5.1.5 Emission Standards

The emission standards on air pollution prescribed in the decree number 2 of 1982 are summarized as follows.

(1) Normal condition

The standards are determined considering the following normal conditions.

Temperature :	25°C
Barometric pressure:	760 mmHg
Altitude:	sea level

(2) Correction Factor for the Stack Height

In case that the stack height is different from the normal height, comparing with the normal height, the rectifier "E" which is determined by applying the correction factor stipulated in this decree should be added to or extracted from the standard value. If the stack height is higher than the normal height, E is added to the standard and otherwise E is reduced from the standard.

(3) Minimum Stack Height

In any case the discharging point of pollutant should not be below 15 m from the ground surface.

(4) Modification Factor fro the Altitude fro Sea Level

If the fixed emission source is not located at the normal altitude, the following modification factor should be applied to the emission.

Altitude above sea level (m)	Modification factor "K" to the emission
500	0.969
750	0.954
1,000	0.939
1,250	0.923
1,500	0.908
1,750	0.893
2,000	0.878
2,250	0.862
2,500	0.847

For the intermediate altitude of the fixed emission sources, the modification factor "K" is determined by the following formula.

$$K = \frac{B.P.}{760} + 0.04H$$

where: K: modification factor according to altitude
B.P.: barometric pressure in mercury column (mm)
H: altitude (km)

(5) Compound Sources

If the emission sources are installed within a lot which is owned by a single owner, the standards are applied to the total emission from all the similar facilities. To unify the various height of discharge points, the equivalent height is determined by the following formula.

$$Heq = \frac{\Sigma\, HiQi}{\Sigma\, Qi}$$

where: Heq: equivalent height of discharge points (m)
Hi: actual height of each discharge point (m)
Qi: emission load from each facility

(6) Standard on Particulates for Coal Boilers

The coal boiler should not emit particulates in excess of the diagram number 1 and the following values shown in the table.

Heat consumption (10^6 kcal/h)	Permissible Emission		Reference altitude of discharge point (m)
	Rural zone (kg/10^6 kcal•h)	Urban zone (kg/10^6 kcal•h)	
10 or less	3.00	2.00	15
25	2.24	1.45	20
50	1.79	1.14	25
75	1.57	0.99	30
100	1.43	0.90	40
200	1.15	0.71	45
300	1.01	0.61	50
400	0.92	0.55	55
500	0.86	0.51	60
750	0.75	0.45	100
1,000	0.68	0.40	115
1,500 or more	0.60	0.35	120

Correction Factor for Coal Boiler

Heat consumption (kg/10^6 kcal/h)	Unit correction factor ΔE for unit height difference between actual and normal discharge point by meters (kg/10^6 kcal•h•m)		Minimum altitude of discharge point (m)
	Urban zone	Rural zone	
10 or less			15
25	0.050	0.075	15
50	0.040	0.065	20
75	0.030	0.060	20
100	0.020	0.042	30
200	0.015	0.032	30
300	0.010	0.022	40
400	0.006	0.013	40
500	0.005	0.011	50
750	0.004	0.009	60
1,000	0.003	0.007	80
2,000 or more	0.025	0.006	100

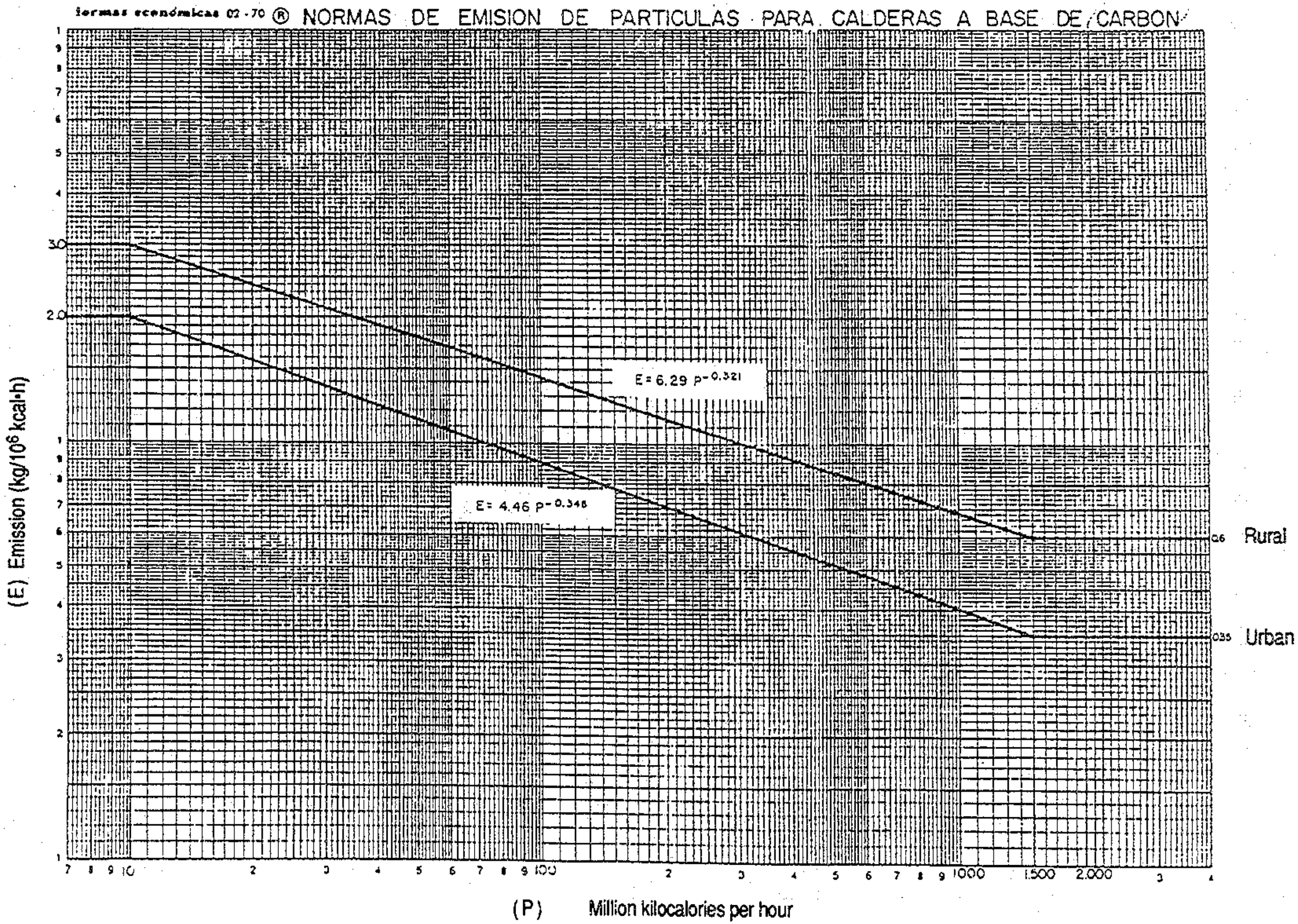


Fig. 1 Standard on Particulates Emission for Coal Boiler

(7) Standard on Particulates for Cement Kilns

The cement kiln should not emit particulates in excess of the diagram number 2 and the following values shown in the table.

Maximum daily production of cement (T/day)	Permissible Emission		Reference altitude (m)
	Rural zone (kg/T)	Urban zone (kg/T)	
500 or less	9.00	6.00	30
600	8.00	5.20	35
700	7.32	4.60	40
800	6.74	4.20	45
1,000	5.88	3.50	50
1,500	4.59	2.50	55
2,000	3.85	2.00	60
2,500	3.35	1.70	65
3,000 or more	3.00	1.50	70

Besides this Table, emissions from the other facilities in the cement factory are prescribed as follows.

a) Clinker cooling shop: particulates 2 kg per 1 t of clinker

b) Milling shop and packing shop: particulates 1 kg per 1 t of cement

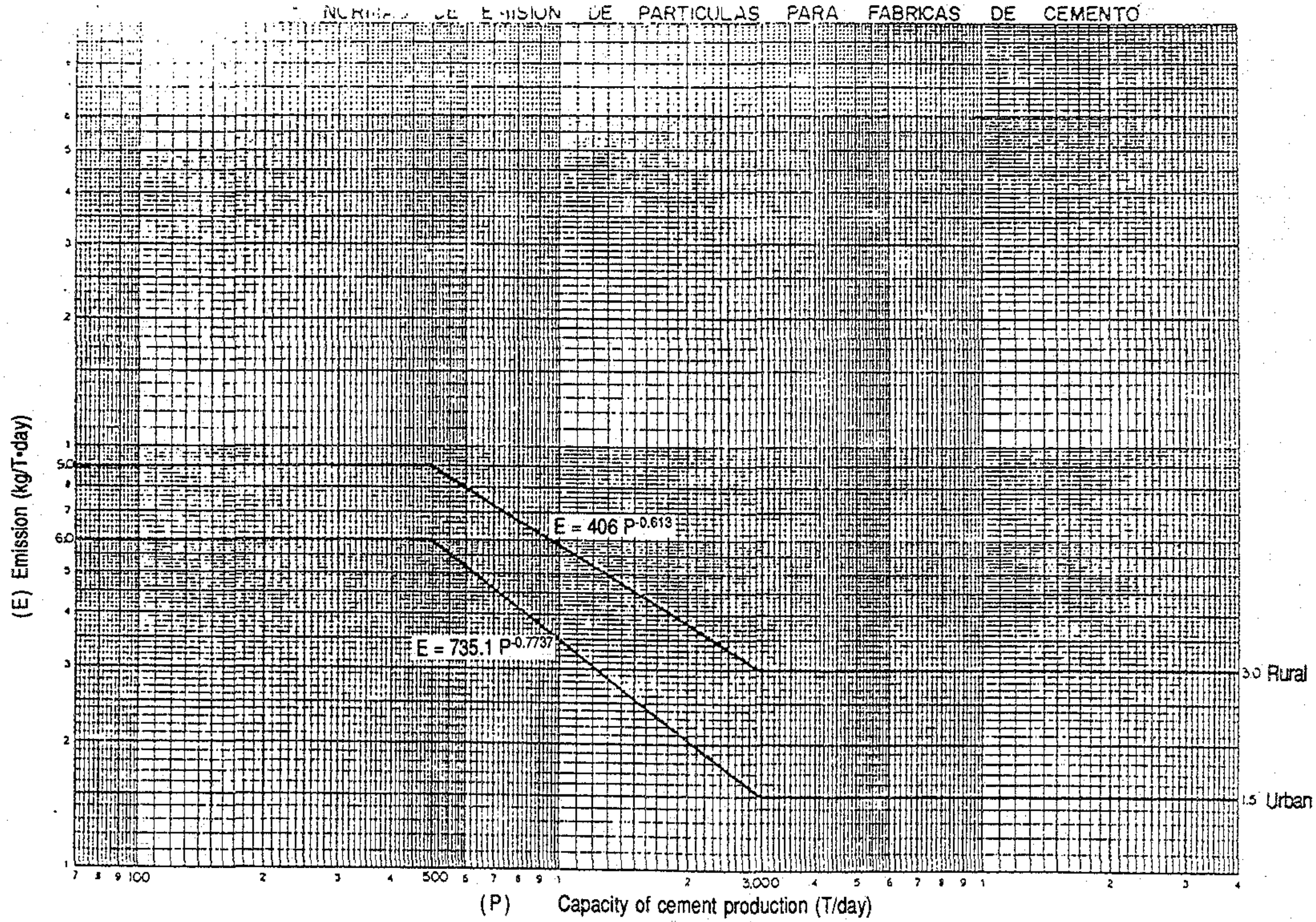


Fig. 2 Standard on Particulates for Cement Kiln

Correction Factor for Cement Kiln

Maximum daily production of cement (T/day)	Unit correction factor ΔE for height difference between actual and normal discharge point (kg/T•day•m)		Minimum altitude of discharge point (m)
	Rural zone	Urban zone	
500 or less			30
600	0.26	0.110	30
700	0.24	0.100	30
800	0.22	0.090	35
1,000	0.19	0.080	40
1,500	0.10	0.040	40
2,000	0.12	0.050	50
2,500	0.07	0.030	50
3,000 or more	0.06	0.027	55

(8) Emission Standards on Particulates for Induction or Arc Electric Furnaces for Steel Works

The permissible particulates emission from induction or arc electric furnaces is prescribed in the diagram number 3 and the following table.

Capacity of production (T/day)	Permissible Emission		Reference altitude (m)
	Rural zone (kg/T)	Urban zone (kg/T)	
10 or less	1.50	1.00	15
20	1.16	0.81	20
30	1.00	0.71	20
40	0.90	0.65	20
50	0.83	0.61	20
60	0.78	0.58	20
70	0.73	0.55	25
80	0.70	0.53	25
90	0.67	0.51	25
100	0.64	0.49	30
150	0.55	0.44	40
200 or more	0.50	0.40	40

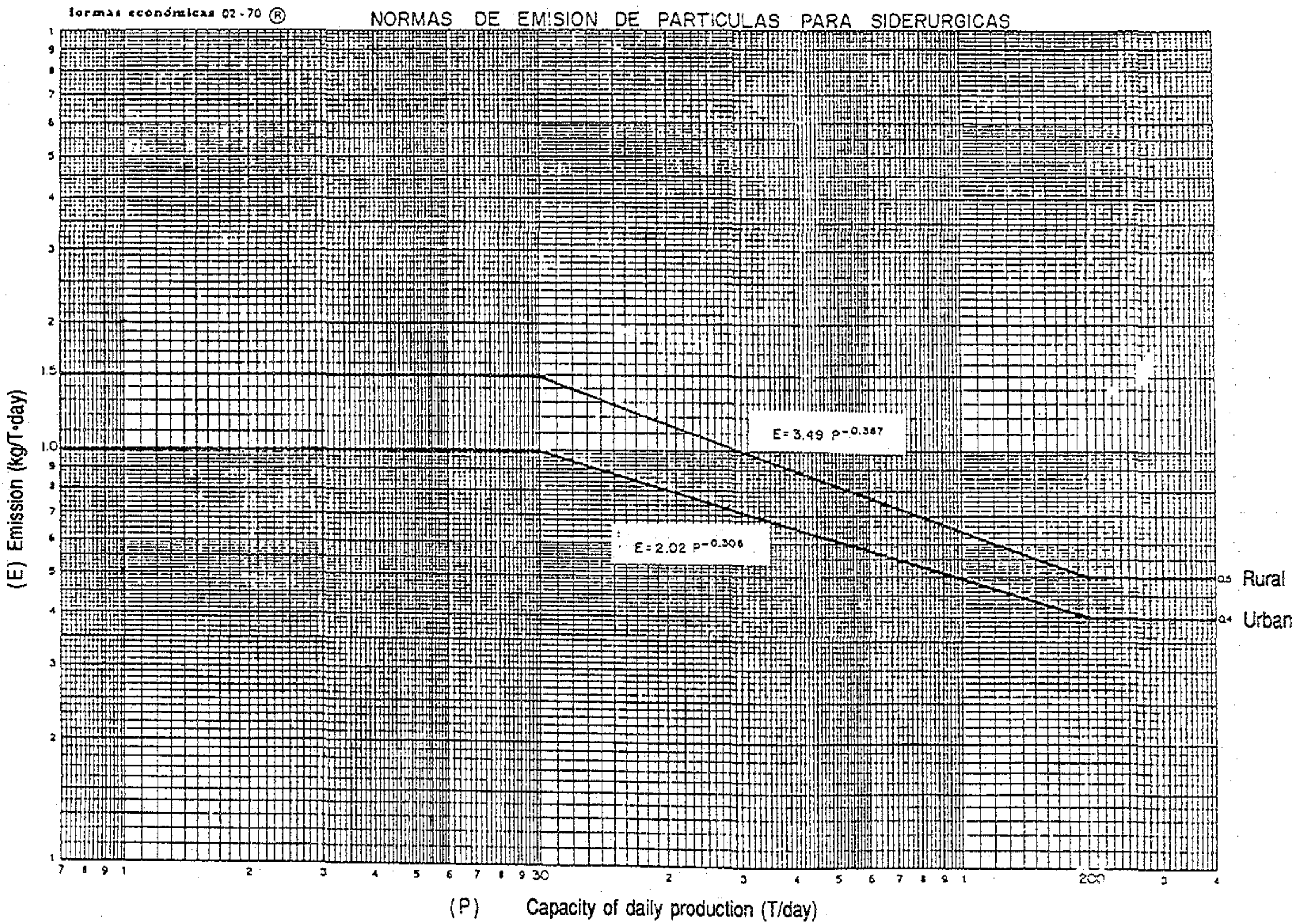


Fig. 3 Emission Standard on Particulates for Induction or Arc Electric furnaces for Steel Works

(9) Emission Standard on Particulates for Asphalt Mixing Plant

The permissible particulates emission from asphalt mixing plant is prescribed in the diagram number 4 and the following table.

Maximum capacity of daily production (T/day)	Permissible Emission		Reference altitude of discharge point (m)
	Rural zone (kg/T)	Urban zone (kg/T)	
50 or less	4.00	2.00	15
60	3.33	1.70	15
70	2.86	1.50	15
80	2.50	1.33	15
90	2.22	1.20	15
100	2.00	1.10	20
150	1.33	0.77	20
200	1.00	0.60	20
250 or more	0.80	0.49	30

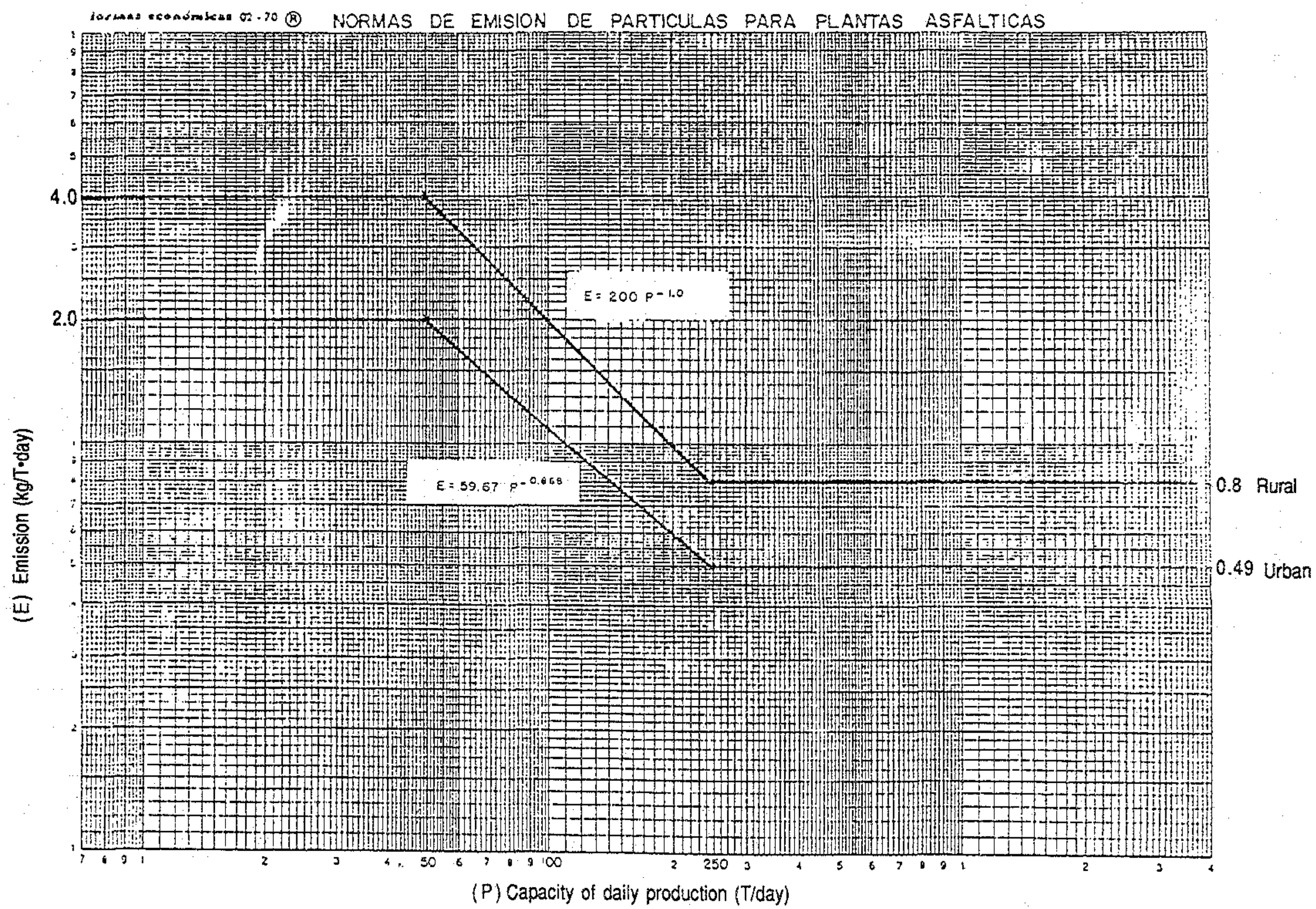


Fig. 4 Emission Standard on Particulates for Asphalt Mixing Plant

(10) Emission Standard on Particulates for Other Factories

The permissible particulates emission from other factories is prescribed in the diagram number 5 and the following table.

Hourly production of final product (T/hour)	Permissible Emission		Reference altitude (m)
	Rural zone (kg/hour)	Urban zone (kg/hour)	
0.1	3.01	1.50	15
0.5	5.96	2.98	15
1.0	8.00	4.00	15
2.0	14.67	7.33	15
3.0	20.92	10.46	15
4.0	26.91	13.45	15
5.0	32.71	16.36	15
10.0	60.00	30.00	20
20.0	79.82	41.21	20
30.0	94.32	49.62	25
40.0	106.17	56.60	25
50.0	116.39	62.70	30
100.0	154.91	86.20	35
200.0	205.93	118.30	40
300.0	243.33	142.42	50
400.0	273.92	162.50	60
500.0 or more	300.27	180.00	70

Correction Factor for Other Factories

Hourly production of final product (T/h)	Unit correction factor ΔE for unit height difference between actual and normal discharge point (kg/T•h•m)		Minimum altitude of discharge point (m)
	Rural zone	Urban zone	
0.1 ~ 5.0			15
5.0 ~ 20.0			20
30.0	3.8	2.80	20
40.0	4.2	3.20	20
50.0	4.7	3.50	25
100.0	6.2	4.60	30
200.0	8.2	6.20	35
300.0	4.9	3.60	40
400.0	3.7	2.70	45
500.0	3.0	2.25	50

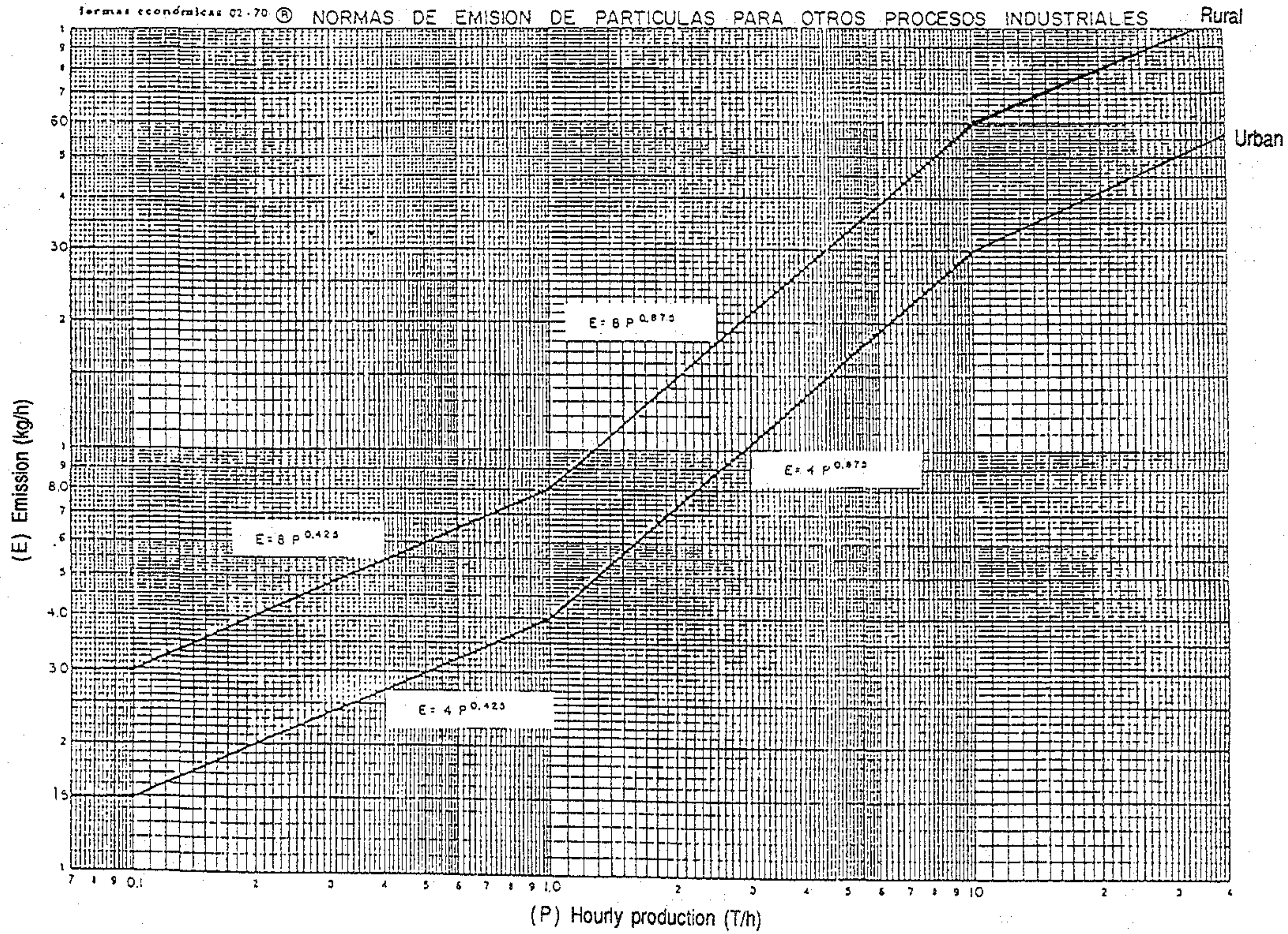


Fig. 5 Emission Standard on Particulates for Other Factories (1)

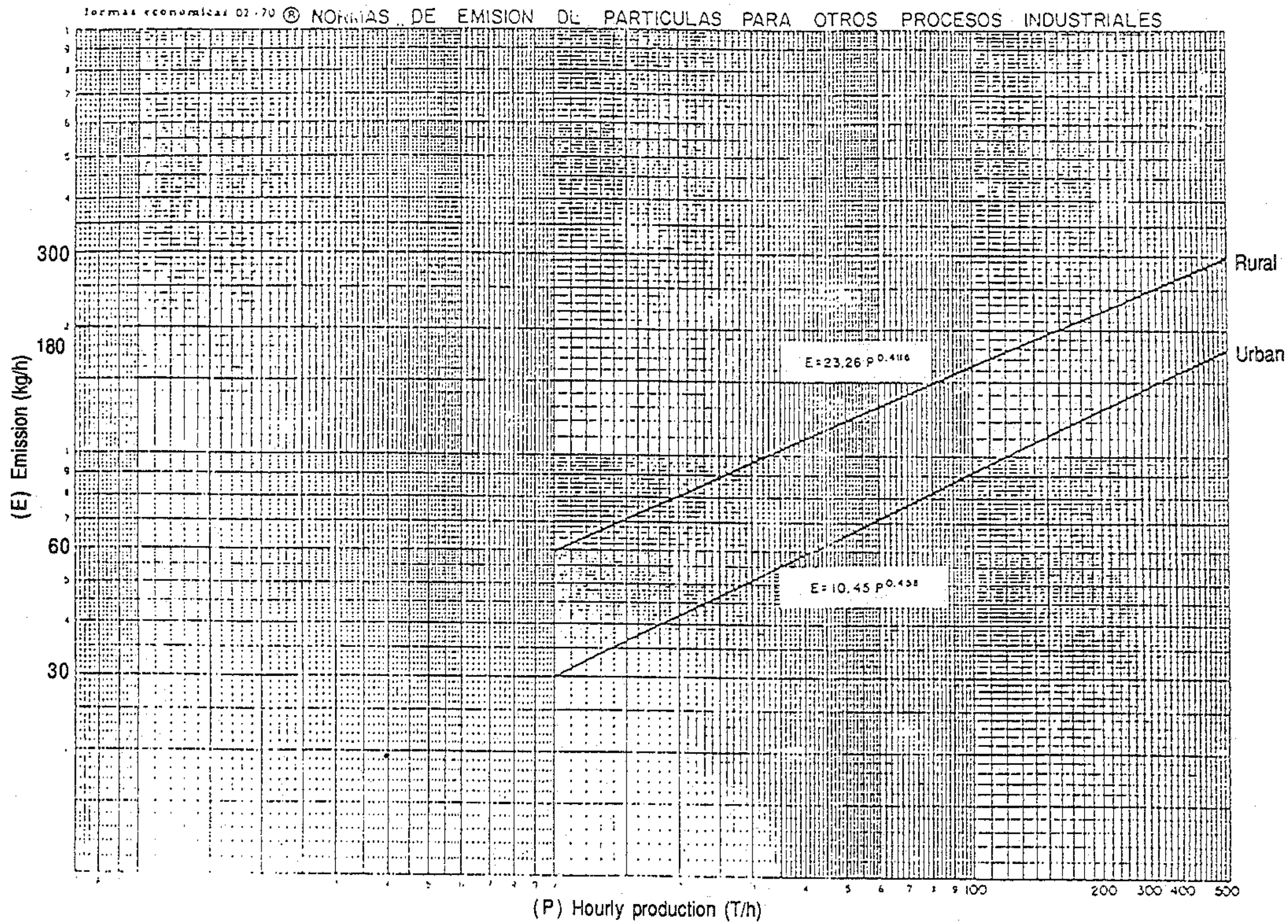


Fig. 5 Emission Standard on Particulates for Other Factories (2)

(11) Emission Standard on Sulfur-dioxide and Sulfuric Acid Mist for Sulfuric Acid Production Plants

The permissible SO_2 and sulfuric acid mist emission from sulfuric acid production plants is prescribed in the following table.

Installed capacity of H_2SO_4 production (T/day)	Permissible Emission		Minimum altitude of discharge point (m)
	SO_2 (kg/T)	Acid mist (kg/T)	
50 or less	10.0	0.10	25
75	7.0	0.10	25
100	5.0	0.10	30
150	4.0	0.06	35
200 or more	3.5	0.06	40

(12) Emission Standard for Boilers, Furnaces and Machines with Liquid fuel or Solid Fuel

Boilers, furnaces and machines which use coal, fuel oil, kerosene, diesel and crude oil as fuel should not emit the exhaust gas through the chimney of the lower height than the height prescribed in the table below.

Total heat discharged	Minimum required altitude of discharge point		
(kcal/hour)	(m)	(m)	(m)
10 or less	15	15	20
11 - 40	20	25	30
50	25	30	35
75	30	37	50
100	35	45	65
200	40	52	72
300	45	60	80
400	52	67	95
500	60	75	110
750	85	100	130
1,000	110	125	150
2,000 or more	125	150	
Sulfur content of fuel	1.4 or less	1.5 - 2.9	3.0 - 6.0

Note 1: To use those fuels which contain sulfur by 6% or more is not permitted.

Note 2: When there exist a building higher than 10m within the radius of 50m around the emission source, the minimum height of discharge point should be determined as the highest among the following provisions.

a) the height higher than the building by 5m

b) required minimum height

Note 3: When the heat discharge is more than 2 billion kilocalories per hour and the sulfur content of fuel is 3.0 to 6.0%, the minimum height of discharge point should be determined taking the impacts on the environment into account.

(13) Emission Standard for Nitric Acid Production Plants

1) Volume

Nitric acid production plants should not emit nitrogen-oxides in excess of the amount of 4.5 kg per 1 ton of nitric acid production.

2) Height of discharge point

The minimum height of discharge point is determined, corresponding to the capacity of daily nitric acid production, according to the same table as applied to the sulfuric acid production plants.

(14) Emission Standard for Incinerators

Incinerators with the capacity of 1 ton per day should not emit particulates in excess of the limit as shown below.

a) particulates of 5 g or more per 1 m^3 of exhaust gas

b) Ringelmann Scale No.2 or more

c) opacity of 40% or more

5.2 Control Measures against Automobiles

5.2.1 Automobiles and Pollutants

1 Kinds of Emission Gas from Automobiles

The emission gas from automobiles includes gas exhausted from the exhaust tube, blow-by gas from the engine crankcase, and fuel vapor evaporated from the fuel tank and carburetor.

Exhaust gas

Exhaust gas is discharged into the atmosphere through the exhaust tube after the fuel has completed depression of the piston through combustion and expansion within the cylinder. The gas contains mostly CO_2 gas and steam produced from combustion, and nitrogen and unused oxygen in air. In addition to these substances, the gas containts pollutants, such as carbon monoxide and hydrocarbons, nitrogen oxides, SPM, and sulfur oxides.

Blow-by gas

Blow-by gas is a gas which escapes through a clearance between the piston and cylinder of the engine into the crankcase. This gas contains partially-burnt or unburnt fuel, that is, hydrocarbons, much more than the exhaust gas.

Fuel vapor gas

The fuel vapor gas is the hydrocarbon gas released into the atmosphere when the fuel is evaporated from the fuel tank, piping, and carburetor. This gas includes the one which leaks in a liquid phase and is evaporated on the outside.

2 Pollutant Generation Process

1) Carbon monoxide

Carbon in fuel is turned into CO_2 gas through combustion, but develops incomplete combustion when air supply is deficient or air-fuel mixing is poor, turning partially into carbon monoxide. Generation of carbon monoxide grows particularly during deceleration.

2) Hydrocarbon

Unburnt hydrocarbon is generated in larger quantity from the exhaust gas than from blow-by gas or fuel vapor gas. As in the case of carbon monoxide, hydrocarbon is generated in the exhaust gas by incomplete combustion due to deficient air supply. Other factors as listed below are also considered responsible for generation of hydrocarbon:

a) The temperature around the wall of the combustion chamber is lower than that of the inside, allowing the fuel to be discharged as unburnt gas without having reached the combustion temperature.

b) When the throttle valve is in the idling position, the pressure in the intake manifold lowers, causing increase in the fuel ratio of the air-fuel mixed gas, resulting in a state similar to less air mixing.

c) Leakage of gas occurs because there exists slight overlap between intake and exhaust valves which are opening and closing alternately.

d) In the air rich state for reduction of carbon monoxide generation, firing loss tends to occur readily, naturally causing discharge of unburnt hydrocarbon.

3) Nitrogen oxides

Nitrogen oxides are abbreviated as NOx. They consist of various compounds of nitrogen and oxygen, but contain principally nitrogen monoxide (NO) and nitrogen dioxide (NO_2). These are produced when nitrogen in air and fuel reacts with oxygen in the high temperature state. The NO_2 content is about 1/10 of NO when the gas is exhausted from the engine. But NO is turned into NO_2 once in the air.

The NOx generation rate is said to increase along with rising combustion temperature, increasing further rapidly beyond 2000°C.

4) SPM

SPM consists of solidified combustion residues of ash or lead (when added) compounds in fuel or carbon particles produced through thermal liberation of carbon in fuel. Extremely fine dusts which can float are also produced through abrasion of tires and the road surface.

5) Sulfur oxides

Sulfur oxides are produced when the sulfur in fuel is burnt. Principal components are sulfur dioxide (sulfurous acid gas, SO_2) and sulfur trioxide (SO_3). SO_3 is a source of aerosol which is measured as a part of SPM.

3 Kind of Engines, and Pollutants

Motor vehicles are mainly driven by gasoline or diesel engines. In the former engine, gasoline is mixed with air and fed into the cylinder combustion chamber to be compressed with a piston and ignited with a spark plug. Resultant explosive expansion is received by the crankshaft to be turned into the rotary motion.

The diesel engine has the air compressed to the high temperature, then inject the diesel oil for spontaneous ignition. The diesel engine is low in the running speed and thus cannot produce high speed, but high in torque at low speed. Accordingly, this kind of engine is suitable for larger vehicles (trucks, etc.). Principal differences between these two engines are shown in Table 1.

Table 1 Kind and Difference of Engines

	Gasoline	Diesel
Fuel	Gasoline	Diesel oil
Fuel supply method	Carburetor or low-pressure range fuel injection	High-pressure range fuel injection
Ignition method	Electric sparking	Spontaneous ignition
Fuel-air mixing	Before cylinder	Inside cylinder
Compression	Mixture by 8 - 10 times	Air only by 16 - 23 times
Output control	Mixture rate	Fuel injection rate

Generation of carbon monoxide, hydrocarbon, and nitrogen oxides in exhaust air depends greatly on the air-fuel ratio. Fig.1 shows change of the concentration of each pollutant in the exhaust gas when the ratio is changed.

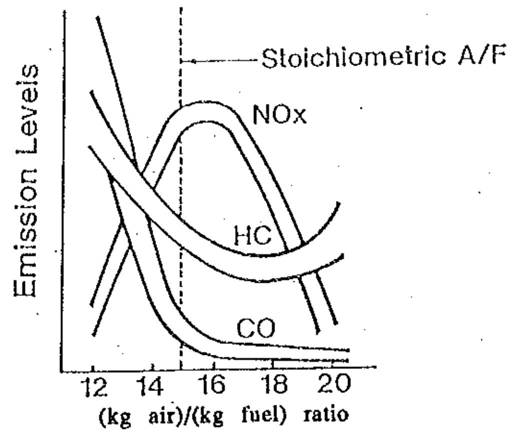


Fig. 1 Effect of the Air-fuel Ratio for Generation of Pollutants

When the mixture shifts toward the lean state (i.e., air rich), the amount of carbon monoxide and hydro-carbon decreases. When the mixture becomes much more lean, hydrocarbon increases due to firing loss. As the fuel is burnt normally in the air rich state in the diesel engine, the content of carbon monoxide and hydrocarbon in exhaust gas becomes far smaller than that of the gasoline engine. However, the diesel engine emits larger amount of nitrogen oxides because of higher compression ratio and higher combustion temperature.

The diesel engine is characterized by the large amount of SPM in exhaust gas. Fine carbon particles (black smoke) is particularly generated because part of fuel is not sufficiently evaporated in the final phase of injection. This occurs because the fuel injection amount increase while the engine runs under full load. The diesel engine also emits the larger amount of sulfur oxides in the exhaust gas because the diesel oil contains larger amount of sulfur than gasoline.

In the case of diesel engine, the air is compressed first of all, reducing leakage of hydrocarbon into the blow-by gas. Besides, the amount of blow-by gas is much smaller than that of gasoline engine because the engine speed is low. Diesel oil is lower in the vapor pressure than gasoline, and release of hydrocarbon as fuel evaporation gas is smaller.

Table 2 shows the generation ratio of a few kinds of pollutants (carbon monoxide, hydrocarbon, nitrogen oxides) depending on the engine type and kind of exhaust gas.

Table 2 Pollutant Emission Ratio (%)

		Carbon monoxide	Hydrocarbon	Nitrogen oxides
Gasoline	Exhaust gas	100	55	100
	Blow gas	-	20	-
	Fuel vapor gas	-	25	-
Diesel gas	Exhaust gas	100	99	100
	Blow-by gas	-	1	-

Excerpt: (#5061)

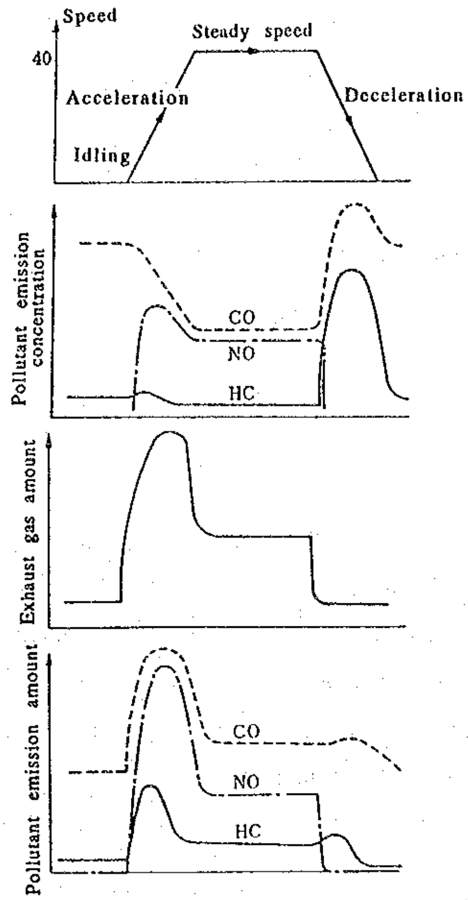
4 Driving State and Pollutants in Exhaust Gas

Gasoline engine operating conditions are divided into idling, acceleration, steady-speed, and deceleration for discussion. The mixture is thick with the high content of hydrocarbon and carbon monoxide, during idling. Subsequently in the acceleration state, the engine load increases and the combustion temperature rises, resulting in increase in the nitrogen oxides emission rate. During deceleration, hydrocarbon increases because of incomplete combustion. These may be illustrated as in Table 3 and Fig. 2.

Table 3 Driving State vs Pollutant Concentration in Exhaust Gas

Driving state		Exhaust gas amount	Hydrocarbon	Carbon monoxide	Nitrogen oxides
Idling		Extremely few	High	High	Extremely low
Acceleration	(Normal)	Large	Low	Low	High
	(Sudden)	Extremely large	Medium	High	Medium
Steady speed	(Low)	Small	Low	Low	Low
	(High)	Large	Extremely low	Extremely low	Medium
Deceleration		Extremely few	Extremely high		

Excerpt (Automobile Emission Pollution, Chemical Industry Publishing Co., 1971)



Excerpt (Automobile emission Pollution, Chem. Ind. Publish. co., 1971)

Fig. 2 Driving State vs Pollutants in Exhaust Gas

As is known from these table and figures, the emission amount of pollutants is largest at acceleration, in particular, sudden acceleration. During idling, the exhaust gas amount is small, but the carbon monoxide emission amount is large.

5. 2. 2 History of Vehicle Exhaust Emission Standards in Various Countries

Following tables indicate trends of vehicle exhaust emission standards in various countries of interest. Associated test modes are also given in subsequent figures and tables.

Trends of Emission Standards

Table 1 U.S.A. New Vehicle Emission Standards
- Part 1-1 Gasoline/Diesel Powered Light Duty Vehicles
- Part 1-2 Gasoline/Diesel Powered Light Duty Trucks
- Part 1-3 Gasoline Powered Heavy Duty Engines & Trucks
- Part 1-4 Diesel Powered Heavy Duty Engines & Trucks

Table 2 Japanese Vehicle Maximum Allowable Exhaust Standards
- Part 2-1 New Gasoline or LPG Powered Passenger Cars
- Part 2-2 New Gasoline or LPG Powered Buses & Trucks (GVW < 1700 kg)
- Part 2-3 ditto (1700 < GVW < 2500 kg)
- Part 2-4 ditto (GVW > 2500 kg)
- Part 2-5 New Diesel Vehicles
- Part 2-6 Vehicles under Circulation

Table 3 EEC Vehicle Emission Limits

Table 4 Mexican Vehicle Exhaust Standards
- Part 4-1 New Gasoline Powered Vehicles
- Part 4-2 Used Gasoline Powered Vehicles

Test Modes

Figure 1 U.S.A. 7-mode Driving Cycle Profile
Figure 2 U.S.A. FTP Driving Cycle Profile
Figure 3 U.S.A. 9-mode Cycle
Table 11 U.S.A. 13-mode Cycle
Figure 4 Japanese 10-mode Cycle
Figure 5 Japanese 11-mode Cycle
Figure 6 Japanese 6-mode Cycle
Table 12 Japanese Diesel 6-mode Cycle
Table 13 Japanese 3-mode Black Smoke Cycle
Figure 7 ECE Driving Test Mode

Table 1 U.S.A. New Vehicle Emission Standards

Part 1-1 Gasoline/Diesel Powered Light Duty Vehicles: Capacity of 12 persons or fewer (up through 1974, apply only to gasoline powered)

Model Year	'70	'71	'72	'73	'74	'75	'76	'77	'78	'79	'80	'81	'82	'83	'84	'85	'86	'87	'88
Hydrocarbons g/mile	2.2		3.4			1.5					0.41		0.41(0.57)		0.41(0.41)				
Carbon Monoxide g/mile	23		39			15					7.0	3.4	3.4(7.8)		3.4(3.4)				
Nitrogen Oxides g/mile				3.0		3.1		3.1(2.0)	2.0			1.0	1.0(1.0)						
Particulates g/mile a)													0.6(-)					0.2(-)	
Evaporative HC g/test b)		6.0	2.0						6.0			2.0	2.0(2.6)		2.0(2.0)				

Part 1-2 Gasoline/Diesel Powered Light Duty Trucks: Gross Vehicle Weight 6,000 lbs or less until 1978, and 8,500 lbs or less from 1979 (up through 1975, apply only to gasoline powered)

Model Year	'70	'71	'72	'73	'74	'75	'76	'77	'78	'79	'80	'81	'82	'83	'84	'85	'86	'87	'88
Hydrocarbons g/mile	2.2		3.4					3.4(2.0)	2.0	1.7			1.7(2.0)		0.8(1.0)				
Carbon Monoxide g/mile	23.0		39					39 (20)	20	18			18(26)		10(14)				
Nitrogen Oxides g/mile				3.0				3.0(3.1)	3.1	2.3								1.2	
Particulates g/mile a)													0.6(-)						
Evaporative HC g/test b)		6.0	2.0						6.0			2.0	2.0(2.6)						

Note
1) Mark a) applied only to diesels
2) b) applied only to gasoline engines
3) Test procedure: 7-mode for '70 & '71, CVS-72 for '72 to '74, CVS-75 for others
CVS-72: Federal Test Procedure with constant volume sample cold start
CVS-75: FTP with constant volume sample including cold and hot starts
4) Test porcedure for Evaporative HC: Carbon trap method through 1977 & SHED method (see next table) from 1978
5) ( ): applied to vehicles and trucks sold in high altitude
6) Data Source (#5017)

Part 1-3 Gasoline Powered Heavy Duty Engines & Trucks

Capacity more than 12 persons or gross vehicle weight more than 8,500 lbs

Model Year	'70 - '73	'74 - '78	'79	'80 - '84	'85 '86	'87 '88
Hydrocarbons	275 ppm		a)1.5 b)-- c)1.0	1.5 --	d) 2.5	1.3
					e) 2.5	2.5
Carbon Monoxide	1.5%	40	a)25.0 b)25.0 c)25.0	25 25	d) 40	15.5
					e) 40	40.0
Nitrogen Oxides					d) 10.7	6.0
					e) 10.7	6.0
HC + NOx		16	a)10.0 b) 5.0 c) 9.5	10 5		
Evaporative HC					d) 3.0 g/test	
					e) 4.0 g/test	

Note

1) Unit: grams per brake horsepower-hour, except otherwise noted
2) Test procedure until 1983 was the 9-mode. Later it was changed to a transient mode.
3) Evaporative emissions determined by the SHED method.
   SHED method: A hot engine is placed in an enclosure. No emission is permitted to leak from the enclosure, except to measure the concentration of the hydrocarbons in the emission.
4) a) & b): a set of manufacturers choice until 1984
5) c) set: if NDIR test for hydrocarbons is used.
6) d) set: applied for gross vehicle weight less than 14,000 lbs
7) e) set: applied for gross vehicle weight more than 14,000 lbs
8) Data Source (#5017)

Part 1-4 Diesel Powered Heavy Duty Engines & Trucks

(Gross vehicle weight more than 8,500 lbs, or more than 6,000 lbs until 1979)

Model Year	'70 ---'73	'74 ----- '78	'79 --- '83	'84	'85 '86	'87 '88
Hydrocarbons			1.5	-- (0.5)	1.3	
Carbon Monoxide		40	25.0	-- (15.5)	15.5	
Nitrogen Oxides				-- (9.0)	--	6.0
HC + NOx		16	10.0		10.7	
Smoke Opacity, ACCEL. LUG PEAK	40 20 --	20 15 20	20 15 50			

Note 1) Unit: grams per brake horsepower-hour, except % for Opacity

2) Test procedure until 1983 was the 13-mode.

Later it was changed to the transient test procedure.

3) ( ): optional standard tested on the 13-mode test procedure

4) Data Source (H5017)

Table 2 Japanese Vehicle Maximum Allowable Exhaust Standards

Part 2-1 New Gasoline (G) or LPG (L) Powered Passenger Cars (10 persons or fewer)

Year	'73	'74	'75	'76	'77	'78 --- '90
Hydrocarbons 10-mode (g/km) 11-mode (g/test)	G 3.8/L 3.2		0.39 9.5			
Carbon Monoxide 10-mode(g/km) 11-mode(g/test)	G 26 /L 18		2.7 85			
Nitrogen Oxides 10-mode(g/km) 11-mode(g/test)	3.0		1.6 11	0.84(1.2) 8.0 (9.0)		0.48 6.0

Note; ( ) in the 1976 regulation were for Equivalent Inertial Weight(EIW) 1,000kg or heavier cars

Part 2-2 New Gasoline (G) or LPG (L) Powered Buses & Trucks (GVW less than 1,700kg)

Year	'73	'74	'75 - '78	'79	'80	'81 -'87	'88 - '90
Hydrocarbons 10-mode (g/km) 11-mode (g/test)	G 3.8/L 3.2		2.7 17.0				0.39 9.5
Carbon Monoxide 10-mode(g/km) 11-mode(g/test)	G 26/L 18		17.0 130				2.7 85.0
Nitrogen Oxides 10-mode(g/km) 11-mode(g/test)	3.0		2.3 20.0	1.4 10.0		0.84 8.0	0.48 6.0

Part 2-3 New Gasoline (G) or LPG (L) Powered Buses & Trucks (GVW between 1,700kg and 2,500kg)

Year	'73	'74	'75 ---'78	'79	'80	'81 - '88	'89 - '90
Hydrocarbons 10-mode (g/km) 11-mode (g/test)	G 3.8/L 3.2		2.7 17.0				
Carbon Monoxide 10-mode(g/km) 11-mode(g/test)	G 26/L 18		17.0 130				
Nitrogen Oxides 10-mode(g/km) 11-mode(g/test)	3.0		2.3 20.0	1.6 11.0		1.26 9.5	0.98 8.5

Part 2-4 New Gasoline (G) or LPG (L) Powered Buses & Trucks (GVW more than 2,500kg)

Year		'73 - '76	'77	'78	'79 - '81	'82 - '88	'89 - '90
Hydrocarbons 6-mode(%)	G	1.6					
	L	1.1					
Carbon Monoxide 6-mode(ppm)	G	520					
	L	440					
Nitrogen Oxides 6-mode(ppm)	G	2200	1850		1390	990	850
	L	2200	1850		1390	990	850

Part 2-5 New Diesel Vehicles

1) Passenger Cars (less than 10 persons)

Year	'86	'87	'88 - '90
Hydrocarbons	2.7		
Carbon Monoxide	0.62		
NOx GWV<1,265 kg	0.98		0.72
>1,265 kg	1.26		0.84

Test: 10-mode, Unit: g/km

Note:
1) For passenger cars until 1985 and buses & trucks (GVW<2,500 kg) until 1987, all the standard numbers are the same with those of Part 2-5-4) under the Diesel 6-mode test.
2) DI : Direct Injection,
IDI: Indirect Injection

2) Buses & Trucks (GVW <1,700 kg)
Test: 10-mode, Unit: g/km

Year	'88 - '90
Hydrocarbons	2.7
Carbon Monoxide	0.62
NOx (IDI)	1.26

3) Buses & Trucks(1,700 kg <GVW <2,500kg)
Test: Diesel 6-mode, Unit: ppm

Year	'88 - '90
Hydrocarbons	980
Carbon Monoxide	670
NOx (DI)	500
(IDI)	350

4) Buses & Trucks (GVW >2,500 kg)

Year		'74 - '76	'77	'78	'79 - '81	'82	'83 - '87	'88	'89-
Hydrocarbons		980							
Carbon Monoxide		670							
Nitrogen Oxides	DI	1000	850		700	700	610	520	520
	IDI	590	500		450	390	390	390	350

Test: Diesel 6-mode, Unit: ppm

Part 2-6 Vehicles under Circulation

		'70	'71	'72 --	'75 ---	'90
All Gasoline & LPG Vehicles (Idling Test)	CO %	5.5		4.5		
	HC ppm				1200	
All Diesel Vehicls Black Smoke % Rate of Contamination					50	

Note: Black Smoke by 3-mode test cycle

Table 3 EEC Vehicle Emission Limits

		'75	'76	'77	'78	'79	'80	'81	'82	'83 --- '88	'89	'90
Carbon Monoxide		ECE 15.00	ECE 15.01				ECE 15.03			ECE 15.04	EEC New	
Hydrocarbons		ECE 15.00	ECE 15.01				ECE 15.03			--------		
Nitrogen Oxides	PC (Manual Transmission)			ECE 15.02			ECE 15.03			--------	EEC New	
	PC (Automatic Transmission)			1.25*(ECE 15.02)		ECE 15.02	1.25*(ECE 15.03)		ECE 15.03	--------		
	CV			1.25*(ECE 15.02)						--------		
Hydrocarbons + Nitrogen Oxides	PC									ECE 15.04	EEC New	
	PC(>7 persons) & CV									1.25*(ECE 15.04)	ECE 15.04	
Idling CO	PC & CV	4.5%					3.5% after ECE mode drive, 4.5% at any other conditions					

Note: 1) PC= Passenger Cars, CV= Commercial Vehiles
2) 1.25*(ECE 15.02) means the limit values are 25% lower than ECE 15.02 regulation.
3) Test: ECE mode & total bag/NDIR up through 1982, and ECE mode + CVS/FID after 1983

Limit Values (g/test)

ECE	15.00		15.01		15.02	15.03			15.04	
RW kg	CO	HC	CO	HC	NOx	CO	HC	NOx	CO	HC+NOx
<750	100	8.0	80	6.8	10	65	6.0	8.5	58	19
750< <850	109	8.4	87	7.1	10	71	6.3	8.5	58	19
850< <1020	117	8.7	94	7.4	10	76	6.5	8.5	58	19
1020< <1250	134	9.4	107	8.0	12	87	7.1	10.2	67	20.5
1250< <1470	152	10.1	122	8.6	14	99	7.6	11.9	76	22
1470< <1700	169	10.8	135	9.2	14.5	110	8.1	12.3	84	23.5
1700< <1930	186	11.4	149	9.7	15	121	8.6	12.8	93	25
1930< <2150	203	12.1	162	10.3	15.5	132	9.1	13.2	101	26.5
2150<	220	12.8	176	10.9	16	143	9.6	13.6	110	28
Applied	Gasoline Engine Gross Vehicle Weight < 3,500 kg								Gas.& Diesel GVW <3,500kg	

		EEC New		
Displace	Engine	CO	HC+NOx	NOx
> 1400 cc	Gas. & Diesel	45	15	6.0
1,400 cc < <2,000 cc	Gas.	30	8.0	-
	Diesel	30	8.0	-
2000 cc <	Gas.	30	8.0	-
	Diesel	25	6.5	3.5
Applied		Gas. & Diesel GVW < 2,500 kg		

Note: 1) RW = Reference Weight = Curb Weight + 100 or 120 kg
2) ECE 15.04 stated diesel CV might be based on ECE 49 (10% lower for CO & NOx and 20% lower for HC).

Table 4 Mexican Vehicle Exhaust Standards

Part 4-1 New Gasoline Powered Vehicles: Maximum Permissible Emission Level

Model Year		'78 ---- '83	'84 ------ '87	'88 '89	'90	'91 '92 '93	'94
Hydrocarbons	a)	3.0	2.9	2.0	1.8	0.7	0.25
	b)		2.9	2.0	2.0	2.0	0.625
	c)				3.0	3.0	0.625
Carbon Monoxide	a)	33	29	22	18	7.0	2.125
	b)		29	22	22	22	8.75
	c)				35	35	8.75
Nitrogen Oxides	a)			2.3	2.0	1.4	0.625
	b)			2.3	2.3	2.3	1.44
	c)				3.5	3.5	1.44

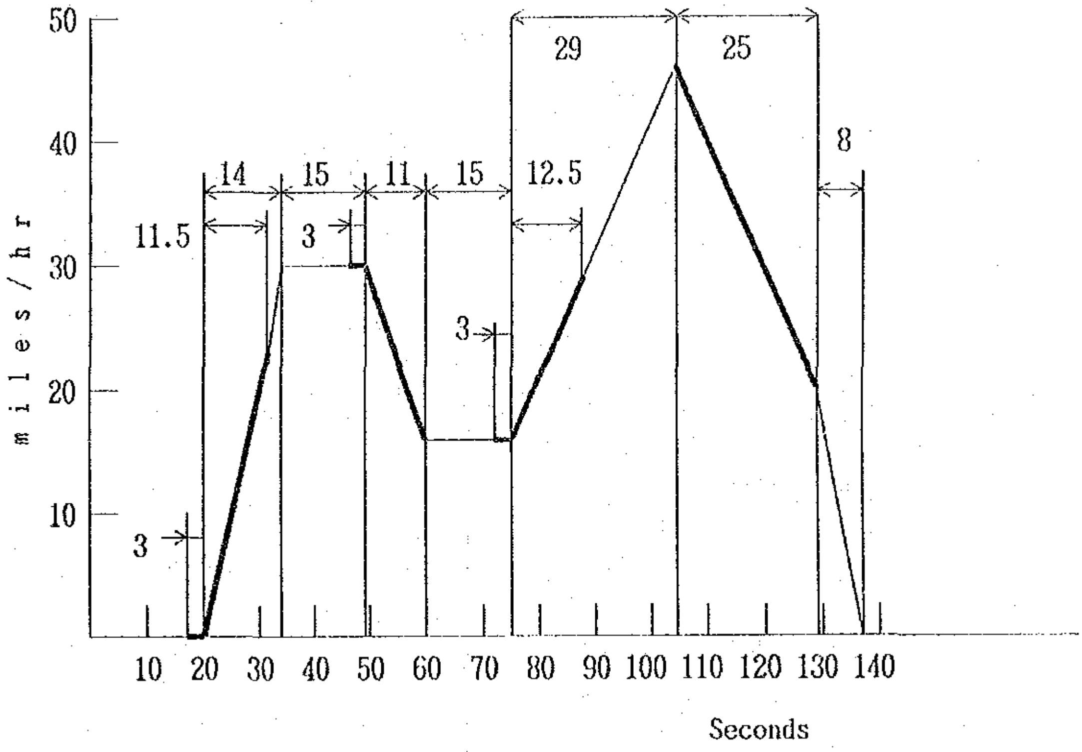
Note
1) Unit: g/km
2) Mark a): Passenger Cars GVW less than 6,000 lbs
b): Commercial Vehicles GVW less than 6,000 lbs
c): Trucks GVW from 6,000 to 6,600 lbs
3) Test Procedure: CVS-75 (see Table 1, Note)
4) Data Source: JICA Study Report 10/1988, and Japn. Envir. Protect. Agency

Part 4-2 Used Gasoline Powered Vehicles: Maximum Permissible Emission Level during Idling

Model Year		before '79	'80 -- '86	'87 & later
Hydrocarbons	d)	700	500	400
(ppm)	e)	650	500	400
Carbon Monoxide	d)	6	4	3
(vol%)	e)	5.5	4	3

Note
1) Mark d): applied to altitude above 1,500 m
2) Mark e): applied to altitude less than 1,500 m
3) Data Source: JICA Study Report 10/1988

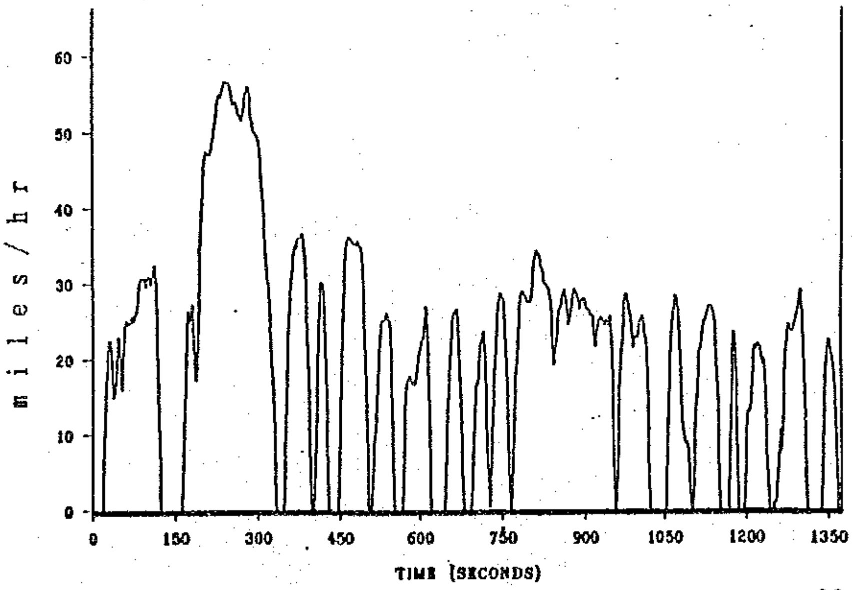
Fig. 1 U.S.A. 7-mode Driving Cycle Profile



Note: 1) Seven bold sections are to be estimated.
2) Weighing Factors

Idling	0.042
Acceleration	0.699
Constant speed	0.168
Deceleration	0.091

Fig. 2 U.S.A. FTP (Federal Test Procedure) Driving Cycle Profile



Note:

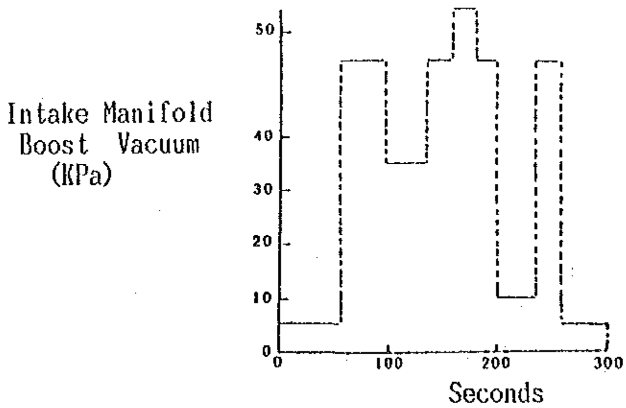
First 505 seconds is defined as the start mode.

The remaining 867 seconds is as the stable mode.

For hot cycle, the start mode must be repeated after 600 seconds soaking.

Data Source: R.D.Scully, J. of Air Pol. Cont. Asso., vol. 39, No.10 (1989)

Fig. 3 U.S.A. 9-mode Cycle



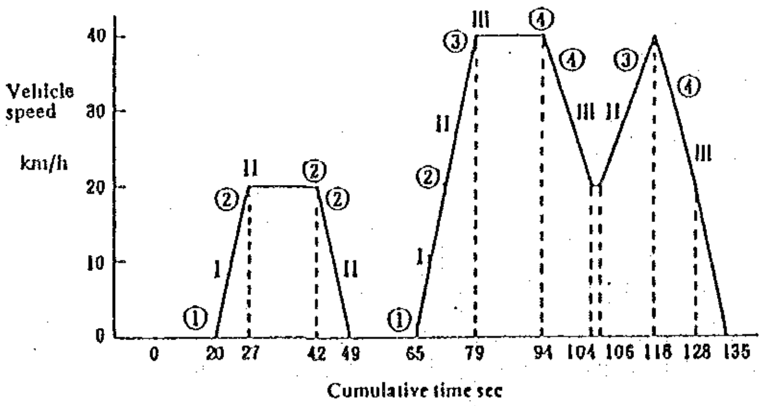
Mode Solid Line No. from Left	Weighing Factors
1	0.232
2	0.077
3	0.147
4	0.077
5	0.057
6	0.077
7	0.113
8	0.077
9	0.143

Table 11 U.S.A. 13-mode Cycle

Mode No.	Engine rpm	Load %	Weighing Factor
1	Idle		0.2
2	a)	2	0.08
3	a)	25	0.08
4	a)	50	0.08
5	a)	75	0.08
6	a)	100	0.08
7	Idle		0.2
8	b)	100	0.08
9	b)	75	0.08
10	b)	50	0.08
11	b)	25	0.08
12	b)	2	0.08
13	Idle		0.2

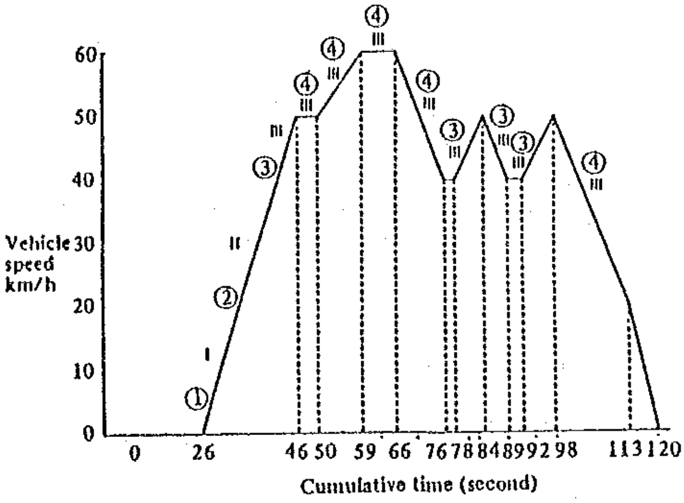
Note: 1) rpm equal to a half of rpm at the maximum torque or at the maximum power output, whichever larger
2) rpm at the maximum power output

Fig. 4 Japanese 10-mode Cycle (H5035)



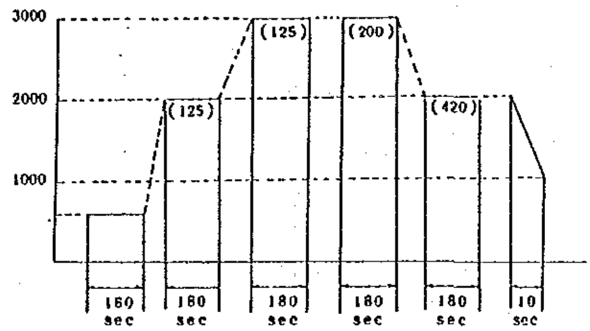
Notes: Encircled Arabic figures (①, ②, ③ and ④) are for motor vehicles with 4-speed transmission.
Roman figures (I, II and III) are for motor vehicles with 3-speed transmission.

Fig. 5 Japanese 11-mode Cycle (H5035)



Notes: Encircled Arabic figures (①, ②, ③ and ④) in the above diagram are for motor vehicles with a 4-speed transmission. Roman figures (I, II and III) are for motor vehicles with a 3-speed transmission.

Fig. 6 Japanese 6-mode Cycle



Mode No. from Left	Weighing Factors
1	0.125
2	0.114
3	0.277
4	0.254
5	0.139
6	0.091

Note: ( ) Intake Manifold Boost Vacuum, mmHg

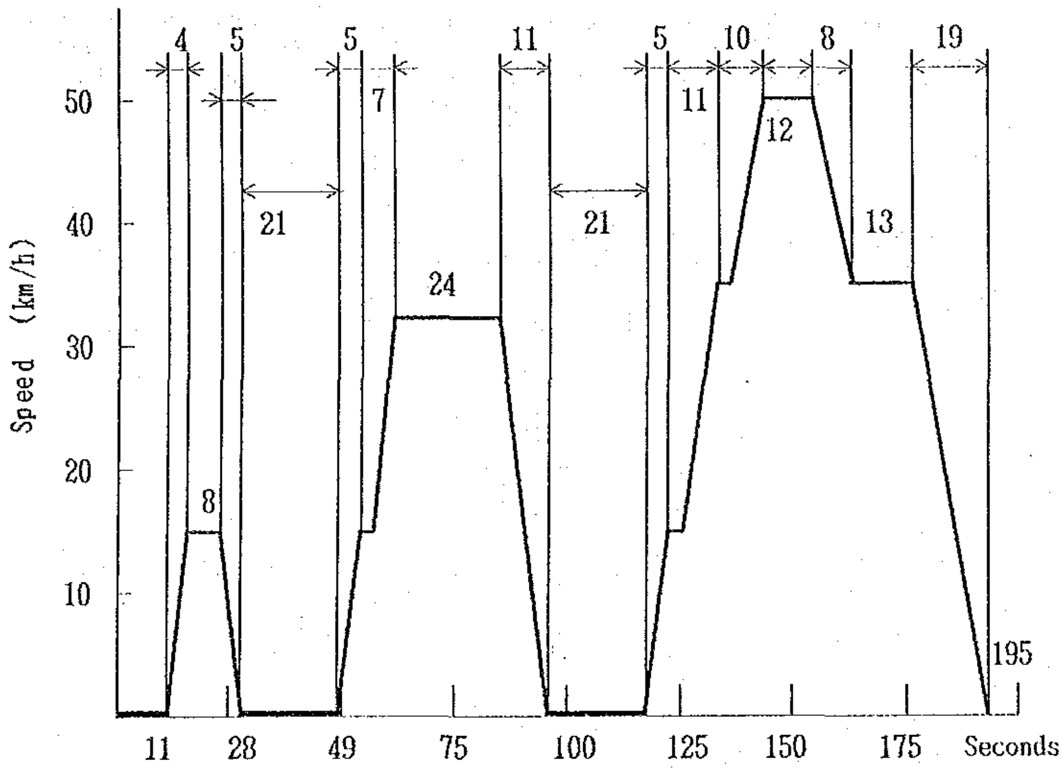
Table 12 Japanese Diesel 6-mode Cycle (H5035)

	Mode	Weighting factor
1	Engine is idling with no-load	0.355
2	Engine is running with full-load and at the rotating speed equal to 40% of the speed at which is produces its maximum output	0.071
3	Engine is running with 25% load of full-load and at the rotating speed equal to 40% of the speed at which it produces its maximum output	0.059
4	Engine is running with full-load and at the rotating speed equal to 60% of the speed at which it produces its maximum output	0.107
5	Engine is running with 25% load of full-load and at the rotating speed equal to 60% of the speed at which it produces its maximum output	0.122
6	Engine is running with 75% load of full-load and at the rotating speed equal to 80% of the speed at which it produces its maximum output	0.286

Table 13 Japanese 3-mode Black Smoke Cycle

Mode	Load	rpm
1	100%	40% of rpm at maximum output
2	100%	60% of rpm at maximum output
3	100%	100% of rpm at maximum output

Figure 7 ECE Driving Test Mode



5. 2. 3 Emission Countermeasures on Gasoline Automobiles

There are various countermeasures on pollutant emissions from gasoline automobiles. Each automobile manufacturer has been applying slightly different measures for its products. Following are generalized discussions of the typical and commonly used measures. Figures are mainly cited from 'Automobile Emission Control', Sankaido Publishing Co., 1990, Japan, other than noted with (#).

The contents of this supplementary report are as follows. Notations with [ ] mean the items which explain techniques abbreviated in Table 8.2.2 of the main report.

1. Carburetor
2. Fuel Injection System [EFI]
3. Control Device during Speed Reduction & Coasting [TP, DP]
4. Intake Air Temperature Controller
5. Intake Manifold
6. Combustion Chamber
7. Exhaust Gas Re-circulation [EGR]
8. Ignition
9. Ignition Timing Control [SC]
10. Secondary Air Supply [AI, AS]
11. Oxidation Catalyst [OC]
12. Three Way Catalyst [TWC]
13. Blow-by (Crankcase Emission) Gas Return System [PCV]
14. Evaporated Fuel Entrap System [EVAP]
15. High Altitude Compensator

1. Carburetor

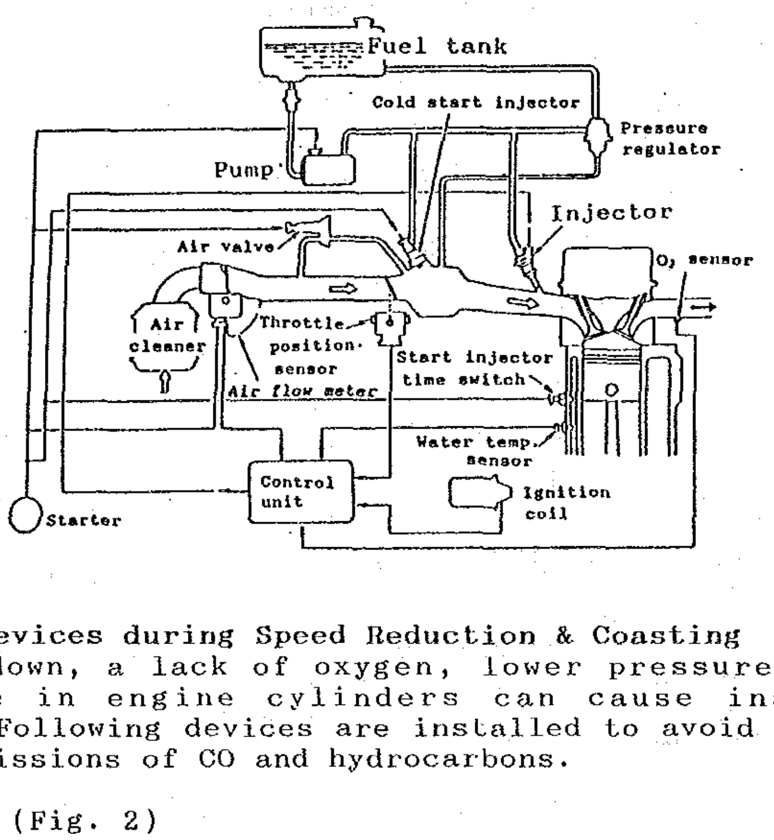
Carburetors have been replaced by fuel injection systems in new automobiles. However, small or compact cars have still carburetors improved as follows;

1)controlled electronically,
2)stricter precisions in manufacturing of each component,
3)better air/fuel ratio at cold start and shorter warm-up period by improving choke mechanism, and
4)addition of an stopper on an air/fuel ratio control screw of the older type which is usually loosened during operation.
(# Prof. T. Saito, Waseda University)

2. Fuel Injection System (Fig. 1)

Instead of having a carburetor, fuel is injected into engine cylinders at a computed rate and timing. Necessary data, such as in Fig. 1, is to be informed to the control unit. This precise control can reduce the emissions. In fact, carbon monoxide emissions can be dramatically reduced because of their predominant dependence on Air/Fuel ratio (refer to Appendix 5.2.1). Elimination of carburetors benefits of better air flow because of less friction loss.

Fig. 1 Fuel Injection System



3. Control Devices during Speed Reduction & Coasting

During slowdown, a lack of oxygen, lower pressure and lower temperature in engine cylinders can cause insufficient combustion. Following devices are installed to avoid this and to eliminate emissions of CO and hydrocarbons.

3-1)Dash Pot (Fig. 2)

A primary throttle valve pushes a dash pot stem when the valve is closed to the specified position during slowdown. Entrapped air in the dash pot is compressed by the stem movement and is released through a small hole. Thus the movements of the stem and subsequently of the throttle valve are slowed. Enough air can flow through the primary throttle valve, during this action, to avoid insufficient combustion.

Fig. 2 Dash Pot

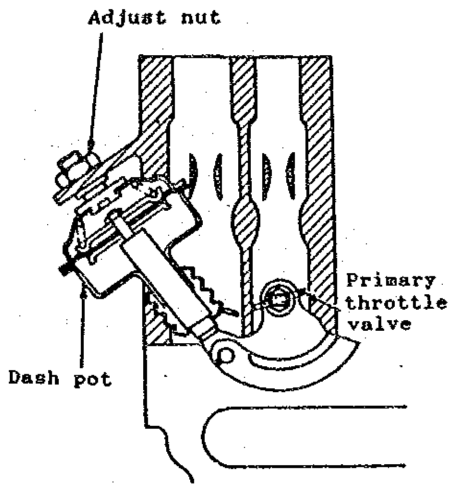
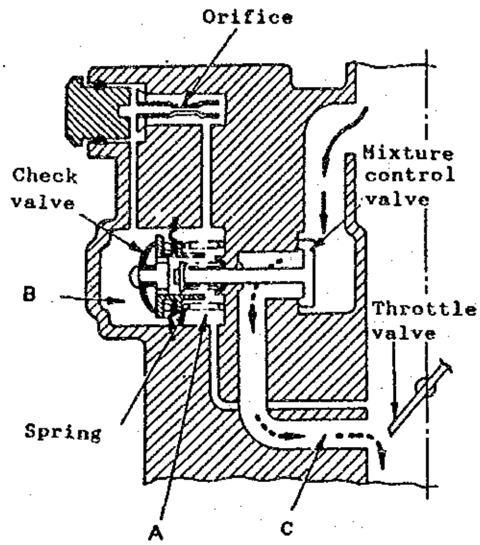


Fig. 3 Mixture Control Valve



3-2)Mixture Control Device (Fig. 3)
Vacuum pressure generated at the downstream (A) of the throttle valve during slowdown actuates a mixture control valve to open, in order that a path (C) is open for air flow bypassing the throttle valve. When the vacuum at the inside (B) of the control valve is equalized by gradual air flow through an orifice, the air path (C) is closed. This prolonged supply of air during slowdown can avoid incomplete combustion.

3-3)Throttle Opener (Fig. 4)
When slowing down, pressure at a intake manifold becomes less and less. This vacuum pressure opens a control valve to supply atmospheric air to a servo diaphragm which then pulls the throttle valve to open. When the speed is less than 10 km/hr, a limit switch of the speedometer forces the throttle valve to close completely. During the throttle valve is opened by the diaphragm, enough air passes through to avoid incomplete combustion.

3-4)Fuel Cut Device
Activated by signals from engine rpm and/or throttle valve opening, a fuel supply line can be cut out during the slowdown period. A computer signal has been widely used in modern cars.

manifold becomes high and pushes up the diaphragm of the back pressure valve closing a path of atmospheric air from a hole of the valve to the upper part of EGR control valve. The upper part pressure becomes low and the inner stem goes up. Thus at high load it can re-circulate more exhaust gas to the intake manifold.

Fig. 6 Intake Manifold Pressure Activated Controller

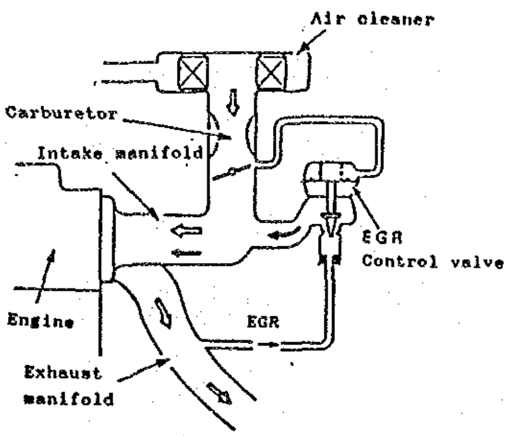
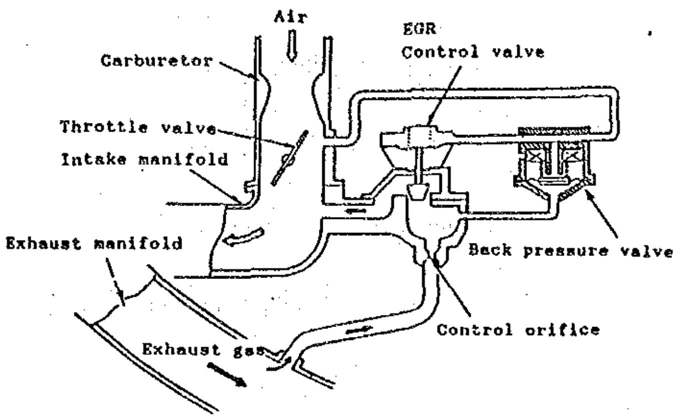


Fig. 7 Exhaust Manifold Pressure Activated Controller



7-3) Demand Proportional Control (Fig. 8)
As a control signal, pressure at a carburetor venturi is used at lighter demand of power and on the other hand exhaust manifold pressure is used at heavier demand. At lighter demand, higher pressure of carburetor venturi opens atmospheric air path of a venturi vacuum transducer (VVT) valve to the EGR control valve. The air pushes down the inner stem of EGR control valve closing the path of exhaust gas for re-circulation. When venturi pressure becomes lower at heavier demand, a center stem of the VVT valve is pushed up by the diaphragm (A) since it is bigger than the diaphragm (B), and additionally by the diaphragm (C) since the exhaust manifold pressure becomes high at heavy load. Thus the air path to EGR valve is closed and the inner stem of the EGR valve is drawn up to allow more exhaust gas for re-circulation.

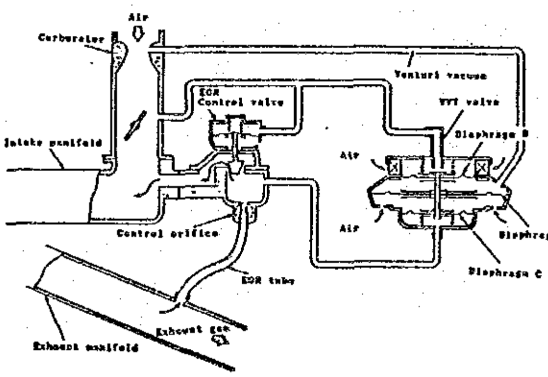


Fig. 8 Demand Proportional Control System

8. Ignition
Complete combustion is required for reducing the hydrocarbons and

6. Combustion Chamber

There are various methods applied to a combustion chamber to reduce pollutant emissions. Following are some of the commonly used methods in car manufactures.

6-1)Compression Ratio

Traditionally compression ratio had been increased to obtain higher thermal efficiency, stronger specific power output and lesser fuel consumption. However, it is known that higher compression ratio produces more hydrocarbon and nitrogen oxides emissions. Therefore, the trends has been changed without heavily sacrificing output power and fuel consumption.

6-2)Surface/Volume Ratio

A surface/volume ratio of the combustion chamber affects on hydrocarbon emission, since temperature on the chamber surface is lower than that of the chamber center and the lower temperature causes insufficient combustion. If the ratio is smaller, the emission becomes less.

6-3)Valve Overlap

When an exhaust gas valve of the combustion chamber is to open, an air intake valve is to close. However, there is some overlapping period of both valves. If this period is long enough to inhale a part of the exhaust gas into the combustion chamber, the combustion temperature becomes low and nitrogen oxides generation becomes low. This effect is significant at low rpm of the engine. However, it is insignificant at high rpm. Also if the overlapping period is too long, the output power of the engine will be deteriorated greatly.

7. Exhaust Gas Re-circulation (EGR)

When an exhaust gas is mixed with air/fuel mixture before combustion, the combustion temperature in the cylinder is lowered by slowing flame speed and accordingly amounts of nitrogen oxides generated is reduced. In order to avoid mal-effects on engine power, fuel consumption, operability, etc., information on air and cooling water temperatures, and also speed and weight of the car may be needed to a EGR control mechanism. Excess EGR rate may also result in increased hydrocarbon emissions. The exhaust gas can be re-circulated to upstream or downstream of the throttle valve. There are three methods of EGR as follows.

7-1) Intake Manifold Pressure Activated Control (Fig. 6)

A pressure change at the throttle valve regulates opening of the EGR control valve which can control the re-circulation rate. However, at high load when the vacuum pressure to the upper side of the diaphragm becomes small, the opening of the valve becomes small with reducing the EGR flow rate. This action is contrary to the desired.

7-2) Exhaust Manifold Pressure Activated Control (Fig. 7)

In order to reverse the above action of the EGR control valve, activating pressure is also introduced from the exhaust manifold, as in the sketch. At high load the pressure at the exhaust manifold becomes high and pushes up the diaphragm of the back pressure valve closing a path of atmospheric air from a hole of the valve to the upper part of EGR control valve. The upper part pressure becomes low and the inner stem goes up. Thus at high load it can re-circulate more exhaust gas to the intake manifold.

Fig. 6 Intake Manifold Pressure Activated Controller

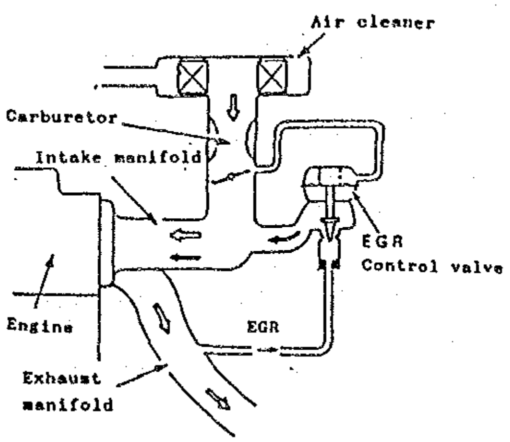
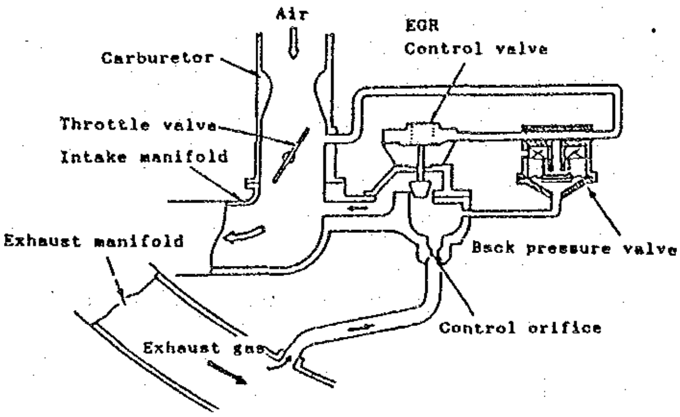
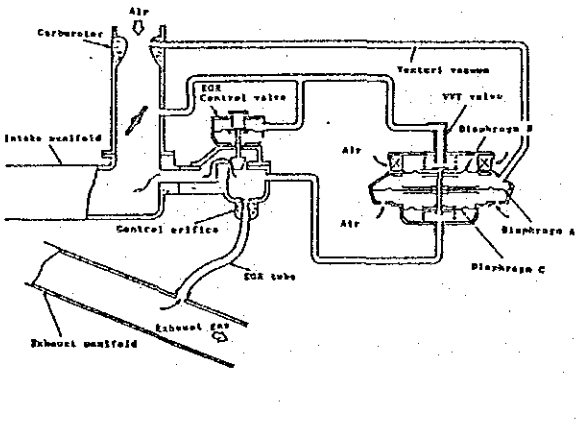


Fig. 7 Exhaust Manifold Pressure Activated Controller



7-3) Demand Proportional Control (Fig. 8)
As a control signal, pressure at a carburetor venturi is used at lighter demand of power and on the other hand exhaust manifold pressure is used at heavier demand. At lighter demand, higher pressure of carburetor venturi opens atmospheric air path of a venturi vacuum transducer (VVT) valve to the EGR control valve. The air pushes down the inner stem of EGR control valve closing the path of exhaust gas for re-circulation. When venturi pressure becomes lower at heavier demand, a center stem of the VVT valve is pushed up by the diaphragm (A) since it is bigger than the diaphragm (B), and additionally by the diaphragm (C) since the exhaust manifold pressure becomes high at heavy load. Thus the air path to EGR valve is closed and the inner stem of the EGR valve is drawn up to allow more exhaust gas for re-circulation.

Fig. 8
Demand Proportional
Control System



8. Ignition
Complete combustion is required for reducing the hydrocarbons and

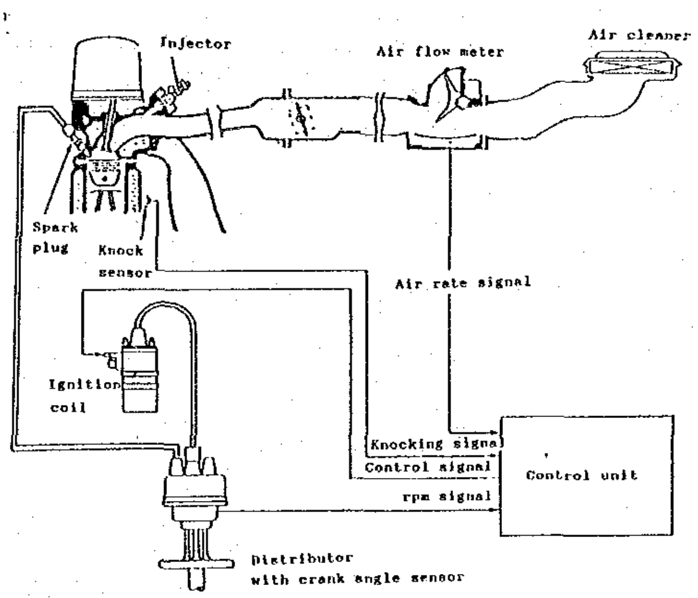
CO emissions. Following improvements have been applied on a ignition system to achieve it.
8-1)strengthening of ignition energy by improving ignition coil and spark plug design.
8-2)utilizing a transistor ignition system which has better properties than an ordinary breaker point system.

9. Ignition Timing Control

Ignition timing is one of the important engine control variables. When the timing is optimized for fuel economy and performance, hydrocarbon and nitrogen oxide emissions are relatively high. The timing can be delayed to reduce around 30 % of NOx emissions (# Nitrogen Oxides, 1977, published by Japan Chem. Society).

Becoming popular is an electronic control system which requires to input information about engine load, water temperature, vehicle running speed, frequency of knocking, etc. Fig. 9 is an example of this system which has been applied to cars having fuel injection system.

Fig. 9 Electronic Ignition Control System



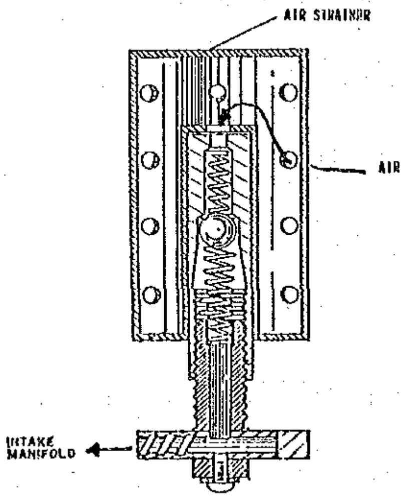
Another system, not electronic, is used to stabilize the combustion during idling and to reduce CO and hydrocarbon emissions by automatically advancing the ignition timing after sensing pressure difference between up-and down-streams of the throttle valve.

10. Secondary Air Supply

10-1)Secondary Air to Intake Manifold

This is to supply air to an intake manifold during idling and speed reduction to reduce CO and hydrocarbon emissions. Fig. 10 is one example of the device(# U.S.Patent No. 3,039,449). Air is introduced through an air strainer to the intake manifold when a ball plugging an air path is pushed down by a vacuum generated at a downstream of a throttle valve.

Fig. 10
Secondary Air
Supply Valve to
Intake Manifold

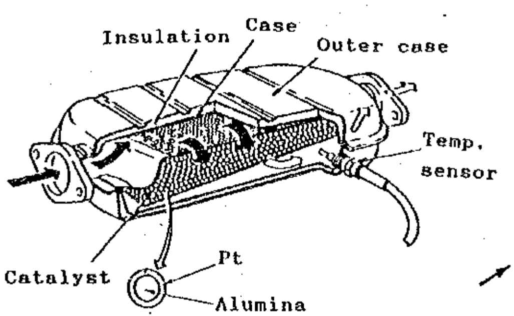


10-2) Secondary Air to Exhaust Manifold
Secondary air is injected to an exhaust manifold by an air blower, or by utilizing pulsation of exhaust gas pressure which is produced by overlapping movements of exhaust valves, in order to burn remaining CO and hydrocarbons. Sometimes this method is called as a thermal reactor. The exhaust gas temperature must be higher than 600°C to keep sufficient after burning. Refer to Fig. 8.2.2 of the main report.

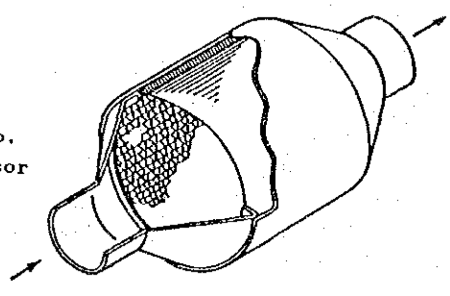
11. Oxidation Catalyst

A catalyst, platinum or mixture of platinum and palladium impregnated on porous carriers, is used to remove CO and hydrocarbons in the exhaust gas.

Fig. 11 Catalyst Converter
a) Pellet Type



b) Monolith Type



As in the illustration (Fig.11), there are pellets and monolith types available. The later one has been widely used for its low pressure loss. The catalyst can oxidize CO to CO_2 and hydrocarbons to CO_2 and water with oxygen at over 300°C. If oxygen is not enough in the exhaust gas, it shall be supplied as the secondary air in front of the catalyst chamber. If amounts of exhausting CO and hydrocarbons are too large, the temperature becomes too high to deteriorate the catalyst. Air/fuel ratio may be adjusted to avoid this condition. The oxidation catalyst is the most effective apparatus to remove CO and hydrocarbons. It may be applicable to used cars. However, lead and sulfur in fuel deteriorate the catalyst.

12. Three Way Catalyst

This catalyst is made of platinum and rhodium mixture on porous carriers and can remove NO_X in addition to CO and hydrocarbons. Excess oxygen is good for removal of CO and hydrocarbons, but it is mal for NO_X, because the reaction of the formers is oxidation and the later one is reduction of NO_X to nitrogen(N_2). Therefore, oxygen contents in the exhaust gas to the catalyst bed is the most critical for good removal. Fig. 12 illustrates that the very narrow control range of oxygen contents is the only way for the high removal of three pollutants. This can be accomplished with an oxygen sensor and a computer. If the EGR and the air supply rate against the fuel rate are well controlled by other means, the sensor and computer may be omitted. Lead and sulfur in fuel are harmful to the catalyst. A configuration of this catalyst is similar with Fig. 11.

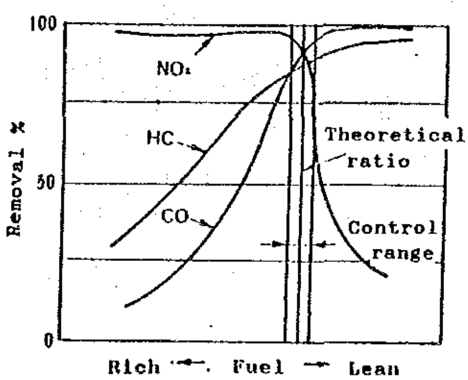


Fig. 12 Removal vs. Air/Fuel Ratio

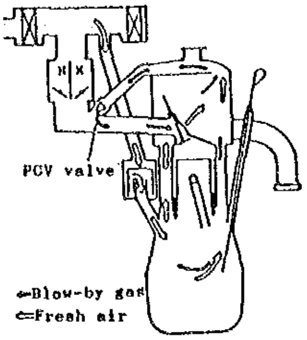
13. Blow-by (Crankcase Emission) Gas Return System

As unburnt hydrocarbons are contained in blow-by gas, it is quite reasonable to return it to a intake system for pollution control. Control techniques of this type have been introduced since 1960s.

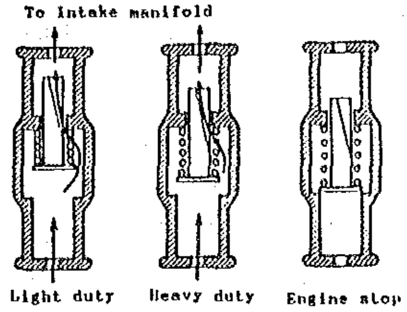
1) Closed Type

As shown in Fig. 13, atmospheric air ventilates a crankcase to return the blow-by gas to the intake manifold through PCV (Positive Crankcase Ventilation) valve . The return flow rate is changeable by movement of the PCV inner rod, which gives a larger flow area at a heavier engine load because of a smaller degree of vacuum at the intake manifold.

Fig. 13 Closed Type
Blow-by Gas Return System

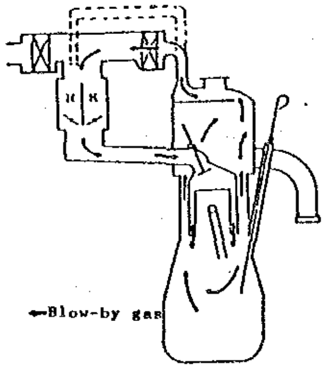


PCV Valve



2)Sealed Type
As in Fig. 14, a cylinder head cover is connected with a tube to an air cleaner. In order to have enough return flow, a flow rate control valve may be needed. Also an oil separator is installed to remove carry-over of lubricant oil.

Fig. 14 Sealed Type
Blow-by Gas Return System



14. Evaporated Fuel Entrap System
In order to avoid hydrocarbon emissions of evaporated fuel from a carburetor and a fuel tank, a few systems are applied as follows.

1) Carbon Canister (Fig. 8.2.4 of Main Report)
In this system, evaporated fuel is removed in a vapor separator from entrained droplets at first and then flows into a carbon canister which can adsorb the vapor. When the engine is mobilized into operation, a purge control valve is opened by the vacuum created at a carburetor venturi. Thus the adsorbed fuel is stripped by the fresh air introduced from the canister bottom.

2) Storage in Crankcase
Without the carbon canister, fuel vapor can be stored in a crank-case through a flow guide valve which opens by pressure in the fuel storage as in Fig. 15. The stored vapor is recovered as the blow-by gas to the engine when it is in operation.

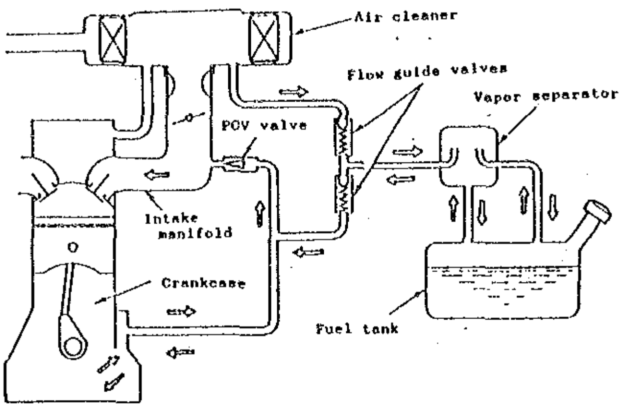


Fig. 15 Fuel Vapor Crankcase Storage System

3) Storage in Fuel Tank (Fig. 8.2.5 of Main Report)
Similarly to the above but with smaller storage capacity, evaporated fuel is kept in a fuel tank. Tanks must have enough strength to withstand higher pressure than atmospheric for storage in both systems, and also to withstand vacuum pressure in this simple system.

15. High Altitude Compensator
There is almost 2500 m difference of altitude between Bogota and Girardot or Honda. When driving from a lower place to a higher place, air density becomes thinner. For engines, it means less oxygen and richer fuel if there is no adjustment of the air/fuel ratio. From the point of pollution, it means high emissions of CO and hydrocarbons.

Engines may be tuned for the middle of the height, running at sea level with leaner air/fuel ratio and on the top with richer one. Cautious drivers may adjust the ratio by manual to get economic fuel consumption and less pollution.

The high altitude compensator is a device to do this adjustment automatically by sensing the changes of the pressure with bellows and springs. It can alter a flow area of air or fuel. A car equipped with an electronic computer does not need to have a particular compensator, because the necessary amount of air or fuel can be calculated and controlled by the computer sensing the change of the air pressure.

PART 6 LIST OF EXISTING DATA COLLECTED

LIST OF EXISTING DATA COLLECTED

1. SOCIO-ECONOMIC CONDITIONS

1001 TITLE : Colombia Censo 85
SOURCE : DANE
YEAR :

1002 TITLE : Boletin de Estadistica
SOURCE : DANE
YEAR : January 1989 - June 1990
(There some volumes missing)

1003 TITLE : La Pobreza en Bogota 1985
SOURCE : DANE
YEAR :

1004 TITLE : Bogota : Prioridad Social (Vol.1,Vol.2)
SOURCE : Camara de Comercio de Bogota
YEAR :

1005 TITLE : Bogota para todos 1987 - 1990
SOURCE : Camara de Comercio de Bogota
YEAR : 1987

1006 TITLE : Mapas de Planeacion de Bogota
SOURC :
YEAR :

1007 TITLE : Ordenament y Administracion del Espacio Urbano en Bogota
SOURCE : DAPD (DEPARTAMENTO ADMINISTRATIVO DE PLANEACION DISTRITAL)
YEAR : 1981

1008 TITLE : CENSO 85 ; Caracteristicas Economicas
SOURCE : DANE
YEAR :

1009 TITLE : Anualio de Industria Manufacturera 1987
SOURCE : DANE
YEAR : 1987

1010 TITLE : Anualio de Industria Manufacturera 1985
SOURCE : DANE
YEAR : 1985

1011 TITLE : Guidance documents of ECOPETROL
SOURCE : ECOPETROL
YEAR :

1012 TITLE : INFORME ANNUAL 1987
SOURCE : ECOPETROL
YEAR :

1013 TITLE : INFORME ANNUAL 1989
SOURCE : ECOPETROL
YEAR :

1014 TITLE : JUNTA NACIONAL DE TARIFAS
SOURCE :
YEAR : Agosto de 1990

1015 TITLE : Resolucion 148,149,062 ; Resolucion 004,106
SOURCE :
YEAR : 1987 and 1989

1016 TITLE : CARACTERIZACION DE CARBONES COLOMBIANOS ZONA CHECUA - LENGUAZAQUE
SOURCE : MINISTERIO DE MINAS Y ENERGIA
YEAR : Boletin Geologico Vol.28, No.2, 1987

1017 TITLE : Precios de Combustibles (Gasolina, Crudo Castilla, Gas Propana y Carbon)
SOURCE :
YEAR :

1018 TITLE : Primer Censo National recursos informaticos en los sectores publico y privado
SOURCE : DANE
YEAR : 1987

1019 TITLE : Sintesis de dicho censo de No. 1018
SOURCE : DANE
YEAR : 1987

1020 TITLE : Bogota 1985 - 1986 ;la realidad de su Situation Social y Economica
SOURCE : Camara de comercio de Bogota
YEAR :

1021 TITLE : PLANO POLITICO (Areas y poblacion de las alcardias en 1980 y 1981)
SOURCE :
YEAR :

1022 TITLE : DECRETO sobre la clasificacion de industrias
SOURCE : MINISTRIO DE SALUD PARA LA PROTECCION DEL AMBIENTE Y ALIMENTOS
YEAR : 1988

1023 TITLE : CARTAS TOPOGRAFICAS DE BOGOTA (1/30,000)
SOURCE : DANE
YEAR :

1024 TITLE : CARTAS TOPOGRAFICAS DE BOGOTA (1/5,000)
SOURCE : DANE
YEAR : 1980

1025 TITLE : CARTAS TOPOGRAFICAS DE BOGOTA (1/25,000)
SOURCE : DANE
YEAR :

1026 TITLE : MAPAS MUDAS DE BOGOTA (1/25,000)
SOURCE : DANE
YEAR :

1027 TITLE : CARTAS TOPOGRAFICAS DE BOGOTA (1/25,000)
SOURCE : AGUSTIN CODAZZI
YEAR : 1987

1028 TITLE : MAPAS MUDAS DE BOGOTA (1/10,000)
SOURCE :
YEAR :

1029 TITLE : CARTAS TOPOGRAFICAS DE BOGOTA (1/50,000)
SOURCE : AGUSTIN CODAZZI
YEAR :

1030 TITLE : AREAS POR SECTORES CESALES Y DENSIDADES DE POBLACION
SOURCE : DAPD
YEAR :

1031 TITLE : ALCALDIAS Y BARRIOS SEGUN ECTORES CENSALES
SOURCE :
YEAR : 1985

1032 TITLE : CATALOGO DE PRODUCTOS
SOURCE : ECOPETROL
YEAR : 1990

1033 TITLE : PRINCIPALES INDICADORES DE LA ECONOMIA COLOMBIANA
SOURCE : EMBAJADA DEL JAPON
YEAR : 1987

1034 TITLE : PLAN CUATRIENAL (1989 - 1992)
SOURCE : Instituto de Desarrollo Urbano
YEAR : 1989

1035 TITLE : Colombia Estadistica Vol.1 (Nacional)
SOURCE :
YEAR : 1987, 1988, 1989

1036 TITLE : Colombia Estadistica Vo:.2 (Municipal)
SOURCE :
YEAR : 1987, 1988, 1989

1037 TITLE : BOGOTA 450 ANOS Retos y Realidades
Foro Nacional por Colombia
SOURCE : Instituto Frances de Estudios Andinos
YEAR : 1988

1038 TITLE : CARTAS TOPOGRAFICAS DE BOGOTA (1/200,000)
SOURCE : AGUSTIN CODAZZI
YEAR : 1986

1039 TITLE : MAPAS DE PLANEACION DE USO DE TIERRA EN BOGOTA (1/25,000)
SOURCE : DEPARTAMENTO ADMINISTRATIVO DE PLANEACION DISTRITAL
YEAR : 1985

1040 TITLE : ACUERDO 7
SOURCE : DAPD
YEAR : 1979

1041 TITLE : Tarifa contralada del gas propano
Resolucion 24 del 4 - Enero / 90
SOURCE : Ministerio de Minas y Energia
YEAR : 1990

1042 TITLE : MISION BOGOTA SIGLO XXI
SOURCE : ALCALDIA MAYOR DE BOGOTA, D.E.
YEAR : 1990

1043 TITLE : SELECTED ECONOMIC INDICATORS
APRIL - JUNE 1990
SOURCE : BANCO DE REPUBLICA
YEAR : 1990

1044 TITLE : Conociendo nuestro petroleo
Cuadro No.1 - 3
SOURCE : Empresa Colombiana de Petroleos
YEAR :

1045 TITLE : ECOPETROL YEAR 2000 DEVELOPMENT PLAN
SOURCE : ECOPETROL
YEAR :

1046 TITLE : Colombia, Economic Structure 1987
SOURCE : Banco de la Republica
YEAR : Enero, 1988

1047 TITLE : Introduccion al Analisis Economico, El Caso Colombiano
SOURCE : Banco de la Republica
YEAR : 1990

1048 TITLE : Revista del Banco de la Republica, Junio 1990
SOURCE : Banco de la Republica
YEAR : Junio, 1990

1049 TITLE : El Diseno de Un Nuebo Pais
SOURCE : Eduardo Noriega Alvarado
YEAR : Junio, 1990

1050 TITLE : Colombia Hoy, 13a.Edicion
SOURCE : Siglo Veintiuno Editores
YEAR : 1990

1051 TITLE : Vivir en Bogota
SOURCE : Coleccion Ciudad y Democracia
YEAR : Mayo, 1990

1052 TITLE : Las 500 Empresas Mas Grandes de Colombia, 1990
SOURCE : Camara de Comercio de Bogota
YEAR : 1990

1053 TITLE : Las 100 Empresas Mas Grandes de Bogota,
SOURCE : Servicio Informativo No.473
YEAR : Agosto, 1990

1054 TITLE : Atlas, Basico de Colombia
SOURCE : IGAC
YEAR : 1989

1055 TITLE : Colombia Estadistica 1989, Vol. 2 Municipal
SOURCE : DANE
YEAR : Juni, 1990

1056 TITLE : Cuentas Nacionales de Colombia 1970-1989
SOURCE : DANE
YEAR : Septiembre, 1990

1057 TITLE : Indicadores de Coyuntura, Octubre 1990
SOURCE : DANE
YEAR : Octubre, 1990

1058 TITLE : Plan de Economica Social, Planes y Programas de Desarrollo Economico y Social 1987-1990
SOURCE : DNP
YEAR : Agosto, 1987

1059 TITLE : Cambio con Equidad 83-86, Plan Nacional de Desarrollo
SOURCE : DNP
YEAR : 1983

1060 TITLE : Revista de Planeacion y Desarrollo, Vol 22 No. 1 y 2
SOURCE : DNP
YEAR : 1990

1061 TITLE : Presupuesto Vigencia Fiscal de 1990
SOURCE : Bogota Distrito Especal
YEAR : 1990

1062 TITLE : Presupuesto 1990, Entidades Descentralizadas
SOURCE : Bogota Distrito Especal
YEAR : 1990

1063 TITLE : El Proyecto de Transporte Urbano para Bogota D.E., Financiacion del Banco Mundial
SOURCE : Coordinador del Proyecto
YEAR : Noviembre, 1990

1064 TITLE : Plan Integral de Transporte Urbano, Programa BIRF Bogota D.E.
SOURCE : Alcaldia Mayor de Bogota
YEAR : Septiembre, 1990

1065 TITLE : Nombre Archivo : PGV.90 Politicas, Vias, Transporte
SOURCE : DAPD
YEAR : 1990

1066 TITLE : COLOMBIA ESTADISTICA VOL.1 : National
SOURCE : DANE
YEAR : 1990

1067 TITLE : PLAN INTEGRAL DE TRANSPORTE URBANO PROGRAMA BIRF BOGOTA 1
SOURCE :
YEAR :

1068 TITLE : TRANSLATION OF #1067 INTO ENGLISH
SOURCE :
YEAR :

1069 TITLE : Indicadores de coyuntra
SOURCE : DANE
YEAR : Marzo 1991

2. AIR POLLUTION CONTROL

2001 TITLE : Decreto No.2
SOURCE : MINISTERIO DE SALUD
YEAR : Enero 11, 1982

2002 *TITLE : Decreto No.2206*
SOURCE : MINISTERIO DE SALUD
YEAR : Agosto 2, 1983

2003 TITLE : Decreto No.2104
SOURCE : MINISTERIO DE SALUD
YEAR : Julio 26, 1983

2004. TITLE : Decreto No.1594
SOURCE : MINISTERIO DE SALUD
YEAR : Junio 26, 1984

2005 TITLE : Mesuring Method of EPA for Air Pollution
SOURCE :
YEAR :

2006 TITLE : La contaminacion del Aire en Bogota 1983 - 1986
SOURCE : Servicio de Salud de Bogota D.E.
YEAR :

2007 TITLE : Mission Bogota Siglo xxl
SOURCE : Alcalde de Bogota D.E.
YEAR :

2008 TITLE : Presupuesto 1990 Administracion Central
SOURCE : Bogota D.E.
YEAR : 1990

2009 TITLE : Presupuesto 1990 Entidadas Descentralizadas
SOURCE : Bogota D.E.
YEAR : 1990

2010 TITLE : Presupuesto 1990 Secretaria de Salud de Bogota D.E.
SOURCE :
YEAR :

2011 TITLE : Plan del Propuesto 1990 - 1994 Seccion de Proteccion Ambiental
SOURCE :
YEAR :

2012 TITLE : POLITICAS GENERALES SOBRE PRODUCCION DE VEHICULOS
SOURCE : *DEPARTAMENTO NACIONAL DE PLANEACION*
YEAR : Octubre 1989

2013 TITLE : POLITICAS GENERALES SOBRE PRODUCCION DE COMBUSTIBLES
SOURCE : ECOPETROL
YEAR : Octubre 1989

2014 TITLE : POLITICAS GENERALES SOBRE CONTAMINACION DER AIRE POR FUENTES MOVILES
SOURCE : DIRECCION SANEAMIENTO AMBIENTAL MINISTEREO DE SALUD
YEAR : Octubre 1989

2015 TITLE : PROPUESTA DE REGLAMENTO DE NORMAS PARA EL CONTROL DE LA CONTAMINACION ORIGINADA *POR FUENTES MOVILES DOCUMENTOS PRELIMINAR*
SOURCE :
YEAR : Octubre 1989

2016 TITLE : DECRETO NUMERO 1600
SOURCE : MINISTERIO DE OBRAS PUBLICAS Y TRANSPORTE
YEAR : 23 JUL, 1990

2017 TITLE : POR EL CUAL ESTABLECEN HORARIOS Y REGLAMENTAN
- ZONAS DE PROHIBIDO ESTACIONAMIENTO
- CARGUE Y DESCARGUE en las vias de Bogota D.E.
SOURCE : SECRETARIA DE TRANSITO Y TRANSPORTE del Distrito
YEAR : Feb.-16-1978

2018 TITLE : Decreto No. 463
SOURCE : EL ALCALDE MAYOR DE BOGOTA DISTRITO ESPECIAL
YEAR : 25 Agosto, 1990

2019 TITLE : DOCUMENTO PRELIMINAR
SOURCE : SECRETARIA DISTRITAL DE SALUD
YEAR :

2020 TITLE : DECRETO 1809
SOURCE : MINISTERIO DE OBRAS PUBLICAS Y TRANSPORTE
YEAR : 1990 .

2021 TITLE : Automotive Air Pollution
SOURCE : The World Bank , WPS 492
YEAR : August 1990

3. ATMOSPHERIC ENVIRONMENT

3001 TITLE : SABANA DE BOGOTA
SOURCE : INSTITUTO GEOGRAFICO AGUSTIN CODAZZI COLOMBIA, ORSTOM
YEAR :

3002 TITLE : ANALISIS ESTADISTICO DE ALGUNOS PARAMETROS METEOROLOGICOS EN BOGOTA
SOURCE : HIMAT (MINISTERIO DE AGRICULTURA)
YEAR : 1979

3003 TITLE : Boletin de Registros Climatologicos 1961 - 1972
SOURCE : MINISTERIO DE AGRICULTURA SERVICIO COLOMBIANO DE METEOROLOGIA E *HIDROLOGIA*
YEAR : 1974

3004 TITLE : REGIMEN DE VIENTOS EN SUPERIFICIE DE LA SABANA DE BOBOTA
SOURCE : HIMAT (DIVISION DE METEOROLOGIA)
YEAR : 1979

3005 TITLE : VALORES MEDIOS MENSUALES DE VELOCIDAD VIENTO
SOURCE : HIMAT
YEAR : 1990

3006 TITLE : TOTAL RADIATION DE DORADO Y GAVIOTAS EN 1989
SOURCE : HIMAT
YEAR : 1989

3007 TITLE : La Contaminacion del aire en Bogota 1983 - 1986
SOURCE : Servicio de Salud de Bogota D.E.
YEAR : 1987

3008 TITLE : Calidad de aire (Concentracion promedio mensual) en Bogota en 1983 - 1987
SOURCE : SERVICIO DE SALUD DE BOGOTA
YEAR : 1988

3009 TITLE : Calidad de aire (Concentracion promedio *annual) en Bogota en 1983 - 1987*
SOURCE : SERVICIO DE SALUD DE BOGOTA
YEAR : 1988

3010 TITLE : EVALUACION HORARIA DE LA DIRECCION Y VELOCIDAD DEL VIENTO EN SUPERFICIE
SOURCE : HIMAT
YEAR : 1987

3011 TITLE : EVALUACION DE LA CONCENTRACION DE MONOXIDO DE CARBONO PROVENIENTE DE AUTO MOTORES EN BOGOTA
SOURCE : SERVICIO DE SALUD DE BOGOTA D.E. DIVISION SANEAMIENTO AMBIENTAL
YEAR : Octubre 1979

3012 TITLE : EVALUACION DE LA CONCENTRACION DE MONOXIDO DE CARBONO EN EL AREA CENTRAL DE BOGOTA
SOURCE : UNIVERSIDAD NACIONAL DE COLOMBIA
YEAR : 1981

3013 TITLE : ANALISIS DE LA DISTRIBUCION POR TAMANOS DE PARTICULAS RESPIRABLES EN LAS AREAS DE MAYOR CONTAMINACION DE LA CIUDAD DE BOGOTA
SOURCE : UNIVERSIDAD NACIONAL DE COLOMBIA FACULTAD DE INGENERIA
YEAR : 1989

3014 TITLE : CALENDARIO METEOROLOGICO 1990
SOURCE : HIMAT
YEAR : 1989

4. POLLUTANT SOURCES (FACTORIES)

4001 TITLE : FORMULARIO PARA SOLICITUD DE AUTORIZACION SANITARIA DE FUNCIONAMIENTO - PARTE AIRE -
SOURCE : Servicio de Salud de Bogota, D.E.
YEAR :

4002 TITLE : muestro isocinetico en chimenea (Uno Ejemplo)
SOURCE : Servicio de Salud de Bogota,D.E.
YEAR : Julio de 1986

4003 TITLE : INVENTARIO DE INDUSTRIAS
SOURCE : Servicio de Salud de Bogota, D.E.
YEAR : 1989

4004 TITLE : FABRICAS CON CALDERAS A BASE DE CARBON
SOURCE : Servicio de Salud de Bogota, D.E.
YEAR : 1989

4005 TITLE : FABRICAS DE LADRILLOS Y TUBOS DE GRES QUE TRABAJAN CON HORNOS
SOURCE : Servicio de Salud de Bogota, D.E.
YEAR : 1989

4006 TITLE : El consumo de combustible industrial en el area de influencia de Bogota
SOURCE : EMPRESA COLOMBIANA DE PETROLEOS
YEAR : 1988

4007 TITLE : Las caracteristicas del carbon utilizado en Bogota
SOURCE : Instituto Nacional Geologico Minero - INGEOMINAS
YEAR :

4008 TITLE : CONSUMO DE COMBUSTIBLES EN BOGOTA Y SU AREA DE INFLUENCIA
SOURCE : ECOPETROL. Division de Planeacion y Analisis Financiero. Grupo de Programacion y Estadistica
YEAR :

4009 TITLE : INVENTORIO DE FABRICAS Y ESTABLECIMIENTOS
SOURCE : Servicio de Salud de Bogota, D.E.
YEAR : 1990

4010 TITLE : CUNDINAMARCA - CONSUMO DE CARBON SEGUN SECTOR ECONOMICO
SOURCE : CARBOCOL, Planeacion Corporativa
YEAR : 1980-1990

4011 TITLE : Los consumos de combustibles en el area de Bogota para 1991
SOURCE : EMPRESA COLOMBIANA DE PETROLEOS - ECOPETROL
YEAR : 1990

4012 TITLE : CATALOGO DE PRODUCTOS
SOURCE : ECOPETROL
YEAR :

4013 TITLE : CALIDAD CARBON EL CERREJON
SOURCE : CARBONES DE COLOMBIA - CARBOCOL S. A.
YEAR : 17 Septiembre 1990

4014 TITLE : CARACTERIZACION DE CARBONES COLOMBIANOS ZONA CHECUA - LENGUAZAQUE
SOURCE : MINISTERIO DE MINAS Y ENERGIA
YEAR : Boletin Geologico Vol.28, No.2, 1987

4015 TITLE : COMPILATION OF AIR POLLUTANT EMISSION FACTORS (Second Edition)
SOURCE : U.S. ENVIRONMENTAL PROTECTION AGENCY
YEAR : April 1973

4016 TITLE : COMPILATION OF AIR POLLUTANT EMISSION FACTORS (Third Edition)
SOURCE : U.S. ENVIRONMENTAL PROTECTION AGENCY
YEAR : August 1977

4017 TITLE : COMPILATION OF AIR POLLUTANT EMISSION FACTORS (Fourth Edition) Volume. 1 : Stationary sources
SOURCE : U.S. ENVIRONMENTAL PROTECTION AGENCY
YEAR : September 1985

4018 TITLE : DIRECTORIO INDUSTRIAL 1988
SOURCE : Bogota, D.E.
YEAR : 1988

4019 TITLE : EL CARBON Y SU TECNOLOGIA
SOURCE : UNIVERSIDAD NACIONAL DE COLOMBIA FACULTAD DE INGENIERIA
YEAR : 1982

4020 TITLE : DECRETO No.2 Enero 11 de 1982 DECRETO No.2206 Agosto de 1983
SOURCE : MINISTERIO DE SALUD
YEAR :

4021 TITLE : CARACTERISTICAS TIPICAS DE COMBUSTIBLES
SOURCE : SPETROL
YEAR :

4022 TITLE : CONSUMO DE COMBUSTIBLE EN BOGOTA Y SU AREA DE INFLUENCIA A JUNIO 1988
SOURCE : Ecopetrol, Division Tecnica
YEAR :

5. POLLUTANT SOURCES (AUTOMOBILES)

5001 TITLE : PARQUE AUTOMOTOR EN BOGOTA A JUNNIO 30 DE 1988
SOURCE : Departamento Administrativo de Transito y Transporte de Bogota. Division de Sistemas
YEAR : 1988

5002 TITLE : CONSUMO DE COMBUSTIBLE EN BOGOTA Y SU AREA DE INFLUENCIA A JUNIO 1988
SOURCE : Ecopetrol. Division Tecnica
YEAR : 1988

5003 TITLE : TIPO DE SERVICIO DE VEHICULOS EN BOGOTA
SOURCE : Departamento Administrativo de Transito y Transporte de Bogota. Division de Sistemas
YEAR : 1988

5004 TITLE : PARQUE AUTOMOTOR EN BOGOTA EN 1977
SOURCE : Ministerio de Obras Publicas. Oficina de Planeacion. Congreso de Ingenieria 1978 Intra Of. de Estadisticas
YEAR :

5005 TITLE : CATALOGO DE PRODUCTOS
SOURCE : ECOPETROL
YEAR :

5006 TITLE : BOLETIN ESTADISTICO PARQUE AUTOMOTOR EN COLOMBIA 1984
SOURCE : INSTITUTO NACIONAL DEL TRANSPORTE
YEAR : Septiembre 1985

5007 TITLE : BOLETIN ESTADISTICO PARQUE AUTOMOTOR EN COLOMBIA 1985
SOURCE : INSTITUTO NACIONAL DEL TRANSPORTE
YEAR : Noviembre 1986

5008 TITLE : BOLETIN ESTADISTICO DE EMPRESAS DE CARGA 1982
SOURCE : INSTITUTO NACIONAL DEL TRANSPORTE
YEAR : Junio de 1983

5009 TITLE : EMPRESAS DE PASAJEROS Y CARGA REGIONAL BOGOTA 1984
SOURCE : INSTITUTO NACIONAL DEL TRANSPORTE
YEAR : Mayo 1986

5010 TITLE : ESTADISTICA POR MARCA Y MODELO
SOURCE : DEPARTAMENTO ADMINISTRATIVO DE TRANSITO Y TRANSPORTES BOGOTA
YEAR : Agosto 29 de 1990

5011 TITLE : EL SECTOR AUTOMOTOR COLOMBIANO 1990 MANUAL ESTADISTICO No.11
SOURCE : ASOCIACION COLOMBIANA DE FABRICANTES DE AUTOPARTES - ACOLFA
YEAR : 1990

5012 TITLE : INSTITUTO NACIONAL DE TRANSPORTE Y TRANSITO 1986 - 1990
SOURCE : MINISTERIO DE OBRAS PUBLICAS Y TRANSPORTE
YEAR : Julio 1990

5013 TITLE : PRODUCCION NACIONAL DE VEHICULOS 1985 - 1986
SOURCE : INSTITUTO NACIONAL DEL TRANSPORTE
YEAR : Septiembre de 1988

5014 TITLE : BOLETIN ESTADISTICO DE ACCIDENTES DE TRANSITO 1980
SOURCE : INSTITUTO NACIONAL DEL TRANSPORTE
YEAR : Julio 1982

5015 TITLE : COMPILATION OF AIR POLLUTANT EMISSION FACTORS (Second Edition)
SOURCE : U.S. ENVIRONMENTAL PROTECTION AGENCY
YEAR : April 1973

5016 TITLE : COMPILATION OF AIR POLLUTANT EMISSION FACTORS (Third Edition)
SOURCE : U.S. ENVIRONMENTAL PROTECTION AGENCY
YEAR : August 1977

5017 TITLE : COMPILATION OF AIR POLLUTANT EMISSION FACTORS (Fourth Edition) Volume.2 : Mobile Sources
SOURCE : U.S. ENVIRONMENTAL PROTECTION AGENCY
YEAR : September 1985

5018 TITLE : EVALUACION DE LA CONCENTRACION DE MONOXIDO DE CARBONO PROVENIENTE DE AUTOMOTORES EN BOGOTA
SOURCE : SERVICIO DE SALUD DE BOGOTA D.E. DIVISION SANEAMIENTO AMBIENTAL
YEAR : Octubre 1979

5019 TITLE : EVALUACION DE LA CONCENTRACION DE MONOXIDO DE CARBONO EN EL AREA CENTRAL DE BOGOTA
SOURCE : UNIVERSIDAD NACIONAL DE COLOMBIA
YEAR : 1981

5020 TITLE : POLITICAS GENERALES SOBRE PRODUCCION DE VEHICULOS
SOURCE : DEPARTAMENTO NACIONAL DE PLANEACION
YEAR : Octubre 1989

5021 TITLE : POLITICAS GENERALES SOBRE PRODUCCION DE COMBUSTIBLES
SOURCE : ECOPETROL
YEAR : Octubre 1989

5022 TITLE : POLITICAS GENERALES SOBRE CONTAMINACION DEL AIRE POR FUENTES MOVILES
SOURCE : DERECCION SANEAMIENTO AMBIENTAL MINISTERIO DE SALUD
YEAR : Octubre 1989

5023 TITLE : PROPUESTA DE REGLAMENTO DE NORMAS PARA EL CONTROL DE LA CONTAMINACION ORIGINADA POR FUENTES MOVILES (DOCUMENTOS PRELIMINAR)
SOURCE :
YEAR : Octubre 1989

5024 TITLE : INFORMACION TECNICA RECOPILADA
SOURCE : INTRA - MINISTERIO DE SALUD
YEAR : Octubre 1989

5025 TITLE : MOTOR VEHICLE EMISSIONS CONTROL TECHNOOGY TRANSFER TO DEVELOPING COUNTRIES
SOURCE : For Presentation at the 79th Annual Meeting of the Air Pollution Control Association Minneapolis, Minnesota
YEAR : June 22 - 27, 1986

5026 TITLE : CARACTERISTICAS TIPICAS DE COMBUSTIBLES
SOURCE : SPETROL
YEAR :

5027 TITLE : CARACTERISTICA TIPICAS DE GASOLINA
SOURCE : ECOPETROL
YEAR :

5028 TITLE : DATOS DE COMBUSTIBLES DE ECOPETROL
SOURCE : ECOPETROL
YEAR :

5029 TITLE : PARQUE AUTOMOTOR EN COLOMBIA (1985 - 1989)
SOURCE : INTRA
YEAR :

5030 TITLE : CONTROL DE NIVEL DE EMISIONES DE ESCAPE POR VEHICULOS AUTOMOTORES
SOURCE : COLMOTORES
YEAR : 1980

5031 TITLE : ESTUDIO PARA EL MINISTERIO DE SALUD PUBLICA SOBRE EL CONTROL DEL NIVEL DE EMISIONES CONTAMINANTES POR VEHICULOS AUTOMOTORES
SOURCE : COLMOTORES
YEAR :

5032 TITLE : DATOS SOBRE VEHICULOS DE COLOMOTORES
SOURCE : COLOMOTORES
YEAR : 1990

5033 TITLE : ANALISE DOS GASES DE ESCAPAMENTO DE VEHICULOS RODOVIARIOS AUTOMOTORES LEVES A GASOLINA
SOURCE : COLOMOTORES
YEAR : June, 1981

5034 TITLE : DATOS SOBRE VEHICULOS DE MAZDA
SOURCE : MAZDA(COmpania Colombiana Automotoriz S.A.)
YEAR : 1990

5035 TITLE : MOTOR VEHICLE POLLUTION CONTROL IN JAPAN (3rd Revision)
SOURCE : Environment Agency, Japan
YEAR : 1988

5036 TITLE : Motor Vehicle Inspection Sydtem in Japan
SOURCE : Ministry of Transport
YEAR :

5037 TITLE : Impact of Altitude on Vehicular Exhaust Emissions
SOURCE : Society of Automotive Engineers 741033
YEAR : October, 1974

5038 TITLE : Analysis of Particulate and Gaseous Emissions Data from In-Use Diesel Passenger Cars
SOURCE : Society of Automotive Engineers 820772
YEAR :

5039 TITLE : Light Duty Diesel Vehicle Emissions at High Altitude
SOURCE : Colorado Department of Health Denver, Colorado
YEAR : June, 1983

5040 TITLE : ESTADISTICA DE BUSES EMPRESA MARCA Y MODELOS
SOURCE : DATT
YEAR : Octubre, 1990

5041 TITLE : ESTADISTICA DE BUSETAS EMPRESA MARCA Y MODELOS
SOURCE : DATT
YEAR : Octubre, 1990

5042 TITLE : Emission factors for large-sized buses in Japan
SOURCE : Pollution Bureau, Tokyo
YEAR : March, 1978

5043 TITLE : Chassis dynamometer test in Mexico City
SOURCE :
YEAR : 1987

5044 TITLE : An Emission and Fuel Usage Computer Model for Trucks and Buses
SOURCE : SAE 780630
YEAR : 1978

5045 TITLE : An Investigation of Emissions from Trucks Above 6000 lb GVW Powered by Spark-Ignited Engines
SOURCE : PB-268 020
YEAR : 1969

5046 TITLE : CHARACTERIZATION OF HEAVY-DUTY MOTOR VEHICLE EMISSIONS UNDER TRANSIENT DRIVING CONDITIONS
SOURCE : EPA/600/3-84/104
YEAR : November, 1984

5047 TITLE : Tarifas para el Servicio publico de transport urbano colectivo en la modalidad de pasajeros mixto en la Ciudad de Bogota
SOURCE :
YEAR : 2 Nov, 1990

5048 TITLE : Las observaciones hechas al Decreto 02 de 1982
SOURCE : SECCION CONTROL CONTAMINACION ATMOSFERICA - Saneamiento Ambiental
YEAR : Diciembre 21, 1990

5049 TITLE : El documento no official sobre sistemas para evitar contaminacion y equipos prevencion y seguridad
SOURCE : INTRA
YEAR : 1990

5050 TITLE : Comerciantes Registrados Ubicados para Reparacion de Automoviles y Motocicletas en Bogota City
SOURCE : CAMARA DE COMERCIO DE BOGOTA
YEAR : Diciembre 7, 1990

5051 TITLE : ESATDISTICA DE VEHICULOS POR MARCA
SOURCE : SECRETARIA DE TRANSITO Y TRANSPORTE DE BOGOTA D.E.
YEAR :

5052 TITLE : REGISTRO NACIONAL AUTOMOTOR R.N.A MANUAL DE INSTRUCCIONES
SOURCE : INTRA
YEAR : 1984

5053 TITLE : Los vehiculos por Marca, linea, Tipo de vehiculo Desplazamiento, Combustible
SOURCE :
YEAR :

5054 TITLE : PRODUCTION DISTRIBUTION, AND COST OF OXYGENATED GASOLINE BLENDS AS CO CONTROL STRATEGY
SOURCE : the 81st Annual Meeting of APCA
YEAR : 1988

5055 TITLE : HIGH ALTITUDE CARBON MONOXIDE CONTROL
SOURCE : the 81st Annual Meeting of APCA
YEAR : 1988

5056 TITLE : THE COLORADO OXYGENATED FUELS DEMONSTRATION PROJECT
SOURCE : the 81st Annual Meeting of APCA
YEAR : 1988

5057 TITLE : SE REGULAMENTA LOS NIVELES DE EMISION PERMISIBLES CONTAMINANTES PRODUCIDOS POR LAS FUENTES MOVILES CON MOTOR A GASOLINA (AUTOMOTORES)
SOURCE : SECRETARIA DISTRITAL DE SALUD
YEAR :

5058 TITLE : DECRETO 1809
SOURCE : MINISTERIO DE OBRAS PUBLICAS Y TRANSPORTE
YEAR : 1990

5059 TITLE : Automotive Air Pollution
SOURCE : The World Bank, WPS 492
YEAR : August 1990

5060 TITLE : Oxygenates for reformulated gasoline
SOURCE : Hydrocarbon Processing
YEAR : July 1990

5061 TITLE : Project Training Text for Sr.Garcia
SOURCE : Mazda
YEAR : 1990

6. POLLUTANT SOURCES (TRAFFIC VOLUME)

6001 TITLE : VOLUMENES DE TRANSITO EN VIAS PRIMARIAS Y SECUNDARIAS
SOURCE : EMPRESA METRO
YEAR : Marzo 15 de 1990

6002 TITLE : PLAN DE ACCIONES DE ETECUCION INMEDIATA PARA EL MEJORAMIENTO DEL TRANSITO EN BOGOTA
SOURCE : DATT
YEAR :

6003 TITLE : Bogota - Buenaventura Road Project D.F (resumen)
SOURCE : JICA
YEAR : 1982

6004 TITLE : DECRETO 909 (AGOSTO 25 DE 1976)
SOURCE : DATT
YEAR :

6005 TITLE : ACUERDO No.2 (DE 1980 y DE 1982)
SOURCE : DATT
YEAR :

6006 TITLE : DECRETO No.1787
SOURCE :
YEAR :

6007 TITLE : ESTUDIO TECNICO DE ORIGEN Y DESTINO EN EL TRANSPORTE PUBLICO COLECTIVO URBANO EN LA CIUDAD DE BOGOTA
SOURCE : INSTITUTO NACIONAL DEL TRANSPORTE
YEAR : 1986

6008 TITLE : TRANSITO Y TRANSPORTES DE BOGOTA
SOURCE : DATT (Departamento Administrativo de Transito y Transporte)
YEAR : 1986

6009 TITLE : DIAGNOSTICO DE TRANSPORTE PUBLICO DE PASAJEROS EN BOGOTA
SOURCE : DATT
YEAR : 1987

6010 TITLE : VOLUMENES DE TRANSITO (CONTEOS MANUALES)
SOURCE : MINISTERIO DE OBRAS PUBLICAS Y TRANSPORTE
YEAR : 1985

6011 TITLE : ACUERDO No.155 (Enero 11 de 1972)
SOURCE : LEGISLACION TRANSPORTE Y TRANSITO
YEAR :

6012 TITLE : DECRETO No.2199 (Octubre 25 de 1988)
SOURCE : LEGISLACION TRANSPORTE Y TRANSITO
YEAR :

6013 TITLE : Resolucion No.10815 (Noviembre 3 de 1988)
SOURCE : INTRA
YEAR :

6014 TITLE : ANTIGUA NOMENCLATURA EN LA QUE SE REGLAMENTA LA PLACA UNICA NACIONAL, PARA CUNDENAMARCA Y BOGOTA D.E. (RESUMEN de dichos acuerdo No.155 y decreto No.2199)
SOURCE :
YEAR : 1990

6015 TITLE : Rutas de Buses en Bogota (Mapa y Lista)
SOURCE : DATT
YEAR :

6016 TITLE : EVALUACION DE LA CONCENTRACION DE MONOXIDO DE CARBONO PROVENIENTE DE AUTOMOTORES EN BOGOTA
SOURCE : SERVICIO DE SALUD DE BOGOTA D.E. DIVISION SANEAMIENTO AMBIENTAL
YEAR : Octubre 1979

6017 TITLE : EVALUACION DE LA CONCENTRACION DE MONOXIDO DE CARBONO EN EL CENTRAL AREA DE BOGOTA
SOURCE : UNIVERSIDAD NACIONAL DE COLOMBIA
YEAR : 1981

6018 TITLE : DECRETO NUMERO 1600
SOURCE : MINISTERIO DE OBRAS PUBLICAS Y TRANSPORTE
YEAR : 23 JUL. 1990

6019 TITLE : POR EL CUAL ESTABLECEN HORARIOS Y REGLAMENTAN
- ZONAS DE PROHIBIDO ESTACIONAMIENTO
- CARGUE Y DESCARGUE en las vias de Bogota D.E.
SOURCE : SECRETARIA DE TRANSITO Y TRANSPORTE del Distrito
YEAR : Feb.-16-1978

6020 TITLE : Decreto No. 463
SOURCE : EL ALCALDE MAYOR DE BOGOTA DISTRITO ESPECIAL
YEAR : 25 Agosto, 1990

6021 TITLE : UNIDAD DE PTRANSPORTE PUBLICO DIVISION RUTAS Y CONTROL CAPACIDAD TRANSPORTADORA
SOURCE : SECETARIA DE TRANSITO Y TRANSPORTE DE BOGOTA D.E.
YEAR :

6022 TITLE : IMPUESTO DE VEHICULOS ESTADISTICAS DE VEHICULOS AL 04/30/91
SOURCE :
YEAR :

6023 TITLE : Pasajeros movilizados por nivel de servicio y kilometros recorridos por mes
SOURCE : TRONICAL CARACAS
YEAR :

6024 TITLE : ACUERDO NUMERO 2
SOURCE : Concejo de Bogota D.E.
YEAR : 1980

6025 TITLE : PROYECTO TROLEBUS BOGOTA S.A (RESUMEN)
SOURCE : Empresa Distrital de Transporte Urbano
YEAR : 1991

6026 TITLE : RECUPERACION DEL TRANSPORTE TERROVIARIO
SOURCE : MOPT. S.T.F S.A.
YEAR : Julio 18 de 1989

7. POLLUTANT SOURCES (AIRPLANES AND HOUSEHOLDS)

7001 TITLE : HORARIOS DE AVIONES EN AEROPUERTO ELEDORADO
SOURCE :
YEAR :

7002 TITLE : CATALOGO DE PRODUCTOS
SOURCE : ECOPETROL
YEAR :

7003 TITLE : Numero de Despegue y Aterrizaje de Aviones en Aeropuerto ELEDORADO
SOURCE : Torre de Control El Dorado
YEAR : Julio 25 - 31 de 1988

7004 TITLE : Rutas de Despegue en Aeropuerto ELEDORADO
SOURCE : Departamento Administrativo de Aeronautica Civil
YEAR : 26 de septiembre de 1990

7005 TITLE : COMPILATION OF AIR POLLUTANT EMISSION FACTORS (Second Edition)
SOURCE : U.S. ENVIRONMENTAL PROTECTION AGENCY
YEAR : April 1973

7006 TITLE : COMPILATION OF AIR POLLUTANT EMISSION FACTORS (Third Edition)
SOURCE : U.S. ENVIRONMENTAL PROTECTION AGENCY
YEAR : August 1977

7007 TITLE : COMPILATION OF AIR POLLUTANT EMISSION FACTORS
(Fourth Edition)
Volume. 1, 2
SOURCE : U.S. ENVIRONMENTAL PROTECTION AGENCY
YEAR : September 1985

7008 TITLE : Los consumos promedios mensuales de Cocinol y
Gas Propano en Bogota D.E.
SOURCE : DHAC
YEAR : 1990

7009 TITLE : Domestic energy survey
SOURCE : Servicio de Saludo de Bogota D.E.
YEAR : Marzo 3, 1991

8. ENVIRONMENT (GENERAL)

8001 TITLE : Indicadores Economico-Ambientales para
las Cuentas Nacionales
SOURCE : CEPAL
YEAR : Marzo, 1990

8002 TITLE : Medio Ambiente y EcologiaE COMBUSTIBLES
SOURCE : Jalio Carrizosa Umana / Camara de Comercio
YEAR : Junio, 1990

8003 TITLE : Seminarios Ecologicos y Ambientales,
Aire y Vida
SOURCE : Fundacion Alma, Serie : Vida No 3
YEAR : Octubre, 1985

8004 TITLE : La Dimension Abbiental en la Planificacion
del Desarrollo, 2
SOURCE : CEPAL-ILPES-PUNUMA
YEAR : 1988

8005 TITLE : Manual on Regulation of Total Emission
of Nitrogen Oxides
SOURCE : Air Quality Bereau, Environment Agency, Japan
YEAR :