. It says any interim standard shall reflect the greatest degree of emission control which is attainable by the technology. You are going to have to face the decision of whether to suspend or not, and you will also have to make a finding as to the greatest degree of control they can achieve by 1975.

Mr. RUCKELSHAUS. That is correct.

Mr. KYROS. I do not want to paraphrase their lengthy testimony, but very few auto companies committed themselves to saying they can reach x percent by 1975. How are you going to be able to reach that decision?

Mr. RUCKELSHAUS. I have 60 days in which to make that decision. We do have independent studies that we are making in-house to try to make some assessment of just what is achievable and what is feasible in the event an extension of time becomes necessary.

Mr. KYROS. I do not know whether you have heard the proposal advanced by our chairman, the idea of fixing 25,000 miles instead of 50,000 for using a catalytic converter and averaging emissions. Could you make that kind of a decision?

Mr. RUCKELSHAUS. I think we could, yes.

Mr. KYROS. Thank you very much, Mr. Chairman.

That would mean you could still meet the 90 percent?

Mr. RUCKELSHAUS. I think the law authorizes that.

Mr. ROGERS. I would concur that you would have that ability under the law to change the durability requirement from 50,000 to 25,000 if that was a necessary change to make. It seems to be the feasible approach to consider anyhow because I do not think warranties on any car extend to 50,000 miles. I am sure the testimony to this committee would show you that the oil industry says they can develop sufficient lead-free gasoline by 1974 and then if there is an emission averaging, the statutory standards could be accomplished, so I think this is possible.

Mr. Stork, I notice that you thought that the cold start does not necessarily have to be weighted against hot starts, or am I misunderstanding you?

Mr. STORK. I am sorry I was not clear. The cold start does have to be considered very carefully in relation to hot starts to come up with the proper test procedure.

Mr. ROGERS. What is the time that the smog problem is the worst?

Mr. STORK. That is a very difficult and complex question to answer, sir. It varies by different pollutants. One of the factors that we had to consider is not that the smog problem is the worst between 6 and 9 a.m., in Los Angeles, but rather the ambient levels of hydrocarbons in Los Angeles between 6 and 9 a.m. are the best predicters of smog later in the day.

However, a good deal of evidence suggests that emissions from cars during the day contribute to a variety of air pollution problems.

Mr. ROGERS. But the indications are that the early morning problem is mainly because of the cold starts and the added pollution of getting all of the automobiles going at the beginning of the day.

Mr. STORK. It has been estimated, based on analysis of the types of control systems that will be used, Mr. Chairman, that approximately 45 percent of the ambient air quality levels of hydrocarbons that will be measured between 6 and 9 in the morning in Los Angeles come from cold starts. In other words, in the first 4 minutes of the vehicle operation, the test we devised would have measured about 70 percent of the total hydrocarbons emitted. There the base point would have overweighted significantly the cold start and also, Mr. Chairman, failed to bring into consideration what cars do when they are started hot. It would have had the potential of greatly distorting what it does to air quality. Anyone who has started a car on a hot day and smelled the raw gasoline, knows this is an engineering problem all its own. From what we hear from the automakers, it is not at all clear whether their burden has been eased or made more difficult by bringing in hot starts.

Mr. ROGERS. I understand from the automobile and oil people that they feel it is the cold start which is involved in getting down to the 90 percent.

Mr. STORK. The cold start is difficult for them to overcome for hydrocarbon and carbon monoxide.

Mr. ROGERS. That is all you require for 1975 and nitrogen oxide in 1976.

Mr. STORK. That is correct, but the automakers have made it clear it is not technologically feasible to go to a totally different system for 1976. So, whatever they do for 1975 they would consider for 1976 and hot operation makes meeting the 1976 standard more difficult.

Mr. ROGERS. Oxides come from heat. That is the problem there.

Mr. STORK. That is correct, Mr. Chairman.

Mr. ROGERS. As I understood it, EPA's posted regulation included a State model plan. OMB reviewed it and then it was taken out and now you only include suggestions which rather changes the thrust of the guidelines. What comment do you have on that?

Mr. RUCKELSHAUS. It was changed by me.

Mr. ROGERS. I know they were all changed by you, but you changed them after hearing from OMB. Why were they put forth at the beginning if you thought they were good at the beginning and you thought you had the authority to do it but then we all visit over at OMB and then all of the changes. It is all right to admit they have some influence. We understand that.

Mr. RUCKELSHAUS. Your suggestion that I took the OMB changes in appendix B of the guidelines as a mandate to change the guidelines is not exactly what happened.

Mr. ROGERS. I am glad to know that. What was the rationale for not putting forth the plan as you originally proposed?

Mr. RUCKELSHAUS. In appendix B we were locking the States into doing it that way, and I don't believe that is our responsibility. I think what we ought to do as an Agency is to say, "here are some suggested ways you can meet the ambient air quality standards. If you know of other ways and can convince us that they are better, go to it." Our opinion is that we should provide the States with maximum flexibility in their ability to meet these standards.

Mr. ROGERS. Do you not think it would be best to at least give them a model to get started?

Mr. RUCKELSHAUS. That is what we do in appendix B.

Mr. ROGERS. In your model plan, and knowing that they have the right to differ from that——

Mr. RUCKELSHAUS. That is precisely what we do in appendix B.

Mr. ROGERS. I think you have changed it considerably from the model plan.

Mr. RUCKELSHAUS. On the one hand, the States want to have control and, on the other hand, they want us to tell them what to do.

Mr. ROGERS. They want you to tell them what to do because you are the one to determine if they are right; and if they do not do it right, you do it for them.

Mr. RUCKELSHAUS. If they follow the suggestions in appendix B, they will be right.

Mr. ROGERS. We go out with model laws all the time suggesting this would be a minimum that would be acceptable. I am just concerned about the impact of this whole thrust.

Mr. RUCKELSHAUS. There is a great distinction between model law and this appendix where we provide the States with suggestions as to

how they might meet the standards. I think the real problem here, Mr. Chairman, is the distinction between these standards which have to be met, and they are stringent standards, and I make no apology for the national ambient air standards.

Mr. ROGERS. Then you do not include emission control?

Mr. RUCKELSHAUS. We do in appendix B itself.

Mr. ROGERS. But emission limitations.

Mr. RUCKELSHAUS. I think we have provided in these guidelines for emission limitation. The States obviously interpret it that way because the plans coming in all have the emission limitations.

Mr. ROGERS. You have mention of blanket exemptions such as the Department of Defense, and after the OMB reviewed it, it was deleted. Has DOD asked for a blanket exemption?

Mr. RUCKELSHAUS. I am really not familiar with that. Is that in the final regulation?

Mr. ROGERS Yes; in your posted regulation. You have a blanket regulation. I wonder if they were given any blanket exemptions.

Mr. RUCKELSHAUS. To my knowledge, they have not been given any.

Mr. ROGERS. Have they asked for any?

Mr. RUCKELSHAUS. Not to my knowledge.

Mr. ROGERS. Have we allowed any exemptions to DOD yet?

Mr. RUCKELSHAUS. Could you point out the section in the guidelines where that occurs?

Mr. ROGERS. Yes; I will get it for you. While they are checking this, I will go ahead.

Mr. RUCKELSHAUS. Mr. Chairman, I think I know what you are referring to. There was a request from the Office of Emergency Preparedness for such inclusion and we ruled it out.

Mr. ROGERS. The staff will get it for us.

One of the problems we are concerned with, for instance, when we went down to look at Birmingham where we think your agency did a good job in using the emergency powers that the Congress put in there for you—one of my concerns is that when we started looking at the fact, we thought U.S. Steel was the greatest polluter down there, but we found that the biggest polluter is the TVA plant on Widow's Creek, a semigovernmental authority. Were you aware of this?

Mr. RUCKELSHAUS. Mr. Chairman, there are some 1,100 Government facilities around the country, and as we have discussed in the past, some of them pollute. Now, there are schedules that those facilities are on for abatement of the pollution they are causing. In the specific case of Birmingham, it is my understanding that what you say is true. Obviously, if the Government itself is guilty of such a violation, there has to be an abatement of that violation.

Mr. ROGERS. They say this really dumps 249,000 tons of sulfur oxides, 211,000 tons of particulates last year. Their other plant was responsible for 156,000 tons of sulfur oxide and 95,000 of particulates and U.S. Steel only had about 46,000 tons of particulates and 15,000 tons of sulfur oxide, and we were enjoining them not to pollute; but we did not enjoin the TVA. I understand there is some difference there. I do not think there was as much right in that particular area but still that is the largest polluter in the State of Alabama.

Mr. RUCKELSHAUS. I am informed TVA has scheduled abatement procedures and abatement schedules for that facility and has set aside several million dollars to meet those schedules.

Mr. ROGERS. Could you furnish that for the committee. It is a little ludicrous for us to go down and use our authority against the State and private industry and then hear that a Government agency or semi-governmental agency is the largest polluter.

(The following information was received for the record:)

TVA AIR POLLUTION ABATEMENT PROJECTS

The following TVA facilities located in the State of Alabama have active air pollution abatement projects:

1. Widows Creek Steam Plant, Stevenson, Ala.

(*a*) Units No. 1 through 6.—Installation of 97 percent efficient electrostatic precipitators in series with existing mechanical collectors. Construction scheduled to be completed December 1974.

(This project is a part of the total plan for particulate control of all TVA steam plants. In order to do this work, the generating units must be taken out of service and a schedule established which will permit TVA to meet power requirements throughout the entire TVA's system during the installation period. The total time needed for design, procurement and installation of controls is such that work on this project cannot be started until after the December 31, 1972, deadline set by Executive Order 11507. The TVA plan, involving the expenditure of over $100 million for particulate controls alone throughout the TVA system is so complex that it would be extremely difficult to accelerate action on this project.)

(*b*) Unit No. 8.—Installation and testing of a wet scrubber to remove both fly ash and SO_2. The developmental nature of this project makes scheduling uncertain. However, current plans are to have the equipment in operation by early 1975.

2. Colbert Steam Plant, Tuscumbia, Ala.

(*a*) Units No. 1 through 4.—Installation of 97 percent efficient electrostatic precipitators in series with existing mechanical collectors. Work is in progress and is scheduled to be completed by December 1972.

(*b*) Unit No. 5.—Plans to improve fly ash collection efficiency of existing equipment were recently abandoned and new electrostatic precipitators will be installed. The project is in the preliminary planning stage and no date has been set for completion as yet.

3. National Fertilizer Development Center, Muscle Shoals, Ala.

(*a*) Nitric acid units Nos. 1, 2, and 3.—Installation of a catalytic reactor to convert nitrogen oxides in exhaust gases to nitrogen. The project is scheduled to be completed in June 1974.

(*b*) Nitric acid unit No. 3.—installation of a refrigerated cooling system to increase recovery of nitrogen oxides and decrease emission of nitrogen oxides in the exhaust gases. Installation scheduled to be completed June, 1972.

(*c*) Phosphoric acid units nos. 1, 6, and 7.—installation of (1) controls for improved phosphorus burning rate and (2) equipment for scrubbing of gases to remove fluoride discharge and for treatment of scrubber water to take out fluorides. Construction scheduled to be completed December, 1972.

(*d*) Recent changes in plans call for discontinuance of the manufacture of phosphoric acid and the discontinuance of three earlier planned projects concerned with the control of air pollutants resulting from the manufacture of phosphoric acid. Controls no longer will be required to abate air-pollution from this source. These are long-range operating plans. They will be in effect before the end of 1973 and will result in a permanent improvement in air quality because of this reduction in emissions from this plant.

Mr. ROGERS. Were you aware of the procedure the National Academy of Sciences was using in its method of operating? Did they confer with you or did they set up their own procedures?

Mr. RUCKELSHAUS. They set up their own procedures, Mr. Chairman.

Mr. ROGERS. Have you sent out your people to see what the companies are doing as far as antipollution work is concerned—the automobile companies?

Mr. RUCKELSHAUS. Yes.

Mr. ROGERS. Your people have been monitoring?

Mr. RUCKELSHAUS. Mr. Stork can address that more specifically. He is in charge of that program.

Mr. STORK. Mr. Chairman, in September, we sent a very thorough questionnaire to all of the manufacturers who are currently selling cars in the United States to determine in great detail what they were doing, and what progress they were making toward meeting the 1975 standards. We received responses from all but some insignificantly small ones. The responses have been analyzed. We have had follow-up visits to those companies and have done everything to know as much as we can know about where the companies stand.

Mr. ROGERS. What testing are you doing? As I recall, in the law we specifically put in a provision where you can set up a testing facility for anyone who might produce an emission-free engine or a reduction of those engines. What has happened to that? How many people do you have working on that? Where is it set up?

Mr. STORK. I believe you are referring to section 206(a)(2) of the act. We have a laboratory at Ann Arbor, Mich. So far, we have not received an application for testing from anyone who says he can meet the 1975 standards and, therefore, no specific tests under that provision have been made. We stand ready to make such tests.

Mr. ROGERS. Do you have the personnel and the equipment ready so that you can certify that they do meet the required standard, if necessary?

Mr. STORK. We have laboratory equipment and personnel for certification purposes and we could clearly work into our schedules any testing procedures, but we do not have people standing by full-time for tests.

Mr. ROGERS. You would require them to be tested first before they come to you so they can show you some results of testing?

Mr. STORK. That is correct.

Mr. ROGERS. I understand the reason for that.

Mr. Lear has not come to you at all?

Mr. STORK. That is not correct, Mr. Chairman, because Mr. Lear was in my office about 11 months ago and we talked about his engine. I offered to test it any time he had it ready. I asked him when it would be ready and he said "soon." I visited Mr. Lear's plant in July with three technical assistants and we discussed the matter again with him at that time. We have had communications with Mr. Lear's corporation, which is near Reno, Nev. We have not been given the opportunity to test Mr. Lear's car but we look forward to the opportunity.

Mr. ROGERS. So you have been in touch and told them you will do it any time?

Mr. STORK. Yes, sir.

Mr. ROGERS. Have any of the automobile companies come to you for testing or certification?

Mr. STORK. Mr. Chairman, the automobile companies come to us currently for certification for the current model year. They do not bring to us vehicles that they consider for 1975. All of the automobile companies, Mr. Chairman, have extensive testing laboratories. What they can achieve for 1975 are important secrets to them. They do not bring those vehicles to us.

Mr. ROGERS. What about our own testing and what we are trying to develop ourselves? Can you bring us up to date on that, and the degree of success.

Mr. STORK. Mr. Chairman, we are pursuing three candidate systems in our advanced automotive power system. They are the stratified charge, the gas turbine, and the Rankine which is similar to the Lear car. The Rankine is not yet at a stage at which it can be tested; it is at a systems design stage.

Gas turbines are in various stages of development, and we have recently tested a gas turbine that was produced by the Williams Motor Co. and was put into an American Motors' Hornet for New York City. We did test that vehicle.

As I recall the test results, the hydrocarbon and carbon monoxide were quite low. However, the nitrogen oxide was high, just as high as compared to any car on the road today.

We have run two recent tests on the stratified-charge engines, the Proco engine, and we are delighted with the results. In the first test, hydrocarbons were 0.18 gm./m., carbon monoxide, 0.14 gm./m., and oxide, 0.25 gm./m.; in the record test the results were 0.23 HC, 0.50 CO, and 0.27 NO_x. All of these values are well within the standards.

I should emphasize, Mr. Chairman, these test results do not represent durability. These are baseline tests on a vehicle that will be put on the test track now and on which 50,000 miles will be accumulated with intermediate testing. We cannot say that this car meets the standard because to meet the standard you have to do it for 50,000 miles, but if you cannot do it at the beginning, you have no hope of meeting the standards.

Mr. ROGERS. That is very encouraging.

Could you explain the type of automobile engine.

Mr. STORK. The stratified charge engine is closer to a conventional internal combustion than any of the other alternative power sources we are pursuing. The principal differences are in the combustion chamber, the way the fuel is put into the combustion chamber, and the timing by which it is put in the combustion chamber. We must emphasize that this engine uses after-exhaust-treated devices. It is not what we like to call an inherently clean engine. Nevertheless, these tests show that with adequate drivability and acceptable fuel economy, standards are attainable at least at the beginning.

Mr. CARTER. How is the fluid supplied within the cylinder of a Proco engine? How is the fuel supplied? Is it by fuel injection?

Mr. STORK. It is injected into each individual cylinder at a very precise point of time in relation to the intake and compression stroke.

Mr. CARTER. You have electronic firing there in place of the regular ignition; is that correct?

Mr. STORK. It uses the spark plug. It does not use the ordinary spark plug but it is basically a spark plug.

Mr. CARTER. You have a fuel injection system though?

Mr. STORK. Yes.

Mr. CARTER. Do you find that more efficient than the regular system?

Mr. STORK. The fuel injection system is essential for the stratified charge engine. Some manufacturers are experimenting with fuel injection for their conventional internal combustion engine, and it is debatable whether it provides significant benefits in terms of emissions. Some companies think it does and others think it does not, but for the stratified-charge engine, it is essential.

Mr. CARTER. I did not get the point about it being debatable.

Mr. STORK. As I understood your question, it was whether fuel injection as distinguished from an ordinary carburetor is a better way of running a vehicle for low emissions. This is not yet clear. Some companies feel carburetion is sufficiently advanced to be adequate and some companies feel fuel injection provides better control for the ordinary internal combustion engine.

Mr. CARTER. Which is more saving of fuel?

Mr. STORK. No such general statement can be made.

Mr. CARTER. What does the Volkswagen use?

Mr. STORK. They use fuel injection on some of their engines and carburetion on others.

Mr. CARTER. Volkswagen is known for its fuel saving.

Mr. STORK. It is a small car, it has a small mass to move around and the fuel saving is largely a function of size and not so much a function of the way the fuel is put in.

Mr. CARTER. It is a great saving to the American people.

About how many years of fuel supply do we have?

Mr. STORK. I am not in a position to answer that question.

Mr. CARTER. It is reported to me to be 9 to 10 years of normal reserves at the present time, and I think we should certainly look into this matter and conserve our fuel as much as possible.

Mr. STORK. We should add, Mr. Carter, there is no correlation between emissions and size of car.

Mr. CARTER. I yield to Mr. Nelsen.

Mr. NELSEN. I was curious about the motor design. How many combustion chambers does it have.

Mr. STORK. In the stratified charge?

Mr. NELSEN. Yes.

Mr. STORK. Basically, it is one combustion chamber although I believe some experimentation is being done with a prechamber design. It is still one combustion chamber with a different configuration.

Mr. NELSEN. I have seen a plastic design of an engine that has a triangular rotor that floats around like some of the water pumps you see. Is this one of the engines that you have tested?

Mr. STORK. We have tested the engine, Mr. Nelsen. You are speaking of the Wankel engine which is currently being produced for sale in the United States by two companies.

General Motors Co. has paid $50 million for two worldwide patent rights to the Wankel engine, and we are not pursuing research and development on that engine.

Our program focuses only on those systems which are deemed to have high potential for low emissions and which we believe are not being adequately exploited. Our resources are totally inadequate to compete with what GM is putting into the Wankel.

Mr. NELSEN. I am curious about the Lear engine. It was shown here and I was fascinated by the explanation of the way it was to work. I assumed from information that we had at the time that it was just about ready to go. Do you have any knowledge of why the hang-up? Why the delay?

Mr. STORK. I cannot speak for Mr. Lear on that point, Mr. Nelsen. We have been advised by Mr. Lear several times that the engine was about ready for testing, beginning a year ago, and something has always come up. It is a very difficult problem to solve. There are problems of control, problems of working fluid, problems of getting enough power out of the turbine.

However, we are not sponsoring Mr. Lear's work, and Mr. Lear has no obligation to give us all of his technical details. We have told Mr. Lear repeatedly that we will judge his engine in terms of its performance when we test it, and we look forward to that opportunity.

Mr. NELSEN. Thank you.

Mr. ROGERS. Have you tested any device such as the catalytic converter?

Mr. STORK. Mr. Chairman, I do not think we have tested catalytic devices as such, although we have tested vehicles, for example, the Ford Proco engine with catalysts on it. The principal test for the catalyst is running it for several hundreds of hours. This is being done in industry on an enormous scale, and we have access to all of the data industry is developing on that. There is no need to spend Government money to duplicate that.

Mr. ROGERS. I was thinking of those companies that might develop it which are not automobile companies.

Mr. STORK. Englehart, UOP.

Mr. ROGERS. I understand they have one that will perform more than 25,000 miles, but they are only willing to warranty it for 25,000 miles; is that correct?

Mr. STORK. Catalysts are being tested by the automobile industry. I have personally seen in this country and overseas Englehart catalysts and other catalysts being tested.

Mr. ROGERS. What I was trying to get at, you are not just allowing the automobile industry to test the catalytic converters, are you?

Mr. STORK. We are not in a position to allow or fail to allow anyone to test anything they want to, Mr. Chairman.

Mr. ROGERS. That is not what I am saying. I understand anybody can test anything, but what I am saying is, on your decisions on the testing of catalytic devices manufactured by independent manufacturers, you are not letting the automobile companies make the decisions on those particular devices, are you?

Mr. STORK. We receive data from a variety of sources, all sources that we can get it from, and we will make our own judgment.

Mr. ROGERS. If you are only allowing your automobile companies to be the ones who are testing the catalytic devices and you have to make the judgment on durability—not that anyone would purposely mislead you, but I am not sure but what it might be well for us to do a little independent research there or else require the manufacturer of that device for testing to present it to us for testing.

Mr. STORK. The manufacturers of catalytic converters or catalysts come to us quite frequently with results of tests they have sponsored.

Those data are available. We have met with UOP and Englehart and Corning.

Mr. RUCKELSHAUS. We are not relying exclusively on the automobile companies to give us this information, but there is incentive on the part of the catalyst companies, if anything, to be more optimistic about the chances of success of the catalyst. We do not believe we need to do the testing ourselves in order to have reliable data.

Mr. ROGERS. Suppose a man has a device that he is very convinced is good but he does not have the money to do the testing.

Mr. RUCKELSHAUS. If he has one that is good, he will find plenty of people who will test it. They are out in my office every day.

Mr. ROGERS. Who takes a look at that? Who determines they ought to be tested? Do you do it or do the automobile companies do it?

Mr. STORK. Under section 206(a) (1) or (2), we stand ready to make such tests, but as we pointed out earlier, we first require test data from independent laboratories. Otherwise, we would be besieged with garage inventors, and we would be so tied up we could not do anything at all.

Mr. ROGERS. We have to use some judgment. If he shows you he has something which might be a reasonable device but he really does not have the money, then maybe we ought to make some judgment on that.

Mr. STORK. We have done that on occasion.

Mr. ROGERS. Let us have a little something for the record on that.

Mr. STORK. We will be very pleased to provide that for you.

(The following information was received for the record.)

EVALUATION AND TESTING PROCEDURE OF A PRIVATE CITIZEN'S EMISSION CONTROL DEVICE INVENTION

The Mobile Source Pollution Control Program of the Office of Air Programs, EPA, receives a large volume of proposals related to devices which are said to be capable of significantly reducing emissions from automobiles. All of these are reviewed and evaluated, in the following manner: The proposer is asked to furnish complete technical information and an explanation of how the device works, as well as test data performed by an independent laboratory capable of making the Federal automobile emission test. If, on the basis of evaluation of the technical data and test results, a device appears to have unusual promise, confirmatory tests of the device may be made in the EPA laboratory at Ann Arbor. The results of such confirmatory tests are written up as test reports and are made available to anyone who is interested in them. Many such devices tend to duplicate each other, and the reductions in emissions that are achievable are usually marginal. So far, no device offered for testing in this manner has achieved, or even approached, the 1975-76 emission standards.

Mr. ROGERS. It is my understanding that the Department of Defense did ask for blanket exemption and you refused it.

Mr. RUCKELSHAUS. It was the Office of Emergency Preparedness, They asked for such a provision to be in the guidelines and we refused.

Mr. ROGERS. Let me ask you one or two more questions and then we will conclude.

Have you used the military, the GSA, or other governmental agencies with fleet cars to do any experimenting? I think it would be well for you to put in the record the contracts you have with agencies or governmental bodies to do research.

Mr. STORK. We have participation with GSA and I believe also the military in the low-emission vehicle procurement program. We have

not so far used GSA for our own fleet testing purposes, but we have cooperated with GSA, Mr. Chairman, on the evaluation of the emission reductions that are possible from gaseous fuels. We have had discussions with GSA on the use of their vehicle fleets for future fleet testing. They have indicated cooperativeness, and we will be very glad to have access to their vehicles for such purposes.

Mr. ROGERS. There is also a plan for purchasing, is there not?

Mr. RUCKELSHAUS. Yes, sir, although we have not received any authorization for the purchase of vehicles.

We have received one tentative application for one heavy-duty vehicle; that is a battery-operated vehicle and presents some problems in evaluating its emissions.

In analyzing battery-charged engines, we will have to balance the sulfur oxides and particulates that will be caused by generating the power needed to charge the batteries against the hydrocarbons, carbon monoxide, and the nitrogen oxides.

Mr. ROGERS. What work are we doing to find a proper testing device for testing emissions from automobiles?

Mr. STORK. We have established testing procedures for light gasoline-fueled vehicles as well as gaseous-fueled vehicles. We will shortly propose tests for diesel-powered light-duty vehicles. We have made it clear to the industry any type of vehicle that will be marketed in 1975 will have to meet the same Federal standards that gasoline-powered light vehicles will have to meet.

Mr. ROGERS. Do you have a procedure or device that could be applied on the assembly line? I do not think that has yet been developed; is that correct?

Mr. STORK. That is correct. There are many tests that have been proposed but none so far meet the requirements that must be met.

Mr. ROGERS. Does it look encouraging?

Mr. STORK. We are working hard on that. It does look encouraging. It looks encouraging for in-use vehicle testing.

On the assembly line, there is another factor that has to be considered and that is where it is even possible to predict from a new engine what its emissions will be when it has stabilized at 2,000, 3,000, or 4,000 miles. We are working to try to find out the answer to that.

Mr. ROGERS. Would you let us have something for the record on both of them.

(The following information was received for the record:)

EVALUATING EMISSION CONTROL TESTING DEVICES

The EPA is just completing a major project, the purpose of which was to evaluate the usefulness of various "short-test" techniques for in-use vehicle emission testing. To be capable of being the technical base for in-use vehicle emission control programs, such "short-tests" must be quick and cheap to make, must be usable on warmed-up cars, and must correlate reasonably well with the results that would be achieved if the full Federal emission test were made on the car. The results of this work should be available by the end of March 1972, and will be used to provide guidance to the States in planning for the control of emissions from in-use vehicles.

As regards assembly-line testing, the above described work will be helpful in identifying tests that might be useful in such a control system. In this area, however, we have another extremely important problem to resolve. That problem is whether there is any kind of reliable correlation between the emissions from a brand new engine, as in a new car, and the emissions from that engine when it has stabilized after several thousand miles of operation. The official Fed-

eral emission test of a car, for certification purposes, is made at the 4000 mile point.

If acceptable correlation between new engines and stabilized engines can not be shown to be possible, it may still be worthwhile to attempt to determine, at the end of the assembly line and on the basis of measured emissions from the engine, whether all of the adjustment and maintenance parameters of the engine are functioning properly.

The EPA is at work to resolve these technological issues, and will propose assembly-line testing as soon as such a program can be shown to be technologically feasible, as well as cost-effective in terms of the degree of emission control that it provides.

Mr. RUCKELSHAUS. As soon as we do get a good short test that correlates with our certifications——

Mr. ROGERS. You would require the States to put in an inspection plan?

Mr. RUCKELSHAUS. When we see that is necessary in order to meet the standards; yes, sir.

Mr. ROGERS. I understand if you felt it is necessary, this would then be incorporated into their implementation plan?

Mr. RUCKELSHAUS. Yes.

Mr. ROGERS. Are there any other questions?

Thank you, Mr. Ruckelshaus, for you and your associates being here. I think you are moving ahead very rapidly. I hope you will be firm, and I know they are not easy decisions to make. This committee realizes this, but I think the report that you gave on durability is encouraging.

Again, thank you very much.

The subcommittee will stand in recess until 2 o'clock this afternoon.

(The subcommittee recessed at 12:35 p.m., to reconvene at 2 p.m. the same day.)

AFTER RECESS

(The subcommittee reconvened at 2 p.m., Hon. Paul G. Rogers, chairman, presiding.)

Mr. ROGERS. The subcommittee will come to order. We will continue our hearings on the oversight of the Clean Air Act.

We are very pleased this afternoon to have Dr. Robert N. Rickles, Commissioner of the New York City Department of Air Resources and one of the big activators in this country for cleaning up the air.

The committee is very pleased to have you here this afternoon. We are grateful for your taking the time to come there and give us the benefit of your thinking on how the Clean Air Act is being administered and what needs to be done.

So, if you would like to begin, we will start now.

STATEMENT OF ROBERT N. RICKLES, PH. D., COMMISSIONER, NEW YORK CITY DEPARTMENT OF AIR RESOURCES

Mr. RICKLES. My name is Robert N. Rickles. I am the outgoing Commissioner of Air Resources for the City of New York. As such I run the largest local air pollution agency in the United States. We in New York City have made rapid progress against stationary sources and, indeed, New York City air, with regard to sulphur oxides and particulates, will be, by 1973, as clean as that of any major world city.

However, everywhere in the city we remain exposed to the insults of the automobile.

No single event has been so injurious to the American city and to the urban life of this country as the widespread use of motor vehicles in urban areas.

The automobile and its associated roadways are destroying my city and others. We must not permit this. The first and minimum obligation is to produce clean cars as promised by the Clean Air Amendments of 1970. We must have those clean cars by 1975. These cars are possible.

We have in New York City in regular service 10 automobiles, including police cars, which regularly achieve 1975 emission standards as set by the Environmental Protection Agency using their standard techniques. I might comment as to how we have achieved this.

To begin with, we have, with the assistance of the Federal Government built one of the three, only three, test facilities owned and operated by governments anywhere in this country. This large facility contains some 16,000 square feet and two test bays and is located in Brooklyn. It has been in operation since October 1971 and regularly tests New York City automobiles and taxicabs to determine their emission levels and control procedures.

We have established a program with the assistance of several catalyst manufacturers to install, in a retrofit way on the manifold exhaust of automobiles, catalytic converters designed to reduce hydrocarbon and carbon monoxide emissions. We will later this year expand this program to include catalysts for the conversion of nitrogen oxides to less harmful gases.

We have determined that as installed one can retrofit 1970 and 1971 American built regular automobiles with catalytic converters and reduce hydrocarbon and carbon monoxide levels between 75 and 99 percent.

These cars will either achieve or come extraordinarily close to achieving the 1975 standards as mandated by the Congress.

We hope later this year to be able to present data on 20,000- and 50,000-mile usage. I want to point out this is the most severe use that any car can be put to. Police cars and taxicabs in the city of New York regularly operate to the extent of 30,000 to 50,000 miles in a calendar year under extreme conditions of acceleration and deceleration.

I might comment parenthetically that we installed such a device in the mayor's Cadillac and achieved the 99-percent reduction of carbon monoxide for his honor. So we believe that the automobile industry can and should meet the 1975 and 1976 standards for reduction of emissions from automobiles. We think this is a vital part of the program to provide clean air for the cities of this country.

I will return to this in more detail toward the latter part of my statement.

I want to discuss several other things before that.

To begin with, I would like to point out I regard two items as being an oversight in the Clean Air Amendments of 1970 which, however, I do believe to be the finest piece of environmental legislation passed by the Congress or, indeed, any legislative body.

To begin with, on the matter of lead in gasoline, we in New York City in 1971, passed the Comprehensive Air Pollution Law covering virtually all stationary sources of air pollution and as well several automotive-related items.

Among these is the reduction of lead in gasoline by stages to a final zero level on January 1, 1974. This was done for two reasons. One, the more conventional one, that we recognize that current technology does not permit the use of catalytic converters for the control of automotive emissions without the absence of lead in the fuel.

But equally important we regard lead as a serious urban health problem.

As you know, I am sure, literally thousands of New York children regularly become sick and many die because of the eating of lead-containing paints. As well, we believe their health is endangered by the breathing of air containing lead particulates. We have extraordinary high levels of lead in the air in the city of New York.

For example, the California proposed standard is 1.5 micrograms per cubic meter of lead. On the streets of New York we have found levels as high as 35 micrograms per cubic meter. At the entrances to tunnels and bridges, and I am particularly familiar with this because I served as the arbitrator between the Triborough Bridge and the tunnel authority and the union that manned these tolls, we have found lead levels as high as 100 micrograms per cubic meter.

To put that into perspective, that means that those men are breathing lead particulate levels that are higher than the Federal standards for all particulates.

We regard that as an extraordinarily dangerous situation and therefore have asked and gotten approval of the city council and the mayor to ban the use of lead in gasoline in 1974. This action would be prevented should the Environmental Protection Agency not approve our regulations because of the stipulation in the Clean Air Amendments that no State or local jurisdiction may include such plans in their regulations unless it is approved by the Environmental Protection Agency and be part of the implementation plan.

We think that all agencies of government, be they State, local, or Federal, should maintain the authority to provide more restrictive regulations when those seem to be deemed necessary by their citizens.

The second point I would like to bring out as an oversight is the peculiarity of the relationships of cities and States. As is so often the case in Federal legislation unfortunately, cities have no place in the Clean Air Act of 1970.

Now that may be quite satisfactory in many cities and States in this country where the State has an effective program and the city does not or where most of the population lives outside the city.

It is clearly not the case in the State of California where the most effective programs have been in the counties or the State of New York where the city agency is larger than the State agency, indeed, we have more people working on air pollution control for the city of New York than work for the States of New Jersey, New York, and Connecticut together.

As an example of the difficulties that the Clean Air Act has made because cities may not submit implementation plans on their own, may I relate to you the situation that currently exists in the State of

New York with regard to the achievement of the clean air goals as set by the Congress.

In June of 1971 I went to Albany and discussed with commissioner of the State department of environmental conservation the development of the implementation plan for automotive pollutants for the city of New York. It was agreed at that time that we would draw up such a plan. Indeed, we did. The city of New York on its own, without Federal or State assistance, spent some $30,000 to draw an implementation plan, the details of which I will go into in slight detail shortly.

Despite this, the State of New York rejected the plan and went ahead and drew and presented its own implementation plan. This plan, which will be presented to Mr. Ruckelshaus on Monday, fails to produce any means of achieving clean air standards for five of the six pollutants.

This means that the State has left the city on the hook, so to speak. It means that the city of New York under the State plan will not achieve clean air by July 1975 as mandated by the Congress.

In addition, the State of New York held a hearing on January 26, 1972. Copies of that plan were not available until January 12, 1972. The Congress has mandated that such plans be available 30 days in advance of the public hearing. They clearly were not.

The Congress also suggests that the State take into consideration the comments of the public during those hearings. It is clear that with precisely four business days between the hearing and date of submission it was impossible for the State of New York to take into consideration the comments of the citizens of its cities with regard to that plan.

I am hopeful that the Environmental Protection Agency rejects the State plan and uses the city plan to achieve clean air because I believe we can achieve clean air in New York by 1975.

In the area of sulfur oxides we are already at levels that are at or below those of London, England. I believe we will achieve clean air standards with regard to sulfur oxides by the mandating of low sulfur fuels, at considerable expense to the citizens of that city, by July of this year.

I believe that by controls over the burning of fuels and the burning of refuse, we will achieve particulate levels in the city of New York by July 1973, 2 years ahead of the mandate of the Congress.

But only by some very tough controls and by the delivery of the goods by the automobile industry will we be able to achieve any sort of low levels of pollutants relative to the automobile by that date.

I had promised Mr. Ruckelshaus when I saw him last that he and I could walk down Fifth Avenue in New York on July 1, 1975, with a carbon monoxide meter and achieve the 9 parts per million on that date. I believe we can. I believe we can by a series of strategies that require the will of the Congress and the city government and State government to be exerted with great energy. First of all, we must have in New York the clean cars promised to us in 1975.

Second of all, we must have for taxicab service, automobiles that meet the 1974 California standards.

Third, we must have a considerable number of our trucks and our taxicabs and fleet vehicles equiped with retrofit catalytic devices by

1975. We must have a program of rationalizing traffic. We must have a program of building pedestrian malls so that people have a place in the city in addition to a place for cars.

Finally, we must have a program of inspections of automobiles and trucks. As I indicated before, the typical taxicab drives from 30,000 to 50,000 miles in a single year. It is clear that any device that goes on will not survive unless there is continual inspection of that vehicle.

We have suggested to the State of New York that all motor vehicles be inspected in a diagnostic fashion once a year, that all commercially licensed vehicles—that would include taxicabs and trucks primarily—be inspected three times per year.

We are hopeful that the Congress demands this kind of action and that the State legislature this year passes it.

I have several other very minor items. I do object very strongly to the deletion that has occurred with regard to the Environmental Protection Agency's proposed guidelines for the implementation plan in the achievement of ambient air goals.

At the time these guidelines were prepared and published as proposed guidelines, they include a model State plan for the control of emission of pollutants including enforcement procedures and control of specific emission sources.

Subsequent to that and by the action of other Federal agencies we have seen those efforts deleted.

I think that we need to return to the original proposed guidelines. Many, many States and many, many cities require the guidance to build the proper local air pollution code. Only by strong Federal action designating minimum standards can we possibly see this in all the cities and States of this country.

Second of all, we have seen a very strange phenomenon in my city with regard to the funding of automotive emission programs. We originally received from the Federal Government approximately $580,000, a large amount of which went to build and operate the test facility which I have described.

Since then, we have received in the current fiscal year approximately $80,000. We have also seen an indication that we will in the next fiscal year receive no additional funds. It seems to me that if the Federal Government, working together with local and State agencies, does not operate an independent operation to keep its eye on the automobile industry, there is no assurance that we can possibly meet the 1975 standards.

We thought that we were building such a program in New York City. We think we are still capable of doing so, and we would hope that EPA would fund that program so that we can test concepts such as retrofitting, which have been knocked down as being unfeasible by the automobile industry but in actual fact turn out to be quite feasible.

I also believe that no substantial change should be made at present with regard to testing of automobiles. I think each car should pass the test and I think that it should be based on the cold-start concept. Only in this way, by being as tough as we can, will we really be assured that we will achieve clean air goals.

I want to point out to you that our experience with 1970, 1971, and 1972 model automobiles on the streets of New York has been extraordinarily unsatisfactory.

We ran CO idle tests for these vehicles on a voluntary basis on the streets in New York in November 1971. The standard was a 3-percent carbon monoxide level at idle.

There is some difficulty in comparing this with the Federal test procedure, but it is our feeling that cars that cannot achieve 3 percent CO at idle will not pass a Federal test.

We found that over 50 percent of the cars, and these are cars between zero and 2 years of age, failed that test. It is clear that we need to be as hard as we can on the automobile industry to obtain compliance and that we need regular inspections of emissions to make sure that the automobile is properly tuned to achieve the best that it can.

We have found that proper tuning of automobiles reduces hydrocarbon and carbon monoxide emissions between 25 and 35 percent—this is a substantial achievement—at a cost of something between $15 and $25 per car, a large portion of which I might add is returned to the motorists in the form of reduced gasoline costs.

I want in closing to say that I believe firmly in my experience as commissioner of air resources in the city of New York that the congressionally mandated Clean Air Amendments of 1970 are completely feasible. There is no problem in achieving it except the will and energy of those who are mandated to do so.

I think there are a few minor modifications that are required to the act, but what is most required is the constant diligence of the Congress and those Federal administrative agencies that are charged with the administration of the law to make sure that New York has again the opportunity to live the kind of life they are entitled to.

I think you very much for this opportunity.

Mr. ROGERS. Thank you, Dr. Rickles, for an excellent statement and a most helpful statement.

Mr. Nelsen?

Mr. NELSEN. I note your statement indicates that in the event Federal standards or even State standards are inadequate that, for example, the cities' laws should be recognized.

I am wondering, if we have a conglomerate of standards all over the country. If so, how would the manufacturer meet this situation?

Maybe there will be so many standards that it will be just about impossible. Would it not be better if whatever standards were released were adequate to take care of the needs of any area of the country?

Mr. RICKLES. I think that would be very ideal. I suspect there are some problems. I think you are talking about items such as gasoline, which are nationally distributed. To begin with, I think that would be very nice. I think there might be some difficulties. One, in total supply, in achieving, for instance, the availability of lead-free gasoline for the entire country in 1974 might be difficult, whereas it might be achievable in, say, 1975.

Also, this suggests that people in relatively sparsely settled parts of the country would be paying in part for New York's privilege to breathe clean air. I think that the automobile gasoline companies can solve the distribution problems related to the availability of lead-free gas. It would obviously be most sensible if those regulations were adopted not by the city of New York, but by the region, because it is clear the cars that come into New York City every day are from Long Island, Westchester County, and New Jersey.

Ideally what I would like to see is a law related to the lead content of gasoline for the region.

We think that the automobile companies can supply markets such as New York and Los Angeles which are very, very large, without great difficulty.

I might comment that our law is in effect now. You may not sell in the city of New York gasoline containing, I believe, more than 1.5 grams per gallon, effective January 1, 1972.

To my knowledge all the gasoline companies are meeting that standard. They were meeting the prior one which went into effect at the end of October 1971. We held public hearings in this regard. It turns out that the approximate distribution costs, additional, for straightening out their distribution system, runs to less than a half cent per gallon which is not a substantial amount and which the people of the city of New York, through their city council, have indicated their willingness to pay.

Mr. NELSEN. Now, you mentioned that you had 10 cars, I believe.

Mr. RICKLES. Yes, sir.

Mr. NELSEN. Is this all accomplished through catalytic converters on the exhaust?

Mr. RICKLES. Yes sir. We will be expanding that to approximately 50 by midyear.

Mr. NELSEN. You mentioned also testing automobiles, checking them out. I am wondering if we will run into the same problem that we do with the health manpower, an inadequacy of personnel who know how to do the job. Is it possible that you will have to train people to do this?

Mr. RICKLES. I think that is very true. That depends on how it is done. Bear in mind, of course, that we have in the city of New York 1,800,000 automobiles. We have 20,000 taxicabs and 115,000 trucks. It will require some training, depending on how it is done, to test these cars even on a once-a-year basis.

As you may know, automobiles in New York State are tested by garages. We don't think this is satisfactory. In New Jersey and other States—these are for safety aspects—these are tested by the State.

We think that automobile emissions, because of the complexity of the problem, should be tested in State inspection stations.

Mr. NELSEN. In the event you do go to testing, is it not possible that if it is done, say in a garage, you might find the public getting gouged unless you have some regulations as to charges that are to be made?

Mr. RICKLES. Yes; I think that is a very, very great possibility. Indeed, my own suspicions are that they are being gouged with regard to safety problems in New York State.

I believe that there is a system of testing which is known as the diagnostic test, which not only indicates whether the car fails or not, but through a computer evaluation tells the motorists the probable causes of the failure so that he can go to a garage and say, "Hey, my sparkplugs are inoperative," or something like that, and get them fixed without a lot of playing around or a lot of gouging.

We believe that the Congress should mandate that all States institute a program of diagnostic testing because, (1) you will get a complete picture and, (2) the motorists will be protected from the problems you have stated.

Mr. NELSEN. Of course, I want to make it clear that none of the garage people in my district do that. They are all topflight.

Mr. RICKLES. I am sure of that, Mr. Nelsen.

Mr. ROGERS. As I understand it then, New York City has actually met the 1975 standards already pertaining to the automobiles; is that correct?

Mr. RICKLES. No; we think we know how. We are very, very far away from that. Our plan, which has been submitted to the Federal Government and submitted to the State on a nonlegal basis, contains a series of steps which we believe will produce clean air with regard to carbon monoxide and hydrocarbons and oxidants and nitrogen oxides by July 1975. It will be a very difficult problem because of the very high excesses of these pollutants in the air, particularly in the central business districts of the city, but we believe it is perfectly possible to do that.

Mr. ROGERS. What about the 10 automobiles?

Mr. RICKLES. Those emissions do meet 1975 standards now.

Mr. ROGERS. So, you have 10 cars that now meet the 1975 standards?

Mr. RICKLES. That is correct.

Mr. ROGERS. You have done that.

Has an automobile maker done it?

Mr. RICKLES. No; we have installed the devices; we have run them and tested them. The question remains as to durability. We hope to have that data sometime later this year.

Mr. ROGERS. What is the durability factor so far?

Mr. RICKLES. We just don't have enough information yet to do that. They meet it when they go on. The initial tests indicate they continue to do so without any degradation. These are cars, as I said, that receive very severe service. I am happy to say that the police have not reported any problems with the cars, for which we are very happy because, obviously, we were concerned that we not interfere with the function of the police department.

Mr. ROGERS. So these are police cars?

Mr. RICKLES. These are largely police cars; that is correct.

Mr. ROGERS. You also said that contrary to what has been claimed by some people that you can retrofit?

Mr. RICKLES. That is correct.

Mr. ROGERS. Tell us a little bit about that. This is a very important factor.

Mr. RICKLES. We had a number of conversations when we started this program with all the major automobile manufacturers, in fact pleaded with them to provide us with catalyst kits such as they are studying and using, without any success.

It was claimed by them that the retrofitting, that is the adding on of a device in the exhaust system of a regularly manufactured automobile after it was in the hands of the user, was not the proper way to reduce emissions.

We do believe and do agree that it is best to design the automobile around the emission device and to install it during manufacture. There is no question that that is better.

But it is also very clear that one can add these devices and achieve very substantial reductions in automotive emissions. Probably not as

high as if we had matched the engine to the device, but certainly high enough to either meet or come close to meeting 1975 standards.

Mr. ROGERS. Even get close to the 1975 standards.

Mr. RICKLES. In most cases to meet them. Either to meet them or to marginally meet them. Certainly a great, great reduction. As I said, 75- to 99-percent reductions in what comes out of the tailpipe.

Mr. ROGERS. Then this argument that we have so many old cars that will be polluting--so it does not much matter if we get to the 1975 standard yet—does not hold then. So we should move as rapidly as possible to the 1975 standards because we can perhaps take action on the old cars as well with a retrofit.

Mr. RICKLES. I believe we can. Politically, from a political and economic point of view in those cases where you are dealing with relatively limited segments of the population, that is largely a financial problem. I don't know what the device will cost, but the guess seems to be a hundred dollars or so. In New York City if we decide to retrofit all the cars, obviously this would be an enormous burden to the population of the city, which is already well burdened.

However, as it turns out, most of the mileage driven in the city of New York in the central business districts are done by taxicabs and gasoline-powered trucks. These are approximately 150,000 vehicles. It will be these vehicles that we will retrofit.

Mr. ROGERS. In other words, you are saying in the core cities where your pollution problems are particularly accentuated by the automobile, by putting that on fleet cars, taxicabs, trucks, this sort of thing, you could really have an impact on cleaning up the air?

Mr. RICKLES. That is right.

To give you an idea, during a normal business day in midtown Manhattan about 80 percent of the vehicular mileage is driven by taxicabs and trucks, only 20 percent by private vehicles. If we can concentrate in New York City—I do not know what the situation is in other cities, but I think that many of the major metropolitan areas will find a substantial impact by those two classes of vehicles.

Mr. ROGERS. I believe you said you thought under a plan drawn by the city that you could meet the clean air standards. In what respect and in what time?

Mr. RICKLES. To begin with, we believe regardless of what happened, we will meet clean air standards for sulfur oxide and particulates at least 2 years before the Federal deadline. That is because we began moving in New York in 1966 to control these sources.

With regard to automotive emissions we believe we can meet the automotive-related standards for carbon monoxide, nitrogen oxide, hydrocarbon, and oxidants on or before the deadline set by Congress in July 1975. We can do so by the programs outlined in our augmentation plan.

Mr. ROGERS. Also, I was concerned that you said that under the New York State plan, that really New York City, I understand, had not much of an input, will not meet five of the six pollutants.

Mr. RICKLES. That is correct. The only input that the city of New York had is that we paid 58 percent of the bills of the State and presumably the cost of printing was partly borne by the citizens of the city. We would like to get the money back. We haven't seen what was printed.

Mr. ROGERS. Where do they fall down?

Mr. RICKLES. On everything but sulfur oxides. The only area which they claim can be achieved is sulfur oxides. They simply throw up their hands and say that it can't be done; the Congress ought to do this or the Federal Government ought to do that. We don't think that is necessary.

We think that by and large the Congress has done its work. We think that the Environmental Protection Agency has done a good bit of its work. We want to make sure that they stay diligent. But they have done what they have asked. We think the State of New York has been unwilling to do a lot of things that they ought to do.

For instance, the problem of car inspections, that is a State function; it is not a Federal function, it is not a city function. At least we do not have home rule rights to do so. The State Department did not include any plans for inspecting automobiles despite the fact that the Congress has suggested it, and there are several pieces of legislation before the Congress making it mandatory.

There is no discussion about retrofitting automobiles despite the fact we have a successful program to do so. There is no discussion of the possibility of buying taxicabs in California.

One of the peculiarities, I might comment, of taxicabs in New York is that they do not last very long. If you have driven with a New York cabby, I think you will understand why. The average life of a taxicab in New York is about 18 months. This means if we can get California 1974 cars which are not quite 1975 standards, but are very close to them; if we can buy cars in California, assembled in California under 1974 laws, for taxicabs, virtually all our taxicabs in New York will be very clean in 1975 because they will all be 1974 and 1975 models.

That is the kind of program we want. We want to take advantage of all the things that are going on in this country to clean the car, put them all together in a package and present it as clean air in New York.

Mr. ROGERS. Does New York's plan set forth specific proposals for limitation of emissions?

Mr. RICKLES. Yes, it does; for both stationary sources and from automobiles.

Mr. ROGERS. I notice you have also been able to work with nonleaded gasolines. Do you have contracts with any particular companies?

Mr. RICKLES. I might comment that all the gasoline that is used by the city of New York is either nonleaded or low-leaded. That is, less than a half gram per gallon. We have a small contract with the Amoco Co., Standard Oil Co. of Indiana, to supply, I think it is in the order of a million gallons or less of nonleaded gasoline, which is their Amoco premium gasoline, to the city for the test program.

All the cars that are on the test program, for instance, all the police cars on Staten Island, in the county of Richmond, some 50 or 100 police cars, all are on nonleaded gasoline. The mayor's car is on nonleaded gasoline. The mayor has an Amoco credit card, and he gets his Amoco at a regular Amoco station. All the rest of the cars of the city of New York—this is about 12,000 vehicles, I am not quite sure how much gasoline they purchase—they don't purchase it, it is brought in bulk of the city garages—use Mobil Special which is a new gasoline provided by the Mobil Oil Co. which is one-half gram per gallon or less.

Actually our analysis indicates it is approximately 0.3 gram per cubic centimeter. It is quite low in lead.

We did this to indicate our belief that cars can operate on low-leaded gasoline, one of the first times in the city's history that the city government did something before we asked the rest of the citizens of the city to do so. That has been in effect since July 1, 1971.

Our experience with the gasoline is quite good. To my knowledge there have been no difficulties at all with the operation of automobiles and I might add that we have an austerity program with regard to purchase of new automobiles for a year or two now so all our cars are in fairly sad shape, but they do operate quite well with no-lead and low-lead gasoline.

Mr. ROGERS. You felt that the agency was doing some of the things right. What are some of the things they have not been doing right—where they need to direct some attention or where they need funding or improvement in the administration?

Mr. RICKLES. I believe there are more things right than wrong. I would like to see, as I indicated, their guidelines very much stronger, that they be very specific with regard to minimum standards for emissions from stationary sources.

I think this is an absolute requirement. I know that in getting through my city council the Clean Air Amendments law of 1971 it was quite helpful to have the Federal Government come in and say that these are the minimum standards, that these are achievable, we think these are the minimum that should be done. Because, as I think you know, most State legislatures and most city councils have very poor service with regard to staff, so they are really at the mercy of outsiders in determining what is possible and what is feasible.

It is extraordinarily helpful when the Federal Government can tell the country as a whole and legislatures in particular what in their best technical opinion is possible because these are very valuable guidelines to legislators.

Second of all, I think that they need to put more money into the area of the automobile program, particularly into city and State agencies, to get testing programs started, to check the feasibility of testing programs, to look at commercial trucks particularly which the EPA has not spent any time on at all.

Mr. ROGERS. EPA has not?

Mr. RICKLES. They have not looked at all at trucks. Just recently they have finally come out with proposed standards for trucks. But up to that time there has been no input in regard to trucks.

I think they have failed to recognize that in most of the commercial cities of the country trucks are a very significant portion of the population and because of the peculiarities of their business they provide a great deal of the emissions.

In New York City they represent 40 percent of the vehicular mileage. They do so in large measure because many of them stand around the city idling while they await their turn to be unloaded.

Incidentally, many of them are gasoline-powered trucks—this is particularly true in large commercial cities—rather than being the diesel-powered over-the-road vans which one sees on the highways, which of course independently are a problem.

Those are the kinds of areas that I would like to see additional funding in.

I also think, however, that a standard amount of additional funding needs to go into the maintenance programs for local agencies and State agencies. I think the Congress cannot forget that when you asked EPA and presumably all the State and local agencies to provide clean air for the citizens of this country by 1975, which was quite proper and indeed quite necessary, you also brought upon yourselves the obligation to supply moneys necessary to undertake that program.

We have in New York City about 342 members of the department of air resources. The Federal EPA in reviewing our program has estimated that we require over 500 staff in order to properly do the job.

I believe we will get the job done with the 342, but it will be difficult. Other agencies are much more poorly staffed than we are. For instance, the State of New York which has authority over the entire State, has less than 200 people. You go out to other States which are much less further along than New York and you will find very much smaller staffs. In the state of Connecticut up to a few years ago the staff in that State numbered less than 10.

We require additional funding in the 1972–73 fiscal year for local and State programs. Remember that when you ask for these control programs you require people to physically go out and inspect the facility, to check the plant, to inspect it for violations. All of these take people and manpower. I do not believe that it is the kind of bill that ought to frighten the Congress. We are not asking for hundreds of millions of dollars. I think the bill is perhaps in the order of $20–$30 million for the entire country.

I think clean air is one of the few areas where we have been able to show substantial progress. I believe we have paid back the investment that the Congress has made in us over the years, and I think we are worthy of future investment, and I would hope that the Congress would see it that way.

Mr. ROGERS. Let me ask you about the testing.

Is the Federal Government, itself, doing enough testing?

Mr. RICKLES. I think not; at least from our examinations certainly we would like to see every car tested. We should like to see the car tested on the assembly line and tested under the most severe conditions possible.

Mr. ROGERS. Also, I was thinking, for instance, about the test models. Have they been doing a sufficient amount in that area?

Mr. RICKLES. No; we would like to see more effort in that area. Whether it be done by the Federal Government or other people, I don't know. But I think a great effort needs to be made in that area.

Mr. ROGERS. You have how many testing facilities?

Mr. RICKLES. We have two test bays. We have 16,000 square feet of area.

Mr. ROGERS. That is probably more than the Federal Government has.

Mr. RICKLES. I am not familiar with their—I have been there once, but I have forgotten. It certainly is the same size.

Mr. NELSEN. Do you have any information as to the cost per car of the 10 cars that you have equipped? How much do you estimate was the cost to put them into compliance?

Mr. RICKLES. We don't, because of a few peculiarities, one of which is that we received the catalyst unit for nothing. We have not been able to get a realistic number from the manufacturer.

In addition, obviously, each car was specially fitted and we took a great deal of effort, because they were police cars, to make sure that they were properly done. I think that number is not available. I don't think you will get a number until a large program is mandated so that the catalyst manufacturers can gear up to make the units in great quantities.

Mr. NELSEN. Thank you.

Mr. ROGERS. Thank you so much. I think what you have done in New York can certainly set an example for the Federal Government to emulate. You have already produced cars to meet the standards.

Now we get to the durability question which is what I think the Administrator says is probably the most severe problem.

Mr. RICKLES. Thank you.

Mr. ROGERS. Thank you so much. We are grateful for you being here this afternoon.

This will conclude the hearing. We will have to decide at a later date on a continuation. Next week we will begin some hearings Tuesday on the oversight of drug abuse enforcement, the amphetamines problem, as well as associated problems.

The committee stands adjourned.

(Whereupon, at 3:10 p.m., the subcommittee adjourned.