UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF ENFORCEMENT AND LEGAL COUNSEL

EPA-330/1-83-001

MOTOR VEHICLE TAMPERING SURVEY - 1982

April 1983

Larry Walz

NATIONAL ENFORCEMENT INVESTIGATIONS CENTER
Denver, Colorado

CONTENTS

EXECUTIVE SUMMARY

INTRODUCTION 1
  1982 SURVEY OBJECTIVES 2

CONCLUSIONS 4

TECHNICAL ANALYSIS

BACKGROUND 6

SURVEY METHODS 8

RESULTS 13
  SITE AND AGGREGATE RESULTS 13
  TYPES OF TAMPERING 16
  EFFECTS OF I/M ON TAMPERING RATES 19
  EFFECTS OF TAMPERING ON EMISSIONS 20
  TAMPERING BY VEHICLE AGE 22
  TAMPERING RATES BY VEHICLE MANUFACTURER 22
  TRUCK TAMPERING 22
  FUEL-RELATED TAMPERING 26
  ADD-ON AND NON-STOCK EQUIPMENT 30

APPENDICES

A SECTIONS 203(a)(3)(A) AND 203(a)(3)(B) OF THE CLEAN AIR ACT
B DATA COLLECTION AND RECORDING PROCEDURES

TABLES

1 Vehicle Status by Aggregate, Site, and Year of Survey 14
2 Rates of Tampering by Component 17
3 Rates of Arguable Tampering by Component 18
4 Mean Idle Emissions of Tampered, Arguably Tampered, and Okay Vehicles 21
5 Percent Tampered and Sample Size by Model Year and Vehicle Age at Time of Survey 23
6 Percent Catalyst Removed and Sample and Sample Size by Model Year and Vehicle Age at Time of Survey 24
7 Comparison of 1978, 1979, 1981, and 1982 Tampering Data by Vehicle Manufacturer 25
8 Fuel Switching Rate for 1982 Survey by Site and Indicator . . 28

FIGURES

1 Comparison of Tampering Rates for Systems by Surveys 15
2 Comparison of Multiple Indicators 29

EXECUTIVE SUMMARY

- INTRODUCTION
- CONCLUSIONS

INTRODUCTION

At the request of the EPA Field Operations and Support Division (FOSD), the National Enforcement Investigations Center (NEIC) conducted a motor vehicle tampering survey at 10 locations within the United States from April through October 1982. The locations surveyed and number of vehicles inspected are as follows:

South Dade County, Florida	309 vehicles
Baton Rouge, Louisiana	183 vehicles
Houston, Texas	293 vehicles
Tulsa, Oklahoma	282 vehicles
Several locations, New Jersey	290 vehicles
Several locations, Rhode Island	324 vehicles
Minneapolis, Minnesota	307 vehicles
Seattle, Washington	312 vehicles
Portland, Oregon	310 vehicles
Las Vegas, Nevada	275 vehicles

Because motor vehicle emissions in urbanized areas account for nearly 90% of the total carbon monoxide and airborne lead, over one-half of the hydrocarbons, and nearly 40% of the nitrogen oxides emitted to the atmosphere, a significant part of the Nation's effort to achieve clean air standards has been directed toward controlling motor vehicle emissions. Automobile manufacturers have installed control devices on new vehicles since 1968 to control these emissions.

The 1977 amendments to the Clean Air Act (Sections 203(a)(3)(A) and (B), Appendix A) make it illegal for automobile dealers, repair and service facilities, and fleet operators to disconnect or modify emission control devices or elements of design. The FOSD is responsible for enforcing the tampering provisions of this Act.

In order to determine the rate of tampering and fuel switching on a nationwide basis, surveys were conducted in 1978*, 1979**, and 1981***. These surveys were conducted by the Mobile Source Enforcement Division (MSED - FOSD's predecessor organization), an expert automotive consultant, and NEIC. Consistent inspection procedures were used during all of these surveys so statistical comparisons could be made.

1982 SURVEY OBJECTIVES

Ten sites were selected throughout the United States to represent geographic diversity. Four of the sites previously inspected were repeated in order to provide a comparison of data to the previous surveys and to update current trends for tampering and fuel switching in these areas.

The following is a list of objectives of this survey:

1. Update previously collected tampering data;
2. Determine current tampering trends for --
   a. The most prevalent types of tampering,
   b. The effects of tampering on vehicle emissions,
   c. The amount of tampering by vehicle age and manufacturer;
3. Determine the extent of fuel switching.

In order to achieve these objectives, a visual inspection was made of the emission control devices on each vehicle. Additionally, hydrocarbon and carbon monoxide idle emissions were measured, and gasoline samples taken from vehicles requiring unleaded fuel. Also, tailpipe deposits of vehicles requiring unleaded fuel were tested for the presence of lead using Plumbtesmo® test paper.

---

* *Motor Vehicle Tampering Survey (1978), U.S. Environmental Protection Agency, Mobile Source Enforcement Division, November 1978*

** *Motor Vehicle Tampering Survey (1979), U.S. Environmental Protection Agency, National Enforcement Investigations Center, May 1980, EPA-330/1-80-001*

*** *Motor Vehicle Tampering Survey - 1981, Chattanooga, Tennessee and Houston, Texas, U.S. Environmental Protection Agency, National Enforcement Investigations Center, March 1982, EPA-330/1-82-001*

® *Registered trademark; appears hereafter without the ®. Manufactured by Macherey-Nogel, Duren, W. Germany; marketed by Gallard-Schlesinger Chemical Corp., Carle Place, New York.*

Four mutually exclusive categories were used to classify all of the inspected vehicles. They were as follows:

1. Tampered (at least one control device removed or rendered inoperative);
2. Arguably tampered (potential but not clear-cut tampering);
3. Malfunctioning;
4. Okay (all control devices present and apparently operating properly).

CONCLUSIONS

The overall tampering rate for 1982 has not changed significantly from the previous surveys. These results are shown below. As will be noted later, the results are not subject to exact comparison but reflect the general trends.

Tampering Category	1978 Survey (%)	1979 Survey (%)	1981 Survey* (%)	1982 Survey (%)
Tampered	18.9	18.0	14.3	16.7
Arguably tampered	48.4	46.5	45.4	38.4
Malfunctioning	2.0	2.2	2.5	1.2
Okay	30.7	33.3	37.8	43.7

* *Because the 1981 survey involved only two sites and a very limited sample size, results may be expected to exhibit more error variance than the three larger surveys.*

In 1982, the most prevalent form of tampering continued to be with the EGR system. However, both filler neck restrictor tampering, and catalyst removal have greatly increased since 1978. Limiter cap tampering was the most common type of arguable tampering.

This survey showed that there was a relationship between tampering rates and idle emissions. The vehicles judged 'okay' emitted approximately one-fourth the CO and one-third the HC of those where tampering had occurred. The okay vehicles are more likely to pass an inspection maintenance (I/M) test than tampered vehicles.

Older vehicles were found to have higher tampering rates than those of a newer model year. Tampering was found on nearly one-third of the vehicles in their eighth year of existence.

A comparison of tampering by manufacturers showed that AMC had the highest tampering rate (27.2%), and that vehicles of Japanese origin had the lowest (3.9%).

Fuel switching*, overall, was 10.6%. Non-I/M areas had a rate of 15.1%, while areas which employed an I/M program showed a rate of 6.2%.

The overall tampering rate was 16.7%. Non-I/M areas had a rate of 19.8%, while areas which employed an I/M program showed a rate of 13.9%. The component-specific tampering rates were also significantly higher in non-I/M areas than in I/M areas. These results are shown below.

TAMPERING RATES - 1982

Tampering Category	Overall (%)	I/M (%)	Non-I/M (%)
Overall	16.7	13.9	19.8
Catalytic converter	4.37	1.71	7.07
Inlet restrictor	5.90	3.13	8.73
Air pump system	4.55	2.29	7.15
EGR system	9.83	10.14	9.4

The overall tampering rate for trucks was 25.1%. The component-specific tampering rates were also generally higher for trucks.

The incidence of add-on and non-stock equipment was very low during the 1982 survey (only four instances detected).

* *A vehicle was judged to be fuel switched if the Plumbtesmo test was positive, there was >.05 g/gallon lead in the gasoline, or the filler restrictor was tampered with.*

TECHNICAL ANALYSIS

- BACKGROUND
- SURVEY METHODS
- RESULTS

BACKGROUND

Before 1978, the Mobile Source Enforcement Division (now FOSD) had data suggesting that tampering with emission control devices was occurring. However, due to the variability of the inspection procedures employed, an accurate assessment of the nature and extent of the tampering could not be made. Because of this, MSED decided in 1978 to conduct tampering surveys on a national level which employed consistent inspection procedures.

The objectives of the 1978 survey were to determine the following:

1. The rate of tampering on a national level;
2. The common types of tampering;
3. If a relationship existed between tampering and idle emissions.

This survey was conducted from May through August 1978, under the direction of MSED, by an expert consultant with assistance provided by the National Enforcement Investigations Center (NEIC). The results of this survey showed that, of the 1,953 vehicles inspected in the States*, 19% showed tampering, 48% showed arguable tampering, 2% showed control device malfunctions, and 31% showed no visible signs of tampering or malfunctioning. The most prevalent type of tampering observed was EGR system tampering. The idle emissions, which were measured during the inspection, were higher from tampered vehicles than from vehicles which showed no signs of tampering.

In order to remain abreast of the tampering rates, MSED requested that NEIC conduct a second nationwide tampering survey during 1979. The following were additional objectives to those of the 1978 survey:

1. Compare the tampering rates in areas with inspection and maintenance regulations (I/M areas) with those having no inspection and maintenance regulations (non-I/M areas).

---

* *Delaware, Maine, Tennessee, Texas, Virginia, and Washington*

2. Check for sampling bias* that may have occurred because of voluntary participation.

This survey was conducted from June through November 1979 by NEIC. In eight states**, 2,499 vehicles were inspected; 18% showed tampering, 46% showed arguable tampering, 2% showed control device malfunction, and 33% showed no tampering. As was the case in the 1978 survey, the most common type of tampering was with the EGR system, and the idle emissions were higher from tampered vehicles than from untampered vehicles. This survey also showed that tampering rates from I/M areas were lower than from non-I/M areas, and that rates were higher in areas where the inspection was mandatory rather than voluntary.

In September 1981, FOSD requested that NEIC perform inspections in Tennessee and Texas to determine the following:

1. The current rate of tampering in Chattanooga, Tennessee, and Houston, Texas in order to ascertain the effectiveness of the antitampering program in Houston;
2. Current trends in those two cities for --
   a. The most prevelant type of tampering;
   b. The effects of tampering on vehicle emissions;
   c. The amount of tampering by vehicle age and manufacturer
3. The extent of fuel switching;
4. The prevalence of add-on and non-stock equipment installations which could affect emissions.

The results of this survey, which was of limited scope, showed that the most prevalent forms of tampering were filler neck and EGR tampering. There was a relationship between tampering and idle emissions, and tampering rates increased as the vehicles aged.

In 1982, FOSD requested that NEIC perform the survey which is memorialized in this report.

---

* *Because participation was voluntary, drivers who knowingly tampered with their vehicles may have avoided the inspection.*

** *Arizona, Delaware, Minnesota, New Jersey, Tennessee, Texas, Vermont, and Virginia*

SURVEY METHODS

A goal of inspecting 300 vehicles in each location was established in order to provide a broad enough database so that the data would be meaningful. All inspections were voluntary; however, selection methods varied and could have influenced the participation rates. The mix of vehicles that came to the inspection sites was assumed to be a self-weighting sample, and no attempt was made to approximate the national vehicle mix.

The inspection teams consisted of two to five inspectors, depending on the locations of the inspections. Two inspectors were used at inspection stations, and five at locations where road stops were made. A designated team leader was responsible for data and sample collection.

Each vehicle inspection included checking all emission control systems, recording basic data about the vehicle including the addition of certain after-market parts, measuring HC and CO emissions, obtaining a fuel sample, and using Plumbtesmo paper to check for lead deposits in the tailpipes of vehicles requiring unleaded fuel*. The inspections focused on 1975 and newer light-duty vehicles fueled with gasoline. This included both passenger cars and light-duty trucks. The condition of each emission control device was determined and recorded on the inspection form in the field. Categorization of the results was not made at the time of the inspection; however, this was determined by evaluating the recorded data subsequent to the surveys. Detailed inspection and recording procedures are contained in Appendix B.

The location, dates, number of vehicles inspected, number of fuel samples analyzed, refusal rates, tampering rates, description of each site, and procedures used to obtain vehicles for inspection follow.

---

* *The Plumbtesmo paper test was not used for the Oregon survey due to failure of the test media.*

South Dade County, Florida - Road Stop

Non-I/M

Dates:	April 12-16, 1982
Vehicles inspected:	309
Fuel samples:	276
Refusal rate:	<1%
Tampering rate:	22.3%

The Florida Highway Patrol provided an officer to conduct a stop of vehicles, and the inspectors solicited voluntary permission to conduct the inspections. Locations for the road stops were changed daily in order to obtain a representative sample of the area.

Baton Rouge, Louisiana - Private Garage Inspection

Non-I/M

Dates:	April 19-24, 1982
Vehicles inspected:	183
Fuel samples:	154
Refusal rate:	15%
Tampering rate:	25.1%

The Louisiana State Police did not have the manpower to dedicate the services of an officer full time for the inspection, so they made arrangements with two private garages to conduct the inspections in conjunction with State safety inspections. Because of heavy rain during the inspection period, turnout for the safety inspection was lower than predicted, and the goal of 300 cars inspected was not achieved.

Houston, Texas - Private Garage Inspection

I/M

Dates:	April 26-30, 1982
Vehicles inspected:	293
Fuel samples:	289
Refusal rate:	22%
Tampering rate:	17.7%

The Texas Department of Public Safety will not assist with roadside inspections; however, they did obtain permission from two private garages to conduct inspections in conjunction with the required State safety inspections.

Tulsa, Oklahoma - Private Garage Inspection

Non-I/M

Dates:	May 3-7, 1982
Vehicles inspected:	282
Fuel samples:	246
Refusal rate:	3%
Tampering rate:	19.5%

Because the Oklahoma Highway Patrol and Tulsa Police Department, due to manpower shortages, declined to conduct roadstops, the Tulsa City-County Health Department arranged for inspections to be conducted at a chain of auto lubrication stations which were conducting safety inspections. The inspection locations were changed throughout the survey period in order to adequately sample the area.

New Jersey - Road Stops

I/M

Dates:	July 19-23, 1982
Vehicles inspected:	290
Fuel samples:	220
Refusal rate:	5%
Tampering rate:	15.9%

Road stops were conducted in the southern portions of New Jersey by the New Jersey Department of Transportation. Locations were changed four times throughout the week to provide more adequate coverage of that part of the State.

Rhode Island - Road Stops

I/M

Dates:	July 26-30, 1982
Vehicles inspected:	324
Fuel samples:	261
Refusal rate:	8%
Tampering rate:	16.0%

Road stops were conducted by local law enforcement officers of municipalities in the Providence, Rhode Island area. Inspection locations were changed daily and included the towns of Providence (2 days at different locations each day), New Port, Westerly, and Woonsocket.

Minneapolis, Minnesota - Road Stops

Non-I/M

Dates:	August 2-6, 1982
Vehicles inspected:	307
Fuel samples:	251
Refusal rate:	3%
Tampering rate:	16.3%

Road stops were conducted by the Minnesota State Patrol at three locations in the Minneapolis-St. Paul, Minnesota area.

Seattle, Washington - State Inspection Stations

I/M

Dates:	September 14-17, 1982
Vehicles inspected:	312
Fuel samples:	229
Refusal rate:	22%
Tampering rate:	11.2%

Inspections were conducted at the Renton inspection station which performs I/M inspections under contract to the State of Washington. Hydrocarbon and carbon monoxide emission values were obtained from the State inspection rather than duplicate the measurement already made.

Portland, Oregon

I/M

Dates:	September 21-24, 1982
Vehicles inspected:	310
Fuel samples:	232
Refusal rate:	4%
Tampering rate:	9.7%

Inspections were conducted at two State I/M inspection stations within the city of Portland.

Las Vegas, Nevada - Service Station/Parking Lot

I/M

Dates:	September 27-October 1, 1982
Vehicles inspected:	275
Fuel samples:	244
Refusal rate:	44%
Tampering rate:	17.1%

Inspections were made at service stations conducting inspections on the first day of the inspection period. However, due to a lack of response, the location was changed to the Nevada Department of Motor Vehicle Registration parking lot where participation was solicited from vehicle owners who had completed their business inside and, in some cases, were in a hurry. This may have accounted, in part, for the high refusal rate.

RESULTS*

SITE AND AGGREGATE RESULTS

The vehicles were classified into one of four categories (tampered, arguably tampered, malfunctioning, and okay) based on the results of the inspection. Because each vehicle inspected had various components which could be tampered with, the vehicle was classified by the worst state of any component in the vehicle. For example, if any one component was "arguably tampered" and all of the other components were functioning properly, the entire vehicle was classified as "arguably tampered". A vehicle classified as "okay" must have all observed components functioning properly.

Results for each 1982 inspection site and for all vehicles are listed in Table 1. A comparison of tampering rates for the major HC/CO-related control systems for the 1978, 1979, 1981, and 1982 surveys is shown in Figure 1.

Trends - Houston, Texas - 1978-1982

Houston, Texas was selected as a survey site during 1982 because it had been surveyed during the previous three surveys, and a comparison could be made of these data. A comparison of the data collected during the 1978, 1979, 1981, and 1982 surveys is presented on page 16.

* *Computer printouts of the data used to produce the tables and figures in this section are on file at NEIC and FOSD.*

Table 1

VEHICLE STATUS BY AGGREGATE, SITE, AND YEAR OF SURVEY*

Site and Survey Year	No. of Vehicles	Tampered (%)	Arguably Tampered (%)	Malfunctioning (%)	Okay (%)
Aggregate - 1982	2,885	16.7	38.4	1.2	43.7
Florida					
1982	309	22.3	26.5	1.0	52.2
Louisiana					
1982	183	25.1	34.4	0.5	39.9
Texas					
1978	218	22.2	59.7	1.4	16.7
1979	236	22.5	50.4	1.7	25.4
1981	209	9.6	46.9	1.4	42.1
1982	293	17.7	36.9	2.7	42.7
Oklahoma					
1982	282	19.5	35.5	4.3	41.1
New Jersey					
1979	318	11.0	51.6	2.8	34.6
1982	290	15.9	41.0	0	43.1
Rhode Island					
1982	324	16.0	32.4	2.2	49.4
Minnesota					
1979	300	13.3	38.7	2.0	46.0
1982	307	16.3	29.3	0	50.4
Washington					
1978	306	15.7	41.8	2.0	40.5
1982	312	11.2	51.9	0.3	36.7
Oregon					
1982	310	9.7	51.9	0.6	37.7
Nevada					
1982	275	17.1	42.9	0.7	43.7

* *Only sites included in the 1982 survey are presented in this table.*

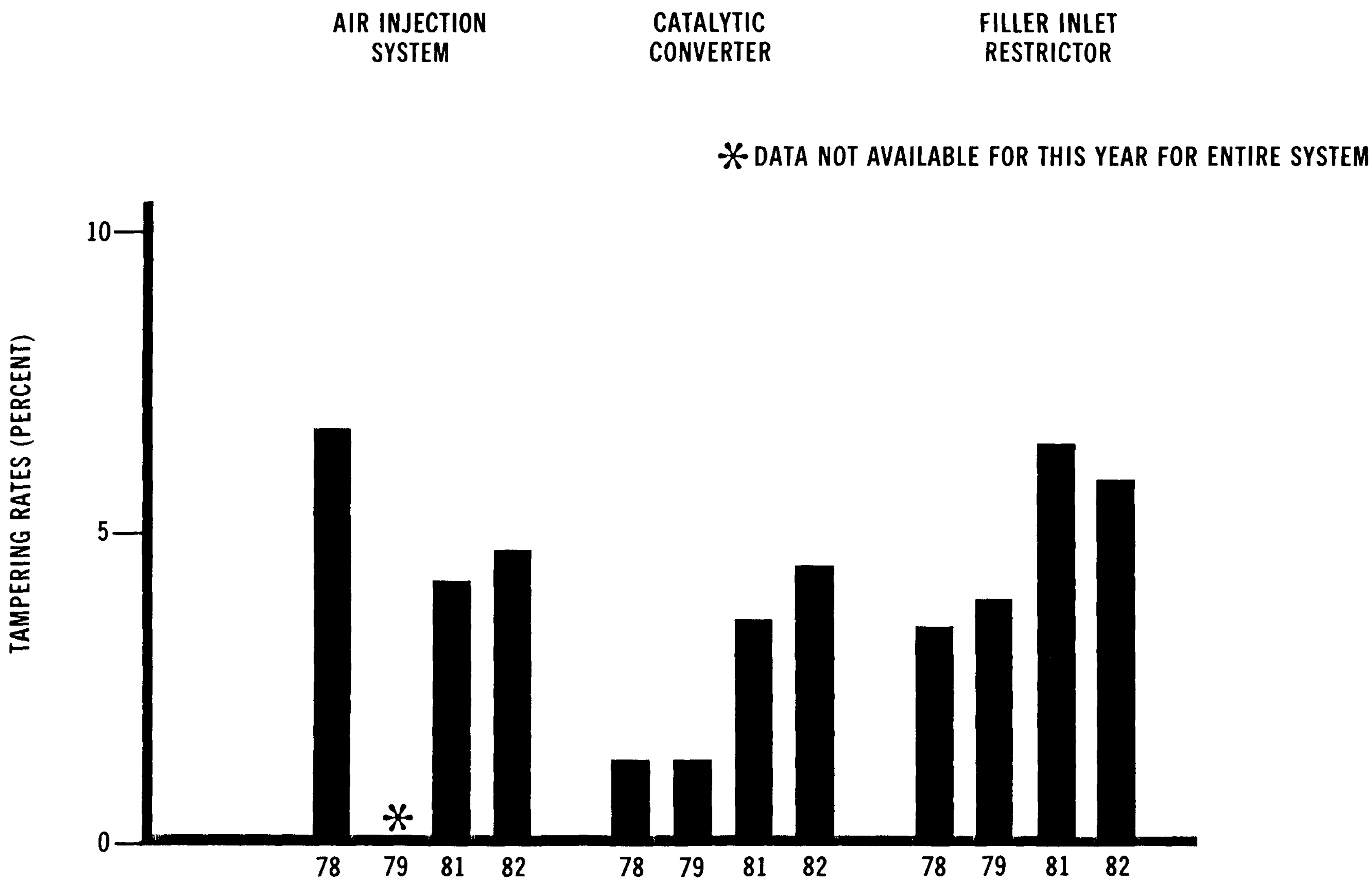

FIGURE 1. COMPARISON OF TAMPERING RATES FOR SYSTEMS BY SURVEYS

COMPARISON OF 1978, 1979, 1981, and 1982 RESULTS
HOUSTON, TEXAS

Vehicle Status	1978	1979	1981	1982
Tampered (%)	22.2	22.5	9.6	17.7
Arguably tampered (%)	59.7	50.4	46.9	36.9
Malfunctioning (%)	1.4	1.7	1.4	2.7
Okay (%)	16.7	25.4	42.1	42.7

As the above comparison shows, the proportion of vehicles judged to be okay, or have all observed components functioning properly, more than doubled from 1978 to 1982. Because the 1978 and 1979 surveys included 1973 and 1974 model year cars, and the 1981 and 1982 included only 1975 and newer, this comparison may be somewhat biased as earlier vintage cars may have a higher potential for being tampered with. Major technological changes in emission control equipment occurred in the 1975 model year. These components did not exist in earlier model years.

TYPES OF TAMPERING

Because there are many different emission control devices which can be tampered with, it is necessary to identify these devices.

As shown in Tables 2 and 3, EGR system tampering was the most prevalent followed by filler neck restrictor tampering. Limiter cap tampering was the most prevalent form of arguable tampering for the 1982 survey.

The rates shown in these tables are a comparison of the percentage of vehicles exhibiting a certain type of tampering among vehicles equipped with the particular control device. For example, 67.7% of those vehicles equipped with limiter caps had them tampered with. Since some vehicles are not equipped with limiter caps, it is not correct to conclude that 67.7% of all of the vehicles had limiter caps tampered with.

Table 2

RATES OF TAMPERING BY COMPONENT

Component	1978 Rate (%)	1979 Rate (%)	1981 Rate (%)	1982 Rate (%)
EGR* system	13.0	9.9	5.4	9.8
EGR control valve	11.9	4.6	4.9	7.4
EGR sensor	5.3	7.1	4.9	6.5
Air injection system	6.6	-	4.1	4.6
Air pump belt	5.7	4.5	3.1	4.7
Air pump control valve	2.9	2.1	3.6	2.9
Air pump	3.2	2.2	3.1	3.1
Aspirator**	***	2.4	0	0.8
Catalytic converter	1.2	1.2	3.5	4.4
PCV*	3.3	2.7	1.5	2.5
Vacuum spark retard	10.5	1.6	0.6	0.2
Idle stop solenoid	0.7	0.6	0	.1
Heated intake	0.8	1.1	0	0.5
ECS* storage	2.6	2.4	2.0	1.5
Filler neck restrictor	3.4	3.8	6.4	5.9

* *EGR: exhaust gas recirculation*
PCV: positive crankcase ventilation
ECS: evaporative control system

** *Vehicles with aspirated air systems are not equipped with other listed air-injection components, nor do conventional systems include aspirators.*

*** *Aspirators were not checked during the 1978 survey.*

Table 3

RATES OF ARGUABLE TAMPERING BY COMPONENT

Component	1978 Rate (%)	1979 Rate (%)	1981 Rate (%)	1982 Rate (%)
Limiter cap	65.0	62.1	82.5	53.5**
ECS* tank cap	0.3	0.6	0.8	1.7
Tank label	5.2	4.4	4.0	3.8
Dash label	0.6	0.7	0.3	0.7
Heated intake	8.5	8.0	9.0	6.1

* *ECS: evaporative control system*

** *This overall rate can be divided into sealed carburetors, for which the rate is 6.8%, and conventional carburetors originally equipped with caps, for which the rate is 74.9%.*

The drop in the rate of EGR tampering seen in the 1981 survey was not seen in the 1982 survey. The 9.8% seen in 1982 closely reflects the 1978 and 1979 surveys (13.0 and 9.9%, respectively) versus 5.4% in 1981. A possible explanation is that the 5.4% in 1981 is representative of a limited survey of only two locations and only 399 cars.

EFFECTS OF I/M ON TAMPERING RATES

Ten sites were surveyed -- five in non-I/M areas and five in I/M areas. The results of this survey show an overall tampering rate of 16.7%. The tampering rates in non-I/M and I/M areas were 19.8% and 13.9%, respectively. The breakdown between non-I/M and I/M areas is almost identical to the results in 1979 when the overall tampering rates were 19.7% and 13.2%, respectively. The primary reason that the overall tampering rate in the 1982 survey is lower than previous national surveys is the inclusion of five I/M areas. The site specific tampering rates are as follows:

Site	1982 Tampering (%)
(Non-I/M)	
Florida	22.3
Louisiana	25.1
Minnesota	16.3
Oklahoma	19.5
Texas	17.7
Average[a]	19.8
(I/M)	
New Jersey	15.9
Oregon	9.7
Rhode Island	16.0
Nevada	17.1
Washington	11.2
Average[a]	13.9

The component-specific tampering rates were also significantly higher in non-I/M areas than in I/M areas (see table, page 5). The following table shows the effect of model years on catalyst removal in I/M and non-I/M areas.

---

a *Averages are computed from totals from non-I/M and I/M areas, respectively.*

PERCENT TAMPERED CATALYST - 1982 SURVEY

	I/M				Non-I/M			
Model	Number of Vehicles	LDV* (%)	Number of Vehicles	LDT** (%)	Number of Vehicles	LDV* (%)	Number of Vehicles	LDT** (%)
1975	69	5.8	5	0.0	58	17.2	6	33.3
1976	118	2.5	6	0.0	101	5.9	12	41.7
1977	140	3.6	14	0.0	111	9.0	6	83.3
1978	178	1.1	13	7.7	153	5.2	18	27.8
1979	170	0.0	47	4.3	153	3.3	54	33.3
1980	176	0.6	24	4.2	194	2.6	34	8.8
1981	162	1.2	22	4.5	201	1.5	56	7.1
1982	119	0.0	18	0.0	98	1.0	15	0.0

* *light-duty cars*
** *light-duty trucks*

EFFECTS OF TAMPERING ON EMISSIONS

In order to ascertain the effect of tampering on idle emissions, the mean idle emissions were calculated for the three categories of vehicles (okay, tampered, and arguably tampered) for the model years 1975-1982. These results [Table 4] show that the vehicles judged 'okay' generally had much lower emissions than tampered or arguably tampered vehicles. With only two exceptions, mean idle scores of the tampered group exceeded those of the okay group for each model year and each pollutant.

Table 4 shows that the mean idle scores for 'okay' vehicles are lower than tampered vehicles. The table following shows the actual effect of the New Jersey I/M cutpoints on the vehicles in the 1982 survey. This table indicates that tampered vehicles are more likely to fail an idle test than okay or arguably tampered vehicles.

Table 4

MEAN IDLE EMISSIONS OF TAMPERED, ARGUABLY TAMPERED, AND OKAY VEHICLES

	Mean Idle CO (%)			Mean Idle HC (%)		
Model Year	Okay	Tampered	Arguably Tampered	Okay	Tampered	Arguably Tampered
75	1.88	2.81	2.08	361	306	225
76	1.27	2.83	2.36	152	276	299
77	1.87	2.42	2.14	255	357	252
78	1.21	2.73	2.29	152	298	240
79	1.04	1.98	1.25	140	256	140
80	0.43	1.96	0.76	62	216	77
81	0.24	1.07	0.95	57	204	62
82	0.19	0.03	0.56	33	50	48
Wt-Average	0.59	2.39	1.80	89	283	202

FAILURE RATES ON VEHICLE STATUS AND CATALYST REMOVED
OR FUEL SWITCHED VEHICLES FOR IDLE HC AND CO
ACCORDING TO NEW JERSEY CUTPOINTS

HC				CO			
Okay	Tampered	Arguably Tampered	Cat/Fuel*	Okay	Tampered	Arguably Tampered	Cat/Fuel
7.70	30.98	22.11	34.59	7.78	36.17	26.08	32.19

* *Vehicles in this category either have their catalyst removed or have at least one of the three indicators of fuel switching.*

TAMPERING BY VEHICLE AGE

As shown in Table 5, the overall tampering rate increases as the vehicle ages, with the tampering rate climbing to over one-third of the cars by the eighth year of vehicle life. These data tend to substantiate the results of the 1978, 1979, and 1981 surveys, which are also shown in Table 5. Also, the catalyst removal rate increases as the vehicle age increases. As shown in Table 6, the removal rate increased from 0% in the first year of vehicle life to 11.5% in the eighth year of vehicle life.

TAMPERING RATES BY VEHICLE MANUFACTURER

A comparison was made by vehicle manufacturer for the 1978, 1979, 1981, and 1982 surveys [Table 7]. As during the previous surveys, AMC had the highest tampering rate during the 1982 survey (27.2%) with vehicles of Japanese manufacture having the lowest (3.9%).

TRUCK TAMPERING

The 1982 survey contained 419 light-duty trucks. The overall and component-specific tampering rates for trucks were very high. The results are as follows:

Table 5

PERCENT TAMPERED AND SAMPLE SIZE BY MODEL YEAR AND VEHICLE AGE AT TIME OF SURVEY

Model	Year of Vehicle Life							
Year	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth
1982	1.2(250)							
1981	1.8(57)	6.5(448)						
1980		4.8(63)	8.8(454)					
1979	5.5(371)		8.5(59)	18.0(477)				
1978	7.4(298)	13.8(502)		15.2(79)	21.4(430)			
1977		10.1(457)	14.9(476)		21.2(66)	26.3(316)		
1976			17.7(395)	19.0(374)		28.8(52)	25.9(317)	
1975				22.3(274)	21.7(271)		31.8(22)	36.6(183)
1974					32.6(276)	27.4(242)		
1973						32.0(253)	35.6(251)	

Table 6

PERCENT CATALYST REMOVED AND SAMPLE SIZE BY MODEL YEAR
AND VEHICLE AGE AT TIME OF SURVEY

Model	Year of Vehicle Life							
Year	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth
1982	0.40(250)							
1981	0(57)	2.3(441)						
1980		1.6(61)	2.3(428)					
1979	0(326)		3.6(55)	5.9(429)				
1978	0(291)	0.45(445)		0(71)	4.4(362)			
1977		0.72(417)	1.2(417)		1.7(59)	7.4(271)		
1976			1.6(377)	2.3(305)		10.4(48)	5.9(257)	
1975				1.6(242)	2.0(204)		26.3(19)	11.5(139)

Table 7

COMPARISON OF 1978, 1979, 1981, and 1982 TAMPERING DATA BY VEHICLE MANUFACTURER

Manufacturer	1978 % Tampered	1978 No. Vehicles Inspected	1979 % Tampered	1979 No. Vehicles Inspected	1981 % Tampered	1981 No. Vehicles Inspected	1982 % Tampered	1982 No. Vehicles Inspected
GMC	19.9	894	17.1	1,121	12.2	221	18.1	1,228
Ford	20.4	496	20.8	557	25.0	85	19.4	634
Chrysler	19.8	237	24.3	375	12.5	40	22.5	320
AMC	32.3	65	24.4	78	33.3	6	27.2	103
European	13.5	89	14.78	115	8.3	12	15.7	115
Japanese	7.4	203	5.7	224	0	38	3.9	485
Aggregate	17.7*	1,984	18.3	2,490	14.3	399	16.7	2,885

* *This rate is different from value reported in 1978 report (18.9%) because certain data points were judged to be invalid and were deleted.*

TRUCK TAMPERING (%)
1982 SURVEY

	Overall	I/M	Non-I/M
Catalyst	13.3	3.3	20.7
Air pump system	7.6	1.8	12.6
Filler inlet	13.5	6.2	19.1
Overall	25.1	16.4	32.2

FUEL-RELATED TAMPERING

Multiple indicators. While a simple definition of fuel switching is possible, a single indicator for detection of this activity is very likely to underestimate its prevalence. For instance, a vehicle which was repeatedly improperly fueled with leaded gasoline during a gasoline shortage may have a deactivated catalytic converter, but due to proper subsequent fuel use, may have little detectable lead in its fuel tank. This situation may also characterize the "occasional" user of leaded fuel.

In order to obtain a better picture of fuel switching, this survey includes three indicators which, singly and in combination, may provide more adequate information than any one measure by itself. The indicators include fuel filler inlet restrictor tampering, a Plumbtesmo test for lead deposits in the tailpipe, and the presence of more than .05 g/gallon of lead in the gasoline. While the presence of lead in the fuel provides a very strong indication of switching, its absence does not indicate that switching has not occurred in the past. Likewise, but for different reasons, the other two measures individually also present the problem of incorrect negative findings where switching has actually occurred. A vehicle with an untampered fuel filler inlet restrictor may have been fueled with a funnel or similar device. The tailpipe lead test, due to the difficulties of field administration, may fail to indicate the presence of lead, and older vehicles may have had their tailpipes replaced since they were operated on leaded fuel. The error in these measures, then, is always in the direction of underestimating the proportion of catalysts damaged through exposure to improper fuel.

Fuel switching rates. Of the vehicles requiring unleaded fuel, 10.6% were identified as fuel switched by at least one of the indicators discussed above. Table 8 displays the rates found for individual indicators as well as the composite rates for I/M and non-I/M.

Indicator overlap. The survey results seem to show less overlap than one might expect among these three indicators of the same phenomenon [Figure 2]. This tends to lend credence to the position that these measures reflect different aspects of fuel switching activity.

Since incorrect positive indications are extremely rare for these measures, the percentage of vehicles with at least one positive indicator seems most reasonable as a minimum estimate of the fuel switching rate in these cities. Reasons for the real rate possibly being higher include the negative bias of the hastily field-administered Plumbtesmo tailpipe test and the bias always associated with refusal to participate in a non-compulsory survey. The nature and possible magnitude of this bias was discussed in the report on the 1979 tampering survey.

Site	Fuel-switching Rate (%)
Non-I/M	
Florida	19.23
Louisiana	12.50
Minnesota	9.76
Oklahoma	18.60
Texas	15.03
Average*	15.14
I/M	
New Jersey	11.40
Oregon**	1.57
Rhode Island	3.72
Nevada	10.42
Washington	3.85
Average*	6.18

* *Averages are computed from totals from Non-I/M and IM areas, respectively.*

** *Plumbtesmo indicator not used during this inspection due to failure of the test paper; actual rates may be higher.*

Table 8

FUEL SWITCHING RATE FOR 1982 SURVEY BY SITE AND INDICATOR

Site	Percent with at Least One Positive Indicator	Percent with >.05 g/gallon Lead in Gasoline	Percent with Tampered Filler Restrictor	Percent with Positive Tailpipe Test
		Non-I/M		
Texas	15.03	6.64	9.44	10.14
Florida	19.23	10.49	9.09	15.73
Oklahoma	18.60	11.24	12.79	13.18
Minnesota	9.76	7.41	4.38	6.06
Louisiana	12.50	7.14	8.33	10.12
Average non-I/M[a]	15.14	8.65	8.73	11.04
		I/M		
New Jersey	11.40	8.09	4.78	7.35
Rhode Island	3.72	1.69	2.36	2.03
Seattle	3.85	1.54	2.31	.77
Las Vegas	10.42	6.18	6.18	5.02
Oregon	1.57	1.57	0	(no test)
Average I/M[a]	6.18	3.80	3.13	3.06
Average (all sites)[a]	10.58	6.18	5.88	6.98

a *Averages are computed from totals from non-I/M and I/M areas, respectively.*

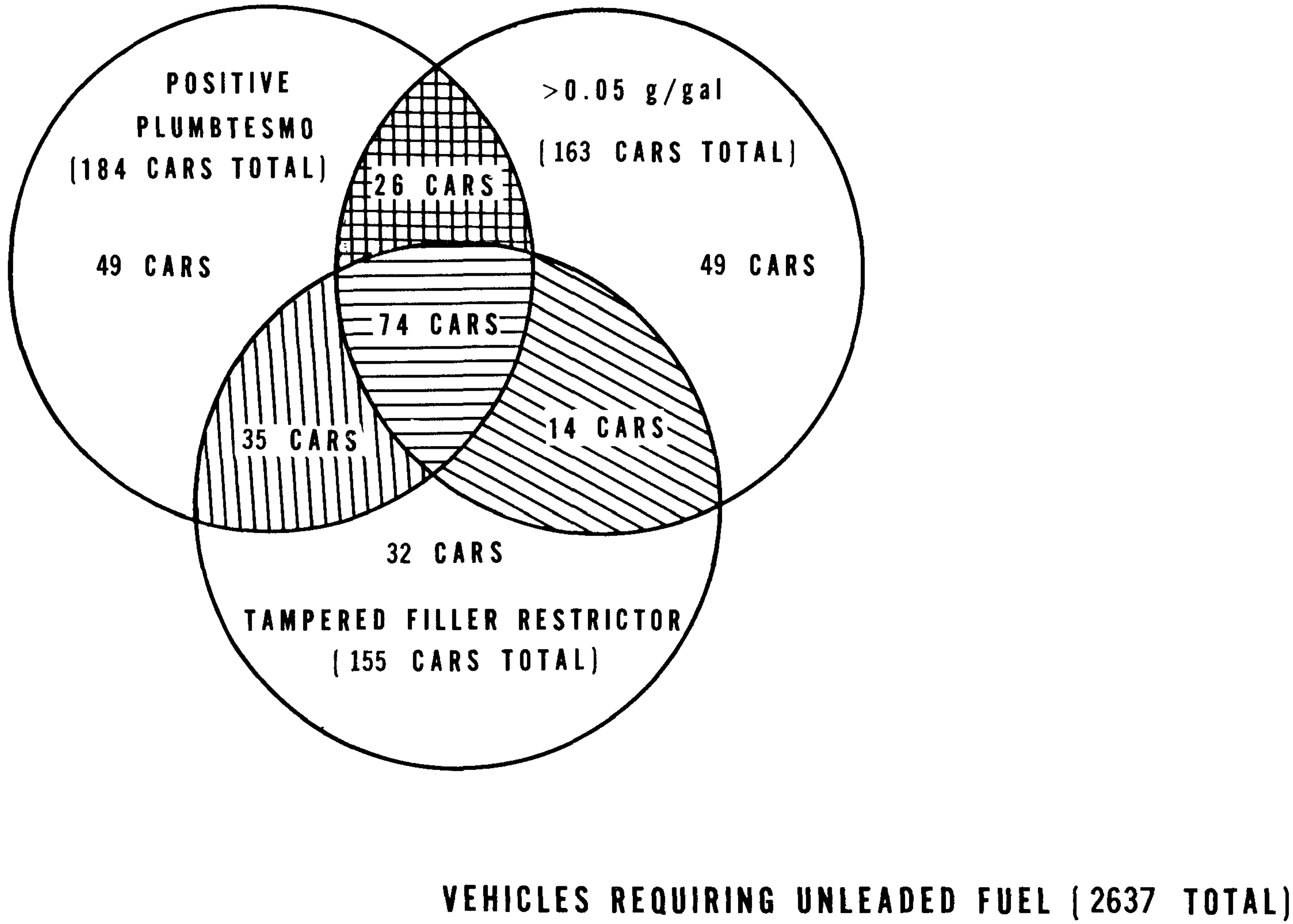

FIGURE 2 COMPARISON OF MULTIPLE INDICATORS

As can be seen, the fuel-switching rates for the non-I/M areas are more than double the rates for the I/M areas.

ADD-ON AND NON-STOCK EQUIPMENT

Because add-on and non-stock equipment are available which could affect emissions, each vehicle was checked for the installation of these devices. This equipment includes turbochargers, non-stock air cleaners, intake and exhaust manifolds, distributors, exhaust systems, and various alleged fuel-saving devices. During the 1982 survey, the addition of such equipment was recorded in only four of the 2,885 vehicles surveyed.

APPENDICES

A SECTIONS 203(a)(3)(A) AND 203(a)(3)(B) OF THE CLEAN AIR ACT

B DATA COLLECTION AND RECORDING PROCEDURES

APPENDIX A

SECTIONS 203(a)(3)(A) AND 203(a)(3)(B) OF THE CLEAN AIR ACT

"Section 203(a)(3): The following acts and the causing thereof are prohibited --

(A) for any person to remove or render inoperative any device or element of design installed on or in a motor vehicle or motor vehicle engine in compliance with regulations under this title prior to its sale and delivery to the ultimate purchaser, or for any manufacturer or dealer knowingly to remove or render inoperative any such device or element of design after such sale and delivery to the ultimate purchaser; or

(B) for any person engaged in the business of repairing, servicing, selling, leasing, or trading motor vehicles or motor vehicle engines, or who operates a fleet of motor vehicles, knowingly to remove or render inoperative any device or element of design installed on or in a motor vehicle or motor vehicle engine in compliance with regulations under this title following its sale and delivery to the ultimate purchaser.

APPENDIX B

DATA COLLECTION AND RECORDING PROCEDURES

DATA COLLECTION AND RECORDING PROCEDURES

The following data will be recorded on the data sheet shown as Figure A-1.

a. Date

b. Vehicle identifying survey number - Vehicles shall be numbered sequentially as they are inspected, and this number shall be preceded by a site identifying letter.

c. Odometer mileage (in thousands).

d. Air cleaner, intake manifold, and exhaust manifold - if these parts are original equipment a "P" is coded. If these parts are aftermarket or non-stock a "6" is coded.

e. Model year - obtained from underhood emission label.

f. Make

g. Model

h. Exhaust system and distributor are coded "P" or "6" as explained above under item d.

i. Turbocharger may be coded "P", "6", "A", or "O". The "A" is used to indicate add-on equipment and the "O" for not equipped.

j. Carburetor - In column 30 a "P" is used to indicate that the carburetor is a production unit (original equipment). If fuel injection is used, then a "F" is recorded. If the carburetor has been replaced with a non-stock unit, then a "6" is recorded and if the carburetor is a sealed unit (without limiter caps), an "S" is recorded. In column 31 indicate the number of barrels for carburetors or an "I" for fuel injection.

k. Engine family/CID (cubic inch displacement) as recorded from the underhood emission label.

l. PCV (positive crankcase ventilation) line may be coded "P" or "A". The "A" is used to indicate add-on equipment. Particular attention should be paid to fuel economy devices installed in the PCV line.

m. The category "other" may be coded "A" or "P" and is used to designate other add-on equipment such as fuel line devices added on to reduce fuel consumption.

The following codes, will be used to record data on the data sheet shown as Figure A-2.

0 - Not equipped

1 - Item is functioning properly

2 - Electrical disconnect

3 - Vacuum disconnect

4 - Mechanical disconnect

5 - Incorrectly routed hose

6 - Non-stock equipment

7 - Missing item

8 - Misadjusted item

9 - Malfunctioning item

N* - Negative

Y* - Positive

*To be used in column 75 to designate the results of the Plumbtesmo paper.

The codes are designed so that the inspector can objectively record the condition of the device and not have to make an "on the spot" judgement with respect to tampering.

The following items will be inspected and the results recorded on Figure A-2.

a. Idle stop solenoid - This solenoid provides an idle stop for maintaining idle speeds to the higher speeds needed to minimize CO emissions. On some vehicles, it is used to close the throttle and thus prevent run-on when the engine ignition is turned off. On vehicles with air conditioning, it is used for increasing engine idle speed to compensate for a decrease in idle speed when the air conditoner is engaged.

   With the air conditioner on, (or in non-air conditioned vehicles) the solenoid should activate and contact the throttle linkage. With the air conditioner turned off, there should be a small gap between the solenoid stop and the throttle linkage.

The idle stop solenoid will be coded as follows:

- 0 - Not equipped
- 1 - Functioning properly
- 2 - Electrical disconnect
- 7 - Missing item
- 9 - Malfunctioning - If the gap between the solenoid and the throttle plate is incorrect.

b. Heated air intake - Provides warm air to the carburetor during cold engine operation. The heated air intake will be coded as follows:

- 0 - Not equipped
- 1 - Functioning properly
- 3 - Vacuum disconnect - If the vacuum line to the vacuum override motor is missing or disconnected.

4 - Mechanical disconnect - When the stovepipe is missing, disconnected or deteriorated. Also when the air cleaner has been unsealed, i.e., inverted air cleaner lid, oversized filter element, or holes punched into air cleaner.

6 - Non-stock equipment - Custom air cleaner.

7 - Missing item - Missing stovepipe hose

9 - Malfunctioning item - Problems with the vacuum override motor.

c. Limiter caps - Plastic caps on idle mixture screws designed to limit carburetor adjustments. Limiter caps will be coded as follows;

0 - Not equipped

1 - Functioning properly

4 - Mechanical disconnect - Tabs broken or bent

7 - Missing item

8 - Misadjusted item (sealed plugs have been removed)

d. Positive crankcase ventilation system - A typical configuration for a V-8 engine consists of the PCV valve connected to a valve cover and then connected to the carburetor by a vacuum line. The other part of the system has a fresh air tube running from the air cleaner to the other valve cover. The PCV will be coded as follows:

0 - Not equipped

1 - Functioning properly

3 - Vacuum disconnect - When the line between the PCV valve and the carburetor is disconnected

4 - Mechanical disconnect - When the fresh air tube between the valve cover and the air cleaner is disconnected or removed.

7 - Missing item - When the entire system has been removed.

e. Evaporative control system - Controls vapors from the fuel tank and carburetor. Some systems have two lines, one from the fuel tank to the canister, and one from the canister to the carburetor or air cleaner to air purge the canister. Other systems have a third line, usually connected to the carburetor. The ECS will be coded as follows:

0 - Not equipped
1 - Functioning properly
3 - Vacuum disconnect-Line from canister to carburetor or air cleaner disconnected.
4 - Mechanical disconnect-Line from fuel tank to canister disconnected.
5 - Incorrectly routed hose
7 - Missing item
9 - Malfunctioning item - When the purge line is connected to the air cleaner and the air cleaner is unsealed.

f. Tank cap - Part of the evaporative system, the tank cap seals with the filler neck to maintain a closed system. Tank caps will be coded as follows:

1 - Functioning properly
7 - Missing item
9 - Malfunctioning item - Tank cap not sealing properly

g. Air injection system - Consists of an air pump driven by a belt connected to the crankshaft pulley. The pump directs air through a control valve and lines connected to the exhaust manifold. An air injection system may also consist of an aspirator located in the air cleaner that supplies air to the exhaust manifold. The air injection system is broken down into three parts which are coded as follows:

Air pump

0 - Not equipped
1 - Functioning properly
4 - Mechanical disconnect
7 - Missing item
9 - Malfunctioning

Air pump belt

0 - Not equipped
1 - Functioning properly
7 - Missing item
8 - Misadjusted item - Loose pump belt

Note: If the vehicle is equipped with an aspirator, the air pump belt is coded "0".

Air pump control valve

0 - Not equipped
1 - Functioning properly
3 - Vacuum disconnect
4 - Mechanical disconnect
7 - Missing item
9 - Malfunctioning item

h. Exhaust gas recirculation (EGR) system - The standard configuration consists of a vacuum line from the carburetor to a sensor (used to detect temperature to activate the EGR valve), and another vacuum line from the sensor to the EGR valve. Some systems have multiple sensors and thus additional vacuum lines. The system directs a portion of the exhaust gases back into the cylinders for the control of oxides of nitrogen. This is one system where a functional check will be performed.

Non-sealed EGR valve functional will consist of:

1. Visually inspecting to see if the valve, sensor(s) and hoses are in place.

2. If the system is intact, revving the engine and checking visually or by touch the EGR valve stem movement.

3. If the stem fails to move, pulling off the vacuum line to the valve and checking for vacuum while the engine is revved. If vacuum occurs, the valve is not functioning and the hose nipple on the valve will be checked for blockage. If vacuum does not occur, the line will be checked for blockage. If it is not blocked, a hand vacuum pump will be connected to the sensor outlet and the engine revved. If a vacuum is obtained, the sensor is functional. If no vacuum is obtained, the line from the sensor to the carburetor will be checked for vacuum while the engine is revved. If this line has vacuum, then the sensor is not functioning and will be checked for a plugged port.

4. Some systems have a vacuum delay valve. If the EGR valve is not functioning, checking the delay valve for plugs and that it is not installed backwards.

Sealed EGR valve functional check will consist of:

1. Visually inspecting the system.

2. Disconnecting the vacuum hose to the EGR valve. The hand vacuum pump will be connected to the valve and vacuum applied with the engine running. If idle speed drops with the application of vacuum, the valve is good. The vacuum pump should then be inserted into the line leading to the valve's vacuum source. The engine will be revved to determine if vacuum is available. If vacuum is not available, the sensors and hosing are checked using the same procedures described for the non-sealed unit.

The EGR control valve and sensor are coded as follows:

EGR control valve

0 - Not equipped
1 - Functioning properly
3 - Vacuum disconnect - Disconnect, removed or plugged vacuum line
7 - Missing item (entire valve removed)
9 - Malfunctioning item

EGR sensor

0 - Not equipped
1 - Functioning properly
3 - Vacuum disconnect
5 - Incorrectly routed hose
7 - Missing item
9 - Malfunctioning item

i. Catalytic converter - Oxidizes the CO and HC to water and CO_2 in the exhaust gases. The converter will be coded as follows:

0 - Not equipped
1 - Functioning properly
7 - Missing item (catalyst removed from cannister or entire cannister removed)
9 - Malfunctioning item - High temperature discoloration usually light blue.

j. Dash and tank labels - will be coded as follows:

0 - Not equipped
1 - Functioning properly
7 - Missing item

k. Filler neck inlet restrictor (unleaded vehicles only) - The restrictor is designed to prevent the introduction of leaded fuel into a vehicle requiring unleaded fuel. It will be coded as follows:

0 - Not equipped
1 - Functioning properly
4 - Mechanical disconnect - Widened to fit a leaded filler nozzle
7 - Missing item

l. Vacuum spark retard - Adjusts the timing as RPM changes. It works on manifold vacuum which is a function of RPM. The vacuum spark retard will be coded as follows:

0 - Not equipped
1 - Functioning properly
2 - Electrical disconnect
3 - Vacuum disconnect - Any removed, plugged, or disconnected vacuum line

4 - Mechanical disconnect
5 - Incorrectly routed hose
7 - Missing item
9 - Malfunctioning item

m. Tampering source - Drivers will be asked who services their vehicle. The following codes shall be used to explain their answers:

K - Don't know
O - Owner or non-mechanic
D - Dealer
M - Mechanic

n. HC in ppm and CO in percent with the engine at curb idle.

o. Plumbtesmo - Plumbtesmo paper is used to check for the presence of lead in vehicle exhaust pipes. A positive indication will be coded as "Y" and a negative as "N".

The data sheet shown as Figure A-3 will be used to keep an accurate record of those not participating. All forms will be numbered and handled according to the NEIC document control procedures.

FIGURE A-1

B-10

EPA VEHICLE TAMPERING SURVEY--BASIC DATA

LOCATION ______________________________ DATE ____________

DEMONSTRATIVE SAMPLE

I.D.	ODOMETER	AIR CLEANER INTAKE MANIFOLD EXHAUST MANIFOLD	M.Y.	MAKE	MODEL	EXHAUST SYSTEM DISTRIBUTOR TURBOCHARGER	CARBURETOR MAKE/MODEL	ENGINE FAMILY	PCV LINE OTHER	CID
1 2 3 4	6 7 8	9 10 11	13 14	16 17 18 19	21 22 23 24	26 27 28	30 31	33 34 35 36 37 38 39 40 41 42 43	44 45	

A - Add-on Devices
P - Original Equipment
6 - Non-stock Equipment

S - Sealed Carburetor
F - Fuel Injection

FIGURE A-2

EPA VEHICLE TAMPERING SURVEY--TAMPERING DATA Date____________

I.D.	CARB SYSTEM: Idle Stop Solenoid	CARB SYSTEM: Heated Intake	CARB SYSTEM: Limiter Caps	PCV System	ECS: Storage	ECS: Tank Cap	AIR SYSTEM: Pump	AIR SYSTEM: Control Valves	AIR SYSTEM: Pump Belt	EGR: Control Valves	EGR: Sensors	CATALYST SYSTEM: Converter	CATALYST SYSTEM: Dash Label	CATALYST SYSTEM: Tank Label	Filler Neck	Vacuum Spark Retard	Tampering Source	IDLE EMISSIONS: CO %	IDLE EMISSIONS: HC ppm	PLUMBTESMO
	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	65 66 67 68	70 71 72 73	75

0 - Not Equipped
1 - Functioning Properly
2 - Electrical Disconnect
3 - Vacuum Disconnect
4 - Mechanical Disconnect
5 - Incorrectly Routed Hose
6 - Non-stock Equipment
7 - Missing Item
8 - Misadjusted Item
9 - Malfunctioning Item
N - Negative

FIGURE A-3

B-12

MOTOR VEHICLE TAMPERING SURVEY

RECORD OF NON-PARTICIPATING VEHICLES

Location ______________________ Date ______________________

TIME	MAKE	MODEL	YEAR	REASON

ATTACHMENT B

FUEL SAMPLE COLLECTION AND LABELING PROCEDURES

A fuel sample will be taken from each vehicle requiring unleaded fuel. These samples will be collected in 4 ounce bottles with a hand fuel pump. Once the sample is drawn, the fuel will be replaced with an equivalent amount of unleaded fuel if the driver requests and the pump will be flushed with unleaded fuel.

Each bottle will be identified with a stick-on label that has the vehicle identifying survey number on it. The vehicle identifying survey number is the first entry on data forms described in Attachment A.

Prior to shipment from the field, a sample tag with the same identifying number will be attached to each bottle. The bottles will be packaged, labeled, and shipped to the NEIC Chemistry Branch according to shippers requirements and the NEIC Policy and Procedures Manual.

ATTACHMENT C

INSTRUCTIONS FOR USING PLUMBTESMO TEST PAPER

Plumbtesmo test paper can be used to determine the presence of lead and lead salts on surfaces. To test for the presence of lead, the paper is moistened with distilled water and pressed firmly for 10 to 20 seconds against the surface to be tested. The presence of lead is indicated when the paper turns from light yellow to pink or dark violet.

ATTACHMENT D
FIELD QUALITY CONTROL/ASSURANCE

Reference and calibration gases will be used to assure the accuracy of the emissions measuring instruments. Horiba gases certified by RTP will be used as reference gases. Two cylinders of reference gas will be used to validate the accuracy of the calibration gases before they are taken to the field on each survey.

Three calibration gases (Horiba) will be used. These gases will be a mixture of CO and HC in nitrogen and will be used to check the instrument at least three times daily. These calibration gases are certified by the manufacturer and the RTP reference gases. Their approximate concentration is:

18% CO
1560 ppm HC (Hexane equivalent)

4% CO
827 ppm HC (Hexane equivalent)

1.6% CO
320 ppm HC (Hexane equivalent)

(Section 110(a) and Section 301(a) of the Clean Air Act, as amended (42 U.S.C. 7410(a) and 7601(a)))

Note.—Incorporation by reference of the Part 52 State Implementation Plan for the State of New Hampshire was approved by the Director of the Federal Register on July 1, 1981.

Dated: December 30, 1981.

Anne M. Gorsuch,

Administrator.

PART 52—APPROVAL AND PROMULGATION OF IMPLEMENTATION PLANS

Part 52 of Chapter I, Title 40 of the Code of Federal Regulations is amended as follows:

Subpart EE—New Hampshire

1. Section 52.1520, paragraph (c) is amended by adding subparagraph (19) as follows:

§ 52.1520 Identification of plan.

* * * * *

(c) * * *

(19) Revisions to meet the requirements of Part D and certain other sections of the Clean Air Act, as amended, for attaining carbon monoxide standards in the City of Manchester which were submitted on January 12, 1981 and February 18, 1981. The revisions supplement the 1979 CO attainment plan (§ 52.1520(c)(12)) and include three air quality-improving transportation projects and a schedule for submitting a plan which will demonstrate attainment by no later than December 31, 1987.

§ 52.1527 [Amended]

2. In § 52.1527, *Rules and Regulations,* subparagraph (a)(1) is hereby removed and reserved as follows:

* * * * *

(a)(1) [Reserved]

* * * * *

PART 81—DESIGNATION OF AREAS FOR AIR QUALITY PLANNING PURPOSES

Part 81—of Chapter I, Title 40 of the Code of Regulations is amended as follows:

Subpart C—Section 107 Attainment Status Designations

§ 81.330 New Hampshire [Amended]

1. In § 81.330, the table entitled "New Hampshire—CO" is amended by changing "Metropolitan Manchester" to "City of Manchester".

[FR Doc. 82-418 Filed 1-6-82; 8:45 am]

BILLING CODE 6560-38-M

40 CFR Part 80

[AEN-FRL 1983-6]

Lead in Gasoline Test Procedure

AGENCY: Environmental Protection Agency (EPA).

ACTION: Final rule.

SUMMARY: EPA is amending its testing procedure for the determination of lead content in gasoline by adding an optional automated method to the standard method. The automated method uses techniques of chemical analysis similar to the standard method, making it suitable for comparison purposes, and it is technically equivalent. Its principal advantage is greater laboratory efficiency at a reduced operational cost.

EFFECTIVE DATE: February 8, 1982.

FOR FURTHER INFORMATION CONTACT: Steven K. Albrink, Tampering Section, Field Operations and Support Division (EN-397), U.S. Environmental Protection Agency, Washington, D.C. 20460; Tel. (202) 382-2669, or Dr. Joe H. Lowry, Chief, Inorganic Analyses Section, Laboratory Services Division, National Enforcement Investigations Center, Building 53, Box 25227, Denver, Colorado 80225; Tel. (303) 234-4661.

SUPPLEMENTARY INFORMATION:

I. Introduction

The use of leaded gasoline in motor vehicles designed for unleaded gasoline reduces the effectiveness of their emission control systems. Therefore, the introduction of leaded fuel into vehicles requiring unleaded fuel is prohibited by law (40 CFR 80.22). To ensure that fuel represented as unleaded does not contain lead in excess of the maximum established by law of 0.05 gram of lead per gallon of gasoline (40 CFR 80.2(g)), the Administrator has established an approved testing procedure (40 CFR Part 80, Appendix B). This rule amends the approved testing procedure by adding an automated procedure to the previously approved standard method. The rule also amends the procedures for the standard and automated testing of gasoline samples with lead content greater then 0.10 g Pb/gal.

The determination of lead in gasoline by atomic absorption spectrometry has been adopted by the American Society for Testing Materials (method #D3237-73) and the U.S. Environmental Protection Agency (40 CFR Part 80, Appendix B) as the standard method of analysis. EPA's method consists of the manual preparation of an *in-situ* reaction of the alkyl lead compounds in gasoline with iodine, stabilization of alkyl lead iodide complexes with tricapryl methyl ammonium chloride (Aliquat 336), ten-fold dilution with methyl isobutyl ketone (MIBK) and measurement by atomic absorption spectrometry with an air-acetylene flame. The iodine reaction eliminates the problem of variations in responses due to different alkyl lead compounds.[1] The dilution compensates for severe nonatomic absorption, scatter from unburned carbon, and minimizes matrix effects.[2]

Proposed rulemaking was published on pages 20698-20703 of the Federal Register of April 7, 1981, and invited comments for 60 days ending June 8, 1981. The proposed rulemaking contained a discussion on the development of the automated method and presented data showing equivalence of the automated and manual procedures and precision and accuracy data gathered over a four-month period during the analysis of about 1,500 samples by EPA's National Enforcement Investigations Center.

Various methods are available for the detection of lead content in gasoline. However, any new method approved for use by EPA for enforcement actions under this Part must be compatible, for comparison purposes, with the approved standard method. Therefore, EPA is amending this rule to permit the use of an efficient, accurate, rapid analysis which is, in its chemistry, similar to and compatible with the standard method.

II. Comments and Discussion

No comments were received during the comment period.

Comparison testing of the standard and automated methods was performed by an independent laboratory under contract to EPA's Office of Research and Development. The results of the comparison testing confirmed that the automated procedure is capable of analyzing more samples in a shorter time than the standard procedure. They also show that the precision and accuracy of the automated procedure are acceptable. The results of the study show accuracy of the automated procedure is better than ±3.5 percent and the precision is better than ±3 percent. The results are consistent with the data presented in the proposed Federal Register notice. A copy of this report is contained in Public Docket A-80-41 at the U.S. Environmental Protection Agency, Central Docket

[1] M. Kashiki, S. Yamazoe, S. Ohima, Amal. Chem Acta, 53, 95 (1971).

[2] Lukasiewicz, R. J., Berens, P. H., Buel, B. E., Amal. Chem., 47, 1045 (1975).

Section, West Tower Lobby, Gallery One, 401 M Street, SW., Washington, D.C. and is available for review weekdays between 8 a.m. and 4 p.m.

The proposed rulemaking included an explicit procedure regarding dilution of gasoline samples above 0.10 g Pb/gal in the standard test method and the automated method. No comments were received regarding this procedure. The final rule adopts this procedure but also allows a higher level calibration standard curve to be used in lieu of dilution if the higher level calibration standard curve is shown to be linear and measurement of lead at levels above 0.10 g Pb/gal is shown to be accurate by the analysis of control samples. The use of dilution of samples or higher level calibration standard curves to determine lead content of samples above the range of the test method has been added to sections 1.1 and 6.3 for the standard method and included in the automated method in sections 1.1 and 8.4.5. to clarify an existing situation. The previous test method in Appendix B did not specify how gasoline samples above 0.10 g Pb/gal were to be tested. Such methods as dilution and higher level calibration standard curves were intended to be used in conjunction with Appendix B even though it is not specifically stated since accurate numerical results for samples with lead content above 0.10 g Pb/gal can only be obtained by such methods. Dilution is the preferable method; however, the use of higher level calibration standard curves is permissible as long as its accuracy can be verified by the use of control samples.

III. Conclusion

The automated system is a useful alternative to the standard method and offers acceptable sensitivity, precision, and accuracy. Accordingly, I am establishing it as an alternative method for the determination of lead content in gasoline.

Note.—Under Executive Order 12291, EPA must judge whether a regulation is "Major" and therefore subject to the requirement of a Regulatory Impact Analysis. This regulation is not major because it will not have an effect on the economy of $100 million or more, it will increase efficiency while decreasing cost to commercial and Government testing facilities which adopt the procedure, and there will not be significant adverse effects on competition, employment, investment, productivity, innovation, or on the ability of United States-based enterprises to compete with foreign-based enterprises in domestic or export markets.

This regulation was submitted to the Office of Management and Budget for review as required by Executive Order 12291.

Note.—Under the Regulatory Flexibility Act, 5 U.S.C. 601 *et seq.*, EPA is required to determine whether a regulation will have a significant economic impact on a substantial number of small entities so as to require preparation of a regulatory flexibility analysis. This amendment authorizes use of an optional automated laboratory procedure for testing lead content of gasoline for enforcement purposes. The automated method allows greater efficiency than the previously authorized standard method. This enables facilities to achieve a cost savings if they test a volume of samples sufficient to warrant the initial investment in the pumps and automatic sampler which are required. Small laboratories which cannot afford to purchase the needed equipment may be placed at a competitive disadvantage if they are unable to test gasoline samples as inexpensively as facilities employing the automated method, however, this impact on small entities is expected to be slight. Therefore, pursuant to the provisions of 5 U.S.C. § 605(b), I hereby certify that this rule will not have a significant economic impact on a substantial number of small entities. Accordingly, I have determined that preparation of a regulatory flexibility analysis is not required.

Authority: Sections 211 and 301(a) of the Clean Air Act, as amended, 42 U.S.C. §§ 7545 and 7601(a).

Dated: December 30, 1981.

John W. Hernandez, Jr.,
Acting Administrator.

PART 80—REGULATION OF FUELS AND FUEL ADDITIVES

Accordingly, 40 CFR Part 80 is amended as follows:

1. Section 80.3 is revised to read as follows:

§ 80.3 Test methods.

The lead and phosphorus content of gasoline shall be determined in accordance with test methods set forth in the Appendices to this part.

2. Appendix B is amended as follows:

a. The title of Appendix B is revised to read:

Appendix B—Tests for Lead in Gasoline by Atomic Absorption Spectrometry

b. The title of the existing test procedure is revised to read "*Method 1—Standard Method Test for Lead in Gasoline by Atomic Absorption Spectrometry*" and inserted as a new center head above the existing text.

c. Section 1 of Method 1 is revised as follows:

1. *Scope.* 1.1. This method covers the determination of the total lead content of gasoline. The procedure's calibration range is 0.010 to 0.10 gram of lead/U.S. gal. Samples above this level should be diluted to fall within this range or a higher level calibration standard curve must be prepared. The higher level curve must be shown to be linear and measurement of lead at these levels must be shown to be accurate by the analysis of control samples at a higher level of alkyl lead content. The method compensates for variations in gasoline composition and is independent of lead alkyl type.

* * * * *

d. Section 6 of method 1 is amended to include a new subsection 6.3 as follows:

* * * * *

6.3 Any sample resulting in a peak greater than 0.05 g Pb/gal will be run in duplicate. Samples registering greater than 0.10 g Pb/gal should be diluted with iso-octane or unleaded fuel to fall within the calibration range or a higher level calibration standard curve must be prepared. The higher level curve must be shown to be linear and measurement of lead at these levels must be shown to be accurate by the analysis of control samples at a higher level of alkyl lead content.

* * * * *

e. An approved alternative test method, Method 2, is added to Appendix B following section 8.1.2 as follows:

Method 2—Automated Method Test for Lead in Gasoline by Atomic Absorption Spectrometry

1. *Scope and Application.* 1.1 This method covers the determination of the total lead content of gasoline. The procedure's calibration range is 0.010 to 0.10 gram of lead/U.S. gal. Samples above this level should be diluted to fall within this range or a higher level calibration standard curve must be prepared. The higher level curve must be shown to be linear and measurement of lead at these levels must be shown to be accurate by the analysis of control samples at a higher level of alkyl lead content. The method compensates for variations in gasoline composition and is independent of lead alkyl type.

1.2 This method may be used as an alternative to the Standard Method set forth above.

1.3 Where trade names or specific products are noted in the method, equivalent apparatus and chemical reagents may be used. Mention of trade names or specific products is for the assistance of the user and does not constitute endorsement by the U.S. Environmental Protection Agency.

2. *Summary of Method.* 2.1 The gasoline sample is diluted with methly isobutyl ketone (MIBK) and the alkyl lead compounds are stabilized by reacting with iodine and a quarternary ammonium salt. An automated system is used to perform the diluting and the chemical reactions and feed the products to the atomic absorption spectrometer with an air-acetylene flame.

2.2 The dilution of the gasoline with MIBK compensates for severe non-atomic absorption, scatter from unburned carbon containing species and matrix effects caused in part by the burning characteristics of gasoline.

2.3 The *in-situ* reaction of alkyl lead in gasoline with iodine eliminates the problem of variations in response due to different alkyl types by leveling the response of all alkyl lead compounds.

2.4 The addition of the quarternary ammonium salt improves response and increases the stability of the alkyl iodide complex.

3. *Sample Handling and Preservation.* 3.1 Samples should be collected and stored in containers which will protect them from changes in the lead content of the gasoline such as from loss of volatile fractions of the gasoline by evaporation or leaching of the lead into the container or cap.

3.2 If samples have been refrigerated they should be brought to room temperature prior to analysis.

4. *Apparatus.* 4.1 AutoAnalyzer system consisting of:

4.1.1 Sampler 20/hr cam, 30/hr cam.

4.1.2 Proportioning pump.

4.1.3 Lead in gas manifold.

4.1.4 Disposable test tubes.

4.1.5 Two 2-liter and one 0.5 liter Erlenmeyer solvent displacement flasks. Alternatively, high pressure liquid chromatography (HPLC) or syringe pumps may be used.

4.2 Atomic Absorption Spectroscopy (AAS) Detector System consisting of:

4.2.1 Atomic absorption spectrometer.

4.2.2 10" strip chart recorder.

4.2.3 Lead hollow cathode lamp or electrodeless discharge lamp (EDL).

5. *Reagents.* 5.1 Aliquat 336/MIBK solution (10% v/v): Dissolve and dilute 100 ml (88.0 g) of Aliquat 336 (Aldrich Chemical Co., Milwaukee, Wisconsin) with MIBK (Burdick & Jackson Lab., Inc., Muskegon, Michigan) to one liter.

5.2 Aliquat 336/iso-octane solution (1% v/v): Dissolve and dilute 10 ml (8.8 g) of Aliquat 336 (reagent 5.1) with iso-octane to one liter.

5.3 Iodine solution (3% w/v): Dissolve and dilute 3.0 g iodine crystals (American Chemical Society) with toluene (Burdick & Jackson Lab., Inc., Muskegon, Michigan) to 100 ml.

5.4 Iodine working solution (0.24% w/v): Dilute 8 ml of reagent 5.3 to 100 ml with toluene.

5.5 Methyl isobutyl ketone (MIBK) (4-methlyl-2-pentanone).

5.6 Certified unleaded gasoline (Phillips Chemical Co., Borger, Texas) or iso-octane (Burdick & Jackson Lab, Inc., Muskegon, Michigan).

6. *Calibration Standards.* 6.1 Stock 5.0 g Pb/gal Standard:

Dissolve 0.4433 gram of lead chloride ($PbCl_2$) previously dried at 105°C for 3 hours in 200 ml of 10% v/v Aliquat 336/MIBK solution (reagent 5.1) in a 250 ml volumetric flask. Dilute to volume with reagent 5.1 and store in an amber bottle.

6.2 Intermediate 1.0 g Pb/gal Standard: Pipet 50 ml of the 5.0 g Pb/gal standard into a 250 ml volumetric flask and dilute to volume with a 1% v/v Aliquat 336/iso-octane solution (reagent 5.2). Store in an amber bottle.

6.3 Working 0.02, 0.05, 0.10 g Pb/gal Standards:

Pipet 2.0, 5.0, and 10.0 ml of the 1.0 g Pb/gal solution to 100 ml volumetric flasks. Add 5 ml of a 1% Aliquat 336/iso-octane solution to each flask. Dilute to volume with iso-octane. These solutions contain 0.02, 0.05, and 0.10 g Pb/gal in a 0.05% Aliquat 336/iso-octane solution.

7. *AAS Instrumental Conditions.* 7.1 Lead hollow cathode lamp.

7.2 Wavelength: 283.3 nm.

7.3 Slit: 4 (0.7mm).

7.4 Range: UV.

7.5 Fuel: Acetylene (approx. 20 ml/min at 8 psi).

7.6 Oxidant: Air (approx. 65 ml/min at 31 psi).

7.7 Nebulizer: 5.2 ml/min.

7.8 Chart speed: 10 in/hr.

8. *Procedures.* 8.1 AAS start-up.

8.1.1 Assure that instrumental conditions have been optimized and aligned according to Section 7 and the instrument has had substantial time for warm-up.

8.2 Auto Analyzer start-up (see figure 1).

8.2.1 Check all pump tubing and replace as necessary. Iodine tubing should be changed daily. All pump tubing should be replaced after one week of use. Place the platen on the pump.

8.2.2 Withdraw any water from the sample wash cup and fill with certified unleaded gasoline (reagent 5.6).

8.2.3 Fill the 2-liter MIBK dilution displacement Erlenmeyer flask (reagent 5.5) and the 0.5 liter Aliquat 336/MIBK 1% v/v (reagent 5.2) displacement flask and place the rubber stopper glass tubing assemblies in their respective flasks.

8.2.4 Fill a 2-liter Erlenmeyer flask with distilled water. The water will be used to displace the solvents. Therefore, place the appropriate lines in this flask. This procedure is not relevant if syringe pumps are used.

8.2.5 Fill the final debubbler reverse displacement 2-liter Erlenmeyer flask with distilled water and place the rubber stopper glass tubing assembly in the flask.

8.2.6 Place the appropriate lines for the iodine reagent (reagent 5.4) and the wash solution (reagent 5.6) in their respective bottles.

8.2.7 Start the pump and connect the aspiration line from the manifold to the AAS.

8.2.8 Some initial checks to assure that the reagents are being added are:

a. A good uniform bubble pattern.

b. Yellow color evident due to iodine in the system.

c. No surging in any tubing.

8.3 Calibration.

8.3.1 Turn the chart drive on and obtain a steady baseline.

8.3.2 Load standards and samples into sample tray.

8.3.3 Start the sampler and run the standards (Note: first check the sample probe positioning with an empty test tube).

8.3.4 Check the linearity of calibration standards response and slope by running a least squares fit. Check these results against previously obtained results. They should agree within 10%.

8.3.5 If the above is in control then start the sample analysis.

8.4 Sample Analysis.

8.4.1 To minimize gasoline vapor in the laboratory, load the sample tray about 5–10 test tubes ahead of the sampler.

8.4.2 Record the sample number on the strip chart corresponding to the appropriate peak.

8.4.3 Every ten samples run the high calibration standard and a previously analyzed sample (duplicate). Also let the sampler skip to check the baseline.

8.4.4 After an acceptable peak (within the calibration range) is obtained, pour the excess sample from the test tube into the waste gasoline can.

8.4.5 Any sample resulting in a peak greater than 0.05 g Pb/gal will be run in duplicate. Samples registering greater than 0.10 g Pb/gal should be diluted with iso-octane or unleaded fuel to fall within the calibration range or a higher level calibration standard curve must be prepared. The higher level curve must be shown to be linear and measurement of lead at these levels must be shown to be accurate by the analysis of control samples at a higher level of alkyl lead content.

8.5 Shut Down.

8.5.1 Replace the solvent displacement flask with flasks filled with distilled water. Also place all other lines in a beaker of distilled water. Rinse the system with distilled water for 15 minutes.

8.5.2 Withdraw the gasoline from the wash cup and fill with water.

8.5.3 Dispose of all solvent waste in waste glass bottles.

8.5.4 Turn the AAS off after extinguishing the flame. Also turn the recorder and pump off. Remove the platen and release the pump tubing.

8.5.5 shut the acetylene off at the tank and bleed the line.

9. *Quality Control.* 9.1 Precision.

9.1.1 All duplicate results should be considered suspect if they differ by more than 0.005 g Pb/gal.

9.2 Accuracy.

9.2.1 All quality control standard checks should agree within 10% of the nominal value of the standard.

9.2.2 All spikes should agree within 10% of the known addition.

10. *Past Quality Control Data.* 10.1 Precision.

10.1.1 Duplicate analysis for 156 samples in a single laboratory has resulted in an average difference of 0.00011 g Pb/gal with a standard deviation of 0.0023.

10.1.2 Replicate analysis in a single laboratory (greater than 5 determinations) of samples at concentrations of 0.010, 0.048, and 0.085 g Pb/gal resulted in relative standard deviations of 4.2%, 3.5%, and 3.3% respectively.

10.2 Accuracy.

10.2.1 The analysis of National Bureau of Standards (NBS) lead in reference fuel of known concentrations in a single laboratory has resulted in found values deviating from the true value for 11 determinations of 0.0322 g Pb/gal by an average of 0.55% with a standard deviation of 6.6%, for 15 determinations of 0.0519 g Pb/gal by an average of −1.1% with a standard deviation of 5.8%, and for 7 determinations of 0.0725 g Pb/gal by an average of 3.5% with a standard deviation of 4.8%.

10.2.2 Twenty-three analyses of blind reference samples in a single laboratory (U.S. EPA, RTP, N.C.) have resulted in found values differing from the true value by an average of −0.0009 g Pb/gal with a standard deviation of 0.004.

10.2.3 In a single laboratory, the average percent recovery of 108 spikes made to samples was 101% with a standard deviation of 5.6%.

BILLING CODE 6560-26-M