SUPPLEMENT NO. 5 FOR COMPILATION OF AIR POLLUTANT EMISSION FACTORS

SECOND EDITION

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Waste Management
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

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NOTICE TO USERS OF SUPPLEMENT 5 PREPRINT

Several users of AP-42 motor vehicle emission factors received an early draft version (dated April 16, 1975) of this Supplement 5 for Compilation of Air Pollutant Emission Factors. The following listing indicates the changes in emission factors that have occurred since April. The user, therefore, can update, with a minimum of effort, any calculations based on the preprint information. Individuals who did not receive the preprint should simply disregard the changes listed here.

Preprint		Entry	Final edition		
Page	Value		Page	Table	Value
78	0.3 g/km	City bus emissions, Aldehydes and	3.1.5-2	3.1.5-1	0.2 g/km
	0.3 g/km	and Organic acids			0.2 g/km
D-11	24.2 g/km	CO--Low altitude, 1974	D.1-3	D.1-3	23.0 g/km
D-12	3.1 g/mi	NO_x--1974	D.1-3	D.1-4	2.0 g/mi
	1.9 g/km				1.2 g/km
D-14	3.3 g/mi	NO_x--1974	D.1-4	D.1-6	2.06 g/mi
	2.05 g/km				1.28 g/km
D-16	3.5 g/mi	NO_x--1974	D.1-5	D.1-8	2.12 g/mi
	2.17 g/km				1.32 g/km
	2.05 g/mi	NO_x--1975			2.06 g/mi
	1.27 g/km				1.28 g/km
D-18	57.8 g/km	CO--1966	D.1-6	D.1-10	52.8 g/km
	3.7 g/mi	NO_x--1974			2.18 g/mi
	2.3 g/km				1.35 g/km
	2.0 g/mi	NO_x--1977			1.5 g/mi
	1.24 g/km				0.93 g/km
D-20	3.9 g/mi	NO_x--1974	D.1-7	D.1-12	2.24 g/mi
	2.42 g/km				1.39 g/km
	2.06 g/mi	NO_x--1977			1.56 g/mi
	1.28 g/km				0.97 g/km
D-22	4.1 g/mi	NO_x--1974	D.1-8	D.1-14	2.3 g/mi
	2.5 g/km				1.43 g/km
	2.18 g/mi	NO_x--1977			1.62 g/mi
	1.35 g/km				1.01 g/km
D-24	4.3 g/mi	NO_x-1974	D.1-9	D.1-16	2.36 g/mi
	2.67 g/km				1.47 g/km
	2.18 g/mi	NO_x--1977			1.68 g/mi
	1.35 g/km				1.04 g/km
D-25	18.0 g/mi	NO_x--Low altitude, 1976	D.1-10	D.1-17	17.1 g/mi
	11.2 g/km				10.6 g/km
D-26	10.4 g/mi	CO--1975	D.1-10	D.1-18	10.8 g/mi
	6.5 g/km				6.7 g/km
	9.9 g/mi	CO--1976			10.3 g/mi
	6.1 g/km				6.4 g/km
	5.0 g/mi	NO_x--1974			2.60 g/mi
	3.1 g/km				1.61 g/km
	2.6 g/mi	NO_x--1975			2.60 g/mi
	1.6 g/km				1.61 g/km
	2.5 g/mi	NO_x--1976			2.54 g/mi
	1.6 g/km				1.58 g/km
	2.48 g/mi	NO_x--1977			1.98 g/mi
	1.54 g/km				1.23 g/km
D-28	2.6 g/mi	NO_x--1977	D.1-11	D.1-20	2.10 g/mi
	1.6 g/km				1.30 g/km
D-50	45.0 g/mi	CO--1976	D.2-6	D.2-9	40.5 g/mi
	25.2 g/km				25.1 g/km
D-83	Post 1972	CO and HC	D.5-2	D.5-1	All
D-102	13.9 g/km	CO--1979	D.7-1	D.7-1	22.9 g/km
	11.7 g/km	CO--1980			19.3 g/km
	5.9 g/km				9.8 g/km

PREFACE

This document reports data available on those atmospheric emissions for which sufficient information exists to establish realistic emission factors. The information contained herein is based on Public Health Service Publication 999-AP-42, *Compilation of Air Pollutant Emission Factors*, by R. L. Duprey, and on a revised and expanded version of *Compilation of Air Pollutant Emission Factors* that was published by the Environmental Protection Agency in February 1972. The scope of this second edition has been broadened to reflect expanding knowledge of emissions.

Chapters and sections of this document have been arranged in a format that permits easy and convenient replacement of material as information reflecting more accurate and refined emission factors is published and distributed. To speed dissemination of emission information, chapters or sections that contain new data will be issued—separate from the parent report—whenever they are revised.

To facilitate the addition of future materials, the punched, loose-leaf format was selected. This approach permits the document to be placed in a three-ring binder or to be secured by rings, rivets, or other fasteners; future supplements or revisions can then be easily inserted. The lower left- or right-hand corner of each page of the document bears a notation that indicates the date the information was issued.

NOTE: Those who obtained AP-42 by purchase or through special order and completed the request for future supplements are hereby advised of a change in the distribution procedure. The availability of these supplements will now be indicated in the publication *Air Pollution Technical Publications of the Environmental Protection Agency*, which is available from the Air Pollution Technical Information Center, Research Triangle Park, N. C. 27711. This listing of publications, normally published in January and July, contains instructions for obtaining the desired documents.

Comments and suggestions regarding this document should be directed to the attention of Director, Monitoring and Data Analysis Division, Office of Air Quality Planning and Standards, Environmental Protection Agency, Research Triangle Park, N. C. 27711.

INSTRUCTIONS FOR INSERTING SUPPLEMENT NO. 5
INTO COMPILATION OF AIR POLLUTANT EMISSION FACTORS

1. **Replace page iii/iv with new page iii/iv.**
2. **Replace page v/vi with new page v/vi.**
3. **Replace pages xiii through xvi with new pages xiii through xviii.**
4. **Insert new pages 1.7-1 through 1.7-3 dated 12/75 after page 1.6-3.**
5. **Replace pages 3.1.1-1 through 3.1.5-2 with new pages 3.1.1-1 through 3.1.5-3 dated 12/75.**
6. **Replace page 5.6-1/5.6-2 with new pages 5.6-1 through 5.6-6 dated 12/75.**
7. **Replace page 6.9-3/6.9-4 with corrected page 6.9-3/6.9-4.**
8. **Replace page 8.20-1/8.20-2 with corrected page 8.20-1/8.20-2.**
9. **Insert pages 11.2-1 through 11.2.4-1 dated 12/75 after page 11.1-5.**
10. **Replace pages C-1 through C-22 with new pages C-1 through C-26 dated 12/75.**
11. **Insert pages D-1 through D.7-2 dated 12/75 after page C-26.**

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Because this document is a product of the efforts of many individuals, it is impossible to acknowledge each person who has contributed. Special recognition is given to Environmental Protection Agency employees in the Technical Development Section, National Air Data Branch, Monitoring and Data Analysis Division, for their efforts in the production of this work. Bylines identify the contributions of individual authors who revised specific sections and chapters.

Issuance		Release Date
Compilation of Air Pollutant Emission Factors (second edition)		4/73
Supplement No. 1		7/73
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Section 4.4	Marketing and Transportation of Petroleum Products	
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Section 3.1.2	Light-Duty, Gasoline-Powered Vehicles	
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ABSTRACT

Emission data obtained from source tests, material balance studies, engineering estimates, etc., have been compiled for use by individuals and groups responsible for conducting air pollution emission inventories. Emission factors given in this document, the result of the expansion and continuation of earlier work, cover most of the common emission categories: fuel combustion by stationary and mobile sources; combustion of solid wastes; evaporation of fuels, solvents, and other volatile substances; various industrial processes; and miscellaneous sources. When no source-test data are available, these factors can be used to estimate the quantities of primary pollutants (particulates, CO, SO_2, NO_x, and hydrocarbons) being released from a source or source group.

Key words: fuel combustion, stationary sources, mobile sources, industrial processes, evaporative losses, emissions, emission data, emission inventories, primary pollutants, emission factors.

1.7 LIGNITE COMBUSTION

by Thomas Lahre

1.7.1 General[1-4]

Lignite is a geologically young coal whose properties are intermediate to those of bituminous coal and peat. It has a high moisture content (35 to 40 percent, by weight) and a low heating value (6000 to 7500 Btu/lb, wet basis) and is generally only burned close to where it is mined, that is, in the midwestern States centered about North Dakota and in Texas. Although a small amount is used in industrial and domestic situations, lignite is mainly used for steam-electric production in power plants. In the past, lignite was mainly burned in small stokers; today the trend is toward use in much larger pulverized-coal-fired or cyclone-fired boilers.

The major advantage to firing lignite is that, in certain geographical areas, it is plentiful, relatively low in cost, and low in sulfur content (0.4 to 1 percent by weight, wet basis). Disadvantages are that more fuel and larger facilities are necessary to generate each megawatt of power than is the case with bituminous coal. There are several reasons for this. First, the higher moisture content of lignite means that more energy is lost in the gaseous products of combustion, which reduces boiler efficiency. Second, more energy is required to grind lignite to the specified size needed for combustion, especially in pulverized coal-fired units. Third, greater tube spacing and additional soot blowing are required because of the higher ash-fouling tendencies of lignite. Fourth, because of its lower heating value, more fuel must be handled to produce a given amount of power because lignite is not generally cleaned or dried prior to combustion (except for some drying that may occur in the crusher or pulverizer and during subsequent transfer to the burner). Generally, no major problems exist with the handling or combustion of lignite when its unique characteristics are taken into account.

1.7.2 Emissions and Controls[2-8]

The major pollutants of concern when firing lignite, as with any coal, are particulates, sulfur oxides, and nitrogen oxides. Hydrocarbon and carbon monoxide emissions are usually quite low under normal operating conditions.

Particulate emissions appear most dependent on the firing configuration in the boiler. Pulverized-coal-fired units and spreader stokers, which fire all or much of the lignite in suspension, emit the greatest quantity of flyash per unit of fuel burned. Both cyclones, which collect much of the ash as molten slag in the furnace itself, and stokers (other than spreader stokers), which retain a large fraction of the ash in the fuel bed, emit less particulate matter. In general, the higher sodium content of lignite, relative to other coals, lowers particulate emissions by causing much of the resulting flyash to deposit on the boiler tubes. This is especially the case in pulverized-coal-fired units wherein a high fraction of the ash is suspended in the combustion gases and can readily come into contact with the boiler surfaces.

Nitrogen oxides emissions are mainly a function of the boiler firing configuration and excess air. Cyclones produce the highest NO_x levels, primarily because of the high heat-release rates and temperatures reached in the small furnace sections of the boiler. Pulverized-coal-fired boilers produce less NO_x than cyclones because combustion occurs over a larger volume, which results in lower peak flame temperatures. Tangentially fired boilers produce the lowest NO_x levels in this category. Stokers produce the lowest NO_x levels mainly because most existing units are much smaller than the other firing types. In most boilers, regardless of firing configuration, lower excess air during combustion results in lower NO_x emissions.

Sulfur oxide emissions are a function of the alkali (especially sodium) content of the lignite ash. Unlike most fossil fuel combustion, in which over 90 percent of the fuel sulfur is emitted as SO_2, a significant fraction of the sulfur in lignite reacts with the ash components during combustion and is retained in the boiler ash deposits and flyash. Tests have shown that less than 50 percent of the available sulfur may be emitted as SO_2 when a high-sodium lignite is burned, whereas, more than 90 percent may be emitted with low-sodium lignite. As a rough average, about 75 percent of the fuel sulfur will be emitted as SO_2, with the remainder being converted to various sulfate salts.

Air pollution controls on lignite-fired boilers in the United States have mainly been limited to cyclone collectors, which typically achieve 60 to 75 percent collection efficiency on lignite flyash. Electrostatic precipitators, which are widely utilized in Europe on lignitic coals and can effect 99+ percent particulate control, have seen only limited application in the United States to date although their use will probably become widespread on newer units in the future.

Nitrogen oxides reduction (up to 40 percent) has been demonstrated using low excess air firing and staged combustion (see section 1.4 for a discussion of these techniques); it is not yet known, however, whether these techniques can be continuously employed on lignite combustion units without incurring operational problems. Sulfur oxides reduction (up to 50 percent) and some particulate control can be achieved through the use of high sodium lignite. This is not generally considered a desirable practice, however, because of the increased ash fouling that may result.

Emission factors for lignite combustion are presented in Table 1.7-1.

Table 1.7-1. EMISSIONS FROM LIGNITE COMBUSTION WITHOUT CONTROL EQUIPMENT[a]
EMISSION FACTOR RATING: B

	Type of boiler							
	Pulverized-coal		Cyclone		Spreaker stoker		Other stokers	
Pollutant	lb/ton	kg/MT	lb/ton	kg/MT	lb/ton	kg/MT	lb/ton	kg/MT
Particulate[b]	7.0A[c]	3.5A[c]	6A	3A	7.0A[d]	3.5A[d]	3.0A	1.5A
Sulfur oxides[e]	30S	15S	30S	15S	30S	15S	30S	15S
Nitrogen oxides[f]	14(8)[g,h]	7(4)[g,h]	17	8.5	6	3	6	3
Hydrocarbons[i]	<1.0	<0.5	<1.0	<0.5	1.0	0.5	1.0	0.5
Carbon monoxide[i]	1.0	0.5	1.0	0.5	2	1	2	1

[a]All emission factors are expressed in terms of pounds of pollutant per ton (kilograms of pollutant per metric ton) of lignite burned, wet basis (35 to 40 percent moisture, by weight).

[b]A is the ash content of the lignite by weight, wet basis. Factors based on References 5 and 6.

[c]This factor is based on data for dry-bottom, pulverized-coal-fired units only. It is expected that this factor would be lower for wet-bottom units.

[d]Limited data preclude any determination of the effect of flyash reinjection. It is expected that particulate emissions would be greater when reinjection is employed.

[e]S is the sulfur content of the lignite by weight, wet basis. For a high sodium-ash lignite (Na_2O > 8 percent) use 17S lb/ton (8.5S kg/MT); for a low sodium-ash lignite (Na_2O < 2 percent), use 35S lb/ton (17.5S kg/MT). For intermediate sodium-ash lignite, or when the sodium-ash content is unknown, use 30S lb/ton (15S kg/MT)). Factors based on References 2, 5, and 6.

[f]Expressed as NO_2. Factors based on References 2, 3, 5, 7, and 9.

[g]Use 14 lb/ton (7 kg/MT) for front-wall-fired and horizontally opposed wall-fired units and 8 lb/ton (4 kg/MT) for tangentially fired units.

[h]Nitrogen oxide emissions may be reduced by 20 to 40 percent with low excess air firing and/or staged combustion in front-fired and opposed-wall-fired units and cyclones.

[i]These factors are based on the similarity of lignite combustion to bituminous coal combustion and on limited data in Reference 7.

References for Section 1.7

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2. Gronhovd, G. H. et al. Some Studies on Stack Emissions from Lignite-Fired Powerplants. (Presented at the 1973 Lignite Symposium. Grand Forks, North Dakota. May 9-10, 1973.)

3. Study to Support Standards of Performance for New Lignite-Fired Steam Generators. Summary Report. Arthur D. Little, Inc., Cambridge, Massachusetts. Prepared for U.S. Environmental Protection Agency, Research Triangle Park, N.C. under contract No. 68-02-1332. July 1974.

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6. Gronhovd, G.H. et al. Comparison of Ash Fouling Tendencies of High and Low-Sodium Lignite from a North Dakota Mine. In: Proceedings of the American Power Conference. Vol. XXVIII. 1966. p. 632-642.

7. Crawford, A. R. et al. Field Testing: Application of Combustion Modifications to Control NO_x Emissions from Utility Boilers. Exxon Research and Engineering Co., Linden, N.J. Prepared for U.S. Environmental Protection Agency, Research Triangle Park, N.C. under Contract No. 68-02-0227. Publication Number EPA-650/2-74-066. June 1974.

8. Engelbrecht, H. L. Electrostatic Precipitators in Thermal Power Stations Using Low Grade Coal. (Presented at 28th Annual Meeting of the American Power Conference. April 26-28, 1966.)

9. Source test data from U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, N.C. 1974.

3. INTERNAL COMBUSTION ENGINE SOURCES

The internal combustion engine in both mobile and stationary applications is a major source of air pollutant emissions. Internal combustion engines were responsible for approximately 73 percent of the carbon monoxide, 56 percent of the hydrocarbons, and 50 percent of the nitrogen oxides (NO_X as NO_2) emitted during 1970 in the United States.[1] These sources, however, are relatively minor contributors of total particulate and sulfur oxides emissions. In 1970, nationwide, internal combustion sources accounted for only about 2.5 percent of the total particulate and 3.4 percent of the sulfur oxides.[1]

The three major uses for internal combustion engines are: to propel highway vehicles, to propel off-highway vehicles, and to provide power from a stationary position. Associated with each of these uses are engine duty cycles that have a profound effect on the resulting air pollutant emissions from the engine. The following sections describe the many applications of internal combustion engines, the engine duty cycles, and the resulting emissions.

DEFINITIONS USED IN CHAPTER 3

Calendar year – A cycle in the Gregorian calendar of 365 or 366 days divided into 12 months beginning with January and ending with December.

Catalytic device – A piece of emission control equipment that is anticipated to be the major component used in post 1974 light-duty vehicles to meet the Federal emission standards.

Cold vehicle operation – The first 505 seconds of vehicle operation following a 4-hour engine-off period. (for catalyst vehicles a 1-hour engine-off period).

Composite emission factor (highway vehicle) – The emissions of a vehicle in gram/mi (g/km) that results from the product of the calendar year emission rate, the speed correction factor, the temperature correction factor, and the hot/cold weighting correction factor.

Crankcase emissions – Airborne substance emitted to the atmosphere from any portion of the crankcase ventilation or lubrication systems of a motor vehicle engine.

1975 Federal Test Procecure (FTP) – The Federal motor vehicle emission test as described in the *Federal Register*, Vol. 36, Number 128, July 2, 1971.

Fuel evaporative emissions – Vaporized fuel emitted into the atmosphere from the fuel system of a motor vehicle.

Heavy-duty vehicle – A motor vehicle designated primarily for transportation of property and rated at more than 8500 pounds (3856 kilograms) gross vehicle weight (GVW) or designed primarily for transportation of persons and having a capacity of more than 12 persons.

High-altitude emission factors – Substantial changes in emission factors from gasoline-powered vehicles occur as altitude increases. These changes are caused by fuel metering enrichment because of decreasing air density. No relationship between mass emissions and altitude has been developed. Tests have been conducted at near sea level and at approximately 5000 feet (1524 meters) above sea level, however. Because most major U.S. urban areas at high altitude are close to 5000 feet (1524 meters), an arbitrary value of 3500 ft (1067 m) and above is used to define high-altitude cities.

Horsepower-hours – A unit of work.

Hot/cold weighting correction factor – The ratio of pollutant exhaust emissions for a given percentage of cold operation (w) to pollutant exhaust emissions measured on the 1975 Federal Test Procedure (20 percent cold operation) at ambient temperature (t).

Light-duty truck – Any motor vehicle designated primarily for transportation of property and rated at 8500 pounds (3856 kilograms) GVW or less. Although light-duty trucks have a load carrying capability that exceeds that of passenger cars, they are typically used primarily for personal transportation as passenger car substitutes.

Light-duty vehicle (passenger car) – Any motor vehicle designated primarily for transportation of persons and having a capacity of 12 persons or less.

Modal emission model – A mathematical model that can be used to predict the warmed-up exhaust emissions for groups of light-duty vehicles over arbitrary driving sequences.

Model year – A motor vehicle manufacturer's annual production period. If a manufacturer has no annual production period, the term "model year" means a calendar year.

Model year mix – The distribution of vehicles registered by model year expressed as a fraction of the total vehicle population.

Nitrogen oxides – The sum of the nitric oxide and nitrogen dioxide contaminants in a gas sample expressed as if the nitric oxide were in the form of nitrogen dioxide. All nitrogen oxides values in this chapter are corrected for relative humidity.

Speed correction factor – The ratio of the pollutant (p) exhaust emission factor at speed "x" to the pollutant (p) exhaust emission factor as determined by the 1975 Federal Test Procedure at 19.6 miles per hour (31.6 kilometers per hour).

Temperature correction factor – The ratio of pollutant exhaust emissions measured over the 1975 Federal Test Procedure at ambient temperature (t) to pollutant exhaust emissions measured over the 1975 Federal Test Procedure at standard temperature conditions (68 to 86°F).

Reference

1. Cavender, J., D. S. Kircher, and J. R. Hammerle. Nationwide Air Pollutant Trends (1940-1970). U. S. Environmental Protection Agency, Office of Air and Water Programs. Research Triangle Park, N.C. Publication Number AP-115. April 1973.

3.1 HIGHWAY VEHICLES

Passenger cars, light trucks, heavy trucks, and motorcycles comprise the four main categories of highway vehicles. Within each of these categories, powerplant and fuel variations result in significantly different emission characteristics. For example, heavy trucks may be powered by gasoline or diesel fuel or operate on a gaseous fuel such as compressed natural gas (CNG).

It is important to note that highway vehicle emission factors change with time and, therefore, must be calculated for a specific time period, normally one calendar year. The major reason for this time dependence is the gradual replacement of vehicles without emission control equipment by vehicles with control equipment, as well as the gradual deterioration of vehicles with control equipment as they accumulate age and mileage. The emission factors presented in this chapter cover only calendar years 1971 and 1972 and are based on analyses of actual tests of existing sources and control systems. Projected emission factors for future calendar years are no longer presented in this chapter because projections are "best guesses" and are best presented independently of analytical results. The authors are aware of the necessity for forecasting emissions; therefore, projected emission factors are available in Appendix D of this document.

Highway vehicle emission factors are presented in two forms in this chapter. Section 3.1.1 contains average emission factors for calendar year 1972 for selected values of vehicle miles traveled by vehicle type (passenger cars, light trucks, and heavy trucks), ambient temperature, cold/hot weighting, and average vehicle speed. The section includes one case that represents the average national emission factors as well as thirteen other scenarios that can be used to assess the sensitivity of the composite emission factor to changing input conditions. All emission factors are given in grams of pollutant per kilometer traveled (and in grams of pollutant per mile traveled).

The emission factors given in sections 3.1.2 through 3.1.7 are for individual classes of highway vehicles and their application is encouraged if specific statistical data are available for the area under study. The statistical data required include vehicle registrations by model year and vehicle type, annual vehicle travel in miles or kilometers by vehicle type and age, average ambient temperature, percentage of cold-engine operation by vehicle type, and average vehicle speed. When regional inputs are not available, national values (which are discussed) may be applied.

3.1.1 Average Emission Factors for Highway Vehicles

revised by David S. Kircher
and Marcia E. Williams

3.1.1.1 General–Emission factors presented in this section are intended to assist those individuals interested in compiling approximate mobile source emission estimates for large areas, such as an individual air quality region or the entire nation, for calendar year 1972. Projected mobile source emission factors for future years are no longer presented in this section. This change in presentation was made to assure consistency with the remainder of this publication, which contains emission factors based on actual test results on currently controlled sources and pollutants. Projected average emission factors for vehicles are available, however, in Appendix D of this publication.

The emission factor calculation techniques presented in sections 3.1.2 through 3.1.5 of this chapter are strongly recommended for the formulation of localized emission estimates required for air quality modeling or for the evaluation of air pollutant control strategies. Many factors, which vary with geographic location and estimation situation, can affect emission estimates considerably. The factors of concern include average vehicle speed, percentage of cold vehicle operation, percentage of travel by vehicle category (automobiles, light trucks, heavy trucks), and ambient temperature. Clearly, the infinite variations in these factors make it impossible to present composite mobile source emission factors for each application. An effort has been made, therefore, to present average emission factors for a range of conditions. The following conditions are considered for each of these cases:

Average vehicle speed – Two vehicle speeds are considered. The first is an average speed of 19.6 mi/hr (31.6 km/hr), which should be typical of a large percentage of urban vehicle operation. The second is an average speed of 45 mi/hr (72 km/hr), which should be typical of highway or rural operation.

Percentage of cold operation – Three percentages of cold operation are considered. The first (at 31.6 km/hr) assumes that 20 percent of the automobiles and light trucks are operating in a cold condition (representative of vehicle start-up after a long engine-off period) and that 80 percent of the automobiles and light trucks are operating in a hot condition (warmed-up vehicle operation). This condition can be expected to assess the engine temperature situation over a large area for an entire day. The second situation assumes that 100 percent of the automobiles and light trucks are operating in a hot condition (at 72 km/hr). This might be applicable to rural or highway operation. The third situation (at 31.6 km/hr) assumes that 100 percent of the automobiles and light trucks are operating in a cold condition. This might be a worst-case situation around an indirect source such as a sports stadium after an event lets out. In all three situations, heavy-duty vehicles are assumed to be operating in a hot condition.

Percentage of travel by vehicle type – Three situations are considered. The first (at both 31.6 km/hr and 72 km/hr) involves a nationwide mix of vehicle miles traveled by automobiles, light trucks, heavy gasoline trucks, and heavy diesel trucks. The specific numbers are 80.4, 11.8, 4.6, and 3.2 percent of total vehicle miles traveled, respectively.[1, 2] The second (at 31.6 km/hr) examines a mix of vehicle miles traveled that might be found in a central city area. The specific numbers are 63, 32, 2.5, and 2.5 percent, respectively. The third (31.6 km/hr) examines a mix of vehicles that might be found in a suburban location or near a localized indirect source where no heavy truck operation exist. The specific numbers are 88.2, 11.8, 0, and 0 percent, respectively.

Ambient temperature – Two situations at 31.6 km/hr are considered: an average ambient temperature of 24°C (75°F) and an average ambient temperature of 10°C (50°F).

Table 3.1.1-1 presents composite CO, HC, and NO_x factors for the 13 cases discussed above for calendar year 1972. Because particulate emissions and sulfur oxides emissions are not assumed to be functions of the factors discussed above, these emission factors are the same for all scenarios and are also presented in the table. The table entries were calculated using the techniques described and data presented in sections 3.1.2, 3.1.4, and 3.1.5 of this chapter. Examination of Table 3.1.1-1 can indicate the sensitivity of the composite emission factor to various

Table 3.1.1-1. AVERAGE EMISSION FACTORS FOR HIGHWAY VEHICLES, CALENDAR YEAR 1972
EMISSION FACTOR RATING: B

Scenario						Emission factors for highway vehicles									
Vehicle weight mix	Average route speed,		Ambient temperature,		Cold operation,	Carbon monoxide		Hydrocarbons		Nitrogen oxides		Particulate		Sulfur oxides	
	mi/hr	km/hr	°F	°C	%	g/mi	g/km	g/mi	g/km	g/mi	g/km	g/mi	g/km	g/mi	g/km
National average	19.6	31.6	75	24	20	76.5	47.5	10.8	6.7	4.9	3.0	0.60	0.37	0.23	0.14
			50	10	20	97.1	60.3	13.0	8.1	5.4	3.4	0.60	0.37	0.23	0.14
			75	24	100	145	90.0	14.6	9.1	4.6	2.9	0.60	0.37	0.23	0.14
			50	10	100	228	142	22.4	13.9	4.6	2.9	0.60	0.37	0.23	0.14
No heavy-duty travel	19.6	31.6	75	24	20	70.6	43.8	9.6	6.0	4.2	2.6	0.54	0.34	0.13	0.08
			50	10	20	92.9	57.7	11.3	7.0	4.7	2.9	0.54	0.34	0.13	0.08
			75	24	100	146	90.7	13.8	8.6	3.8	2.4	0.54	0.34	0.13	0.08
			50	10	100	234	145	22.1	13.7	3.8	2.4	0.54	0.34	0.13	0.08
Central City	19.6	31.6	75	24	20	78.2	48.6	11.2	7.0	4.8	3.0	0.60	0.37	0.20	0.12
			50	10	20	101	62.7	13.7	8.5	5.3	3.3	0.60	0.37	0.20	0.12
			75	24	100	154	95.6	15.6	9.7	4.5	2.8	0.60	0.37	0.20	0.12
			50	10	100	245	152	24.5	15.2	4.5	2.8	0.60	0.37	0.20	0.12
National average	45	72.5	75	24	0	29.8	18.5	4.7	2.9	8.0	5.0	0.60	0.37	0.23	0.14

conditions. A user who has specific data on the input factors should calculate a composite factor to fit the exact scenario. When specific input factor data are not available, however, it is hoped that the range of values presented in the table will cover the majority of applications. The user should be sure, however, that the appropriate scenario is chosen to fit the situation under analysis. In many cases, it is not necessary to apply the various temperature, vehicle speed, and cold/hot operation correction factors because the basic emission factors (24°C, 31.6 km/hr, 20 percent cold operation, nationwide mix of travel by vehicle category) are reasonably accurate predictors of motor vehicle emissions on a regionwide (urban) basis.

References for Section 3.1.1

1. Highway Statistics 1971. U.S. Department of Transportation. Federal Highway Administration. Washington, D.C. 1972. p. 81.

2. 1972 Census of Transportation. Truck Inventory and Use Survey. U.S. Department of Commerce. Bureau of the Census. Washington, D.C. 1974.

3.1.2 Light-Duty, Gasoline-Powered Vehicles (Automobiles)

by David S. Kircher, Marcia E. Williams, and Charles C. Masser

3.1.2.1 General – Because of their widespread use, light-duty vehicles (automobiles) are responsible for a large share of air pollutant emissions in many areas of the United States. Substantial effort has been expended recently to accurately characterize emissions from these vehicles.[1,2] The methods used to determined composite automobile emission factors have been the subject of continuing EPA research, and, as a result, two different techniques for estimating CO, HC, and NO_x exhaust emission factors are discussed in this section.

The first method, based on the Federal Test Procedure (FTP),[3,4] is a modification of the procedure that was discussed in this chapter in earlier editions of AP-42. The second and newer procedure, "modal" emissions analysis, enables the user to input a specific driving pattern (or driving "cycle") and to arrive at an emissions rate.[5] The modal technique driving "modes", which include idle, steady-speed cruise, acceleration, and deceleration, are of sufficient complexity that computerization was required. Because of space limitations, the computer program and documentation are not provided in this section but are available elsewhere.[5]

In addition to the methodologies presented for calculating CO, HC, and NO_x exhaust emissions, data are given later in this section for emissions in the idle mode, for crankcase and evaporative hydrocarbon emissions, and for particulate and sulfur oxides emissions.

3.1.2.2 FTP Method for Estimating Carbon Monoxide, Exhaust Hydrocarbons and Nitrogen Oxides Emission Factors – This discussion is begun with a note of caution. At the outset, many former users of this method may be somewhat surprised by the organizational and methodological changes that have occurred. Cause for concern may stem from: (1) the apparent disappearance of "deterioration" factors and (2) the apparent loss of the much-needed capability to project future emission levels. There are, however, substantive reasons for the changes implemented herein.

Results from EPA's annual surveillance programs (Fiscal Years 1971 and 1972) are not yet sufficient to yield a statistically meaningful relationship between emissions and accumulated mileage. Contrary to the previous assumption, emission deterioration can be convincingly related not only to vehicle mileage but also to vehicle age. This relationship may not come as a surprise to many people, but the complications are significant. Attempts to determine a functional relationship between *only* emissions and accumulated mileage have indicated that the data can fit a linear form as well as a non-linear (log) form. Rather than attempting to force the data into a mathematical mold, the authors have chosen to present emission factors by both model year and calendar year. The deterioration factors are, therefore, "built in" to the emission factors. This change simplifies the calculations and represents a realistic, sound use of emission surveillance data.

The second change is organizational: emission factors projected to future years are no longer presented in this section. This is in keeping with other sections of the publication, which contains emission factors only for existing sources based on analyses of test results. As mentioned earlier, projections are "best guesses" and are best presented independently of analytical results (see Appendix D).

The calculation of composite exhaust emission factors using the FTP method is given by:

$$e_{npstw} = \sum_{i=n-12}^{n} c_{ipn}\, m_{in}\, v_{ips}\, z_{ipt}\, r_{iptw} \qquad (3.1.2\text{-}1)$$

where: e_{npstw} = Composite emission factor in g/mi (g/km) for calendar year (n), pollutant (p), average speed (s), ambient temperature (t), and percentage cold operation (w)

c_{ipn} = The FTP (1975 Federal Test Procedure) mean emission factor for the i^{th} model year light-duty vehicles during calendar year (n) and for pollutant (p)

m_{in} = The fraction of annual travel by the i^{th} model year light-duty vehicles during calendar year (n)

v_{ips} = The speed correction factor for the i^{th} model year light-duty vehicles for pollutant (p) and average speed (s)

z_{ipt} = The temperature correction factor for the i^{th} model year light-duty vehicles for pollutant (p) and ambient temperature (t)

r_{iptw} = The hot/cold vehicle operation correction factor for the i^{th} model year light-duty vehicles for pollutant (p), ambient temperature (t), and percentage cold operation (w)

The data necessary to complete this calculation for any geographic area are presented in Tables 3.1.2-1 through 3.1.2-8. Each of the variables in equation 3.1.2-1 is described in greater detail below, after which the technique is illustrated by an example.

Table 3.1.2-1. CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR LIGHT-DUTY VEHICLES —EXCLUDING CALIFORNIA—FOR CALENDAR YEAR 1971[a,b] (BASED ON 1975 FEDERAL TEST PROCEDURE) EMISSION FACTOR RATING: A

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low altitude						
Pre-1968	86.5	53.7	8.74	5.43	3.54	2.20
1968	67.8	42.1	5.54	3.44	4.34	2.70
1969	61.7	38.3	5.19	3.22	5.45	3.38
1970	47.6	29.6	3.77	2.34	5.15	3.20
1971	39.6	24.6	3.07	1.91	5.06	3.14
High altitude						
Pre-1968	126.9	78.8	10.16	6.31	1.87	1.17
1968	109.2	67.8	7.34	4.59	2.20	1.37
1969	76.4	47.4	6.31	3.91	2.59	1.61
1970	94.8	58.9	6.71	4.17	2.78	1.73
1971	88.0	54.6	5.6	3.48	3.05	1.89

[a]Note: The values in this table can be used to estimate emissions only for calendar year 1971. This reflects a substantial change over past presentation of data in this chapter (see text for details).
[b]References 1 and 2. These references summarize and analyze the results of emission tests of light-duty vehicles in several U.S. cities.

Table 3.1.2-2. CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR LIGHT-DUTY VEHICLES–STATE OF CALIFORNIA ONLY–FOR CALENDAR YEAR 1971[a,b]
(BASED ON 1975 FEDERAL TEST PROCEDURE)
EMISSION FACTOR RATING: A

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
California						
Pre-1966[c]	86.5	53.7	8.74	5.43	3.54	2.20
1966	65.2	40.5	7.84	4.87	3.40	2.11
1967	67.2	41.7	5.33	3.31	3.42	2.12
1968[c]	67.8	42.1	5.54	3.44	4.34	2.70
1969[c]	61.7	38.3	5.19	3.22	5.45	3.38
1970[c]	50.8	31.5	4.45	2.76	4.62	2.87
1971	42.3	26.3	3.02	1.88	3.83	2.38

[a]Note: The values in this table can be used to estimate emissions only for calendar year 1971. This reflects a substantial change past presentations of data in this chapter (see text for details).
[b]References 1. This reference summarizes and analyzes the results of emission tests of light-duty vehicles in Los Angeles as well as five other U.S. cities during 1971-1972.
[c]Data for these model years are mean emission test values for the five low altitude test cities summarized in Reference 1.

Table 3.1.2.-3. CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR LIGHT-DUTY VEHICLES–EXCLUDING CALIFORNIA–FOR CALENDAR YEAR 1972[a,b]
(BASED ON 1975 FEDERAL TEST PROCEDURE)
EMISSION FACTOR RATING: A

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low altitude						
Pre-1968	93.5	58.1	8.67	5.38	3.34	2.07
1968	63.7	39.6	6.33	3.93	4.44	2.76
1969	64.2	39.9	4.95	3.07	5.00	3.10
1970	53.2	33.0	4.89	3.04	4.35	2.70
1971	51.1	31.7	3.94	2.45	4.30	2.67
1972	36.9	22.9	3.02	1.88	4.55	2.83
High altitude						
Pre-1968	141.0	87.6	11.9	7.39	2.03	1.26
1968	101.4	63.0	6.89	4.26	2.86	1.78
1969	97.8	60.7	5.97	3.71	2.93	1.82
1970	87.5	54.3	5.56	3.45	3.32	2.06
1971	80.3	49.9	5.19	3.22	2.74	1.70
1972	80.4	50.0	4.75	2.94	3.08	1.91

[a]Note: The values in this table can be used to estimate emissions only for calendar year 1972. This reflects a substantial change over past presentation of data in this chapter (see text for details).
[b]Reference 2. This reference summarizes and analyzes the results of emission tests of light-duty vehicles in six U.S. metropolitan areas during 1972-1973.

Table 3.1.2-4. CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR LIGHT-DUTY VEHICLES–STATE OF CALIFORNIA ONLY–FOR CALENDAR YEAR 1972[a,b] (BASED ON 1975 FEDERAL TEST PROCEDURE) EMISSION FACTOR RATING: A

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
California						
Pre-1966[c]	93.5	58.1	8.67	5.38	3.34	2.07
1966	86.9	54.0	7.46	4.63	3.43	2.13
1967	75.4	46.8	5.36	3.33	3.77	2.34
1968[c]	63.7	39.6	6.33	3.93	4.44	2.76
1969[c]	64.2	39.9	4.95	3.07	5.00	3.10
1970	78.5	48.7	6.64	4.12	4.46	2.77
1971	59.7	37.1	3.98	2.47	3.83	2.38
1972	46.7	29.0	3.56	2.21	3.81	2.37

[a]Note: The values in this table can be used to estimate emissions only for calendar year 1972. This represents a substantial change over past presentation of data in this chapter (see text for details).
[b]Reference 2. This reference summarizes and analyzes the results of emission tests of light-duty vehicles in Los Angeles as well as in five other U.S. cities during 1972-1973.
[c]Data for these model years are mean emission test values for the five low altitude test cities summarized in Reference 2.

Table 3.1.2-5. SAMPLE CALCULATION OF FRACTION OF LIGHT-DUTY VEHICLE ANNUAL TRAVEL BY MODEL YEAR[a]

Age, years	1972 Fraction of total vehicles in use nationwide (a)[b]	Average annual miles driven (b)[c]	a x b	1972 Fraction of annual travel (m)[d]
1	0.083	15,900	1,320	0.116
2	0.103	15,000	1,545	0.135
3	0.102	14,000	1,428	0.125
4	0.106	13,100	1,389	0.122
5	0.099	12,200	1,208	0.106
6	0.087	11,300	983	0.086
7	0.092	10,300	948	0.083
8	0.088	9,400	827	0.072
9	0.068	8,500	578	0.051
10	0.055	7,600	418	0.037
11	0.039	6,700	261	0.023
12	0.021	6,700	141	0.012
≥13	0.057	6,700	382	0.033

[a]References 6 and 7.
[b]These data are for July 1, 1972, from Reference 7 and represent the U.S. population of light-duty vehicles by model year for that year only.
[c]Mileage values are the results of at least squares analysis of data in Reference 6.
[d]$m = ab/\Sigma ab$.

Table 3.1.2-6. COEFFICIENTS FOR SPEED CORRECTION FACTORS FOR LIGHT-DUTY VEHICLES[a,b]

Location	Model year	$v_{ips} = e^{(A + BS + CS^2)}$						$v_{ips} = A + BS$	
		Hydrocarbons			Carbon monoxide			Nitrogen oxides	
		A	B	C	A	B	C	A	B
Low altitude (Excluding 1966-1967 Calif.)	1957-1967	0.953	-6.00×10^{-2}	5.81×10^{-4}	0.967	-6.07×10^{-2}	5.78×10^{-4}	0.808	0.980×10^{-2}
California	1966-1967	0.957	-5.98×10^{-2}	5.63×10^{-4}	0.981	-6.22×10^{-2}	6.19×10^{-4}	0.844	0.798×10^{-2}
Low altitude	1968	1.070	-6.63×10^{-2}	5.98×10^{-4}	1.047	-6.52×10^{-2}	6.01×10^{-4}	0.888	0.569×10^{-2}
	1969	1.005	-6.27×10^{-2}	5.80×10^{-4}	1.259	-7.72×10^{-2}	6.60×10^{-4}	0.915	0.432×10^{-2}
	1970	0.901	-5.70×10^{-2}	5.59×10^{-4}	1.267	-7.72×10^{-2}	6.40×10^{-4}	0.843	0.798×10^{-2}
	1971-1972	0.943	-5.92×10^{-2}	5.67×10^{-4}	1.241	-7.52×10^{-2}	6.09×10^{-4}	0.843	0.804×10^{-2}
High altitude	1957-1967	0.883	-5.58×10^{-2}	5.52×10^{-4}	0.721	-4.57×10^{-2}	4.56×10^{-4}	0.602	2.027×10^{-2}
	1968	0.722	-4.63×10^{-2}	4.80×10^{-4}	0.662	-4.23×10^{-2}	4.33×10^{-4}	0.642	1.835×10^{-2}
	1969	0.706	-4.55×10^{-2}	4.84×10^{-4}	0.628	-4.04×10^{-2}	4.26×10^{-4}	0.726	1.403×10^{-2}
	1970	0.840	-5.33×10^{-2}	5.33×10^{-4}	0.835	-5.24×10^{-2}	4.98×10^{-4}	0.614	1.978×10^{-2}
	1971-1972	0.787	-4.99×10^{-2}	4.99×10^{-4}	0.894	-5.54×10^{-2}	4.99×10^{-4}	0.697	1.553×10^{-2}

[a]Reference 8. Equations should not be extended beyond the range of the data (15 to 45 mi/hr; 24 to 72 km/hr). For speed correction factors at low speeds (5 and 10 mi/hr; 8 and 16 km/hr) see Table 3.1.2-7.

[b]The speed correction factor equations and coefficients presented in this table are expressed in terms of english units (miles per hour). In order to perform calculations using the metric system of units, it is suggested that kilometers per hour be first converted to miles per hour (1 km/hr = 0.621 mi/hr). Once speed correction factors are determined, all other calculations can be performed using metric units.

Table 3.1.2-7. LOW AVERAGE SPEED CORRECTION FACTORS FOR LIGHT-DUTY VEHICLES[a]

Location	Model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
		5 mi/hr (8 km/hr)	10 mi/hr (16 km/hr)	5 mi/hr (8 km/hr)	10 mi/hr (16 km/hr)	5 mi/hr (8 km/hr)	10 mi/hr (16 km/hr)
Low altitude (Excluding 1966-1967 Calif.)	1957-1967	2.72	1.57	2.50	1.45	1.08	1.03
California	1966-1967	1.79	1.00	1.87	1.12	1.16	1.09
Low altitude	1968	3.06	1.75	2.96	1.66	1.04	1.00
	1969	3.57	1.86	2.95	1.65	1.08	1.05
	1970	3.60	1.88	2.51	1.51	1.13	1.05
	1971-1972	4.15	2.23	2.75	1.63	1.15	1.03
High altitude	1957-1967	2.29	1.48	2.34	1.37	1.33	1.20
	1968	2.43	1.54	2.10	1.27	1.22	1.18
	1969	2.47	1.61	2.04	1.22	1.22	1.08
	1970	2.84	1.72	2.35	1.36	1.19	1.11
	1971-1972	3.00	1.83	2.17	1.35	1.06	1.02

[a]Driving patterns developed from CAPE-21 vehicle operation data (Reference 9) were input to the modal emission analysis model (see section 3.1.2.3). The results predicted by the model (emissions at 5 and 10 mi/hr; 8 and 16 km/hr) were divided by FTP emission factors for hot operation to obtain the above results. The above data are approximate and represent the best currently available information.

Table 3.1.2-8. LIGHT-DUTY VEHICLE TEMPERATURE CORRECTION FACTORS AND HOT/COLD VEHICLE OPERATION CORRECTION FACTORS FOR FTP EMISSION FACTORS[a]

Pollutant	Temperature correction (z_{ipt})[b]	Hot/Cold operation correction [f(t)][b]
Carbon monoxide	–0.0127 t + 1.95	0.0045 t + 0.02
Hydrocarbons	–0.0113 t + 1.81	0.0079 t + 0.03
Nitrogen oxides	–0.0046 t + 1.36	–0.0068 t + 1.64

[a]Reference 10. Temperature (t) is expressed in °F. In order to apply these equations, °C must be first converted to °F. The appropriate conversion formula is: F=(9/5)C + 32. For temperatures expressed on the Kelvin (K) scale: F=9/5(K-273.16) + 32.
[b]The formulae for z_{ipt} enable the correction of the FTP emission factors for ambient temperature effects only. The amount of cold/hot operation is not affected. The formulae for f(t), on the other hand, are part of equation 3.1.2-2 for calculating r_{iptw}. The variable r_{iptw} corrects for cold/hot operation as well as ambient temperature.

Note: z_{ipt} can be applied without r_{iptw}, but not vica versa.

FTP emission factor (c_{ipn}). The results of the first two EPA annual light-duty vehicle surveillance programs are summarized in Tables 3.1.2-1 through 3.1.2-4. These data for calendar years 1971 and 1972 are divided by geographic area into: low altitude (excluding California), high altitude (excluding California), and California only. California emission factors are presented separately because, for several model years, California vehicles have been subject to emission standards that differ from standards applicable to vehicles under the Federal emission control program. For those model year vehicles for which California did not have separate emission standards, the national emission factors are assumed to apply in California as well. Emissions at high altitude are differentiated from those at low altitude to account for the effect that altitude has on air-fuel ratios and concomitant emissions. The tabulated values are applicable to calendar years 1971 and 1972 for each model year.

Fraction of annual travel by model year (m_i). A sample calculation of this variable is presented in Table 3.1.2-5. In the example, nationwide statistics are used, and the fraction of in-use vehicles by model year (vehicle age) is weighted on the basis of the annual miles driven. The calculation may be "localized" to reflect local (county, state, etc.) vehicle age mix, annual miles driven, or both. Otherwise, the national data can be used. The data presented in Table 3.1.2-5 are for calendar year 1972 only; for later calendar years, see Appendix D.

Speed Correction Factors (v_{ips}). Speed correction factors enable the "adjustment" of FTP emission factors to account for differences in average route speed. Because the implicit average route speed of the FTP is 19.6 mi/hr (31.6 km/hr), estimates of emissions at higher or lower average speeds require a correction.

It is important to note the difference between "average route speed" and "steady speed". Average route speed is trip-related and based on a composite of the driving modes (idle, cruise, acceleration, deceleration) encountered, for example, during a typical home-to-work trip. Steady speed is highway facility-oriented. For instance, a group of vehicles traveling over an uncongested freeway link (with a volume to capacity ratio of 0.1, for example) might be traveling at a steady speed of about 55 mi/hr (89 km/hr). Note, however, that steady speeds, even at the link level, are unlikely to occur where resistance to traffic flow occurs (unsynchronized traffic signaling, congested flow, etc.)

In previous revisions to this section, the limited data available for correcting for average speed were presented graphically. Recent research, however, has resulted in revised speed relationships by model year.[8] To facilitate the presentation, the data are given as equations and appropriate coefficients in Table 3.1.2-6. These relationships were developed by performing five major tasks. First, urban driving pattern data collected during the CAPE-10 Vehicle Operations Survey[11] were processed by city and time of day into freeway, non-freeway, and composite speed-mode matrices. Second, a large number of driving patterns were computer-generated for a range of average speeds (15 to 45 mi/hr; 24 to 72 km/mi) using weighted combinations of freeway and non-freeway matrices. Each of these patterns was filtered for "representativeness." Third, the 88 resulting patterns were input (second-by-second speeds) to the EPA modal emission analysis model (see sections 3.1.2.3). The output of the model was estimated emissions for each pattern of 11 vehicle groups (see Table 3.1.2.6 for a listing of these groups). Fourth, a regression analysis was performed to relate estimated emissions to average route speed for each of the 11 vehicle groups. Fifth, these relationships were normalized to 19.6 mi/hr (31.6 km/hr) and summarized in Table 3.1.2-6.

The equations in Table 3.1.2-6 apply only for the range of the data – from 15 to 45 mi/hr (24 to 72 km/hr). Because there is a need, in some situations, to estimate emissions at very low average speeds, correction factors for 5 and 10 mi/hr (8 and 16 km/hr) presented in Table 3.1.2-7 were developed using a method somewhat like that described above, again using the modal emission model. The modal emission model predicts emissions from warmed-up vehicles. The use of this model to develop speed correction factors makes the assumption that a given speed correction factor applies equally well to hot and cold vehicle operation. Estimation of warmed-up idle emissions are presented in section 3.1.2.4 on a gram per minute basis.

Temperature Correction Factor (z_{ipt}). The 1975 FTP requires that emissions measurements be made within the limits of a relatively narrow temperature band (68 to 86°F). Such a band facilitates uniform testing in laboratories without requiring extreme ranges of temperature control. Present emission factors for motor vehicles are based on data from the standard Federal test (assumed to be at 75°F). Recently, EPA and the Bureau of Mines undertook a test program to evaluate the effect of ambient temperature on motor vehicle exhaust emission levels.[10] The study indicates that changes in ambient temperature result in significant changes in emissions during cold start-up operation. Because many Air Quality Control Regions have temperature characteristics differing considerably from the 68 to 86°F range, the temperature correction factor should be applied. These correction factors, which can be applied between 20 and 80°F, are presented in Table 3.1.2-8. For temperatures outside this range, the appropriate endpoint correction factor should be applied.

Hot/Cold Vehicle Operation Correction Factor (r_{iptw}). The 1975 FTP measures emissions during: a cold transient phase (representative of vehicle start-up after a long engine-off period), a hot transient phase (representative of vehicle start-up after a short engine-off period), and a stabilized phase (representative of warmed-up vehicle operation). The weighting factors used in the 1975 FTP are 20 percent, 27 percent, and 53 percent of total miles (time) in each of the three phases, respectively. Thus, when the 1975 FTP emission factors are applied to a given region for the purpose of accessing air quality, 20 percent of the light-duty vehicles in the area of interest are assumed to be operating in a cold condition, 27 percent in a hot start-up condition, and 53 percent in a hot stabilized condition. For non-catalyst equipped vehicles (all pre-1975 model year vehicles), emissions in the two hot phases are essentially equivalent on a grams per mile (grams per kilometer basis). Therefore, the 1975 FTP emission factor represents 20 percent cold operation and 80 percent hot operation.

Many situations exist in which the application of these particular weighting factors may be inappropriate. For example, light-duty vehicle operation in the center city may have a much higher percentage of cold operation during the afternoon peak when work-to-home trips are at a maximum and vehicles have been standing for 8 hours. The hot/cold vehicle operation correction factor allows the cold operation phase to range from 0 to 100 percent of total light-duty vehicle operations. This correction factor is a function of the percentage of cold operation (w) and the ambient temperature (t). The correction factor is:

$$r_{iptw} = \frac{w + (100-w)\ f(t)}{20 + 80f(t)} \qquad (3.1.2\text{-}2)$$

where: f(t) is given in Table 3.1.2-8.

Sample Calculation. As a means of further describing the application of equation 3.1.2-1, calculation of the carbon monoxide composite emission factor is provided as an example. To perform this calculation (or any calculation using this procedure), the following questions must be answered:

1. What calendar year is being considered?
2. What is the average vehicle speed in the area of concern?
3. Is the area at low altitude (non-California), in California, or at high altitude?
4. Are localized vehicle mix and/or annual travel data available?
5. Which pollutant is to be estimated? (For non-exhaust hydrocarbons see section 3.1.2.5).
6. What is the ambient temperature (if it does not fall within the 68 to 86°F Federal Test Procedure range)?
7. What percentage of vehicle operation is cold operation (first 500 seconds of operation after an engine-off period of at least 4 hours)?

For this example, the composite carbon monoxide emission factor for 1972 will be estimated for a hypothetical county. Average vehicle speed for the county is assumed to be 30 mi/hr. The county is at low altitude (non-California), and localized vehicle mix/annual travel data are unavailable (nationwide statistics are to be used). The ambient temperature is assumed to be 50°F and the percentage of cold vehicle operation is assumed to be 40 percent. To simplify the presentation, the appropriate variables are entered in the following tabulation.

Model year(s)	c_{ipn}	m_{in}	Variables,[a] v_{ips}	z_{ipt}	r_{iptw}	$(c_{ipn})(m_{in})(v_{ips})(z_{ipt})(r_{iptw})$
Pre-1968	58.1	0.396	0.72	1.315	1.39	30.3
1968	39.6	0.106	0.69	1.315	1.39	5.3
1969	39.9	0.122	0.63	1.315	1.39	5.6
1970	33.0	0.125	0.62	1.315	1.39	4.7
1971	31.7	0.135	0.63	1.315	1.39	4.9
1972	22.9	0.116	0.63	1.315	1.39	3.1
						e_{npstw} = 53.9 g/km

[a]The variable c_{ipn} above is from Table 3.1.2-3, and the variable m_{in} was taken from the sample calculation based on nationwide data, Table 3.1.2-5. The fraction of travel for pre-1968 (6 years old and older) vehicles is the sum of the last eight values in the far right-hand column of the table. The speed correction factor (v_{ips}) was calculated from the appropriate equations in Table 3.1.2-6. The variable z_{ipt} was calculated from the appropriate equation in Table 3.1.2-8. The variable r_{iptw} was calculated using an equation from Table 3.1.2-8 and equation 3.1.2-2.

The resultant composite carbon monoxide emission factor for 1972 for the hypothetical county is 53.9 g/km.

3.1.2.3 Modal Emission Model for Estimating Carbon Monoxide, Hydrocarbons, and Nitrogen Oxides Emission Factors – The modal emission model and allied computer programs permit an analyst to calculate mass emission quantities of carbon monoxide, hydrocarbons, and nitrogen oxides emitted by individual vehicles or groups of vehicles over any specified driving sequence or pattern. The complexity of the model and accompanying computer programs makes presentation of the entire procedure in this publication impractical. Instead, the capabilities and limitations of the model are briefly described in the following paragraphs with the details to be found in a separate report, *Automobile Exhaust Emission Modal Analysis Model.*[5]

The modal emission model was developed because of the well-established fact that emission rates for a particular vehicle depend upon the manner in which it is operated. Stated another way, the emissions from a particular vehicle are a function of the time it spends in each of four general operating modes (idle, cruise, deceleration, acceleration) as well as specific operation within each of the four modes. In many situations, use of the basic FTP emission factors may be sufficient. Certainly, nationwide, statewide, and county-wide emission estimates that involve spatial aggregation of vehicular travel data lend themselves to the FTP method (section 3.1.2.2). There are, however, a relatively large number of circumstances for which an analyst may require emission estimates at a zonal or link level of aggregation. The analyst, for example, may be faced with providing inputs to a carbon monoxide dispersion model, estimating the impact of an indirect source (sports complex, shopping center, etc.), or preparing a highway impact statement. In such instances, the resources may be available to determine the necessary inputs to the modal model either by estimation or field studies. These data are input to the modal model and emission estimates are output.

Although the computer software package is sufficiently flexible to accept any set of input modal emission data, EPA data based on tests of 1020 individual light-duty vehicles (automobiles) that represent variations in model year, manufacture, engine and drive train equipment, accumulated mileage, state of maintenance, attached pollution abatement devices, and geographic location are a part of the package. The user, therefore, need not input any modal emission data. He inputs the driving sequence desired as speed (mi/hr) versus time (sec) in 1-second intervals and specifies the vehicle mix for which emission estimates are desired (vehicles are grouped by model year and geographic location). The output of the model can then be combined with the appropriate traffic volume for the desired time period to yield an emission estimate. The use of the modal emission model to estimate a composite emission factor does not, however, eliminate the need for temperature and cold/hot weighting correction factors. The model predicts emissions from warmed-up vehicles at an ambient temperature of approximately 75°F. The estimate of composite exhaust emission factors using the modal emission model is given by:

$$e_{ptw} = c_p \, a_{pt} \, b_{ptw} \qquad (3.1.2\text{-}3)$$

where: e_{ptw} = Composite emission factor in grams per mile (g/km) for calendar year 1971, pollutant (p), ambient temperature (t), percentage cold operation (w), and the specific driving sequence and vehicle mix specified

c_p = The mean emission factor for pollutant (p) for the specified vehicle mix and driving sequence

a_{pt} = The temperature correction factor for pollutant (p) and temperature (t) for warmed-up operation

b_{ptw} = The hot/cold vehicle operation correction factor for pollutant (p), temperature (t), and percentage cold operation (w)

The data necessary to compute a_{pt} and b_{ptw} are given in Table 3.1.2-9. The modal analysis computer program is necessary to compute c_p.[5]

Table 3.1.2-9. LIGHT-DUTY VEHICLE MODAL EMISSION MODEL CORRECTION FACTORS FOR TEMPERATURE AND COLD/HOT START WEIGHTING[a]

Pollutant	Temperature correction (a_{pt})	Hot/cold temperature correction [f(t)]
Carbon monoxide	1.0	0.0045 t + 0.02
Hydrocarbons	1.0	0.0079 t + 0.03
Nitrogen oxides	–0.0065 t + 1.49	–0.0068 t + 1.64

[a]Reference 10. Temperature is expressed in °F. In order to apply these equations, convert °C to °F (F=9/5C + 32); or °K to °F (F=9/5(K-273.16) + 32).

Temperature Correction Factor (a_{pt}). The modal analysis model predicts emissions at approximately 75°F. The temperature correction factors are expressed in equational form and presented in Table 3.1.2-9.

Hot/Cold Vehicle Operation Correction Factor (b_{ptw}). The modal analysis model predicts emissions during warmed-up vehicle operation, but there are many urban situations for which this assumption is not appropriate. The hot/cold vehicle operation correction factor allows for the inclusion of a specific percentage of cold operation. This correction factor is a function of the percentage of cold operation (w) and the ambient temperature (t). The correction factor is:

$$b_{ptw} = \frac{w + (100-w)f(t)}{100\ f(t)} \qquad (3.1.2\text{-}4)$$

where: f(t) is given in Table 3.1.2-9.

It is important that potential users of modal analysis recognize of the important limitations of the model. Although the model provides the capability of predicting emission estimates for any driving pattern, it can only predict emissions for the vehicle groups that have been tested. Presently this capability is limited to 1971 and older light-duty vehicles. Efforts are underway to add additional model years (1972-1974), and new models will be tested as they become available. Although the model is not directly amenable to projecting future year emissions, it can predict "base" year emissions. Future year emissions can be estimated using the ratio of future year to base year emissions based on FTP composite emission factors. Finally, the technique requires the input of a driving sequence and the use of a computer, and is therefore, more complex and more costly to use than the simple FTP technique (section 3.1.2.1).

The modal procedure discussion in this section is recommended when the user is interested in comparing emissions over several different specific driving scenarios. Such an application will result in more accurate comparisons than can be obtained by the method given in section 3.1.2.2. For other applications where average speed is all that is known or when calendar year to calendar year comparisons are required, the method in section 3.1.2.2 is recommended.

3.1.2.4 Carbon Monoxide, Hydrocarbon, and Nitrogen Oxides Idle Emission Factors – Estimates of emissions during a vehicles' idle operating mode may be appropriate at trip attractions such as shopping centers, airports, sports complexes, etc. Because idle emission factors are expressed (by necessity) in terms of elapsed time, emissions at idle can be estimated using vehicle operating minutes rather than the conventional vehicle miles of travel.

Application of the idle values (Table 3.1.2-10) requires calculation of a composite idle emission factor (c_p) through the use of the variable m_{in}(see section 3.1.2.2) and i_{ip} (idle pollutant p emission factor for the i^{th} model year). The temperature and hot/cold weighting factors presented in Table 3.1.2-9 apply to idle emissions. The tabulated values are based on warmed-up emissions. (For a_{pt}, see Table 3.1.2-9; for b_{ptw}, see Table 3.1.2-9 and equation 3.1.2-4.)

Table 3.1.2-10. CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EMISSION FACTORS FOR LIGHT-DUTY VEHICLES IN WARMED-UP IDLE MODE[a]
(grams/minute)

Location and model year(s)	Carbon monoxide	Exhaust hydrocarbons	Nitrogen oxides
Low altitude			
Pre-1968	16.9	1.63	0.08
1968	15.8	1.32	0.12
1969	17.1	1.17	0.12
1970	13.1	0.73	0.13
1971	13.0	0.63	0.11
High altitude			
Pre-1968	18.6	1.83	0.11
1968	16.8	1.09	0.11
1969	16.6	0.90	0.10
1970	16.6	1.13	0.11
1971	16.9	0.80	0.16
California only (low altitude)			
Pre-1966	16.9	1.63	0.08
1966	18.7	1.27	0.07
1967	18.7	1.27	0.07
1968	15.8	1.32	0.12
1969	17.1	1.17	0.12
1970	19.3	0.76	0.28
1971	13.3	0.78	0.18

[a]Reference 12.

The mathematical expression is simply:

$$c_p = \sum_{i=n-12}^{n} i_{ip}\ m_{in}\ a_{pt}\ b_{ptw} \qquad (3.1.2\text{-}5)$$

Because the idle data are from the same data base used to develop the modal analysis procedure, they are subject to the same limitations. Most importantly, idle values cannot be directly used to estimate future emissions.

3.1.2.5 Crankcase and Evaporative Hydrocarbon Emission Factors – In addition to exhaust emission factors, the calculation of hydrocarbon emission from gasoline motor vehicles involves evaporative and crankcase hydrocarbon emission factors. Composite crankcase emissions can be determined using:

$$f_n = \sum_{i=n-12}^{n} h_i\ m_{in} \qquad (3.1.2\text{-}6)$$

where: f_n = The composite crankcase hydrocarbon emission factor for calendar year (n)

h_i = The crankcase emission factor for the i^{th} model year

m_{in} = The weighted annual travel of the i^{th} year during calendar year (n)

Crankcase hydrocarbon emission factor by model year are summarized in Table 3.1.2-11.

The two major sources of evaporative hydrocarbon emissions from light-duty vehicles are the fuel tank and the carburetor system. Diurnal changes in ambient temperature result in expansion of the air-fuel mixture in a partially filled fuel tank. As a result, gasoline vapor is expelled to the atmosphere. Running losses from the fuel tank occur as the fuel is heated by the road surface during driving, and hot-soak losses from the carburetor system occur after engine shut down at the end of a trip. These carburetor losses are from locations such as: the

Table 3.1.2-11. CRANKCASE HYDROCARBON EMISSIONS BY MODEL YEAR FOR LIGHT-DUTY VEHICLES EMISSION FACTOR RATING: B

Model year	Hydrocarbons g/mi	Hydrocarbons g/km
California only		
Pre-1961	4.1	2.5
1961 through 1963	0.8	0.5
1964 through 1967	0.0	0.0
Post-1967	0.0	0.0
All areas except California		
Pre-1963	4.1	2.5
1963 through 1967	0.8	0.5
Post-1967	0.0	0.0

[a]Reference 13.

carburetor vents, the float bowl, and the gaps around the throttle and choke shafts. Because evaporative emissions are a function of the diurnal variation in ambient temperature and the number of trips per day, emissions are best calculated in terms of evaporative emissions per day per vehicle. Emissions per day can be converted to emissions per mile (if necessary) by dividing by an average daily miles per vehicle value. This value is likely to vary from location to location, however. The composite evaporative hydrocarbon emission factor is given by:

$$e_n = \sum_{i=n-12}^{n} (g_i + k_i d)(m_i) \qquad (3.1.2\text{-}7)$$

where: e_n = The composite evaporative hydrocarbon emission factor for calendar year (n) in lb/day (g/day)

g_i = The diurnal evaporative hydrocarbon emission factor for model year (i) in lb/day (g/day)

k_i = The hot soak evaporative emission factor in lb/trip (g/trip) for the i^{th} model year

d = The number of daily trips per vehicle (3.3 trips/vehicle-day is the nationwide average)

m_i = The fraction of annual travel by the i^{th} model year during calendar year n

The variables g_i and k_i are presented in Table 3.1.2-12 by model year.

Table 3.1.2-12. EVAPORATIVE HYDROCARBON EMISSION FACTORS BY MODEL YEAR FOR LIGHT-DUTY VEHICLES[a]
EMISSION FACTOR RATING: A

Location and model year	By source[b]		Composite emissions[c]		
	Diurnal, g/day	Hot soak, g/trip	g/day	g/mi	g/km
Low altitude					
Pre-1970	26.0	14.7	74.5	2.53	1.57
1970 (Calif.)	16.3	10.9	52.3	1.78	1.11
1970 (non-Calif.)	26.0	14.7	74.5	2.53	1.57
1971	16.3	10.9	52.3	1.78	1.11
1972	12.1	12.0	51.7	1.76	1.09
High altitude[d]					
Pre-1971	37.4	17.4	94.8	3.22	2.00
1971-1972	17.4	14.2	64.3	2.19	1.36

[a]References 1, 14 and 15.
[b]See text for explanation.
[c]Gram per day values are diurnal emissions plus hot soak emisssions multiplied by the average number of trips per day. Nationwide data from References 16 and 17 indicate that the average vehicle is used for 3.3 trips per day. Gram per mile values were determined by dividing average g/day by the average nationwide travel per vehicle (29.4 mi/day) from Reference 16.
[d]Vehicles without evaporative control were not tested at high altitude. Values presented here are the product of the ratio of pre-1971 (low altitude) evaporative emissions to 1972 evaporative emissions and 1971-1972 high altitude emissions.

3.1.2.6 Particulate and Sulfur Oxide Emissions – Light-duty, gasoline-powered vehicles emit relatively small quantities of particulate and sulfur oxides in comparison with the emissions of the three pollutants discussed above. For this reason, average rather than composite emission factors should be sufficiently accurate for approximating particulate and sulfur oxide emissions from light-duty, gasoline-powered vehicles. Average emission factors for these pollutants are presented in Table 3.1.2-13. No Federal standards for these two pollutants are presently in effect, although many areas do have opacity (antismoke) regulations applicable to motor vehicles.

Table 3.1.2-13. PARTICULATE AND SULFUR OXIDES EMISSION FACTORS FOR LIGHT-DUTY VEHICLES
EMISSION FACTOR RATING: C

Pollutant	Emissions for Pre-1973 vehicles	
	g/mi	g/km
Particulate[a]		
Exhaust	0.34	0.21
Tire wear	0.20	0.12
Sulfur oxides[b] (SO_x as SO_2)	0.13	0.08

[a]References 18, 19, and 20.
[b]Based on an average fuel consumption of 13.6 mi/gal (5.8 km/liter) from Reference 21 and on the use of a fuel with a 0.032 percent sulfur content from References 22 through 24 and a density of 6.1 lb/gal (0.73 kg/liter) from References 22 and 23.

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3.1.3 Light-Duty, Diesel-Powered Vehicles

by David S. Kircher

3.1.3.1 General – In comparison with the conventional, "uncontrolled," gasoline-powered, spark-ignited, automotive engine, the uncontrolled diesel automotive engine is a low pollution powerplant. In its uncontrolled form, the diesel engine emits (in grams per mile) considerably less carbon monoxide and hydrocarbons and somewhat less nitrogen oxides than a comparable uncontrolled gasoline engine. A relatively small number of light-duty diesels are in use in the United States.

3.1.3.2 Emissions – Carbon monoxide, hydrocarbons, and nitrogen oxides emission factors for the light-duty, diesel-powered vehicle are shown in Table 3.1.3-1. These factors are based on tests of several Mercedes 220D automobiles using a slightly modified version of the Federal light-duty vehicle test procedure.[1,2] Available automotive diesel test data are limited to these results. No data are available on emissions versus average speed. Emissions from light-duty diesel vehicles during a calendar year (n) and for a pollutant (p) can be approximately calculated using:

$$e_{np} = \sum_{i=n-12}^{n} c_{ipn} \, m_{in} \qquad (3.1.2\text{-}1)$$

where: e_{np} = Composite emission factor in grams per vehicle mile for calendar year (n) and pollutant (p)

c_{ipn} = The 1975 Federal test procedure emission rate for pollutant (p) in grams/mile for the i^{th} model year at calendar year (n) (Table 3.1.3-1)

m_{in} = The fraction of total light-duty diesel vehicle miles driven by the i^{th} model year diesel light-duty vehicles

Details of this calculation technique are discussed in section 3.1.2.

The emission factors in Table 3.1.3-1 for particulates and sulfur oxides were developed using an average sulfur content fuel in the case of sulfur oxides and the Dow Measuring Procedure on the 1975 Federal test cycle for particulate.[1,6]

Table 3.1.3-1. EMISSION FACTORS FOR LIGHT-DUTY, DIESEL-POWERED VEHICLES
EMISSION FACTOR RATING: B

Pollutant	Emission factors, Pre-1973 model years	
	g/mi	g/km
Carbon monoxide[a]	1.7	1.1
Exhaust hydrocarbons	0.46	0.29
Nitrogen oxides[a,b] (NO_x as NO_2)	1.6	0.99
Particulate[b]	0.73	0.45
Sulfur oxides[c]	0.54	0.34

[a] Estimates are arithmetic mean of tests of vehicles, References 3 through 5 and 7.
[b] Reference 4.
[c] Calculated using the fuel consumption rate reported in Reference 7 and assuming the use of a diesel fuel containing 0.20 percent sulfur.

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3.1.4 Light-Duty, Gasoline-Powered Trucks and Heavy-Duty, Gasoline-Powered Vehicles

by David S. Kircher and Marcia E. Williams

3.1.4.1 General – This vehicle category consists of trucks and buses powered by gasoline-fueled, spark-ignited internal combustion engines that are used both for commercial purposes (heavy trucks and buses) and personal transportation (light trucks). In addition to the use classification, the categories cover different gross vehicle weight (GVW) ranges. Light trucks range from 0 to 8500 pounds GVW (0 to 3856 kg GVW); heavy-duty vehicles have GVWs of 8501 pounds (3856 kg) and over. The light-duty truck, because of its unique characteristics and usage, is treated in a separate category in this revision to AP-42. Previously, light trucks with a GVW of 6000 pounds (2722 kg) or less were included in section 3.1.2 (Light-Duty, Gasoline-Powered Vehicles), and light trucks with a GVW of between 6001 and 8500 pounds (2722-3855 kg) were included in section 3.1.4 (Heavy-Duty, Gasoline-Powered Vehicles).

3.1.4.2 Light-Duty Truck Emissions – Because of many similarities to the automobile, light truck emission factor calculations are very similar to those presented in section 3.1.2. The most significant difference is in the Federal Test Procedure emission rate.

3.1.4.2.1. Carbon monoxide, hydrocarbon and nitrogen oxides emissions – The calculation of composite exhaust emission factors using the FTP method is given by:

$$e_{npstw} = \sum_{i=n-12}^{n} c_{ipn}\ m_{in}\ v_{ips}\ z_{ipt}\ r_{iptw} \qquad (3.1.4\text{-}1)$$

where:

- e_{npstw} = Composite emission factor in g/mi (g/km) for calendar year (n), pollutant (p), average speed (s), ambient temperature (t), and percentage cold operation (w)
- c_{ipn} = The FTP (1975 Federal Test Procedure) mean emission factor for the i_{th} model year light-duty trucks during calendar year (n) and for pollutant (p)
- m_{in} = The fraction of annual travel by the i^{th} model year light-duty trucks during calendar year (n)
- v_{ips} = The speed correction factor for the i^{th} model year light-duty trucks for pollutant (p) and average speed (s)
- z_{ipt} = The temperature correction for the i^{th} model year light-duty trucks for pollutant (p) and ambient temperature (t)
- r_{iptw} = The hot/cold vehicle operation correction factor for the i_{th} model year light-duty trucks for pollutant (p), ambient temperature (t), and percentage of cold operation (w)

The data necessary to complete this calculation for any geographic area are presented in Tables 3.1.4-1 through 3.1.4-5. Each of the variables in equation 3.1.4-1 is described in greater detail below. The technique is illustrated, by example, in section 3.1.2.

Table 3.1.4-1. EXHAUST EMISSION FACTORS FOR LIGHT-DUTY, GASOLINE-POWERED TRUCKS FOR CALENDAR YEAR 1972
EMISSION FACTOR RATING: B

Location	Model year	Carbon monoxide		Exhaust hydrocarbons		Nitrogen oxides	
		g/mi	g/km	g/mi	g/km	g/mi	g/km
All areas except high altitude and California[a]	Pre-1968[a]	125	77.6	17.0	10.6	4.2	2.6
	1968	66.5	41.3	7.1	4.4	4.9	3.0
	1969	64.3	39.9	5.3	3.3	5.3	3.3
	1970	53.5	33.2	4.8	3.0	5.2	3.2
	1971	53.5	33.2	4.2	2.6	5.2	3.2
	1972	42.8	26.6	3.4	2.1	5.3	3.3
High altitude[b]	Pre-1968	189	117	23.3	14.5	2.6	1.6
	1968	106	65.8	9.7	6.0	3.2	2.0
	1969	98.0	60.9	6.4	4.0	3.1	1.9
	1970	88.0	54.6	5.5	3.4	4.0	2.5
	1971	84.1	52.2	5.5	3.4	3.3	2.0
	1972	84.1	52.2	5.3	3.3	3.6	2.2

[a]References 1 through 4. California emission factors can be estimated as follows:

1. Use pre-1968 factors for all pre-1966 California light trucks.
2. Use 1968 factors for all 1966-1968 California light trucks.
3. For 1969-1972, use the above values multiplied by the ratio of California LDV emission factors to low altitude LDV emission factors (see section 3.1.2).

[b]Based on light-duty emission factors at high altitude compared with light-duty emission factors at low altitude (section 3.1.2).

Table 3.1.4-2. COEFFICIENTS FOR SPEED ADJUSTMENT CURVES FOR LIGHT-DUTY TRUCKS[a]

Location	Model year	$v_{ips} = e^{(A + BS + CS^2)}$						$v_{ips} = A + BS$	
		Hydrocarbons			Carbon monoxide			Nitrogen oxides	
		A	B	C	A	B	C	A	B
Low altitude (Excluding 1966-1967 Calif.)	1957-1967	0.953	-6.00×10^{-2}	5.81×10^{-4}	0.967	-6.07×10^{-2}	5.78×10^{-4}	0.808	0.980×10^{-2}
California	1966-1967	0.957	-5.98×10^{-2}	5.63×10^{-4}	0.981	-6.22×10^{-2}	6.19×10^{-4}	0.844	0.798×10^{-2}
Low altitude	1968	1.070	-6.63×10^{-2}	5.98×10^{-4}	1.047	-6.52×10^{-2}	6.01×10^{-4}	0.888	0.569×10^{-2}
	1969	1.005	-6.27×10^{-2}	5.80×10^{-4}	1.259	-7.72×10^{-2}	6.60×10^{-4}	0.915	0.432×10^{-2}
	1970	0.901	-5.70×10^{-2}	5.59×10^{-4}	1.267	-7.72×10^{-2}	6.40×10^{-4}	0.843	0.798×10^{-2}
	1971-1972	0.943	-5.92×10^{-2}	5.67×10^{-4}	1.241	-7.52×10^{-2}	6.09×10^{-4}	0.843	0.804×10^{-2}
High altitude	1957-1967	0.883	-5.58×10^{-2}	5.52×10^{-4}	0.721	-4.57×10^{-2}	4.56×10^{-4}	0.602	2.027×10^{-2}
	1968	0.722	-4.63×10^{-2}	4.80×10^{-4}	0.662	-4.23×10^{-2}	4.33×10^{-4}	0.642	1.835×10^{-2}
	1969	0.706	-4.55×10^{-2}	4.84×10^{-4}	0.628	-4.04×10^{-2}	4.26×10^{-4}	0.726	1.403×10^{-2}
	1970	0.840	-5.33×10^{-2}	5.33×10^{-4}	0.835	-5.24×10^{-2}	4.98×10^{-4}	0.614	1.978×10^{-2}
	1971-1972	0.787	-4.99×10^{-2}	4.99×10^{-4}	0.894	-5.54×10^{-2}	4.99×10^{-4}	0.697	1.553×10^{-2}

[a]Reference 5. Equations should not be extended beyond the range of data (15 to 45 mi/hr). These data are for light-duty vehicles and are assumed applicable to light-duty trucks.

Table 3.1.4-3. LOW AVERAGE SPEED CORRECTION FACTORS FOR LIGHT-DUTY TRUCKS[a]

Location	Model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
		5 mi/hr (8 km/hr)	10 mi/hr (16 km/hr)	5 mi/hr (8 km/hr)	10 mi/hr (16 km/hr)	5 mi/hr (8 km/hr)	10 mi/hr (16 km/hr)
Low altitude (Excluding 1966-1967 Calif.)	1957-1967	2.72	1.57	2.50	1.45	1.08	1.03
California	1966-1967	1.79	1.00	1.87	1.12	1.16	1.09
Low altitude	1968	3.06	1.75	2.96	1.66	1.04	1.00
	1969	3.57	1.86	2.95	1.65	1.08	1.05
	1970	3.60	1.88	2.51	1.51	1.13	1.05
	1971-1972	4.15	2.23	2.75	1.63	1.15	1.03
High altitude	1957-1967	2.29	1.48	2.34	1.37	1.33	1.20
	1968	2.43	1.54	2.10	1.27	1.22	1.18
	1969	2.47	1.61	2.04	1.22	1.22	1.08
	1970	2.84	1.72	2.35	1.36	1.19	1.11
	1971-1972	3.00	1.83	2.17	1.35	1.06	1.02

[a]Driving patterns developed from CAPE-21 vehicle operation data (Reference 6) were input to the modal emission analysis model (see section 3.1.2.3). The results predicted by the model (emissions at 5 and 10 mi/hr; 8 and 16 km/hr) were divided by FTP emission factors for hot operation to obtain the above results. The above data are approximate and represent the best currently available information.

Table 3.1.4-4. SAMPLE CALCULATION OF FRACTION OF ANNUAL LIGHT-DUTY TRUCK TRAVEL BY MODEL YEAR[a]

Age, years	Fraction of total vehicles in use nationwide (a)[b]	Average annual miles driven (b)	a x b	Fraction of annual travel (m)[c]
1	0.061	15,900	970	0.094
2	0.095	15,000	1,425	0.138
3	0.094	14,000	1,316	0.127
4	0.103	13,100	1,349	0.131
5	0.083	12,200	1,013	0.098
6	0.076	11,300	859	0.083
7	0.076	10,300	783	0.076
8	0.063	9,400	592	0.057
9	0.054	8,500	459	0.044
10	0.043	7,600	327	0.032
11	0.036	6,700	241	0.023
12	0.024	6,700	161	0.016
≥13	0.185	4,500	832	0.081

[a]Vehicles in use by model year as of 1972 (Reference 7).
[b]References 7 and 8.
[c]$m = ab/\Sigma ab$.

Table 3.1.4-5. LIGHT-DUTY TRUCK TEMPERATURE CORRECTION FACTORS AND HOT/COLD VEHICLE OPERATION CORRECTION FACTORS FOR FTP EMISSION FACTORS[a]

Pollutant	Temperature correction $(z_{ipt})^b$	Hot/cold operation correction $[f(t)]^b$
Carbon monoxide	$-0.0127\,t + 1.95$	$0.0045\,t + 0.02$
Hydrocarbons	$-0.0113\,t + 1.81$	$0.0079\,t + 0.03$
Nitrogen oxides	$-0.0046\,t + 1.36$	$-0.0068\,t + 1.64$

[a] Reference 9. Temperature (t) is expressed in °F. In order to apply these equations, °C must be first converted to °F. The appropriate conversion formula is: F=(9/5)C + 32. For temperatures expressed on the Kelvin (K) scale: F=9/5 (K-273.16) +32.

[b] The formulae for z_{ipt} enable the correction of the FTP emission factors for ambient temperature effects only. The amount of cold/hot operation is not affected. The formulae for f(t), on the other hand, are part of equation 3.1.4-2 for calculating r_{iptw}. The variable r_{iptw} corrects for cold/hot operation as well as ambient temperature. Note: z_{ipt} can be applied without r_{iptw}, but not vice versa.

FTP Emission Factor (c_{ipn}). The results of the EPA light-duty truck surveillance programs are summarized in Table 3.1.4-1. These data are divided by geographic area into: low altitude (non-California), high altitude, and California only. California emission factors are presented separately (as a footnote) because light-duty trucks operated in California have been, in the case of several model years, subject to emission standards that differ from those standards applicable to light trucks under the Federal emission control program. Emissions at high altitude are differentiated from those at low altitude to account for the effect that altitude has on air-fuel ratios and concomitant emissions. The tabulated values are applicable to calendar year 1972 for each model year.

Fraction of Annual Travel by Model Year (m_{in}). A sample calculation of this variable is presented in Table 3.1.4-4. In the example, nationwide statistics are used and the fraction of in-use vehicles by model year (vehicle age) are weighted on the basis of the annual miles driven (again, nationwide data are used). The calculation may be "localized" to reflect local (county, state, etc.) vehicle age mix, annual miles driven, or both. Otherwise, the national data can be used. The data presented in Table 3.1.4-3 are for calendar year 1972 only; for later calendar years, see Appendix D.

Speed Correction Factors (v_{ips}). Speed correction factors enable the "adjustment" of FTP emission factors to account for differences in average route speed. Because the implicit average route speed of the FTP is 19.6 mi/hr (31.6 km/hr), estimates of emissions at higher or lower average speeds require a correction.

It is important to note the difference between "average route speed" and "steady speed." Average route speed is trip-related and based on a composite of the driving modes (idle, cruise, acceleration, deceleration) encountered during a typical home-to-work trip, for example. Steady speed is highway-facility-oriented. For instance, a group of vehicles traveling over an uncongested freeway link (with a volume to capacity ratio of 0.1, for example) might be traveling at a steady speed of about 55 mi/hr (89 km/hr). Note, however, that steady speeds, even at the link level, are unlikely to occur where resistance to traffic flow occurs (unsynchronized traffic signaling, congested flow, etc.).

In previous revisions to this section, the limited data available for correcting for average speed were presented graphically. Recent research however, resulted in revised speed relationships by model year.[5] To facilitate the presentation, the data are given as equations and appropriate coefficients in Table 3.1.4-2. These relationships were developed by performing five major tasks. First, urban driving pattern data collected during the CAPE-10 Vehicle Operation Survey[10] were processed by city and time of day into freeway, non-freeway, and composite speed-mode matrices. Second, a large number of driving patterns were computer-generated for a range of average speeds (15 to 45 mi/hr; 24 to 72 km/hr) using weighted combinations of freeway and non-freeway matrices. Each of these patterns was filtered for "representativeness." Third, the 88 resulting patterns were input (second by second speeds) to the EPA modal emission analysis model (see 3.1.2.3).[11] The output of the model was estimated emissions for each of 11 vehicle groups (see Table 3.1.4-2 for a listing of these groups). Fourth, a regression analysis was performed to relate estimated emissions to average route speed for each of the 11 vehicle groups. Fifth, these relationships were normalized to 19.6 mi/hr (31.6 km/hr) and summarized in Table 3.1.4-2.

The equations in Table 3.1.4-2 apply only for the range of the data – from 15 to 45 mi/hr (24 to 72 km/hr). Because of the need, in some situations, to estimate emissions at very low average speeds, correction factors have been developed for this purpose. The speed correction factors for 5 and 10 mi/hr (8 and 16 km/hr) presented in Table 3.1.4-3 were developed using a method somewhat like that described above, again using the modal emission model. Because the modal emission model predicts warmed-up vehicle emissions, the use of this model to develop speed correction factors makes the assumption that a given speed correction factor applies equally well to hot and cold vehicle operation.

Temperature Correction Factor (z_{ipt}). The 1975 FTP requires that emission measurements be made within the limits of a relatively narrow temperature band (68 to 86°F). Such a band facilitates uniform testing in laboratories without requiring extreme ranges of temperature control. Present emission factors for motor vehicle are based on data from the standard Federal test (assumed to be at 75°F). Recently, EPA and the Bureau of Mines undertook a test program to evaluate the effect of ambient temperatures on motor vehicle exhaust emissions levels.[9] The study indicates that changes in ambient temperature result in significant changes in emissions during cold start-up operation. Because many Air Quality Control Regions have temperature characteristics differing considerably from the 68 to 86°F range, the temperature correction factor should be applied. The corrections factors are expressed in equational form and presented in Table 3.1.4-5 and can be applied between 20 and 80°F. For temperatures outside this range, the appropriate endpoint correction factor should be applied.

Hot/Cold Vehicle Operation Correction Factor (r_{iptw}). The 1975 FTP measures emissions over three types of driving: a cold transient phase (representative of vehicle start-up after a long engine-off period), a hot transient phase (representative of vehicle start-up after a short engine-off period), and a stabilized phase (representative of warmed-up vehicle operation). The weighting factors used in the 1975 FTP are 20 percent, 27 percent, and 53 percent of total miles (time) in each of the three phases, respectively. Thus, when the 1975 FTP emission factors are applied to a given region for the purpose of assessing air quality, 20 percent of the light-duty trucks in the area of interest are assumed to be operating in a cold condition, 27 percent in a hot start-up condition, and 53 percent in a hot stabilized condition. For non-catalyst equipped vehicles (all pre-1975 model year vehicles), emission in the two hot phases are essentially equivalent on a grams per mile (g/km) basis. Therefore, the 1975 FTP emission factor represents 20 percent cold operation and 80 percent hot operation.

Many situations exist in which the application of these particular weighting factors may be inappropriate. For example, light-duty truck operation in center city areas may have a much higher percentage of cold operation during the afternoon pollutant emissions peak when work-to-home trips are at a maximum and vehicles have been standing for 8 hours. The hot/cold vehicle operation correction factor allows the cold operation phase to range from 0 to 100 percent of total light-duty truck operations. This correction factor is a function of the percentage of cold operation (w) and the ambient temperature (t). The correction factor is:

$$r_{iptw} = \frac{w+(100-w)f(t)}{20+80f(t)} \qquad (3.1.4\text{-}2)$$

where: f(t) is given in Table 3.1.4-5.

3.1.4.2.2 Crankcase and evaporative hydrocarbon emissions – Evaporative and crankcase hydrocarbon emissions are determined using:

$$f_n = \sum_{i=n-12}^{n} h_i \, m_{in} \qquad (3.1.4\text{-}3)$$

where: f_n = The combined evaporative and crankcase hydrocarbon emission factor for calendar year (n)

h_i = The combined evaporative and crankcase hydrocarbon emission rate for the i^{th} model year. Emission factors for this source are reported in Table 3.1.4-6. The crankcase and evaporative emissions reported in the table are added together to arrive at this variable.

m_{in} = The weighted annual travel of the i^{th} model year vehicle during calendar year (n)

Table 3.1.4-6. CRANKCASE AND EVAPORATIVE HYDROCARBON EMISSION FACTORS FOR LIGHT-DUTY, GASOLINE-POWERED TRUCKS
EMISSION FACTOR RATING: B

Location	Model years	Crankcase emissions[a]		Evaporative emissions[b]	
		g/mi	g/km	g/mi	g/km
All areas except high altitude and California[c]	Pre-1963	4.6	2.9	3.6	2.2
	1963-1967	2.4	1.5	3.6	2.2
	1968-1970	0.0	0.0	3.6	2.2
	1971	0.0	0.0	3.1	1.9
	1972	0.0	0.0	3.1	1.9
High altitude	Pre-1963	4.6	2.9	4.6	2.9
	1963-1967	2.4	1.5	4.6	2.9
	1968-1970	0.0	0.0	4.6	2.9
	1971-1972	0.0	0.0	3.9	2.4

[a]Reference 12. Tabulated values were determined by assuming that two-thirds of the light-duty trucks are 6000 lbs GVW (2700 kg) and under and that one-third are 6001 to 8500 lbs GVW (2700 to 3860 kg).
[b]Light-duty vehicle evaporative data (section 3.1.2) and heavy-duty vehicle evaporative data (Table 3.1.4-8) were used to estimate the values.
[c]For California: Evaporative emissions for the 1970 model year are 1.9 g/km (3.1 g/mi). All other model years are the same as those reported as "All areas except high altitude and California." Crankcase emissions for the pre-1961 California light-duty trucks are 4.6 g/mi (2.9 g/km) and 1961-1963 models years are 2.4 g/mi (1.5 g/km) all post-1963 model year vehicles are 0.0 g/mi (0.0 g/km).

3.1.4.2.3 Sulfur oxide and particulate emissions – Sulfur oxide and particulate emission factors for all model year light trucks are presented in Table 3.1.4-7. Sulfur oxides factors are based on fuel sulfur content and fuel consumption. Tire-wear particulate factors are based on automobile test results, a premise necessary because of the lack of data. Light truck tire wear is likely to result in greater particulate emissions than automobiles because of larger tires and heavier loads on tires.

Table 3.1.4-7. PARTICULATE AND SULFUR OXIDES EMISSION FACTORS FOR LIGHT-DUTY, GASOLINE-POWERED TRUCKS
EMISSION FACTOR RATING: C

Pollutant	Emissions, Pre-1973 vehicles	
	g/mi	g/km
Particulate[a]		
Exhaust	0.34	0.21
Tire wear[b]	0.20	0.12
Sulfur oxides[c] (SO_x as SO_2)	0.18	0.11

[a]References 13 and 14. Based on tests of automobiles.
[b]Reference 14 summarized tests of automotive tire wear particulate. It is assumed that light-duty truck emissions are similar. The automotive tests assume a four-tire vehicle. If corrections for vehicles with a greater number of tires are needed, multiply the above value by the number of tires and divide by four.
[c]Based on an average fuel consumption 10.0 mi/gal (4.3 km/liter) from Reference 15 and on the use of a fuel with a 0.032 percent sulfur content from References 17 and 18 and a density of 6.1 lb/gal (0.73 kg/liter) from References 17 and 18.

3.1.4.3 Heavy-Duty Vehicle Emissions – Emissions research on heavy-duty, gasoline-powered vehicles has been limited in contrast to that for light-duty vehicles and light-duty trucks. As a result, cold operation correction factors, temperature correction factors, speed correction factors, idle emission rates, etc. are not available for heavy-duty vehicles. For some of these variables, however, light-duty vehicle data can be applied to heavy-duty vehicles. In instances in which light-duty vehicle data are not appropriate, a value of unity if assumed.

3.1.4.3.1 Carbon monoxide, hydrocarbon, and nitrogen oxides emissions – The calculation of heavy-duty, gasoline-powered vehicle exhaust emission factors can be accomplished using:

$$e_{nps} = \sum_{i=n-12}^{n} c_{ipn}\ m_{in}\ v_{ips} \qquad (3.1.4\text{-}4)$$

where: e_{nps} = Composite emission factor in grams per mile (grams per kilometer) for calendar year (n) and pollutant (p) and average speed(s)

c_{ipn} = The test procedure emission rate (Table 3.1.4-8) for pollutant (p) in g/mi (g/km) for the i^{th} model year in calendar year (n)

m_{in} = The weighted annual travel of the i^{th} model year vehicles during calendar year (n). The determination of this variable involves the use of the vehicle year distribution.

v_{ips} = The speed correction factor for the i^{th} model year vehicles for pollutant (p) and average speed(s)

Table 3.1.4-8. EXHAUST EMISSION FACTORS FOR HEAVY-DUTY, GASOLINE-POWERED TRUCKS FOR CALENDAR YEAR 1972[a]
EMISSION FACTOR RATING: B

Location	Model year	Carbon monoxide		Exhaust hydrocarbons		Nitrogen oxides	
		g/mi	g/km	g/mi	g/km	g/mi	g/km
All areas except high altitude	Pre-1970	238	148	35.4	22.0	6.8	4.2
	1970	188	117	13.8	8.6	12.6	7.8
	1971	188	117	13.7	8.5	12.6	7.8
	1972	188	117	13.6	8.4	12.5	7.8
High altitude only[b]	Pre-1970	359	223	48.6	30.2	4.1	2.5
	1970	299	186	15.0	9.3	8.1	5.0
	1971	299	186	14.9	9.3	8.1	5.0
	1972	299	186	14.8	9.2	8.1	5.0

[a]Data from References 19 and 20.
[b]Based on light-duty emissions at high altitude compared with light-duty emissions at low altitudes.

A brief discussion of the variables presented in the above equation is necessary to help clarify their formulation and use. The following paragraphs further describe the variables c_{ipn}, m_{in}, and v_{ips} as they apply to heavy-duty, gasoline-powered vehicles.

Test procedure emission factor (c_{ipn}). The emission factors for heavy-duty vehicles (Table 3.1.4-8) for all areas are based on tests of vehicles operated on-the-road over the San Antonio Road Route (SARR). The SARR, located in San Antonio, Texas, is 7.24 miles long and includes freeway, arterial, and local/collector highway segments.[19] A constant volume sampler is carried on board each of the test vehicles for collection of a proportional part of the exhaust gas from the vehicle. This sample is later analyzed to yield mass emission rates. Because the SARR is an actual road route, the average speed varies depending on traffic conditions at the time of the test. The average speed tends to be around 18 mi/hr (29 km/hr) with about 20 percent of the time spent at idle. The test procedure emission factor is composed entirely of warmed-up vehicle operation. Based on preliminary analysis of vehicle operation data[6], almost all heavy-duty vehicle operation is under warmed-up conditions.

Weighted annual mileage (m_{in}). The determination of this variable is illustrated in Table 3.1.4-9. For purposes of this illustration, nation-wide statistics have been used. Localized data, if available, should be substituted when calculating the variable m_{in} for a specific area under study.

Table 3.1.4-9. SAMPLE CALCULATION OF FRACTION OF GASOLINE-POWERED, HEAVY-DUTY VEHICLE ANNUAL TRAVEL BY MODEL YEAR[a]

Age, years	Fraction of total vehicles in use nationwide (a)[b]	Average annual miles driven (b)	a x b	Fraction of annual travel (m)[c]
1	0.037	19,000	703	0.062
2	0.070	18,000	1,260	0.111
3	0.078	17,000	1,326	0.117
4	0.086	16,000	1,376	0.122
5	0.075	14,000	1,050	0.093
6	0.075	12,000	900	0.080
7	0.075	10,000	750	0.066
8	0.068	9,500	646	0.057
9	0.059	9,000	531	0.047
10	0.053	8,500	451	0.040
11	0.044	8,000	352	0.031
12	0.032	7,500	240	0.021
$\geq$13	0.247	7,000	1,729	0.153

[a] Vehicles in use by model year as of 1972 (Reference 7).
[b] Reference 7.
[c] $m = ab/\Sigma ab$.

Speed correction factor (v_{ips}). Data based on tests of heavy-duty emissions versus average speed are unavailable. In the absence of these data, light-duty vehicle speed correction factors are recommended. The data presented in Tables 3.1.4-10 and Table 3.1.4-11 should be considered as interim heavy-duty vehicle speed correction factors until appropriate data become available.

Table 3.1.4-10. SPEED CORRECTION FACTORS FOR HEAVY-DUTY VEHICLES[a,b]

Location	Model year	$v_{ips} = e^{(A + BS + CS^2)}$						$v_{ips} = A + BS$	
		Hydrocarbons			Carbon monoxide			Nitrogen oxides	
		A	B	C	A	B	C	A	B
Low altitude	Pre-1970	0.953	-6.00×10^{-2}	5.81×10^{-4}	0.967	-6.07×10^{-2}	5.78×10^{-4}	0.808	0.980×10^{-2}
	1970-1972	1.070	-6.63×10^{-2}	5.98×10^{-4}	1.047	-6.52×10^{-2}	6.01×10^{-4}	0.888	0.569×10^{-2}
High altitude	Pre-1970	0.883	-5.58×10^{-2}	5.52×10^{-4}	0.721	-4.57×10^{-2}	4.56×10^{-4}	0.602	2.027×10^{-2}
	1970-1972	0.722	-4.63×10^{-2}	4.80×10^{-4}	0.662	-4.23×10^{-2}	4.33×10^{-4}	0.642	1.835×10^{-2}

[a]Reference 5. Equations should not be extended beyond the range of data (15 to 45 mi/hr). These data are from tests of light-duty vehicles and are assumed applicable to heavy-duty vehicles.
[b]Speed (s) is in miles per hour (1 mi/hr = 1.61 km/hr).

Table 3.1.4-11. LOW AVERAGE SPEED CORRECTION FACTORS FOR HEAVY-DUTY VEHICLES[a]

Location	Model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
		5 mi/hr (8 km/hr)	10 mi/hr (16 km/hr)	5 mi/hr (8 km/hr)	10 mi/hr (16 km/hr)	5 mi/hr (8 km/hr)	10 mi/hr (16 km/hr)
Low altitude	Pre-1970	2.72	1.57	2.50	1.45	1.08	1.03
	1970-1972	3.06	1.75	2.96	1.66	1.04	1.00
High altitude	Pre-1970	2.29	1.48	2.34	1.37	1.33	1.20
	1970-1972	2.43	1.54	2.10	1.27	1.22	1.18

[a] Driving patterns developed from CAPE-21 vehicle operation data (Reference 6) were input to the modal emission analysis model (see section 3.1.2.3). The results predicted by the model (emissions at 5 and 10 mi/hr; 8 and 16 km/hr) were divided by FTP emission factors for hot operation to obtain the above results. The above data represent the best currently available information for light-duty vehicles. These data are assumed applicable to heavy-duty vehicles given the lack of better information.

For an explanation of the derivation of these factors, see section 3.1.4.2.1.

In addition to exhaust emission factors, the calculation of evaporative and crankcase hydrocarbon emissions are determined using:

$$f_n = \sum_{i=n-12}^{n} h_i \, m_{in} \qquad (3.1.4\text{-}5)$$

where: f_n = The combined evaporative and crankcase hydrocarbon emission factor for calendar year (n)

h_i = The combined evaporative and crankcase hydrocarbon emission rate for the i^{th} model year. Emission factors for this source are reported in Table 3.1.4-12.

m_{in} = The weighted annual travel of the i^{th} model year vehicle during calendar year (n)

Table 3.1.4-12. CRANKCASE AND EVAPORATIVE HYDROCARBON EMISSION FACTORS FOR HEAVY-DUTY, GASOLINE-POWERED VEHICLES
EMISSION FACTOR RATING: B

Location	Model years	Crankcase hydrocarbon[a]		Evaporative hydrocarbons[b]	
		g/mi	g/km	g/mi	g/km
All areas except high altitude and California	Pre-1968	5.7	3.5	5.8	3.6
	1968-1972	0.0	0.0	5.8	3.6
California only	Pre-1964	5.7	3.5	5.8	3.6
	1964-1972	0.0	0.0	5.8	3.6
High altitude	Pre-1968	5.7	3.5	7.4	4.6
	1968-1972	0.0	0.0	7.4	4.6

[a] Crankcase factors are from Reference 12.
[b] References 1, 21, and 22 were used to estimate evaporative emission factors for heavy-duty vehicles. Equation 3.1.2-6 was used to calculate g/mi (g/km) values. (Evaporative emission factor = g + kd). The heavy-duty vehicle diurnal evaporative emissions (g) were assumed to be three times the light-duty vehicle value to account for the larger size fuel tanks used on heavy-duty vehicles. Nine trips per day (d = number of trips per day) from Reference 6 were used in conjunction with the light-duty vehicle hot soak emissions (k) to yield a total evaporative emission rate in grams per day. This value was divided by 36.2 mi/day (58.3 km/day) from Reference 7 to obtain the per mile (per kilometer) rate.

3.1.4.3.2 Sulfur oxide and particulate emissions – Sulfur oxide and particulate emission factors for all model year heavy-duty vehicles are presented in Table 3.1.4-13. Sulfur oxides factors are based on fuel sulfur content and fuel consumption. Tire-wear particulate factors are based on automobile test results – a premise necessary because of the lack of data. Truck tire wear is likely to result in greater particulate emissions than automobiles because of larger tires, heavier loads on tires, and more tires per vehicle. Although the factors presented in Table 3.1.4-13 can be adjusted for the number of tires per vehicle, adjustments cannot be made to account for the other differences.

Table 3.1.4-13. PARTICULATE AND SULFUR OXIDES EMISSION FACTORS FOR HEAVY-DUTY, GASOLINE-POWERED VEHICLES
EMISSION FACTOR RATING: B

Pollutant	Emissions	
	g/mi	g/km
Particulate		
Exhaust[a]	0.91	0.56
Tire wear[b]	0.20T	0.12T
Sulfur oxides[c] (SO_x as SO_2)	0.36	0.22

[a] Calculated from the Reference 13 value of 12 lb/10^3 gal (1.46 g/liter) gasoline. A 6.0 mi/gal (2.6 km/liter) value from Reference 23 was used to convert to a per kilometer (per mile) emission factor.

[b] Reference 14. The data from this reference are for passenger cars. In the absence of specific data for heavy-duty vehicles, they are assumed to be representative of truck-tire-wear particulate. An adjustment is made for trucks with more than four tires. T equals the number of tires divided by four.

[c] Based on an average fuel consumption of 6.0 mi/gal (2.6 km/liter) from Reference 23, on a 0.04 percent sulfur content from Reference 16 and 17, and on a density of 6.1 lb/gal (0.73 kg/liter) from References 16 and 17.

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3.1.5 Heavy-Duty, Diesel-Powered Vehicles

revised by David S. Kircher
and Marcia E. Williams

3.1.5.1 General[1,2] – On the highway, heavy-duty diesel engines are primarily used in trucks and buses. Diesel engines in any application demonstrate operating principles that are significantly different from those of the gasoline engine.

3.1.5.2 Emissions – Diesel trucks and buses emit pollutants from the same sources as gasoline-powered vehicles: exhaust, crankcase blow-by, and fuel evaporation. Blow-by is practically eliminated in the diesel, however, because only air is in the cylinder during the compression stroke. The low volatility of diesel fuel along with the use of closed injection systems essentially eliminates evaporation losses in diesel systems.

Exhaust emissions from diesel engines have the same general characteristics of auto exhausts. Concentrations of some of the pollutants, however, may vary considerably. Emissions of sulfur dioxide are a direct function of the fuel composition. Thus, because of the higher average sulfur content of diesel fuel (0.20 percent S) as compared with gasoline (0.035 percent S), sulfur dioxide emissions are relatively higher from diesel exhausts.[3,4]

Because diesel engines allow more complete combustion and use less volatile fuels than spark-ignited engines, their hydrocarbon and carbon monoxide emissions are relatively low. Because hydrocarbons in diesel exhaust represent largely unburned diesel fuel, their emissions are related to the volume of fuel sprayed into the combustion chamber. Both the high temperature and the large excesses of oxygen involved in diesel combustion are conducive to high nitrogen oxide emission, however.[6]

Particulates from diesel exhaust are in two major forms – black smoke and white smoke. White smoke is emitted when the fuel droplets are kept cool in an environment abundant in oxygen (cold starts). Black smoke is emitted when the fuel droplets are subjected to high temperatures in an environment lacking in oxygen (road conditions).

Emissions from heavy-duty diesel vehicles during a calendar year (n) and for a pollutant (p) can be approximately calculated using:

$$e_{nps} = \sum_{i=n-12}^{n} c_{ipn} v_{ips} \qquad (3.1.5\text{-}1)$$

where: e_{nps} = Composite emission factor in g/mi (g/km) for calendar year (n), pollutant (p), and average speed (s)

c_{ipn} = The emission rate in g/mi (g/km) for the i^{th} model year vehicles in calendar year (n) over a transient urban driving schedule with an average speed of approximately 18 mi/hr (29 km/hr)

v_{ips} = The speed correction factor for the i^{th} model year heavy-duty diesel vehicles for pollutant (p) and average speed (s)

Values for c_{ipn} are given in Table 3.1.5-1. These emission factors are based on tests of vehicles on-the-road over the San Antonio Road Route (SARR). The SARR, located in San Antonio, Texas, is 7.24 miles long and includes freeway, arterial, and local/collector highway segments.[7] A constant volume sampler is carried on board each test vehicle for collection of a proportional part of the vehicle's exhaust. This sample is later analyzed to yield mass emission rates. Because the SARR is an actual road route, the average speed varies depending on traffic conditions at the time of the test. The average speed, however, tends to be around 18 mi/hr (29 km/hr), with about 20 percent of the time spent at idle. The test procedure emission factor is composed entirely of warmed-up vehicle operation. Based on a preliminary analysis of vehicle operation data, heavy-duty vehicles operate primarily (about 95 percent) in a warmed-up condition.

Table 3.1.5-1. EMISSION FACTORS FOR HEAVY-DUTY, DIESEL-POWERED VEHICLES (ALL PRE-1973 MODEL YEARS) FOR CALENDAR YEAR 1972
EMISSION FACTOR RATING: B

Pollutant	Truck emissions[a]		City bus emissions[b]	
	g/mi	g/km	g/mi	g/km
Particulate[c]	1.3	0.81	1.3	0.81
Sulfur oxides[c,d] (SO_x as SO_2)	2.8	1.7	2.8	1.7
Carbon monoxide	28.7	17.8	21.3	13.2
Hydrocarbons	4.6	2.9	4.0	2.5
Nitrogen oxides (NO_x as NO_2)	20.9	13.0	21.5	13.4
Aldehydes[c] (as HCHO)	0.3	0.2	0.3	0.2
Organic acids[c]	0.3	0.2	0.3	0.2

[a] Truck emissions are based on over-the-road sampling of diesel trucks by Reference 7. Sampling took place on the San Antonio (Texas) Road Route (SARR), which is 7.24 miles (11.7 kilometers) long and includes freeway, arterial, and local/collector highway segments. Vehicles average about 18 mi/hr (29 km/hr) over this road route.

[b] Bus emission factors are also based on the SARR. 13-Mode emission data from Reference 6 were converted to SARR values using cycle-to-cycle conversion factors from Reference 8.

[c] Reference 6. Tire wear particulate not included in above particulate emission factors. See tire wear particulate, heavy-duty gasoline section.

[d] Data based on assumed fuel sulfur content of 0.20 percent. A fuel economy of 4.6 mi/gal (2.0 km/liter) was used from Reference 9.

The speed correction factor, v_{ips}, can be computed using data in Table 3.1.5-2. Table 3.1.5-2 gives heavy-duty diesel HC, CO, and NO_x emission factors in grams per minute for the idle mode, an urban transient mode with average speed of 18 mi/hr (29 km/hr), and an over-the-road mode with an average speed of approximately 60 mi/hr (97 km/hr). For average speeds less than 18 mi/hr (29 km/hr), the correction factor is:

$$v_{ips} = \frac{\text{Urban} + (\frac{18}{S} - 1)\ \text{Idle}}{\text{Urban}} \qquad (3.1.5\text{-}2)$$

where: s is the average speed of interest (in mi/hr), and the urban and idle values (in g/min) are obtained from Table 3.1.5-2. For average speeds above 18 mi/hr (29 km/hr), the correction factor is:

$$v_{ips} = \frac{\frac{18}{42S}\ [(60\text{-}S)\ \text{Urban} + (S\text{-}18)\ \text{Over the Road}]}{\text{Urban}} \qquad (3.1.5\text{-}3)$$

Where: S is the average speed (in mi/hr) of interest. Urban and over-the-road values (in g/min) are obtained from Table 3.1.5-2. Emission factors for heavy-duty diesel vehicles assume all operation to be under warmed-up vehicle conditions. Temperature correction factors, therefore, are not included because ambient temperature has minimal effects on warmed-up operation.

Table 3.1.5-2. EMISSION FACTORS FOR HEAVY-DUTY DIESEL VEHICLES UNDER DIFFERENT OPERATING CONDITIONS
EMISSION FACTOR RATING: B

Pollutant	Emission factors,[a] g/min		
	Idle	Urban [18 mi/hr (29 km/hr)]	Over-the-road [60 mi/hr (97 km/hr]
Carbon monoxide	0.64	8.61	5.40
Hydrocarbons	0.32	1.38	2.25
Nitrogen oxides (NO_x as NO_2)	1.03	6.27	28.3

[a]Reference 7. Computed from data contained in the reference.

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3.3 OFF-HIGHWAY, STATIONARY SOURCES

by David S. Kircher and Charles C. Masser

In general, engines included in this category are internal combustion engines used in applications similar to those associated with external combustion sources (see Chapter 1). The major engines within this category are gas turbines and large, heavy-duty, general utility reciprocating engines. Emission data currently available for these engines are limited to gas turbines and natural-gas-fired, heavy-duty, general utility engines. Most stationary internal combustion engines are used to generate electric power, to pump gas or other fluids, or to compress air for pneumatic machinery.

3.3.1 Stationary Gas Turbines for Electric Utility Power Plants

3.3.1.1 General – Stationary gas turbines find application in electric power generators, in gas pipeline pump and compressor drives, and in various process industries. The majority of these engines are used in electrical generation for continuous, peaking, or standby power.[1] The primary fuels used are natural gas and No. 2 (distillate) fuel oil, although residual oil is used in a few applications.

3.3.1.2 Emissions – Data on gas turbines were gathered and summarized under an EPA contract.[2] The contractor found that several investigators had reported data on emissions from gas turbines used in electrical generation but that little agreement existed among the investigators regarding the terms in which the emissions were expressed. The efforts represented by this section include acquisition of the data and their conversion to uniform terms. Because many sets of measurements reported by the contractor were not complete, this conversion often involved assumptions on engine air flow or fuel flow rates (based on manufacturers' data). Another shortcoming of the available information was that relatively few data were obtained at loads below maximum rated (or base) load.

Available data on the population and usage of gas turbines in electric utility power plants are fairly extensive, and information from the various sources appears to be in substantial agreement. The source providing the most complete information is the Federal Power Commission, which requires major utilities (electric revenues of $1 million or more) to submit operating and financial data on an annual basis. Sawyer and Farmer[3] employed these data to develop statistics on the use of gas turbines for electric generation in 1971. Although their report involved only the major, publicly owned utilities (not the private or investor-owned companies), the statistics do appear to include about 87 percent of the gas turbine power used for electric generation in 1971.

Of the 253 generating stations listed by Sawyer and Farmer, 137 have more than one turbine-generator unit. From the available data, it is not possible to know how many hours *each* turbine was operated during 1971 for these multiple-turbine plants. The remaining 116 (single-turbine) units, however, were operated an average of 1196 hours during 1971 (or 13.7 percent of the time), and their average load factor (percent of rated load) during operation was 86.8 percent. This information alone is not adequate for determining a representative operating pattern for electric utility turbines, but it should help prevent serious errors.

Using 1196 hours of operation per year and 250 starts per year as normal, the resulting average operating day is about 4.8 hours long. One hour of no-load time per day would represent about 21 percent of operating time, which is considered somewhat excessive. For economy considerations, turbines are not run at off-design conditions any longer than necessary, so time spent at intermediate power points is probably minimal. The bulk of turbine operation must be at base or peak load to achieve the high load factor already mentioned.

If it is assumed that time spent at off-design conditions includes 15 percent at zero load and 2 percent each at 25 percent, 50 percent, and 75 percent load, then the percentages of operating time at rated load (100 percent) and peak load (assumed to be 125 percent of rated) can be calculated to produce an 86.8 percent load factor. These percentages turn out to be 19 percent at peak load and 60 percent at rated load; the postulated cycle based on this line of reasoning is summarized in Table 3.3.1-1.

Table 3.3.1-1. TYPICAL OPERATING CYCLE FOR ELECTRIC UTILITY TURBINES

Condition, % of rated power	Percent operating time spent at condition	Time at condition based on 4.8-hr day		Contribution to load factor at condition
		hours	minutes	
0	15	0.72	43	0.00 x 0.15 = 0.0
25	2	0.10	6	0.25 x 0.02 = 0.005
50	2	0.10	6	0.50 x 0.02 = 0.010
75	2	0.10	6	0.75 x 0.02 = 0.015
100 (base)	60	2.88	173	1.0 x 0.60 = 0.60
125 (peak)	19	0.91	55	1.25 x 0.19 = 0.238
		4.81	289	Load factor = 0.868

The operating cycle in Table 3.3.1-1 is used to compute emission factors, although it is only an estimate of actual operating patterns.

Table 3.3.1-2. COMPOSITE EMISSION FACTORS FOR 1971 POPULATION OF ELECTRIC UTILITY TURBINES
EMISSION FACTOR RATING: B

Time basis	Nitrogen oxides	Hydro-carbons	Carbon Monoxide	Partic-ulate	Sulfur oxides
Entire population					
lb/hr rated load[a]	8.84	0.79	2.18	0.52	0.33
kg/hr rated load	4.01	0.36	0.99	0.24	0.15
Gas-fired only					
lb/hr rated load	7.81	0.79	2.18	0.27	0.098
kg/hr rated load	3.54	0.36	0.99	0.12	0.044
Oil-fired only					
lb/hr rated load	9.60	0.79	2.18	0.71	0.50
kg/hr rated load	4.35	0.36	0.99	0.32	0.23
Fuel basis					
Gas-fired only					
$lb/10^6\ ft^3$ gas	413.	42.	115.	14.	940S[b]
$kg/10^6\ m^3$ gas	6615.	673.	1842.	224.	15,000S
Oil-fired only					
$lb/10^3$ gal oil	67.8	5.57	15.4	5.0	140S
$kg/10^3$ liter oil	8.13	0.668	1.85	0.60	16.8S

[a]Rated load expressed in megawatts.

[b]S is the percentage sulfur. Example: If the factor is 940 and the sulfur content is 0.01 percent, the sulfur oxides emitted would be 940 times 0.01, or 9.4 $lb/10^6\ ft^3$ gas.

Table 3.3.1-2 is the resultant composite emission factors based on the operating cycle of Table 3.3.1-1 and the 1971 population of electric utility turbines.

5.6 EXPLOSIVES

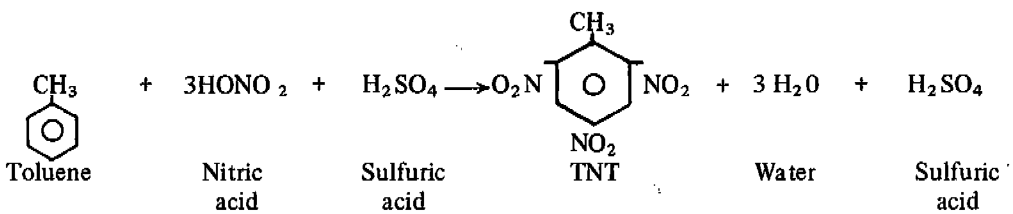
by Charles Mann

5.6.1 General[1]

An explosive is a material that, under the influence of thermal or mechanical shock, decomposes rapidly and spontaneously with the evolution of large amounts of heat and gas. Explosives fall into two major categories: high explosives and low explosives. High explosives are further subdivided into initiating or primary high explosives and secondary high explosives. Initiating high explosives are very sensitive and are generally used in small quantities in detonators and percussion caps to set off larger quantities of secondary high explosives. Secondary high explosives, chiefly nitrates, nitro compounds, and nitramines, are much less sensitive to mechanical or thermal shock, but explode with great violence when set off by an initiating explosive. The chief secondary high explosives manufactured for commercial and military use are ammonium nitrate blasting agents and 2.4. 6,-trinitrotoluene (TNT). Low explosives, such as black powder and nitrocellulose, undergo relatively slow autocombustion when set off and evolve large volumes of gas in a definite and controllable manner. A multitude of different types of explosives are manufactured. As examples of the production of a high explosive and a low explosive, the production of TNT and nitrocellulose are discussed in this section.

5.6.2 TNT Production [1-3]

TNT may be prepared by either a continuous process or a batch, three-stage nitration process using toluene, nitric acid, and sulfuric acid as raw materials. In the batch process, a mixture of oleum (fuming sulfuric acid) and nitric acid that has been concentrated to a 97 percent solution is used as the nitrating agent. The overall reaction may be expressed as:



(1)

Spent acid from the nitration vessels is fortified with make-up 60 percent nitric acid before entering the next nitrator. Fumes from the nitration vessels are collected and removed from the exhaust by an oxidation-absorption system. Spent acid from the primary nitrator is sent to the acid recovery system in which the sulfuric and nitric acid are separated. The nitric acid is recovered as a 60 percent solution, which is used for refortification of spent acid from the second and third nitrators. Sulfuric acid is concentrated in a drum concentrator by boiling water out of the dilute acid. The product from the third nitration vessel is sent to the wash house at which point asymmetrical isomers and incompletely nitrated compounds are removed by washing with a solution of sodium sulfite and sodium hydrogen sulfite (Sellite). The wash waste (commonly called red water) from the purification process is discharged directly as a liquid waste stream, is collected and sold, or is concentrated to a slurry and incinerated in rotary kilns. The purified TNT is solidified, granulated, and moved to the packing house for shipment or storage. A schematic diagram of TNT production by the batch process is shown in Figure 5.6-1.

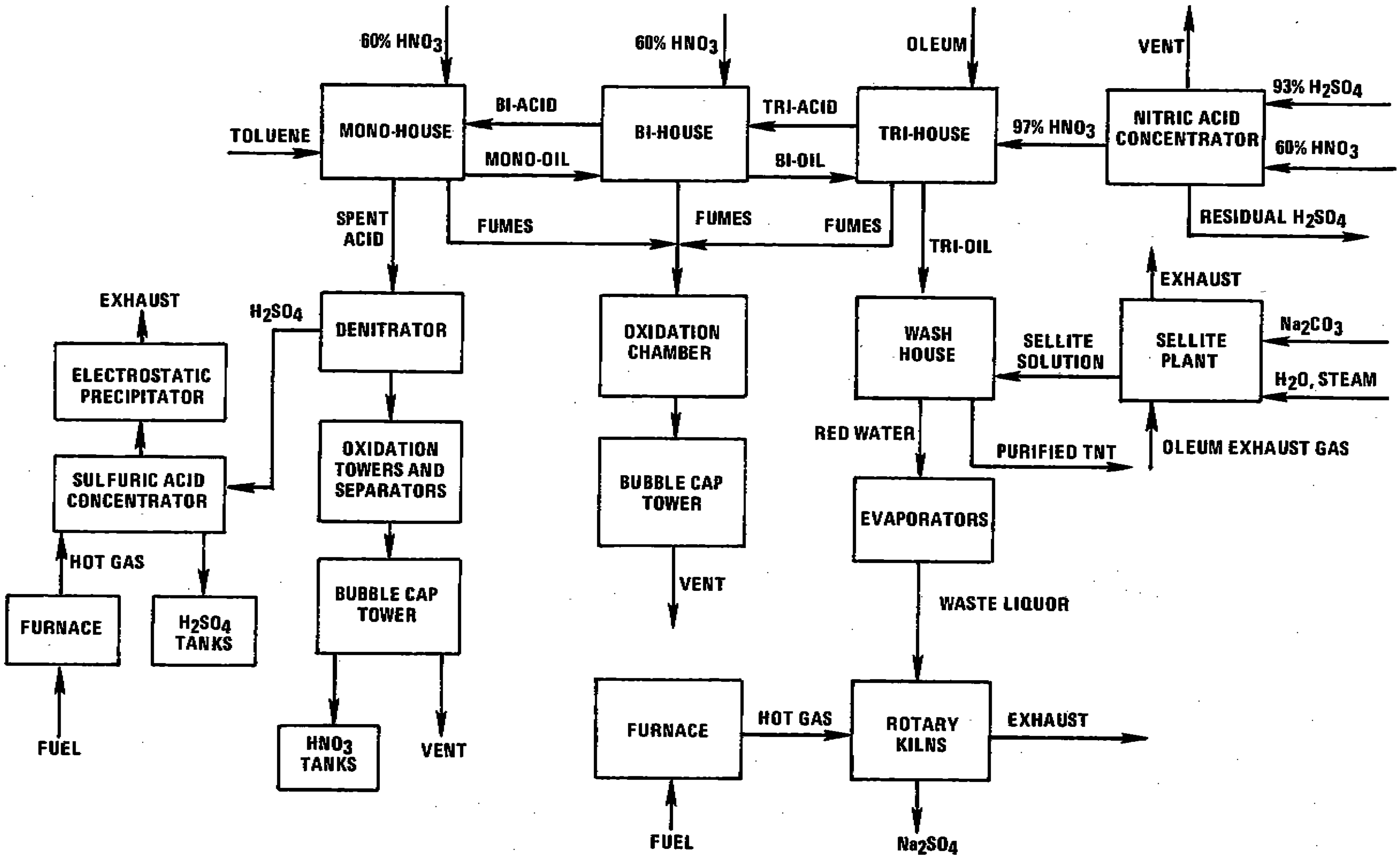


Figure 5.6-1. Flow diagram of typical batch process TNT plant.

5.6.3 Nitrocellulose Production [1]

Nitrocellulose is prepared by the batch-type "mechanical dipper" process. Cellulose, in the form of cotton linters, fibers, or specially prepared wood pulp, is purified, bleached, dried, and sent to a reactor (niter pot) containing a mixture of concentrated nitric acid and a dehydrating agent such as sulfuric acid, phosphoric acid, or magnesium nitrate. The overall reaction may be expressed as:

$$\underset{\text{Cellulose}}{C_6H_7O_2(OH)_3} + \underset{\text{Nitric acid}}{3HONO_2} + \underset{\text{Sulfuric acid}}{H_2SO_4} \longrightarrow \underset{\text{Nitrocellulose}}{C_6H_7O_2(ONO_2)_3} + \underset{\text{Water}}{3\,H_2O} + \underset{\text{Sulfuric acid}}{H_2SO_4} \qquad (2)$$

When nitration is complete, the reaction mixtures are centrifuged to remove most of the spent acid. The spent acid is fortified and reused or otherwise disposed of. The centrifuged nitrocellulose undergoes a series of water washings and boiling treatments for purification of the final product.

5.6.4 Emissions and Controls[2,3,5]

The major emissions from the manufacture of explosives are nitrogen oxides and acid mists, but smaller amounts of sulfuric oxides and particulates may also be emitted. Emissions of nitrobodies (nitrated organic compounds) may also occur from many of the TNT process units. These compounds cause objectionable odor problems and act to increase the concentration of acid mists. Emissions of sulfur oxides and nitrogen oxides from the production of nitric acid and sulfuric acid used for explosives manufacturing can be considerable. It is imperative to identify all processes that may take place at an explosives plant in order to account for all sources of emissions. Emissions from the manufacture of nitric and sulfuric acid are discussed in other sections of this publication.

In the manufacture of TNT, vents from the fume recovery system, sulfuric acid concentrators, and nitric acid concentrators are the principal sources of emissions. If open burning or incineration of waste explosives is practiced, considerable emissions may result. Emissions may also result from the production of Sellite solution and the incineration of red water. Many plants, however, now sell the red water to the paper industry where it is of economic importance.

Principal sources of emissions from nitrocellulose manufacture are from the reactor pots and centrifuges, spent acid concentrators, and boiling tubs used for purification.

The most important factor affecting emissions from explosives manufacture is the type and efficiency of the manufacturing process. The efficiency of the acid and fume recovery systems for TNT manufacture will directly affect the atmospheric emissions. In addition, the degree to which acids are exposed to the atmosphere during the manufacturing process affects the NO_X and SO_X emissions. For nitrocellulose production, emissions are influenced by the nitrogen content and the desired quality of the final product. Operating conditions will also affect emissions. Both TNT and nitrocellulose are produced in batch processes. Consequently, the processes may never reach steady state and emission concentrations may vary considerably with time. Such fluctuations in emissions will influence the efficiency of control methods. Several measures may be taken to reduce emissions from explosives manufacturing. The effects of various control devices and process changes upon emissions, along with emission factors for explosives manufacturing, are shown in Table 5.6-1. The emission factors are all related to the amount of product produced and are appropriate for estimating long-term emissions or for evaluating plant operation at full production conditions. For short time periods or for plants with intermittent operating schedules, the emission factors in Table 5.6-1 should be used with caution, because processes not associated with the nitration step are often not in operation at the same time as the nitration reactor.

Table 5.6-1. **EMISSION FACTORS FOR**
EMISSION FACTOR

Type of process	Particulates		Sulfur oxides (SO_2)	
	lb/ton	kg/MT	lb/ton	kg/MT
TNT - batch process[b]				
Nitration reactors				
Fume recovery	—	—	—	—
Acid recovery	—	—	—	—
Nitric acid concentrators	—	—	—	—
Sulfuric acid concentrators[c]				
Electrostatic precipitator (exit)	—	—	14(4-40)	7(2-20)
Electrostatic precipitator with scrubber[d]	—	—	Neg.	Neg.
Red water incinerator				
Uncontrolled[e]	25(0.03-126)	12.5(0.015-63)	2(0.05-3.5)	1(0.025-1.75)
Wet scrubber[f]	1	0.5	2(0.05-3.5)	1(0.025-1.75)
Sellite exhaust	—	—	59(0.01-177)	29.5(0.005-88)
TNT - continuous process[g]				
Nitration reactors				
Fume recovery	—	—	—	—
Acid recovery	—	—	—	—
Red water incinerator	0.25(0.03-0.05)	0.13(0.015-0.025)	0.24(0.05-0.43)	0.12(0.025-0.22)
Nitrocellulose[g]				
Nitration reactors[h]	—	—	1.4(0.8-2)	0.7(0.4-1)
Nitric acid concentrator	—	—	—	—
Sulfuric acid concentrator	—	—	68(0.4-135)	34(0.2-67)
Boiling tubs	—	—	—	—

[a] For some processes considerable variations in emissions have been reported. The average of the values reported is shown first, with the ranges given in parentheses. Where only one number is given, only one source test was available.
[b] Reference 5.
[c] Acid mist emissions influenced by nitrobody levels and type of fuel used in furnace.
[d] No data available for NO_x emissions after the scrubber. It is assumed that NO_x emissions are unaffected by the scrubber.

EXPLOSIVES MANUFACTURING[a]
RATING: C

Nitrogen oxides (NO_2)		Nitric acid mist (100% HNO_3)		Sulfuric acid mist (100% H_2SO_4)	
lb/ton	kg/MT	lb/ton	kg/MT	lb/ton	kg/MT
25(6-38)	12.5(3-19)	1(0.3-1.9)	0.5(0.5-0.95)	–	–
55(1-136)	27.5(0.5-68)	92(0.01-275)	46(0.005-137)	–	–
37(16-72)	18.5(8-36)	–	–	9(0.3-27)	4.5(0.15-13.5)
40(2-80)	20(1-40)	–	–	65(1-188)	32.5(0.5-94)
40(2-80)	20(1-40)	–	–	5(4-6)	2.5(2-3)
26(1.5-101)	13(0.75-50)	–	–	–	–
5	2.5	–	–	–	–
–	–	–	–	6(0.6-16)	3(0.3-8)
8(6.7-10)	4(3.35-5)	1(0.3-1.9)	0.5(0.15-0.95)	–	–
3(1-4.5)	1.5(0.5-2.25)	0.02(0.01-0.03)	0.01(0.005-0.015)	–	–
7(6.1-8.4)	3.5(3-4.2)	–	–	–	–
14(3.7-34)	7(1.85-17)	19(0.5-36)	9.5(0.25-18)	–	–
14(10-18)	7(5-9)	–	–	–	–
		–	–	0.3	0.3
2	1	–	–	–	–

[e] Use low end of range for modern, efficient units and high end of range for older, less efficient units.

[f] Apparent reductions in NO_x and particulate after control may not be significant because these values are based on only one test result.

[g] Reference 4.

[h] For product with low nitrogen content (12 percent), use high end of range. For products with higher nitrogen content, use lower end of range.

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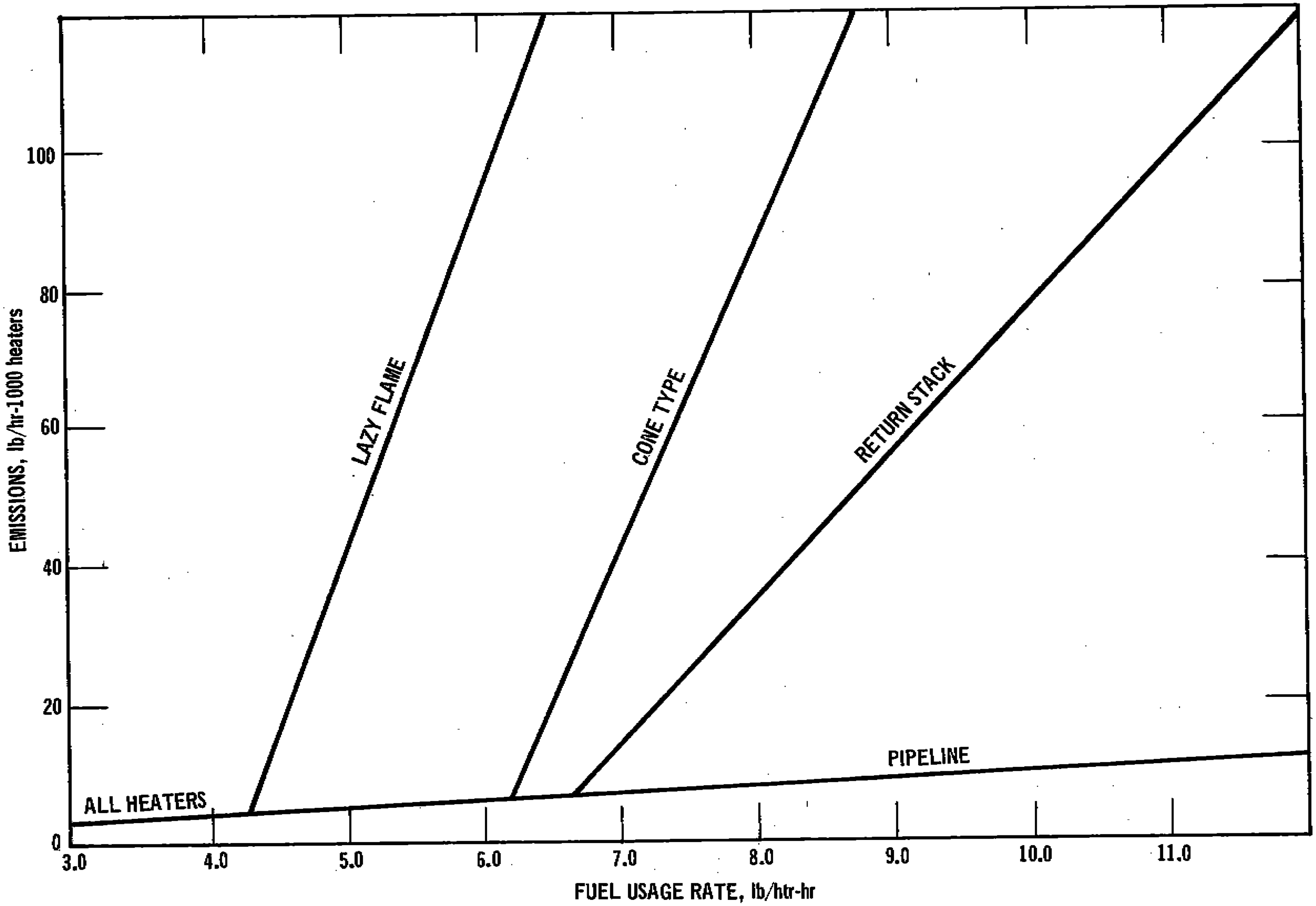

Figure 6.9-2. Particulate emissions from orchard heaters.[3,6]

Table 6.9-1. EMISSION FACTORS FOR ORCHARD HEATERS[a]
EMISSION FACTOR RATING: C

Pollutant	Type of heater				
	Pipeline	Lazy flame	Return stack	Cone	Solid fuel
Particulate					
lb/htr-hr	b	b	b	b	0.05
kg/htr-hr	b	b	b	b	0.023
Sulfur oxides					
lb/htr-hr	0.13S[d]	0.11S	0.14S	0.14S	NA[e]
kg/htr-hr	0.06S	0.05S	0.06S	0.06S	NA
Carbon monoxide					
lb/htr-hr	6.2	NA	NA	NA	NA
kg/htr-hr	2.8	NA	NA	NA	NA
Hydrocarbons[f]					
lb/htr-yr	Neg[g]	16.0	16.0	16.0	Neg
kg/htr-yr	Neg	7.3	7.3	7.3	Neg
Nitrogen oxides[h]					
lb/htr-hr	Neg	Neg	Neg	Neg	Neg
kg/htr-hr	Neg	Neg	Neg	Neg	Neg

[a]References 1, 3, 4, and 6.
[b]Particulate emissions for pipeline, lazy flame, return stack, and cone heaters are shown in Figure 6.9-2.
[c]Based on emission factors for fuel oil combustion in Section 1.3.
[d]S=sulfur content.
[e]Not available.
[f]Based on emission factors for fuel oil combustion in Section 1.3. Evaporative losses only. Hydrocarbon emissions from combustion are considered negligible. Evaporative hydrocarbon losses for units that are part of a pipeline system are negligible.
[g]Negligible.
[h]Little nitrogen oxide is formed because of the relatively low combustion temperatures.

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Table 7.5-1 (continued). EMISSION FACTORS FOR IRON AND STEEL MILLS[a,b]
EMISSION FACTOR RATINGS: A (PARTICULATES AND CARBON MONOXIDE)
C (FLUORIDES)

Type of operation	Total particulates		Carbon monoxide		Fluorides[c,d] Gaseous (HF)		Fluorides[c,d] Particulates (CaF_2)	
	lb/ton	kg/MT	lb/ton	kg/MT	lb/ton	kg/MT	lb/ton	kg/MT
Venturi scrubber	0.17	0.085	–	–	0.011	0.0055	0.0015	0.0008
Electrostatic precipitator	0.35	0.175	–	–	0.100	0.050	0.0006	0.0003
Basic oxygen, uncontrolled[j]	51 (32 to 86)	25.5 (16 to 43)	139 (104 to 237)	69.5 (52.0 to 118.5)	Neg	Neg	0.200	0.100
Venturi scrubber	0.51	0.255	–	–	–	–	0.002	0.001
Electrostatic precipitator	0.51	0.255	–	–	–	–	0.002	0.001
Spray chamber	15.3	7.65	–	–	–	–	0.060	0.030
Electric arc[k]								
No oxygen lance[l], uncontrolled	9.2 (7.0 to 10.6)	4.6 (3.5 to 5.3)	18	9	0.012	0.006	0.238	0.119
Venturi scrubber	0.18	0.09	18	9	0.0018	0.0009	0.011	0.0055
Electrostatic precipitator	0.28 to 0.74	0.14 to 0.37	18	9	0.012	0.006	0.011	0.0055
Baghouse	0.09	0.045	18	9	0.012	0.006	0.0024	0.0012
Oxygen lance[m], uncontrolled	11	5.5	18	9	0.012	0.006	0.238	0.119
Venturi scrubber	0.22	0.11	18	9	0.0018	0.0009	0.011	0.0055
Electrostatic precipitator	0.33 to 0.88	0.165 to 0.44	18	9	0.012	0.006	0.011	0.0055
Baghouse	0.11	0.055	18	9	0.012	0.006	0.0024	0.0012
Scarfing[n], uncontrolled	$\leq$1	$\leq$0.5	–	–	–	–	–	–
Electrostatic precipitator	$\leq$0.06	$\leq$0.03	–	–	–	–	–	–
Venturi scrubber	$\leq$0.02	$\leq$0.01	–	–	–	–	–	–

[a]Emission factors expressed as units per unit weight of metal produced.
[b]Numbers in parentheses after uncontrolled values are ranges. Controlled factors are calculated using average uncontrolled factors and observed equipment efficiencies.
[c]Reference 4.
[d]Value included in "Total Particulates" figure.
[e]References 2, 3, and 5.
[f]These factors should be used to estimate particulate and carbon monoxide emissions from the entire blast furnace operation. The total particulate factors for ore charging and agglomerates charging apply only to those operations.
[g]Reference 3.
[h]Approximately 0.3 pounds of sulfur dioxide per ton (0.15 kg/MT) of sinter is produced at windbox.
[i]References, 2, 3, 5, and 6.
[j]References 2 through 10.
[k]Values are for carbon type electric arc furnaces. For alloy type furnaces, multiply given values by 2.80.
[l]References 2 through 5.
[m]References 3 and 4.
[n]Factors are based on operating experience and engineering judgment.

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8.20 STONE QUARRYING AND PROCESSING

8.20.1 Process Description[1]

Rock and crushed stone products are loosened by drilling and blasting them from their deposit beds and are removed with the use of heavy earth-moving equipment. This mining of rock is done primarily in open pits. The use of pneumatic drilling and cutting, as well as blasting and transferring, causes considerable dust formation. Further processing includes crushing, regrinding, and removal of fines.[2] Dust emissions can occur from all of these operations, as well as from quarrying, transferring, loading, and storage operations. Drying operations, when used, can also be a source of dust emissions.

8.20.2 Emissions[1]

As enumerated above, dust emissions occur from many operations in stone quarrying and processing. Although a big portion of these emissions is heavy particles that settle out within the plant, an attempt has been made to estimate the suspended particulates. These emission factors are shown in Table 8.20-1. Factors affecting emissions include the amount of rock processed; the method of transfer of the rock; the moisture content of the raw material; the degree of enclosure of the transferring, processing, and storage areas; and the degree to which control equipment is used on the processes.

Table 8.20-1. PARTICULATE EMISSION FACTORS FOR ROCK-HANDLING PROCESSES
EMISSION FACTOR RATING: C

Type of process	Uncontrolled total[a]		Settled out in plant,	Suspended emission	
	lb/ton	kg/MT	%	lb/ton	kg/MT
Dry crushing operations[b,c]					
Primary crushing	0.5	0.25	80	0.1	0.05
Secondary crushing and screening	1.5	0.75	60	0.6	0.3
Tertiary crushing and screening (if used)	6	3	40	3.6	1.8
Recrushing and screening	5	2.5	50	2.5	1.25
Fines mill	6	3	25	4.5	2.25
Miscellaneous operations[d]					
Screening, conveying, and handling[e]	2	1			
Storage pile losses[f]					

[a]Typical collection efficiencies: cyclone, 70 to 85 percent; fabric filter, 99 percent.

[b]All values are based on raw material entering primary crusher, except those for recrushing and screening, which are based on throughput for that operation.

[c]Reference 3.

[d]Based on units of stored product.

[e]Reference 4.

[f] See section 11.2.3.

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11.2 FUGITIVE DUST SOURCES

by Charles O. Mann, EPA,
and Chatten C. Cowherd, Jr.,
Midwest Research Institute

Significant sources of atmospheric dust arise from the mechanical disturbance of granular material exposed to the air. Dust generated from these open sources is termed "fugitive" because it is not discharged to the atmosphere in a confined flow stream. Common sources of fugitive dust include: (1) unpaved roads, (2) agricultural tilling operations, (3) aggregate storage piles, and (4) heavy construction operations.

For the above categories of fugitive dust sources, the dust generation process is caused by two basic physical phenomena:

1. Pulverization and abrasion of surface materials by application of mechanical force through implements (wheels, blades, etc.).
2. Entrainment of dust particles by the action of turbulent air currents. Airborne dust may also be generated independently by wind erosion of an exposed surface if the wind speed exceeds about 12 mi/hr (19 km/hr).

The air pollution impact of a fugitive dust source depends on the quantity and drift potential of the dust particles injected into the atmosphere. In addition to large dust particles that settle out near the source (often creating a localized nuisance problem), considerable amounts of fine particles are also emitted and dispersed over much greater distances from the source.

Control techniques for fugitive dust sources generally involve watering, chemical stabilization, or reduction of surface wind speed using windbreaks or source enclosures. Watering, the most common and generally least expensive method, provides only temporary dust control. The use of chemicals to treat exposed surfaces provides longer term dust suppression but may be costly, have adverse impacts on plant and animal life, or contaminate the treated material. Windbreaks and source enclosures are often impractical because of the size of fugitive dust sources. At present, too few data are available to permit estimation of the control efficiencies of these methods.

11.2.1 Unpaved Roads (Dirt and Gravel)

11.2.1.1 General–Dust plumes trailing behind vehicles traveling on unpaved roads are a familiar sight in rural areas of the United States. When a vehicle travels over an unpaved road, the force of the wheels on the road surface cause pulverization of surface material. Particles are lifted and dropped from the rolling wheels, and the road surface is exposed to strong air currents in turbulent shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed.

11.2.1.2 Emissions and Correction Parameters – The quantity of dust emissions from a given segment of unpaved road varies linearly with the volume of traffic. In addition, emissions depend on correction parameters (average vehicle speed, vehicle mix, surface texture, and surface moisture) that characterize the condition of a particular road and the associated vehicular traffic.

In the typical speed range on unpaved roads, that is, 30-50 mi/hr (48-80 km/hr), the results of field measurements indicate that emissions are directly proportional to vehicle speed.[1-3] Limited field measurements further indicate that vehicles produce dust from an unpaved road in proportion to the number of wheels.[1] For roads with a significant volume of vehicles with six or more wheels, the traffic volume should be adjusted to the equivalent volume of four-wheeled vehicles.

Dust emissions from unpaved roads have been found to vary in direct proportion to the fraction of silt (that is, particles smaller than 75 μm in diameter–as defined by American Association of State Highway Officials) in the road surface material.[1] The silt fraction is determined by measuring the proportion of loose, dry, surface dust that passes a 200-mesh screen. The silt content of gravel roads averages about 12 percent, and the silt content of a dirt road may be approximated by the silt content of the parent soil in the area.[1]

Unpaved roads have a hard, nonporous surface that dries quickly after a rainfall. The temporary reduction in emissions because of rainfall may be accounted for by neglecting emissions on "wet" days, that is, days with more than 0.01 in. (0.254 mm) of rainfall.

11.2.1.3 Corrected Emission Factor – The quantity of fugitive dust emissions from an unpaved road, per vehicle-mile of travel, may be estimated (within ± 20 percent) using the following empirical expression[1]:

$$E = \left(0.81\ s\right)\left(\frac{S}{30}\right)\left(\frac{365 - w}{365}\right) \qquad (1)$$

where: E = Emission factor, pounds per vehicle-mile

s = Silt content of road surface material, percent

S = Average vehicle speed, miles per hour

w = Mean annual number of days with 0.01 in. (0.254 mm) or more of rainfall (see Figure 11.2-1)

The equation is valid for vehicle speeds in the range of 30-50 mi/hr (48-80 km/hr).

On the average, dust emissions from unpaved roads, as given by equation 1, have the following particle size characteristics:[1]

Particle size	Weight percent
$< 30\ \mu m$	60
$> 30\ \mu m$	40

The 30 μm value was determined[1] to be the effective aerodynamic cutoff diameter for the capture of road dust by a standard high-volume filtration sampler, based on a particle density of 2.0-2.5 g/cm^3. On this basis, road dust emissions of particles larger than 30-40 μm in diameter are not likely to be captured by high-volume samplers remote from unpaved roads. Furthermore, the potential drift distance of particles is governed by the initial injection height of the particle, the particle's terminal settling velocity, and the degree of atmospheric turbulence. Theoretical drift distances, as a function of particle diameter and mean wind speed, have been computed for unpaved road emissions.[1] These results indicate that, for a typical mean wind speed of 10 mi/hr (16 km/hr), particles larger than about 100 μm are likely to settle out within 20-30 feet (6-9 m) from the edge of the road. Dust that settles within this distance is not included in equation 1. Particles that are 30-100 μm in diameter are likely to undergo impeded settling. These particles, depending upon the extent of atmospheric turbulence, are likely to settle within a few hundred feet from the road. Smaller particles, particularly those less than 10-15 μm in diameter, have much slower gravitational settling velocities and are much more likely to have their settling rate retarded by atmospheric turbulence. Thus, based on the presently available data, it appears appropriate to report only those particles smaller than 30 μm (60 percent of the emissions predicted by Equation 1) as emissions that may remain indefinitely suspended.

11.2.1.4 Control Methods – Common control techniques for unpaved roads are paving, surface treating with penetration chemicals, working of soil stabilization chemicals into the roadbed, watering, and traffic control regulations. Paving as a control technique is often not practical because of its high cost. Surface chemical treatments and watering can be accomplished with moderate to low costs, but frequent retreatments are required for such techniques to be effective. Traffic controls, such as speed limits and traffic volume restrictions, provide moderate emission reductions, but such regulations may be difficult to enforce. Table 11.2.1-1 shows

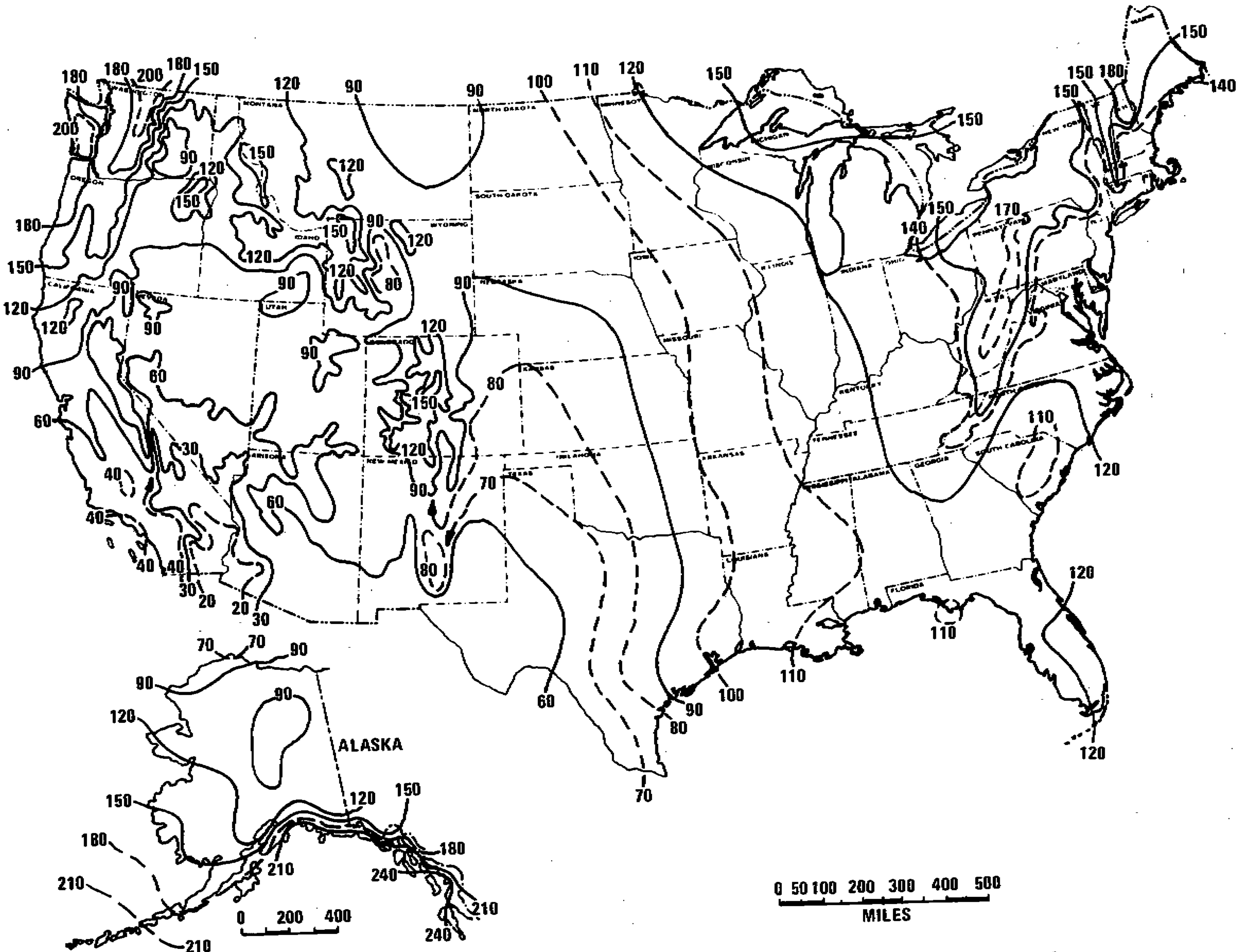

Figure 11.2-1. Mean number of days with 0.01 inch or more of precipitation in United States.[4]

approximate control efficiencies achievable for each method. Watering, because of the frequency of treatments required, is generally not feasible for public roads and is effectively used only where watering equipment is readily available and roads are confined to a single site, such as a construction location.

Table 11.2.1-1 CONTROL METHODS FOR UNPAVED ROADS

Control method	Approximate control efficiency, %
Paving	85
Treating surface with penetrating chemicals	50
Working soil stabilizing chemicals into roadbed	50
Speed control[a]	
30 mi/hr	25
20 mi/hr	65
15 mi/hr	80

[a]Based on the assumption that "uncontrolled" speed is typically 40 mi/hr. Between 30-50 mi/hr emissions are linearly proportional to vehicle speed. Below 30 mi/hr, however, emissions appear to be proportional to the square of the vehicle speed.[1]

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11.2.2 Agricultural Tilling

11.2.2.1 General – The two universal objectives of agricultural tilling are the creation of the desired soil structure to be used as the crop seedbed and the eradication of weeds. Plowing, the most common method of tillage, consists of some form of cutting loose, granulating, and inverting the soil and turning under the organic litter. Implements that loosen the soil and cut off the weeds but leave the surface trash in place, have recently become more popular for tilling in dryland farming areas.

During a tilling operation, dust particles from the loosening and pulverization of the soil are injected into the atmosphere as the soil is dropped to the surface. Dust emissions are greatest when the soil is dry and during final seedbed preparation.

11.2.2.2 Emissions and Correction Parameters – The quantity of dust emissions from agricultural tilling is proportional to the area of land tilled. In addition, emissions depend on the following correction parameters, which characterize the condition of a particular field being tilled: (1) surface soil texture, and (2) surface soil moisture content.

Dust emissions from agricultural tilling have been found to vary in direct proportion to the silt content (that is, particles between 2 μm and 50 μm in diameter–as defined by U.S. Department of Agriculture) of the surface soil (0-10 cm depth).[1] The soil silt content is commonly determined by the Buoyocous hydrometer method.[2]

Field measurements indicate that dust emissions from agricultural tilling are inversely proportional to the square of the surface soil moisture (0-10 cm depth).[1] Thornthwaite's precipitation-evaporation (PE) index[3] is a useful approximate measure of average surface soil moisture. The PE index is determined from total annual rainfall and mean annual temperature; rainfall amounts must be corrected for irrigation.

Available test data indicate no substantial dependence of emissions on the type of tillage implement when operating at a typical speed (for example, 8-10 km/hr).[1]

11.2.2.3 Corrected Emission Factor – The quantity of dust emissions from agricultural tilling, per acre of land tilled, may be estimated (within ± 20 percent) using the following empirical expression[1] :

$$E = \frac{1.4s}{\left(\frac{PE}{50}\right)^2} \qquad (2)$$

where: E = Emission factor, pounds per acre

s = Silt content of surface soil, percent

PE = Thornthwaite's precipitation-evaporation index (Figure 11.2-2)

Equation 2, which was derived from field measurements, excludes dust that settles out within 20-30 ft (6-9 m) of the tillage path.

On the average, the dust emissions from agricultural tilling, as given by Equation 2, have the following particle size characteristics[1] :

Particle size	*Weight percent*
< 30 μm	80
> 30 μm	20

The 30 μm value was determined[1] to be the effective aerodynamic cutoff diameter for capture of tillage dust by a standard high-volume filtration sampler, based on a particle density of 2.0-2.5 g/cm^3. As discussed in section 11.2.1.3, only particles smaller than about 30 μm have the potential for long range transport. Thus, for agricultural tilling about 80 percent of the emissions predicted by Equation 2 are likely to remain suspended indefinitely.

11.2.2.4 Control Methods[4] – In general, control methods are not applied to reduce emissions from agricultural tilling. Irrigation of fields prior to plowing will reduce emissions, but in many cases this practice would make the soil unworkable and adversely affect the plowed soil's characteristics. Control methods for agricultural activities are aimed primarily at reduction of emissions from wind erosion through such practices as continuous cropping, stubble mulching, strip cropping, applying limited irrigation to fallow fields, building windbreaks, and using chemical stabilizers. No data are available to indicate the effects of these or other control methods on agricultural tilling, but as a practical matter it may be assumed that emission reductions are not significant.

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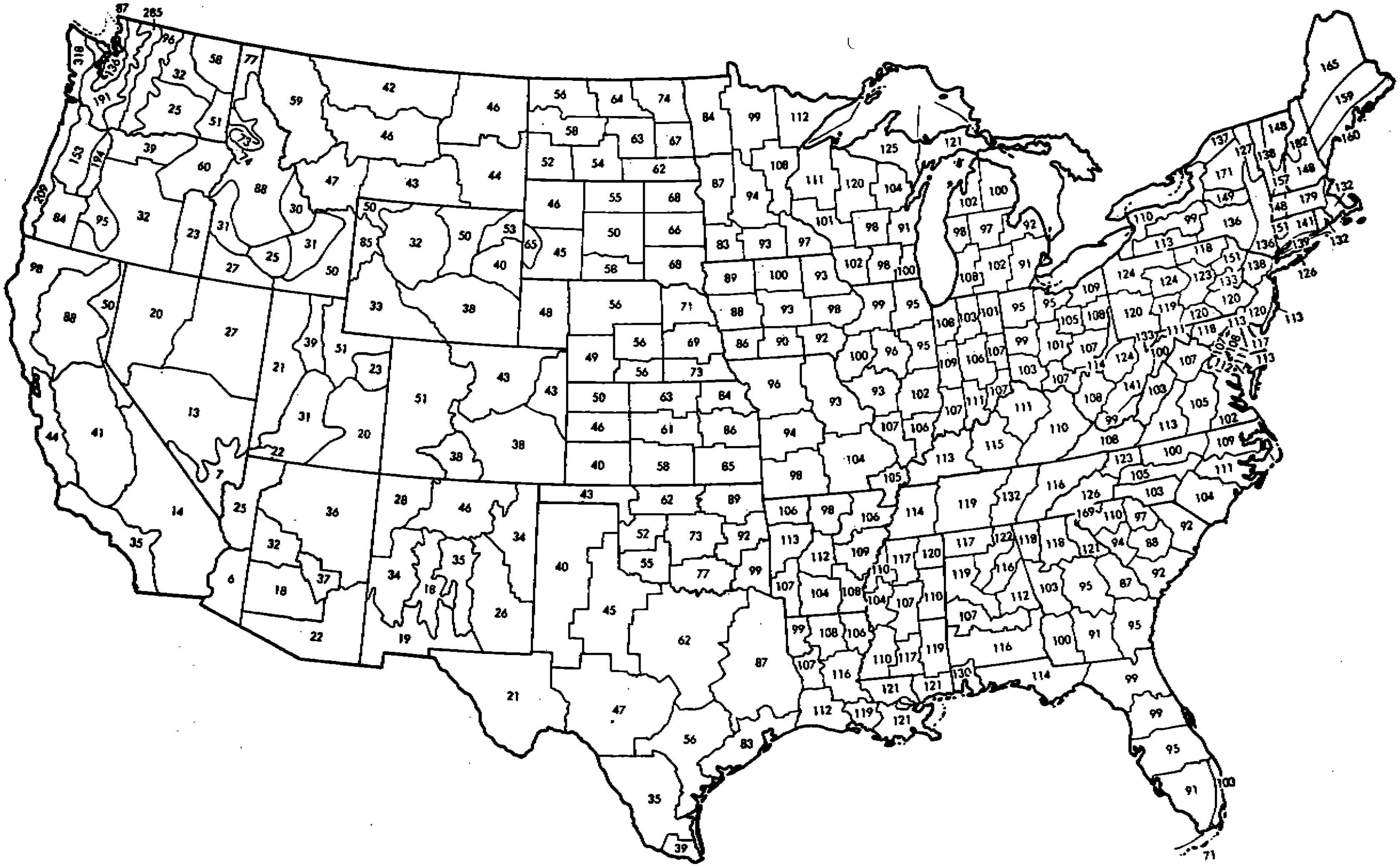

Figure 11.2-2. Map of Thornthwaite's Precipitation-Evaporation Index[3] values for state climatic divisions.

11.2.3 Aggregate Storage Piles

11.2.3.1 General – An inherent part of the operation of plants that utilize minerals in aggregate form is the maintenance of outdoor storage piles. Storage piles are usually left uncovered, partially because of the necessity for frequent transfer of material into or out of storage.

Dust emissions occur at several points in the storage cycle–during loading of material onto the pile, during disturbances by strong wind currents, and during loadout of material from the pile. The movement of trucks and loading equipment in the storage pile area is also a substantial source of dust emissions.

11.2.3.2 Emissions and Correction Parameters – The quantity of dust emissions from aggregate storage operations varies linearly with the volume of aggregate passing through the storage cycle. In addition, emissions depend on the following correction parameters that characterize the condition of a particular storage pile: (1) age of the pile, (2) moisture content, and (3) proportion of aggregate fines.

When freshly processed aggregate is loaded onto a storage pile, its potential for dust emissions is at a maximum. Fines are easily disaggregated and released to the atmosphere upon exposure to air currents resulting from aggregate transfer or high winds. As the aggregate weathers, however, the potential for dust emissions is greatly reduced. Moisture causes aggregation and cementation of fines to the surfaces of larger particles. Any significant rainfall soaks the interior of the pile, and the drying process is very slow.

11.2.3.3 Corrected Emission Factor – Total dust emissions from aggregate storage piles can be divided into the contributions of several distinct source activities that occur within the storage cycle:

1. Loading of aggregate onto storage piles.
2. Equipment traffic in storage area.
3. Wind erosion.
4. Loadout of aggregate for shipment.

Table 11.2.3-1 shows the emissions contribution of each source activity, based on field tests of suspended dust emissions from crushed stone and sand and gravel storage piles.[1] A 3-month storage cycle was assumed in the calculations.

Table 11.2.3-1 AGGREGATE STORAGE EMISSIONS

Source activity	Correction parameter	Approximate percentage of total
Loading onto piles	PE index[a]	12
Vehicular traffic	Rainfall frequency	40
Wind erosion	Climatic factor	33
Loadout from piles	PE index[a]	15
Total		100

[a]Thornthwaite's precipitation-evaporation index.

Also shown in Table 11.2.3-1 are the climatic correction parameters that differentiate the emissions potential of one aggregate storage area from another. Overall, Thornthwaite's precipitation-evaporation index[2] best characterizes the variability of total emissions from aggregate storage piles.

The quantity of suspended dust emissions from aggregate storage piles, per ton of aggregate placed in storage, may be estimated using the following empirical expression[1]:

$$E = \frac{0.33}{\left(\frac{PE}{100}\right)^2} \qquad (3)$$

where: E = Emission factor, pounds per ton placed in storage

PE = Thornthwaite's precipitation-evaporation index (see Figure 11.2-2)

Equation 3 describes the emissions of particles less than 30 μm in diameter. This particle size was determined[1] to be the effective cutoff diameter for the capture of aggregate dust by a standard high-volume filtration sampler, based on a particle density of 2.0-2.5 g/cm^3. Because only particles smaller than 30 μm are included, equation 3 expresses the total emissions likely to remain indefinitely suspended. (See section 11.2.1.3).

11.2.3.4 Control Methods – Watering and use of chemical wetting agents are the principal means for control of aggregate storage pile emissions. Enclosure or covering of inactive piles to reduce wind erosion can also reduce emissions. Watering is useful mainly to reduce emissions from vehicular traffic in the storage pile area. Frequent watering can, based on the breakdowns shown in Table 11.2-3, reduce total emission by about 40 percent. Watering of the storage piles themselves typically has only a very temporary, minimal effect on total emissions. A much more effective technique is to apply chemical wetting agents to provide better wetting of fines and longer retention of the moisture film. Continuous chemical treatment of material loaded onto piles, coupled with watering or treatment of roadways, can reduce total particulate emissions from aggregate storage operations by up to 90 percent.[3]

References for Section 11.2.3

1. Cowherd, C., Jr., K. Axetell, Jr., C. M. Guenther, and G. A. Jutze. Development of Emission Factors for Fugitive Dust Sources. Midwest Research Institute, Kansas City, Mo. Prepared for Environmental Protection Agency, Research Triangle Park, N.C. under Contract No. 68-02-0619. Publication No. EPA-450/3-74-037. June 1974.

2. Thornthwaite, C. W. Climates of North America According to a New Classification. Geograph. Rev. *21*: 633-655, 1931.

3. Jutze, G. A., K. Axetell, Jr., and W. Parker. Investigation of Fugitive Dust-Sources Emissions and Control. PEDCo Environmental Specialists, Inc., Cincinnati, Ohio. Prepared for Environmental Protection Agency, Research Triangle Park, N.C. under Contract No. 68-02-0044. Publication No. EPA-450/3-74-036a. June 1974.

11.2.4 Heavy Construction Operations

11.2.4.1 General – Heavy construction is a source of dust emissions that may have substantial temporary impact on local air quality. Building and road construction are the prevalent construction categories with the highest emissions potential. Emissions during the construction of a building or road are associated with land clearing, blasting, ground excavation, cut and fill operations, and the construction of the particular facility itself. Dust emissions vary substantially from day to day depending on the level of activity, the specific operations, and the prevailing weather. A large portion of the emissions result from equipment traffic over temporary roads at the construction site.

11.2.4.2 Emissions and Correction Parameters – The quantity of dust emissions from construction operations are proportional to the area of land being worked and the level of construction activity. Also, by analogy to the parameter dependence observed for other similar fugitive dust sources,[1] it is probable that emissions from heavy construction operations are directly proportional to the silt content of the soil (that is, particles smaller than 75 μm in diameter) and inversely proportional to the square of the soil moisture, as represented by Thornthwaite's precipitation-evaporation (PE) index.[2]

11.2.4.3 Emission Factor – Based on field measurements of suspended dust emissions from apartment and shopping center construction projects, an approximate emission factor for construction operations is:

1.2 tons per acre of construction per month of activity

This value applies to construction operations with: (1) medium activity level, (2) moderate silt content ($\sim$30 percent), and (3) semiarid climate (PE $\sim$50; see Figure 11.2-2). Test data are not sufficient to derive the specific dependence of dust emissions on correction parameters.

The above emission factor applies to particles less than about 30 μm in diameter, which is the effective cut-off size for the capture of construction dust by a standard high-volume filtration sampler[1], based on a particle density of 2.0-2.5 g/cm^3.

11.2.4.4 Control Methods – Watering is most often selected as a control method because water and necessary equipment are usually available at construction sites. The effectiveness of watering for control depends greatly on the frequency of application. An effective watering program (that is, twice daily watering with complete coverage) is estimated to reduce dust emissions by up to 50 percent.[3] Chemical stabilization is not effective in reducing the large portion of construction emissions caused by equipment traffic or active excavation and cut and fill operations. Chemical stabilizers are useful primarily for application on completed cuts and fills at the construction site. Wind erosion emissions from inactive portions of the construction site can be reduced by about 80 percent in this manner, but this represents a fairly minor reduction in total emissions compared with emissions occurring during a period of high activity.

References for Section 11.2.4

1. Cowherd, C., Jr., K. Axetell, Jr., C. M. Guenther, and G. A. Jutze. Development of Emissions Factors for Fugitive Dust Sources. Midwest Research Institute, Kansas City, Mo. Prepared for Environmental Protection Agency, Research Triangle Park, N.C. under Contract No. 68-02-0619. Publication No. EPA-450/3-74-037. June 1974.

2. Thornthwaite, C. W. Climates of North America According to a New Classification. Geograph. Rev. *21*: 633-655, 1931.

3. Jutze, G. A., K. Axetell, Jr., and W. Parker. Investigation of Fugitive Dust-Sources Emissions and Control, PEDCo Environmental Specialists, Inc., Cincinnati, Ohio. Prepared for Environmental Protection Agency, Research Triangle Park, N.C. under Contract No. 68-02-0044. Publication No. EPA-450/3-74-036a. June 1974.

APPENDIX C

NEDS SOURCE CLASSIFICATION CODES
AND
EMISSION FACTOR LISTING

The Source Classification Codes (SCC's) presented herein comprise the basic "building blocks" upon which the National Emissions Data System (NEDS) is structured. Each SCC represents a process or function within a source category logically associated with a point of air pollution emissions. In NEDS, any operation that causes air pollution can be represented by one or more of these SCC's.

Also presented herein are emission factors for the five NEDS pollutants (particulates, sulfur oxides, nitrogen oxides, hydrocarbons, and carbon monoxide) that correspond to each SCC. These factors are utilized in NEDS to automatically compute estimates of air pollutant emissions associated with a process when a more accurate estimate is not supplied to the system. These factors are, for the most part, taken directly from AP-42. In certain cases, however, they may be derived from better information not yet incorporated into AP-42 or be based merely on the similarity of one process to another for which emissions information does exist.

Because these emission factors are merely single representative values taken, in many cases, from a broad range of possible values and because they do not reflect all of the variables affecting emissions that are described in detail in this document, the user is cautioned not to use the factors listed in Appendix C out of context to estimate the emissions from any given source. Instead, if emission factors must be used to estimate emissions, the appropriate section of this document should be consulted to obtain the most applicable factor for the source in question. The factors presented in Appendix C are reliable only when applied to numerous sources as they are in NEDS.

NOTE: The Source Classification Code and emission factor listing presented in Appendix C was created on October 21, 1975, to replace the listing dated June 20, 1974. The listing has been updated to include several new Source Classification Codes as well as several new or revised emission factors that are considered necessary for the improvement of NEDS. The listing will be updated periodically as better source and emission factor information becomes available. Any comments regarding this listing, especially those pertaining to the need for additional SCC's, should be directed to:

Chief, Emission Factor Section (MD-14)
National Air Data Branch
Environmental Protection Agency
Research Triangle Park, N.C. 27711

NATIONAL EMISSION DATA SYSTEM
SOURCE CLASSIFICATION CODES

EXTCOMB BOILER	-ELECTRIC GENERATN	POUNDS EMITTED PER UNIT PART	SOX	NOX	HC	CO	UNITS
ANTHRACITE COAL							
1-01-001-01	>100MMBTU PULVIZD	17.0 A	38.0 S	18.0	0.03	1.00	TONS BURNED
1-01-001-02	>100MMBTU STOKERS	2.00 A	38.0 S	10.5	0.20	6.00	TONS BURNED
1-01-001-03	10-100MMBTU PULVD	17.0 A	38.0 S	18.0	0.03	1.00	TONS BURNED
1-01-001-04	10-100MMBTU STOKR	2.00 A	38.0 S	10.5	0.20	6.00	TONS BURNED
1-01-001-05	<10MMBTU PULVIZED	17.0 A	38.0 S	18.0	0.03	1.00	TONS BURNED
1-01-001-06	<10MMBTU STOKER	2.00 A	38.0 S	6.00	0.20	10.0	TONS BURNED
1-01-001-99	OTHER/NOT CLASIFD	17.0 A	38.0 S	18.0	0.03	1.00	TONS BURNED
BITUMINOUS COAL							
1-01-002-01	>100MMBTU PULVWET	13.0 A	38.0 S	30.0	0.30	1.00	TONS BURNED
1-01-002-02	>100MMBTU PULVDRY	17.0 A	38.0 S	18.0	0.30	1.00	TONS BURNED
1-01-002-03	>100MMBTU CYCLONE	2.00 A	38.0 S	55.0	0.30	1.00	TONS BURNED
1-01-002-04	>100MMBTU SPDSTKR	13.0 A	38.0 S	15.0	1.00	2.00	TONS BURNED
1-01-002-05	>100MMBTU/HR OFSK	5.00 A	38.0 S	15.0	1.00	2.00	TONS BURNED
1-01-002-06	10-100MMBTU PULWT	13.0 A	38.0 S	30.0	0.30	1.00	TONS BURNED
1-01-002-07	10-100MMBTU PULDY	17.0 A	38.0 S	18.0	0.30	1.00	TONS BURNED
1-01-002-08	10-100MMBTU OFSTK	5.00 A	38.0 S	15.0	1.00	2.00	TONS BURNED
1-01-002-09	10-100MMBTU UFSTK	5.00 A	38.0 S	15.0	1.00	2.00	TONS BURNED
1-01-002-10	<10MMBTU OFSTOKER	7.00 A	38.0 S	6.00	3.00	10.0	TONS BURNED
1-01-002-11	<10MMBTU UFSTOKER	2.00 A	38.0 S	6.00	3.00	10.0	TONS BURNED
1-01-002-12	<10MMBTU PULV-DRY	17.0 A	38.0 S	18.0	0.30	1.00	TONS BURNED
1-01-002-99	OTHER/NOT CLASIFD	16.0 A	38.0 S	18.0	0.30	0.50	TONS BURNED
LIGNITE							
1-01-003-01	>100MMBTU PULVWET	6.50 A	30.0 S	13.0	0.30	1.00	TONS BURNED
1-01-003-02	>100MMBTU PULVDRY	6.50 A	30.0 S	13.0	0.30	1.00	TONS BURNED
1-01-003-03	>100MMBTU CYCLONE	6.50 A	30.0 S	17.0	0.30	1.00	TONS BURNED
1-01-003-04	>100MMBTU OF STKR	6.50 A	30.0 S	13.0	0.30	2.00	TONS BURNED
1-01-003-05	>100MMBTU UF STKR	6.50 A	30.0 S	13.0	0.30	2.00	TONS BURNED
1-01-003-06	>100MMBTU SPDSTKR	6.50 A	30.0 S	13.0	0.30	2.00	TONS BURNED
1-01-003-07	10-100MMBTU DYPUL	6.50 A	30.0 S	13.0	0.30	1.00	TONS BURNED
1-01-003-08	10-100MMBTU WTPUL	6.50 A	30.0 S	13.0	0.30	1.00	TONS BURNED
1-01-003-09	10-100MMBTU OFSTK	6.50 A	30.0 S	13.0	1.00	2.00	TONS BURNED
1-01-003-10	10-100MMBTU UFSTK	6.50 A	30.0 S	13.0	1.00	2.00	TONS BURNED
1-01-003-11	10-100MMBTUSPDSTK	6.50 A	30.0 S	13.0	1.00	2.00	TONS BURNED
1-01-003-12	<10MMBTU PULV DRY	6.50 A	30.0 S	13.0	3.00	10.0	TONS BURNED
1-01-003-13	<10MMBTU OF STOKR	6.50 A	30.0 S	13.0	3.00	10.0	TONS BURNED
1-01-003-14	<10MMBTU UF STOKR	6.50 A	30.0 S	13.0	3.00	10.0	TONS BURNED
1-01-003-15	<10MMBTU SPDSTOKR	6.50 A	30.0 S	13.0	3.00	10.0	TONS BURNED
RESIDUAL OIL							
1-01-004-01	>100MMBTU/HR GENL	8.00	157. S	105.	2.00	3.00	1000GALLONS BURNED
1-01-004-02	10-100MMBTU/HRGNL	8.00	157. S	105.	2.00	3.00	1000GALLONS BURNED
1-01-004-03	<10MMBTU/HR GENL	8.00	157. S	105.	2.00	3.00	1000GALLONS BURNED
DISTILLATE OIL							
1-01-005-01	>100MMBTU/HR GENL	8.00	144. S	105.	2.00	3.00	1000GALLONS BURNED
1-01-005-02	10-100MMBTU/HRGNL	8.00	144. S	105.	2.00	3.00	1000GALLONS BURNED
1-01-005-03	<10MMBTU/HR GENL	8.00	144. S	105.	2.00	3.00	1000GALLONS BURNED
NATURAL GAS							
1-01-006-01	>100MMBTU/HR	10.0	0.60	600.	1.00	17.0	MILLION CUBIC FEET BURNED
1-01-006-02	10-100MMBTU/HR	10.0	0.60	230.	1.00	17.0	MILLION CUBIC FEET BURNED
1-01-006-03	<10MMBTU/HR	10.0	0.60	120.	1.00	17.0	MILLION CUBIC FEET BURNED
PROCESS GAS							
1-01-007-01	>100MMBTU/HR	15.0	950. S	600.	1.00	17.0	MILLION CUBIC FEET BURNED
1-01-007-02	10-100MMBTU/HR	15.0	950. S	230.	1.00	17.0	MILLION CUBIC FEET BURNED
1-01-007-03	<10 MMBTU/HR	15.0	950. S	120.	1.00	17.0	MILLION CUBIC FEET BURNED
COKE							
1-01-008-01	>100MMBTU/HR	17.0 A	38.0 S	18.0	0.03	1.00	TONS BURNED
WOOD/BARK WASTE							
1-01-009-01	BARK BOILER	75.0	1.50	10.0	2.00	2.00	TONS BURNED
1-01-009-02	WOOD/BARK BOILER	37.5	1.50	10.0	2.00	2.00	TONS BURNED
1-01-009-03	WOOD BOILER	10.0	1.50	10.0	5.00	10.0	TONS BURNED
BAGASSE							
1-01-011-01	>100MMBTU/HR	22.0	0.	2.00	2.00	2.00	TONS BURNED
1-01-011-02	10-100MMBTU/HR	22.0	0.	2.00	2.00	2.00	TONS BURNED
1-01-011-03	<10MMBTU/HR	22.0	0.	2.00	2.00	2.00	TONS BURNED
SLD WASTE-SPECIFY							
1-01-012-01	>100 MMBTU/HR						TONS BURNED
1-01-012-02	10-100 MMBTU/HR						TONS BURNED
1-01-012-03	<10 MMBTU/HR						TONS BURNED

'A' INDICATES THE ASH CONTENT, 'S' INDICATES THE SULFUR CONTENT OF THE FUEL ON A PERCENT BASIS (BY WEIGHT)

N A T I O N A L   E M I S S I O N   D A T A   S Y S T E M
S O U R C E   C L A S S I F I C A T I O N   C O D E S

P O U N D S   E M I T T E D   P E R   U N I T

		PART	SOX	NOX	HC	CO	U N I T S
EXCOMB BOILER	-ELECTRIC GENERATN						
LIQ WASTE-SPECIFY							
1-01-013-01	>100 MMBTU/HR						1000 GALLONS BURNED
1-01-013-02	10-100 MMBTU/HR						1000 GALLONS BURNED
1-01-013-03	<10 MMBTU/HR						1000 GALLONS BURNED
OTHER/NOT CLASIFD							
1-01-999-97	SPECIFY IN REMARK						MILLION CUBIC FEET BURNED
1-01-999-98	SPECIFY IN REMARK						1000 GALLON (LIQUID) BURNED
1-01-999-99	SPECIFY IN REMARK						TONS BURNED (SOLID)
EXTCOMB BOILER	-INDUSTRIAL						
ANTHRACITE COAL							
1-02-001-01	>100MMBTU/HR PULV	17.0 A	38.0 S	18.0	0.03	1.00	TONS BURNED
1-02-001-02	>100MMBTU/HR STKR	2.00 A	38.0 S	10.5	0.20	6.00	TONS BURNED
1-02-001-03	10-100MMBTU PULVD	17.0 A	38.0 S	18.0	0.03	1.00	TONS BURNED
1-02-001-04	10-100MMBTU STKR	2.00 A	38.0 S	10.5	0.20	6.00	TONS BURNED
1-02-001-05	<10MMBTU/HR PULVD	17.0 A	38.0 S	18.0	0.03	1.00	TONS BURNED
1-02-001-06	<10MMBTU/HR STKR	2.00 A	38.0 S	6.00	0.20	10.0	TONS BURNED
1-02-001-07	<10MMBTU/HR HNDFR	10.0	38.0 S	3.00	2.50	90.0	TONS BURNED
1-02-001-99	OTHER/NOT CLASIFD	17.0 A	38.0 S	18.0	0.03	2.00	TONS BURNED
BITUMINOUS COAL							
1-02-002-01	>100MMBTU PULVWET	13.0 A	38.0 S	30.0	0.30	1.00	TONS BURNED
1-02-002-02	>100MMBTU PULVDRY	17.0 A	38.0 S	18.0	0.30	1.00	TONS BURNED
1-02-002-03	>100MMBTU CYCLONE	2.00 A	38.0 S	55.0	0.30	1.00	TONS BURNED
1-02-002-04	>100MMBTU SPDSTKR	13.0 A	38.0 S	15.0	1.00	2.00	TONS BURNED
1-02-002-05	10-100MMBTU OFSTK	5.00 A	38.0 S	15.0	1.00	2.00	TONS BURNED
1-02-002-06	10-100MMBTU UFSTK	5.00 A	38.0 S	15.0	1.00	2.00	TONS BURNED
1-02-002-07	10-100MMBTU PULWT	13.0 A	38.0 S	30.0	0.30	1.00	TONS BURNED
1-02-002-08	10-100MMBTU PULDY	17.0 A	38.0 S	18.0	0.30	1.00	TONS BURNED
1-02-002-09	10-100MMBTUSPDSTK	13.0 A	38.0 S	15.0	1.00	2.00	TONS BURNED
1-02-002-10	<10MMBTU OFD STKR	2.00 A	38.0 S	6.00	3.00	10.0	TONS BURNED
1-02-002-11	<10MMBTU UFD STKR	2.00 A	38.0 S	6.00	3.00	10.0	TONS BURNED
1-02-002-12	<10MMBTU PULV DRY	17.0 A	38.0 S	18.0	0.30	2.00	TONS BURNED
1-02-002-13	<10MMBTU SPD STKR	2.00 A	38.0 S	6.00	3.00	10.0	TONS BURNED
1-02-002-14	<10MMBTU HANDFIRE	20.0	38.0 S	3.00	20.0	90.0	TONS BURNED
1-02-002-99	OTHER/NOT CLASIFD	13.0 A	38.0 S	15.0	0.30	2.00	TONS BURNED
LIGNITE							
1-02-003-01	>100MMBTU PULVWET	6.50 A	30.0 S	13.0	0.30	1.00	TONS BURNED
1-02-003-02	>100MMBTU PULVDRY	6.50 A	30.0 S	13.0	0.30	1.00	TONS BURNED
1-02-003-03	>100MMBTU CYCLONE	6.50 A	30.0 S	17.0	0.30	1.00	TONS BURNED
1-02-003-04	>100MMBTU OFSTKR	6.50 A	30.0 S	13.0	1.00	2.00	TONS BURNED
1-02-003-05	>100MMBTU UFSTKR	6.50 A	30.0 S	13.0	1.00	2.00	TONS BURNED
1-02-003-06	>100MMBTU SPDSTKR	6.50 A	30.0 S	13.0	1.00	2.00	TONS BURNED
1-02-003-07	10-100MMBTU DYPUL	6.50 A	30.0 S	13.0	0.30	1.00	TONS BURNED
1-02-003-08	10-100MMBTU WTPUL	6.50 A	30.0 S	13.0	0.30	1.00	TONS BURNED
1-02-003-09	10-100MMBTU OFSTK	6.50 A	30.0 S	13.0	1.00	2.00	TONS BURNED
1-02-003-10	10-100MMBTU UFSTK	6.50 A	30.0 S	13.0	1.00	2.00	TONS BURNED
1-02-003-11	10-100MMBTUSPDSTK	6.50 A	30.0 S	13.0	1.00	2.00	TONS BURNED
1-02-003-12	<10MMBTU PULV DRY	6.50 A	30.0 S	13.0	3.00	10.0	TONS BURNED
1-02-003-13	<10MMBTU OFSTOKR	6.50 A	30.0 S	13.0	3.00	10.0	TONS BURNED
1-02-003-14	<10MMBTU UFSTOKR	6.50 A	30.0 S	13.0	3.00	10.0	TONS BURNED
1-02-003-15	<10MMBTU HANDFIRE	6.50 A	30.0 S	13.0	20.0	90.0	TONS BURNED
1-02-003-16	<10MMBTU SPDSTKR	6.50 A	30.0 S	13.0	3.00	10.0	TONS BURNED
RESIDUAL OIL							
1-02-004-01	>100MMBTU/HR	23.0	157. S	60.0	3.00	4.00	1000 GALLONS BURNED
1-02-004-02	10-100MMBTU/HR	23.0	157. S	60.0	3.00	4.00	1000 GALLONS BURNED
1-02-004-03	<10MMBTU/HR	23.0	157. S	60.0	3.00	4.00	1000 GALLONS BURNED
DISTILLATE OIL							
1-02-005-01	>100MMBTU/HR	15.0	142. S	60.0	3.00	4.00	1000 GALLONS BURNED
1-02-005-02	10-100MMBTU/HR	15.0	142. S	60.0	3.00	4.00	1000 GALLONS BURNED
1-02-005-03	<10MMBTU/HR	15.0	142. S	60.0	3.00	4.00	1000 GALLONS BURNED
NATURAL GAS							
1-02-006-01	>100MMBTU/HR	10.0	0.60	600.	3.00	17.0	MILLION CUBIC FEET BURNED
1-02-006-02	10-100MMBTU/HR	10.0	0.60	230.	3.00	17.0	MILLION CUBIC FEET BURNED
1-02-006-03	<10MMBTU/HR	10.0	0.60	120.	3.00	17.0	MILLION CUBIC FEET BURNED
PROCESS GAS							
1-02-007-01	REFINERY >100						MILLION CUBIC FEET BURNED
1-02-007-02	REFINERY 10-100						MILLION CUBIC FEET BURNED
1-02-007-03	REFINERY <10						MILLION CUBIC FEET BURNED
1-02-007-04	BLAST FNC >100						MILLION CUBIC FEET BURNED
1-02-007-05	BLAST FNC 10-100						MILLION CUBIC FEET BURNED
1-02-007-06	BLAST FNC <10						MILLION CUBIC FEET BURNED

'A' INDICATES THE ASH CONTENT, 'S' INDICATES THE SULFUR CONTENT OF THE FUEL ON A PERCENT BASIS (BY WEIGHT)

NATIONAL EMISSION DATA SYSTEM
SOURCE CLASSIFICATION CODES

POUNDS EMITTED PER UNIT

		PART	SOX	NOX	HC	CO	UNITS
EXTCOMB BOILER	**-INDUSTRIAL**						
PROCESS GAS	CONTINUED						
1-02-007-07	COKE OVEN >100						MILLION CUBIC FEET BURNED
1-02-007-08	COKE OVEN 10-100						MILLION CUBIC FEET BURNED
1-02-007-09	COKE OVEN <10						MILLION CUBIC FEET BURNED
1-02-007-99	OTHER/NOT CLASIFD						MILLION CUBIC FEET BURNED
COKE							
1-02-008-02	10-100MMBTU/HR	2.00 A	38.0 S	15.0	0.20	2.00	TONS BURNED
1-02-008-03	<10MMBTU/HR	2.00 A	38.0 S	6.00	0.20	10.0	TONS BURNED
WOOD/BARK WASTE							
1-02-009-01	BARK BOILER	75.0	1.50	10.0	2.00	2.00	TONS BURNED
1-02-009-02	WOOD/BARK BOILER	37.5	1.50	10.0	2.00	2.00	TONS BURNED
1-02-009-03	WOOD BOILER	10.0	1.50	10.0	5.00	10.0	TONS BURNED
LIQ PETROLEUM GAS							
1-02-010-02	10-100MMBTU/HR	1.75	86.5 S	11.7	0.30	1.55	1000GALLONS BURNED
1-02-010-03	<10MMBTU/HR	1.75	86.5 S	11.7	0.30	1.55	1000GALLONS BURNED
BAGASSE							
1-02-011-01	>100 MMBTU/HR	22.0	0.	2.00	2.00	2.00	TONS BURNED
1-02-011-02	10-100MMBTU/HR	22.0	0.	2.00	2.00	2.00	TONS BURNED
1-02-011-03	<10MMBTU/HR	22.0	0.	2.00	2.00	2.00	TONS BURNED
SLD WASTE-SPECIFY							
1-02-012-01	>100 MMBTU/HR						TONS BURNED
1-02-012-02	100-100 MMBTU/HR						TONS BURNED
1-02-012-03	<10 MMBTU/HR						TONS BURNED
LIQ WASTE-SPECIFY							
1-02-013-01	>100 MMBTU/HR						1000 GALLONS BURNED
1-02-013-02	10-100 MMBTU/HR						1000 GALLONS BURNED
1-02-013-03	<10 MMBTU/HR						1000 GALLONS BURNED
OTHER/NOT CLASIFD							
1-02-999-97	SPECIFY IN REMARK						MILLION CUBIC FEET BURNED
1-02-999-98	SPECIFY IN REMARK						1000 GALLON BURNED (LIQUID)
1-02-999-99	SPECIFY IN REMARK						TONS BURNED (SOLID)
EXTCOMB BOILER	**-COMMERCL-INSTUTNL**						
ANTHRACITE COAL							
1-03-001-05	10-100MMBTU PULWT	13.0 A	38.0 S	30.0	0.03	1.00	TONS BURNED
1-03-001-06	10-100MMBTU PULDY	17.0 A	38.0 S	18.0	0.03	1.00	TONS BURNED
1-03-001-07	10-100MMBTUSPDSTK	13.0 A	38.0 S	15.0	1.00	2.00	TONS BURNED
1-03-001-08	<10MMBTU PULVIZED	17.0 A	38.0 S	18.0	0.03	1.00	TONS BURNED
1-03-001-09	<10MMBTU STOKER	2.00 A	39.0 S	6.00	0.20	10.0	TONS BURNED
1-03-001-10	<10MMBTU SPDSTOKR	2.00 A	38.0 S	15.0	1.00	10.0	TONS BURNED
1-03-001-99	OTHER/NOT CLASIFD	17.0 A	38.0 S	18.0	0.03	1.00	TONS BURNED
BITUMINOUS COAL							
1-03-002-05	10-100MMBTU PULWT	13.0 A	38.0 S	30.0	0.03	1.00	TONS BURNED
1-03-002-06	10-100MMBTU PULDY	17.0 A	38.0 S	18.0	0.03	1.00	TONS BURNED
1-03-002-07	10-100MMBTU OFSTK	5.00 A	38.0 S	15.0	1.00	2.00	TONS BURNED
1-03-002-08	10-100MMBTU UFSTK	5.00 A	38.0 S	15.0	1.00	2.00	TONS BURNED
1-03-002-09	10-100MMBTUSPDSTK	13.0 A	38.0 S	15.0	1.00	2.00	TONS BURNED
1-03-002-10	10-100MMBTU HANFR	20.0	38.0 S	3.00	20.0	90.0	TONS BURNED
1-03-002-11	<10MMBTU OFSTOKER	2.00 A	38.0 S	6.00	3.00	10.0	TONS BURNED
1-03-002-12	<10MMBTU UFSTOKER	2.00 A	38.0 S	6.00	3.00	10.0	TONS BURNED
1-03-002-13	<10MMBTU SPDSTOKR	2.00 A	38.0 S	6.00	3.00	10.0	TONS BURNED
1-03-002-14	<10MMBTU HANDFIRE	20.0	38.0 S	3.00	20.0	90.0	TONS BURNED
1-03-002-99	OTHER/NOT CLASIFD	13.0 A	38.0 S	15.0	0.30	2.00	TONS BURNED
LIGNITE							
1-03-003-05	10-100MMBTU PULWT	6.50 A	30.0 S	13.0	1.00	2.00	TONS BURNED
1-03-003-06	10-100MMBTU PULDY	6.50 A	30.0 S	13.0	1.00	2.00	TONS BURNED
1-03-003-07	10-100MMBTU OFSTK	6.50 A	30.0 S	13.0	1.00	2.00	TONS BURNED
1-03-003-08	10-100MMBTU UFSTK	6.50 A	30.0 S	13.0	1.00	2.00	TONS BURNED
1-03-003-09	10-100MMBTUSPDSTK	6.50 A	30.0 S	13.0	1.00	2.00	TONS BURNED
1-03-003-10	<10MMBTU PULV-DRY	6.50 A	30.0 S	13.0	1.00	10.0	TONS BURNED
1-03-003-11	<10MMBTU OFSTOKER	6.50 A	30.0 S	13.0	3.00	10.0	TONS BURNED
1-03-003-12	<10MMBTU UFSTOKER	6.50 A	30.0 S	13.0	3.00	10.0	TONS BURNED
1-03-003-13	<10MMBTU SPDSTOKR	6.50 A	30.0 S	13.0	3.00	10.0	TONS BURNED
1-03-003-14	<10MMBTU HANDFIRE	6.50 A	30.0 S	13.0	20.0	90.0	TONS BURNED

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NATIONAL EMISSION DATA SYSTEM
SOURCE CLASSIFICATION CODES

POUNDS EMITTED PER UNIT

		PART	SOX	NOX	HC	CO	UNITS
EXTCOMB BOILER	-COMMERCL-INSTUTNL						
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RESIDUAL OIL							
1-03-004-01	>100MMBTU/HR	23.0	157. S	60.0	3.00	4.00	1000 GALLONS BURNED
1-03-004-02	10-100MMBTU/HR	23.0	157. S	60.0	3.00	4.00	1000 GALLONS BURNED
1-03-004-03	<10MMBTU/HR	23.0	157. S	60.0	3.00	4.00	1000 GALLONS BURNED
DISTILLATE							
1-03-005-01	>100MMBTU/HR	15.0	142. S	60.0	3.00	4.00	1000 GALLONS BURNED
1-03-005-02	10-100MMBTU/HR	15.0	142. S	60.0	3.00	4.00	1000 GALLONS BURNED
1-03-005-03	<10MMBTU/HR	15.0	142. S	60.0	3.00	4.00	1000 GALLONS BURNED
NATURAL GAS							
1-03-006-01	>100MMBTU/HR	10.0	0.60	230.	8.00	20.0	MILLION CUBIC FEET BURNED
1-03-006-02	10-100MMBTU/HR	10.0	0.60	120.	8.00	20.0	MILLION CUBIC FEET BURNED
1-03-006-03	<10MMBTU/HR	10.0	0.60	80.0	8.00	20.0	MILLION CUBIC FEET BURNED
PROCESS GAS							
1-03-007-01	SEWAGE>100MMBTUHR						MILLION CUBIC FEET BURNED
1-03-007-02	SEWAGE 10-100						MILLION CUBIC FEET BURNED
1-03-007-03	SEWAGE<10MMBTU/HR						MILLION CUBIC FEET BURNED
1-03-007-99	OTHER/NOT CLASIFD						MILLION CUBIC FEET BURNED
WOOD/BARK WASTE							
1-03-009-01	BARK BOILER	75.0	1.50	10.0	2.00	2.00	TONS BURNED
1-03-009-02	WOOD/BARK BOILER	37.5	1.50	10.0	2.00	2.00	TONS BURNED
1-03-009-03	WOOD BOILER	10.0	1.50	10.0	5.00	10.0	TONS BURNED
LIQ PETROLEUM GAS							
1-03-010-02	10-100MMBTU/HR	1.85	86.5 S	9.50	0.75	1.95	1000 GALLONS BURNED
1-03-010-03	<10MMBTU/HR	1.85	86.5 S	9.50	0.75	1.95	1000 GALLONS BURNED
SLD WASTE-SPECIFY							
1-03-012-01	>100 MMBTU/HR						TONS BURNED
1-03-012-02	10-100 MMBTU/HR						TONS BURNED
1-03-012-03	<10 MMBTU/HR						TONS BURNED
LIQ WASTE-SPECIFY							
1-03-013-01	>100 MMBTU/HR						1000 GALLONS BURNED
1-03-013-02	10-100 MMBTU/HR						1000 GALLONS BURNED
1-03-013-03	<10 MMBTU/HR						1000 GALLONS BURNED
OTHER/NOT CLASIFD							
1-03-999-97	SPECIFY IN REMARK						MILLION CUBIC FEET BURNED
1-03-999-98	SPECIFY IN REMARK						1000 GALLON BURNED (LIQUID)
1-03-999-99	SPECIFY IN REMARK						TONS BURNED (SOLID)
EXTCOMB BOILER	-SPACE HEATER						
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INDUSTRIAL							
1-05-001-01	ANTHRACITE COAL						TONS BURNED
1-05-001-02	BITUMINOUS COAL						TONS BURNED
1-05-001-03	LIGNITE						TONS BURNED
1-05-001-04	RESIDUAL OIL						1000 GALLONS BURNED
1-05-001-05	DISTILLATE OIL						1000 GALLONS BURNED
1-05-001-06	NATURAL GAS						MILLION CUBIC FEET BURNED
1-05-001-10	LIQ PETROLEUM GAS						1000 GALLONS BURNED
1-05-001-97	OTHER-SPECIFY						TONS BURNED
1-05-001-98	OTHER-SPECIFY						1000 GALLONS BURNED
1-05-001-99	OTHER-SPECIFY						MILLION CUBIC FEET BURNED
COMMERCL-INSTU.							
1-05-002-01	ANTHRACITE COAL						TONS BURNED
1-05-002-02	BITUMINOUS COAL						TONS BURNED
1-05-002-03	LIGNITE						TONS BURNED
1-05-002-04	RESIDUAL OIL						1000 GALLONS BURNED
1-05-002-05	DISTILLATE OIL						1000 GALLONS BURNED
1-05-002-06	NATURAL GAS						MILLION CUBIC FEET BURNED
1-05-002-10	LIQ PETROLEUM GAS						1000 GALLONS BURNED
1-05-002-97	OTHER-SPECIFY						TONS BURNED
1-05-002-98	OTHER-SPECIFY						1000 GALLONS BURNED
1-05-002-99	OTHER-SPECIFY						MILLION CUBIC FEET BURNED

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POUNDS EMITTED PER UNIT

INTERNLCOMBUSTION -ELECTRIC GENERATN		PART	SOX	NOX	HC	CO	UNITS
DISTILLATE OIL							
2-01-001-01	TURBINE	5.00	140. S	67.8	5.57	15.4	1000 GALLONS BURNED
2-01-001-02	RECIPROCATING		140. S				1000 GALLONS BURNED
NATURAL GAS							
2-01-002-01	TURBINE	14.0	940. S	413.	42.0	115.	MILLION CUBIC FEET
2-01-002-02	RECIPROCATING		940. S				MILLION CUBIC FEET
DIESEL							
2-01-003-01	RECIPROCATING	13.0	140. S	370.	37.0	225.	THOUSANDS OF GALLONS
2-01-003-02	TURBINE	5.00	140. S	67.8	5.57	15.4	1000 GALLONS BURNED
RESIDUAL OIL							
2-01-004-01	TURBINE		159. S				1000 GALLONS BURNED
JET FUEL							
2-01-005-01	TURBINE		6.20				1000 GALLONS BURNED
CRUDE OIL							
2-01-006-01	TURBINE		146. S				1000 GALLONS BURNED
PROCESS GAS							
2-01-007-01	TURBINE		950. S				MILLION CUBIC FEET
OTHER/NOT CLASIFD							
2-01-999-97	SPECIFY IN REMARK						MILLION CUBIC FEET BURNED
2-01-999-98	SPECIFY IN REMARK						1000 GALLONS BURNED
INTERNLCOMBUSTION -INDUSTRIAL							
DISTILLATE OIL							
2-02-001-01	TURBINE	5.00	140. S	67.8	5.57	15.4	1000 GALLONS BURNED
2-02-001-02	RECIPROCATING	33.5	144. S	469.	37.5	102.	1000 GALLONS BURNED
NATURAL GAS							
2-02-002-01	TURBINE	14.0	940. S	413.	42.0	115.	MILLION CUBIC FEET
2-02-002-02	RECIPROCATING		940. S				MILLION CUBIC FEET
GASOLINE							
2-02-003-01	RECIPROCATING	6.50	5.30	102.	161.	3,940.	1000 GALLONS BURNED
DIESEL FUEL							
2-02-004-01	RECIPROCATING	33.5	144. S	469.	37.5	102.	1000 GALLONS BURNED
2-02-004-02	TURBINE	5.00	140. S	67.8	5.57	15.4	1000 GALLONS BURNED
RESIDUAL OIL							
2-02-005-01	TURBINE		159. S				1000 GALLONS BURNED
JET FUEL							
2-02-006-01	TURBINE		6.20				1000 GALLONS BURNED
CRUDE OIL							
2-02-007-01	TURBINE		146. S				1000 GALLONS BURNED
PROCESS GAS							
2-02-008-01	TURBINE		950. S				MILLION CUBIC FEET
2-02-008-02	RECIPROCATING		950. S				MILLION CUBIC FEET BURNED
OTHER/NOT CLASIFD							
2-02-999-97	SPECIFY IN REMARK						MILLION CUBIC FEET BURNED
2-02-999-98	SPECIFY IN REMARK						1000 GALLONS BURNED

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	POUNDS EMITTED PER UNIT PART	SOX	NOX	HC	CO	UNITS
INTERNLCOMBUSTION -COMMERCL-INSTUTNL						
DIESEL						
2-03-001-01 RECIPROCATING	33.5	149. S	469.	37.5	102.	THOUSANDS OF GALLONS
OTHER/NOT CLASIFD						
2-03-999-97 SPECIFY IN REMARK						MILLION CUBIC FEET BURNED
2-03-999-98 SPECIFY IN REMARK						1000 GALLONS BURNED
INTERNLCOMBUSTION -ENGINE TESTING						
AIRCRAFT						
2-04-001-01 TURBOJET	11.8	13.0	14.6	46.0	32.7	THOUSANDS OF GALLON/FUEL
ROCKET MOTOR						
2-04-002-01 SOLID PROPELLANT						TONS OF FUEL
OTHER/NOT CLASIFD						
2-04-999-97 SPECIFY IN REMARK						MILLION CUBIC FEET BURNED
2-04-999-98 SPECIFY IN REMARK						1000 GALLONS BURNED
2-04-999-99 SPECIFY IN REMARK						TONS BURNED
INDUSTRIAL PROCES -CHEMICAL MFG						
ADIPIC ACID PROD						
3-01-001-01 GENERAL-CYCLOHEX	0.	0.	12.0	0.	0.	TONS PRODUCED
3-01-001-99 OTHER/NOT CLASIFD						TONS PRODUCED
AMMONIA W/METHNTR						
3-01-002-01 PURGE GAS	0.	0.	0.	90.0	0.	TONS PRODUCED
3-01-002-02 STORAGE/LOADING	0.	0.	0.	0.	0.	TONS PRODUCED
AMMONIA W/COABSRB						
3-01-003-01 REGENERATOR EXIT	0.	0.	0.	0.	200.	TONS PRODUCED
3-01-003-02 PURGE GAS	0.	0.	0.	90.0	0.	TONS PRODUCED
3-01-003-03 STORAGE/LOADING	0.	0.	0.	0.	0.	TONS PRODUCED
3-01-003-99 OTHER/NOT CLASIFD						TONS PRODUCED
AMMONIUM NITRATE						
3-01-004-01 GENERAL		0.				TONS PRODUCED
3-01-004-99 OTHER/NOT CLASIFD						TONS PRODUCED
CARBON BLACK						
3-01-005-01 CHANNEL PROCESS	2,300.	0.	0.	11,500.	33,500.	TONS PRODUCED
3-01-005-02 THERMAL PROCESS	0.	0.	0.	0.	0.	TONS PRODUCED
3-01-005-03 FURNACE PROC GAS				1,800.	5,300.	TONS PRODUCED
3-01-005-04 FURNACE PROC OIL				400.	4,500.	TONS PRODUCED
3-01-005-05 FURNACE W/GAS/OIL	220.					TONS PRODUCED
3-01-005-99 OTHER/NOT CLASFD						TONS PRODUCT
CHARCOAL MFG						
3-01-006-01 PYROL/DISTIL/GENL	400.			100.	320.	TONS PRODUCED
3-01-006-99 OTHER/NOT CLASFD						TONS PRODUCT
CHLORINE						
3-01-007-01 GENERAL		0.				TONS PRODUCED
3-01-007-99 OTHER/NOT CLASIFD						TONS PRODUCED
CHLOR-ALKALI						
3-01-008-01 LIQUIFTN-DIAPHRGM		0.				100 TONS CHLORINE LIQUEFIED
3-01-008-02 LIQUIFTN-MERC CEL		0.				100 TONS CHLORINE LIQUEFIED
3-01-008-03 LOADING TNKCARVNT	0.	0.	0.	0.	0.	100 TONS CHLORINE LIQUEFIED
3-01-008-04 LOADING STGTNKVNT	0.	0.	0.	0.	0.	100 TONS CHLORINE LIQUEFIED
3-01-008-05 AIR-BLOW MC BRINE	0.	0.	0.	0.	0.	100 TONS CHLORINE LIQUEFIED
3-01-008-99 OTHER/NOT CLASIFD						100 TONS CHLORINE LIQUEFIED
CLEANING CHEMICLS						
3-01-009-01 SOAP/DET SPRYDRYR	90.0					TONS PRODUCED
3-01-009-10 SPECIALTY CLEANRS		0.				TONS PRODUCT
3-01-009-99 OTHERS/NOT CLASFD						TONS PRODUCED

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INDUSTRIAL PROCES -CHEMICAL MFG		POUNDS EMITTED PER UNIT PART	SOX	NOX	HC	CO	UNITS
EXPLOSIVES-TNT							
3-01-010-01	NITRATION REACTRS	0.	0.	160.	0.	0.	TONS PRODUCED
3-01-010-02	HNO3 CONCTRTRS	0.	0.	9.00	0.	0.	TONS PRODUCED
3-01-010-03	H2SO4 REGENERATR	0.	15.0	2.00	0.	0.	TONS PRODUCED
3-01-010-04	RED WATER INCIN	32.0	2.00	38.0	0.	0.	TONS PRODUCED
3-01-010-05	OPEN WASTE BURN						TONS BURNED
3-01-010-06	SELLITE EXHAUST	0.	0.70	0.	0.	0.	TONS PRODUCED
3-01-010-99	OTHER/NOT CLASIFD						TONS PRODUCED
HYDROCHLORIC ACID							
3-01-011-01	BYPRODUCTW/OSCRUB		0.				TONS FINAL ACID
3-01-011-02	BYPRODUCT W/SCRUB		0.				TONS FINAL ACID
3-01-011-99	OTHER/NOT CLASIFD						TONS FINAL ACID
HYDROFLUORIC ACID							
3-01-012-01	ROTRYKILNW/SCRUBR	0.					TONS ACID
3-01-012-02	ROTRYKILNW/OSCRUB	0.					TONS ACID
3-01-012-03	GRIND/DRY FLUOSPR	200.					TONS FLUORSPAR
3-01-012-99	OTHER/NOT CLASIFD						TONS ACID
NITRIC ACID							
3-01-013-01	AMMONIAOXIDATNOLD			52.5			TONS PURE ACID PRODUCED
3-01-013-02	AMMONIAOXIDATNNEW			4.50			TONS PURE ACID PRODUCED
3-01-013-03	NITACD CONCTR OLD			5.00			TONS PURE ACID PRODUCED
3-01-013-04	NITACD CONCTR NEW			0.20			TONS PURE ACID PRODUCED
3-01-013-05	UNCONTROLLED						TONS PURE ACID PRODUCED
3-01-013-06	W/CATYL/COMBUSTER						TONS PURE ACID PRODUCED
3-01-013-07	UNCONTROLLED						TONS PURE ACID PRODUCED
3-01-013-08	W/ABSORBERS						TONS PURE ACID PRODUCED
3-01-013-99	OTHER/NOT CLASIFD						TONS PURE ACID PRODUCED
PAINT MFG							
3-01-014-01	GENERAL	2.00			30.0		TONS PRODUCED
3-01-014-02	PIGMENT KILN						TONS PRODUCT
3-01-014-99	OTHER/NOT CLASFD						TONS PRODUCT
VARNISH MFG							
3-01-015-01	BODYING OIL GENL	0.			40.0		TONS PRODUCED
3-01-015-02	OLEORESINOUS GENL	0.			150.		TONS PRODUCED
3-01-015-03	ALKYD GENERAL	0.			160.		TONS PRODUCED
3-01-015-05	ACRYLIC GENERAL	0.			20.0		TONS PRODUCED
3-01-015-99	OTHER/NOT CLASFD						TONS PRODUCED
PHOS-ACID WETPROC							
3-01-016-01	REACTOR-UNCONTLD	0.					TONS PHOSPHATE ROCK
3-01-016-02	GYPSUM POND	0.					TONS PHOSPHATE ROCK
3-01-016-03	CONDENSR-UNCONTLD	0.					TONS PHOSPHATE ROCK
3-01-016-99	OTHER/NOT CLASFD						TONS PRODUCED
PHOS-ACID THERMAL							
3-01-017-01	GENERAL						TONS PHOSPHOROUS BURNED
3-01-017-99	OTHER/NOT CLASFD						TONS PRODUCED
PLASTICS							
3-01-018-01	PVC-GENERAL	35.0					TONS PRODUCED
3-01-018-02	POLYPROD-GENERAL	3.00					TONS PRODUCED
3-01-018-05	BAKELITE-GENERAL						TONS PRODUCT
3-01-018-99	OTHER/NOT CLASFD						TONS PRODUCED
PHTHALIC ANHYDRID							
3-01-019-03	UNCONTROLLED-GENL				32.0		TONS PRODUCED
PRINTING INK							
3-01-020-01	COOKING-GENERAL	0.			120.		TONS PRODUCED
3-01-020-02	COOKING-OILS	0.			40.0		TONS PRODUCED
3-01-020-03	COOKING-OLEORESIN	0.			150.		TONS PRODUCED
3-01-020-04	COOKING-ALKYDS	0.			160.		TONS PRODUCED
3-01-020-05	PIGMENT MIXINGGEN	2.00					TONS PIGMENT
3-01-020-99	OTHER/NOT CLASFD						TONS PRODUCED
SODIUM CARBONATE							
3-01-021-01	SOLVAY-NH3 RECVRY	0.					TONS PRODUCED
3-01-021-02	SOLVAY-HANDLING	6.00					TONS PRODUCED
3-01-021-10	TRONA-CALCINING						TONS PRODUCT
3-01-021-11	TRONA-DRYER						TONS PRODUCED
3-01-021-20	BRINE EVAP-GENERL						TONS PRODUCED
3-01-021-99	OTHER/NOT CLASFD						TONS PRODUCED

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INDUSTRIAL PROCES -CHEMICAL MFG		POUNDS EMITTED PER UNIT PART	SOX	NOX	HC	CO	UNITS
H2SO4 -CHAMBER							
3-01-022-01	GENERAL				0.		TONS PURE ACID PRODUCED
H2SO4-CONTACT							
3-01-023-01	99.7 CONVERSION	2.50	4.00				TONS PURE ACID PRODUCED
3-01-023-04	99.5 CONVERSION	2.50	7.00				TONS PURE ACID PRODUCED
3-01-023-06	99.0 CONVERSION	2.50	14.0				TONS PURE ACID PRODUCED
3-01-023-08	98.0 CONVERSION	2.50	27.0				TONS PURE ACID PRODUCED
3-01-023-10	97.0 CONVERSION	2.50	40.0				TONS PURE ACID PRODUCED
3-01-023-12	96.0 CONVERSION	2.50	55.0				TONS PURE ACID PRODUCED
3-01-023-14	95.0 CONVERSION	2.50	70.0				TONS PURE ACID PRODUCED
3-01-023-16	94.0 CONVERSION	2.50	82.0				TONS PURE ACID PRODUCED
3-01-023-18	93.0 CONVERSION	2.50	96.0				TONS PURE ACID PRODUCED
3-01-023-99	OTHER/NOT CLASFD						TONS PRODUCED
SYNTHETIC FIBERS							
3-01-024-01	NYLON GENERAL				7.00		TONS FIBER
3-01-024-02	DACRON GENERAL				0.		TONS FIBER
3-01-024-03	ORLON						TONS PRODUCT
3-01-024-04	ELASTIC						TONS PRODUCT
3-01-024-05	TEFLON						TONS PRODUCT
3-01-024-06	POLYESTER						TONS PRODUCT
3-01-024-08	NOMEX						TONS PRODUCT
3-01-024-10	ACRYLIC						TONS PRODUCT
3-01-024-12	TYVEX						TONS PRODUCT
3-01-024-14	OLEFINS						TONS PRODUCT
3-01-024-99	OTHERS/NOT CLASFD						TONS PRODUCED
SEMISYNTHTICFIBR							
3-01-025-01	RAYON GENERAL				0.		TONS FIBER
3-01-025-05	ACETATE						TONS PRODUCED
3-01-025-10	VISCOSE						TONS PRODUCED
3-01-025-99	OTHERS/NOT CLASFD						TONS PRODUCED
SYNTHETIC RUBBER							
3-01-026-01	BUTADIENE-GENERAL						TONS PRODUCT
3-01-026-02	METHYLPROPENE-GNL						TONS PRODUCT
3-01-026-03	BUTYNE GENERAL						TONS PRODUCT
3-01-026-04	PENTADIENE-GENRL						TONS PRODUCT
3-01-026-05	DIMETHHEPTNE GENL						TONS PRODUCT
3-01-026-06	PENTANE-GENERAL						TONS PRODUCT
3-01-026-07	ETHANENITRILE-GEN						TONS PRODUCT
3-01-026-08	ACRYLONITRILE-GEN						TONS PRODUCT
3-01-026-09	ACROLEIN-GENERAL						TONS PRODUCT
3-01-026-20	AUTO TIRES GENERL						TONS PRODUCT
3-01-026-99	OTHER/NOT CLASFD						TONS PRODUCT
FERTILIZ AMONNITR							
3-01-027-01	PRILTWR-NEUTRLIZR	0.		0.			TONS PRODUCED
3-01-027-02	PRILLING TOWER	0.90		0.			TONS PRODUCED
3-01-027-03	PRILTWR-DRYCOOLRS	12.0		0.			TONS PRODUCED
3-01-027-04	GRANULAT-NEUTLIZR	0.		0.			TONS PRODUCED
3-01-027-05	GRANULATOR	0.40		0.45			TONS PRODUCED
3-01-027-06	GRANULAT-DRYCOOLR	7.00		3.00			TONS PRODUCED
FERTILIZ-NSUPPHOS							
3-01-028-01	GRIND-DRY	9.00					TONS PRODUCED
3-01-028-02	MAIN STACK	0.					TONS PRODUCED
FERTILIZ-TRPSPHOS							
3-01-029-01	RUN OF PILE	0.					TONS PRODUCED
3-01-029-02	GRANULAR	0.					TONS PRODUCED
FERTILIZ-DIAMPHOS							
3-01-030-01	DRYER-COOLERS	80.0					TONS PRODUCED
3-01-030-02	AMONIAT-GRANULATE	2.00					TONS PRODUCED
3-01-030-99	OTHER/NOT CLASIFD						TONS PRODUCED
TEREPTHALIC ACID							
3-01-031-01	HNO3-PARAXYLENGEN			13.0			TONS PRODUCED
3-01-031-99	OTHER/NOT CLASIFD						TONS PRODUCED
SULFUR(ELEMENTAL)							
3-01-032-01	MOD-CLAUS 2STAGE		280.				TONS PRODUCT
3-01-032-02	MOD-CLAUS 3STAGE		189.				TONS PRODUCT
3-01-032-03	MOD-CLAUS 4STAGE		146.				TONS PRODUCT
3-01-032-99	OTHER/NOT CLASIFD						TONS PRODUCT

'A' INDICATES THE ASH CONTENT, 'S' INDICATES THE SULFUR CONTENT OF THE FUEL ON A PERCENT BASIS (BY WEIGHT)

POUNDS EMITTED PER UNIT

INDUSTRIAL PROCES -CHEMICAL MFG		PART	SOX	NOX	HC	CO	UNITS
PESTICIDES							
3-01-033-01	MALATHION						GALLONS OF PRODUCT
3-01-033-99	OTHER/NOT CLASIFD						TONS PRODUCED
AMINES/AMIDES							
3-01-034-01	GENERAL/OTHER						TONS PRODUCT
PIGMENT-INORGAN							
3-01-035-01	CALCINATION						TONS OF PRODUCT
3-01-035-99	OTHER/NOT CLASIFD						TONS OF PRODUCT
SODIUM SULFATE							
3-01-036-01	GENERAL/OTHER						TONS PRODUCT
3-01-036-02	KILNS						TONS PRODUCT
SODIUM SULFITE							
3-01-037-01	GENERAL/OTHER						TONS PRODUCT
3-01-037-02	KILNS						TONS PRODUCT
SODIUM BICARB							
3-01-038-01	GENERAL						TONS PRODUCT
LITHIUM HYDROXIDE							
3-01-039-01	GENERAL						TONS PRODUCT
FERTILIZER UREA							
3-01-040-01	GENERAL						TONS PRODUCT
NITROCELLULOSE							
3-01-041-01	REACTOR POTS	0.	1.30	21.0	0.	0.	TONS PRODUCED
3-01-041-02	H2SO4 CONCENTRTRS	0.	65.0	29.0	0.	0.	TONS PRODUCED
3-01-041-03	BOILING TUBS	0.	0.	2.00	0.	0.	TONS PRODUCED
3-01-041-99	OTHER/NOT CLASIFD				0.	0.	TONS PRODUCED
ADHESIVES							
3-01-050-01	GENL/COMPND UNKWN						TONS PRODUCT
ACETATE FLAKE							
3-01-090-99	OTHER/NOT CLASFD						TONS PRODUCT
ACETONE							
3-01-091-01	OTHER/NOT CLASFD						TONS PRODUCT
MALEIC ANHYDRIDE							
3-01-100-01	GENERAL/OTHER						TONS PRODUCT
POLVINL PYRILIDON							
3-01-101-01	GENERAL/OTHER						TONS PRODUCT
SULFONIC ACID/ATS							
3-01-110-01	GENERAL/OTHER						TONS PRODUCT
ASBESTOS CHEMICAL							
3-01-111-01	CAULKING		0.	0.	0.	0.	TONS PRODUCT
3-01-111-02	SEALANTS		0.	0.	0.	0.	TONS PRODUCT
3-01-111-03	BRAKE LINE/GRIND		0.	0.	0.	0.	TONS PRODUCT
3-01-111-04	FIRE PROOF MFG		0.	0.	0.	0.	TONS PRODUCT
3-01-111-99	OTHERS/NOT CLASFD						TONS PRODUCT
FORMALDEHYDE							
3-01-120-01	SILVER CATALYST						TONS PRODUCT
3-01-120-02	MIXED OXIDE CTLST						TONS PRODUCT
ETHYLENE DICHLRDE							
3-01-125-01	OXYCHLORINATION						TONS PRODUCT
3-01-125-02	DIRECT CHLRNATION						TONS PRODUCT
AMMONIUM SULFATE							
3-01-130-01	NH3-H2SO4 PROCES						TONS PRODUCT
3-01-130-02	COKE OVEN BY-PROD						TONS PRODUCT
3-01-130-03	CAPROLCTM BY-PROD						TONS PRODUCT

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INDUSTRIAL PROCES -CHEMICAL MFG		PART	SOX	NOX	HC	CO	UNITS
		POUNDS EMITTED PER UNIT					
WASTE GAS FLARES							
3-01-900-99	OTHER/NOT CLASIFD OTHER/NOT CLASIFD						MILLION CUBIC FEET BURNED
3-01-999-99	SPECIFY IN REMARK						TONS PRODUCT
INDUSTRIAL PROCES -FOOD/AGRICULTURAL							
ALFALFA DEHYDRATN							
3-02-001-01	GENERAL	60.0					TONS MEAL PRODUCED
3-02-001-99	OTHER/NOT CLASFD						TONS PRODUCT
COFFEE ROASTING							
3-02-002-01	DIRECTFIRE ROASTR	7.60		0.10			TONS GREEN BEANS
3-02-002-02	INDIRCTFIREROASTR	4.20		0.10			TONS GREEN BEANS
3-02-002-03	STONER/COOLER	1.40		0.			TONS GREEN BEANS
3-02-002-99	OTHER/NOT CLASFD						TONS PRODUCT
COFFEE-INSTANT							
3-02-003-01	SPRAY DRIER	1.90		0.			TONS GREEN BEANS
COTTON GINNING							
3-02-004-01	UNLOADING FAN	5.00	0.	0.	0.	0.	BALES COTTON
3-02-004-02	CLEANER	1.00	0.	0.	0.	0.	BALES COTTON
3-02-004-03	STICK/BURR MACHNE	3.00	0.	0.	0.	0.	BALES COTTON
3-02-004-99	OTHER/NOT CLASFD						BALES COTTON
FEED/GRAIN TERMEL							
3-02-005-01	SHIPING/RECEIVING	1.00	0.	0.	0.	0.	TONS GRAIN PROCESSED
3-02-005-02	TRANSFER/CONVEYNG	2.00	0.	0.	0.	0.	TONS GRAIN PROCESSED
3-02-005-03	SCREENING/CLEANNG	5.00	0.	0.	0.	0.	TONS GRAIN PROCESSED
3-02-005-04	DRYING	6.00					TONS GRAIN PROCESSED
FEED/GRAIN CNTRYE							
3-02-006-01	SHIPNG/RECEIVNG	5.00	0.	0.	0.	0.	TONS GRAIN PROCESSED
3-02-006-02	TRANSFER/CONVEYNG	3.00	0.	0.	0.	0.	TONS GRAIN PROCESSED
3-02-006-03	SCREENING/CLEANNG	8.00	0.	0.	0.	0.	TONS GRAIN PROCESSED
3-02-006-04	DRYING	7.00					TONS GRAIN PROCESSED
3-02-006-99	OTHER/NOT CLASIFD						TONS GRAIN PROCESSED
GRAIN PROCESSING							
3-02-007-01	CORN MEAL	5.00					TONS GRAIN PROCESSED
3-02-007-02	SOY BEAN	7.00					TONS GRAIN PROCESSED
3-02-007-03	BARLEY/WHEATCLEAN	0.20					TONS GRAIN PROCESSED
3-02-007-04	MILO CLEANER	0.40					TONS GRAIN PROCESSED
3-02-007-05	BARLEYFLOUR MILL	3.00					TONS GRAIN PROCESSED
3-02-007-06	WET CORN MILLING		0.				TONS OF PRODUCT
3-02-007-30	WHEAT FLOUR MILL		0.				TONS PRODUCT
3-02-007-99	OTHER/NOT CLASFD						TONS PROCESSED
FEED MANUFACTURE							
3-02-008-01	BARLEY FEED-GENL	3.00					TONS GRAIN PROCESSED
3-02-008-99	OTHER/NOT CLASFD						TONS PROCESSED
FERMENTATN-BEER							
3-02-009-01	GRAIN HANDLING	3.00			0.		TONS GRAIN PROCESSED
3-02-009-02	DRYING SPNT GRAIN	5.00					TONS GRAIN PROCESSED
3-02-009-03	BREWING						THOUSANDS OF GALLONS
3-02-009-98	OTHER/NOT CLASFD						GALLONS PRODUCT
3-02-009-99	OTHER/NOT CLASFD						TONS GRAIN PROCESSED
FERMENTATN-WHISKY							
3-02-010-01	GRAIN HANDLING	3.00			0.		TONS GRAIN PROCESSED
3-02-010-02	DRYING SPNT GRAIN	5.00					TONS GRAIN PROCESSED
3-02-010-03	AGING	0.			10.0		BARREL(50 GAL)
3-02-010-99	OTHER/NOT CLASFD						GALLONS PRODUCT
FERMENTATN-WINE							
3-02-011-01	GENERAL	0.			0.		GALLONS PRODUCT
FISH MEAL							
3-02-012-01	COOKERS-FRESHFISH	0.					TONS FISH MEAL PRODUCED
3-02-012-02	COOKERS-STALEFISH	0.					TONS FISH MEAL PRODUCED
3-02-012-03	DRIERS	0.10					TONS FISH SCRAP
3-02-012-99	OTHER/NOT CLASIFD						TONS PROCESSED

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N A T I O N A L   E M I S S I O N   D A T A   S Y S T E M
S O U R C E   C L A S S I F I C A T I O N   C O D E S

INDUSTRIAL PROCES -FOOD/AGRICULTURAL		POUNDS EMITTED PER UNIT PART	SOX	NOX	HC	CO	UNITS
MEAT SMOKING							
3-02-013-01	GENERAL	0.30			0.07	0.60	TONS MEAT SMOKED
STARCH MFG							
3-02-014-01	GENERAL	8.00					TONS STARCH PRODUCED
SUGAR CANE PROCES							
3-02-015-01	GENERAL						TONS SUGAR PRODUCED
3-02-015-99	OTHER/NOT CLASIFD						TONS PROCESSED
SUGAR BEET PROCES							
3-02-016-01	DRYER ONLY						TONS RAW BEETS
3-02-016-99	OTHER/NOT CLASIFD						TONS RAW BEETS
PEANUT PROCESSING							
3-02-017-20	OIL/NOT CLASFD						TONS PRODUCT
3-02-017-99	OTHER/NOT CLASFD						TONS PROCESSED
CANDY/CONFECTNRY							
3-02-018-99	OTHER/NOT CLASFD						TONS PRODUCT
DAIRY PRODUCTS							
3-02-030-01	MILK SPRAY-DRYER		0.				TONS PRODUCT
3-02-030-99	OTHER/NOT CLASFD						TONS PRODUCT
OTHER/NOT CLASIFD							
3-02-999-98	SPECIFY IN REMARK						TONS PROCESSED (INPUT)
3-02-999-99	SPECIFY IN REMARK						TONS PRODUCED (FINISHED)
INDUSTRIAL PROCES -PRIMARY METALS							
ALUMINUM ORE-BAUX							
3-03-000-01	CRUSHING/HANDLING	6.00					TONS OF ORE
AL ORE-ELECROREDN							
3-03-001-01	PREBAKE CELLS	81.3					TONS ALUMINUM PRODUCED
3-03-001-02	HORIZSTD SODERBRG	98.4					TONS ALUMINUM PRODUCED
3-03-001-03	VERTSTD SODERBERG	78.4					TONS ALUMINUM PRODUCED
3-03-001-04	MATERIALS HANDLNG	10.0					TONS ALUMINUM PRODUCED
3-03-001-05	ANODE BAKE FURNCE	3.00					TONS ALUMINUM PRODUCED
3-03-001-99	OTHER/NOT CLASFD						TONS ALUMINUM PRODUCED
AL ORE-CALC ALHYD							
3-03-002-01	GENERAL	200.					TONS ALUMINUM PRODUCED
COKE MET BYPRODUC							
3-03-003-01	GENERAL	3.50	4.00	0.04	4.20	1.27	TONS COAL CHARGED
3-03-003-02	OVEN CHARGING	1.50	0.02	0.03	2.50	0.60	TONS COAL CHARGED
3-03-003-03	OVEN PUSHING	0.60			0.20	0.07	TONS COAL CHARGED
3-03-003-04	QUENCHING	0.90					TONS COAL CHARGED
3-03-003-05	UNLOADING	0.40					TONS COAL CHARGED
3-03-003-06	UNDERFIRING		4.00				TONS COAL CHARGED
3-03-003-07	COAL CRUSH/HANDL						TONS COAL CHARGED
3-03-003-99	OTHER/NOT CLASFD						TONS COAL CHARGED
COKE MET-BEEHIVE							
3-03-004-01	GENERAL	200.	0.	0.	8.00	1.00	TONS COAL CHARGED
COPPER SMELTER							
3-03-005-01	TOTAL/GENERAL	135.	1,250.				TONS CONCENTRATED ORE
3-03-005-02	ROASTING	45.0	60.0				TONS CONCENTRATED ORE
3-03-005-03	SMELTING	20.0	320.				TONS CONCENTRATED ORE
3-03-005-04	CONVERTING	60.0	870.				TONS CONCENTRATED ORE
3-03-005-05	REFINING	10.0	0.				TONS CONCENTRATED ORE
3-03-005-06	ORE DRYER						TONS OF ORE
3-03-005-08	FINISH OPER-GENL						TONS PRODUCED
3-03-005-99	OTHER/NOT CLASFD						TONS CONCENTRATED ORE
FERALLOY OPEN FNC							
3-03-006-01	50% FESI	200.					TONS PRODUCED
3-03-006-02	75% FESI	315.					TONS PRODUCED
3-03-006-03	90% FESI	565.					TONS PRODUCED
3-03-006-04	SILICON METAL	625.					TONS PRODUCED
3-03-006-05	SILICOMANGANESE	195.					TONS PRODUCED

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INDUSTRIAL PROCES -PRIMARY METALS		POUNDS EMITTED PER UNIT PART	SOX	NOX	HC	CO	UNITS
FERROALLOY	CONTINUED						
3-03-006-10	SCREENING			0.			TONS PROCESSED
3-03-006-11	ORE DRYER						TONS PROCESSED
3-03-006-12	LOWCARB CR-REACTR						TONS PROCESSED
3-03-006-99	OTHER/NOT CLASFD						TONS PRODUCED
FERALOY SEMCOVFNC							
3-03-007-01	FEROMANGANESE	45.0					TONS PRODUCED
3-03-007-02	GENERAL						TONS PRODUCED
IRON PRODUCTION							
3-03-008-01	BLAST FNC-ORECHG	121.	0.	0.	0.	1,750.	TONS PRODUCED
3-03-008-02	BLAST FNC-AGLCHG	44.0	0.	0.	0.	0.	TONS PRODUCED
3-03-008-03	SINTERING GENERAL	42.0				44.0	TONS PRODUCED
3-03-008-04	ORE-CRUSH/HANDLE			0.	0.		TONS OF ORE
3-03-008-05	SCARFING	1.00	0.	0.	0.	0.	TONS PROCESSED
3-03-008-06	SAND HANDLING OPN		0.				TONS HANDLED
3-03-008-07	MOLD OVENS						TONS SAND BAKED
3-03-008-08	SLAG CRUSH/HANDL						TONS HANDLED
3-03-008-99	OTHER/NOT CLASFD						TONS PRODUCED
STEEL PRODUCTION							
3-03-009-01	OPNHEARTH OXLANCE	17.4				0.	TONS PRODUCED
3-03-009-02	OPNHEARTH NOXLNCE	8.30				0.	TONS PRODUCED
3-03-009-03	BOF-GENERAL	51.0				139.	TONS PRODUCED
3-03-009-04	ELECT ARC W/LANCE	11.0				18.0	TONS PRODUCED
3-03-009-05	ELECT ARC NOLANCE	9.20				18.0	TONS PRODUCED
3-03-009-10	FINISH/PICKLING						TONS PRODUCED
3-03-009-11	FINISH/SOAK PITS						TONS PRODUCED
3-03-009-12	FINISH/GRIND,ETC						TONS PRODUCED
3-03-009-20	FINISH/OTHER						TONS PRODUCED
3-03-009-99	OTHER/NOT CLASFD						TONS PRODUCED
LEAD SMELTERS							
3-03-010-01	SINTERING	169.	423.	0.	0.	0.	TONS CONCENTRATED ORE
3-03-010-02	BLAST FURNACE	278.	34.9	0.	0.	0.	TONS CONCENTRATED ORE
3-03-010-03	REVERB FURNACE	15.4	0.	0.	0.	0.	TONS CONCENTRATED ORE
3-03-010-04	ORE CRUSHING	2.00	0.	0.	0.	0.	TONS OF ORE CRUSHED
3-03-010-05	MATERIALS HANDLNG	5.00	0.	0.	0.	0.	TONS OF LEAD PRODUCT
3-03-010-99	OTHER/NOT CLASFD						TONS CONCENTRATED ORE
MOLYBDENUM							
3-03-011-01	MINING-GENERAL			0.			HUNDREDS OF TONS MINED
3-03-011-02	MILLING-GENERAL			0.			TONS PRODUCT
3-03-011-99	PROCESS-OTHER						TONS PROCESSED
TITANIUM PROCESS							
3-03-012-01	CHLORINATION STAT		0.	0.	0.		TONS PRODUCT
3-03-012-99	OTHER/NOT CLASIFD						TONS PROCESSED
GOLD							
3-03-013-01	MINING/PROCESSING				0.		TONS ORE
BARIUM							
3-03-014-01	ORE GRIND			0.			TONS PROCESSED
3-03-014-02	REDUCTN KILN						TONS PROCESSED
3-03-014-03	DRIERS/CALCINERS						TONS PROCESSED
3-03-014-99	OTHER/NOT CLASFD						TONS PROCESSED
BERYLLIUM ORE							
3-03-015-01	STORAGE		0.	0.	0.	0.	TONS OF ORE
3-03-015-02	CRUSHING		0.	0.	0.	0.	TONS PROCESSED
3-03-015-03	MELTING				0.		TONS PROCESSED
3-03-015-04	QUENCH/HEAT TREAT		0.	0.	0.	0.	TONS PROCESSED
3-03-015-05	GRINDING		0.	0.	0.	0.	TONS PROCESSED
3-03-015-06	SULFATION/DISSOLV			0.	0.	0.	TONS PROCESSED
3-03-015-07	SINTERING				0.		TONS PROCESSED
3-03-015-08	VENTILATION				0.		TONS PROCESSED
3-03-015-09	LEACH/FILTER		0.	0.	0.	0.	TONS PROCESSED
3-03-015-99	OTHER/NOT CLASFD				0.		TONS PROCESSED
MERCURY MINING							
3-03-025-01	SURFACE BLASTING		0.	0.	0.	0.	TONS OF ORE
3-03-025-02	SURFACE DRILLING		0.	0.	0.	0.	TONS OF ORE
3-03-025-03	SURFACE HANDLING		0.	0.	0.	0.	TONS OF ORE
3-03-025-04	NATURAL VAPOR	0.	0.	0.	0.	0.	TONS OF ORE
3-03-025-05	STRIPPING		0.	0.	0.	0.	TONS REMOVED
3-03-025-06	LOADING		0.	0.	0.	0.	TONS OF ORE
3-03-025-07	CONVEY/HAULING		0.	0.	0.	0.	TONS OF ORE
3-03-025-08	UNLOADING		0.	0.	0.	0.	TONS OF ORE

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NATIONAL EMISSION DATA SYSTEM
SOURCE CLASSIFICATION CODES

POUNDS EMITTED PER UNIT

INDUSTRIAL PROCES -PRIMARY METALS		PART	SOX	NOX	HC	CO	UNITS
MERCURY MINING CONTINUED							
3-03-025-09	CONV/HAUL WASTE		0.	0.	0.	0.	TONS OF ORE
3-03-025-99	OTHER/NOT CLASFD						TONS OF ORE
MERCURY ORE PROCS							
3-03-026-01	CRUSHING		0.	0.	0.	0.	TONS PROCESSED
3-03-026-02	ROTARY FURNACE				0.		TONS PROCESSED
3-03-026-03	RETORT FURNACE				0.		TONS PROCESSED
3-03-026-04	CALCINE		0.	0.	0.	0.	TONS PROCESSED
3-03-026-05	BURNT ORE BIN		0.	0.	0.	0.	TONS PROCESSED
3-03-026-06	HOEING PROCESS		0.	0.	0. 2	0.	TONS PROCESSED
3-03-026-99	OTHER/NOT CLASFD						TONS PROCESSED
ZINC SMELTING							
3-03-030-01	GENERAL				0.		TONS PROCESSED
3-03-030-02	ROASTNG/MULT-HRTH	120.	1,100.				TONS PROCESSED
3-03-030-03	SINTERING	90.0					TONS PROCESSED
3-03-030-04	HORIZ RETORTS	8.00					TONS PROCESSED
3-03-030-05	VERT RETORTS	100.					TONS PROCESSED
3-03-030-06	ELECTROLYTIC PROC	3.00					TONS PROCESSED
3-03-030-99	OTHER/NOT CLASFD						TONS PROCESSED
OTHER/NOT CLASFD							
3-03-999-99	SPECIFY IN REMARK						TONS PRODUCED

INDUSTRIAL PROCES -SECONDARY METALS		PART	SOX	NOX	HC	CO	UNITS
ALUMINUM OPERATN							
3-04-001-01	SWEATINGFURNACE	14.5					TONS PRODUCED
3-04-001-02	SMELT-CRUCIBLE	1.90					TONS METAL PRODUCED
3-04-001-03	SMELT-REVERB FNC	4.30					TONS METAL PRODUCED
3-04-001-09	CHLORINATN STATN	12.5	0.	0.	0.	0.	TONS METAL PRODUCED
3-04-001-10	FOIL ROLLING					0.	TONS PRODUCT
3-04-001-11	FOIL CONVERTING					0.	TONS PRODUCED
3-04-001-20	CAN MANUFACTURE					0.	TONS PRODUCED
3-04-001-50	ROLL-DRAW-EXTRUDE					0.	TONS PRODUCED
3-04-001-99	OTHER/NOT CLASFD						TONS PRODUCED
BRASS/BRONZ MELT							
3-04-002-01	BLAST FNC	18.0					TONS CHARGE
3-04-002-02	CRUCIBLE FNC	12.0					TONS CHARGE
3-04-002-03	CUPOLA FNC	73.0					TONS CHARGE
3-04-002-04	ELECT INDUCTION	2.00					TONS CHARGE
3-04-002-05	REVERB FNC	70.0					TONS CHARGE
3-04-002-06	ROTARY FNC	60.0					TONS CHARGE
3-04-002-99	OTHER/NOT CLASIFD						TONS PRODUCED
GRAY IRON							
3-04-003-01	CUPOLA	17.0				145.	TONS METAL CHARGE
3-04-003-02	REVERB FNC	2.00				0.	TONS METAL CHARGE
3-04-003-03	ELECT INDUCTION	1.50				0.	TONS METAL CHARGE
3-04-003-05	ANNEALING OPERATN						TONS METAL CHARGE
3-04-003-30	MISC CAST-FABCTN						TONS PROCESSED
3-04-003-40	GRINDING-CLEANING		0.	0.	0.	0.	TONS PROCESSED
3-04-003-50	SAND HANDL-GENL						TONS HANDLED
3-04-003-99	OTHER/NOT CLASIFD						TONS METAL CHARGE
LEAD SMELT SEC							
3-04-004-01	POT FURNACE	0.80	0.	0.	0.	0.	TONS METAL CHARGED
3-04-004-02	REVERB FNC	147.	80.0	0.	0.	0.	TONS METAL CHARGED
3-04-004-03	BLAST/CUPOLA FNC	193.	53.0	0.	0.	0.	TONS METAL CHARGED
3-04-004-04	ROTARY REVERB FNC	70.0	0.	0.	0.	0.	TONS METAL CHARGED
3-04-004-08	LEAD OXIDE MFG						TONS PROCESSED
3-04-004-99	OTHER/NOT CLASIFD						TONS PROCESSED
LEAD BATTERY							
3-04-005-01	TOTAL-GENERAL	0.90	0.	0.	0.	0.	TONS OF BATTERIES PRODUCED
3-04-005-02	CASTING FURNACE	0.04	0.	0.	0.	0.	TONS OF BATTERIES PRODUCED
3-04-005-03	PASTE MIXER	0.21	0.	0.	0.	0.	TONS OF BATTERIES PRODUCED
3-04-005-04	THREE PROCES OPER	0.64	0.	0.	0.	0.	TONS OF BATTERIES PRODUCED
3-04-005-99	OTHER/NOT CLASIFD						TONS PROCESSED
MAGNESIUM SEC							
3-04-006-01	POT FURNACE	4.00					TONS PROCESSED
3-04-006-99	OTHER/NOT CLASIFD						TONS PROCESSED

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NATIONAL EMISSION DATA SYSTEM
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		POUNDS EMITTED PER UNIT					
		PART	SOX	NOX	HC	CO	UNITS
INDUSTRIAL PROCES -SECONDARY METALS							
STEEL FOUNDRY							
3-04-007-01	ELECTRIC ARC FNC	13.0		0.20			TONS PROCESSED
3-04-007-02	OPEN HEARTH FNC	11.0		0.<1			TONS PROCESSED
3-04-007-03	OPEN HEARTH LANCD	10.0		0.			TONS PROCESSED
3-04-007-04	HEAT-TREAT FNC						TONS PROCESSED
3-04-007-05	INDUCTION FURNACE	0.10	0.	0.	0.	0.	TONS PROCESSED
3-04-007-06	SAND GRIND/HANDL						TONS HANDLED
3-04-007-10	FINISH/SOAK PITS						TONS PROCESSED
3-04-007-15	FINISH/NOT CLASFD						TONS PROCESSED
3-04-007-99	OTHER/NOT CLASIFD						TONS PROCESSED
ZINC SEC							
3-04-008-01	RETORT FNC	47.0					TONS PRODUCED
3-04-008-02	HORIZ MUFFLE FNC	45.0					TONS PRODUCED
3-04-008-03	POT FURNACE	0.10					TONS PRODUCED
3-04-008-04	KETTLE-SWEAT FNC	11.0					TONS PRODUCED
3-04-008-05	GALVANIZING KETTL	5.00					TONS PRODUCED
3-04-008-06	CALCINING KILN	89.0					TONS PRODUCED
3-04-008-07	CONCENTRATE DRYER						TONS PROCESSED
3-04-008-08	REVERB-SWEAT FNC	13.0					TONS PRODUCED
3-04-008-99	OTHER/NOT CLASIFD						TONS PROCESSED
MALLEABLE IRON							
3-04-009-01	ANNEALING OPERATN						TONS METAL CHARGE
3-04-009-99	OTHER/NOT CLASIFD						TONS METAL CHARGE
NICKEL							
3-04-010-01	FLUX FURNACE						TONS PROCESSED
3-04-010-99	OTHER/NOT CLASIFD						TONS PROCESSED
ZIRCONIUM							
3-04-011-01	OXIDE KILN						TONS PROCESSED
3-04-011-99	OTHER/NOT CLASIFD						TONS PROCESSED
FURNACE ELECTRODE							
3-04-020-01	CALCINATION						TONS PROCESSED
3-04-020-02	MIXING		0.	0.	0.	0.	TONS PROCESSED
3-04-020-03	PITCH TREATING		0.	0.			TONS PROCESSED
3-04-020-04	BAKE FURNACES						TONS PROCESSED
3-04-020-99	OTHER/NOT CLASIFD						TONS PROCESSED
MISC CAST&FABRCTN							
3-04-050-01	SPECIFY IN REMARK						TONS PRODUCED
OTHER/NOT CLASIFD							
3-04-999-99	SPECIFY IN REMARK						TONS PROCESSED
INDUSTRIAL PROCES -MINERAL PRODUCTS							
ASPHALT ROOFING							
3-05-001-01	BLOWING OPERATION	2.50			1.50	0.90	TONS SATURATED FELT PRODUCED
3-05-001-02	DIPPING ONLY	1.00			0.	0.	TONS SATURATED FELT PRODUCED
3-05-001-03	SPRAYING ONLY	3.00			0.	0.	TONS SATURATED FELT PRODUCED
3-05-001-04	DIPPING/SPRAYING	2.00			0.	0.	TONS SATURATED FELT PRODUCED
3-05-001-99	OTHER/NOT CLASIFD						TONS SATURATED FELT PRODUCED
ASPHALTIC CONCRET							
3-05-002-01	ROTARY DRYER	35.0					TONS PRODUCED
3-05-002-02	OTHER SOURCES	10.0	0.	0.	0.	0.	TONS PRODUCED
3-05-002-99	OTHER/NOT CLASIFD						TONS PRODUCED
BRICK MANUFACTURE							
3-05-003-01	DRYING-RAW MTL	70.0		0.			TONS PRODUCED
3-05-003-02	GRINDING-RAW MTL	76.0		0.			TONS PRODUCED
3-05-003-03	STORAGE-RAW MTL	34.0		0.			TONS PRODUCED
3-05-003-04	CURING GAS FIRED	0.07	0.02	0.29	0.03	0.07	TONS PRODUCED
3-05-003-05	CURING OIL FIRED	0.07	5.00 S	1.40	0.10	0.	TONS PRODUCED
3-05-003-06	CURING COAL FIRED	1.30 A	9.60 S	1.10	0.70	2.60	TONS PRODUCED
3-05-003-99	OTHER/NOT CLASIFD						TONS PRODUCED
CALCIUM CARBIDE							
3-05-004-01	ELECTRIC FNC	38.0	3.00				TONS PRODUCED
3-05-004-02	COKE DRYER	2.00	3.00				TONS PRODUCED
3-05-004-03	FNC ROOM VENTS	26.0	0.				TONS PRODUCED
3-05-004-99	OTHER/NOT CLASIFD						TONS PROCESSED

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INDUSTRIAL PROCES -MINERAL PRODUCTS

SCC	DESCRIPTION	PART	SOX	NOX	HC	CO	UNITS
		POUNDS EMITTED PER UNIT					
CASTABLE REFRACTY							
3-05-005-01	RAWMATL DRYER	30.0					TONS FEED MATERIAL
3-05-005-02	RAWMATL CRUSH/PRC	120.					TONS FEED MATERIAL
3-05-005-03	ELECTRIC ARC MELT	50.0					TONS FEED MATERIAL
3-05-005-04	CURING OVEN	0.20					TONS FEED MATERIAL
3-05-005-05	MOLD/SHAKEOUT	25.0					TONS FEED MATERIAL
3-05-005-99	OTHER/NOT CLASIFD						TONS FEED MATERIAL
CEMENT MFG DRY							
3-05-006-01	KILNS	46.0	3.00	0.50			BARRELS CEMENT PRODUCED
3-05-006-02	DRYERS/GRINDERETC	18.0					BARRELS CEMENT PRODUCED
3-05-006-03	KILNS-OIL FIRED	245.	14.9	2.60	0.	0.	TONS CEMENT PRODUCED
3-05-006-04	KILNS-GAS FIRED	245.	10.2	2.60	0.	0.	TONS CEMENT PRODUCED
3-05-006-05	KILNS-COAL FIRED	245.	23.8	2.60	0.	0.	TONS CEMENT PRODUCED
3-05-006-99	OTHER/NOT CLASIFD						TONS CEMENT PRODUCED
CEMENT MFG WET							
3-05-007-01	KILNS	43.0	3.00	0.50	0.	0.	BARRELS CEMENT PRODUCED
3-05-007-02	DRYERS/GRINDERETC	6.00					BARRELS CEMENT PRODUCED
3-05-007-03	KILNS-OIL FIRED	228.	14.9	2.60	0.	0.	TONS CEMENT PRODUCED
3-05-007-04	KILNS GAS FIRED	228.	10.2	2.60	0.	0.	TONS CEMENT PRODUCED
3-05-007-05	KILNS-COAL FIRED	228.	23.8	2.60	0.	0.	TONS CEMENT PRODUCED
3-05-007-99	OTHER/NOT CLASIFD						TONS CEMENT PRODUCED
CERAMIC/CLAY MFG							
3-05-008-01	DRYING	70.0					TONS INPUT TO PROCESS
3-05-008-02	GRINDING	76.0					TONS INPUT TO PROCESS
3-05-008-03	STORAGE	34.0					TONS INPUT TO PROCESS
3-05-008-99	OTHER/NOT CLASIFD						TONS PRODUCED
CLAY/FLYASHSINTER							
3-05-009-01	FLYASH	110.					TONS FINISHED PRODUCT
3-05-009-02	CLAY/COKE	55.0					TONS FINISHED PRODUCT
3-05-009-03	NATURAL CLAY	24.0					TONS FINISHED PRODUCT
3-05-009-99	OTHER/NOT CLASIFD						TONS PRODUCED
COAL CLEANING							
3-05-010-01	THERM/FLUID BED	20.0					TONS COAL DRIED
3-05-010-02	THERM/FLASH	16.0					TONS COAL DRIED
3-05-010-03	THERM/MULTILOUVRD	25.0					TONS COAL DRIED
3-05-010-99	OTHER/NOT CLASIFD						TONS COAL CLEANED
CONCRETE BATCHING							
3-05-011-01	GENERAL	0.20					CUBIC YARDS CONCRETE PRODUCED
3-05-011-20	ASBEST/CEMNT PDTS	0.20	0.	0.	0.	0.	TONS PRODUCT
3-05-011-21	ROAD SURFACE		0.	0.	0.	0.	TONS PRODUCT
3-05-011-99	OTHER/NOT CLASFD						TONS PRODUCT
FIBERGLASS MFG							
3-05-012-01	REVERBFNC-REGENEX	3.00					TONS MATERIAL PROCESSED
3-05-012-02	REVERBFNC-RECUPEX	1.00					TONS MATERIAL PROCESSED
3-05-012-03	ELECTRIC IND FNC	0.					TONS MATERIAL PROCESSED
3-05-012-04	FORMING LINE	50.0					TONS MATERIAL PROCESSED
3-05-012-05	CURING OVEN	7.00					TONS MATERIAL PROCESSED
3-05-012-99	OTHER/NOT CLASIFD						TONS PROCESSED
FRIT MFG							
3-05-013-01	ROTARY FNC GENL	16.0					TONS CHARGE
3-05-013-99	OTHER/NOT CLASIFD						TONS CHARGED
GLASS MFG							
3-05-014-01	SODALIME GENL FNC	2.00					TONS GLASS PRODUCED
3-05-014-10	RAW MAT REC/STORG						TONS PROCESSED
3-05-014-11	BATCHING/MIXING		0.	0.	0.	0.	TONS PROCESSED
3-05-014-12	MOLTEN HOLD TANKS		0.				TONS PROCESSED
3-05-014-99	OTHER/NOT CLASIFD						TONS PRODUCED
GYPSUM MFG							
3-05-015-01	RW MTL DRYER	40.0					TONS THROUGHPUT
3-05-015-02	PRIMARY GRINDER	1.00					TONS THROUGHPUT
3-05-015-03	CALCINER	90.0					TONS THROUGHPUT
3-05-015-04	CONVEYING	0.70					TONS THROUGHPUT
3-05-015-99	OTHER/NOT CLASIFD						TONS THROUGHPUT
LIME MFG							
3-05-016-01	PRIMARY CRUSHING	31.0	0.	0.	0.	0.	TONS PROCESSED
3-05-016-02	SECNDRY CRUSHING	2.00	0.	0.	0.	0.	TONS PROCESSED
3-05-016-03	CALCINNG-VERTKILN	8.00					TONS PROCESSED

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POUNDS EMITTED PER UNIT

INDUSTRIAL PROCES -MINERAL PRODUCTS

Code	Description	PART	SOX	NOX	HC	CO	UNITS
LIME MFG	CONTINUED						
3-05-016-09	CALCINNG-ROTYKILN	200.					TONS PROCESSED
3-05-016-05	CALCIMATIC KILN						TONS PROCESSED
3-05-016-06	FLUIDIZD BED KILN						TONS PROCESSED
3-05-016-09	HYDRATOR						TONS HYDRATED LIME PRODUCED
3-05-016-99	OTHER/NOT CLASIFD						TONS PROCESSED
MINERAL WOOL							
3-05-017-01	CUPOLA	22.0	0.02				TONS CHARGE
3-05-017-02	REVERB FNC	5.00					TONS CHARGE
3-05-017-03	BLOW CHAMBER	17.0					TONS CHARGE
3-05-017-04	CURING OVEN	4.00					TONS CHARGE
3-05-017-05	COOLER	2.00					TONS CHARGE
3-05-017-99	OTHER/NOT CLASIFD						TONS PROCESSED
PERLITE MFG							
3-05-018-01	VERTICAL FNC GEN	21.0					TONS CHARGE
3-05-018-99	OTHER/NOT CLASIFD						TONS PROCESSED
PHOSPHATE ROCK							
3-05-019-01	DRYING	15.0					TONS PHOSPHATE ROCK
3-05-019-02	GRINDING	20.0					TONS PHOSPHATE ROCK
3-05-019-03	TRANSFER/STORAGE	2.00					TONS PHOSPHATE ROCK
3-05-019-04	OPEN STORAGE	40.0					TONS PHOSPHATE ROCK
3-05-019-99	OTHER/NOT CLASIFD						TONS PROCESSED
STONE QUARY/PROC							
3-05-020-01	PRIMARY CRUSHING	0.50	0.	0.	0.	0.	TONS RAW MATERIAL
3-05-020-02	SEC CRUSH/SCREEN	1.50	0.	0.	0.	0.	TONS RAW MATERIAL
3-05-020-03	TERT CRUSH/SCREEN	6.00	0.	0.	0.	0.	TONS RAW MATERIAL
3-05-020-04	RECRUSH/SCREENING	5.00	0.	0.	0.	0.	TONS RAW MATERIAL
3-05-020-05	FINES MILL	6.00	0.	0.	0.	0.	TONS RAW MATERIAL
3-05-020-06	SCREEN/CONVY/HNDL	2.00	0.	0.	0.	0.	TONS PRODUCT
3-05-020-07	OPEN STORAGE	10.0	0.	0.	0.	0.	TONS PRODUCT STORED
3-05-020-08	CUT STONE-GENERAL		0.	0.	0.	0.	TONS PROCESSED
3-05-020-09	BLASTING-GENERAL		0.	0.	0.	0.	TONS PROCESSED
3-05-020-99	OTHER/NOT CLASIFD						TONS PROCESSED
SALT MINING							
3-05-021-01	GENERAL		0.				TONS MINED
POTASH PRODUCTION							
3-05-022-01	MINE-GRIND/DRY		0.				TONS ORE
3-05-022-99	OTHER/NOT CLASIFD						TONS PROCESSED
CALCIUM BORATE							
3-05-023-01	MINING/PROCESSING				0.		TONS PRODUCT
3-05-023-99	OTHER/NOT CLASIFD						TONS PROCESSED
MG CARBONATE							
3-05-024-01	MINE/PROCESS				0.		TONS PRODUCT
3-05-024-99	OTHER/NOT CLASIFD						TONS PROCESSED
SAND/GRAVEL							
3-05-025-01	CRUSHING/SCREEN	0.10	0.	0.	0.	0.	TONS PRODUCT
3-05-025-99	OTHER/NOT CLASIFD						TONS PROCESSED
DIATOMACOUSERTH							
3-05-026-01	HANDLING		0.	0.	0.	0.	TONS PRODUCT
3-05-026-99	OTHER/NOT CLASIFD						TONS PROCESSED
CERAMIC ELECT PTS							
3-05-030-99	OTHER/NOT CLASIFD						TONS PROCESSED
ASBESTOS MINING							
3-05-031-01	SURFACE BLASTING		0.	0.	0.	0.	TONS OF ORE
3-05-031-02	SURFACE DRILLING		0.	0.	0.	0.	TONS OF ORE
3-05-031-03	COBBING		0.	0.	0.	0.	TONS OF ORE
3-05-031-04	LOADING		0.	0.	0.	0.	TONS OF ORE
3-05-031-05	CONVEY/HAUL ASBES		0.	0.	0.	0.	TONS OF ORE
3-05-031-06	CONVEY/HAUL WASTE		0.	0.	0.	0.	TONS OF ORE
3-05-031-07	UNLOADING		0.	0.	0.	0.	TONS OF ORE
3-05-031-08	STRIPPING		0.	0.	0.	0.	TONS REMOVED
3-05-031-09	VENTILATION		0.	0.	0.	0.	TONS OF ORE
3-05-031-10	STOCKPILING		0.	0.	0.	0.	TONS OF ORE
3-05-031-11	TAILINGS		0.	0.	0.	0.	TINS OF MATERIAL
3-05-031-99	OTHER/NOT CLASFD						TONS PROCESSED

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		POUNDS EMITTED PER UNIT					
		PART	SOX	NOX	HC	CO	UNITS
INDUSTRIAL PROCES -MINERAL PRODUCTS							
ASBESTOS MILLING							
3-05-032-01	CRUSHING		0.	0.	0.	0.	TONS PROCESSED
3-05-032-02	DRYING		0.	0.	0.	0.	TONS PROCESSED
3-05-032-03	RECRUSHING		0.	0.	0.	0.	TONS PROCESSED
3-05-032-04	SCREENING		0.	0.	0.	0.	TONS PROCESSED
3-05-032-05	FIBERIZING		0.	0.	0.	0.	TONS PROCESSED
3-05-032-06	BAGGING		0.	0.	0.	0.	TONS PROCESSED
3-05-032-99	OTHER/NOT CLASFD						TONS PROCESSED
MINING-SPEC MATL							
3-05-040-01	OPEN PIT-BLASTING		0.	0.	0.	0.	TONS OF MATERIAL
3-05-040-02	OPEN PIT-DRILLING		0.	0.	0.	0.	TONS OF MATERIAL
3-05-040-03	OPEN PIT-COBBING		0.	0.	0.	0.	TONS OF MATERIAL
3-05-040-10	UNDERGRD-VENTILAT		0.	0.	0.	0.	TONS OF MATERIAL
3-05-040-20	LOADING		0.	0.	0.	0.	TONS OF MATERIAL
3-05-040-21	CONVEY/HAUL MATL		0.	0.	0.	0.	TONS OF MATERIAL
3-05-040-22	CONVEY/HAUL WASTE		0.	0.	0.	0.	TONS OF MATERIAL
3-05-040-23	UNLOADING		0.	0.	0.	0.	TONS OF MATERIAL
3-05-040-24	STRIPPING		0.	0.	0.	0.	TONS OF MATERIAL
3-05-040-25	STOCKPILE		0.	0.	0.	0.	TONS OF MATERIAL
3-05-040-30	PRIMARY CRUSHER		0.	0.	0.	0.	TONS OF MATERIAL
3-05-040-31	SECONDARY CRUSHER		0.	0.	0.	0.	TONS OF MATERIAL
3-05-040-32	ORE CONCENTRATOR		0.	0.	0.	0.	TONS OF MATERIAL
3-05-040-33	ORE DRYER		0.	0.	0.	0.	TONS OF MATERIAL
3-05-040-34	SCREENING		0.	0.	0.	0.	TONS OF MATERIAL
3-05-040-36	TAILING PILES		0.	0.	0.	0.	TONS OF MATERIAL
3-05-040-99	OTHER/NOT CLASIFD						TONS OF MATERIAL
OTHER/NOT CLASIFD							
3-05-999-99	SPECIFY IN REMARK						TONS PRODUCT
INDUSTRIAL PROCES -PETROLEUM INDRY							
PROCESS HEATER							
3-06-001-01	OIL	840.	6,720. S	2,900.	140.	0.	1000 BARRELS OIL BURNED
3-06-001-02	GAS	0.02	0.83 S	0.23	0.03	0.	1000 CUBIC FEET GAS BURNED
3-06-001-03	OIL	20.0	160. S	69.0	3.34	0.	1000 GALLONS OIL BURNED
3-06-001-04	GAS	20.0	830. S	230.	30.0	0.	MILLION CUBIC FEET BURNED
FLUID CRACKERS							
3-06-002-01	GENERAL (FCC)	242.	493.	71.0	220.	13,700.	1000 BARRELS FRESH FEED
MOV-BED CAT-CRACK							
3-06-003-01	GENERAL (TCC)	17.0	60.0	5.00	87.0	3,800.	1000 BARRELS FRESH FEED
BLOW-DOWN SYSTM							
3-06-004-01	W/CONTROLS	0.	0.	0.	5.00	0.	1000 BARRELS REFINERY CAPACITY
3-06-004-02	W/O CONTROLS	0.	0.	0.	300.	0.	1000 BARRELS REFINERY CAPACITY
PROCESS DRAINS							
3-06-005-01	GEN W/CONTROL	0.	0.	0.	8.00	0.	1000 BARRELS WASTE WATER
3-06-005-02	GEN W/O CONTROL	0.	0.	0.	210.	0.	1000 BARRELS WASTE WATER
VACUUM JETS							
3-06-006-01	W/CONTROL	0.	0.	0.	0.	0.	1000 BARRELS VACUUM DISTILLATION
3-06-006-02	W/O CONTROL	0.	0.	0.	130.	0.	1000 BARRELS VACUUM DISTILLATION
COOLING TOWERS							
3-06-007-01		0.	0.	0.	6.00	0.	MILLION GALLONS COOLING WATER
MISCELLANEOUS							
3-06-008-01	PIPE/VALVE-FLANGE	0.	0.	0.	28.0	0.	1000 BARRELS REFINERY CAPACITY
3-06-008-02	VESL RELIEF VALUE	0.	0.	0.	11.0	0.	1000 BARRELS REFINERY CAPACITY
3-06-008-03	PUMP SEALS	0.	0.	0.	17.0	0.	1000 BARRELS REFINERY CAPACITY
3-06-008-04	COMPRESR SEALS	0.	0.	0.	5.00	0.	1000 BARRELS REFINERY CAPACITY
3-06-008-05	OTHER-GENL	0.	0.	0.	10.0	0.	1000 BARRELS REFINERY CAPACITY
FLARES							
3-06-009-01	NATURAL GAS			0.			MILLIONS OF CUBIC FEET
3-06-009-99	OTHER/NOT CLASIFD						MILLIONS OF CUBIC FEET
SLUDGE CONVERTER							
3-06-010-01	GENERAL						TONS PROCESSED

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NATIONAL EMISSION DATA SYSTEM
SOURCE CLASSIFICATION CODES

		POUNDS EMITTED PER UNIT					
		PART	SOX	NOX	HC	CO	UNITS
INDUSTRIAL PROCES -PETROLEUM INDRY							
ASPHALT OXIDIZER							
3-06-011-01	GENERAL						TONS PROCESSED
3-06-011-99	OTHER/NOT CLASIFD						TONS PROCESSED
FLUID COKING							
3-06-012-01	GENERAL	523.					1000 BARRELS FRESH FEED
3-06-012-02	COOLING OPER						1000 BARRELS FRESH FEED
3-06-012-03	TRANSPORTATION						1000 BARRELS FRESH FEED
3-06-012-04	STORAGE						1000 BARRELS FRESH FEED
CATALYTIC REFORM							
3-06-013-01	GENERAL						1000 BARRELS FRESH FEED
OTHER/NOT CLASIFD							
3-06-999-98	SPECIFY IN REMARK						TONS PROCESSED
3-06-999-99	SPECIFY IN REMARK						BARRELS-PROCESSED
INDUSTRIAL PROCES -WOOD PRODUCTS							
SULFATE PULPNG							
3-07-001-01	BLOWTNK ACCUMULTR	0.	0.			0.	AIR-DRY TONS UNBLEACHED PULP
3-07-001-02	WASHRS/SCREENS	0.	0.			0.	AIR-DRY TONS UNBLEACHED PULP
3-07-001-03	MULT-EFFECT EVAP	0.	0.			0.	AIR-DRY TONS UNBLEACHED PULP
3-07-001-04	RECVY BOLR/DCEVAP	151.	5.00			60.0	AIR-DRY TONS UNBLEACHED PULP
3-07-001-05	SMELT DISSOLV TNK	2.00	0.			0.	AIR-DRY TONS UNBLEACHED PULP
3-07-001-06	LIME KILNS	45.0	0.			10.0	AIR-DRY TONS UNBLEACHED PULP
3-07-001-07	TURPENTINE CONDSR	0.	0.			0.	AIR-DRY TONS UNBLEACHED PULP
3-07-001-08	FLUIDBED CALCINER	72.0	0.			0.	AIR-DRY TONS UNBLEACHED PULP
3-07-001-09	LIQUOR OXIDN TOWR						AIR-DRY TONS UNBLEACHED PULP
3-07-001-99	OTHER/NOT CLASIFD						AIR-DRY TONS UNBLEACHED PULP
SULFITE PULPING							
3-07-002-01	LIQUOR RECOVERY						AIR-DRY TONS UNBLEACHED PULP
3-07-002-02	SULFITE TOWER						AIR-DRY TONS UNBLEACHED PULP
3-07-002-03	DIGESTER				0.		AIR-DRY TONS UNBLEACHED PULP
3-07-002-04	SMELT TANK				0.		AIR-DRY TONS UNBLEACHED PULP
3-07-002-05	EVAPORATORS				0.		AIR-DRY TONS UNBLEACHED PULP
3-07-002-06	PULP DIGESTER				0.		TONS AIR DRY PULP
3-07-002-99	OTHER/NOT CLASIFD						TONS AIR DRY PULP
PULPBOARD MFG							
3-07-004-01	PAPERBOARD-GEN	0.					TONS FINISHED PRODUCT
3-07-004-02	FIBERBOARD-GEN	0.60					TONS FINISHED PRODUCT
3-07-004-99	OTHER/NOT CLASIFD						TONS FINISHED PRODUCT
PRESSURE TREATING							
3-07-005-01	CREOSOTE						TONS OF WOOD TREATED
3-07-005-99	OTHER/NOT CLASIFD						TONS OF WOOD TREATED
TALLOIL/ROSIN							
3-07-006-01	GENERAL						TONS OF PRODUCT
PLYWOOD/PARTBOARD							
3-07-007-01	VENEER DRYER	0.	0.		1.20	0.	TONS PROCESSED
3-07-007-02	SANDING		0.	0.	0.	0.	TONS PROCESSED
3-07-007-99	OTHER/NOT CLASIFD						TONS PROCESSED
SAWMILL OPERATNS							
3-07-008-99	OTHER/NOT CLASIFD						TONS PROCESSED
EXCELSIOR MFG							
3-07-009-99	OTHER/NOT CLASIFD						TONS PROCESSED
CORK PROCESSING							
3-07-010-99	OTHER/NOT CLASIFD						TONS PROCESSED
FURNITURE MFG							
3-07-020-99	OTHER/NOT CLASIFD						TONS PROCESSED
OTHER/NOT CLASIFD							
3-07-999-99	SPECIFY IN REMARK						TONS PROCESSED

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NATIONAL EMISSION DATA SYSTEM
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POUNDS EMITTED PER UNIT

INDUSTRIAL PROCES -METAL FABRICATION		PART	SOX	NOX	HC	CO	UNITS
**************** ****************							
IRON/STEEL							
3-09-001-01	MISC HARDWARE		0.	0.		0.	TONS OF PRODUCT
3-09-001-02	FARM MACHINERY		0.	0.			TONS OF PRODUCT
3-09-001-99	OTHER/NOT CLASIFD						TONS PROCESSED
PLATING OPERATONS							
3-09-010-99	OTHER/NOT CLASIFD						TONS PLATED
CAN MAKING OPRNS							
3-09-020-99	OTHER/NOT CLASIFD						TONS PRODUCT
MACHINING OPER							
3-09-030-01	DRILLING-SP MATL		0.	0.	0.	0.	TONS PROCESSED
3-09-030-02	MILLING-SP MATL		0.	0.	0.	0.	TONS PROCESSED
3-09-030-03	REAMING-SP MATL		0.	0.	0.	0.	TONS PROCESSED
3-09-030-04	GRINDING-SP MATL		0.	0.	0.	0.	TONS PROCESSED
3-09-030-05	SAWING-SP MATL		0.	0.	0.	0.	TONS PROCESSED
3-09-030-06	HONING-SP MATL		0.	0.	0.	0.	TONS PROCESSED
3-09-030-99	OTHER-SP MATL						TONS PROCESSED
OTHER/NOT CLASIFD							
3-09-999-99	SPECIFY IN REMARK						TONS PROCESSED
INDUSTRIAL PROCES -LEATHER PRODUCTS							
**************** ****************							
OTHER/NOT CLASIFD							
3-20-999-99	SPECIFY IN REMARK						TONS PROCESSED
INDUSTRIAL PROCES -TEXTILE MFG							
**************** ****************							
GENERAL FABRICS							
3-30-001-01	YARN PREP/BLEACH						TONS PROCESSED
3-30-001-02	PRINTING						TONS PROCESSED
3-30-001-99	OTHER/NOT SPECIFD						TONS PROCESSED
RUBBERIZED FABRIC							
3-30-002-01	IMPREGNATION						TONS PROCESSED
3-30-002-02	WET COATING						TONS PROCESSED
3-30-002-03	HOT MELT COATING						TONS PROCESSED
3-30-002-99	OTHER/NOT SPECIFD						TONS PROCESSED
CARPET OPERATNS							
3-30-003-99	OTHER/NOT SPECIFD						TONS PROCESSED
INDUSTRIAL PROCES -INPROCESS FUEL							
**************** ****************							
ANTHRACITE COAL							
3-90-001-99	OTHER/NOT CLASIFD	0.	0.	0.	0.	0.	TONS BURNED
BITUMINOUS COAL							
3-90-002-01	CEMENT KILN/DRYER	0.	0.	0.	0.	0.	TONS BURNED
3-90-002-03	LIME KILN	0.	0.	0.	0.	0.	TONS BURNED
3-90-002-04	KAOLIN KILN	0.	0.	0.	0.	0.	TONS BURNED
3-90-002-06	BRICK KILN/DRY	0.	0.	0.	0.	0.	TONS BURNED
3-90-002-07	GYPSUM KILN/ETC	0.	0.	0.	0.	0.	TONS BURNED
3-90-002-08	COAL DRYERS	0.	0.	0.	0.	0.	TONS BURNED
3-90-002-09	ROCK/GRAVEL DRYER	0.	0.	0.	0.	0.	TONS BURNED
3-90-002-99	OTHER/NOT CLASIFD	0.	0.	0.	0.	0.	TONS BURNED
RESIDUAL OIL							
3-90-004-01	ASPHALT DRYER	0.	0.	0.	0.	0.	1000 GALLONS BURNED
3-90-004-02	CEMENT KILN/DRYER	0.	0.	0.	0.	0.	1000 GALLONS BURNED
3-90-004-03	LIME KILN	0.	0.	0.	0.	0.	1000 GALLONS BURNED
3-90-004-04	KAOLIN KILN	0.	0.	0.	0.	0.	1000 GALLONS BURNED
3-90-004-05	METAL MELTING	0.	0.	0.	0.	0.	1000 GALLONS BURNED
3-90-004-06	BRICK KILN/DRY	0.	0.	0.	0.	0.	1000 GALLONS BURNED
3-90-004-07	GYPSUM KILN/ETC	0.	0.	0.	0.	0.	1000 GALLONS BURNED
3-90-004-08	GLASS FURNACE	0.	0.	0.	0.	0.	1000 GALLONS BURNED
3-90-004-09	ROCK/GRAVEL DRYER	0.	0.	0.	0.	0.	1000 GALLONS BURNED
3-90-004-10	FRIT SMELTER	0.	0.	0.	0.	0.	1000 GALLONS BURNED
3-90-004-11	PERLITE FURNACE	0.	0.	0.	0.	0.	1000 GALLONS BURNED
3-90-004-30	FEED/GRAIN DRYING	0.	0.	0.	0.	0.	1000 GALLONS BURNED

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INDUSTRIAL PROCES -INPROCESS FUEL		POUNDS EMITTED PER UNIT PART	SOX	NOX	HC	CO	UNITS
RESIDUAL OIL	CONTINUED						
3-90-004-31	FOOD-DRY/COOK/ETC	0.	0.	0.	0.	0.	1000 GALLONS BURNED
3-90-004-32	FERTILIZER DRYING	0.	0.	0.	0.	0.	1000 GALLONS BURNED
3-90-004-50	PULPBOARD-DRYERS	0.	0.	0.	0.	0.	1000 GALLONS BURNED
3-90-004-51	PLYWOOD-DRYERS	0.	0.	0.	0.	0.	1000 GALLONS BURNED
3-90-004-52	PULP-RECOV BOILER	0.	0.	0.	0.	0.	1000 GALLONS BURNED
3-90-004-99	OTHER/NOT CLASIFD	0.	0.	0.	0.	0.	1000 GALLONS BURNED
DISTILLATE OIL							
3-90-005-01	ASPHALT DRYER	0.	0.	0.	0.	0.	1000 GALLONS BURNED
3-90-005-02	CEMENT KILN/DRYER	0.	0.	0.	0.	0.	1000 GALLONS BURNED
3-90-005-03	LIME KILN	0.	0.	0.	0.	0.	1000 GALLONS BURNED
3-90-005-04	KAOLIN KILN	0.	0.	0.	0.	0.	1000 GALLONS BURNED
3-90-005-05	METAL MELTING	0.	0.	0.	0.	0.	1000 GALLONS BURNED
3-90-005-06	BRICK KILN/DRY	0.	0.	0.	0.	0.	1000 GALLONS BURNED
3-90-005-07	GYPSUM KILN/ETC	0.	0.	0.	0.	0.	1000 GALLONS BURNED
3-90-005-08	GLASS FURNACE	0.	0.	0.	0.	0.	1000 GALLONS BURNED
3-90-005-09	ROCK/GRAVEL DRYER	0.	0.	0.	0.	0.	1000 GALLONS BURNED
3-90-005-10	FRIT SMELTER	0.	0.	0.	0.	0.	1000 GALLONS BURNED
3-90-005-11	PERLITE FURNACE	0.	0.	0.	0.	0.	1000 GALLONS BURNED
3-90-005-30	FEED/GRAIN DRYING	0.	0.	0.	0.	0.	1000 GALLONS BURNED
3-90-005-31	FOOD-DRY/COOK/ETC	0.	0.	0.	0.	0.	1000 GALLONS BURNED
3-90-005-32	FERTILIZER DRYING	0.	0.	0.	0.	0.	1000 GALLONS BURNED
3-90-005-50	PULPBOARD-DRYERS	0.	0.	0.	0.	0.	1000 GALLONS BURNED
3-90-005-51	PLYWOOD-DRYERS	0.	0.	0.	0.	0.	1000 GALLONS BURNED
3-90-005-52	PULP-RECOV BOILER	0.	0.	0.	0.	0.	1000 GALLONS BURNED
3-90-005-99	OTHER/NOT CLASIFD	0.	0.	0.	0.	0.	1000 GALLONS BURNED
NATURAL GAS							
3-90-006-01	ASPHALT DRYER	0.	0.	0.	0.	0.	MILLION CUBIC FEET BURNED
3-90-006-02	CEMENT KILN/DRYER	0.	0.	0.	0.	0.	MILLION CUBIC FEET BURNED
3-90-006-03	LIME KILN	0.	0.	0.	0.	0.	MILLION CUBIC FEET BURNED
3-90-006-04	KAOLIN KILN	0.	0.	0.	0.	0.	MILLION CUBIC FEET BURNED
3-90-006-05	METAL MELTING	0.	0.	0.	0.	0.	MILLION CUBIC FEET BURNED
3-90-006-06	BRICK KILN/DRYS	0.	0.	0.	0.	0.	MILLION CUBIC FEET BURNED
3-90-006-07	GYPSUM KILN ETC	0.	0.	0.	0.	0.	MILLION CUBIC FEET BURNED
3-90-006-08	GLASS FURNACE	0.	0.	0.	0.	0.	MILLION CUBIC FEET BURNED
3-90-006-09	ROCK/GRAVEL DRYER	0.	0.	0.	0.	0.	MILLION CUBIC FEET BURNED
3-90-006-10	FRIT SMELTER	0.	0.	0.	0.	0.	MILLION CUBIC FEET BURNED
3-90-006-11	PERLITE FURNACE	0.	0.	0.	0.	0.	MILLION CUBIC FEET BURNED
3-90-006-30	FEED/GRAIN DRYING	0.	0.	0.	0.	0.	MILLION CUBIC FEET BURNED
3-90-006-31	FOOD-DRY/COOK/ETC	0.	0.	0.	0.	0.	MILLION CUBIC FEET BURNED
3-90-006-32	FERTILIZER DRYING	0.	0.	0.	0.	0.	MILLION CUBIC FEET BURNED
3-90-006-50	PULPBOARD-DRYERS	0.	0.	0.	0.	0.	MILLION CUBIC FEET BURNED
3-90-006-51	PLYWOOD-DRYERS	0.	0.	0.	0.	0.	MILLION CUBIC FEET BURNED
3-90-006-52	PULP-RECOV BOILER	0.	0.	0.	0.	0.	MILLION CUBIC FEET BURNED
3-90-006-99	OTHER/NOT CLASIFD	0.	0.	0.	0.	0.	MILLION CUBIC FEET BURNED
PROCESS GAS							
3-90-007-01	CO/BLAST FURNACE	0.	0.	0.	0.	0.	MILLION CUBIC FEET BURNED
3-90-007-02	COKE OVEN GAS	0.	0.	0.	0.	0.	MILLION CUBIC FEET BURNED
3-90-007-99	OTHER/NOT CLASIFD	0.	0.	0.	0.	0.	MILLION CUBIC FEET BURNED
COKE							
3-90-008-01	MINERAL WOOL FURN	0.	0.	0.	0.	0.	TONS BURNED
3-90-008-99	OTHER/NOT CLASIFD	0.	0.	0.	0.	0.	TONS
WOOD							
3-90-009-99	OTHER/NOT CLASIFD	0.	0.	0.	0.	0.	TONS BURNED
LIQ PET GAS (LPG)							
3-90-010-99	OTHER/NOT CLASIFD	0.	0.	0.	0.	0.	1000 GALLONS BURNED
OTHER/NOT CLASIFD							
3-90-999-97	SPECIFY IN REMARK	0.	0.	0.	0.	0.	MILLION CUBIC FEET BURNED
3-90-999-98	SPECIFY IN REMARK	0.	0.	0.	0.	0.	1000 GALLONS BURNED
3-90-999-99	SPECIFY IN REMARK	0.	0.	0.	0.	0.	TONS BURNED
INDUSTRIAL PROCES -OTHER/NOT CLASIFD							
SPECIFY IN REMARK							
3-99-999-99							TONS PROCESSED

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POINT SC EVAP	-CLEANING SOLVENT	PART	SOX	NOX	HC	CO	UNITS
		POUNDS EMITTED PER UNIT					
DRYCLEANING							
4-01-001-01	PERCHLORETHYLENE	0.	0.	0.	210.	0.	TONS CLOTHES CLEANED
4-01-001-02	STODDARD	0.	0.	0.	305.	0.	TONS CLOTHES CLEANED
4-01-001-99	SPECIFY SOLVENT						TONS CLOTHES CLEANED
DEGREASING							
4-01-002-01	STODDARD	0.	0.	0.		0.	TONS SOLVENT USED
4-01-002-02	TRICHLOROETHANE						TONS SOLVENT USED
4-01-002-03	PERCHLOROETHYLENE						TONS SOLVENT USED
4-01-002-04	METHYLENE CHLORDE						TONS SOLVENT USED
4-01-002-05	TRICHLOROETHYLENE						TONS SOLVENT USED
4-01-002-06	TOLUENE						TONS SOLVENT USED
4-01-002-99	OTHER/NOT CLASIFD						TONS SOLVENT USED
OTHER/NOT CLASIFD							
4-01-999-99	SPECIFY IN REMARK						TONS SOLVENT USED
POINT SC EVAP	-SURFACE COATING						
PAINT							
4-02-001-01	GENERAL	0.	0.	0.	1,120.	0.	TONS COATING
4-02-001-02	ACETONE				2,000.		TONS SOLVENT IN COATING
4-02-001-03	ETHYL ACETATE				2,000.		TONS SOLVENT IN COATING
4-02-001-04	MEK				2,000.		TONS SOLVENT IN COATING
4-02-001-05	TOLUENE				2,000.		TONS SOLVENT IN COATING
4-02-001-99	SOLVENT GENERAL				2,000.		TONS SOLVENT IN COATING
VARNISH/SHELLAC							
4-02-003-01	GENERAL				1,000.		TONS COATING
4-02-003-02	ACETONE				2,000.		TONS SOLVENT IN COATING
4-02-003-03	ETHYL ACETATE				2,000.		TONS SOLVENT IN COATING
4-02-003-04	TOLUENE				2,000.		TONS SOLVENT IN COATING
4-02-003-05	XYLENE				2,000.		TONS SOLVENT IN COATING
4-02-003-99	SOLVENT GENERAL				2,000.		TONS SOLVENT IN COATING
LAQUER							
4-02-004-01	GENERAL				1,540.		TONS COATING
4-02-004-02	ACETONE				2,000.		TONS SOLVENT IN COATING
4-02-004-03	ETHYL ACETATE				2,000.		TONS SOLVENT IN COATING
4-02-004-04	ISOPROPYL ALCOHOL				2,000.		TONS SOLVENT IN COATING
4-02-004-05	MEK				2,000.		TONS SOLVENT IN COATING
4-02-004-06	TOLUENE				2,000.		TONS SOLVENT IN COATING
4-02-004-07	XYLENE				2,000.		TONS SOLVENT IN COATING
4-02-004-99	SOLVENT GENERAL				2,000.		TONS SOLVENT IN COATING
ENAMEL							
4-02-005-01	GENERAL	0.	0.	0.	840.	0.	TONS COATING
4-02-005-02	CELLOSOLVE ACETAT				2,000.		TONS SOLVENT IN COATING
4-02-005-03	MEK				2,000.		TONS SOLVENT IN COATING
4-02-005-04	TOLUENE				2,000.		TONS SOLVENT IN COATING
4-02-005-05	XYLENE				2,000.		TONS SOLVENT IN COATING
4-02-005-99	SOLVENT GENERAL				2,000.		TONS SOLVENT IN COATING
PRIMER							
4-02-006-01	GENERAL				1,320.		TONS COATING
4-02-006-02	NAPHTHA				2,000.		TONS SOLVENT IN COATING
4-02-006-03	XYLENE				2,000.		TONS SOLVENT IN COATING
4-02-006-04	MINERAL SPIRITS				2,000.		TONS SOLVENT IN COATING
4-02-006-05	TOLUENE				2,000.		TONS SOLVENT IN COATING
4-02-006-99	SOLVENT GENERAL				2,000.		TONS SOLVENT IN COATING
ADHESIVE							
4-02-007-01	GENERAL						TONS COATING
4-02-007-02	MEK				2,000.		TONS SOLVENT IN COATING
4-02-007-03	TOLUENE				2,000.		TONS SOLVENT IN COATING
4-02-007-04	BENZENE				2,000.		TONS SOLVENT IN COATING
4-02-007-05	NAPHTHA				2,000.		TONS SOLVENT IN COATING
4-02-007-99	SOLVENT GENERAL				2,000.		TONS SOLVENT IN COATING
COATING OVEN							
4-02-008-01	GENERAL						TONS COATING
4-02-008-02	DRIED < 175F						TONS COATING
4-02-008-03	BAKED > 175F						TONS COATING
4-02-008-99	OTHER/SPECIFY						TONS COATING

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POUNDS EMITTED PER UNIT

POINT SC EVAP	*SURFACE COATING	PART	SOX	NOX	HC	CO	UNITS
SOLVENT							
4-02-009-01	GENERAL				2,000.		TONS SOLVENT
4-02-009-02	ACETONE				2,000.		TONS SOLVENT
4-02-009-03	BUTYL ACETATE				2,000.		TONS SOLVENT
4-02-009-04	BUTYL ALCOHOL				2,000.		TONS SOLVENT
4-02-009-05	CARBITOL				2,000.		TONS SOLVENT
4-02-009-06	CELLOSOLVE				2,000.		TONS SOLVENT
4-02-009-07	CELLOSOLVE ACETAT				2,000.		TONS SOLVENT
4-02-009-08	DIMETHYLFORMAMIDE				2,000.		TONS SOLVENT
4-02-009-09	ETHYL ACETATE				2,000.		TONS SOLVENT
4-02-009-10	ETHYL ALCOHOL				2,000.		TONS SOLVENT
4-02-009-11	GASOLINE				2,000.		TONS SOLVENT
4-02-009-12	ISOPROPYL ALCOHOL				2,000.		TONS SOLVENT
4-02-009-13	ISOPROPYL ACETATE				2,000.		TONS SOLVENT
4-02-009-14	KEROSENE				2,000.		TONS SOLVENT
4-02-009-15	LACTOL SPIRITS				2,000.		TONS SOLVENT
4-02-009-16	METHYL ACETATE				2,000.		TONS SOLVENT
4-02-009-17	METHYL ALCOHOL				2,000.		TONS SOLVENT
4-02-009-18	MEK				2,000.		TONS SOLVENT
4-02-009-19	MIBK				2,000.		TONS SOLVENT
4-02-009-20	MINERAL SPIRITS				2,000.		TONS SOLVENT
4-02-009-21	NAPHTHA				2,000.		TONS SOLVENT
4-02-009-22	TOLUENE				2,000.		TONS SOLVENT
4-02-009-23	VARSOL				2,000.		TONS SOLVENT
4-02-009-24	XYLENE				2,000.		TONS SOLVENT
OTHER/NOT CLASIFD							
4-02-999-99	SPECIFY IN REMARK						TONS COATING

POINT SC EVAP	*PETROL PROD STG	PART	SOX	NOX	HC	CO	UNITS
FIXED ROOF							
4-03-001-01	BREATH-GASOLINE	0.	0.	0.	80.3	0.	1000 GALLONS STORAGE CAPACITY
4-03-001-02	BREATH-CRUDE	0.	0.	0.	54.8	0.	1000 GALLONS STORAGE CAPACITY
4-03-001-03	WORKING-GASOLINE	0.	0.	0.	9.00	0.	1000 GALLONS THROUGHPUT
4-03-001-04	WORKING-CRUDE	0.	0.	0.	7.30	0.	1000 GALLONS THROUGHPUT
4-03-001-05	BREATH-JET FUEL	0.	0.	0.	25.2	0.	1000 GALLONS STORAGE CAPACITY
4-03-001-06	BREATH-KEROSENE	0.	0.	0.	13.1	0.	1000 GALLONS STORAGE CAPACITY
4-03-001-07	BREATH-DIST FUEL	0.	0.	0.	13.1	0.	1000 GALLONS STORAGE CAPACITY
4-03-001-08	BREATH-BENZENE	0.	0.	0.	18.3	0.	1000 GALLONS STORAGE CAPACITY
4-03-001-09	BREATH-CYCLOHEX	0.	0.	0.	20.8	0.	1000 GALLONS STORAGE CAPACITY
4-03-001-10	BREATH-CYCLOPENT	0.	0.	0.	58.4	0.	1000 GALLONS STORAGE CAPACITY
4-03-001-11	BREATH-HEPTANE	0.	0.	0.	11.3	0.	1000 GALLONS STORAGE CAPACITY
4-03-001-12	BREATH-HEXANE	0.	0.	0.	32.1	0.	1000 GALLONS STORAGE CAPACITY
4-03-001-13	BREATH-ISOOCTANE	0.	0.	0.	13.9	0.	1000 GALLONS STORAGE CAPACITY
4-03-001-14	BREATH-ISOPENTANE	0.	0.	0.	142.	0.	1000 GALLONS STORAGE CAPACITY
4-03-001-15	BREATH-PENTANE	0.	0.	0.	94.9	0.	1000 GALLONS STORAGE CAPACITY
4-03-001-16	BREATH-TOLUENE	0.	0.	0.	5.84	0.	1000 GALLONS STORAGE CAPACITY
4-03-001-50	WORKING-JET FUEL	0.	0.	0.	2.40	0.	1000 GALLONS THROUGHPUT
4-03-001-51	WORKING-KEROSENE	0.	0.	0.	1.00	0.	1000 GALLONS THROUGHPUT
4-03-001-52	WORKING-DIST FUEL	0.	0.	0.	1.00	0.	1000 GALLONS THROUGHPUT
4-03-001-53	WORKING-BENZENE	0.	0.	0.	2.00	0.	1000 GALLONS THROUGHPUT
4-03-001-54	WORKING-CYCLOHEX	0.	0.	0.	2.30	0.	1000 GALLONS THROUGHPUT
4-03-001-55	WORKING-CYCLOPENT	0.	0.	0.	6.90	0.	1000 GALLONS THROUGHPUT
4-03-001-56	WORKING-HEPTANE	0.	0.	0.	1.20	0.	1000 GALLONS THROUGHPUT
4-03-001-57	WORKING-HEXANE	0.	0.	0.	3.60	0.	1000 GALLONS THROUGHPUT
4-03-001-58	WORKING-ISOOCTANE	0.	0.	0.	1.50	0.	1000 GALLONS THROUGHPUT
4-03-001-59	WORKING-ISOPENT	0.	0.	0.	15.7	0.	1000 GALLONS THROUGHPUT
4-03-001-60	WORKING-PENTANE	0.	0.	0.	10.6	0.	1000 GALLONS THROUGHPUT
4-03-001-61	WORKING-TOLUENE	0.	0.	0.	0.64	0.	1000 GALLONS THROUGHPUT
4-03-001-98	BREATHE-SPECIFY						1000 GALLONS STORAGE CAPACITY
4-03-001-99	WORKING-SPECIFY						1000 GALLONS THRUPUT
FLOATING ROOF							
4-03-002-01	STAND STG-GASOLN	0.	0.	0.	12.1	0.	1000 GALLONS STORAGE CAPACITY
4-03-002-02	WORKING-PRODUCT				0.		1000 GALLONS THROUGHPUT
4-03-002-03	STAND STG-CRUDE	0.	0.	0.	10.6	0.	1000 GALLONS STORAGE CAPACITY
4-03-002-04	WORKING-CRUDE				0.		1000 GALLONS THROUGHPUT
4-03-002-05	STAND STG-JETFUEL	0.	0.	0.	4.38	0.	1000 GALLONS STORAGE CAPACITY
4-03-002-06	STAND STG-KEROSNE	0.	0.	0.	1.90	0.	1000 GALLONS STORAGE CAPACITY
4-03-002-07	STAND STG-DIST FL	0.	0.	0.	1.90	0.	1000 GALLONS STORAGE CAPACITY
4-03-002-08	STAND STG-BENZENE	0.	0.	0.	2.70	0.	1000 GALLONS STORAGE CAPACITY
4-03-002-09	STAND STG-CYCLHEX	0.	0.	0.	3.03	0.	1000 GALLONS STORAGE CAPACITY
4-03-002-10	STAND STG-CYCLPEN	0.	0.	0.	8.76	0.	1000 GALLONS STORAGE CAPACITY
4-03-002-11	STAND STG-HEPTANE	0.	0.	0.	1.64	0.	1000 GALLONS STORAGE CAPACITY
4-03-002-12	STAND STG-HEXANE	0.	0.	0.	4.75	0.	1000 GALLONS STORAGE CAPACITY
4-03-002-13	STAND STG-ISOOCTN	0.	0.	0.	2.01	0.	1000 GALLONS STORAGE CAPACITY
4-03-002-14	STAND STG-ISOPENT	0.	0.	0.	20.8	0.	1000 GALLONS STORAGE CAPACITY
4-03-002-15	STAND STG-PENTANE	0.	0.	0.	13.9	0.	1000 GALLONS STORAGE CAPACITY
4-03-002-16	STAND STG-TOLUENE	0.	0.	0.	0.88	0.	1000 GALLONS STORAGE CAPACITY
4-03-002-99	STAND STG-SPECIFY						1000 GALLONS STORAGE CAPACITY

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NATIONAL EMISSION DATA SYSTEM
SOURCE CLASSIFICATION CODES

		POUNDS EMITTED PER UNIT					
POINT SC EVAP	-PETROL PROD STG	PART	SOX	NOX	HC	CO	UNITS
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VAR-VAPOR SPACE							
4-03-003-02	WORKING-GASOLINE	0.	0.	0.	10.2	0.	1000 GALLONS THROUGHPUT
4-03-003-03	WORKING-JET FUEL	0.	0.	0.	2.30	0.	1000 GALLONS THROUGHPUT
4-03-003-04	WORKING-KEROSENE	0.	0.	0.	1.00	0.	1000 GALLONS THROUGHPUT
4-03-003-05	WORKING-DIST FUEL	0.	0.	0.	1.00	0.	1000 GALLONS THROUGHPUT
4-03-003-06	WORKING-BENZENE	0.	0.	0.	2.30	0.	1000 GALLONS THROUGHPUT
4-03-003-07	WORKING-CYCLOHEX	0.	0.	0.	2.60	0.	1000 GALLONS THROUGHPUT
4-03-003-08	WORKING-CYCLOPENT	0.	0.	0.	7.20	0.	1000 GALLONS THROUGHPUT
4-03-003-09	WORKING-HEPTANE	0.	0.	0.	1.90	0.	1000 GALLONS THROUGHPUT
4-03-003-10	WORKING-HEXANE	0.	0.	0.	4.00	0.	1000 GALLONS THROUGHPUT
4-03-003-11	WORKING-ISOOCTANE	0.	0.	0.	1.70	0.	1000 GALLONS THROUGHPUT
4-03-003-12	WORKING-ISOPENT	0.	0.	0.	17.8	0.	1000 GALLONS THROUGHPUT
4-03-003-13	WORKING-PENTANE	0.	0.	0.	12.0	0.	1000 GALLONS THROUGHPUT
4-03-003-14	WORKING-TOLUENE	0.	0.	0.	0.73	0.	1000 GALLONS THROUGHPUT
4-03-003-99	WORKING-SPECIFY						1000 GALLONS THRUPUT
OTHER/NOT CLASIFD							
4-03-999-99	SPECIFY IN REMARK						1000 GAL STORED
POINT SC EVAP	-MISC ORGANIC STOR						
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OTHER/NOT CLASIFD							
4-04-001-99	SPECIFY IN REMARK						TONS STORED
POINT SC EVAP	-PRINTING PRESS						
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DRYERS							
4-05-001-01	GENERAL			0.			TONS SOLVENT
LETTERPRESS							
4-05-002-01	GENERAL				700.		TONS INK
4-05-002-02	KEROSENE				2,000.		TONS SOLVENT IN INK
4-05-002-03	MINERAL SPIRITS				2,000.		TONS SOLVENT IN INK
4-05-002-99	SOLVENT GENERAL				2,000.		TONS SOLVENT IN INK
FLEXOGRAPHIC							
4-05-003-01	GENERAL				1,300.		TONS INK
4-05-003-02	CARBITOL				2,000.		TONS SOLVENT IN INK
4-05-003-03	CELLOSOLVE				2,000.		TONS SOLVENT IN INK
4-05-003-04	ETHYL ALCOHOL				2,000.		TONS SOLVENT IN INK
4-05-003-05	ISOPROPYL ALCOHOL				2,000.		TONS SOLVENT IN INK
4-05-003-06	N-PROPYL ALCOHOL				2,000.		TONS SOLVENT IN INK
4-05-003-07	NAPHTHA				2,000.		TONS SOLVENT IN INK
4-05-003-99	SOLVENT GENERAL				2,000.		TONS SOLVENT IN INK
LITHOGRAPHIC							
4-05-004-01	GENERAL				700.		TONS INK
4-05-004-02	MINERAL SPIRITS				2,000.		TONS SOLVENT IN INK
4-05-004-03	ISOPROPYL ALCOHOL				2,000.		TONS SOLVENT IN INK
4-05-004-99	SOLVENT GENERAL				2,000.		TONS SOLVENT IN INK
GRAVURE							
4-05-005-01	GENERAL				1,300.		TONS INK
4-05-005-02	DIMETHYLFORMAMIDE				2,000.		TONS SOLVENT IN INK
4-05-005-03	ETHYL ACETATE				2,000.		TONS SOLVENT IN INK
4-05-005-04	ETHYL ALCOHOL				2,000.		TONS SOLVENT IN INK
4-05-005-05	ISOPROPYL ALCOHOL				2,000.		TONS SOLVENT IN INK
4-05-005-06	MEK				2,000.		TONS SOLVENT IN INK
4-05-005-07	MIBK				2,000.		TONS SOLVENT IN INK
4-05-005-08	MINERAL SPIRITS				2,000.		TONS SOLVENT IN INK
4-05-005-09	N-PROPYL ALCOHOL				2,000.		TONS SOLVENT IN INK
4-05-005-10	TOLUENE				2,000.		TONS SOLVENT IN INK
4-05-005-99	SOLVENT GENERAL				2,000.		TONS SOLVENT IN INK

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		POUNDS EMITTED PER UNIT					
POINT SC EVAP	-PETROL MRKT-TRANS	PART	SOX	NOX	HC	CO	UNITS
TANK CARS/TRUCKS							
4-06-001-01	LOAD(SPLASH)-GASO	0.	0.	0.	12.4	0.	1000 GALLONS TRANSFERRED
4-06-001-02	LOAD(SPLASH)-CRUD	0.	0.	0.	10.6	0.	1000 GALLONS TRANSFERRED
4-06-001-03	LOAD(SPLASH)-JET	0.	0.	0.	1.84	0.	1000 GALLONS TRANSFERRED
4-06-001-04	LOAD(SPLASH)-KERO	0.	0.	0.	0.88	0.	1000 GALLONS TRANSFERRED
4-06-001-05	LOAD(SPLASH)-DIST	0.	0.	0.	0.93	0.	1000 GALLONS TRANSFERRED
4-06-001-26	LOAD(SUBM)-GASOLN	0.	0.	0.	4.10	0.	1000 GALLONS TRANSFERRED
4-06-001-27	LOAD(SUBM)-CRUDE	0.	0.	0.	3.90	0.	1000 GALLONS TRANSFERRED
4-06-001-28	LOAD(SUBM)-JET FL	0.	0.	0.	0.91	0.	1000 GALLONS TRANSFERRED
4-06-001-29	LOAD(SUBM)-KEROSN	0.	0.	0.	0.45	0.	1000 GALLONS TRANSFERRED
4-06-001-30	LOAD(SUBM)-DIST	0.	0.	0.	0.49	0.	1000 GALLONS TRANSFERRED
4-06-001-51	UNLOAD-GASOLINE	0.	0.	0.	2.10	0.	1000 GALLONS TRANSFERRED
4-06-001-52	UNLOAD-CRUDE OIL	0.	0.	0.	1.98	0.	1000 GALLONS TRANSFERRED
4-06-001-53	UNLOAD-JET FUEL	0.	0.	0.	0.45	0.	1000 GALLONS TRANSFERRED
4-06-001-54	UNLOAD-KEROSENE	0.	0.	0.	0.23	0.	1000 GALLONS TRANSFERRED
4-06-001-55	UNLOAD-DIST OIL	0.	0.	0.	0.24	0.	1000 GALLONS TRANSFERRED
4-06-001-97	LOAD(SPLSH)SPECFY						1000 GALLONS TRANSFERRED
4-06-001-98	LOAD(SUBM)SPECIFY						1000 GALLONS TRANSFERRED
4-06-001-99	UNLOAD-SPECIFY						1000 GALLONS TRANSFERRED
MARINE VESSELS							
4-06-002-01	LOADING-GASOLINE	0.	0.	0.	2.88	0.	1000 GALLONS TRANSFERRED
4-06-002-02	LOADING-CRUDE OIL	0.	0.	0.	2.58	0.	1000 GALLONS TRANSFERRED
4-06-002-03	LOADING-JET FUEL	0.	0.	0.	0.60	0.	1000 GALLONS TRANSFERRED
4-06-002-04	LOADING-KEROSENE	0.	0.	0.	0.27	0.	1000 GALLONS TRANSFERRED
4-06-002-05	LOADING-DIST OIL	0.	0.	0.	0.29	0.	1000 GALLONS TRANSFERRED
4-06-002-26	UNLOAD-GASOLINE	0.	0.	0.	2.52	0.	1000 GALLONS TRANSFERRED
4-06-002-27	UNLOAD-CRUDE OIL	0.	0.	0.	2.25	0.	1000 GALLONS TRANSFERRED
4-06-002-28	UNLOAD-JET FUEL	0.	0.	0.	0.52	0.	1000 GALLONS TRANSFERRED
4-06-002-29	UNLOAD-KEROSENE	0.	0.	0.	0.24	0.	1000 GALLONS TRANSFERRED
4-06-002-30	UNLOAD-DIST OIL	0.	0.	0.	0.25	0.	1000 GALLONS TRANSFERRED
4-06-002-98	LOADING-SPECIFY						1000 GALLONS TRANSFERRED
4-06-002-99	UNLOAD-SPECIFY						1000 GALLONS TRANSFERRED
UNDERGRD GASO STG							
4-06-003-01	SPLASH LOADING	0.	0.	0.	11.5	0.	1000 GALLONS TRANSFERRED
4-06-003-02	SUB LOAD-UNCONT	0.	0.	0.	7.30	0.	1000 GALLONS TRANSFERRED
4-06-003-03	SUB LOAD-OPN SYS	0.	0.	0.	0.80	0.	1000 GALLONS TRANSFERRED
4-06-003-04	SUB LOAD-CLS SYS	0.	0.	0.	0.	0.	1000 GALLONS TRANSFERRED
4-06-003-05	UNLOADING	0.	0.	0.	1.00	0.	1000 GALLONS TRANSFERRED
4-06-003-99	SPECIFY METHOD						1000 GALLONS TRANSFERRED
FILL VEH GAS TANK							
4-06-004-01	VAP DISP LOSS	0.	0.	0.	11.0	0.	1000 GALLONS PUMPED
4-06-004-02	LIQ SPILL LOSS	0.	0.	0.	0.67	0.	1000 GALLONS PUMPED
4-06-004-99	OTHER LOSS						1000 GALLONS PUMPED
POINT SC EVAP	-MISC HC EVAP						
OTHER/NOT CLASIFD							
4-90-999-99	SPECIFY IN REMARK						TONS PROCESSED
SOLID WASTE	-GOVERNMENT						
MUNICIPAL INCIN							
5-01-001-01	MULTIPLE CHAMBER	30.0	2.50	2.00	1.50	35.0	TONS BURNED
5-01-001-02	SINGLE CHAMBER	15.0	2.50	2.00	15.0	20.0	TONS BURNED
OPEN BURNING DUMP							
5-01-002-01	GENERAL	16.0	1.00	6.00	30.0	85.0	TONS BURNED
5-01-002-02	LANDSCAPE/PRUNING	17.0		2.00	20.0	60.0	TONS BURNED
5-01-002-03	JET FUEL						HUNDREDS OF GALLONS
INCINERATOR							
5-01-005-05	PATHOLOGICAL	8.00	0.	3.00	0.	0.	TONS BURNED
5-01-005-06	SLUDGE	100.	1.00	5.00	1.00	0.	TONS DRY SLUDGE
5-01-005-07	CONICAL	20.0	2.00	5.00	20.0	60.0	TONS BURNED
5-01-005-99	OTHER/NOT CLASIFD						TONS BURNED
AUX.FUEL/NO EMSNS							
5-01-900-04	RESIDUAL OIL	0.	0.	0.	0.	0.	1000 GALLONS
5-01-900-05	DISTILLATE OIL	0.	0.	0.	0.	0.	1000 GALLONS
5-01-900-06	NATURAL GAS	0.	0.	0.	0.	0.	MILLION CUBIC FEET
5-01-900-10	LPG	0.	0.	0.	0.	0.	1000 GALLONS
5-01-900-97	OTHER/NOT CLASIFD	0.	0.	0.	0.	0.	MILLION CUBIC FEET
5-01-900-98	OTHER/NOT CLASIFD	0.	0.	0.	0.	0.	1000 GALLONS
5-01-900-99	OTHER/NOT CLASIFD	0.	0.	0.	0.	0.	TONS

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NATIONAL EMISSION DATA SYSTEM
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		POUNDS EMITTED PER UNIT					
		PART	SOX	NOX	HC	CO	UNITS
SOLID WASTE	-COMM-INST						
INCINERATOR GEN							
5-02-001-01	MULTIPLE CHAMBER	7.00	2.50	3.00	3.00	10.0	TONS BURNED
5-02-001-02	SINGLE CHAMBER	15.0	2.50	2.00	15.0	20.0	TONS BURNED
5-02-001-03	CONTROLLED AIR	1.40	1.50	10.0	0.	0.	TONS BURNED
5-02-001-04	CONICAL-REFUSE	20.0	2.00	5.00	20.0	60.0	TONS BURNED
5-02-001-05	CONICAL-WOOD	7.00	0.10	1.00	11.0	130.	TONS BURNED
OPEN BURNING							
5-02-002-01	WOOD	17.0		2.00	4.00	50.0	TONS BURNED
5-02-002-02	REFUSE						TONS BURNED
APARTMENT INCIN							
5-02-003-01	FLUE FED	30.0	0.50	3.00	15.0	20.0	TONS BURNED
5-02-003-02	FLUE FED-MODIFIED	6.00	0.50	10.0	3.00	10.0	TONS BURNED
INCINERATOR							
5-02-005-05	PATHOLOGICAL	8.00	0.	3.00	0.	0.	TONS BURNED
5-02-005-06	SLUDGE	100.	1.00	5.00	1.00	0.	TONS DRY SLUDGE
5-02-005-99	OTHER/NOT CLASIFD						TONS BURNED
AUX.FUEL/NO EMSNS							
5-02-900-04	RESIDUAL OIL	0.	0.	0.	0.	0.	1000 GALLONS
5-02-900-05	DISTILLATE OIL	0.	0.	0.	0.	0.	1000 GALLONS
5-02-900-06	NATURAL GAS	0.	0.	0.	0.	0.	MILLION CUBIC FEET
5-02-900-10	LPG	0.	0.	0.	0.	0.	1000 GALLONS
5-02-900-97	OTHER/NOT CLASIFD	0.	0.	0.	0.	0.	MILLION CUBIC FEET
5-02-900-98	OTHER/NOT CLASIFD	0.	0.	0.	0.	0.	1000 GALLONS
5-02-900-99	OTHER/NOT CLASIFD	0.	0.	0.	0.	0.	TONS
SOLID WASTE	-INDUSTRIAL						
INCINERATOR							
5-03-001-01	MULTIPLE CHAMBER	7.00	2.50	3.00	3.00	10.0	TONS BURNED
5-03-001-02	SINGLE CHAMBER	15.0	2.50	2.00	15.0	20.0	TONS BURNED
5-03-001-03	CONTROLLED AIR	1.40	1.50	10.0	0.	0.	TONS BURNED
5-03-001-04	CONICAL REFUSE	20.0	2.00	5.00	20.0	60.0	TONS BURNED
5-03-001-05	CONICAL WOOD	7.00	0.10	1.00	11.0	130.	TONS BURNED
5-03-001-06	OPEN PIT	13.0	0.10	4.00	0.	0.	TONS OF WASTE
OPEN BURNING							
5-03-002-01	WOOD	17.0	0.	2.00	4.00	50.0	TONS BURNED
5-03-002-02	REFUSE	16.0	1.00	6.00	30.0	85.0	TONS BURNED
5-03-002-03	AUTO BODY COMPTS	100.	0.	4.00	30.0	125.	TONS BURNED
5-03-002-04	COAL REFUSE PILES	0.90	1.10	0.10	0.50	2.50	CUBIC YARDS OF PILE
AUTO BODY INCINAT							
5-03-003-01	W/O AFTERBURNER	2.00		0.10	0.50	2.50	AUTOS BURNED
5-03-003-02	W/ AFTERBURNER	1.50		0.02	0.	0.	AUTOS BURNED
RAIL CAR BURNING							
5-03-004-01	OPEN						CARS BURNED
INCINERATOR							
5-03-005-06	SLUDGE	100.	1.00	5.00	1.00	0.	TONS DRY SLUDGE
5-03-005-99	OTHER/NOT CLASIFD						TONS BURNED
AUX.FUEL/NO EMSNS							
5-03-900-04	RESIDUAL OIL	0.	0.	0.	0.	0.	1000 GALLONS
5-03-900-05	DISTILLATE OIL	0.	0.	0.	0.	0.	1000 GALLONS
5-03-900-06	NATURAL GAS	0.	0.	0.	0.	0.	MILLION CUBIC FEET
5-03-900-07	PROCESS GAS	0.	0.	0.	0.	0.	MILLION CUBIC FEET
5-03-900-10	L P G	0.	0.	0.	0.	0.	1000 GALLONS
5-03-900-97	OTHER/NOT CLASIFD	0.	0.	0.	0.	0.	MILLION CUBIC FEET
5-03-900-98	OTHER/NOT CLASIFD	0.	0.	0.	0.	0.	1000 GALLONS
5-03-900-99	OTHER/NOT CLASIFD	0.	0.	0.	0.	0.	TONS
MISCELLANEOUS	-FEDRL NONEMITTERS						
OTHER/NOT CLASIFD							
6-01-999-98	SPECIFY IN REMARK						INSTALLATIONS (EACH)
6-01-999-99	SPECIFY IN REMARK						AREA/ACRES

'A' INDICATES THE ASH CONTENT, 'S' INDICATES THE SULFUR CONTENT OF THE FUEL ON A PERCENT BASIS (BY WEIGHT)

APPENDIX D
PROJECTED EMISSION FACTORS FOR HIGHWAY VEHICLES

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INTRODUCTION

In earlier editions of *Compilation of Air Pollutant Emission Factors* (AP-42), projected emission factors for highway vehicles were integrated with actual, measured emission factors. Measured emission factors are mean values arrived at through a testing program that involves a random statistical sample of in-use vehicles. Projected emission factors, on the other hand, are a conglomeration of measurements of emissions from prototype vehicles, best estimates based on applicable Federal standards, and, in some cases, outright educated guesses. In an attempt to make the user more aware of these differences, projected emission factors are separated from the main body of emission factors and presented as an appendix in this supplement to the report.

Measured emission estimates are updated annually at the conclusion of EPA's annual surveillance program. Projected emission factors, however, are updated when new data become available and not necessarily on a regular schedule. For several reasons, revisions to projected emission factors are likely to be necessary more frequently than on an annual basis. First, current legislation allows for limited time extensions for achieving the statutory motor vehicle emission standards. Second, Congressional action that would change the timetable for achieving these standards, the standards themselves, or both is likely in the future. Third, new data on catalyst-equipped (1975) automobiles are becoming available daily. As a result, the user of these data is encouraged to keep abreast of happenings likely to affect the data presented herein. Every attempt will be made to revise these data in a timely fashion when revisions become necessary.

This appendix contains mostly tables of data. Emission factor calculations are only briefly described because the more detailed discussion in Chapter 3 applies in nearly all cases. Any exceptions to this are noted. The reader is frequently referred to the text of Chapter 3; thus, it is recommended that a copy be close at hand.

Six vehicle categories encompassing all registered motor vehicles in use and projected to be in use on U.S. highways are dealt with in this appendix. The categories in order of presentation are:

1. Light-duty, gasoline-powered vehicles
2. Light-duty, gasoline-powered trucks
3. Light-duty, diesel-powered vehicles
4. Heavy-duty, gasoline-powered vehicles
5. Heavy-duty, diesel-powered vehicles
6. Motorcycles
7. All highway vehicles

D.1 LIGHT-DUTY, GASOLINE-POWERED VEHICLES

D.1.1 General

This vehicle category represents passenger cars, a major source of ambient levels of carbon monoxide, hydrocarbons, and nitrogen oxides in many areas of the United States. The reader is encouraged to become familiar with section 3.1.2, which discusses light-duty gasoline-powered vehicles in greater detail, before using the data presented here.

D.1.2 CO, HC, NO_x Exhaust Emissions

The calculation of projected composite emission factors is limited in this presentation to the Federal Test Procedure (FTP) methodology (see section 3.1.2). The modal technique is not, generally, amenable to absolute emission projections. A user who wants to quantify the projected emissions over a specific driving sequence can apply the modal technique to the 1972 calendar as discussed in section 3.1.2. A ratio of the 1972 calendar year modal emissions to the 1972 calendar year FTP emissions can be obtained, and this ratio can be applied to a projected FTP value to adjust for the specific driving cycle of interest.

The calculation of composite emission factors for light-duty vehicles using the FTP procedure is given by:

$$e_{npstwx} = \sum_{i=n-12}^{n} c_{ipn}\, m_{in}\, v_{ips}\, z_{ipt}\, r_{iptwx} \quad \text{(D1-1)}$$

where: e_{npstwx} = Composite emission factor in grams per mile (g/km) for calendar year (n), pollutant (p), average speed (s), ambient temperature (t), percentage cold operation (w), and percentage hot start operation (x)

c_{ipn} = The FTP mean emission factor for the i^{th} model year light-duty vehicles during calendar year (n) and for pollutant (p)

m_{in} = The fraction of annual travel by the i^{th} model year light-duty vehicles during calendar year (n)

v_{ips} = The speed correction factor for the i^{th} model year light-duty vehicles for pollutant (p), and average speed (s). This variable applies only to CO, HC, and NO_x.

z_{ipt} = The temperature correction for the i^{th} model year light-duty vehicles for pollutant (p) and ambient temperature (t)

r_{iptwx} = The hot/cold vehicle operation correction factor for the i^{th} model year light-duty vehicles for pollutant (p), ambient temperature (t), percentage cold operation (w), and percentage hot start operation (x).

The variable c_{ipn} is summarized in Tables D.1-1 through D.1-21, segregated by location (California, non-California, high altitude). The input m_{in} is described by example in Table D.1-22. The speed correction factors are presented in Tables D.1-23 and D.1-24.

The temperature correction and hot/cold vehicle operation correction factors, given in Table D.1-25, are separated into non-catalyst and catalyst correction factors. Catalyst correction factors should be applied for model years 1975-1977. For non-catalyst vehicles, the factors are the same as those presented in section 3.1.2.

For catalyst vehicles, emissions during the hot start phase of operation (vehicle start-up after a short--less than 1 hour--engine-off period) are greater than vehicle emissions during the hot stabilized phase. Therefore, the correction factor is a function of the percentage of cold operation, the percentage of hot start operation, and the ambient temperature(t).

$$r_{iptw} = \frac{w + (100\text{-}w)f(t)}{20 + 80\,f(t)} \quad \text{Pre-1975 model years} \qquad (D1\text{-}2)$$

$$r_{iptwx} = \frac{w + x\,f(t) + (100\text{-}w\text{-}x)\,g(t)}{20 + 27\,f(t) + 53\,g(t)} \quad \text{Post-1974 model years} \qquad (D1\text{-}3)$$

Table D.1-1. CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR LIGHT-DUTY, GASOLINE-POWERED VEHICLES--EXCLUDING CALIFORNIA--FOR CALENDAR YEAR 1973 (BASED ON 1975 FEDERAL TEST PROCEDURE)

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low altitude						
Pre-1968	94.0	58.4	8.8	5.5	3.34	2.07
1968	67.6	42.0	6.8	4.2	4.32	2.68
1969	65.4	40.6	5.3	3.3	5.08	3.15
1970	56.0	34.8	5.3	3.3	4.35	2.70
1971	53.5	33.2	4.3	2.7	4.30	2.67
1972	39.0	24.2	3.5	2.2	4.55	2.83
1973	37.0	23.0	3.2	2.0	3.1	1.9
High altitude						
Pre-1968	143	88.8	12.0	7.5	2.0	1.2
1968	106	65.8	7.6	4.7	2.86	1.77
1969	101	62.7	6.6	4.1	2.93	1.82
1970	91.0	56.5	6.0	3.7	3.32	2.06
1971	84.0	52.2	5.7	3.5	2.74	1.70
1972	84.0	52.2	5.2	3.2	3.08	1.91
1973	80.0	49.7	4.7	2.9	3.1	1.93

Table D.1-2. CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR LIGHT-DUTY, GASOLINE-POWERED VEHICLES--STATE OF CALIFORNIA ONLY--FOR CALENDAR YEAR 1973 (BASED ON 1975 FEDERAL TEST PROCEDURE)

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
California						
Pre-1966	94.0	58.4	8.8	5.5	3.34	2.07
1966	81.0	50.3	6.5	4.0	3.61	2.24
1967	81.0	50.3	6.5	4.0	3.61	2.24
1968	67.6	42.0	6.8	4.2	4.32	2.68
1969	65.4	40.6	5.3	3.3	5.08	3.15
1970	56.0	34.8	5.3	3.3	4.35	2.70
1971	53.5	33.2	4.3	2.7	3.83	2.38
1972	49.0	30.4	3.9	2.4	3.81	2.37
1973	37.0	23.0	3.2	2.0	3.1	1.9

Table D.1-3. CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR LIGHT-DUTY, GASOLINE-POWERED VEHICLES—EXCLUDING CALIFORNIA—FOR CALENDAR YEAR 1974 (BASED ON 1975 FEDERAL TEST PROCEDURE)

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low altitude						
Pre-1968	95.0	59.0	8.9	5.5	3.34	2.07
1968	70.6	43.8	7.4	4.6	4.32	2.68
1969	68.4	42.5	5.8	3.6	5.08	3.15
1970	58.5	36.3	5.8	3.6	4.35	2.70
1971	56.0	34.8	4.7	2.9	4.30	2.67
1972	41.0	25.5	3.8	2.4	4.55	2.83
1973	39.0	24.2	3.5	2.2	3.3	2.0
1974	37.0	23.0	3.2	2.0	3.1	1.9
High altitude						
Pre-1968	145	90.0	12.1	7.5	2.0	1.2
1968	111	68.9	8.3	5.2	2.86	1.78
1969	106	65.8	7.2	4.5	2.93	1.82
1970	95.0	59.0	6.6	4.1	3.32	2.06
1971	88.0	54.6	6.2	3.9	2.74	1.70
1972	88.0	54.6	5.7	3.5	3.08	1.91
1973	84.0	52.2	5.2	3.2	3.3	2.05
1974	80.0	49.7	4.7	2.9	3.1	1.9

Table D.1-4. CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR LIGHT-DUTY, GASOLINE-POWERED VEHICLES—STATE OF CALIFORNIA ONLY—FOR CALENDAR YEAR 1974 (BASED ON 1975 FEDERAL TEST PROCEDURE)

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
California						
Pre-1966	95.0	59.0	8.9	5.5	3.34	2.07
1966	82.0	50.9	7.1	4.4	3.61	2.24
1967	82.0	50.9	7.1	4.4	3.61	2.24
1968	70.6	43.8	7.4	4.6	4.32	2.68
1969	68.4	42.5	5.8	3.6	5.08	3.15
1970	58.5	36.3	5.8	3.6	4.35	2.70
1971	56.0	34.8	4.7	2.9	3.83	2.38
1972	51.0	31.7	4.2	2.6	3.81	2.37
1973	39.0	24.2	3.5	2.2	3.3	2.05
1974	37.0	23.0	3.2	2.0	2.0	1.2

Table D.1-5. CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR LIGHT-DUTY, GASOLINE-POWERED VEHICLES—EXCLUDING CALIFORNIA—FOR CALENDAR YEAR 1975 (BASED ON 1975 FEDERAL TEST PROCEDURE)

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low altitude						
Pre-1968	96.0	59.6	9.0	5.6	3.34	2.07
1968	73.6	45.7	8.0	5.0	4.32	2.68
1969	71.4	44.3	6.3	3.9	5.08	3.15
1970	61.0	37.9	6.3	3.9	4.35	2.70
1971	58.5	36.3	5.1	3.2	4.30	2.67
1972	43.0	26.7	4.1	2.5	4.55	2.83
1973	41.0	25.5	3.8	2.4	3.5	2.2
1974	39.0	24.2	3.5	2.2	3.3	2.0
1975	9.0	5.6	1.0	0.6	3.1	1.9
High altitude						
Pre-1968	147	91.3	12.2	7.6	2.0	1.2
1968	116	72.0	9.0	5.6	2.86	1.78
1969	111	68.9	7.8	4.8	2.93	1.82
1970	99.0	61.5	7.2	4.5	3.32	2.06
1971	92.0	57.1	6.7	4.2	2.74	1.70
1972	92.0	57.1	6.2	3.9	3.08	1.91
1973	88.0	54.6	5.7	3.5	3.5	2.17
1974	84.0	52.2	5.2	3.2	3.3	2.05
1975	19.5	12.1	1.46	0.91	3.1	1.9

Table D.1-6. CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR LIGHT-DUTY, GASOLINE-POWERED VEHICLES—STATE OF CALIFORNIA ONLY—FOR CALENDAR YEAR 1975 (BASED ON 1975 FEDERAL TEST PROCEDURE)

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
California						
Pre-1966	96.0	59.6	9.0	5.6	3.34	2.07
1966	83.0	51.5	7.7	4.8	3.61	2.24
1967	83.0	51.5	7.7	4.8	3.61	2.24
1968	73.6	45.7	8.0	5.0	4.32	2.68
1969	71.4	44.3	6.3	3.9	5.08	3.15
1970	61.0	37.9	6.3	3.9	4.35	2.70
1971	58.5	36.3	5.1	3.2	3.83	2.38
1972	53.0	32.9	4.5	2.8	3.81	2.37
1973	41.0	25.5	3.8	2.4	3.5	2.17
1974	39.0	24.2	3.5	2.2	2.06	1.28
1975	5.4	3.4	0.6	0.4	2.0	1.2

Table D.1-7. CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR LIGHT-DUTY, GASOLINE-POWERED VEHICLES– EXCLUDING CALIFORNIA–FOR CALENDAR YEAR 1976 (BASED ON 1975 FEDERAL TEST PROCEDURE)

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low altitude						
Pre-1968	97.0	60.2	9.1	5.7	3.34	2.07
1968	76.6	47.6	8.6	5.3	4.32	2.86
1969	74.4	46.2	6.8	4.2	5.08	3.15
1970	63.5	39.4	6.8	4.2	4.35	2.70
1971	61.0	37.9	5.5	3.4	4.30	2.67
1972	45.0	27.9	4.4	2.7	4.55	2.83
1973	43.0	26.7	4.1	2.5	3.7	2.3
1974	41.0	25.5	3.8	2.4	3.5	2.2
1975	9.9	6.1	1.20	0.75	3.2	2.0
1976	9.0	5.6	1.0	0.6	3.1	1.9
High altitude						
Pre-1968	149	92.5	12.3	7.6	2.0	1.2
1968	121	75.1	9.7	6.0	2.86	1.78
1969	116	72.0	8.4	5.2	2.93	1.82
1970	103	64.0	7.8	4.8	3.32	2.06
1971	96.0	59.6	7.2	4.5	2.74	1.70
1972	96.0	59.6	6.7	4.2	3.08	1.91
1973	92.0	57.1	6.2	3.9	3.7	2.3
1974	88.0	54.6	5.7	3.5	3.5	2.2
1975	21.5	13.4	1.76	1.09	3.2	2.0
1976	19.5	12.1	1.46	0.91	3.1	1.9

Table D.1-8. CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR LIGHT-DUTY, GASOLINE-POWERED VEHICLES– STATE OF CALIFORNIA ONLY–FOR CALENDAR YEAR 1976 (BASED ON 1975 FEDERAL TEST PROCEDURE)

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
California						
Pre-1966	97.0	60.2	9.1	5.7	3.34	2.07
1966	84.0	52.2	8.3	5.2	3.61	2.24
1967	84.0	52.2	8.3	5.2	3.61	2.24
1968	76.6	47.6	8.6	5.3	4.32	2.68
1969	74.4	46.2	6.8	4.2	5.08	3.15
1970	63.5	39.4	6.8	4.2	4.35	2.70
1971	61.0	37.9	5.5	3.4	3.83	2.37
1972	55.0	34.2	4.8	3.0	3.81	2.37
1973	43.0	26.7	4.1	2.5	3.7	2.30
1974	41.0	25.5	3.8	2.4	2.12	1.32
1975	5.9	3.7	0.7	0.4	2.06	1.28
1976	5.4	3.4	0.6	0.4	2.0	1.24

Table D.1-9. CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR LIGHT-DUTY, GASOLINE-POWERED VEHICLES–EXCLUDING CALIFORNIA–FOR CALENDAR YEAR 1977 (BASED ON 1975 FEDERAL TEST PROCEDURE)

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low altitude						
Pre-1968	98.0	60.9	9.2	5.7	3.34	2.07
1968	79.6	49.4	9.2	5.7	4.32	2.68
1969	77.4	48.1	7.3	4.5	5.08	3.15
1970	66.0	41.0	7.3	4.5	4.35	2.70
1971	63.5	39.4	5.9	3.7	4.30	2.67
1972	47.0	29.2	4.7	2.9	4.55	2.83
1973	45.0	27.9	4.4	2.7	3.9	2.4
1974	43.0	26.7	4.1	2.5	3.7	2.3
1975	10.8	6.7	1.4	0.9	3.3	2.0
1976	9.9	6.1	1.2	0.7	3.2	2.0
1977	9.0	5.6	1.0	0.6	2.0	1.2
High altitude						
Pre-1968	151	93.8	12.4	7.7	2.0	1.2
1968	126	78.2	10.4	6.5	2.86	1.78
1969	121	75.1	9.0	5.6	2.93	1.82
1970	107	66.4	8.4	5.2	3.32	2.06
1971	100	62.1	7.7	4.8	2.74	1.70
1972	100	62.1	7.2	4.5	3.08	1.91
1973	96.0	59.6	6.7	4.2	3.9	2.4
1974	92.0	57.1	6.2	3.9	3.7	2.3
1975	23.5	14.6	2.06	1.28	3.3	2.0
1976	21.5	13.4	1.76	1.09	3.2	2.0
1977	9.0	5.6	1.0	0.6	2.0	1.2

Table D.1-10. CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR LIGHT-DUTY, GASOLINE-POWERED VEHICLES–STATE OF CALIFORNIA ONLY–FOR CALENDAR YEAR 1977 (BASED ON 1975 FEDERAL TEST PROCEDURE)

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
California						
Pre-1966	98.0	60.9	9.2	5.7	3.34	2.07
1966	85.0	52.8	9.0	5.6	3.61	2.24
1967	85.0	52.8	9.0	5.6	3.61	2.24
1968	79.6	49.4	9.2	5.7	4.32	2.68
1969	77.4	48.1	7.3	4.5	5.08	3.15
1970	66.0	41.0	7.3	4.5	4.35	2.70
1971	63.5	39.4	5.9	3.7	3.83	2.38
1972	57.0	35.4	5.1	3.2	3.81	2.37
1973	45.0	27.9	4.4	2.7	3.9	2.4
1974	43.0	26.7	4.1	2.5	2.18	1.35
1975	6.5	4.0	0.8	0.5	2.12	1.32
1976	5.9	3.7	0.7	0.4	2.06	1.28
1977	5.4	3.4	0.6	0.4	1.5	0.93

Table D.1-11. CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR LIGHT-DUTY, GASOLINE-POWERED VEHICLES– EXCLUDING CALIFORNIA–FOR CALENDAR YEAR 1978 (BASED ON 1975 FEDERAL TEST PROCEDURE)

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low altitude						
Pre-1968	99.0	61.5	9.3	5.8	3.34	2.07
1968	82.6	51.3	9.3	5.8	4.32	2.68
1969	80.4	49.9	7.8	4.8	5.08	3.15
1970	68.5	42.5	7.8	4.8	4.35	2.70
1971	66.0	41.0	6.3	3.9	4.30	2.67
1972	49.0	30.4	5.0	3.1	4.55	2.83
1973	47.0	29.2	4.7	2.9	4.1	2.5
1974	45.0	27.9	4.4	2.7	3.9	2.4
1975	11.7	7.3	1.6	1.0	3.4	2.1
1976	10.8	6.7	1.4	0.9	3.3	2.0
1977	9.9	6.1	1.2	0.7	2.06	1.3
1978	2.8	1.7	0.27	0.17	0.24	0.15
High altitude						
Pre-1968	153	95	12.5	7.8	2.0	1.2
1968	131	81.4	11.1	6.9	2.86	1.78
1969	126	78.2	9.6	6.0	2.93	1.82
1970	111	68.9	9.0	5.6	3.32	2.06
1971	104	64.6	8.2	5.1	2.74	1.70
1972	104	64.6	7.7	4.8	3.08	1.91
1973	100	62.1	7.2	4.5	4.1	2.5
1974	96.0	59.6	6.7	4.2	3.9	2.4
1975	25.5	15.8	2.36	1.47	3.4	2.1
1976	23.5	14.6	2.06	1.28	3.3	2.0
1977	9.9	6.1	1.2	0.6	2.06	1.3
1978	2.8	1.7	0.27	0.17	0.24	0.15

Table D.1-12. CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR LIGHT-DUTY, GASOLINE-POWERED VEHICLES– STATE OF CALIFORNIA ONLY–FOR CALENDAR YEAR 1978 (BASED ON 1975 FEDERAL TEST PROCEDURE)

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
California						
Pre-1966	99.0	61.5	9.3	5.8	3.34	2.07
1966	85.0	52.8	9.0	5.6	3.61	2.24
1967	85.0	52.8	9.0	5.6	3.61	2.24
1968	82.6	51.3	9.3	5.8	4.32	2.68
1969	80.4	49.9	7.8	4.8	5.08	3.15
1970	68.5	42.5	7.8	4.8	4.35	2.70
1971	66.0	41.0	6.3	3.9	3.83	2.38
1972	59.0	36.6	5.4	3.4	3.81	2.37
1973	47.0	29.2	4.7	2.9	4.1	2.55
1974	45.0	27.9	4.4	2.7	2.24	1.39
1975	7.0	4.3	1.0	0.6	2.18	1.35
1976	6.5	4.0	0.8	0.5	2.12	1.32
1977	5.9	3.7	0.7	0.4	1.56	0.97
1978	2.8	1.7	0.27	0.17	0.24	0.15

Table D.1-13. CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR LIGHT-DUTY, GASOLINE-POWERED VEHICLES—EXCLUDING CALIFORNIA—FOR CALENDAR YEAR 1979 (BASED ON 1975 FEDERAL TEST PROCEDURE)

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low altitude						
Pre-1968	99.0	61.5	9.3	5.8	3.34	2.07
1968	82.6	51.3	9.3	5.8	4.32	2.68
1969	83.4	51.8	8.3	5.2	5.08	3.15
1970	71.0	44.1	8.3	5.2	4.35	2.70
1971	68.5	42.5	6.7	4.2	4.30	2.67
1972	51.0	31.7	5.3	3.3	4.55	2.83
1973	49.0	30.4	5.0	3.1	4.3	2.7
1974	47.0	29.2	4.7	2.9	4.1	2.5
1975	12.6	7.8	1.8	1.1	3.5	2.2
1976	11.7	7.3	1.6	1.0	3.4	2.1
1977	10.8	6.7	1.4	0.9	2.12	1.32
1978	3.1	1.9	0.32	0.20	0.29	0.18
1979	2.8	1.7	0.27	0.17	0.24	0.15
High altitude						
Pre-1968	153	95.0	12.5	7.8	2.00	1.20
1968	131	81.4	11.1	6.9	2.86	1.78
1969	131	81.4	10.2	6.3	2.93	1.82
1970	115	71.4	9.6	6.0	3.32	2.06
1971	108	67.1	8.7	5.4	2.74	1.70
1972	108	67.1	8.2	5.1	3.08	1.91
1973	104	64.6	7.7	4.8	4.3	2.7
1974	100	62.1	7.2	4.5	4.1	2.5
1975	27.5	17.1	2.66	1.65	3.5	2.2
1976	25.5	15.8	2.36	1.47	3.4	2.1
1977	10.8	6.7	1.4	0.9	2.12	1.32
1978	3.1	1.9	0.32	0.20	0.29	0.18
1979	2.8	1.7	0.27	0.17	0.24	0.15

Table D.1-14. CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR LIGHT-DUTY, GASOLINE-POWERED VEHICLES—STATE OF CALIFORNIA ONLY—FOR CALENDAR YEAR 1979 (BASED ON 1975 FEDERAL TEST PROCEDURE)

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
California						
1966	85.0	52.8	9.0	5.6	3.61	2.24
1967	85.0	52.8	9.0	5.6	3.61	2.24
1968	82.6	51.3	9.3	5.8	4.32	2.68
1969	83.4	51.8	8.3	5.2	5.08	3.15
1970	71.0	44.1	8.3	5.2	4.35	2.70
1971	68.5	42.5	6.7	4.2	3.83	2.38
1972	61.0	37.9	5.7	3.5	3.81	2.37
1973	49.0	30.4	5.0	3.1	4.30	2.70
1974	47.0	29.2	4.7	2.9	2.30	1.43
1975	7.6	4.7	1.1	0.7	2.24	1.39
1976	7.0	4.3	1.0	0.6	2.18	1.35
1977	6.5	4.0	0.8	0.5	1.62	1.01
1978	3.1	1.9	0.32	0.20	0.29	0.18
1979	2.8	1.7	0.27	0.17	0.24	0.15

Table D.1-15. CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR LIGHT-DUTY, GASOLINE-POWERED VEHICLES–EXCLUDING CALIFORNIA–FOR CALENDAR YEAR 1980 (BASED ON 1975 FEDERAL TEST PROCEDURE)

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low altitude						
Pre-1968	99.0	61.5	9.3	5.8	3.34	2.07
1968	82.6	51.3	9.3	5.8	4.32	2.68
1969	83.4	51.8	8.3	5.2	5.08	3.15
1970	73.5	45.6	8.8	5.5	4.35	2.70
1971	71.0	44.1	7.1	4.4	4.30	2.67
1972	53.0	32.9	5.6	3.5	4.55	2.83
1973	51.0	31.7	5.3	3.3	4.5	2.8
1974	49.0	30.4	5.0	3.1	4.3	2.7
1975	13.5	8.4	2.0	1.2	3.6	2.2
1976	12.6	7.8	1.8	1.1	3.5	2.2
1977	11.7	7.3	1.6	1.0	2.18	1.35
1978	3.4	2.1	0.38	0.24	0.34	0.21
1979	3.1	1.9	0.32	0.20	0.29	0.18
1980	2.8	1.7	0.27	0.17	0.24	0.15
High altitude						
Pre-1968	153	95.0	12.5	7.8	2.0	1.2
1968	131	81.4	11.1	6.9	2.86	1.78
1969	131	81.4	10.2	6.3	2.93	1.82
1970	119	73.9	10.2	6.3	3.32	2.06
1971	112	69.6	9.2	5.7	2.74	1.70
1972	112	69.6	8.7	5.4	3.08	1.91
1973	108	67.1	8.2	5.1	4.5	2.8
1974	104	64.6	7.7	4.8	4.3	2.7
1975	29.5	18.3	2.96	1.84	3.6	2.2
1976	27.5	17.1	2.66	1.65	3.5	2.2
1977	11.7	7.3	1.6	1.0	2.18	1.35
1978	3.4	2.1	0.38	0.24	0.34	0.21
1979	3.1	1.9	0.32	0.20	0.29	0.18
1980	2.8	1.7	0.27	0.17	0.24	0.15

Table D.1-16. CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR LIGHT-DUTY, GASOLINE-POWERED VEHICLES–STATE OF CALIFORNIA ONLY–FOR CALENDAR YEAR 1980 (BASED ON 1975 FEDERAL TEST PROCEDURE)

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
California						
1967	85.0	52.8	9.0	5.6	3.61	2.24
1968	82.6	51.3	9.3	5.8	4.32	2.68
1969	83.4	51.8	8.3	5.2	5.08	3.15
1970	73.5	45.6	8.8	5.5	4.35	2.70
1971	71.0	44.1	7.1	4.4	3.83	2.38
1972	63.0	39.1	6.0	3.7	3.81	2.37
1973	51.0	31.7	5.3	3.3	4.50	2.79
1974	49.0	30.4	5.0	3.1	2.36	1.47
1975	8.1	5.0	1.2	0.7	2.30	1.43
1976	7.6	4.7	1.1	0.7	2.24	1.39
1977	7.0	4.3	1.0	0.6	1.68	1.04
1978	3.4	2.1	0.38	0.24	0.34	0.21
1979	3.1	1.9	0.32	0.20	0.29	0.18
1980	2.8	1.7	0.27	0.17	0.24	0.15

Table D.1-17. CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR LIGHT-DUTY, GASOLINE-POWERED VEHICLES– EXCLUDING CALIFORNIA–FOR CALENDAR YEAR 1985 (BASED ON 1975 FEDERAL TEST PROCEDURE)

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low altitude						
1972	57.0	35.4	6.2	3.9	4.55	2.83
1973	57.0	35.4	6.2	3.9	5.0	3.1
1974	57.0	35.4	6.2	3.9	5.0	3.1
1975	18.0	11.2	3.0	1.9	4.1	2.5
1976	17.1	10.6	2.8	1.7	4.0	2.5
1977	16.2	10.1	2.6	1.6	2.48	1.54
1978	4.8	3.0	0.65	0.40	1.1	0.68
1979	4.5	2.8	0.59	0.37	0.90	0.56
1980	4.2	2.6	0.54	0.34	0.73	0.45
1981	3.9	2.4	0.49	0.30	0.56	0.35
1982	3.6	2.2	0.43	0.27	0.40	0.25
1983	3.4	2.1	0.38	0.24	0.34	0.21
1984	3.1	1.9	0.32	0.20	0.29	0.18
1985	2.8	1.7	0.27	0.17	0.24	0.15
High altitude						
1972	120	74.5	9.7	6.0	3.08	1.91
1973	120	74.5	9.7	6.0	5.0	3.1
1974	120	74.5	9.7	6.0	5.0	3.1
1975	39.5	24.5	3.46	2.15	4.1	2.5
1976	37.5	23.3	3.16	1.96	4.0	2.5
1977	16.2	10.1	2.60	1.60	2.48	1.54
1978	4.8	3.0	0.65	0.40	1.00	0.68
1979	4.5	2.8	0.59	0.37	0.90	0.56
1980	4.2	2.6	0.54	0.34	0.73	0.45
1981	3.9	2.4	0.49	0.30	0.56	0.35
1982	3.6	2.2	0.43	0.27	0.40	0.25
1983	3.4	2.1	0.38	0.24	0.34	0.21
1984	3.1	1.9	0.32	0.20	0.29	0.18
1985	2.8	1.7	0.27	0.17	0.24	0.15

Table D.1-18. CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR LIGHT-DUTY, GASOLINE-POWERED VEHICLES– STATE OF CALIFORNIA ONLY–FOR CALENDAR YEAR 1985 (BASED ON 1975 FEDERAL TEST PROCEDURE)

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
California						
1972	67.0	41.6	6.6	4.1	3.81	2.37
1973	57.0	35.4	6.2	3.9	5.0	3.1
1974	57.0	35.4	6.2	3.9	2.60	1.61
1975	10.8	6.7	1.8	1.1	2.60	1.61
1976	10.3	6.4	1.7	1.1	2.54	1.58
1977	9.7	6.0	1.6	1.0	1.98	1.23
1978	4.8	3.0	0.65	0.40	1.1	0.68
1979	4.5	2.8	0.59	0.37	0.90	0.56
1980	4.2	2.6	0.54	0.34	0.73	0.45
1981	3.9	2.4	0.49	0.30	0.56	0.35
1982	3.6	2.2	0.43	0.27	0.40	0.25
1983	3.4	2.1	0.38	0.24	0.34	0.21
1984	3.1	1.9	0.32	0.20	0.29	0.18
1985	2.8	1.7	0.27	0.17	0.24	0.15

Table D.1-19. CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR LIGHT-DUTY, GASOLINE-POWERED VEHICLES—EXCLUDING CALIFORNIA—FOR CALENDAR YEAR 1990 (BASED ON 1975 FEDERAL TEST PROCEDURE)

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low and high altitude						
1977	18.0	11.2	3.0	1.9	2.6	1.6
1978	5.6	3.6	0.81	0.50	1.70	1.06
1979	5.6	3.6	0.81	0.50	1.70	1.06
1980	5.6	3.6	0.81	0.50	1.70	1.06
1981	5.3	3.3	0.76	0.47	1.50	0.93
1982	5.0	3.1	0.70	0.43	1.30	0.81
1983	4.8	3.0	0.65	0.40	1.10	0.68
1984	4.5	2.8	0.59	0.37	0.90	0.56
1985	4.2	2.6	0.54	0.34	0.73	0.45
1986	3.9	2.4	0.49	0.30	0.56	0.35
1987	3.6	2.2	0.43	0.27	0.40	0.25
1988	3.4	2.1	0.38	0.24	0.34	0.21
1989	3.1	1.9	0.32	0.20	0.29	0.18
1990	2.8	1.7	0.27	0.17	0.24	0.15

Table D.1-20. CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR LIGHT-DUTY, GASOLINE-POWERED VEHICLES—STATE OF CALIFORNIA ONLY—FOR CALENDAR YEAR 1990 (BASED ON 1975 FEDERAL TEST PROCEDURE)

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
California						
1977	10.8	6.7	1.8	1.1	2.10	1.30
1978	5.6	3.5	0.81	0.50	1.70	1.06
1979	5.6	3.5	0.81	0.50	1.70	1.06
1980	5.6	3.5	0.81	0.50	1.70	1.06
1981	5.3	3.3	0.76	0.47	1.50	0.93
1982	5.0	3.1	0.70	0.43	1.30	0.81
1983	4.8	3.0	0.65	0.40	1.10	0.68
1984	4.5	2.8	0.59	0.37	0.90	0.56
1985	4.2	2.6	0.54	0.34	0.73	0.45
1986	3.9	2.4	0.49	0.30	0.56	0.35
1987	3.6	2.2	0.43	0.27	0.40	0.25
1988	3.4	2.1	0.38	0.24	0.34	0.21
1989	3.1	1.9	0.32	0.20	0.29	0.18
1990	2.8	1.7	0.27	0.17	0.24	0.15

Table D.1-21. PARTICULATE, SULFURIC ACID, AND TOTAL SULFUR OXIDES EMISSION FACTORS FOR LIGHT-DUTY, GASOLINE-POWERED VEHICLES

Pollutant	Emission factors		
	Non-catalyst (Leaded fuel)	Non-catalyst (Unleaded fuel)	Catalyst (Unleaded fuel)
Particulate			
Exhaust[a]			
g/mi	0.34	0.05	0.05
g/km	0.21	0.03	0.03
Tire wear			
g/mi	0.20	0.20	0.20
g/km	0.12	0.12	0.12
Sulfuric acid			
g/mi	0.001	0.001	0.02-0.06[b]
g/km	0.001	0.001	0.01-0.04
Total sulfur oxides			
g/mi	0.13	0.13	0.13
g/km	0.08	0.08	0.08

[a]Excluding particulate sulfate or sulfuric acid aerosol.
[b]Sulfuric acid emission varies markedly with driving mode and fuel sulfur levels.

Table D.1-22. SAMPLE CALCULATION OF FRACTION OF ANNUAL LIGHT-DUTY VEHICLE TRAVEL BY MODEL YEAR[a]

Age, years	Fraction of total vehicles in use nationwide (a)[b]	Average annual miles driven (b)[c]	a x b	Fraction of annual travel (m)[d]
1	0.081	15,900	1,288	0.112
2	0.110	15,000	1,650	0.143
3	0.107	14,000	1,498	0.130
4	0.106	13,100	1,389	0.121
5	0.102	12,200	1,244	0.108
6	0.096	11,300	1,085	0.094
7	0.088	10,300	906	0.079
8	0.077	9,400	724	0.063
9	0.064	8,500	544	0.047
10	0.049	7,600	372	0.032
11	0.033	6,700	221	0.019
12	0.023	6,700	154	0.013
$\geq$13	0.064	6,700	429	0.039

[a]References 1 through 6.
[b]These data are for July 1. Data from References 2-6 were averaged to produce a value for m that is better suited for projections.
[c]Mileage values are the results of at least squares analysis of data in Reference 1.
[d]$m = ab/\Sigma ab$.

Table D.1-23. COEFFICIENTS FOR SPEED CORRECTION FACTORS FOR LIGHT-DUTY VEHICLES[a,b]

Location	Model year	$v_{ips} = e^{(A + BS + CS^2)}$						$v_{ips} = A + BS$	
		Hydrocarbons			Carbon monoxide			Nitrogen oxides	
		A	B	C	A	B	C	A	B
Low altitude (Excluding 1966-1967 Calif.)	1957-1967	0.953	-6.00×10^{-2}	5.81×10^{-4}	0.967	-6.07×10^{-2}	5.78×10^{-4}	0.808	0.980×10^{-2}
California	1966-1967	0.957	-5.98×10^{-2}	5.63×10^{-4}	0.981	-6.22×10^{-2}	6.19×10^{-4}	0.844	0.798×10^{-2}
Low altitude	1968	1.070	-6.63×10^{-2}	5.98×10^{-4}	1.047	-6.52×10^{-2}	6.01×10^{-4}	0.888	0.569×10^{-2}
	1969	1.005	-6.27×10^{-2}	5.80×10^{-4}	1.259	-7.72×10^{-2}	6.60×10^{-4}	0.915	0.432×10^{-2}
	1970	0.901	-5.70×10^{-2}	5.59×10^{-4}	1.267	-7.72×10^{-2}	6.40×10^{-4}	0.843	0.798×10^{-2}
	Post-1970	0.943	-5.92×10^{-2}	5.67×10^{-4}	1.241	-7.52×10^{-2}	6.09×10^{-4}	0.843	0.804×10^{-2}
High altitude	1957-1967	0.883	-5.58×10^{-2}	5.52×10^{-4}	0.721	-4.57×10^{-2}	4.56×10^{-4}	0.602	2.027×10^{-2}
	1968	0.722	-4.63×10^{-2}	4.80×10^{-4}	0.662	-4.23×10^{-2}	4.33×10^{-4}	0.642	1.835×10^{-2}
	1969	0.706	-4.55×10^{-2}	4.84×10^{-4}	0.628	-4.04×10^{-2}	4.26×10^{-4}	0.726	1.403×10^{-2}
	1970	0.840	-5.33×10^{-2}	5.33×10^{-4}	0.835	-5.24×10^{-2}	4.98×10^{-4}	0.614	1.978×10^{-2}
	Post-1970	0.787	-4.99×10^{-2}	4.99×10^{-4}	0.894	-5.54×10^{-2}	4.99×10^{-4}	0.697	1.553×10^{-2}

[a]Reference 7. Equations should not be extended beyond the range of the data (15 to 45 mi/hr; 24 to 72 km/hr). For speed correction factors at low speeds (5 and 10 mi/hr; 8 and 16 km/hr) see Table D.1-24.

[b]The speed correction factor equations and coefficients presented in this table are expressed in terms of english units (miles per hour). In order to perform calculations using the metric system of units, it is suggested that kilometers per hour be first converted to miles per hour (1 km/hr = 0.621 mi/hr). Once speed correction factors are determined, all other calculations can be performed using metric units.

Table D.1-24. LOW AVERAGE SPEED CORRECTION FACTORS FOR LIGHT-DUTY VEHICLES[a]

Location	Model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
		5 mi/hr (8 km/hr)	10 mi/hr (16 km/hr)	5 mi/hr (8 km/hr)	10 mi/hr (16 km/hr)	5 mi/hr (8 km/hr)	10 mi/hr (16 km/hr)
Low altitude (Excluding 1966-1967 Calif.)	1957-1967	2.72	1.57	2.50	1.45	1.08	1.03
California	1966-1967	1.79	1.00	1.87	1.12	1.16	1.09
Low altitude	1968	3.06	1.75	2.96	1.66	1.04	1.00
	1969	3.57	1.86	2.95	1.65	1.08	1.05
	1970	3.60	1.88	2.51	1.51	1.13	1.05
	Post-1970	4.15	2.23	2.75	1.63	1.15	1.03
High altitude	1957-1967	2.29	1.48	2.34	1.37	1.33	1.20
	1968	2.43	1.54	2.10	1.27	1.22	1.18
	1969	2.47	1.61	2.04	1.22	1.22	1.08
	1970	2.84	1.72	2.35	1.36	1.19	1.11
	Post-1970	3.00	1.83	2.17	1.35	1.06	1.02

[a]Driving patterns developed from CAPE-21 vehicle operation data (Reference 8) were input to the modal emission analysis model (see section 3.1.2.3). The results predicted by the model (emissions at 5 and 10 mi/hr; 8 and 16 km/hr) were divided by FTP emission factors for hot operation to obtain the above results. The above data are approximate and represent the best currently available information.

Table D.1-25. LIGHT-DUTY VEHICLE TEMPERATURE CORRECTION FACTORS AND HOT/COLD VEHICLE OPERATION CORRECTION FACTORS FOR FTP EMISSION FACTORS[a]

Pollutant and controls	Temperature correction factor (z_{ipt})[b]	Hot/cold vehicle operation correction factors	
		g(t)	f(t)
Carbon monoxide			
Non-catalyst	$-0.0127t + 1.95$	–	$0.0045t + 0.02$
Catalyst	$-0.0743t + 6.58$	$e^{0.035t - 5.24}$	$e^{0.036t - 4.14}$
Hydrocarbons			
Non-catalyst	$-0.0113t + 1.81$	–	$0.0079t + 0.03$
Catalyst	$-0.0304t + 3.25$	$0.0018t + 0.0095$	$0.0050t - 0.0409$
Nitrogen oxides			
Non-catalyst	$-0.0046t + 1.36$	–	$-0.0068t + 1.64$
Catalyst	$-0.0060t + 1.52$	$-0.0010t + 0.858$	$0.0010t + 0.835$

[a]Reference 9. Temperature (t) is expressed in °F. In order to apply the above equations, °C must first be converted to °F (F= 9/5C +32). Similarly °Kelvin (K) must be converted to °F (F= 9/5(K-273.16)+32).
[b]The formulae for z_{ipt} enable the correction of FTP emission factors for ambient temperature. The formulae for f(t) are used in conjunction with Equation D1-2 to calculate r_{iptw}. If the variable r_{iptw} is used in Equation D1-1, z_{ipt} must be used also.

where: f(t) and g(t) are given in Table D.1-25, w is the percentage of cold operation, and x is the percentage of hot start operation. For pre-1975 model year vehicles, non-catalyst factors should be used. For 1975-1977, catalyst factors should be used.

The use of catalysts after 1978 is uncertain at present. For model years 1979 and beyond, the use of those correction factors that produce the highest emission estimates is suggested in order that emissions are not underestimated. The extent of use of catalysts in 1977 and 1978 will depend on the impact of the 1979 sulfuric acid emission standard, which cannot now be predicted.

D.1.3 Crankcase and Evaporative Hydrocarbon Emission Factors

In addition to exhaust emission factors, the calculation of hydrocarbon emissions from gasoline motor vehicles involves evaporative and crankcase hydrocarbon emission factors. Composite crankcase emissions can be determined using:

$$f_n = \sum_{i=n-12}^{n} h_i m_{in} \qquad \text{(D1-4)}$$

where: f_n = The composite crankcase hydrocarbon emission factor for calendar year (n)

h_i = The crankcase emission factor for the i^{th} model year

m_{in} = The weighted annual travel of the i^{th} model year during calendar year (n)

Crankcase hydrocarbon emission factor by model year are summarized in Table D.1-26.

Table D. 1-26. CRANKCASE HYDROCARBON EMISSIONS BY MODEL YEAR FOR LIGHT-DUTY VEHICLES EMISSION FACTOR RATING: B

Model year	Hydrocarbons g/mi	Hydrocarbons g/km
California only		
Pre-1961	4.1	2.5
1961 through 1963	0.8	0.5
1964 through 1967	0.0	0.0
Post-1967	0.0	0.0
All areas except California		
Pre-1963	4.1	2.5
1963 through 1967	0.8	0.5
Post-1967	0.0	0.0

There are two sources of evaporative hydrocarbon emissions from light-duty vehicles: the fuel tank and the carburetor system. Diurnal changes in ambient temperature result in expansion of the air-fuel mixture in a partially filled fuel tank. As a result, gasoline vapor is expelled to the atmosphere. Running losses from the fuel tank occur as the fuel is heated by the road surface during driving, and hot soak losses from the carburetor system occur after engine shutdown at the end of a trip. Carburetor system losses occur from such locations as the carburetor vents, the float bowl, and the gaps around the throttle and choke shafts. Because evaporative emissions are a function of the diurnal variation in ambient temperature and the number of trips per day, emissions are best calculated in terms of evaporative emissions per day per vehicle. Emissions per day can be converted to emissions per mile (if necessary) by dividing the emissions per day be an average daily miles per vehicle value. This value is likely to vary from location to location, however. The composite evaporative hydrocarbon emission factor is given by:

$$e_n = \sum_{i=n-12}^{n} (g_i + k_i d)\,(m_{in}) \qquad \text{(D1-5)}$$

where: e_n = The composite evaporative hydrocarbon emission factor for calendar year (n) in lbs/day (g/day)

g_i = The diurnal evaporative hydrocarbon emission factor for model year (i) in lbs/day (g/day)

k_i = The hot soak evaporative emission factor in lbs/trip (g/trip) for the i^{th} model year

d = The number of daily trips per vehicle (3.3 trips/vehicle-day is the nationwide average)

m_{in} = The weighted annual travel of the i^{th} model year during calendar year (n)

The variables g_i and k_i are presented in Table D.1-27 by model year.

Table D.1-27. EVAPORATIVE HYDROCARBON EMISSIONS BY MODEL YEAR FOR LIGHT-DUTY VEHICLES[a]
EMISSION FACTOR RATING: A

Location and model year	By source[b] Diurnal, g/day	Hot soak, g/trip	g/day[c]	Composite g/mi	g/km
Low altitude					
Pre-1970	26.0	14.7	74.5	2.53	1.57
1970 (Calif.)	16.3	10.9	52.3	1.78	1.11
1970 (non-Calif.)	26.0	14.7	74.5	2.53	1.57
1971	16.3	10.9	52.3	1.78	1.11
1972-1979	12.1	12.0	51.7	1.76	1.09
Post-1979[d]	–	–	–	0.5	0.31
High altitude[e]					
Pre-1971	37.4	17.4	94.8	3.22	2.00
1971-1979	17.4	14.2	64.3	2.19	1.36
Post-1979[e]	–	–	–	0.5	0.31

[a]References 10 and 11.
[b]See text for explanation.
[c]Gram per day values are diurnal emissions plus hot soak emissions multiplied by the average number of trips per day. Nationwide data from References 1 and 2 indicate that the average vehicle is used for 3.3 trips per day. Gram/mile values were determined by dividing average g/day by the average nationwide travel per vehicle (29.4 mi/day) from Reference 2.
[d]Post-1979 evaporative emission factors are based on the assumption that existing technology can result in further control of evaporative hydrocarbons. A breakdown of post-1979 emissions by source (that is, diurnal and hot soak) is not available.
[e]Vehicles without evaporative control were not tested at high altitude. Values presented here are the product of the ratio of pre-1971 (low altitude) evaporative emissions to 1972 evaporative emissions and 1971-1972 high altitude emissions.

D.1.4 Particulate and Sulfur Oxide Emissions

Light-duty, gasoline-powered vehicles emit relatively small quantities of particulate and sulfur oxides in comparison with emission levels of the three pollutants discussed above. For this reason, average rather than composite emission factors should be sufficiently accurate for approximating particulate and sulfur oxide emissions from light-duty, gasoline-powered vehicles. Average emission factors for these pollutants are presented in Table D.1-21. No Federal standards for these two pollutants are presently in effect, although many areas do have opacity (antismoke) regulations applicable to motor vehicles.

Sulfuric acid emission from catalysts is presently receiving considerable attention. An emission standard for that pollutant is anticipated beginning in model year 1979.

D.1.5 Basic Assumptions

Light-duty vehicle emission standards. A critical assumption necessary in the calculation of projected composite emission rates is the timetable for implementation of future emission standards for light- duty vehicles. The timetable used for light-duty vehicles in this appendix is that which reflects current legislation and administrative actions as of April 1, 1975. This schedule is:

- For hydrocarbons – 1.5 g/mi (0.93 g/km) for 1975 through 1977 model years; 0.41 g/mi (0.25 g/km) for 1978 and later model years.
- For carbon monoxide – 15 g/mi (9.3 g/km) for 1975 through 1977 model years; 3.4 g/mi (2.1 g/km) for 1978 and later model years.
- For nitrogen oxides – 3.1 g/mi (1.9 g/km) for 1975 and 1976 model years; 2.0 g/mi (1.24 g/km) for the 1977 model year; 0.4 g/mi (0.25 g/km) for 1978 and later model years.

Although the statutory standards of 0.41 g/mi for HC, 3.4 g/mi for CO, and 0.4 g/mi for NO_x are legally scheduled for implementation in 1978, consideration of increased sulfuric acid emission from catalysts, fuel economy problems and control technology availability, and reevaluation of the level of NO_x control needed to achieve the NO_2 air quality standard led the EPA Administrator to recommend to Congress that the light-duty vehicle emission control schedule be revised. The tabulated values in this appendix do not, however, reflect these recent recommendations. If Congress accepts the proposed revisions, the appropriate tables will be revised.

Deterioration and emission factors. Although deterioration factors are no longer presented by themselves in this publication, they are, nontheless, used implicitly to calculate calendar year emission factors for motor vehicles. Based on an analysis of surveillance data,[10,11] approximate linear deterioration rates for pre-1968 model years were established as follows: carbon monoxide – 1 percent per calendar year, hydrocarbons–1 percent per calendar year, and nitrogen oxides–0 percent per calendar year. For 1968-1974 model years, deterioration was assumed to be 5 percent per calendar year for CO, 10 percent per calendar year for HC, and 7 percent per calendar year for NO_x. For all pre-1975 model years, linear deterioration was applied to the surveillance test results to determine tabulated values.[11] Vehicles of model year 1975 and later are assumed to have a deterioration rate of 10 percent per calendar year for CO and 20 percent per calendar year for HC. For NO_x, see the following section on credit for inspection/maintenance systems. These deterioration rates are applied to new vehicle emission factors for prototype cars.

D.1.6 Credit for Inspection/Maintenance Systems

If an Air Quality Control Region has an inspection/maintenance (I/M) program, the following credits can be applied to light-duty vehicles:

1. A 10 percent reduction in CO and HC can be applied to all model year vehicles starting the year I/M is introduced.
2. Deterioration following the initial 10 percent is assumed to follow the schedules below:

	HC	CO
Pre-1975 vehicles	2 percent per year	2 percent per year
1975 and later vehicles	12 percent per year	7 percent per year

3. This deterioration rate continues until a vehicle is 10 years old and remains stable thereafter. No catalyst replacement is assumed.

4. The NO_x emission deterioration and response to I/M is highly conjectural; the estimates below are based on the assumption of engine-out emission of 1.2 g/mi at low mileage, deterioration of engine-out emission at 4 percent per year, NO_x catalyst efficiency deterioration from 80 percent to 70 percent in the first 3 years, and a linear deterioration in average catalyst efficiency from 70 percent to zero over the next 7 years because of catalyst failures. The response to I/M without catalyst replacement is a reduction in the engine-out deterioration from 4 to 2 percent per year. One catalyst replacement is assumed for the catalyst replacement scenario. Note: There is no emission reduction due to I/M for pre-1978 vehicles.

NO_x EMISSION DETERIORATION

(Standard is 0.4 g/mi, 0.25 g/km)

Year	No I/M		I/M, no catalyst replacement		I/M, one catalyst replacement	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
1	0.24	0.15	0.24	0.15	0.24	0.15
2	0.29	0.18	0.28	0.17	0.28	0.17
3	0.34	0.21	0.33	0.20	0.33	0.20
4	0.40	0.25	0.38	0.24	0.38	0.24
5	0.56	0.35	0.52	0.32	0.39	0.24
6	0.73	0.45	0.66	0.41	0.40	0.25
7	0.90	0.56	0.81	0.50	0.47	0.29
8	1.1	0.68	0.96	0.60	0.55	0.34
9	1.3	0.81	1.12	0.70	0.63	0.39
10	1.5	0.93	1.3	0.81	0.71	0.44
> 10	1.7	1.1	1.5	0.93	0.80	0.50

[a]Table does not apply to pre-1978 vehicles.

D.1.7 Adjusting Emission Factor Tables for Changes in Future Light-Duty Vehicle Emission Standards

Because it is likely that Congressional action will alter the existing light-duty emission standard schedule, a methodology is presented here to enable modification of the emission factor tables (Tables D.1-1 through D.1-20). The emission factor tables presented in this appendix, as stated previously, reflect statutory carbon monoxide, hydrocarbon, and nitrogen oxides exhaust emission standards. If changes in the magnitude of the standards and/or the implementation dates occur, appropriate adjustments can be accomplished using Table D.1-28. This table contains emission factors by vehicle age for a number of likely future emission standards.

In order to illustrate the proper use of Table 1-28, the following hypothetical example is given. Emission standards applicable up to and including the 1977 model year are set by law, but changes in the schedule after 1977 (beginning with 1978 models) may occur. For purposes of this example, assume that the Congress changes the existing law such that 1978-1979 model year vehicles are subject to a carbon monoxide emission standard of 9.0 g/mi, a hydrocarbon emission standard of 0.9 g/mi, and a nitrogen oxides emission standard of 2.0 g/mi. Assume also that this scenario has no effect on 1980 and later models, which remain at present statutory levels.

Table D.1-28. EXHAUST EMISSION FACTORS BY VEHICLE AGE FOR SELECTED LIGHT-DUTY VEHICLE EMISSION STANDARDS

Vehicle age, years[a]	Carbon monoxide						Hydrocarbons						Nitrogen oxides							
	15.0 g/mi Standard		9.0 g/mi Standard		3.4 g/mi Standard		1.5 g/mi Standard		0.9 g/mi Standard		0.41 g/mi Standard		2.0 g/mi Standard		1.5 g/mi Standard		1.0 g/mi Standard		0.4 g/mi Standard	
	g/mi	g/km	g/mi	g/km	g/mi	g/km	g/mi	g/km	g/mi	g/km	g/mi	g/km	g/mi	g/km	g/mi	g/km	g/mi	g/km	g/mi	g/km
1	9.0	5.6	5.4	3.4	2.8	1.7	1.0	0.6	0.6	0.4	0.27	0.17	2.00	1.2	1.50	0.93	1.0	0.6	0.24	0.15
2	9.9	6.1	5.9	3.7	3.1	1.9	1.2	0.7	0.7	0.4	0.32	0.20	2.06	1.28	1.56	0.97	1.04	0.65	0.29	0.18
3	10.8	6.7	6.5	4.0	3.4	2.1	1.4	0.9	0.8	0.5	0.38	0.24	2.12	1.32	1.62	1.01	1.08	0.67	0.34	0.21
4	11.7	7.3	7.0	4.3	3.6	2.2	1.6	1.0	1.0	0.6	0.43	0.27	2.18	1.35	1.68	1.04	1.12	0.70	0.40	0.25
5	12.6	7.8	7.6	4.7	3.9	2.4	1.8	1.1	1.1	0.7	0.49	0.30	2.24	1.39	1.74	1.08	1.16	0.72	0.56	0.35
6	13.5	8.4	8.1	5.0	4.2	2.6	2.0	1.2	1.2	0.7	0.54	0.34	2.30	1.43	1.80	1.12	1.20	0.75	0.73	0.45
7	14.4	8.9	8.6	5.3	4.5	2.8	2.2	1.4	1.3	0.8	0.59	0.37	2.36	1.47	1.86	1.16	1.24	0.77	0.90	0.56
8	15.3	9.5	9.2	5.7	4.8	3.0	2.4	1.5	1.4	0.9	0.65	0.40	2.42	1.50	1.92	1.19	1.28	0.79	1.1	0.68
9	16.2	10.1	9.7	6.0	5.0	3.1	2.6	1.6	1.6	1.0	0.70	0.43	2.48	1.54	1.98	1.23	1.32	0.82	1.3	0.81
10	17.1	10.6	10.3	6.4	5.3	3.3	2.8	1.7	1.7	1.1	0.76	0.47	2.54	1.58	2.04	1.27	1.36	0.84	1.5	0.93
11+	18.0	11.2	10.8	6.7	5.6	3.5	3.0	1.9	1.8	1.1	0.81	0.50	2.60	1.61	2.10	1.30	1.40	0.87	1.7	1.06

[a] Vehicle age refers to a year in a vehicle's life. For example, age one means vehicles from 0 to 1 year old.

This change in the standard schedule affects the tabulated values for the 1978 and 1979 model years presented in Tables D.1-11 through D.1-20. In other words, every number in every column in these tables headed with "1978 or 1979" model year must be completely changed. The appropriate replacement values are summarized in Table D.1-28. The age of the vehicle refers to a year in a vehicle's life. For example, the 1978 *model* year vehicles are assumed to be age one in *calendar* year 1978, age two in *calendar* year 1979 and so on.

To change the 1978 model year column in Table D.1-11 to reflect our hypothetical Congressional action, the appropriate values are extracted from the first *row* (age one) of Table D.1-28. For a 9.0 g/mi CO standard, the age one emission factor for both low and high altitude locations is 5.4 g/mi (3.4 g/km). This value is used to replace the existing value [2.8 g/mi (1.7 g/km)] in the 1978 column of Table D.1-11. A similar procedure is used for hydrocarbons and nitrogen oxides.

To illustrate a slightly more complicated situation, consider the revision of Table D.1-16 to reflect our hypothetical situation. All the values in the 1978 and 1979 columns must be changed. In 1980, the 1978 model year vehicles are age three, thus from Table D.1-28 the appropriate carbon monoxide emission factor is 6.5 g/mi (4.0 g/km). This value replaces the existing value of 3.4 g/mi (2.1 g/km). The 1979 model year carbon monoxide emission factor is 5.9 g/mi (3.7 g/km), replacing the existing Table D.1-16 value of 3.1 g/mi (1.9 g/km). This procedure is followed, using Table D.1-28, for all three pollutants. The procedure is similar for other standard schedules and other calendar year tables.

The above methodology was designed to enable the user of this document to quickly revise the tables. Any Congressional action will result in revision of the appropriate tables by EPA. Publication of these revised tables takes time, however, and although every effort is made by EPA to make these changes quickly, the required lead time is such that certain users may want to perform the modifications to the tables in advance. The standards covered in Table D.1-28 represent the most likely values Congress will adopt, but by no means represent all possible standards.

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D.2 LIGHT-DUTY, GASOLINE-POWERED TRUCKS

D.2.1 General

This class of vehicles includes all trucks with a gross vehicle weight (GVW) of 8500 lb (3856 kg) or less. It is comprised of vehicles that formerly were included in the light-duty truck (6000 lb; 2722 kg GVW and under) and the heavy-duty vehicle (6001 lb; 2722 kg GVW and over) classes. Generally, these trucks are used for personal transportation as opposed to commercial use.

D.2.2 FTP Exhaust Emissions

Projected emission factors for light trucks are summarized in Tables D.2-1 through D.2-12, (For information on projected emission factors for vehicles operated in California and at high altitude, see sections D.2.5 and D.2.6). The basic methodology used for projecting light-duty vehicle emission factors (section D.1 of this appendix) also applies to this class. As in section D.1, the composite emission factor for light-duty trucks is given by:

$$e_{npstwx} = \sum_{i=n-12}^{n} c_{ipn}\, m_{in}\, v_{ips}\, z_{ipt}\, r_{iptwx} \qquad \text{(D2-1)}$$

where: e_{npstwx} = Composite emission factor in g/mi (g/km) for calendar year (n), pollutant (p), average speed (s), ambient temperature (t), percentage cold operation (w), and percentage hot start operation (x)

c_{ipn} = The 1975 Federal Test Procedure mean emission factor for the i^{th} model year light-duty trucks during calendar year (n) and for pollutant (p)

m_{in} = The fraction of annual travel by the i^{th} model year light-duty trucks during calendar year (n)

v_{ips} = The speed correction factor for the i^{th} model year light-duty trucks for pollutant (p) and average speed (s)

z_{ipt} = The temperature correction for the i^{th} model year light-duty trucks for pollutant (p) and ambient temperature (t)

r_{iptwx} = The hot/cold vehicle operation correction factor for the i^{th} model year light-duty trucks for pollutant (p), ambient temperature (t), percentage cold operation (w), and percentage hot start operation (x)

Values for m_{in} are given in Table D.2-11. Unless other data are available, v_{ips} (Tables D.2-12 and D.2-13), z_{ipt}, and r_{iptwx} (Table D.2-14) are the same for this class as for light-duty vehicles.

Table D.2-1. PROJECTED CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR LIGHT-DUTY, GASOLINE-POWERED TRUCKS—EXCLUDING CALIFORNIA—FOR CALENDAR YEAR 1973 (BASED ON 1975 FEDERAL TEST PROCEDURE)

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low altitude						
Pre-1968	125.0	77.6	17.0	10.6	4.2	2.6
1968	70.0	43.5	7.9	4.9	4.9	3.0
1969	67.8	42.1	5.9	3.7	5.3	3.3
1970	56.0	34.8	5.4	3.4	5.2	3.2
1971	56.0	34.8	4.7	2.9	5.2	3.2
1972	45.0	27.9	3.8	2.4	5.3	3.3
1973	42.8	26.6	3.6	2.2	4.4	2.7

Table D.2-2. PROJECTED CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR LIGHT-DUTY, GASOLINE-POWERED TRUCKS EXCLUDING CALIFORNIA—FOR CALENDAR YEAR 1974 (BASED ON 1975 FEDERAL TEST PROCEDURE)

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low altitude						
Pre-1968	125.0	77.6	17.0	10.6	4.2	2.6
1968	73.5	45.6	8.7	5.4	4.9	3.0
1969	71.3	44.3	6.5	4.0	5.3	3.3
1970	58.5	36.3	6.0	3.7	5.2	3.2
1971	58.5	36.3	5.2	3.2	5.2	3.2
1972	47.2	29.3	4.2	2.6	5.3	3.3
1973	45.0	27.9	4.0	2.5	4.6	2.9
1974	42.8	26.6	3.6	2.2	4.4	2.7

Table D.2-3. PROJECTED CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR LIGHT-DUTY, GASOLINE-POWERED TRUCKS–EXCLUDING CALIFORNIA–FOR CALENDAR YEAR 1975 (BASED ON 1975 FEDERAL TEST PROCEDURE)

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low altitude						
Pre-1968	125	77.6	17.0	10.6	4.2	2.6
1968	77.0	47.8	9.5	5.9	4.9	3.0
1969	74.8	46.5	7.1	4.4	5.3	3.3
1970	61.0	37.9	6.6	4.1	5.2	3.2
1971	61.0	37.9	5.7	3.5	5.2	3.2
1972	49.4	30.7	4.6	2.9	5.3	3.3
1973	47.2	29.3	4.4	2.7	4.8	3.0
1974	45.0	27.9	4.0	2.5	4.6	2.9
1975	27.0	16.8	2.7	1.7	4.4	2.7

Table D.2-4. PROJECTED CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR LIGHT-DUTY, GASOLINE-POWERED TRUCKS–EXCLUDING CALIFORNIA–FOR CALENDAR YEAR 1976 (BASED ON 1975 FEDERAL TEST PROCEDURE)

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low altitude						
Pre-1968	125	77.6	17.0	10.6	4.2	2.6
1968	80.5	50.0	10.3	6.4	4.9	3.0
1969	78.3	48.6	7.7	4.8	5.3	3.3
1970	63.5	39.4	7.2	4.5	5.2	3.2
1971	63.5	39.4	6.2	3.9	5.2	3.2
1972	51.6	32.0	5.0	3.1	5.3	3.3
1973	49.4	30.7	4.8	3.0	5.0	3.1
1974	47.2	29.3	4.4	2.7	4.8	3.0
1975	28.5	17.7	3.0	1.9	4.6	2.9
1976	27.0	16.8	2.7	1.7	4.4	2.7

Table D.2-5. PROJECTED CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR LIGHT-DUTY, GASOLINE-POWERED TRUCKS—EXCLUDING CALIFORNIA—FOR CALENDAR YEAR 1977 (BASED ON 1975 FEDERAL TEST PROCEDURE)

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low altitude						
Pre-1968	125	77.5	17.0	10.6	4.2	2.6
1968	84.0	52.2	11.1	6.9	4.9	3.0
1969	81.8	50.8	8.3	5.2	5.3	3.3
1970	66.0	41.0	7.8	4.8	5.2	3.2
1971	66.0	41.0	6.7	4.2	5.2	3.2
1972	53.8	33.4	5.4	3.4	5.3	3.3
1973	51.6	32.0	5.2	3.2	5.2	3.2
1974	49.4	30.7	4.8	3.0	5.0	3.1
1975	30.0	18.6	3.3	2.0	4.8	3.0
1976	28.5	17.7	3.0	1.9	4.6	2.9
1977	27.0	16.8	2.7	1.7	4.4	2.7

Table D.2-6. PROJECTED CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR LIGHT-DUTY, GASOLINE-POWERED TRUCKS—EXCLUDING CALIFORNIA—FOR CALENDAR YEAR 1978

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low altitude						
Pre-1968	125	77.6	17.0	10.6	4.2	2.6
1968	87.5	54.3	11.9	7.4	4.9	3.0
1969	85.3	53.0	8.9	5.5	5.3	3.3
1970	68.5	42.5	8.4	5.2	5.2	3.2
1971	68.5	42.5	7.2	4.5	5.2	3.2
1972	56.0	34.8	5.8	3.6	5.3	3.3
1973	53.8	33.4	5.6	3.5	5.4	3.4
1974	51.6	32.0	5.2	3.2	5.2	3.2
1975	31.5	19.6	3.6	2.2	5.0	3.1
1976	30.0	18.6	3.3	2.0	4.8	3.0
1977	28.5	17.7	3.0	1.9	4.6	2.9
1978	9.8	6.1	1.0	0.6	2.3	1.4

Table D.2-7. PROJECTED CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR LIGHT-DUTY, GASOLINE-POWERED TRUCKS–EXCLUDING CALIFORNIA–FOR CALENDAR YEAR 1979 (BASED ON 1975 FEDERAL TEST PROCEDURE)

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low altitude						
Pre-1968	125	77.6	17.0	10.6	4.2	2.6
1968	87.5	54.3	11.9	7.4	4.9	3.0
1969	88.8	55.1	9.5	5.9	5.3	3.3
1970	71.0	44.1	9.0	5.6	5.2	3.2
1971	71.0	44.1	7.7	4.8	5.2	3.2
1972	58.2	36.1	6.2	3.9	5.3	3.3
1973	56.0	34.8	6.0	3.7	5.6	3.5
1974	53.8	33.4	5.6	3.5	5.4	3.4
1975	33.0	20.5	3.9	2.4	5.2	3.2
1976	31.5	19.6	3.6	2.2	5.0	3.1
1977	30.0	18.6	3.3	1.4	4.8	3.0
1978	10.8	6.7	1.2	0.7	2.35	1.46
1979	9.8	6.1	1.0	0.6	2.3	1.4

Table D.2-8. PROJECTED CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR LIGHT-DUTY, GASOLINE-POWERED TRUCKS–EXCLUDING CALIFORNIA–FOR CALENDAR YEAR 1980 (BASED ON 1975 FEDERAL TEST PROCEDURE)

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low altitude						
Pre-1968	125	77.6	17.0	10.6	4.2	2.6
1968	87.5	54.3	11.9	7.4	4.9	3.0
1969	88.8	55.1	9.5	5.9	5.3	3.3
1970	73.5	45.6	9.6	6.0	5.2	3.2
1971	73.5	45.6	8.2	5.1	5.2	3.2
1972	60.4	37.5	6.6	4.1	5.3	3.3
1973	58.2	36.1	6.4	4.0	5.8	3.6
1974	56.0	34.8	6.0	3.7	5.6	3.5
1975	34.5	21.4	4.2	2.6	5.4	3.4
1976	33.0	20.5	3.9	2.4	5.2	3.2
1977	31.5	19.6	3.6	2.2	5.0	3.1
1978	11.8	7.3	1.4	0.9	2.4	1.5
1979	10.8	6.7	1.2	0.7	2.35	1.46
1980	9.8	6.1	1.0	0.6	2.3	1.4

Table D.2-9. PROJECTED CARBON MONODIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR LIGHT-DUTY, GASOLINE-POWERED TRUCKS—EXCLUDING CALIFORNIA—FOR CALENDAR YEAR 1985 (BASED ON 1975 FEDERAL TEST PROCEDURE)

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low altitude						
1972	64.8	40.2	7.4	4.6	5.3	3.3
1973	64.8	40.2	7.6	4.7	6.4	4.0
1974	64.8	40.2	7.6	4.7	6.4	4.0
1975	42.0	26.1	5.7	3.5	6.4	4.0
1976	40.5	25.1	5.4	3.4	6.2	3.9
1977	39.0	24.2	5.1	3.2	6.0	3.7
1978	16.8	10.4	2.4	1.5	2.65	1.65
1979	15.8	9.8	2.2	1.4	2.6	1.6
1980	14.8	9.2	2.0	1.2	2.55	1.58
1981	13.8	8.6	1.8	1.1	2.5	1.6
1982	12.8	7.9	1.6	1.0	2.45	1.52
1983	11.8	7.3	1.4	0.9	2.4	1.5
1984	10.8	6.7	1.2	0.7	2.35	1.46
1985	9.8	6.1	1.0	0.6	2.3	1.4

Table D.2-10. PROJECTED CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR LIGHT-DUTY, GASOLINE-POWERED TRUCKS— EXCLUDING CALIFORNIA—FOR CALENDAR YEAR 1990 (BASED ON 1975 FEDERAL TEST PROCEDURE)

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low altitude						
1977	42.0	26.1	5.7	3.5	6.4	4.0
1978	19.8	12.3	3.0	1.9	2.8	1.74
1979	19.8	12.3	3.0	1.9	2.8	1.74
1980	19.8	12.3	3.0	1.9	2.8	1.74
1981	18.8	11.7	2.8	1.7	2.75	1.71
1982	17.8	11.1	2.6	1.6	2.7	1.68
1983	16.8	10.4	2.4	1.5	2.65	1.65
1984	15.8	9.8	2.2	1.4	2.6	1.61
1985	14.8	9.2	2.0	1.2	2.55	1.58
1986	13.8	8.7	1.8	1.1	2.5	1.55
1987	12.8	7.9	1.6	1.0	2.45	1.52
1988	11.8	7.3	1.4	0.9	2.4	1.49
1989	10.8	6.7	1.2	0.7	2.35	1.46
1990	9.8	6.1	1.0	0.6	2.3	1.43

Table D.2-11. SAMPLE CALCULATION OF FRACTION OF ANNUAL LIGHT-DUTY, GASOLINE-POWERED TRUCK TRAVEL BY MODEL YEAR

Age, years	Fraction of total vehicles in use nationwide (a)[a]	Average annual miles driven (b)[b]	a x b	Fraction of annual travel (m)[c]
1	0.061	15,900	970	0.094
2	0.097	15,000	1,455	0.141
3	0.097	14,000	1,358	0.132
4	0.097	13,100	1,270	0.123
5	0.083	12,200	1,013	0.098
6	0.076	11,300	859	0.083
7	0.076	10,300	783	0.076
8	0.063	9,400	592	0.057
9	0.054	8,500	459	0.044
10	0.043	7,600	327	0.032
11	0.036	6,700	241	0.023
12	0.024	6,700	161	0.016
≥13	0.185	4,500	832	0.081

[a] Vehicles in use by model year as of 1972 (Reference 1 and 2).
[b] Reference 2.
[c] $m = ab/\Sigma ab$.

Table D.2-12. COEFFICIENTS FOR SPEED CORRECTION FACTORS FOR LIGHT-DUTY TRUCKS[a]

Location	Model year	$v_{ips} = e^{(A + BS + CS^2)}$						$v_{ips} = A + BS$	
		Hydrocarbons			Carbon monoxide			Nitrogen oxides	
		A	B	C	A	B	C	A	B
Low altitude (Excluding 1966-1967 Calif.)	1957-1967	0.953	-6.00×10^{-2}	5.81×10^{-4}	0.967	-6.07×10^{-2}	5.78×10^{-4}	0.808	0.980×10^{-2}
California	1966-1967	0.957	-5.98×10^{-2}	5.63×10^{-4}	0.981	-6.22×10^{-2}	6.19×10^{-4}	0.844	0.798×10^{-2}
Low altitude	1968	1.070	-6.63×10^{-2}	5.98×10^{-4}	1.047	-6.52×10^{-2}	6.01×10^{-4}	0.888	0.569×10^{-2}
	1969	1.005	-6.27×10^{-2}	5.80×10^{-4}	1.259	-7.72×10^{-2}	6.60×10^{-4}	0.915	0.432×10^{-2}
	1970	0.901	-5.70×10^{-2}	5.59×10^{-4}	1.267	-7.72×10^{-2}	6.40×10^{-4}	0.843	0.798×10^{-2}
	Post-1970	0.943	-5.92×10^{-2}	5.67×10^{-4}	1.241	-7.52×10^{-2}	6.09×10^{-4}	0.843	0.804×10^{-2}
High altitude	1957-1967	0.883	-5.58×10^{-2}	5.52×10^{-4}	0.721	-4.57×10^{-2}	4.56×10^{-4}	0.602	2.027×10^{-2}
	1968	0.722	-4.63×10^{-2}	4.80×10^{-4}	0.662	-4.23×10^{-2}	4.33×10^{-4}	0.642	1.835×10^{-2}
	1969	0.706	-4.55×10^{-2}	4.84×10^{-4}	0.628	-4.04×10^{-2}	4.26×10^{-4}	0.726	1.403×10^{-2}
	1970	0.840	-5.33×10^{-2}	5.33×10^{-4}	0.835	-5.24×10^{-2}	4.98×10^{-4}	0.614	1.978×10^{-2}
	Post-1970	0.787	-4.99×10^{-2}	4.99×10^{-4}	0.894	-5.54×10^{-2}	4.99×10^{-4}	0.697	1.553×10^{-2}

[a]Reference 3. Equations should not be extended beyond the range of data (15 to 45 mi/hr). These data are for light-duty vehicles and are assumed applicable to light-duty trucks.

Table D.2-13. LOW AVERAGE SPEED CORRECTION FACTORS FOR LIGHT-DUTY TRUCKS[a]

Location	Model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
		5 mi/hr (8 km/hr)	10 mi/hr (16 km/hr)	5 mi/hr (8 km/hr)	10 mi/hr (16 km/hr)	5 mi/hr (8 km/hr)	10 mi/hr (16 km/hr)
Low altitude (Excluding 1966-1967 Calif.)	1957-1967	2.72	1.57	2.50	1.45	1.08	1.03
California	1966-1967	1.79	1.00	1.87	1.12	1.16	1.09
Low altitude	1968	3.06	1.75	2.96	1.66	1.04	1.00
	1969	3.57	1.86	2.95	1.65	1.08	1.05
	1970	3.60	1.88	2.51	1.51	1.13	1.05
	Post-1970	4.15	2.23	2.75	1.63	1.15	1.03
High altitude	1957-1967	2.29	1.48	2.34	1.37	1.33	1.20
	1968	2.43	1.54	2.10	1.27	1.22	1.18
	1969	2.47	1.61	2.04	1.22	1.22	1.08
	1970	2.84	1.72	2.35	1.36	1.19	1.11
	Post-1970	3.00	1.83	2.17	1.35	1.06	1.02

[a] Driving patterns developed from CAPE-21 vehicle operation data (Reference 4) were input to the modal emission analysis model (see section 3.1.2.3). The results predicted by the model (emissions at 5 and 10 mi/hr (8 and 16 km/hr) were divided by FTP emission factors for operation to obtain the above results. The above data are approximate and represent the best currently available information.

Table D.2-14. LIGHT-DUTY TRUCK TEMPERATURE CORRECTION FACTORS AND HOT/COLD VEHICLE OPERATION CORRECTION FACTORS FOR FTP EMISSION FACTORS[a]

Pollutant and controls	Temperature correction factor (z_{ipt})[b]	Hot/cold vehicle operation correction factors	
		g(t)	f(t)
Carbon monoxide			
Non-catalyst	$-0.0127t + 1.95$	–	$0.0045t + 0.02$
Catalyst	$-0.0743t + 6.58$	$e^{0.035t} - 5.24$	$e^{0.036t} - 4.14$
Hydrocarbons			
Non-catalyst	$-0.0113t + 1.81$	–	$0.0079t + 0.03$
Catalyst	$-0.0304t + 3.25$	$0.0018t + 0.0095$	$0.0050t - 0.0409$
Nitrogen oxides			
Non-catalyst	$-0.0046t + 1.36$	–	$-0.0068t + 1.64$
Catalyst	$-0.0060t + 1.52$	$-0.0010t + 0.858$	$0.0010t + 0.835$

[a] Reference 5. Temperature (t) is expressed in °F. In order to apply the above equations, °C must first be converted to °F (F=9/5C + 32). Similarly °Kelvin (K) must be converted to °F (F= 9/5(K – 273.16) + 32).

[b] The formulae for z_{ipt} enable the correction of FTP emission factors for ambient temperature. The formulae for f(t) are used in conjunction with equation D.1-2 to calculate r_{ipwx}. If the variable r_{iptwx} is used in equation D.1-1, z_{ipt} must be used also. See section D1 for appropriate formulae for calculating r_{iptwx}.

For pre-1975 model year vehicles, noncatalyst temperature correction factors should be used. For 1975-1977 model year vehicles, temperature-dependent correction factors should be calculated for the catalyst and noncatalyst class, and the results weighted into an overall factor that is two-thirds catalyst, one-third noncatalyst. For 1978 and later model year vehicles, noncatalyst temperature correction factors should be applied.

D.2.3 Evaporative and Crankcase Emissions

In addition to exhaust emission factors, evaporative crankcase hydrocarbon emissions are determined using:

$$f_n = \sum_{i=n-12}^{n} h_i m_{in} \tag{D2-2}$$

where: f_n = The combined evaporative and crankcase hydrocarbon emission factor for calendar year (n)

h_i = The combined evaporative and crankcase hydrocarbon emission rate for the i^{th} model year. Emission factors for this source are reported in Table D.2-15. The crankcase and evaporative emissions reported in the table are added together to arrive at this variable.

m_{in} = The weighted annual travel of the i^{th} model year vehicle during calendar year (n)

Table D.2-15. CRANKCASE AND EVAPORATIVE HYDROCARBONS EMISSION FACTORS FOR LIGHT-DUTY, GASOLINE-POWERED TRUCKS
EMISSION FACTOR RATING: B

Location	Model years	Crankcase emissions[a]		Evaporative emissions[b]	
		g/km	g/mi	g/km	g/mi
All areas except high altitude and California[c]	Pre-1963	2.9	4.6	2.2	3.6
	1963-1967	1.5	2.4	2.2	3.6
	1968-1970	0.0	0.0	2.2	3.6
	1971	0.0	0.0	1.9	3.1
	1972-1979	0.0	0.0	1.9	3.1
	Post-1979[d]	0.0	0.0	0.3	0.5
High altitude	Pre-1963	2.9	4.6	2.9	4.6
	1963-1967	1.5	2.4	2.9	4.6
	1968-1970	0.0	0.0	2.9	4.6
	1971-1979	0.0	0.0	2.4	3.9
	Post-1979[d]	0.0	0.0	0.3	0.5

[a]Reference 6. Tabulated values were determined by assuming that two-thirds of the light-duty trucks are 6000 lbs GVW (2700 kg) and under, and that one-third are 6001-8500 lbs GVW (2700-3860 kg).
[b]Light-duty vehicle evaporative data (section 3.1.2) and heavy-duty vehicle evaporative data (section 3.1.4) were used to estimate the listed values.
[c]For California: Evaporative emissions for the 1970 model year are 1.9 g/km (3.1 g/mi) all other model years are the same as those reported as "All area except high altitude and California". Crankcase emissions for the pre-1961 California light-duty trucks are 4.6 g/mi (2.9 g/km), 1961-1963 model years are 2.4 (g/mi (1.5 g/km), all post-1963 model year vehicles are 0.0 g/mi (0.0 g/km).
[d]Post-1979 evaporative emission factors are based on the assumption that existing technology, when applied to the entire light truck class, can result in further control of evaporative hydrocarbons.

D.2.4 Particulate and Sulfur Oxides Emissions

Particulate and sulfur oxides emission factors are presented in Table D.2-16.

Table D.2-16. PARTICULATE, SULFURIC ACID, AND TOTAL SULFUR OXIDES EMISSION FACTORS FOR LIGHT-DUTY, GASOLINE-POWERED VEHICLES

Pollutant	Emission factors		
	Non-catalyst (Leaded fuel)	Non-catalyst (Unleaded fuel)	Catalyst (Unleaded fuel)
Particulate			
Exhaust[a]			
g/mi	0.34	0.05	0.05
g/km	0.21	0.03	0.03
Tire wear			
g/mi	0.20	0.20	0.20
g/km	0.12	0.12	0.12
Sulfuric acid			
g/mi	0.001	0.001	0.02-0.06[b]
g/km	0.001	0.001	0.01-0.04
Total sulfur oxides			
g/mi	0.18	0.18	0.18
g/km	0.11	0.11	0.11

[a] Excluding particulate sulfate or sulfuric acid aerosol.
[b] Sulfuric acid emission varies markedly with driving mode and fuel sulfur levels.

D.2.5 Basic Assumptions

Composition of class. For emission estimation purposes, this class is composed of trucks having a GVW of 8500 lb (3856 kg) or less. Thus, this class includes the group of trucks previously defined in AP-42 as light-duty vehicles (LDV) plus a group of vehicles previously defined as heavy-duty vehicles (HDV). On the basis of numbers of vehicles nationwide, the split is two-thirds LDVs, one-third HDVs.

Standards. The pollutant standards assumed for this category are weighted averages of the standards applicable to the various vehicle classes that were combined to create the light-duty truck class. Until 1975, those light-duty trucks that weighed 6000 lb (2722 kg) and under were required to meet light-duty vehicle emission standards. Beginning in 1975, in accordance with a court order, a separate light truck class was created. This class, which comprises two-thirds of the light-duty truck class (as defined here), is required to meet standards of 20 g/mi (12.4 g/km) of carbon monoxide, 2 g/mi (1.2 g/km) of hydrocarbons, and 3.1 g/mi (1.9 g/km) of nitrogen oxides from 1975 through 1977. The remaining one-third of the light-duty trucks are currently subject to heavy-duty vehicle standards. Data presented in section D.2 are based on the assumption that, beginning in 1978, the light-duty truck class of 0-8500 lb (3856 kg) GVW will be subject to the following standards: carbon monoxide–17.9 g/mi (11.1 g/km), hydrocarbon–1.65 g/mi (1.0 g/km), and nitrogen oxides–2.3 g/mi (1.4 g/km).

Deterioration. The same deterioration assumptions discussed in section D.1 for light-duty vehicles apply except that 1975-1977 model year vehicles weighing between 6000 and 8500 lb (2722-3856 kg) are assumed not to be equipped with catalytic converters. Therefore, the deterioration factors for light-duty trucks are weighted values composed of 6000-lb (2722 kg) GVW truck deterioration values and 6001 to 8500-lb (2722-3856 kg) GVW truck deterioration values. The weighting factors are two-thirds and one-third, respectively.

Actual emission values. For 1972 and earlier model year vehicles, emission values are those measured in the EPA Emission Surveillance Program[7,8] and the baseline study of 6,000- to 10,000-lb (2,722-4,536 kg) trucks.[9,10]

The tabulated values are weighted two-thirds for 0-6000-lb (0-2722 kg) trucks and one-third for 6000- to 8500-lb (2722-3856 kg) trucks. For 1973-1974 model year emission values, this same weighting factor is applied to projected 1973-1974 light-duty vehicle emissions and 1972 model year 6,000- to 10,000-lb (2,722-4,536 kg) emission values. 1975-1977 model year emission values for 0- to 6000-lb (0 to 2722 kg) GVW trucks are based on unpublished certification test data along with estimates of prototype-to-production differences. Post-1977 model year emission values are based on previous relationships of low mileage in-use emission values to the standards.

California values. Projected emission factors for vehicles operated in California were not computed because of a lack of information. The Pre-1975 California light-duty vehicle ratios can be applied to the light-duty trucks as a best estimate (see section D.1). For 1975 and later, no difference is expected except in the value for nitrogen oxides in 1975-1976; the California standards can be weighted two-thirds, and the truck baseline value of 7.1 g/mi (4.4 gm/km) one-third to get an estimated value for nitrogen oxides in 1975-1976.

D.2.6 High Altitude and Inspection/Maintenance Corrections

To correct for high altitude for all pollutants for light-duty trucks, the light-duty vehicle ratio of high altitude to low altitude emission factors for the model year vehicle is applied to the calendar year in question (see section D.1). Credit for inspection/maintenance for light-duty trucks is the same as that given for autos in section D.1. of this appendix.

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D.3 LIGHT-DUTY, DIESEL-POWERED VEHICLES

D.3.1 General

Although light-duty diesels represent only a small fraction of automobiles in use, their numbers can be expected to increase in the future. Currently, only two manufacturers produce diesel-powered automobiles for sale in the United States, but this may change as the demand for low polluting, economical engines grows.

D.3.2 Emissions

Because of the limited data base for these vehicles, no attempt has been made to predict deterioration factors. The composite emission factor calculation procedure involves only the Federal Test Procedure (FTP) emission factor and the fraction of travel by model year (see main text, section 3.1.3). The values presented in Table 3.1.3-1 apply to all model years and pollutants.

D.3.3 Basic Assumptions

Standards. See section D.1, Light-Duty, Gasoline-Powered Vehicles.

Deterioration. Because of the lack of data, no deterioration factors are assumed. Diesels are expected to continue to emit carbon monoxide and hydrocarbons at their present rates but to meet future NO_x standards exactly.

D.4 HEAVY-DUTY, GASOLINE-POWERED VEHICLES

D.4.1 General

This class includes vehicles with a gross vehicle weight of more than 8500 lb (3856 kg). Most of the vehicles are trucks; however, buses and special purpose vehicles such as motor homes are also included. As in other sections of this appendix the reader is encouraged to refer to the main text (see section 3.1.4) for a much more detailed presentation. The discussion presented here is brief, consisting primarily of data summaries.

D.4.2 Carbon Monoxide, Hydrocarbon, and Nitrogen Oxides Exhaust Emissions

The composite exhaust emission factor is calculated using:

$$e_{nps} = \sum_{i=n-12}^{n} c_{ipn}\, m_{in}\, v_{ips} \qquad \text{(D.4-1)}$$

where: e_{nps} = Composite emission factor in g/mi (g/km) for calendar year (n) pollutant (p), and average speed (s)

c_{ipn} = The test procedure emission factor for pollutant (p) in g/mi (g/km) for the i^{th} model year in calendar year (n)

m_{in} = The weighted annual travel of the i^{th} model year vehicles during calendar year (n). The determination of this variable involves the use of the vehicle year distribution.

v_{ips} = The speed correction factor for the i^{th} model year vehicles for pollutant (p) and average speed (s)

The projected test procedure emission factors (c_{ipn}) are summarized in Tables D.4-1 through D.4-10. These projected factors are based on the San Antonio Road Route test (see section 3.1.4) and assume 100 percent warmed-up vehicle operation at an average speed of approximately 18 mi/hr (29 km/hr). Table D.4-11 contains a sample calculation of the variable m_{in}, using nationwide statistics. Speed correction factor data are contained in Table D.4-12 and Table D.4-13.

Table D.4-1. PROJECTED CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR HEAVY-DUTY, GASOLINE-POWERED VEHICLES— EXCLUDING CALIFORNIA—FOR CALENDAR YEAR 1973

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low altitude						
Pre-1970	238	148	35.4	22.0	6.8	4.2
1970	188	117	13.9	8.6	12.7	7.9
1971	188	117	13.8	8.6	12.6	7.8
1972	188	117	13.7	8.5	12.6	7.8
1973	188	117	13.6	8.4	12.5	7.8

Table D.4-2. PROJECTED CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR HEAVY-DUTY, GASOLINE-POWERED VEHICLES–EXCLUDING CALIFORNIA–FOR CALENDAR YEAR 1974

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low altitude						
Pre-1970	238	148	35.4	22.0	6.8	4.2
1970	188	117	14.0	8.7	12.7	7.9
1971	188	117	13.9	8.6	12.7	7.9
1972	188	117	13.8	8.6	12.6	7.8
1973	188	117	13.7	8.5	12.6	7.8
1974	167	104	13.1	8.1	12.5	7.8

Table D.4-3. PROJECTED CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR HEAVY-DUTY, GASOLINE-POWERED VEHICLES–EXCLUDING CALIFORNIA–FOR CALENDAR YEAR 1975

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low altitude						
Pre-1970	238	148	35.4	22.0	6.8	4.2
1970	188	117	14.1	8.8	12.8	7.9
1971	188	117	14.0	8.7	12.7	7.9
1972	188	117	13.9	8.6	12.7	7.9
1973	188	117	13.8	8.6	12.6	7.8
1974	168	104	13.2	8.2	12.6	7.8
1975	167	104	13.1	8.1	12.5	7.8

Table D.4-4. PROJECTED CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR HEAVY-DUTY, GASOLINE-POWERED VEHICLES–EXCLUDING CALIFORNIA–FOR CALENDAR YEAR 1976

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low altitude						
Pre-1970	238	148	35.4	22.0	6.8	4.2
1970	188	117	14.2	8.8	12.8	7.9
1971	188	117	14.1	8.8	12.8	7.9
1972	188	117	14.0	8.7	12.7	7.9
1973	188	117	13.9	8.6	12.7	7.9
1974	169	105	13.3	8.3	12.6	7.8
1975	168	104	13.2	8.2	12.6	7.8
1976	167	104	13.1	8.1	12.5	7.8

Table D.4-5. PROJECTED CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR HEAVY-DUTY, GASOLINE-POWERED VEHICLES–EXCLUDING CALIFORNIA–FOR CALENDAR YEAR 1977

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low altitude						
Pre-1970	238	148	35.4	22.0	6.8	4.2
1970	188	117	14.3	8.9	12.9	8.0
1971	188	117	14.2	8.8	12.8	7.9
1972	188	117	14.1	8.8	12.8	7.9
1973	188	117	14.0	8.7	12.7	7.9
1974	170	106	13.4	8.3	12.7	7.9
1975	169	105	13.3	8.3	12.6	7.8
1976	168	104	13.2	8.2	12.6	7.8
1977	167	104	13.1	8.1	12.5	7.8

Table D.4-6. PROJECTED CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR HEAVY-DUTY, GASOLINE-POWERED VEHICLES–EXCLUDING CALIFORNIA–FOR CALENDAR YEAR 1978

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low altitude						
Pre-1970	238	148	35.4	22.0	6.8	4.2
1970	188	117	14.4	8.9	12.9	8.0
1971	188	117	14.3	8.9	12.9	8.0
1972	188	117	14.2	8.8	12.8	7.9
1973	188	117	14.1	8.8	12.8	7.9
1974	171	106	13.5	8.4	12.7	7.9
1975	170	106	13.4	8.3	12.7	7.9
1976	169	105	13.3	8.3	12.6	7.8
1977	168	104	13.2	8.2	12.6	7.8
1978	117	73	6.0	3.7	11.4	7.1

Table D.4-7. PROJECTED CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR HEAVY-DUTY, GASOLINE-POWERED VEHICLES– EXCLUDING CALIFORNIA–FOR CALENDAR YEAR 1979

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low altitude						
Pre-1970	238	148	35.4	22.0	6.8	4.2
1970	188	117	14.4	8.9	13.0	8.1
1971	188	117	14.4	8.9	12.9	8.0
1972	188	117	14.3	8.9	12.9	8.0
1973	188	117	14.2	8.8	12.8	7.9
1974	172	107	13.6	8.4	12.8	7.9
1975	171	106	13.5	8.4	12.7	7.9
1976	170	106	13.4	8.3	12.7	7.9
1977	169	105	13.3	8.3	12.6	7.8
1978	118	73	6.0	3.7	11.6	7.2
1979	117	73	6.0	3.7	11.4	7.1

Table D.4-8. PROJECTED CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR HEAVY-DUTY, GASOLINE-POWERED VEHICLES– EXCLUDING CALIFORNIA–FOR CALENDAR YEAR 1980

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low altitude						
Pre-1970	238	148	35.4	22.0	6.8	4.2
1970	188	117	14.4	8.9	13.0	8.1
1971	188	117	14.4	8.9	13.0	8.1
1972	188	117	14.4	8.9	12.9	8.0
1973	188	117	14.3	8.9	12.9	8.0
1974	173	107	13.7	8.5	12.8	7.9
1975	172	107	13.6	8.4	12.8	7.9
1976	171	106	13.5	8.4	12.7	7.9
1977	170	106	13.4	8.3	12.7	7.9
1978	119	74	6.1	3.8	11.8	7.3
1979	118	73	6.0	3.7	11.6	7.2
1980	117	73	6.0	3.7	11.4	7.1

Table D.4-9. PROJECTED CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR HEAVY-DUTY, GASOLINE-POWERED VEHICLES—EXCLUDING CALIFORNIA—FOR CALENDAR YEAR 1985

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low altitude						
1972	188	117	14.4	8.9	13.0	8.1
1973	188	117	14.4	8.9	13.0	8.1
1974	176	109	14.0	8.7	13.0	8.1
1975	176	109	14.0	8.7	13.0	8.1
1976	175	109	14.0	8.7	12.9	8.0
1977	174	108	13.9	8.6	12.9	8.0
1978	124	77	6.3	3.9	12.8	7.9
1979	123	76	6.2	3.9	12.6	7.8
1980	122	76	6.2	3.9	12.4	7.7
1981	121	75	6.2	3.9	12.2	7.6
1982	120	75	6.1	3.8	12.0	7.5
1983	119	74	6.1	3.8	11.8	7.3
1984	118	73	6.1	3.8	11.6	7.2
1985	117	73	6.0	3.7	11.4	7.1

Table D.4-10. PROJECTED CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR HEAVY-DUTY, GASOLINE-POWERED VEHICLES—EXCLUDING CALIFORNIA—FOR CALENDAR YEAR 1990

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low altitude						
1977	176	109	14.0	8.7	13.0	8.1
1978	126	78	6.3	3.9	13.0	8.1
1979	126	78	6.3	3.9	13.0	8.1
1980	126	78	6.2	3.9	13.0	8.1
1981	126	78	6.2	3.9	13.0	8.1
1982	125	78	6.2	3.9	13.0	8.1
1983	124	77	6.2	3.9	12.8	7.9
1984	123	76	6.2	3.9	12.6	7.8
1985	122	76	6.2	3.9	12.4	7.7
1986	121	75	6.1	3.8	12.2	7.6
1987	120	75	6.1	3.8	12.0	7.5
1988	119	74	6.1	3.8	11.8	7.3
1989	118	73	6.0	3.7	11.6	7.3
1990	117	73	6.0	3.7	11.4	7.1

Table D.4-11. SAMPLE CALCULATION OF FRACTION OF ANNUAL HEAVY-DUTY, GASOLINE-POWERED VEHICLE TRAVEL BY MODEL YEAR

Age, years	Fraction of total vehicles in use nationwide (a)[a]	Average annual miles driven (b)[b]	a x b	Fraction of annual travel (m)[c]
1	0.037	19,000	703	0.062
2	0.078	18,000	1,404	0.124
3	0.078	17,000	1,326	0.117
4	0.078	16,000	1,248	0.110
5	0.075	14,000	1,050	0.093
6	0.075	12,000	900	0.080
7	0.075	10,000	750	0.066
8	0.068	9,500	646	0.057
9	0.059	9,000	531	0.047
10	0.053	8,500	451	0.040
11	0.044	8,000	352	0.031
12	0.032	7,500	240	0.021
$\geq$13	0.247	7,000	1,729	0.153

[a] Vehicles in use by model year as of 1972 (Reference 1).
[b] Reference 1.
[c] $m = ab/\Sigma ab$.

Table D.4-12. COEFFICIENTS FOR SPEED CORRECTION FACTORS FOR HEAVY-DUTY, GASOLINE-POWERED VEHICLES[a,b]

Location	Model year	$v_{ips} = e^{(A + BS + CS^2)}$						$v_{ips} = A + BS$	
		Hydrocarbons			Carbon monoxide			Nitrogen oxides	
		A	B	C	A	B	C	A	B
Low altitude	Pre-1970	0.953	-6.00×10^{-2}	5.81×10^{-4}	0.967	-6.07×10^{-2}	5.78×10^{-4}	0.808	0.980×10^{-2}
	Post-1969	1.070	-6.63×10^{-2}	5.98×10^{-4}	1.047	-6.52×10^{-2}	6.01×10^{-4}	0.888	0.569×10^{-2}
High altitude	Pre-1970	0.883	-5.58×10^{-2}	5.52×10^{-4}	0.721	-4.57×10^{-2}	4.56×10^{-4}	0.602	2.027×10^{-2}
	Post-1969	0.722	-4.63×10^{-2}	4.80×10^{-4}	0.662	-4.23×10^{-2}	4.33×10^{-4}	0.642	1.835×10^{-2}

[a]Reference 2. Equations should not be extended beyond the range of data (15 to 45 mi/hr). These data are from tests of light-duty vehicles and are assumed applicable to heavy-duty vehicles.
[b]Speed (s) is in miles per hour (1 mi/hr = 1.61 km/hr).

Table D.4-13. LOW AVERAGE SPEED CORRECTION FACTORS FOR HEAVY-DUTY, GASOLINE-POWERED VEHICLES[a]

Location	Model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
		5 mi/hr (8 km/hr)	10 mi/hr (16 km/hr)	5 mi/hr (8 km/hr)	10 mi/hr (16 km/hr)	5 mi/hr (8 km/hr)	10 mi/hr (16 km/hr)
Low altitude	Pre-1970	2.72	1.57	2.50	1.45	1.08	1.03
	Post-1969	3.06	1.75	2.96	1.66	1.04	1.00
High altitude	Pre-1970	2.29	1.48	2.34	1.37	1.33	1.20
	Post-1969	2.43	1.54	2.10	1.27	1.22	1.18

[a] Driving patterns developed from CAPE-21 vehicle operation data (Reference 3) were input to the modal emission analysis model (see section 3.1.2.3). The results predicted by the model (emissions at 8 and 16 km/hr; 5 and 10 mi/hr) were divided by FTP emission factors for hot operation to obtain the above results. The above data represent the best currently available information for light-duty vehicles. These data are assumed applicable to heavy-duty vehicles given the lack of better information.

D.4.3 Crankcase and Evaporative Hydrocarbons

In addition to exhaust emission factors, the calculation of evaporative and crankcase hydrocarbon emissions are determined using:

$$f_n = \sum_{i=n-12}^{n} h_i m_{in} \qquad \text{(D.4-2)}$$

where: f_n = The combined evaporative and crankcase hydrocarbon emission factor for calendar year (n)

h_i = The combined evaporative and crankcase hydrocarbon emission rate for the i^{th} model year. Emission factors for this source are reported in Table D.4-14. Crankcase and evaporative emissions must be combined before applying equation D.4-2.

m_{in} = The weighted annual travel of the i^{th} model year vehicle during calendar year (n)

Table D.4-14. CRANKCASE AND EVAPORATIVE HYDROCARBON EMISSION FACTORS FOR HEAVY-DUTY, GASOLINE-POWERED VEHICLES
EMISSION FACTOR RATING: B

Location	Model years	Crankcase emissions[b]		Evaporative emissions[a]	
		g/mi	g/km	g/mi	g/km
All areas except high altitude and California	Pre-1968	5.7	3.5	5.8	3.6
	Post-1967[c]	0.0	0.0	5.8	3.6
California only	Pre-1964	5.7	3.5	5.8	3.6
	Post-1963[c]	0.0	0.0	5.8	3.6
High altitude	Pre-1968	5.7	3.5	7.4	4.6
	Post-1967[c]	0.0	0.0	7.4	4.6

[a] References 4 through 6 were used to estimate evaporative emission factors for heavy-duty vehicles (HDV). The formula from section 3.1.2.5 was used to calculate g/mi (g/km) values, (evaporative emission factor = g + kd). The HDV diurnal evaporative emissions (g) were assumed to be three times the LDV value to account for the larger size fuel tanks used on HDV. Nine trips per day (d = number of trips per day) from Reference 3 were used in conjunction with the LDV hot soak emissions (t) to yield a total evaporative emission rate in grams per day. This value was divided by 36.2 miles per day (58.3 km/day) from Reference 1 to obtain the per mile (per kilometer) rate.

[b] Crankcase factors are from Reference 7.

[c] HDV evaporative emissions are expected to be controlled in 1978. Assume 50 percent reduction over the above post-1967 values (post-1963 California).

D.4.4 Sulfur Oxide and Particulate Emissions

Projected sulfur oxide and particulate emission factors for all model year heavy-duty, gasoline-powered vehicles are presented in Table D.4-15. Sulfur oxides factors are based on fuel sulfur content and fuel consumption. (Sulfuric acid emissions are between 1 and 3 percent of sulfur oxides emissions.) Tire-wear particulate factors are based on automobile test results, a premise necessary because of the lack of data for heavy-duty vehicles. Truck tire wear is likely to result in greater particulate emission than that for automobiles because of larger tires, heavier loads on tires, and more tires per vehicle. Although the factors presented in Table D.4-15 can be adjusted for the number of tires per vehicle, adjustments cannot be made to account for the other differences.

Table D.4-15. SULFUR OXIDES AND PARTICULATE EMISSION FACTORS FOR HEAVY-DUTY, GASOLINE-POWERED VEHICLES
EMISSION FACTOR RATING: B

Pollutant	Emissions g/mi	Emissions g/km
Particulate		
Exhaust[a]	0.91	0.56
Tire wear[b]	0.20T	0.12T
Sulfur oxides[c] (SO_x as SO_2)	0.36	0.22

[a] Calculated from the Reference 8 value of 12 lb/10^3 gal (1.46 g/liter) gasoline. A 6.0 mi/gal (2.6 km/liter) value from Reference 9 was used to convert to a per kilometer (per mile) emission factor.

[b] Reference 10. The data from this reference are for passenger cars. In the absence of specific data for heavy-duty vehicles, they are assumed to be representative of truck-tire-wear particulate. An adjustment is made for trucks with more than four tires. T equals the number of tires divided by four.

[c] Based on an average fuel consumption of 6.0 mi/gal (2.6 km/liter) from Reference 9, on a 0.04 percent sulfur content from References 11 and 12, and on a density of 6.1 lb/gal (0.73 kg/liter) from References 11 and 12.

D.4.5 Basic Assumptions

Emission factors for heavy-duty vehicles (HDV) are based on San Antonio Road Route data for controlled (1970-1973 model years) trucks[13] and for uncontrolled (pre-1970 model years) trucks.[14] Unpublished data on 1974 trucks and technical judgment were used to estimate emission factors for post-1973 HDV. In doing so, it was assumed that diesel trucks will take over most of the "heavy" HDV market (trucks weighing more than 13,000 kg) and that the average weight of a gasoline-powered HDV will be approximately 26,000 lbs (11,790 kg). It is expected that interim standards for HDV, which will result in significant HC reduction, will be implemented in 1978.

Projected emission factors at high altitude and for the State of California are not reported in these tables; however, they can be derived using the following methodologies. Although all pre-1975 model year HDV emission factors for California vehicles are the same as those reported in these tables, the hydrocarbon and nitrogen oxides values for 1975-1977 model years in California can be assumed equal to the national (tabulated) values for the 1978 model year. Carbon monoxide levels for 1975-1977 HDV in California can be assumed to be 9 percent lower than the 1975-1977 national levels. To convert the national HDV levels for high altitude for all pollutants in a given calendar year, the light-duty vehicle (LDV) ratio of high altitude to low altitude emission factors (by pollutant) can be used. For pre-1970 model year trucks, the pre-1968 model year LDV ratio can be applied. For 1970-1973 model year trucks, the 1968 model year LDV ratio can be applied. For 1974-1977 trucks, the 1970 LDV ratio can be applied. For post-1977 trucks, the 1975 model year LDV ratio can be applied. See section D.1 of this appendix to obtain the data necessary to calculate these ratios.

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D.5 HEAVY-DUTY, DIESEL-POWERED VEHICLES

D.5.1 General

This class of vehicles includes all diesel vehicles with a gross vehicle weight (GVW) of more than 6000 lb (2772 kg). On the highway, heavy-duty diesel engines are primarily used in trucks and buses. Diesel engines in any application demonstrate operating principles that are significantly different from those of the gasoline engine.

D.5.2 Emissions of Carbon Monoxide, Hydrocarbons, and Nitrogen Oxides

Emissions from heavy-duty, diesel-powered vehicles during a calendar year (n) and for a pollutant (p) can be approximately calculated using:

$$e_{nps} = \sum_{i=n-12}^{n} c_{ipn} \, m_{in} \, v_{ips} \qquad \text{(D.5-1)}$$

where: e_{nps} = Composite emission factor in g/mi (g/km) for calendar year (n), pollutant (p), and average speed (s)

c_{ipn} = The emission rate in g/mi (g/km) for the i^{th} model year vehicles in calendar year (n) over a transient urban driving schedule with average speed of approximately 18 mi/hr

m_{in} = The fraction of total heavy-duty diesel miles (km) driven by the i^{th} model year vehicles during calendar year (n)

v_{ips} = The speed correction factor for the i^{th} model year heavy-duty diesel vehicles for pollutant (p) and average speed (s)

Values for c_{ipn} are given in Table D.5-1; values for m_{in} are in Table D.5-2. The speed correction factor (v_{ips}) can be computed using data in Table D.5-3. Table D.5-3 gives heavy-duty diesel HC, CO, and NO_x emission factors in grams per minute for idle operation, for an urban route with average speed of 18 mi/hr (29 km/hr), and for operation at an over-the-road speed of 60 mi/hr (97 km/hr).

Table D.5-1. CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR HEAVY-DUTY DIESEL-POWERED VEHICLES BY CALENDAR YEAR

Pollutant	Model year	Emission factors by calendar year[a]																			
		1973		1974		1975		1976		1977		1978		1979		1980		1985		1990	
		g/mi	g/km	g/mi	g/km	g/mi	g/km	g/mi	g/km	g/mi	g/km	g/mi	g/km	g/mi	g/km	g/mi	g/km	g/mi	g/km	g/mi	g/km
Carbon monoxide	All	28.7	17.8	28.7	17.8	28.7	17.8	28.7	17.8	28.7	17.8	28.7	17.8	28.7	17.8	28.7	17.8	28.7	17.8	28.7	17.8
Hydrocarbons	All	4.6	2.9	4.6	2.9	4.6	2.9	4.6	2.9	4.6	2.9	4.6	2.9	4.6	2.9	4.6	2.9	4.6	2.9	4.6	2.9
Nitrogen oxides	Pre-1978	20.9	13.0	20.9	13.0	20.9	13.0	20.9	13.0	20.9	13.0	20.9	13.0	20.9	13.0	20.9	13.0	20.9	13.0	20.9	13.0
	1978											18.1	11.2	19.0	11.8	19.9	12.4	20.9	13.0	20.9	13.0
	1979													18.1	11.2	19.0	11.8	20.9	13.0	20.9	13.0
	1980															18.1	11.2	20.9	13.0	20.9	13.0
	1981																	20.9	13.0	20.9	13.0
	1982																	20.8	12.9	20.9	13.0
	1983																	19.9	12.4	20.9	13.0
	1984																	19.0	11.8	20.9	13.0
	1985																	18.1	11.2	20.9	13.0
	1986																			20.9	13.0
	1987																			20.8	12.9
	1988																			19.9	12.4
	1989																			19.0	11.8
	1990																			18.1	11.2

[a] Reference 1.

Table D.5-2. SAMPLE CALCULATION OF FRACTION OF ANNUAL HEAVY-DUTY, DIESEL-POWERED VEHICLE TRAVEL BY MODEL YEAR

Age, years	Fraction of total vehicles in use nationwide (a)[a]	Average annual miles driven (b)[b]	a x b	Fraction of annual travel (m)[c]
1	0.077	70,000	5,390	0.096
2	0.135	70,000	9,450	0.169
3	0.134	70,000	9,380	0.168
4	0.131	70,000	9,170	0.164
5	0.099	62,000	6,138	0.110
6	0.090	50,000	4,500	0.080
7	0.082	46,000	3,772	0.067
8	0.062	43,000	2,666	0.048
9	0.045	42,000	1,890	0.034
10	0.033	30,000	990	0.018
11	0.025	25,000	625	0.011
12	0.015	25,000	375	0.007
$\geq$13	0.064	25,000	1,600	0.029

[a]Vehicles in use by model year as of 1972 (Reference 2).
[b]Reference 2.
[c]$m = ab/\Sigma ab$.

Table D.5-3. EMISSION FACTORS FOR HEAVY-DUTY, DIESEL-POWERED VEHICLES UNDER DIFFERENT OPERATING CONDITIONS[a]
(g/min)
EMISSION FACTOR RATING: B

Pollutant	Operating mode		
	Idle	Urban (18 mi/hr; 29 km/hr)	Over-the-road (60 mi/hr; 97 km/hr)
Carbon monoxide	0.64	8.61	5.40
Hydrocarbons	0.32	1.38	2.25
Nitrogen oxides (NO_x as NO_2)	1.03	6.27	28.3

[a]Data are obtained by analysis of results in Reference 1.

For average speeds less than 18 mi/hr (29 km/hr), the correction factor is:

$$v_{ips} = \frac{\text{Urban} + (\frac{18}{S} - 1)\ \text{Idle}}{\text{Urban}} \qquad \text{(D.5-2)}$$

Where: s is the average speed of interest (in mi/hr), and the urban and idle values (in g/min) are obtained from Table D.5-3. For average speeds above 18 mi/hr (29 km/hr), the correction factor is:

$$v_{ips} = \frac{\frac{18}{42S}\ [(60\text{-}S)\ \text{Urban} + (S\text{-}18)\ \text{Over the Road}]}{\text{Urban}} \qquad \text{(D.5-3)}$$

Where: S is the average speed (in mi/hr) of interest. Urban and over-the-road values (in g/min) are obtained from Table D.5-3. Emission factors for heavy-duty diesel vehicles assume all operation to be under warmed-up vehicle conditions. Temperature correction factors, therefore, are not included because ambient temperature has minimal effects on warmed-up operation.

D.5.3 Emissions of Other Pollutants

Emissions of sulfur oxides, sulfuric acid, particulate, aldehydes, and organic acids are summarized in Table D.5-4.

Table D.5-4. SULFUR OXIDES, PARTICULATE, ALDEHYDES, AND ORGANIC ACIDS EMISSION FACTORS FOR HEAVY-DUTY, DIESEL-POWERED VEHICLES
EMISSION FACTOR RATING: B

Pollutant	Emissions[a]	
	g/mi	g/km
Particulate	1.3	0.81
Sulfur oxides[b] (SO_x as SO_2)	2.8	1.7
Aldehydes (as HCHO)	0.3	0.2
Organic acids	0.3	0.2

[a]Reference 3. Particulate does not include tire wear; see heavy-duty gasoline vehicle section for tire wear emission factors.
[b]Data based on assumed fuel sulfur content of 0.20 percent. A fuel economy of 4.6 mi/gal (2.0 km/liter) was used from Reference 4. Sulfuric acid emissions range from 0.5 - 3.0 percent of the sulfur oxides emissions, with the best estimate being 1 percent. These estimates are based on engineering judgment rather than measurement data.

D.5.4 Basic Assumptions

Hydrocarbon and carbon monoxide levels for heavy-duty diesel vehicles until model year 1978 are given by Reference 1. An interim standard for diesel HDV that will restrict nitrogen oxides levels, but not hydrocarbon or carbon monoxide levels, is expected to be implemented in 1978. For purposes of the projections, the nitrogen oxides standard was assumed to be 9 grams per brake horsepower per hour. Nitrogen oxide emission standards in California for 1975-1977 model year HDV are assumed to be equivalent to the national levels in 1978; hydrocarbon and carbon monoxide levels in California will be the same as national levels. A separate table is not given for California, but emissions are the same at those reported in Table D.5-1, with the exception of the 1975-1977 model years. It is assumed that the effect of altitude on diesel emissions is minimal and can be considered negligible.[3]

References for Section D.5

1. Ingalls, M. N. and K. J. Springer. Mass Emissions from Diesel Trucks Operated Over a Road Course. Southwest Research Institute, San Antonio, Texas. Prepared for Environmental Protection Agency, Ann Arbor, Mich. Under Contract No. 68-01-2113. Publication No. EPA-460/3-74-017. August 1974.

2. Census of Transportation. Truck Inventory and Use Survey. Department of Commerce, Bureau of the Census, Washington, D. C. 1974.

3. Young T. C. Unpublished emission factor data on diesel engines. Engine Manufacturers Association Emission Standards Committee, Chicago, Ill. October 16, 1974.

4. Truck and Bus Fuel Economy. U. S. Department of Transportation, Cambridge, Mass. and Environmental Protection Agency, Ann Arbor, Mich. November 1974.

D.6 MOTORCYCLES

D.6.1 General

Motorcycles are becoming an increasingly popular mode of transportation as reflected by steady increases in sales over the past few years. A detailed discussion of motorcycles may be found in section 3.1.7.

D.6.2 Carbon Monoxide, Hydrocarbon, and Nitrogen Oxides Exhaust Emissions

The composite exhaust emission factor is calculated using:

$$e_{nps} = \sum_{i=n-12}^{n} c_{ipn}\, m_{in}\, v_{ips} \qquad \text{(D.6-1)}$$

where: e_{nps} = Composite emission factor in g/mi (g/km) for calendar year (n), pollutant (p), and average speed (s)

c_{ipn} = The test procedure emission factor for pollutant (p) in g/mi (g/km) for the i^{th} model year in calendar year (n)

m_{in} = The weighted annual travel of the i^{th} model year vehicles during calendar year (n). The determination of this variable involves the use of the vehicle year distribution.

v_{ips} = The speed correction factor for the i^{th} model year vehicles for pollutant (p) and average speed (s)

The emission factor results of the Federal Test Procedure (c_{ipn}) as modified for motorcycles are summarized in Tables D.6-1 through D.6-6. Table D.6-7 contains a sample calculation of the variable m_{in} using nationwide statistics.[2] Because there are no speed correction factor data for motorcycles, the variable v_{ips} will be assumed to equal one. The emission factor for particulate, sulfur oxide, and aldehyde and for crankcase and evaporative hydrocarbons are presented in Table D.6-8.

Table D.6-1. PROJECTED CARBON MONOXIDE, HYDROCARBON AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR MOTORCYCLES FOR PRE-1977 AND 1977 CALENDAR YEARS

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low altitude						
Pre-1977[a,b]	30.6	19.0	8.1	5.0	0.2	0.1
1977[b]	28.0	17.4	5.0	3.1	0.25	0.16

[a]Factors for pre-1977 calendar years.
[b]Factors for calendar year 1977.

Table D.6-2. PROJECTED CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR MOTORCYCLES FOR CALENDAR YEAR 1978

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low altitude						
Pre-1977	30.6	19.0	8.1	5.0	0.2	0.1
1977	29.4	18.3	5.5	3.4	0.25	0.16
1978	28.0	17.4	5.0	3.1	0.25	0.16

Table D.6-3. PROJECTED CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR MOTORCYCLES FOR CALENDAR YEAR 1979

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low altitude						
Pre-1977	30.6	19.0	8.1	5.0	0.2	0.1
1977	30.6	19.0	6.0	3.7	0.25	0.16
1978	29.4	18.3	5.5	3.4	0.25	0.16
1979	28.0	17.4	5.0	3.1	0.25	0.16

Table D.6-4. PROJECTED CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR MOTORCYCLES FOR CALENDAR YEAR 1980

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low altitude						
Pre-1977	30.6	19.0	8.1	5.0	0.2	0.1
1977	30.6	19.0	6.5	4.0	0.25	0.16
1978	30.6	19.0	6.0	3.7	0.25	0.16
1979	29.4	18.3	5.5	3.4	0.25	0.16
1980	28.0	17.4	5.0	3.1	0.25	0.16

Table D.6-5. PROJECTED CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR MOTORCYCLES FOR CALENDAR YEAR 1985

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low altitude						
Pre-1977	30.6	19.0	8.1	5.0	0.2	0.1
1977	30.6	19.0	8.1	5.0	0.25	0.16
1978	30.6	19.0	8.1	5.0	0.25	0.16
1979	30.6	19.0	8.0	5.0	0.25	0.16
1980	30.6	19.0	7.5	4.7	0.25	0.16
1981	30.6	19.0	7.0	4.3	0.25	0.16
1982	30.6	19.0	6.5	4.0	0.25	0.16
1983	30.6	19.0	6.0	3.7	0.25	0.16
1984	29.4	18.3	5.5	3.4	0.25	0.16
1985	2.1	1.3	0.41	0.25	0.4	0.2

Table D.6-6. PROJECTED CARBON MONOXIDE, HYDROCARBON, AND NITROGEN OXIDES EXHAUST EMISSION FACTORS FOR MOTORCYCLES FOR CALENDAR YEAR 1990

Location and model year	Carbon monoxide		Hydrocarbons		Nitrogen oxides	
	g/mi	g/km	g/mi	g/km	g/mi	g/km
Low altitude						
1977	30.6	19.0	8.1	5.0	0.25	0.16
1978	30.6	19.0	8.1	5.0	0.25	0.16
1979	30.6	19.0	8.1	5.0	0.25	0.16
1980	30.6	19.0	8.1	5.0	0.25	0.16
1981	30.6	19.0	8.1	5.0	0.25	0.16
1982	30.6	19.0	8.1	5.0	0.25	0.16
1983	30.6	19.0	8.1	5.0	0.25	0.16
1984	30.6	19.0	8.0	5.0	0.25	0.16
1985	3.1	1.9	0.81	0.50	0.4	0.25
1986	2.9	1.8	0.73	0.45	0.4	0.25
1987	2.7	1.7	0.65	0.40	0.4	0.25
1988	2.5	1.6	0.57	0.35	0.4	0.25
1989	2.3	1.4	0.49	0.30	0.4	0.25
1990	2.1	1.3	0.41	0.25	0.4	0.25

Table D.6-7. SAMPLE CALCULATION OF FRACTION OF ANNUAL MOTORCYCLE TRAVEL BY MODEL YEAR

Age, years	Fraction of total vehicles in use nationwide (a)[a]	Average annual miles driven (b)[b]	a x b	Fraction of annual travel (m)[c]
1	0.04	2,500	100	0.064
2	0.20	2,100	420	0.268
3	0.19	1,800	342	0.218
4	0.16	1,600	256	0.163
5	0.10	1,400	140	0.089
6	0.09	1,200	108	0.069
7	0.05	1,100	55	0.035
8	0.03	1,000	30	0.019
9	0.03	950	29	0.019
10	0.02	900	18	0.011
11	0.0005	850	4	0.003
≥12	0.085	800	68	0.043

[a]Vehicles in use by model year as of 1974 (Reference 2).
[b]Reference 2.
[c]$m = ab/\Sigma ab$.

Table D.6-8. SULFUR OXIDE, ALDEHYDE, AND CRANKCASE AND EVAPORATIVE HYDROCARBON EMISSION FACTORS FOR MOTORCYCLES[a]

Pollutant	Emissions			
	2-stroke engine		4-stroke engine	
	g/mi	g/km	g/mi	g/km
Hydrocarbons				
Crankcase[b]	–	–	0.60	0.37
Evaporative[c]	0.36	0.22	0.36	0.22
Particulates	0.33	0.21	0.046	0.029
Sulfur oxides[d] (SO_x as SO_2)	0.038	0.024	0.022	0.014
Aldehydes (RCHO as HCHO)	0.11	0.068	0.047	0.029

[a]Reference 1.
[b]Most 2-stroke engines use crankcase induction and produce no crankcase losses.
[c]Evaporative emissions were calculated assuming that carburetor losses were negligible. Diurnal breathing of the fuel tank (a function of fuel vapor pressure, vapor space in the tank, and diurnal temperature variation) was assumed to account for all the evaporative losses associated with motorcycles. The value presented is based on average vapor pressure, vapor space, and temperature variation.
[d]Calculated using a 0.043 percent sulfur content (by weight) for regular fuel used in 2-stroke engines and 0.022 percent sulfur content (by weight) for premium fuel used in 4-stroke engines.

D.6.3 Basic Assumptions

Baseline emission data are from Reference 1. The motorcycle population was assumed to be 60 percent 4-stroke and 40 percent 2-stroke.

For the interim standards, deterioration factors for 1977 through 1984 were assumed to be: 10 percent per calendar year for hydrocarbons, 5 percent per calendar year for carbon monoxide, and 0 percent per calendar year for nitrogen oxides. For 1985 and beyond, deterioration factors are: 20 percent per calendar year for hydrocarbon, 10 percent per calendar year for carbon monoxide, and 0 percent per calendar year for nitrogen oxides. Motorcycles are assumed to deteriorate until they reach uncontrolled emission values. The deterioration rate is a fixed percentage of base year emissions.

References for Section D.6

1. Hare, C. T. and K. J. Springer. Exhaust Emissions from Uncontrolled Vehicles and Related Equipment Using Internal Combustion Engines. Part III, Motorcycles. Final Report. Southwest Research Institute, San Antonio, Texas. Prepared for Environmental Protection Agency, Research Triangle Park, N. C. under Contract No. EHS 70-108. Publication No. APTD-1492. March 1973.

2. Motorcycle Usage and Owner Profile Study. Hendrix, Tucker and Walder, Inc., Los Angeles, Calif. March 1974.

D.7 ALL HIGHWAY VEHICLES

D.7.1 General

Emission factors for 1972 for all major classes of highway vehicle are summarized in section 3.1.1. A number of scenarios that embody a range of local conditions, such as different ambient temperatures and average route speeds, are considered. Although similar data for calendar years 1973 through 1990 are presented here, only one scenario is presented. This single scenario is presented because it is general in nature and, therefore, most appropriate for a range of applications. The authors, however, believe that projections of any significance should be based on the data and methodologies presented in sections D.1 through D.6 of this appendix. The data presented in this section are, clearly, only approximations and are useful only for rough estimates.

The scenario considers the four major highway vehicle classes: light-duty, gasoline-powered vehicles (LDV); light-duty, gasoline-powered trucks (LDT); heavy-duty, gasoline-powered vehicles (HDV); and heavy-duty, diesel-powered vehicles (HDD). An average route speed of approximately 19.6 mi/hr (31.6 km/hr) is assumed. The ambient temperature is assumed to be 24°C (75°F). Twenty percent of LDV and LDT operation is considered to be in a cold operation; all HDV and HDG operation is taken to be in warmed-up condition. The percentage of total vehicular travel by each of the vehicle classes is based on nationwide data.[1,2] The percentage of travel by class is assumed to be 80.4 percent by LDV, 11.8 percent by LDT, 4.6 by HDV, and 3.2 percent by HDD.

D.7.2 Emissions

Emissions for the five pollutants for all highway vehicles are presented in Table D.7-1. The results are only an approximate indication of how future emission-controlled vehicles will influence the overall emissions from the fleet of vehicles on the road. These values do not apply to high altitude areas, nor do they apply to vehicles in the State of California.

Table D.7-1. AVERAGE EMISSION FACTORS FOR HIGHWAY VEHICLES FOR SELECTED CALENDAR YEARS

Calendar year	Carbon monoxide		Hydrocarbons		Nitrogen oxides		Sulfur oxides[a]		Particulate	
	g/mi	g/km	g/mi	g/km	g/mi	g/km	g/mi	g/km	g/mi	g/km
1973	71.5	44.4	10.1	6.3	4.9	3.0	0.23	0.14	0.61	0.38
1974	67.5	41.9	9.4	5.8	4.8	3.0	0.23	0.14	0.61	0.38
1975	61.1	37.9	8.8	5.5	4.8	3.0	0.23	0.14	0.59	0.37
1976	54.6	33.9	8.0	5.0	4.8	3.0	0.22	0.14	0.57	0.35
1977	48.3	30.0	7.2	4.5	4.6	2.9	0.22	0.14	0.54	0.34
1978	42.7	26.5	6.6	4.1	4.3	2.7	0.21	0.13	0.51	0.32
1979	36.8	22.9	6.1	3.8	3.9	2.4	0.21	0.13	0.49	0.30
1980	31.0	19.3	5.4	3.4	3.6	2.2	0.20	0.12	0.47	0.29
1985	15.7	9.8	2.7	1.7	2.4	1.5	0.19	0.12	0.41	0.25
1990	11.3	7.0	1.9	1.2	2.0	1.2	0.19	0.12	0.40	0.25

[a]Fuel sulfur levels may be reduced in the future. If so, sulfur oxides emissions will be reduced proportionately.

References for Section D.7.

1. Highway Statistics 1971. U.S. Department of Transportation, Federal Highway Administration, Washington, D. C. 1972. p. 81

2. 1972 Census of Transportation. Truck Inventory and Use Survey. U.S. Department of Commerce, Bureau of the Census, Washington, D.C. 1974.

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16. ABSTRACT

In this supplement for Compilation of Air Pollutant Emission Factors (AP-42), revised and updated emissions data are presented for lignite combustion sources, for various categories of mobile sources, for explosives manufacturing sources, and for fugitive dust sources.

17. KEY WORDS AND DOCUMENT ANALYSIS

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