

State of California
AIR RESOURCES BOARD

**CALIFORNIA EXHAUST EMISSIONS STANDARDS AND TEST PROCEDURES
FOR 1997 AND LATER OFF-HIGHWAY RECREATIONAL VEHICLES AND ENGINES**

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PROCEDURES
FOR 1997 AND LATER
OFF-HIGHWAY RECREATIONAL VEHICLES AND ENGINES**

Subpart E. General Provisions for Emission Regulations for 1978 and Later New Motorcycles.

Sec. 86.401-90 General applicability.

(a) This subpart applies to all 1997 and later model year off-road motorcycles, all-terrain vehicles, golf carts, and engines used in such vehicles produced on or after January 1, 1997 and all 2007 and later model year off-road sport vehicles, off-road utility vehicles, sand cars, and engines used in such vehicles produced on or after January 1, 2007.

Sec. 86.402-78 Definitions.

(a) The definitions in this section apply to this subpart and also to subpart F.

“Act” means part A of title II of the Clean Air Act, 42 U.S.C. 1857 f-1 through f-7, as amended by Pub. L. 91-604.

“Administrator” means the Executive Officer of the Air Resources Board, or their designee.

“All-Terrain Vehicle” means any off-highway motor vehicle 50 inches (1270 mm) or less in overall width that has all of the following features and characteristics: designed to travel on four or more low pressure tires, having a single seat designed to be straddled by the operator or a single seat designed to be straddled by the operator and a seat for no more than one passenger, having handlebars for steering control, and is powered by an internal combustion engine. Width shall be exclusive of accessories and optional equipment. A golf cart, off-road sport vehicle, off-road utility vehicle or sand car is not, for purposes of this regulation, to be classified as an all-terrain vehicle.

“Certificate of Conformity” means an Executive Order.

“Certification” means certification as defined in Section 39018 of the Health and Safety Code.

“Class,” see Sec. 86.419.

“Crankcase emissions” means airborne substances emitted to the atmosphere from any portion of the engine crankcase ventilation or lubrication systems.

“Curb mass” means the actual or manufacturer's estimated mass of the vehicle with fluids at nominal capacity and with all equipment specified by the Administrator.

“Displacement,” and “Displacement Class,” see Sec. 86.419.

“Engine family” means the basic classification unit of a manufacturer's product line used for the purpose of test fleet selection and determined in accordance with Sec. 86.420.

“Engine-displacement-system combination” means an engine family-displacement-emission control system combination.

“EPA Enforcement Officer” means an “ARB Enforcement Officer” which means any employee of the Air Resources Board so designated in writing by the Executive Officer of the Air Resources Board or by the Executive Officer's designee.

“Executive Order” means an order issued by the Executive Officer of the Air Resources Board certifying engines for sale in California.

“Exhaust Emissions” means substances emitted to the atmosphere from any opening downstream from the exhaust port of an off-highway recreational vehicle.

“Fuel system” means the combination of fuel tank, fuel pump, fuel lines, oil injection metering system, and carburetor or fuel injection components, and includes all fuel system vents.

“Golf Cart” means a vehicle used to convey equipment and no more than two persons, including the driver, to play the game of golf in an area designated as a golf course. Golf carts are designed to have an unladen weight of less than 1,300 pounds and carry not more than 100 pounds, excluding passengers, accessories and optional equipment. A golf cart is not used for grounds keeping or maintenance purposes.

“Loaded vehicle mass” means curb mass plus 80 kg (176 lb.), average driver mass.

Model year means the manufacturer's annual production period (as determined by the Administrator) which includes January first of such calendar year. If the manufacturer has no annual production period, the term model year shall mean the calendar year.

“Motorcycle,” for purposes of these test procedures, means Off-Road Motorcycle, All-Terrain Vehicle, Off-Road Sport Vehicle, Off-Road Utility Vehicle, Sand Car and Engines used in such vehicles.

“Off-Highway Recreational Vehicle Engines” or “Engines” are identified as: two-stroke or four-stroke, air-cooled, liquid-cooled, gasoline, diesel, or alternate-fuel powered engines or electric motors that are designed for powering off-road recreational vehicles and engines included in the following: off-road motorcycles, all-terrain vehicles, off-road sport vehicles, off-road utility vehicles, sand cars, and golf carts. All engines and equipment that fall within the scope of the preemption of Section 209(e)(1)(A) of the Federal Clean Air Act, as amended, and as defined by regulation of the Environmental Protection Agency, are specifically not included within this category.

“Off-Road Equipment and Vehicle” means any non-stationary device, powered by an internal combustion engine or electric motor, used primarily off the highways, to propel, move, or draw persons or property including any device propelled, moved, or drawn exclusively by human power, and used in, but not limited to the following applications: Marine Vessels, Construction/Farm Equipment, Locomotives, Utility engines and Lawn and Garden Equipment, Off-Road Motorcycles, and Off-Highway Vehicles.

“Off-Road Motorcycle” means any two or three wheeled vehicle equipped with an internal combustion engine and weighing less than 1,499 pounds. An off-road motorcycle is primarily designed for use off highways. These vehicles are mainly used for recreational riding on dirt trails but are not limited to this purpose.

“Off-Road Sport Vehicle” means any off-highway motor vehicle that has all of the following features and characteristics: designed to travel on four wheels, having bench or bucket seating for one or more persons, having a steering wheel for steering control, designed for operation over rough terrain, having a rear payload not exceeding 600 pounds, having an internal combustion engine with a displacement less than or equal to one liter, and is capable of speeds 25 miles per hour or more. Vehicles otherwise meeting the definition for sand cars but powered by an engine with a displacement less than or equal to one liter are considered off-road sport vehicles.

“Off-Road Utility Vehicle” means any off-highway motor vehicle that has all of the following features and characteristics: designed to travel on four or more wheels, having bench or bucket seating for two or more persons, having a steering wheel for steering control, designed for operation over rough terrain, having an internal combustion engine with a displacement less than or equal to one liter, having a maximum brake power less than or equal to 30 kilowatts, capable of speeds 25 miles per hour or more, and having either 1) a rear payload of 350 pounds or more, or 2) seating for six or more passengers.

“Oxides of nitrogen” means the sum of the nitric oxide and nitrogen dioxide contained in a gas sample as if the nitric oxide were in the form of nitrogen dioxide.

“Sand Car” means any off-highway motor vehicle that has all of the following features and characteristics: designed to travel on four wheels, having bench or bucket seating for one or more persons, having a steering wheel for steering control, designed primarily for operation over sand dunes, and is powered by an internal combustion engine with a displacement greater than one liter. Vehicles otherwise meeting the criteria in the previous sentence that are powered by an engine with a displacement less than or equal to one liter are considered off-road sport vehicles.

“Scheduled maintenance” means any adjustment, repair, removal, disassembly, cleaning, or replacement of vehicle components or systems which is performed on a periodic basis to prevent part failure or vehicle malfunction, or anticipated as necessary to correct an overt indication of vehicle malfunction or failure for which periodic maintenance is not appropriate.

“Span gas” means a gas of known concentration which is used routinely to set the output level of any analyzer.

“System” includes any motor vehicle modification which controls or causes the reduction of substances emitted from motor vehicles.

“Total Test Distance” is defined as the appropriate distance the vehicle should be driven to stabilize the emission characteristics of the engine. The manufacturer shall determine the appropriate distance.

“Ultimate Purchaser” means the first person who in good faith purchases or leases a new engine, vehicle, or piece of equipment for purposes other than resale.

“Unscheduled maintenance” means any inspection, adjustment, repair, removal, disassembly, cleaning, or replacement of vehicle components or systems which is performed to correct or diagnose a part failure or vehicle malfunction which was not anticipated.

“Useful life” is defined as follows:

ENGINE DISPLACEMENT
(in cubic centimeters)

USEFUL LIFE
(in years and Kilometers)

0 to less than 170

5 years or 10,000 km

170 to less than 280

5 years or 10,000 km

280 or greater

5 years or 10,000 km

“Vehicle Identification Number (VIN)” means an alpha numeric code which has been permanently assigned by the manufacturer to a vehicle. The VIN is unique to each vehicle and may contain information deemed necessary by governing agencies. Unless otherwise noted, the VIN will follow formats specified in the Code of Federal Regulations 49, Chapter V, Parts 565, 566, and 571, section 571.115 – Vehicle Identification Number – Content Requirements.

“Zero kilometers” means that point after normal assembly line operations and adjustments, after normal dealer setup and pre-ride inspection operations have been completed, and before 100 kilometers of vehicle operation of three hours of engine operation have been accumulated, including emission testing if performed.

(b) [Reserved]

Sec. 86.403-78 Abbreviations.

The abbreviations used in this subpart have the following meanings in both capital and lowercase:

ARB--California Air Resources Board.

ASTM--American Society for Testing and Materials.

Bhp--Brake-horsepower.

Bhp-hr--Brake horsepower-hour.

C--Celsius.

cc--Cubic centimetre(s).

cfh--Cubic feet per hour.

cfm--Cubic feet per minute.

cm--Centimetre(s).

CO--Carbon monoxide.

CO₂--Carbon dioxide.

Conc--Concentration.

cu.--Cubic.

CVS--Constant volume sampler.

EGR--Exhaust gas recirculation.

EP--End point.

EPA--Environmental Protection Agency.

F--Fahrenheit.

h--hour.

HC--Hydrocarbon(s).

Hg--Mercury.

Hp--Horsepower.

H₂O--Water.

in.--Inch(es).

K--Kelvin.

kg--Kilogram(s).
km--Kilometre(s).
kpa--Kilopascals.
lb--Pound(s).
m--Metre(s).
mph--Miles per hour.
mm--Millimetre(s).
N₂--Nitrogen.
NO_x--Oxides of nitrogen.
No.--Number.
O₂--Oxygen.
Pa--Pascal(s).
Pb--lead.
PM--Particulate Matter
ppm--Parts per million by volume.
psi--Pounds per square inch.
psig--Pounds per square inch gauge.
R--Rankine.
rpm--Revolutions per minute.
wt--Weight.
[deg]--Degree(s).
%--Percent.

Sec. 86.404-78 Section numbering.

(a) The year of initial applicability of a section is indicated by its section number. The two digits following the hyphen designate the first model year for which a section is effective. A section remains effective until superseded.

Example: Section 86.411-78 applies to 1978 and subsequent model years until it is superseded. If a Sec. 86.411-81 is promulgated it would take effect beginning with 1981; Sec. 86.411-78 would apply to years 1978 through 1980.

(b) A reference to a section without a year designation implies the appropriate model year.

Example: When considering 1979 vehicles a reference to Sec. 86.411 implies Sec. 86.411-79. However if no Sec. 86.411-79 has been promulgated then Sec. 86.411-78 is implied; See paragraph (a) of this section.

Sec. 86.405-78 Measurement system.

(a) This subpart and subpart F have been written using System International (SI) units. SI units will be used to determine compliance with these regulations. English equivalents have been indicated solely for the user's convenience.

(b) [Reserved]

Sec. 86.407-78 Certificate of conformity required.

Every new off-road motorcycle, all-terrain vehicle, off-road sport vehicle, off-road utility vehicle, sand car, golf cart, and engine used in such vehicles produced for sale, lease, or use, or introduced into commerce in California which is subject to any of the standards prescribed in this subpart is required to be covered by an executive order issued pursuant to this subpart.

Sec. 86.408-78 General standards; increase in emissions; unsafe conditions.

(a) Any system installed on or incorporated in a new off-road motorcycle, all-terrain vehicle, off-road sport vehicle, off-road utility vehicle, sand car, golf cart or engine used in such vehicles to enable such vehicles to conform to standards imposed by this subpart:

(1) Shall not in its operation or function cause the emission into the ambient air of any noxious or toxic substance that would not be emitted in the operation of such vehicle without such system, except as specifically permitted by regulation; and

(2) Shall not in its operation, function, or malfunction result in any unsafe condition endangering the motorcycle, its rider(s), or persons or property in close proximity to the vehicle.

(b) Every manufacturer of new off-road motorcycles, all-terrain vehicles, off-road sport vehicles, off-road utility vehicles, sand cars, and engines used in such vehicles, which subject to any of the standards imposed by this subpart shall test or cause to be tested off-road motorcycles, all-terrain vehicles, off-road sport vehicles, off-road utility vehicles, sand cars, and engines used in such vehicles, in accordance with good engineering practice to ascertain that such test vehicles will meet the requirements of this section for the useful life of the vehicle.

Sec. 86.409-78 Defeat devices, prohibition.

(a) No off-road motorcycle, all-terrain vehicle, golf cart, off-road sport vehicle, off-road utility vehicle, sand car, and engines used in such vehicles shall be equipped with a defeat device.

(b) Defeat device means any element of design which:

(1) Senses temperature, vehicle speed, engine RPM, transmission gear, manifold vacuum, or any other parameter for the purpose of activating, modulating, delaying or deactivating the operation of any part of the emission control system and

(2) Reduces the effectiveness of the emission control system under conditions which may reasonably be expected to be encountered in normal urban vehicle operation and use, unless

(i) Such conditions are substantially included in the Federal emission test procedure, or

(ii) The need for the device is justified in terms of protecting the vehicle against damage or accident, or

(iii) The device does not go beyond the requirements of engine starting or warm-up.

Sec. 86.410-90 Emission standards for 1990 and later model year motorcycles.

(a)(1) Unless otherwise specified in California Code of Regulations, Title 13, section 2412, exhaust emissions from 1997 and later off-road motorcycles and all-terrain vehicles with engines greater than 90 cc must not exceed:

(i) Hydrocarbons. 1.2 grams per vehicle kilometer. Compliance is based on a manufacturer's corporate average basis, as provided in (b) below.

(ii) Carbon Monoxide. 15.0 grams per vehicle kilometer.

(2) Unless otherwise specified in California Code of Regulations, Title 13, section 2412, exhaust emissions from 1999 and later off-road motorcycles and all-terrain vehicles with engines 90 cc or less must not exceed:

(i) Hydrocarbons. 1.2 grams per vehicle kilometer. Compliance is based on a manufacturer's corporate average basis, as provided in (b) below.

(ii) Carbon Monoxide. 15.0 grams per vehicle kilometer.

(3) Unless otherwise specified in California Code of Regulations, Title 13, section 2412, exhaust emissions from 2007 and later off-road sport vehicles, off-road utility vehicles, and sand cars must not exceed:

(i) Hydrocarbons. 1.2 grams per vehicle kilometer. Compliance is based on a manufacturer's corporate average basis, as provided in (b) below.

(ii) Carbon Monoxide. 15.0 grams per vehicle kilometer.

(4) The standards set forth in paragraphs (a)(1), (a)(2), and (a)(3) of this section refer to the exhaust emitted over driving schedules as set forth in subpart F and measured and calculated in accordance with those procedures.

(b) Compliance with a standards to be applied as a "corporate average" shall be determined as follows:

$$\frac{\sum_{j=1}^n (PROD)_{jx} (STD)_{jx}}{\sum_{j=1}^n (PROD)_{jx}} = STD_{ca}$$

n = Off-highway recreational vehicle engine families.

PROD_{jx} = Number of units in engine family j produced for sale in California in model year x.

STD_{jx} = The manufacturer designated HC exhaust emission standard for engine family j in model year x, which shall be determined by the manufacturer subject to the following conditions: (1) no individual engine family exhaust emission standard shall exceed 2.5 g/km, and (2) no engine family designation or engine family exhaust emission standard shall be amended in a model year after the engine family is certified for the model year, and (3) prior to sale or offering for sale in California, each engine family shall be certified in accordance with these test procedures, and shall be required to meet the manufacturer's designated HC exhaust emission standard as a condition of the certification Executive Order, and (4) zero emission off-road vehicles shall be assigned an HC or HC + NOx exhaust emission standard of negative one (-1). Prior to certification the manufacturer shall also submit estimated production volumes for each engine family to be offered for sale in California.

STD_{ca} = A manufacturer's corporate average HC exhaust emissions from those California off-road motorcycles and all-terrain vehicles subject to the California corporate average HC exhaust emissions standard, as established by an Executive Order certifying the California production for the model year. This order must be obtained prior to the issuance of certification Executive Orders for individual engine families for the model year and shall include but not be limited to the following requirements:

(1) During the manufacturer's production year, for each vehicle produced for sale in California, the manufacturer must provide the following information to the Executive Officer within 30 days after the last day in each calendar quarter:

- (i) vehicle identification numbers and an explanation of the identification code if applicable;
- (ii) model number and engine size of vehicle;

(iii) the total number of vehicles marketed and produced for sale in California and their applicable designated emissions standards;

(2) The manufacturer's average HC exhaust emissions shall meet the corporate average standard at the end of the manufacturer's production for the model year.

(3) Production and sale of vehicles which result in noncompliance with the California standard for the model year shall cause a manufacturer to be subject to civil penalties, according to applicable provisions of the Health and Safety Code. All excess emissions resulting from non-compliance with the California standard shall be made up in the following model year.

(4) For a period of up to one year following the end of the model year, for each model the manufacturer shall submit California sales and registration data as it becomes available.

(c) As an option to the standards set forth in section (a)(1) above, exhaust emissions from 1997 and later all-terrain vehicle engines and 2007 and later off-road sport vehicles, off-road utility vehicles, and sand cars must not exceed the applicable HC+NO_x standard in Section 2412(b), CCR, Title 13, using the test procedures set forth in "California Exhaust Emission Standards and Test Procedures for 1995-2004 Small Off-Road Engines", adopted March 20, 1992, and last amended July 26, 2004, which is hereby incorporated by reference herein. Compliance with the optional HC+NO_x standard is based on a manufacturer's corporate average basis, as provided in Section 2412(d), CCR, Title 13.

(d)(1) Emissions from 1997 and later model year golf carts operating in federal ozone non-attainment areas of California must not exceed zero grams hydrocarbon, carbon monoxide, oxides of nitrogen, and particulate matter.

(2) These vehicles must be certified by the Executive Officer pursuant to all applicable regulations set forth in CCR, Title 13, Chapter 9. Emission test procedures are not applicable to these vehicles.

(3) On or after January 1, 1997, manufacturers must not produce for sale in federal ozone non-attainment areas of California new nonzero emission engines for use in golf carts.

(e)(1) As an option to the standards set forth in section (a) above, off-road motorcycles and ATVs of model year 2003 through 2021, and engines used in such vehicles, that do not meet the emissions standards in section (a) may operate only during certain periods at certain off-highway vehicle (OHV) riding areas until January 1, 2025. CCR, Title 13, Chapter 9, Article 3, Section 2415 lists these California OHV riding areas and their associated riding seasons for off-highway recreational vehicles that are subject to use restrictions.

(2) These vehicles must be certified by the Executive Officer pursuant to all applicable regulations set forth in CCR, Title 13, Chapter 9. Emission testing is not applicable to these vehicles.

(f) No crankcase emissions shall be discharged into the ambient atmosphere from the following vehicle or from engines used in such vehicles:

(1) 1997 and later off-road motorcycles, all-terrain vehicles, and golf carts;

(2) 2007 and later off-road sport vehicles, off-road utility vehicles, and sand cars.

(g) The Executive Officer may find that any off-road motorcycles, all-terrain vehicles, off-road sport vehicles, off-road utility vehicles, sand cars or engines used in such vehicles certified to comply with California emission standards and test procedures for on-road or other off-road applications are in compliance with these regulations.

Sec. 86.411-78 Maintenance instructions, vehicle purchaser.

(a) The manufacturer shall furnish or cause to be furnished to the ultimate purchaser of each new off-road motorcycle, all-terrain vehicle, golf cart, off-road sport vehicle, off-road utility vehicle, sand car, and engines used in such vehicles the written instructions for the periodic and anticipated maintenance and use of the vehicle by the ultimate purchaser as may be reasonable and necessary to assure the proper functioning of emission control systems for the vehicle's useful life.

(1) Such instructions shall be provided for those vehicle and engine components listed in appendix VI to this part (and for any other components) to the extent that maintenance of these components is necessary to assure the proper functioning of emission control systems.

(2) Such instructions shall be in the English language and in clear, and to the extent practicable, nontechnical language.

(b) The maintenance instructions required by this section shall:

(1) Contain a general description of the documentation which the manufacturer will require from the ultimate purchaser or any subsequent purchaser as evidence of compliance with the instructions, and

(2) Specify the performance of all scheduled maintenance performed by the manufacturer under Sec. 86.428.

Sec. 86.412-78 Maintenance instructions, submission to Administrator.

(a) Instructions for ultimate purchaser.

(1) The manufacturer must provide to the Executive Officer, at least 30 days before being supplied to the ultimate purchaser (unless the Executive Officer consents to a lesser period of time), a copy of the maintenance instructions which the manufacturer proposes to supply to the ultimate purchaser. The instructions must include the periodic and anticipated maintenance contained in the applications for certification or contained in the manufacturers' records. Such instructions must be reasonable and necessary to assure the proper functioning of the vehicle's emission control systems.

(2) Any revision to the maintenance instructions which will affect emissions shall be supplied to the Administrator at least 30 days before being supplied to the ultimate purchaser unless the Administrator consents to a lesser period of time.

(b) Other instructions. The manufacturer of any new off-road motorcycle, all-terrain vehicle, golf cart, off-road sport vehicle, off-road utility vehicle, sand car, and engines used in such vehicles subject to any of the standards prescribed in this subpart shall submit to the Administrator at the time of issuance by the manufacturer, copies of all sales brochures, instructions, or explanations regarding the use, repair, adjustment, maintenance, or testing of such vehicle relevant to the control of crankcase or exhaust emissions, issued by the manufacturer for use by other manufacturers, assembly plants, distributors, dealers, repair facilities, and ultimate purchasers. Any material not translated into the English language need not be submitted unless specifically requested by the Administrator.

Sec. 86.413-78 Labeling.

(a) All 1997 and later model year off-road motorcycles, all-terrain vehicles, and engines used in such vehicles, except those certified according to 86.410-90(e), and 2007 and later model year off-road sport vehicles, off-road utility vehicles, sand cars, and engines used in such vehicles, have California labeling requirements which shall be consistent with (a) these test procedures, and (b) Title 13, California Code of Regulations, Chapter 9, Section 2413.

Sec. 86.414-78 Submission of vehicle identification number.

(a) Upon the request by the Executive Officer, the manufacturer of any off-road motorcycle, all-terrain vehicle, off-road sport vehicle, off-road utility vehicle, or sand car shall, within 30 days, identify by vehicle identification number, the vehicle(s) covered by the executive order.

(b)(1) The manufacturer of any off-road motorcycle, all-terrain vehicle, off-road sport vehicle, off-road utility vehicle, or sand car certified under an Executive Order shall furnish to the Executive Officer, at the beginning of each model year, its vehicle identification-number (VIN) coding system description which identifies such vehicle(s) as covered by the Executive Order.

(2) The (VIN) shall be consistent with the Code of Federal Regulations 49, Chapter V, Parts 565, 566, and 571, section 571.115 – Vehicle Identification Number – Content Requirements, which are incorporated herein by reference, except as noted below.

(3) Manufacturers shall identify all California certified off-road motorcycles, all-terrain vehicles, off-road sport vehicles, off-road utility vehicles, and sand cars meeting the emission standards in 86.410-90(a) by using any letter or digit other than the letter “C” or the digit “3” in the eighth character of the VIN.

(4) Manufacturers shall exclusively reserve all letters and digits other than the letter “C” or the digit “3” for use in the eighth character of the VIN of California certified off-road motorcycles, all-terrain vehicles, off-road sport vehicles, off-road utility vehicles, and sand cars meeting the emission standards in 86.410-90(a).

(5) Manufacturers shall use either the letter “C” or the digit “3” for use in the eighth character of the VIN of California off-road motorcycles and all-terrain vehicles meeting the requirements in 86.410-90(e).

(6) In lieu of (b)(3) and (b)(4) above, manufacturers may, at their option, agree to identify off-road motorcycles and all-terrain vehicles that do not meet the emission standards in 86.410-90(a), and do not meet the requirements in 86.410-90(e), and are offered for sale in California, by using the letter “C” or the digit “3” in the eighth character of the VIN.

Sec. 86.415-78 Production vehicles.

(a) Any manufacturer obtaining certification shall supply to the Administrator, upon his request, a reasonable number of production vehicles selected by the Administrator which are representative of the engines, emission control systems, fuel systems, and transmissions offered and typical of production models available for sale under the certificate. These vehicles shall be supplied for testing at such time and place and for such reasonable periods as the Administrator may require.

(b) Any manufacturer obtaining certification shall notify the Administrator, on a yearly basis, of the number of vehicles of each engine family--engine displacement--emission control system--fuel system--transmission type--inertial mass category combination produced for sale in the United States during the preceding year.

(c) All motorcycles covered by a certificate of conformity shall prior to delivery to the ultimate purchaser be adjusted, by the manufacturer or his agent, to the ignition timing specification detailed in Sec. 86.413.

Sec. 86.416-80 Application for certification.

(a) New off-road motorcycles, all-terrain vehicles, off-road sport vehicles, off-road utility vehicles, sand cars, and engines used in such vehicles are covered by the following:

(1) An application for a certificate of conformity to the regulations in the English language applicable to new motorcycles shall be made to the Administrator by the manufacturer and shall be updated and corrected by amendment. Where possible, a manufacturer should include in a single application for certification, a description of all vehicles in each class for which certification is required. A manufacturer may, however, choose to apply separately for certification of part of his product line. The selection of test vehicles and the computation of test results will be determined separately for each application.

(2) The application shall be in writing signed by an authorized representative of the manufacturer, and shall include the following:

(i) Identification and description of the vehicles covered by the application and a description of their engine, emission control system and fuel system components. This shall include a detailed description of each auxiliary emission control device. Transmission gear ratios, overall drive ratios and vehicle mass (or range of mass) shall also be included. The label and its location shall be specified, Sec. 86.413. Available optional equipment shall be described.

(ii) The range of available fuel and ignition system adjustments.

(iii) Projected California sales data sufficient to enable the Executive Officer to select a test fleet representative of the vehicles for which certification is requested.

(iv) A description of the test equipment (if applicable) and fuel and engine lubricant proposed to be used.

(v) A description of the proposed service accumulation procedure and a description of the proposed scheduled maintenance.

(vi) A statement of recommended periodic and anticipated maintenance and procedures necessary to assure that the vehicles covered by a certificate of conformity in operation conform to the regulations, listings of the fuels and lubricants to be recommended to the ultimate purchaser and a description of the program for training of personnel for such maintenance, and the equipment required to perform this maintenance.

(vii) A description of normal assembly line operations and adjustments if such procedures exceed 100 km (62 miles) or three hours of engine operations.

(viii) Beginning with model year 2008, a description of the evaporative emission controls and applicable test data.

(3) Completed copies of the application and of any amendments thereto, and all notifications under Sec. Sec. 86.438 and 86.439 shall be submitted in such multiple copies as the Administrator may require.

(4) For purposes of this section, "auxiliary emission control device" means any element of design which senses temperature, vehicle speed, engine RPM, transmission gear, manifold vacuum, or any other parameter for the purpose of activating, modulating, delaying, or deactivating the operation of any part of the emission control system.

(b) For new 1997 and subsequent model golf carts and off-road motorcycles and all-terrain vehicles meeting the requirements of 86.410-90(e) ["the vehicle(s)"], the certification application shall include the following, as applicable:

(1) Identification and description of the vehicle(s) covered by the application.

(2) Identification of the curb weight and gross vehicle weight rating of the vehicle.

(3) Identification and description of the propulsion system for the vehicle (golf carts only).

(4) Projected number of vehicles produced and delivered for sale or use in California, and projected California sales.

(5) All information necessary for proper and safe operation and maintenance of the vehicle, including recharging information (golf carts only), and other relevant information as determined by the Executive Officer.

(6) A copy of the owner's manual must be submitted during certification for approval by the Executive Officer. The manual must include the information as required by subsections (1), (2), (3), and (5) above.

(c)(1) Manufacturers of off-road motorcycles, all-terrain vehicles, off-road sport vehicles, off-road utility vehicles, sand cars, and engines used in such vehicles must submit to the Executive Officer the number of vehicles, and engines used in such vehicles, marketed and produced for sale in California.

(2) Such data must be submitted on a quarterly basis for all such vehicles and engines identified in the preceding paragraph that have been produced for sale in California on or after January 1, 1997. In addition to the data required under paragraph (c)(1), manufacturers must also provide the model number and VIN of each vehicle or engine sold for use in California and the number sold for use in California for each model. These data must be provided to the Executive Officer within 30 days after the last day in each calendar quarter.

(d)(1) The Administrator has determined that the following certification procedure may be used to demonstrate compliance for each motorcycle engine family for which certification is sought. Manufacturers may follow these procedures at their option.

(i) The manufacturer shall satisfy all applicable requirements of part 86 necessary to demonstrate compliance with the standards for each class of new motorcycles for which certification is sought.

(ii) As specifically allowed by the Administrator the manufacturer shall assume the responsibility for part or all of the decisions applicable to the family for which certification is sought and which are within the jurisdiction of the Administrator, with the exception that the Administrator will determine whether a test motorcycle has met the applicable emission standards.

(iii) The manufacturer shall maintain, update, and correct all records and information required.

(iv) The Administrator may review a manufacturer's records at any time. At the Administrator's discretion, this review may take place either at the manufacturer's facility or at another facility designated by the Administrator.

(v) At the Administrator's request, the manufacturer shall notify the Administrator of the status of the certification program including projected schedules of those significant accomplishments specified by the Administrator.

(vi) The manufacturer shall permit the Administrator to inspect any facilities, records, and vehicles from which data were obtained under the abbreviated certification review procedure.

(vii) Upon completing all applicable requirements of part 86 the manufacturer shall submit a separate application for a certificate of conformity for each class of new motorcycles for which certification is sought. Such application shall be made in writing to the Administrator by the manufacturer.

(A) The Administrator may approve or disapprove in whole or in part an application for certification according to the procedures specified in Sec. 86.417-78(b).

(B) If, after a review of the application for certification, test reports and data submitted by the manufacturer, data obtained during an inspection, and any other pertinent data or information, the Administrator determines that a test vehicle(s) has not met the requirements of the Act and the applicable subpart, he will notify the manufacturer in writing and set forth the reason(s) for the determination.

(2) Those families which are not following the procedure described in paragraph (d)(1) of this section will follow the procedure in this subpart with the exception of paragraph (d)(1) of this section.

(e) The Administrator may require that an engine family previously allowed to be subjected to the abbreviated certification review procedure be transferred to the complete review procedure.

Sec. 86.417-78 Approval of application for certification.

(a) After a review of the application for certification and any other information which the Administrator may require, the Administrator may approve the application and select a test fleet as appropriate.

(b) The Administrator may disapprove in whole or in part an application for certification for reasons including incompleteness, inaccuracy, inappropriate proposed distance accumulation procedures, maintenance, test equipment, label content or location, fuel or lubricant, and incorporation of defeat devices in vehicles described by the application. Where any part of an application is rejected the Administrator shall notify the manufacturer in writing and set forth the reasons for such rejection. The manufacturer may request a hearing under Sec. 86.443.

Sec. 86.418-78 Test fleet selection.

(a) Test fleet selection and requirements on test vehicles are found in 86.419 to 86.423.

Sec. 86.419-78 Engine displacement, motorcycle classes.

(a)(1) Engine displacement shall be calculated using nominal engine values and rounded to the nearest whole cubic centimetre, in accordance with ASTM E 29-67.

(2) For rotary engines, displacement means the maximum volume of a combustion chamber between two rotor tip seals minus the minimum volume of that combustion chamber between those two rotor tip seals times three times the number of rotors.

$$\text{cc} = (\text{max. chamber volume} - \text{min. chamber volume}) \times 3 \times \text{no. of rotors}$$

(b) Motorcycles will be divided into classes based on engine displacement.

(1) Class I -- 0 to 169 cc displacement (0 to 10.4 cu. in.).

(2) Class II -- 170 to 279 cc (10.4 to 17.1 cu. in.).

(3) Class III -- 280 cc and over (17.1 cu. in. and over).

(c) At the manufacturer's option, a vehicle described in an application for certification may be placed in a higher class (larger displacement). All procedures for the higher class must then be complied with, compliance with emission standards will be determined on the basis of engine displacement.

Sec. 86.420-78 Engine families.

(a) The vehicles covered in the application will be divided into groupings whose engines are expected to have similar emission characteristics throughout their useful life. Each group of engines with similar emission characteristics shall be defined as a separate engine family.

(b) Reciprocating families. To be classed in the same engine family, reciprocating engines must be identical in all of the following applicable respects:

- (1) The combustion cycle.
- (2) The cooling mechanism.
- (3) The cylinder configuration (inline, vee, opposed, bore spacings, etc.).
- (4) The number of cylinders.
- (5) The engine displacement class, Sec. 86.419.
- (6) The method of air aspiration.
- (7) The number of catalytic converters, location, volume, and composition.
- (8) The thermal reactor characteristics.
- (9) The number of carburetors.
- (10) The prechamber characteristics.

(c) At the manufacturer's option, reciprocating engines identical in all the respects listed in paragraph (b) of this section may be further divided into different engine families if the Administrator determines that they may be expected to have different emission characteristics. This determination will be based upon a consideration of features such as:

- (1) The bore and stroke.
- (2) The combustion chamber configuration.
- (3) The intake and exhaust timing method of actuation (poppet valve, reed valve, rotary valve, etc.).
- (4) The intake and exhaust valve or port sizes, as applicable.
- (5) The fuel system.
- (6) The exhaust system.

(d) Rotary families. To be classed in the same engine family, rotary combustion cycle engines must be identical in all of the following applicable respects:

- (1) The major axis of the epitrochoidal curve.
- (2) The minor axis of the epitrochoidal curve.
- (3) The generating radius of the epitrochoidal curve.
- (4) The cooling mechanism.
- (5) The number of rotors.
- (6) The engine displacement class, Sec. 86.419.
- (7) The method of air aspiration.
- (8) The number of catalytic converters, location, volume and composition.
- (9) The thermal reactor characteristics.
- (10) The number of carburetors.
- (11) The prechamber characteristics.

(e) At the manufacturer's option, rotary combustion cycle engines identical in all the respects listed in paragraph (d) of this section, may be further divided into different engine families if the Administrator determines that they may be expected to have different emission characteristics. This determination will be based upon a consideration of features, such as:

- (1) The width of the rotor housing.
- (2) The type and location of intake port (side, peripheral, combination, etc.).
- (3) The number of spark plugs per rotor.
- (4) The fuel system.
- (5) The exhaust system.

(f) Where engines are of a type which cannot be divided into engine families based upon the criteria listed in paragraphs (b) and (d) of this section, the Administrator will establish families of those engines based upon the features most related to their emission characteristics.

Sec. 86.421-78 Test fleet.

(a) A test vehicle will be selected by the Administrator to represent each engine-displacement-system combination. The configuration (engine calibration, transmission, drive ratio, mass, options, etc.) in the manufacturer's application which the Administrator believes has the greatest probability of exceeding the standards will be selected.

(b) A manufacturer may elect to operate and test additional vehicles which are identical to those selected by the Administrator. Written notice of a commitment to operate and test additional vehicles shall be given to the Administrator prior to the start of testing and not later than 30 days following notification of the test fleet selection. The results of tests performed by the manufacturer will be combined to determine deterioration factors. Each vehicle must meet applicable standards when tested by the Administrator and when those results are projected to the useful life.

(c) In lieu of testing a test vehicle and submitting data therefore, a manufacturer may, with the prior written approval of the Administrator, submit exhaust emission data on a similar vehicle for which certification has previously been obtained or for which all applicable data has previously been submitted.

Sec. 86.422-78 Administrator's fleet.

The Administrator may require additional test vehicles identical in all material respects to vehicles selected in accordance with Sec. 86.421. The number of vehicles selected shall not increase the size of the test fleet by more than 20 percent or one vehicle, whichever is greater.

Sec. 86.423-78 Test vehicles.

(a)(1) The manufacturer may perform a zero-kilometer exhaust emission test.

(2) If such a test is performed, the data shall be submitted to the Administrator when the application is submitted.

(b) Once a manufacturer begins to operate a test vehicle, as indicated by compliance with paragraph (a) of this section, the data from the vehicle will be used, unless specified otherwise by the Administrator. Discontinuation of a vehicle shall be allowed only with the written consent of the Administrator.

(c) Test vehicles shall be calibrated at zero kilometres within the production tolerances applicable to the manufacturer's specifications.

(d) The Administrator may disqualify a vehicle which receives assemblyline operations and adjustments which will not be performed on production vehicles.

Sec. 86.425-78 Test procedures.

(a) Off-road motorcycle, all-terrain vehicle, off-road sport vehicle, off-road utility vehicle, and sand car emission test procedures are found in Subpart F. All-terrain vehicles, off-road sport vehicles, off-road utility vehicles and sand cars shall be tested on the Class I cycle, regardless of the engine displacement. With prior approval by the Executive Officer, manufacturers of all-terrain vehicles, off-road sport vehicles, off-road utility vehicles, and sand cars may use the emission test procedures incorporated in California Code of Regulations, Title 13, Section 2403 to certify their vehicles. The Executive Officer shall grant approval to those manufacturers who provide information and test results showing the appropriate emission standards on the-small off-road engine test cycle that are equivalent to the all-terrain vehicle emission standards set forth in 86.410-90(a)(1). The Executive Officer shall consider data submitted by the manufacturer from engines similar to the engine to be certified. This data will include, but not be limited to, the engine size, performance, operating characteristics, and technology used. The data should be statistically valid in order to set the complying emissions standard applicable for the engine family to be certified on the small off-road engine test cycle.

(b) The Administrator may prescribe emission test procedures for any motorcycle which he determines is not susceptible to satisfactory testing by the procedures set forth in subpart F.

(c) Testing of any type with respect to any test vehicle other than that specified in this subpart and subpart F is not allowed except as specifically authorized by the Administrator.

Sec. 86.426-78 Service accumulation.

Manufacturers shall determine the appropriate service accumulation for their vehicles.

Sec. 86.427-78 Emission tests.

(a)(1) Each test vehicle shall be driven with all emission control systems installed and operating for a period of time as deemed appropriate by the manufacturer to stabilize the emission characteristics of the engine.

(2) A zero kilometer emission test may be performed prior to the beginning of service accumulation.

(b) All vehicles shall undergo at least two emission tests at intervals specified by the manufacturer. Additional tests may be performed at the manufacturer's option.

(c) The Administrator may require that any one or more of the test vehicles be submitted to him, at such places as he may designate, for the purpose of conducting emissions tests. The Administrator may specify that he will conduct such testing at the manufacturer's facility, in which case instrumentation and equipment specified by the Administrator shall be made available by the manufacturer for test operations. Any testing conducted at a manufacturer's facility pursuant to this paragraph shall be scheduled by the manufacturer as promptly as possible.

(d) Whenever the Administrator conducts a test on a test vehicle, the results of that test, unless subsequently invalidated by the Administrator, shall comprise the data for the vehicle at that prescribed test point and the manufacturer's data for that prescribed test point shall not be used in determining compliance with emission standards.

Sec. 86.428-80 Maintenance, scheduled; test vehicles.

Periodic maintenance on the engine, emission control system, and fuel system of test vehicles shall be scheduled for the same intervals that will be specified in the manufacturer's maintenance instructions furnished to the ultimate purchaser.

Sec. 86.429-78 Maintenance, unscheduled; test vehicles.

(a) Any unscheduled engine, emission control system, or fuel system adjustment, repair, removal, disassembly, cleaning, or replacement on vehicles shall be performed only with the advance approval of the Administrator.

(1) In the case of unscheduled maintenance, such approval will be given if the Administrator:

(i) Has made a preliminary determination that part failure or system malfunction, or the repair of such failure or malfunction, does not render the vehicle unrepresentative of vehicles in use, and does not require direct access to the combustion chamber, except for spark plug, fuel injection component, or removable prechamber removal or replacement; and

(ii) Has made a determination that the need for maintenance or repairs is indicated by an overt indication of malfunction such as persistent misfire, vehicle stall, overheating, fluid leakage, loss of oil pressure, or charge indicator warning.

(2) Emission measurements may not be used as a means of determining the need for unscheduled maintenance under paragraph (a)(1)(i) of this section.

(b) Repairs to vehicle components of test vehicles, other than the engine, emission control system, or fuel system, shall be performed only as a result of part failure, vehicle system malfunction, or with the advance approval of the Administrator.

(c) The Administrator shall be given the opportunity to verify the extent of an overt indication of part failure and/or vehicle malfunction (e.g., misfire, stall), or an activation of an audible and/or visual signal, prior to the performance of any maintenance to which such overt indication or signal is relevant under the provisions of this section.

(d) Equipment, instruments, or tools may not be used to identify malfunctioning, maladjusted, or defective engine components unless the same or equivalent equipment, instruments, or tools will be available at dealerships and other service outlets and

(1) Are used in conjunction with scheduled maintenance on such components, and

(2) Are used subsequent to the identification of a vehicle or engine malfunction, as provided in paragraph (a)(1) of this section for durability or emission data vehicles, or

(3) Unless specifically authorized by the Administrator.

(e) If the Administrator determines that part failure or system malfunction occurrence and/or repair rendered the vehicle unrepresentative of vehicles in use, the vehicle shall not be used as a test vehicle.

(f) Complete emission tests are required, unless waived by the Administrator, before and after any vehicle maintenance which may reasonably be expected to affect emissions.

Sec. 86.430-78 Vehicle failure.

Any test vehicle which incurs major mechanical failure necessitating disassembly of the engine shall not be used as a test vehicle. This prohibition does not apply to failures occurring after the completion of all required tests at the total test distance.

Sec. 86.431-78 Data submission.

(a) Data from all tests (including voided tests) performed by a manufacturer shall be included in the applications.

(b) The manufacturer shall furnish to the Administrator explanation for voiding any test. The Administrator will determine if voiding the test was appropriate based upon the explanation given by the manufacturer. If the Administrator determines that voiding the test was not appropriate, the Administrator may require that the data from that test be used in the calculation of the deterioration factor for emissions.

(c) When unscheduled or anticipated maintenance is performed, a complete record of all pertinent maintenance, including the malfunction diagnosis made, the corrective action taken, and the test data obtained shall be included in the application.

(d) A complete record of all maintenance shall be supplied.

Sec. 86.432-78 Deterioration factor.

(a) The manufacturer shall determine the appropriate deterioration factors.

(b) Emission results which are less than 0.10 g/km shall be considered to be 0.10 g/km for purposes of this section.

(c) Manufacturers shall determine the appropriate deterioration factor for the designated useful life.

(d) Deterioration factors computed to be less than 1.000 shall be 1.000.

Sec. 86.434-78 Testing by the Administrator.

(a) At the conclusion of certification testing by manufacturers, the ARB may require confirmatory testing. The ARB will designate where such testing shall be performed.

(b) The manufacturer may request a retest. The results of the retest will be used to determine compliance.

(c) If the emission results exceed the standard, certification will be denied.

Sec. 86.437-78 Certification.

(a) Manufacturers of new off-road motorcycles and all-terrain vehicles produced on or after January 1, 1997, and manufacturers of off-road sport vehicles, off-road utility vehicles, and sand cars produced on or after January 1, 2007, shall submit to the Executive Officer a statement that the test vehicles, for which data are submitted, have been tested, and conform to the requirements of the regulations to their designated useful life.

(1) The manufacturer shall submit to the Administrator a statement that the test vehicles with respect to which data are submitted have been tested in accordance with the applicable test procedures, that they meet the requirements of such tests, and that, on the basis of such tests, they conform to the requirements of the regulations in this part. If such statements cannot be made with respect to any vehicle tested, the vehicle shall be identified, and all pertinent test data relating thereto shall be supplied.

(2)(i) If, after a review of the test reports and data submitted by the manufacturer, data derived from any inspection carried out under Sec. 86.441 and any other pertinent data or information, the Administrator determines that a test vehicle(s) meets the requirements of the Act and of this subpart, he will issue a certificate of conformity with respect to such vehicle(s) except in cases covered by Sec. 86.442.

(ii) Such certificate will be issued for such period not to exceed one model year as the Administrator may determine and upon such terms as he may deem necessary to assure that any new motorcycle covered by the certificate will meet the requirements of the act and of this subpart.

(iii) The certificate will cover all vehicles represented by the test vehicle and will certify compliance with no more than one set of applicable standards.

(3)(i) If, after a review of the test reports and data submitted by the manufacturer, data derived from any additional testing conducted pursuant to Sec. 86.427, or information derived from any inspection carried out under Sec. 86.441, or any other pertinent data or information, the Administrator determines that one or more test vehicles of the certification test fleet do not meet applicable standards, he will notify the manufacturer in writing, setting forth the basis for his determination. The manufacturer may request a hearing on the Administrator's determination.

(ii) The manufacturer may, at his option, proceed with any of the following alternatives with respect to any vehicles represented by a test vehicle(s) determined not in compliance with applicable standards:

(A) Request a hearing.

(B) Delete from the application for certification the vehicles represented by the failing test vehicle. (Vehicles so deleted may be included in a later request for certification under paragraph (b)(2)(iii) of this section.) The Administrator will then select in place of each failing vehicle an alternate vehicle chosen in accordance with selection criteria employed in selecting the vehicle that failed, or

(C) Repair the test vehicle and demonstrate by testing that it meets applicable standards. Another vehicle which is in all material respects the same as the first vehicle, as repaired, shall then be operated and tested in accordance with applicable test procedures.

(iii) If the manufacturer does not request a hearing or present the required data under subparagraph (2) of this paragraph, the Administrator will deny certification.

Sec. 86.438-78 Amendments to the application.

(a) The manufacturer shall inform the Administrator by way of amendment to the application of any proposed changes to vehicles in production or additional vehicles to be produced. The Administrator will, if appropriate, select a new test vehicle. Except as provided in Sec. 86.439, no changes may be instituted until approved by the Administrator.

(b) The Administrator may allow reduced testing.

Sec. 86.439-78 Alternative procedure for notification of additions and changes.

(a)(1) A manufacturer may, in lieu of notifying the Administrator in advance of an addition of a vehicle or a change in a vehicle under Sec. 86.438-78, notify the Administrator concurrently with the addition of a vehicle or the making of a change in a vehicle if the manufacturer determines that following the change all vehicles affected by the addition or change will still meet the applicable emission standards.

(2) Such notification shall include a full description of the addition or change and any supporting documentation the manufacturer may include to support the manufacturer's determination that the addition or change does not cause noncompliance.

(3) The manufacturer's determination that the addition or change does not cause noncompliance shall be based on an engineering evaluation of the addition or change and/or testing.

(b) [Reserved]

(c)(1) The Administrator may require that additional emission testing be performed to support the manufacturer's original determination submitted in accordance with paragraph (a) of this section.

(2) If additional testing is required, the Administrator shall proceed as in Sec. 86.438-78.

(3) Additional test data, if requested, must be provided within 30 days of the request or the manufacturer must rescind the addition or change immediately.

(4) The Administrator may grant additional time to complete testing.

(5) If based on this additional testing or any other information, the Administrator determines that the vehicles affected by the addition or change do not meet the applicable standards, the Administrator will notify the manufacturer to rescind the addition or change immediately upon receipt of the notification.

(d) Election to produce vehicles under this section will be deemed to be a consent to recall all vehicles which the Administrator determines under Sec. 86.438-78 do not meet applicable standards, and to cause such nonconformity to be remedied at no expense to the owner.

Sec. 86.440-78 Maintenance of records.

(a) The manufacturer of any motorcycle subject to any of the standards or procedures prescribed in this subpart shall establish, maintain and retain the following adequately organized and indexed records;

(1) General records.

(i)(A) Identification and description of all certification vehicles for which testing is required under this subpart.

(B) A description of all emission control systems which are installed on or incorporated in each certification vehicle.

(C) A description of all procedures used to test each such certification vehicle.

(ii) A properly completed application, following the format prescribed by the U.S. EPA for the appropriate year of production, fulfills each of the requirements of this paragraph.

(2) Individual records.

(i) A brief history of each motorcycle used for certification under this subpart including:

(A)(1) In the case where a current production engine is modified for use in a certification vehicle, a description of the process by which the engine was selected and of the modification made.

(2) In the case where the engine for a certification vehicle is not derived from a current production engine, a general description of the build-up of the engine (e.g., experimental heads were cast and machined according to supplied drawings, etc.)

(3) In both cases above, a description of the origin and selection process for the carburetor, fuel system, emission control system components, and exhaust after treatment device shall be included.

(4) The required description shall specify the steps taken to assure that the certification vehicle with respect to its engine, drive train, fuel system, emission control system components, exhaust after treatment device, vehicle mass, or any other device or component that can reasonably be expected to influence exhaust emissions, will be representative of production vehicles, and that either all components and/or vehicle construction processes, component inspection and selection techniques, and assembly techniques employed in constructing such vehicles are reasonably likely to be implemented for production vehicles, or they are as closely analogous as practicable to planned construction and assembly processes.

(B) A complete record of all emission tests performed (except tests performed by EPA directly) including test results, the date and purpose of each test, and the distance accumulated on the vehicle.

(C) The date of each service accumulation run, listing the distance accumulated.

(D) [Reserved]

(E) A record and description of all maintenance and other servicing performed, giving the date of the maintenance or service and the reason for it.

(F) A record and description of each test performed to diagnose engine or emissions control system performance, giving the date and time of the test and the reason for it.

(G) [Reserved]

(H) A brief description of any significant events affecting the vehicle during any time in the period covered by the history, not described by an entry under one of the previous headings, including such extraordinary events as vehicle accidents or dynamometer runaway.

(ii) Each such history shall be started on the date that the first of any of the selection or build-up activities in paragraph (a)(2)(i)(A) of this section occurred with respect to the certification vehicle, shall be updated each time the operational status of the vehicle changes or additional work is performed on it, and shall be kept in a designated location.

(3) All records, other than routine emission test records, required to be maintained under this subpart shall be retained by the manufacturer for a period of six (6) years after the issuance of all certificates of conformity to which they relate. Routine emission test records shall be retained by the manufacturer for a period of one (1) year after issuance of all certificates of conformity to which they relate. Records may be retained as hard copy or reduced to microfilm, punch cards, etc., depending on the record retention procedures of the manufacturer:

Provided That, in every case, all the information contained in the hard copy shall be retained.

Sec. 86.441-78 Right of entry.

(a) Any manufacturer who has applied for certification of a new motorcycle subject to certification tests under this subpart shall admit or cause to be admitted any EPA Enforcement Officer during operating hours on presentation of any credentials to any of the following:

(1) Any facility where any such tests or any procedures or activities connected with such tests are or were performed.

(2) Any facility where any new motorcycle which is being, was or is to be tested is present.

(3) Any facility where any construction process or assembly process used in the modification or build-up of such a vehicle into a certification vehicle is taking place or has taken place.

(4) Any facility where any record or other document relating to any of the above is located.

(b) Upon admission to any facility referred to in paragraph (c)(1) of this section, any EPA Enforcement Officer shall be allowed:

(1) To inspect and monitor any part or aspect of such procedures, activities, and testing facilities, including, but not limited to, monitoring vehicle preconditioning, emissions tests and service accumulation, maintenance, and vehicle soak and storage procedures; and to verify correlation or calibration of test equipment;

(2) To inspect and make copies of any such records, designs, or other documents; and

(3) To inspect and/or photograph any part or aspect of any such certification vehicle and any components to be used in the construction thereof.

(c) In order to allow the Administrator to determine whether or not production motorcycles conform in all material respects to the design specifications which applied to those vehicles described in the application for certification for which a certificate of conformity has been issued and to standards prescribed under section 202 of the Act, any manufacturer shall admit any EPA Enforcement Officer on presentation of credentials to both:

(1) Any facility where any document design, or procedure relating to the translation of the design and construction of engines and emission related components described in the application for certification or used for certification testing into production vehicles is located or carried on; and

(2) Any facility where any motorcycles to be introduced into commerce are manufactured or assembled.

(d) On admission to any such facility referred to in paragraph (c)(3) of this section, any EPA Enforcement Officer shall be allowed:

(1) To inspect and monitor any aspects of such manufacture or assembly and other procedures;

(2) To inspect and make copies of any such records, documents or designs; and

(3) To inspect and photograph any part or aspect of any such new motorcycles and any component used in the assembly thereof that are reasonably related to the purpose of his entry.

(e) Any EPA Enforcement Officer shall be furnished by those in charge of a facility being inspected with such reasonable assistance as he may request to help him discharge any function listed in this paragraph. Each applicant for or recipient of certification is required to cause those in charge of a facility operated for its benefit to furnish such reasonable assistance without charge to EPA whether or not the applicant controls the facility.

(f) The duty to admit or cause to be admitted any EPA Enforcement Officer applies whether or not the applicant owns or controls the facility in question and applies both to domestic and to foreign manufacturers and facilities. EPA will not attempt to make any inspections which it has been informed that local law forbids. However, if local law makes it impossible to do what is necessary to insure the accuracy of data generated at a facility, no informed judgment that a vehicle or engine is certifiable or is covered by a certificate can properly be based on that data. It is the responsibility of the manufacturer to locate its testing and manufacturing facilities in jurisdictions where this situation will not arise.

(g) For purposes of this section:

(1) Presentation of credentials shall mean display of the document designating a person as an EPA Enforcement Officer.

(2) Where vehicle, component, or engine storage areas or facilities are concerned, operating hours shall mean all times during which personnel other

than custodial personnel are at work in the vicinity of the area or facility and have access to it.

(3) Where facilities or areas other than those covered by paragraph (g)(2) of this section are concerned, operating hours shall mean all times during which an assembly line is in operation or all times during which testing, maintenance, service accumulation, production or compilation of records, or any other procedure or activity related to certification testing, to translation of designs from the test stage to the production stage, or to vehicle manufacture or assembly is being carried out in a facility.

(4) Reasonable assistance includes, but is not limited to, clerical, copying, interpretation and translation services, the making available on request of personnel of the facility being inspected during their working hours to inform the EPA Enforcement Officer of how the facility operates and to answer his questions, and the performance on request of emissions tests on any vehicle which is being, has been, or will be used for certification testing. Such tests shall be nondestructive, but may require appropriate service accumulation. A manufacturer may be compelled to cause the personal appearance of any employee at such a facility before an EPA Enforcement Officer by written request for his appearance, signed by the Assistant Administrator for Enforcement, served on the manufacturer. Any such employee who has been instructed by the manufacturer to appear will be entitled to be accompanied, represented, and advised by counsel. No counsel who accompanies, represents, or advises an employee compelled to appear may accompany, represent, or advise any other person in the investigation.

(5) Any entry without 24 hours prior written or oral notification to the affected manufacturer shall be authorized in writing by the Assistant Administrator for Enforcement.

Sec. 86.442-78 Denial, revocation, or suspension of certification.

(a) Notwithstanding the fact that any certification vehicle(s) may comply with other provisions of this subpart, the Administrator may withhold or deny the issuance of a certificate of conformity (or suspend or revoke any such certificate which has been issued) with respect to any such vehicle(s) if:

(1) The manufacturer submits false or incomplete information in his application for certification thereof; or

(2) The manufacturer renders inaccurate or invalid any test data which he submits pertaining thereto or otherwise circumvents the intent of the Act or of this subpart with respect to such vehicle; or

(3) Any EPA Enforcement Officer is denied access on the terms specified in Sec. 86.441 to any facility or portion thereof which contains any of the following:

- (i) The vehicle, or
- (ii) Any components used or considered for use in its modification or build-up into a certification vehicle, or
- (iii) Any production vehicle which is or will be claimed by the manufacturer to be covered by the certificate, or
- (iv) Any step in the construction of a vehicle described in paragraph (c) of this section, or
- (v) Any records, documents, reports, or histories required by this part to be kept concerning any of the above.

(4) Any EPA Enforcement Officer is denied "reasonable assistance" (as defined in Sec. 86.444) in examining any of the items listed in paragraph (a)(1)(iii) of this section.

(b) The sanctions of withholding, denying, revoking, or suspending of a certificate may be imposed for the reasons in paragraph (a) of this section only when the infraction is substantial.

(c) In any case in which a manufacturer knowingly submits false or inaccurate information, or knowingly renders inaccurate or invalid any test data, or commits any fraudulent acts and such acts contribute substantially to the Administrator's decision to issue a certificate of conformity, the Administrator may deem such certificate void ab initio.

(d) In any case in which certification of a vehicle is proposed to be withheld, denied, revoked, or suspended under paragraph (a) (3) or (4) of this section, and in which the Administrator has presented to the manufacturer involved reasonable evidence that a violation of Sec. 86.441 in fact occurred, the manufacturer, if he wishes to contend that, even though the violation occurred, the vehicle in question was not involved in the violation to a degree that would warrant withholding, denial, revocation, or suspension of certification under either paragraph (a) (3) or (4) of this section, shall have the burden of establishing that contention to the satisfaction of the Administrator.

(e) Any revocation or suspension of certification under paragraph (a) of this section shall:

(1) Be made only after the manufacturer concerned has been offered an opportunity for a hearing conducted in accordance with Sec. 86.444 hereof.

(2) Extend no further than to forbid the introduction into commerce of vehicles previously covered by the certification which are still in the hands of the manufacturer, except in cases of such fraud or other misconduct as makes the certification invalid ab initio.

(f) The manufacturer may request in the form and manner specified in Sec. 86.443 that any determination made by the Administrator under paragraph (a) of this section to withhold or deny certification be reviewed in a hearing conducted in accordance with Sec. 86.444. If the Administrator finds, after a review of the request and supporting data, that the request raises a substantial factual issue, he will grant the request with respect to such issue.

Sec. 86.443-78 Request for hearing.

Within 30 days following receipt of notification that an application has been rejected or that certification has been denied, the manufacturer may request a hearing on the Administrator's determination. The request shall be in writing, signed by an authorized representative of the manufacturer and shall include a statement specifying the manufacturer's objections to the Administrator's determinations, and data in support of such objections. If, after the review of the request and supporting data, the Administrator finds that the request raises a substantial factual issue, he shall provide the manufacturer a hearing with respect to such issue.

Sec. 86.444-78 Hearings on certification.

(a)(1) After granting a request for a hearing under Sec. 86.443 the Administrator will designate a Presiding Officer for the hearing.

(2) The General Counsel will represent the Environmental Protection Agency in any hearing under this section.

(3) If a time and place for the hearing have not been fixed by the Administrator under Sec. 86.443, the hearing shall be held as soon as practicable at a time and place fixed by the Administrator or by the Presiding Officer.

(4) In the case of any hearing requested pursuant to Sec. 86.437, the Administrator may in his discretion direct that all argument and presentation of evidence be concluded within such fixed period not less than 30 days as he may establish from the date that the first written offer of a hearing is made to the manufacturer. To expedite proceedings, the Administrator may direct that the decision of the Presiding Officer (who may, but need not be the Administrator himself) shall be the final EPA decision.

(b)(1) Upon his appointment pursuant to paragraph (a) of this section, the Presiding Officer will establish a hearing file. The file shall consist of the notice issue by the Administrator under a hearing and the supporting data submitted therewith and all documents relating to the request for certification and all documents submitted therewith, and correspondence and other data material to the hearing.

(2) The appeal file will be available for inspection by the applicant at the office of the Presiding Officer.

(c) An applicant may appear in person, or may be represented by counsel or by any other duly authorized representative.

(d)(1) The Presiding Officer upon the request of any party, or in his discretion, may arrange for a prehearing conference at a time and place specified by him to consider the following:

- (i) Simplification of the issues;
 - (ii) Stipulations, admissions of fact, and the introduction of documents;
 - (iii) Limitation of the number of expert witnesses;
 - (iv) Possibility of agreement disposing of all or any of the issues in dispute;
 - (v) Such other matters as may aid in the disposition of the hearing,
- including such additional tests as may be agreed upon by the parties.

(2) The results of the conference shall be reduced to writing by the Presiding Officer and made part of the record.

(e)(1) Hearings shall be conducted by the Presiding Officer in an informal but orderly and expeditious manner. The parties may offer oral or written evidence, subject to the exclusion by the Presiding Officer of irrelevant, immaterial, and repetitious evidence.

(2) Witnesses will not be required to testify under oath. However, the Presiding Officer shall call to the attention of witnesses that their statements may be subject to the provisions of title 18 U.S.C. 1001 which imposes penalties for knowingly making false statements or representations, or using false documents in any matter within the jurisdiction of any department or agency of the United States.

(3) Any witness may be examined or cross-examined by the Presiding Officer, the parties, or their representatives.

(4) Hearings shall be reported verbatim. Copies of transcripts of proceedings may be purchased by the applicant from the reporter.

(5) All written statements, charts, tabulations, and similar data offered in evidence at the hearing shall, upon a showing satisfactory to the Presiding Officer of their authenticity, relevancy, and materiality, be received in evidence and shall constitute a part of the record.

(6) Oral argument may be permitted in the discretion of the Presiding Officer and shall be reported as part of the record unless otherwise ordered by him.

(f)(1) The Presiding Officer shall make an initial decision which shall include written findings and conclusions and the reasons or basis therefore on all the material issues of fact, law, or discretion presented on the record. The findings, conclusions, and written decision shall be provided to the parties and made a part of the record. The initial decision shall become the decision of the Administrator without further proceedings unless there is an appeal to the Administrator or motion for review by the Administrator within 20 days of the date the initial decision was filed.

(2) On appeal from or review of the initial decision the Administrator shall have all the powers which he would have in making the initial decision including the discretion to require or allow briefs, oral argument, the taking of additional evidence or the remanding to the Presiding Officer for additional proceedings. The decision by the Administrator shall include written findings and conclusions and the reasons or basis therefore on all the material issues of fact, law, or discretion presented on the appeal or considered in the review.

Subpart F. Emission Regulations for 1978 and Later New Motorcycles; Test Procedures

Sec. 86.501-78 Applicability.

- (a) This subpart contains the motorcycle test procedures specified in subpart E.
- (b) Provisions of this subpart apply to tests performed by both the Administrator and motor vehicle manufacturers.

Sec. 86.502-78 Definitions.

- (a) The definitions in Sec. 86.402-78 apply to this subpart.
- (b) [Reserved]

Sec. 86.503-78 Abbreviations.

The abbreviations in 86.403-78 apply to this subpart, with the following additions:

- ARB--California Air Resources Board.
- Bhp--Brake-horsepower.
- Bhp-hr--Brake horsepower-hour.
- Hp--Horsepower.
- PM--Particulate Matter.

Sec. 86.504-78 Section numbering.

- (a) The section numbering system described in Sec. 86.404-78 is used in this subpart.
- (b) [Reserved]

Sec. 86.505-78 Introduction; structure of subpart.

- (a) This subpart describes the equipment required and the procedures to follow in order to perform exhaust emission tests on motorcycles. Subpart E sets forth the testing requirements and test intervals necessary to comply with EPA certification procedures.
- (b) Three topics are addressed in this subpart. Sections 86.508 through 86.515 set forth specifications and equipment requirements; Sec. Sec. 86.516 through 86.526 discuss calibration methods and frequency; test procedures and data requirements are listed (in approximate order of performance) in Sec. Sec. 86.527 through 86.544.

Sec. 86.508-78 Dynamometer.

- (a) The dynamometer shall have a single roll with a diameter of at least 0.400 metre.
- (b) The dynamometer shall be equipped with a roll revolution counter for measuring actual distance traveled.
- (c) Flywheels or other means shall be used to stimulate the inertia specified in Sec. 86.529.
- (d) A variable speed cooling blower shall direct air to the vehicle. The blower outlet shall be at least 0.40 m² (4.31 ft²) and shall be squarely positioned between 0.3 m (0.98 ft) and 0.45 m (1.48 ft) in front of the vehicle's front wheel. The velocity of the air at the blower outlet shall be within the following limits (as a function of roll speed):

Actual roll speed	Allowable cooling air speed
0 km/h to 5 km/h.....	0 km/h to 10 km/h.
5 km/h to 10 km/h.....	0 km/h to roll speed + 5 km/h.
10 km/h to 50 km/h.....	Roll speed ± 5 km/h.
50 km/h to 70 km/h.....	Roll speed ± 10 pct.
Above 70 km/h.....	At least 63 km/h.

- (e) The dynamometer shall comply with the tolerances in Sec. 86.529.

Sec. 86.509-90 Exhaust gas sampling system.

(a)(1) *General.* The exhaust gas sampling system is designed to measure the true mass emissions of vehicle exhaust. In the CVS concept of measuring mass emissions, two conditions must be satisfied: the total volume of the mixture of exhaust and dilution air must be measured and a continuously proportioned volume of sample must be collected for analysis. Mass emissions are determined from the sample concentration and totalized flow over the test period.

(2) *Vehicle tailpipe to CVS duct.* For methanol fueled vehicles, cooling of the exhaust gases in the duct connecting the vehicle tailpipe to the CVS shall be minimized. This may be accomplished by:

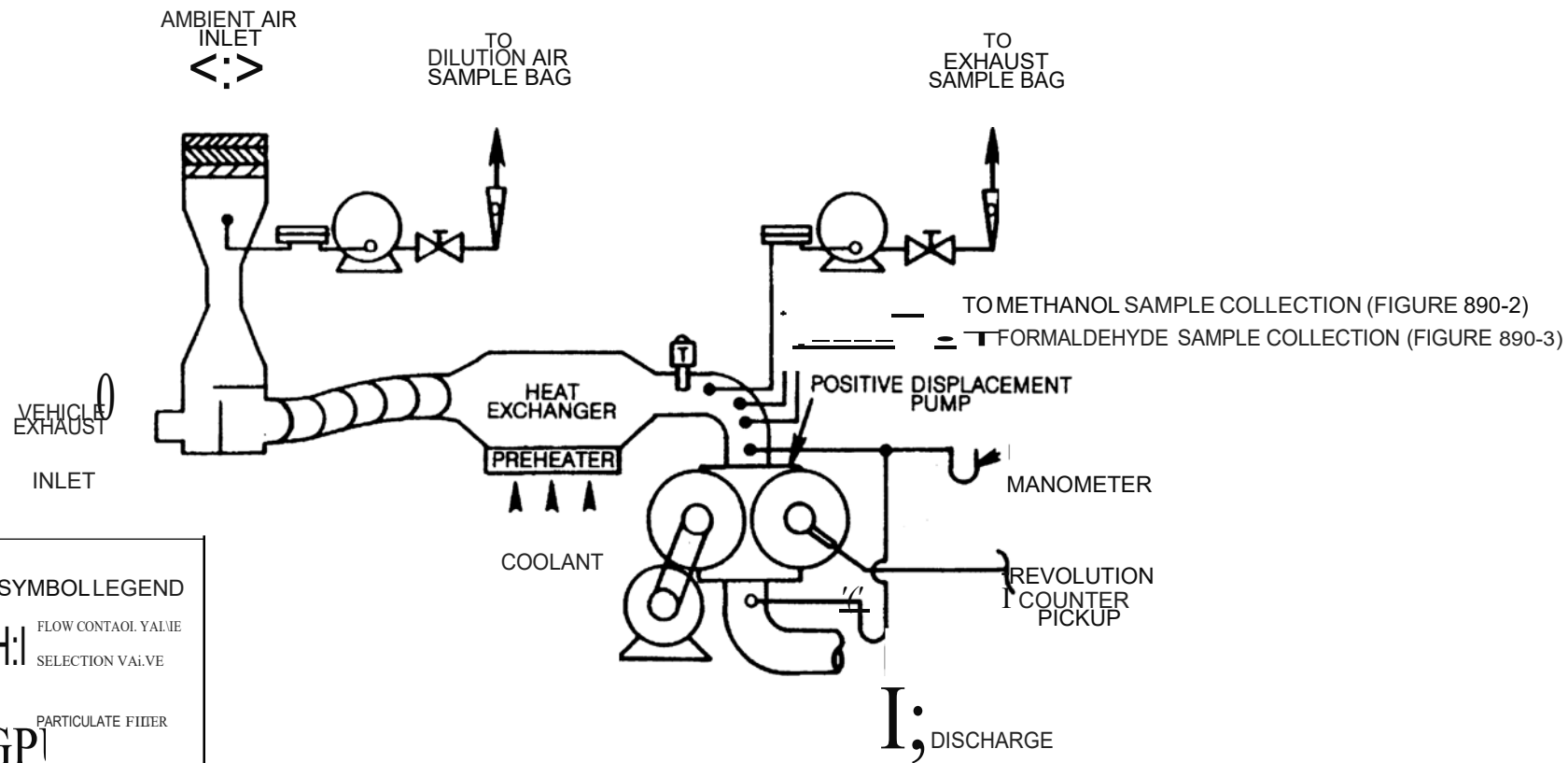
- (i) Using a duct of unrestricted length maintained at a temperature above the maximum dew point of the exhaust, but below 121 [deg]C (250 [deg]F); heating and possibly cooling capabilities are required; or
- (ii) Using a short duct (up to 12 feet long) constructed of smooth wall pipe with a minimum of flexible sections, maintained at a temperature above the maximum dew point of the exhaust, but below 121 [deg]C (250 [deg]F), prior to the test and during any breaks in the test and uninsulated during the test

(insulation may remain in place and/or heating may occur during testing provided maximum temperature is not exceeded); or

(iii) Using smooth wall duct less than five feet long with no required heating. A maximum of two short flexible connectors are allowed under this option; or

(iv) Omitting the duct and performing the exhaust gas dilution function at the motorcycle tailpipe exit.

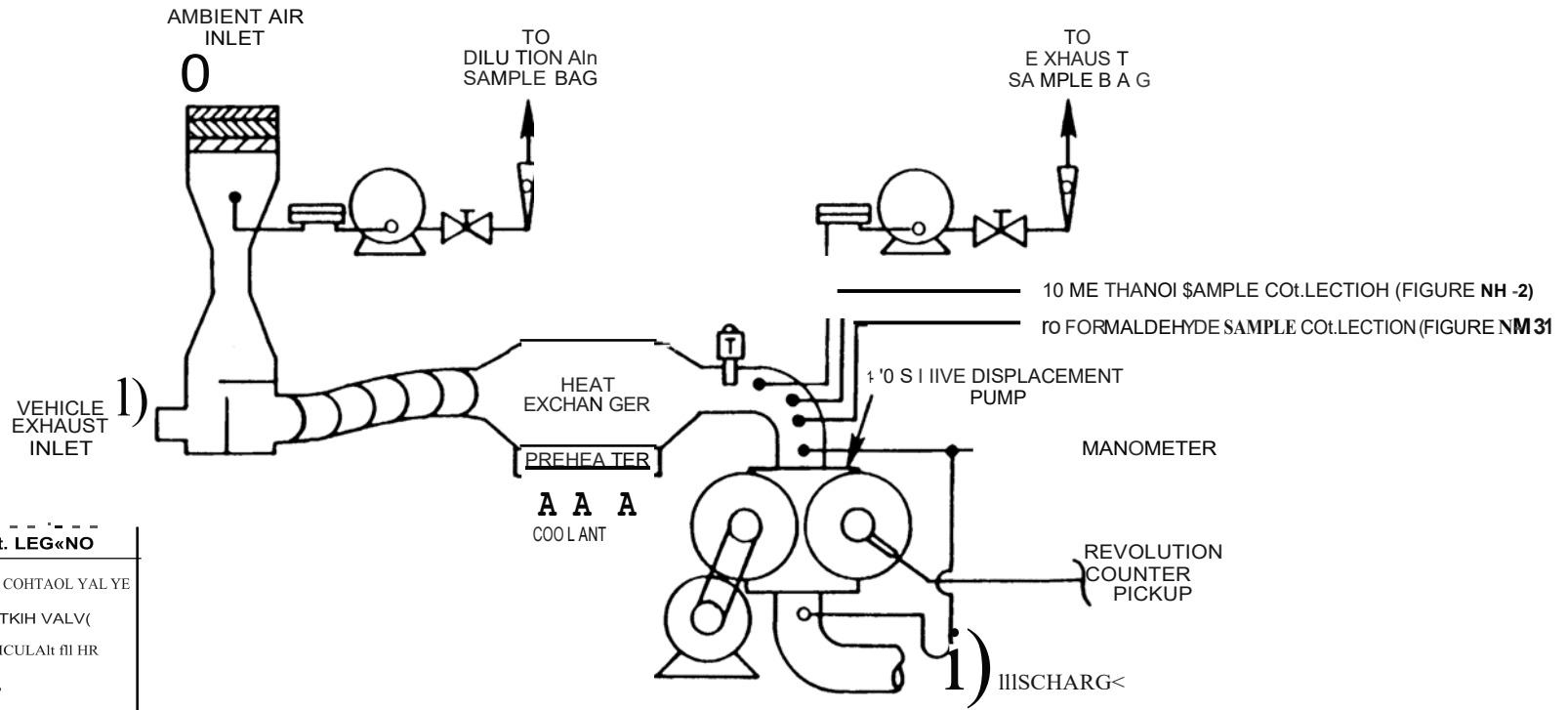
(3) *Positive displacement pump.* The Positive Displacement Pump-Constant Volume Sampler (PDP-CVS), Figure F90-1 satisfies the first condition by metering at a constant temperature and pressure through the pump. The total volume is measured by counting the revolutions made by the calibrated positive displacement pump. The proportional samples are achieved by sampling at a constant flow rate. For methanol-fueled motorcycle sample lines for the methanol and formaldehyde samples are heated to prevent condensation. The temperature of the sample lines shall be more than 3 [deg]C (5 [deg]F) above the maximum dew point of the sample, but below 121 [deg]C (250 [deg]F). (Note: For 1990 through 1994 model year methanol-fueled motorcycles, methanol and formaldehyde sampling may be omitted provided the bag sample (hydrocarbons and methanol) is analyzed using a HFID calibrated with methanol.)



SYMBOL LEGEND	
	FLOW CONTROL VALVE
	SELECTION VALVE
	PARTICULATE FILTER
	FLOWMETER
	PRESSURE GAUGE
	RECORDER
	TEMPERATURE SENSOR

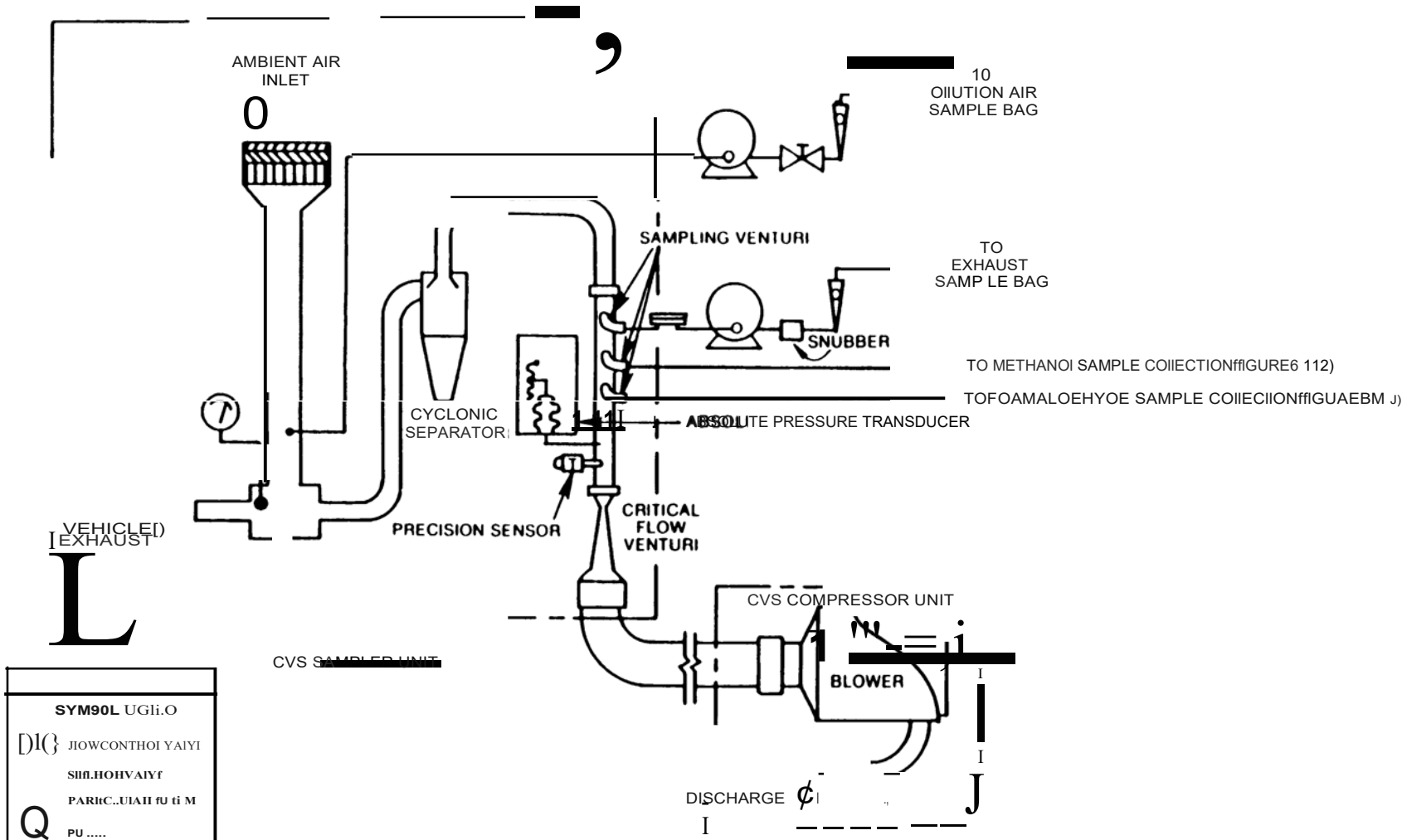
FIGURE F90-1 EXHAUST GAS SAMPLING SYSTEM (PDP-CVS)

(4) *Critical flow venturi.* The operation of the Critical Flow Venturi--Constant Volume Sampler (CFV-CVS) sample system, Figure F90-2, is based upon the principles of fluid dynamics associated with critical flow. Proportional sampling throughout temperature excursions is maintained by use of small CFVs in the sample lines, which respond to the varying temperatures in the same manner as the main CFV. For methanol-fueled motorcycles, the methanol and formaldehyde sample lines are heated to prevent condensation. The temperature of the sample lines shall be more than 3 [deg]C (5 [deg]F) above the maximum dew point of the sample, but below 121 [deg]C (250 [deg]F). Care must be taken to ensure that the CFVs of the sample probes are not heated since heating of the CFVs would cause loss of proportionality. (Note: For 1990 through 1994 model year methanol-fueled motorcycles, methanol and formaldehyde sampling may be omitted provided the bag sample (hydrocarbons and methanol) is analyzed using a HFID calibrated with methanol.) Total flow per test is determined by continuously computing and integrating instantaneous flow. A low response time temperature sensor is necessary for accurate flow calculation.



SYMBOL LEGEND	
(J)	FLOW CONTROL VALVE
(S)	ISOLATION VALVE
G	PUMP
y	FLOW-ETHER
P	PRESSURE GAUGE
OD	ORIE COIL (R)
ti	TEMPERATURE SENSOR

FIGURE N90-1 EXHAUST GAS SAMPLING SYSTEM (PDP-CVS)



SYM90L UGh.O
LOWCONTHOI YAIYI
SHH.HOHVAIYf
PARIc..UIAH fu ti M
PU
flOWMe III
PA(SS,UA) GAIKJt
RfCOAOfR
I(WPEAAItH-ti I Ht-

FIGURE F90·2
EXHAUST GAS SAMPLING SYSTEM (CFV-CVS)

(5) *Electronic Flow Control.* The Critical Flow Venturi--Electronic Flow Control--Constant Volume Sampler (CFV-EFC-CVS) system is identical to the CFV-CVS system described in paragraphs (a)(4) and (c) of this section, except that it maintains proportional sampling for methanol and formaldehyde by measuring the CVS flow rate, and electronically controlling sample flow rates. It is recommended that sample volumes be measured by separate flow meters. For methanol-fueled motorcycles, the samples lines for the methanol and formaldehyde samples are heated to prevent condensation. The temperature of the sample lines shall be more than 20 [deg]F (11 [deg]C) above the maximum dew point of the sample, but below 121 [deg]C (250 [deg]F).

(6) *Other systems.* Other sampling systems may be used if shown to yield equivalent results, and if approved in advance by the Administrator (e.g., a heat exchanger with the CFV-CVS or an electronic flow integrator without a heat exchanger, with the PDP-CVS).

(b) *Component description, PDP-CVS.* The PDP-CVS, Figure F90-1, consists of a dilution air filter and mixing assembly, heat exchanger, positive displacement pump, sampling systems including, probes and sampling lines which, in the case of the methanol-fueled motorcycles, are heated to prevent condensation (heating of the sample lines may be omitted, provided the methanol and formaldehyde sample collection systems are close coupled to the probes thereby preventing loss of sample due to cooling and resulting condensation in the sample lines), and associated valves, pressure and temperature sensors. The PDP-CVS shall conform to the following requirements:

(1) Static pressure variations at the tailpipe(s) of the vehicle shall remain within ± 1.25 kPa (5.02 in H₂O) of the static pressure variations measured during a dynamometer driving cycle with no connection to the tailpipe(s). (Sampling systems capable of maintaining the static pressure to within ± 0.25 kPa (1.00 in. H₂O) will be used by the Administrator if a written request substantiates the need for this closer tolerance.)

(2) The gas mixture temperature, measured at a point immediately ahead of the positive displacement pump, shall be within 5 [deg]C (9 [deg]F) of the designed operating temperature at the start of the test. The gas mixture temperature variation from its value at the start of the test shall be limited to ± 5 [deg]C (9 [deg]F) during the entire test. The temperature measuring system shall have an accuracy and precision of ± 1 [deg]C (1.8 [deg]F).

(3) The pressure gauges shall have an accuracy and precision of ± 0.4 kPa (± 3 mm Hg).

(4) The location of the dilution air inlet shall be placed so as to use test-cell air for dilution and the flow capacity of the CVS shall be large enough to completely eliminate water condensation in the dilution and sampling systems. Control of water condensation with methanol-fueled vehicles is critical. Additional care may also be required to eliminate water condensation when testing natural gas and liquefied petroleum gas-fueled vehicles. (Procedures for determining CVS flow rates are detailed in "Calculation of Emissions and Fuel Economy When Using Alternative Fuels," EPA 460/3-83-009.) Dehumidifying the dilution air before entering the CVS is allowed. Heating the dilution air is also allowed, provided:

(i) The air (or air plus exhaust gas) temperature does not exceed 121 [deg]C (250 [deg]F).

(ii) Calculation of the CVS flow rate necessary to prevent water condensation is based on the lowest temperature encountered in the CVS prior to sampling. (It is recommended that the CVS system be insulated when heated dilution air is used.)

(iii) The dilution ratio is sufficiently high to prevent condensation in bag samples as they cool to room temperature.

(5) Sample collection bags for dilution air and exhaust samples (hydrocarbons and carbon monoxide) shall be of sufficient size so as not to impede sample flow. A single dilution air sample, covering the total test period, may be collected for the determination of methanol and formaldehyde background (methanol-fueled motorcycles).

(6) The methanol sample collection system and the formaldehyde sample collection system shall each be of sufficient capacity so as to collect samples of adequate size for analysis without significant impact on the volume of dilute exhaust passing through the PDP. The systems shall also comply with the following requirements that apply to the design of the systems, not to individual tests:

(i) The methanol system shall be designed such that if a test motorcycle continuously emitted the maximum allowable level of methanol (based on all applicable standards) the measured concentration in the primary impinger would exceed either 25 mg/l or a concentration equal to 25 times the limit of detection for the GC analyzer.

(ii) The formaldehyde system shall be designed such that if a test motorcycle continuously emitted formaldehyde at a rate equal to twenty percent of the maximum allowable level of THCE (i.e., 1.0 g/km for a 5.0 g/km standard), or the maximum formaldehyde level allowed by a specific formaldehyde standard, whichever is less, the concentration of formaldehyde in the DNPH solution of the primary impinger, or solution resulting from the extraction of the DNPH cartridge, shall exceed either 2.5 mg/l or a concentration equal to 25 times the limit of detection for the HPLC analyzer.

(iii) The methanol and formaldehyde systems shall be designed such that the primary impinger collects at least 90 percent of the analyte in the samples. The remaining analyte shall be collected by the secondary impinger. This

requirement does not apply to dilution air samples, since they do not require secondary impingers, or to samples in which the concentrations approach the limit of detection.

(c) *Component description, CFV-CVS.* The CFV-CVS sample system, Figure F90-2, consists of a dilution air filter and mixing assembly, a cyclone particulate separator, unheated sampling venturies for the bag samples, and for the methanol and formaldehyde samples from methanol-fueled vehicles, samples lines heated to prevent condensation for the methanol and formaldehyde samples from methanol fueled vehicles (heating of the sample lines may be omitted provided, the methanol and formaldehyde sample collection systems are close coupled to the probes thereby preventing loss of sample due to cooling and resulting condensation in the sample lines), a critical flow venturi, and assorted valves, and pressure and temperature sensors. The CFV sample system shall conform to the following requirements:

(1) Static pressure variations at the tailpipe(s) of the vehicle shall remain within ± 1.25 kPa (5.02 in H₂O) of the static pressure variations measured during a dynamometer driving cycle with no connection to the tailpipe(s). (Sampling systems capable of maintaining the static pressure to within ± 0.25 kPa (1.00 in H₂O) will be used by the Administrator if a written request substantiates the need for this closer tolerance.)

(2) The temperature measuring system shall have an accuracy and precision of ± 1 [deg]C (1.8 [deg]F) and a response time of 0.100 second to 62.5 percent of a temperature change (as measured in hot silicone oil).

(3) The pressure measuring system shall have an accuracy and precision of ± 0.4 kPa (± 3 mm Hg).

(4) The location of the dilution air inlet shall be placed so as to use test-cell air for dilution and the flow capacity of the CVS shall be large enough to completely eliminate water condensation in the dilution and sampling systems. Control of water condensation with methanol-fueled vehicles is critical. Additional care may also be required to eliminate water condensation when testing natural gas and liquefied petroleum gas-fueled vehicles. (Procedures for determining CVS flow rates are detailed in "Calculation of Emissions and Fuel Economy When Using Alternative Fuels," EPA 460/3-83-009.) Dehumidifying the dilution air before entering the CVS is allowed. Heating the dilution air is also allowed, provided:

(i) The air (or air plus exhaust gas) temperature does not exceed 250 [deg]F.

(ii) Calculation of the CVS flow rate necessary to prevent water condensation is based on the lowest temperature encountered in the CVS prior to sampling. (It is recommended that the CVS system be insulated when heated dilution air is used.)

(iii) The dilution ratio is sufficiently high to prevent condensation in bag samples as they cool to room temperature.

(5) Sample collection bags for dilution air and exhaust samples (hydrocarbons and carbon monoxide) shall be of sufficient size so as not to impede sample flow. A single dilution air sample, covering the total test period, may be collected for the determination of methanol and formaldehyde background (methanol-fueled motorcycles).

(6) The methanol sample collection system and the formaldehyde sample collection system shall each be of sufficient capacity so as to collect samples of adequate size for analysis without significant impact on the volume of dilute exhaust passing through the CVS. The systems shall also comply with the following requirements that apply to the design of the systems, not to individual tests:

(i) The methanol system shall be designed such that if a test motorcycle continuously emitted the maximum allowable level of methanol (based on all applicable standards) the measured concentration in the primary impinger would exceed either 25 mg/l or a concentration equal to 25 times the limit of detection for the GC analyzer.

(ii) The formaldehyde system shall be designed such that if a test motorcycle continuously emitted formaldehyde at a rate equal to twenty percent of the maximum allowable level of THCE (i.e., 1.0 g/km for a 5.0 g/km standard), or the maximum formaldehyde level allowed by a specific formaldehyde standard, whichever is less, the concentration of formaldehyde in the DNPH solution of the primary impinger, or solution resulting from the extraction of the DNPH cartridge, shall exceed either 2.5 mg/l or a concentration equal to 25 times the limit of detection for the HPLC analyzer.

(iii) The methanol and formaldehyde systems shall be designed such that the primary impinger collects at least 90 percent of the analyte in the samples. The remaining analyte shall be collected by the secondary impinger. This requirement does not apply to dilution air samples, since they do not require secondary impingers, or to samples in which the concentrations approach the limit of detection.

(d) *Component description, CFV-EFC-CVS.* The CVS sample system is identical to the system described in paragraph (c) of this section, plus includes a means of electronically measuring the CVS flow rate, and electronic mass flow controllers for the methanol and formaldehyde sample lines, and separate flow meters to totalize sample flow volumes (optional). The EFC sample system shall conform to all of the requirements listed in paragraph (c) of this section, except that the methanol and formaldehyde samples may both be drawn from a single static probe. It also must comply with the following additional requirements:

(1) The ratio of the CVS flow rate to the sample flow rate shall not deviate from the ratio at the start of the test by more than 5 percent. (The volumetric sample

flow rate shall be varied inversely with the square root of the bulk stream temperature.)

(2) Flow totalizers for methanol and/or formaldehyde samples shall have an accuracy of ± 2 percent. Total sample volumes may be obtained from the flow controllers, with the advance approval of the administrator, provided that the controllers can be shown to have an accuracy of ± 2 percent.

Sec. 86.511-90 Exhaust gas analytical system.

(a) *Schematic drawings.* Figure F90-3 is a schematic drawing of the exhaust gas analytical system for analysis of hydrocarbons (HC) (hydrocarbons plus methanol in the case of methanol-fueled motorcycles), carbon monoxide (CO), carbon dioxide (CO₂), and oxides of nitrogen (NO_x). Since various configurations can produce accurate results, exact conformance with the drawing is not required. Additional components such as instruments, valves, solenoids, pumps and switches may be used to provide additional information and coordinate the functions of the component systems

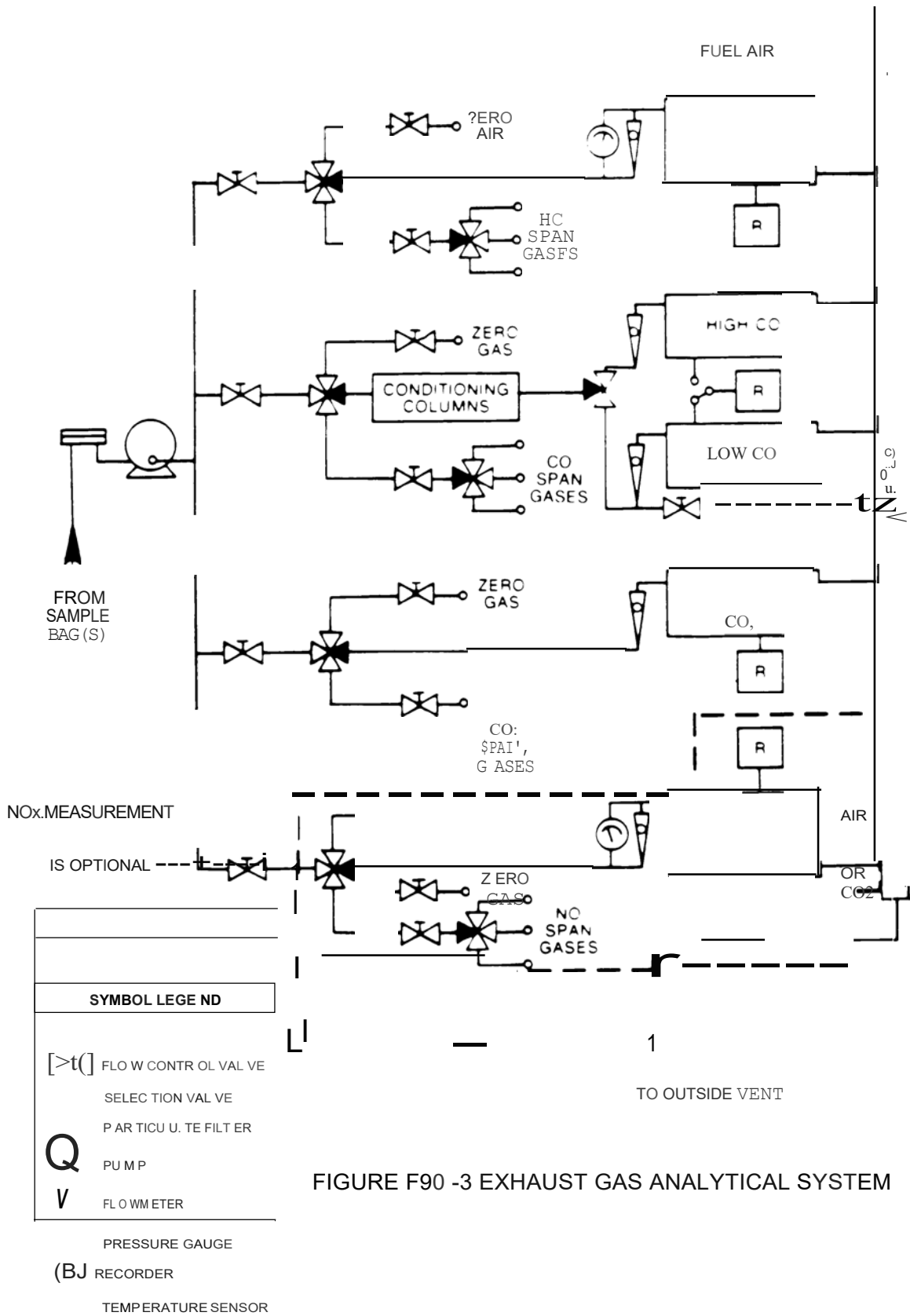


FIGURE F90 -3 EXHAUST GAS ANALYTICAL SYSTEM

(b) *Major component description.* The exhaust gas analytical system for HC, CO and CO₂, Figure F90-3, consists of a flame ionization detector (FID) (heated (235[deg]±15 [deg]C (113[deg]±8 [deg]C)) for methanol-fueled vehicles) for the determination of hydrocarbons, nondispersive infrared analyzers (NDIR) for the determination of carbon monoxide and carbon dioxide and, if oxides of nitrogen are measured, a chemiluminescence analyzer (CL) for the determination of oxides of nitrogen. The analytical system for methanol consists of a gas chromatograph (GC) equipped with a flame ionization detector. The analysis for formaldehyde is performed using high pressure liquid chromatography (HPLC) of 2,4-dinitrophenylhydrazine (DNPH) derivatives using ultraviolet (UV) detection. The exhaust gas analytical system shall conform to the following requirements:

(1) The CL requires that the nitrogen dioxide present in the sample be converted to nitric oxide before analysis. Other types of analyzers may be used if shown to yield equivalent results and if approved in advance by the Administrator.

(2) The carbon monoxide (CO) NDIR analyzer may require a sample conditioning column containing CaSO₄, or indicating silica gel to remove water vapor and containing ascarite to remove carbon dioxide from the CO analysis stream.

(i) If CO instruments which are essentially free of CO₂ and water vapor interference are used, the use of the conditioning column may be deleted, see Sec. 86.522 and 86.544.

(ii) A CO instrument will be considered to be essentially free of CO₂ and water vapor interference if its response to a mixture of 3 percent CO₂ in N₂ which has been bubbled through water at room temperature produces an equivalent CO response, as measured on the most sensitive CO range, which is less than 1 percent of full scale CO concentration on ranges above 300 ppm full scale or less than 3 ppm on ranges below 300 ppm full scale; see Sec. 86.522.

(c) Other analyzers and equipment. Other types of analyzers and equipment may be used if shown to yield equivalent results and if approved in advance by the Administrator.

Sec. 86.513-90 Fuel and engine lubricant specifications.

(a)(1) Gasoline having the following specifications will be used by the Administrator in exhaust emission testing. Gasoline having the following specifications or substantially equivalent specifications approved by the Administrator, shall be used by the manufacturer for emission testing except that the octane specifications do not apply.

(a)(1)(A) Additionally for the 2013-2019 model-year off-highway recreational vehicles, the manufacturer has the option to use the fuel specified in (a)(1)(B) below.

(a)(1)(B) For 2020 and later model-year off-highway recreational vehicles: The certification test fuel for exhaust emission testing must be consistent with the fuel specifications as outlined in title 13, section 1961.2 and the “California 2015 and Subsequent Model Criteria Pollutant Exhaust Emission Standards and Test Procedures and 2017 and Subsequent Model Greenhouse Gas Exhaust Emission Standards and Test Procedures for Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles,” adopted December 6, 2012, and incorporated by reference herein. The test fuel specifications should remain consistent from batch to batch. Optionally, manufacturers may use other renewable fuel blends under this paragraph that have been certified by ARB as yielding test results equivalent, or more stringent than, those resulting from the fuel specified by 13 CCR 1961.2, and which are appropriate for the certification of off-highway recreational vehicles.

(b)(1) Unleaded gasoline and engine lubricants representative of commercial fuels and engine lubricants which will be generally available through retail outlets shall be used in service accumulation.

(2) The octane rating of the gasoline used shall be no higher than 4.0 Research octane numbers above the minimum recommended by the manufacturer.

(3) The Reid Vapor Pressure of the fuel used shall be characteristic of the motor fuel during the season in which the service accumulation takes place.

(4) If the manufacturer specifies several lubricants to be used by the ultimate purchaser, the Administrator will select one to be used during service accumulation.

(c) Methanol fuel used for exhaust and evaporative emission testing and in service accumulation of methanol-fueled motorcycle vehicles shall be representative of commercially available methanol fuel and shall consist of at least 50 percent methanol by volume.

(1) Manufacturers shall recommend the methanol fuel to be used for testing and service accumulation in accordance with paragraph (c).

(2) The Administrator shall determine the methanol fuel to be used for testing and service accumulation.

(d) Other methanol fuels may be used for testing and service accumulation provided:

(1) They are commercially available, and

(2) Information, acceptable to the Administrator, is provided to show that only the designated fuel would be used in customer service, and

(3) Use of a fuel listed under paragraph (a)(3) of this section would have a detrimental effect on emissions or durability, and

(4) Written approval from the Administrator of the fuel specifications must be provided prior to the start of testing.

(e) The specification range of the fuels and engine lubricants to be used under paragraph (b) of this section shall be reported in accordance with Sec. 86.416.

(f) The same lubricant(s) shall be used for both service accumulation and emission testing.

(g) Fuels not meeting the specifications set forth in this section may be used only with the advance approval of the Administrator.

(h) *Mixtures of petroleum and methanol fuels for flexible fuel motorcycles.*

(1) Mixtures of petroleum and methanol fuels used for exhaust and evaporative emission testing and service accumulation for flexible fuel motorcycles shall be within the range of fuel mixtures for which the vehicle was designed.

(2) Manufacturer testing and service accumulation may be performed using only those mixtures (mixtures may be different for exhaust testing, evaporative testing, and service accumulation) expected to result in the highest emissions, provided:

(i) The fuels which constitute the mixture will be used in customer service, and

(ii) Information, acceptable to the Administrator, is provided by the manufacturer to show that the designated fuel mixtures would result in the highest emissions, and

(iii) Written approval from the Administrator of the fuel specifications must be provided prior to the start of testing.

(3) The specification range of the fuels to be used under paragraph (h)(1) of this section shall be reported in accordance with Sec. 86.090 21(b)(3).

Sec. 86.514-78 Analytical gases.

(a) *Analyzer gases.*

(1) Gases for the CO and CO₂ analyzers shall be single blends of CO and CO₂ respectively using nitrogen as the diluent.

(2) Gases for the THC analyzer shall be:
(i) Single blends of propane using air as the diluent; and
(ii) Optionally, for response factor determination, single blends of methanol using air as the diluent.

(3) Gases for the NO_x analyzer shall be single blends of NO named as NO_x with a maximum NO₂ concentration of 5 percent of the nominal value using nitrogen as the diluent.

(4) [Reserved]

(5) The allowable zero gas (air or nitrogen) impurity concentrations shall not exceed 1 ppm equivalent carbon response, 1 ppm carbon monoxide, 0.04 percent (400 ppm) carbon dioxide, and 0.1 ppm nitric oxide.

(6) "Zero grade air" includes artificial "air" consisting of a blend of nitrogen and oxygen with oxygen concentrations between 18 and 21 mole percent.

(7) The use of proportioning and precision blending devices to obtain the required analyzer gas concentrations is allowable provided their use has been approved in advance by the Administrator.

(b) Calibration gases (not including methanol) shall be known to within 2 percent of true values.

(c) Methanol in air gases used for response factor determination shall:

(1) Be traceable to within ± 2 percent of NIST (formerly NBS) gas standards, or other gas standards which have been approved by the Administrator; and

(2) Remain within ± 2 percent of the labeled concentration. Demonstration of stability shall be based on a quarterly measurement procedure with a precision of ± 2 percent (two standard deviations), or other method approved by the Administrator. The measurement procedure may incorporate multiple measurements. If the true concentration of the gas changes by more than two percent, but less than ten percent, the gas may be relabeled with the new concentration.

Sec. 86.515-78 EPA urban dynamometer driving schedule.

(a) The dynamometer driving schedules are listed in appendix I. The driving schedules are defined by a smooth trace drawn through the specified speed vs. time relationships. They consist of a nonrepetitive series of idle, acceleration, cruise, and deceleration modes of various time sequences and rates. Appropriate driving schedules are as follows:

Class I--Appendix I(c)
Class II--Appendix I(b)
Class III--Appendix I(b)

(b) The speed tolerance at any given time on the dynamometer driving schedule prescribed in appendix I or as printed on a driver's aid chart approved by the Administrator, when conducted to meet the requirements of Sec. 86.537 is defined by upper and lower limits. The upper limit is 3.2 km/h (2 mph) higher than the highest point on the trace within 1 second of the given time. The lower limit is 3.2 km/h (2 mph) lower than the lowest point on the trace within 1 second of the given time. Speed variations greater than the tolerances (such as may occur during gear changes) are acceptable provided they occur for less than 2 seconds on any occasion. Speeds lower than those prescribed are acceptable provided the vehicle is operated at maximum available power during such occurrences. When conducted to meet the requirements of Sec. 86.532 the speed tolerance shall be as specified above, except that the upper and lower limits shall be 6.4 km/h (4 mph).

(c) Figure F78-4 shows the range of acceptable speed tolerances for typical points. Figure F78-4(a) is typical of portions of the speed curve which are increasing or decreasing throughout the two second time interval. Figure F78-4(b) is typical of portions of the speed curve which include a maximum or minimum value.

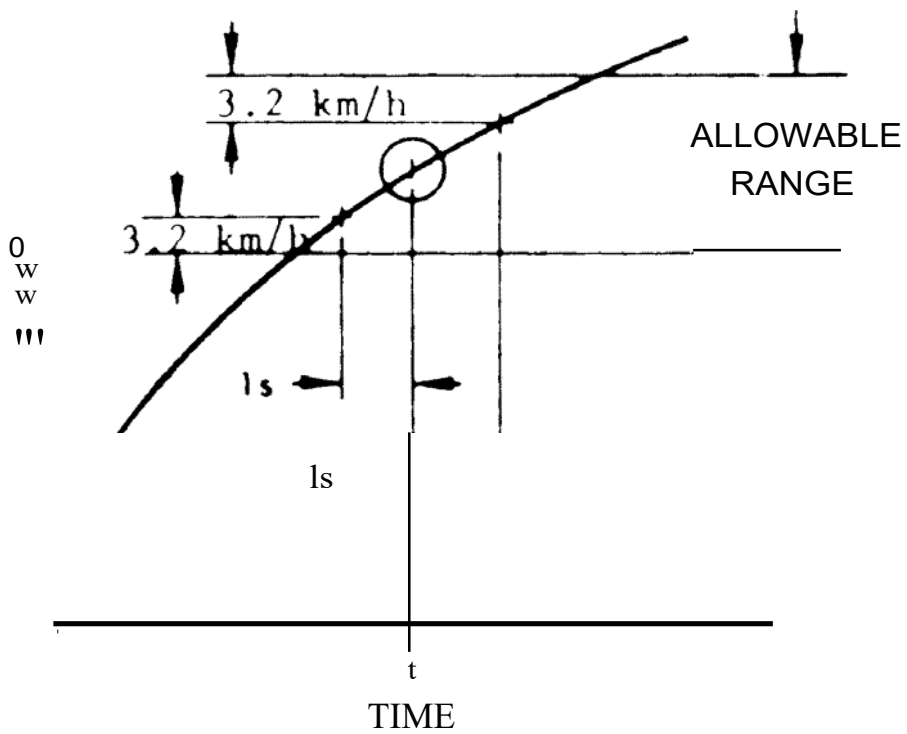


FIGURE 78-- **OVUS** TIA a , ALLOWABLE RANGE

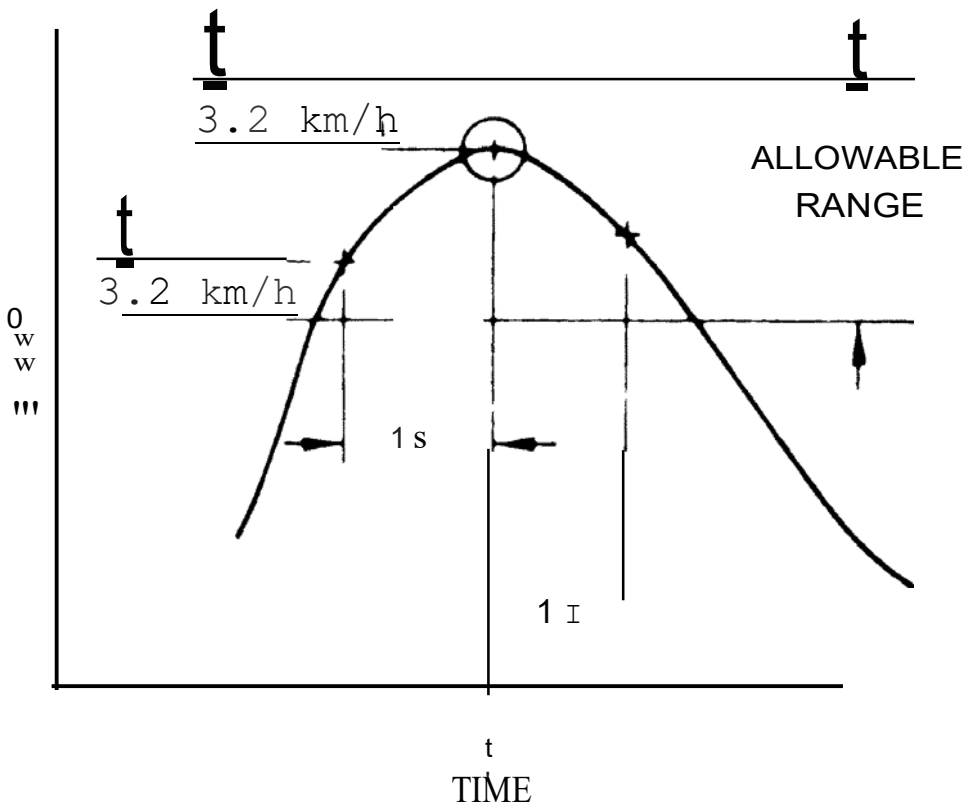


FIGURE 78--a. **OIVIS** TIA CE, ALLOWABLE RANGE

(d) For motorcycles with an engine displacement less than 50 cc and a top speed less than 58.7 km/hr (36.5 mph), the speed indicated for each second of operation on the applicable Class I driving trace (speed versus time sequence) in appendix I(c) shall be adjusted downward by the ratio of actual top speed to specified maximum test speed. Calculate the ratio with three significant figures by dividing the top speed of the motorcycle in km/hr by 58.7. For example, for a motorcycle with a top speed of 48.3 km/hr (30 mph), the ratio would be $48.3/58.7 = 0.823$. The top speed to be used under this section shall be indicated in the manufacturer's application for certification, and shall be the highest sustainable speed of the motorcycle with an 80 kg rider on a flat paved surface. If the motorcycle is equipped with a permanent speed governor that is unlikely to be removed in actual use, measure the top speed in the governed configuration; otherwise measure the top speed in the ungoverned configuration.

Sec. 86.516-90 Calibrations, frequency and overview.

(a) Calibrations shall be performed as specified in Sec. Sec. 86.517 through 86.526.

(b) [Reserved]

(c) At least monthly or after any maintenance which could alter calibration, the following calibrations and checks shall be performed:

(1) Calibrate the hydrocarbon analyzer, methane analyzer, carbon dioxide analyzer, carbon monoxide analyzer, and oxides of nitrogen analyzer (certain analyzers may require more frequent calibration depending on particular equipment and uses).

(2) Calibrate the dynamometer. If the dynamometer receives a weekly performance check (and remains within calibration), the monthly calibration need not be performed.

(3) Check the oxides of nitrogen converter efficiency.

(d) At least weekly or after any maintenance which could alter calibration, the following calibrations and checks shall be performed:

(1) [Reserved]

(2) Perform a CVS system verification, and

(3) Run a performance check on the dynamometer. This check may be omitted if the dynamometer has been calibrated within the preceding month.

(e) The CVS positive displacement pump or Critical Flow Venturi shall be calibrated following initial installation, major maintenance or as necessary when indicated by the CVS system verification (described in Sec. 86.519).

(f) Sample conditioning columns, if used in the CO analyzer train, should be checked at a frequency consistent with observed column life or when the indicator of the column packing begins to show deterioration.

Sec. 86.518-78 Dynamometer calibration.

(a) The dynamometer shall be calibrated at least once each month or performance verified at least once each week and then calibrated as required. The dynamometer is driven above the test speed range. The device used to drive the dynamometer is then disengaged from the dynamometer and the roll is allowed to coast down. The kinetic energy of the system is dissipated by the dynamometer. This method neglects the variations in roll bearing friction due to the drive axle weight of the vehicle.

(b) Calibration shall consist of coasting down the dynamometer for each inertia load combination used. Coastdown times for the interval from 70 to 60 km/h shall be within the tolerances specified in Sec. 86.529. The dynamometer adjustments necessary to produce these results shall be noted for future reference.

(c) The performance check consists of conducting a dynamometer coastdown at one or more inertia-horsepower settings and comparing the coastdown time to the table in Figure F98-9 of Sec. 86.529-98. If the coastdown time is outside the tolerance, a new calibration is required.

Sec. 86.519-90 Constant volume sampler calibration.

(a) The CVS (Constant Volume Sampler) is calibrated using an accurate flowmeter and restrictor valve. Measurements of various parameters are made and related to flow through the unit. Procedures used by EPA for both PDP (Positive Displacement Pump) and CFV (Critical Flow Venturi) are outlined below. Other procedures yielding equivalent results may be used if approved in advance by the Administrator. After the calibration curve has been obtained, verification of the entire system can be performed by injecting a known mass of gas into the system and comparing the mass indicated by the system to the true mass injected. An indicated error does not necessarily mean that the calibration is wrong, since other factors can influence the accuracy of the system, e.g., analyzer calibration. A verification procedure is found in paragraph (d) of this section.

(b) *PDP calibration.*

(1) The following calibration procedures outlines the equipment, the test configuration, and the various parameters which must be measured to establish the flow rate of the constant volume sampler pump. All the parameters related to the pump are simultaneously measured with the parameters related to a flowmeter which is connected in series with the pump. The calculated flow rate (at pump inlet absolute pressure and temperature) can then be plotted versus a correlation function which is the value of a specific combination of pump parameters. The linear equation which relates the pump flow and the correlation function is then determined. In the event that a CVS has a multiple speed drive, a calibration for each range must be performed.

(2) This calibration procedure is based on the measurement of the absolute values of the pump and flowmeter parameters that relate the flow rate at each point. Three conditions must be maintained to assure the accuracy and integrity of the calibration curve. First, the pump pressures should be measured at taps on the pump rather than at the external piping on the pump inlet and outlet. Pressure taps that are mounted at the top center and bottom center of the pump drive headplate are exposed to the actual pump cavity pressures, and therefore reflect the absolute pressure differentials. Secondly, temperature stability must be maintained during the calibration. The laminar flowmeter is sensitive to inlet temperature oscillations which cause the data points to be scattered. Gradual changes (± 1 [deg]C (1.8 [deg]F)) in temperature are acceptable as long as they occur over a period of several minutes. Finally, all connections between the flowmeter and the CVS pump must be absolutely void of any leakage.

(3) During an exhaust emission test the measurement of these same pump parameters enables the user to calculate the flow rate from the calibration equation.

(4) Connect a system as shown in Figure F78-5. Although particular types of equipment are shown, other configurations that yield equivalent results may be used if approved in advance by the Administrator. For the system indicated, the following data with given accuracy are required:

Calibration Data Measurements

Parameter	Symbol	Units	Tolerances
Barometric pressure corrected.....	P _B	kPa (in. Hg)	±0.03 kPa (±0.01 in. Hg)
Ambient temperature.....	T _A	[deg]C ([deg]F)	±0.3 [deg]C (0.54 [deg]F)
Air Temperature into LFE.....	ETI	[deg]C ([deg]F)	±0.15 [deg]C (0.27 [deg]F)
Pressure depression upstream of LFE.....	EPI	kPa (in H ₂ O)	±0.01 kPa (0.05 in. H ₂ O)
Pressure drop across the LFE matrix.....	EDP	kPa (in H ₂ O)	±0.001 kPa (0.005 in. H ₂ O)
Air temperature at CVS pump inlet.....	PTI	[deg]C ([deg]F)	±0.25 [deg]C (0.45 [deg]F)
Pressure depression at CVS pump inlet.....	PPI	kPa (in. Fluid)	±0.021 kPa (0.046 in. Fluid)
Specific gravity of manometer fluid (1.75 oil)	Sp. Gr.		
Pressure head at CVS pump outlet.....	PPO	kPa (in. Fluid)	±0.021 kPa (0.046 in. Fluid)
Air temperature at CVS pump outlet.....	PTO	[deg]C ([deg]F)	±0.25 [deg]C (0.45 [deg]F)
Pump revolutions during test period.....	N	Revs	±1 Rev.
Elapsed time for test period.....	t	sec.	±0.05 sec.

(5) After the system has been connected as shown in Figure F78-6, set the variable restrictor in the wide open position and run the CVS pump for twenty minutes. Record the calibration data.

(6) Reset the restrictor valve to a more restricted condition in an increment of pump inlet depression (about 1.0 kPa (4 in. H₂O)) that will yield a minimum of six data points for the total calibration. Allow the system to stabilize for 3 minutes and repeat the data acquisition.

(7) Data analysis:

(i) The air flow rate, Q_s, at each test point is calculated from the flowmeter data using the manufacturers' prescribed method.

(ii) The air flow rate is then converted to pump flow, V_o in m³ per revolution at absolute pump inlet temperature and pressure.

$$V_o = (Q_s/n) \times (T_p/293) \times (101.3/P_p)$$

Where:

(A) V_o = Pump flow, m³/rev (ft³/rev) at T_p, P_p.

(B) Q_s = Meter air flow rate in standard cubic meters per minute; standard conditions are 20 [deg]C, 101.3 kPa (68 [deg]F, 29.92 in. Hg).

(C) n = Pump speed in revolutions per minute.

(D)(1) T_p = Pump inlet temperature, ([deg]K) = PTI + 273.

(2) For English units, T_p = PTI + 460.

(E)(1) P_p = Absolute pump inlet pressure, kPa (in. Hg) = P_B - PPI.

(2) For English units, P_p = P_B - PPI(SP.GR./13.57).

Where:

(F) P_B = barometric pressure, kPa (in. Hg.).

(G) PPI = Pump inlet depression, kPa (in. fluid).

(H) SP. GR. = Specific gravity of manometer fluid relative to water.

(iii) The correlation function at each test point is then calculated from the calibration data:

$$X_o = \frac{1}{n} \sqrt{\frac{\Delta P_p}{P_e}}$$

Where:

- (A) X_o = correlation function.
- (B) $[\Delta] P_p$ = The pressure differential from pump inlet to pump outlet, kPa (in. Hg) = $P_e - P_p$.
- (C)(1) P_e = Absolute pump outlet pressure, kPa (in. Hg) = $P_B + PPO$.
(2) *For English units, $P_e = P_B + PPO$ (SP. GR./13.57).*

Where:

- (D) PPO = Pressure head at pump outlet, kPa (in. fluid).
- (iv) A linear least squares fit is performed to generate the calibration equations which have the forms:

$$V_o = D_o - M(X_o)$$

$$n = A - B([\Delta] P_p)$$

D_o' M, A, and B are the slope-intercept constants, describing the lines.

(8) A CVS system that has multiple speeds shall be calibrated on each speed used. The calibration curves generated for the ranges will be approximately parallel and the intercept values, D_o' will increase as the pump flow range decreases.

(9) If the calibration has been performed carefully, the calculated values from the equation will be within ± 0.50 percent of the measured value of V_o . Values of M will vary from one pump to another, but values of D_o for pumps of the same make, model, and range should agree within ± 3 percent of each other. Particulate influx from use will cause the pump slip to decrease as reflected by lower values for M. Calibrations should be performed at pump startup and after major maintenance to assure the stability of the pump slip rate. Analysis of mass injection data will also reflect pump slip stability.

(c) *CFV calibration.*

(1) Calibration of the Critical Flow Venturi (CFV) is based upon the flow equation for a critical venturi. Gas flow is a function of inlet pressure and temperature:

$$Q_s = \frac{K_v P}{\sqrt{T}}$$

Where:

- (i) Q_s = Flow.
- (ii) K_v = Calibration coefficient.
- (iii) P = Absolute pressure.
- (iv) T = Absolute temperature.

The calibration procedure described below establishes the value of the calibration coefficient at the measured values of pressure, temperature and air flow.

(2) The manufacturer's recommended procedure shall be followed for calibrating electronic portions of the CFV.

(3) Measurements necessary for flow calibration are as follows:

Calibration Data Measurements

Parameter	Symbol	Units	Tolerances
Barometric pressure (corrected).....	P_B	kPa (in. Hg).....	±0.03 kPa (±0.01 in. Hg)
Air temperature, flowmeter.....	ETI.....	[deg]C ([deg]F)	±0.15 [deg]C (±0.27 [deg]F)
Pressure depression upstream of LFE.....	EPI.....	kPa (in. H ₂ O)...	±0.01kPa (±0.05 in. H ₂ O)
Pressure drop across LFE matrix.....	EDP.....	kPa (in. H ₂ O)...	±0.001 kPa (±0.005 in. H ₂ O)
Air flow.....	Q_s	m ³ min (ft ³ min)..	±0.5%
CFV inlet depression.....	PPI.....	kPa (in. fluid)...	±0.02 kPa (±0.05 in. fluid)
Temperature at venturi inlet.....	T_v	[deg]C ([deg]F)	±0.25 [deg]C (±0.45 [deg]F)
Specific gravity of manometer fluid (1.75 oil)	Sp. Gr. ...		

(4) Set up equipment as shown in Figure F78-6 and check for leaks. Any leaks between the flow measuring device and the critical flow venturi will seriously affect the accuracy of the calibration.

(5) Set the variable flow restrictor to the open position, start the blower and allow the system to stabilize. Record data from all instruments.

(6) Vary the flow restrictor and make at least 8 readings across the critical flow range of the venturi.

(7) Data analysis. The data recorded during the calibration are to be used in the following calculations:

- (i) The air flow rate, Q_s , at each test point is calculated from the flowmeter data using the manufacturer's prescribed method.
- (ii) Calculate values of the calibration coefficient for each test point:

$$K_v = \frac{Q_s \sqrt{T_v}}{P_v}$$

Where:

(A) Q_s = Flow rate in m³/minute, standard conditions are 20 [deg]C, 101.3 kPa (68 [deg]F, 29.92 in. Hg)

(B) T_v = Temperature at venturi inlet, [deg]K([deg]R).

(C)(1) P_v = Pressure at venturi inlet, kPa (mm Hg) = $P_B - PPI$.

(2) For English units, $P_v = P_B - PPI$ (SP.GR./13.57).

Where:

(D) PPI = Venturi inlet pressure depression, kPa (in. fluid).

(E) SP.GR.=Specific gravity of manometer fluid, relative to water.

(iii) Plot K_v as a function of venturi inlet depression.

For sonic flow, K_v will have a relatively constant value. As pressure decreases (vacuum increases), the venturi becomes unchoked and K_v decreases (is no longer constant). See Figure F78-7.

(iv) For a minimum of 8 points in the critical region, calculate an average K_v and the standard deviation.

(v) If the standard deviation exceeds 0.3 percent of the average K_v , take corrective action.

(d) *CVS system verification.* The following “gravimetric” technique can be used to verify that the CVS and analytical instruments can accurately measure a mass of gas that has been injected into the system. If the CVS and analytical system will be used only in the testing of gasoline-fueled vehicles, the system verification may be performed using either propane or carbon monoxide. If the CVS and analytical system will be used with methanol-fueled vehicles as well as gasoline-fueled vehicles, system verification performance check must include a methanol check in addition to either the propane or carbon monoxide check. (Verification can also be accomplished by constant flow metering using critical flow orifice devices.)

(1) Obtain a small cylinder that has been charged with pure propane or carbon monoxide gas (CAUTION--carbon monoxide is poisonous).

(2) Determine a reference cylinder weight to the nearest 0.01 grams.

(3) Operate the CVS in the normal manner and release a quantity of pure propane or carbon monoxide into the system during the sampling period (approximately 5 minutes).

(4) Following completion of step (3) above (if methanol injection is required), continue to operate the CVS in the normal manner and release a known quantity of pure methanol (in gaseous form) into the system during the sampling period (approximately 5 minutes). This step does not need to be performed with each verification, provided that it is performed at least twice annually.

(5) The calculations of Sec. 86.544 are performed in the normal way except in the case of propane. The density of propane (0.6109 kg/m³/carbon atom (17.30 g/ft³/carbon atom)) is used in place of the density of exhaust hydrocarbons. In the case of carbon monoxide, the density of 1.164 kg/m³ (32.97 g/ft³) is used. In the case of methanol, the density of 1.332 kg/m³ (37.71 g/ft³) is used.

(6) The gravimetric mass is subtracted from the CVS measured mass and then divided by the gravimetric mass to determine the percent accuracy of the system.

(7) The cause for any discrepancy greater than 2 percent must be found and corrected. The Administrator, upon request, may waive the requirement to comply with ± 2 percent methanol recovery tolerance, and instead require compliance with a higher tolerance (not to exceed 6 percent), provided that:

(i) The Administrator determines that compliance with the specified tolerance is not practically feasible; and

(ii) The manufacturer makes information available to the Administrator which indicates that the calibration tests and their results are consistent with good laboratory practice, and that the results are consistent with the results of calibration testing conducted by the Administrator.

Sec. 86.521-90 Hydrocarbon analyzer calibration.

(a) The FID hydrocarbon analyzer shall receive the following initial and periodic calibration. The HFID used with methanol-fueled vehicles shall be operated at 235 [deg]F \pm 15 [deg]F (113 [deg]C \pm 8 [deg]C).

(b) *Initial and periodic optimization of detector response.* Prior to its introduction into service and at least annually thereafter, the FID hydrocarbon analyzer shall be adjusted for optimum hydrocarbon response. Analyzers used with petroleum fuels and liquefied petroleum gas-fuel shall be optimized using propane. Analyzers used with natural gas-fuel for measurement of hydrocarbons shall be optimized using methane. If a single analyzer is used for all measurements, it shall be optimized using propane and its response factor for methane shall be determined and accounted for in measurements of total hydrocarbons from natural gas-fuel. Alternate methods yielding equivalent results may be used, if approved in advance by the Administrator.

(1) Follow the manufacturer's instructions or good engineering practice for instrument startup and basic operating adjustment using the appropriate FID fuel and zero-grade air.

(2) Optimize on the most common operating range. Introduce into the analyzer a propane (methane as appropriate) in air mixture (methanol in air mixture for methanol-fueled vehicles when optional methanol calibrated FID procedure is used during the 1990 through 1994 model year) with a propane (or methane or

methanol as appropriate) concentration equal to approximately 90 percent of the most common operating range.

(3) Select an operating FID fuel flow rate that will give near maximum response and least variation in response with minor fuel flow variations.

(4) To determine the optimum air flow, use the FID fuel flow setting determined above and vary air flow.

(5) After the optimum flow rates have been determined, record them for future reference.

(c) *Initial and periodic calibration.* Prior to its introduction into service and monthly thereafter the FID hydrocarbon analyzer shall be calibrated on all normally used instrument ranges, and, if applicable, the methanol response factor shall be determined (paragraph (d) of this section). Use the same flow rate as when analyzing sample.

(1) Adjust analyzer to optimize performance.

(2) Zero the hydrocarbon analyzer with zero grade air.

(3) Calibrate on each normally used operating range with propane in air (or methanol or methane in air as appropriate) calibration gases having nominal concentrations of 15, 30, 45, 60, 75 and 90 percent of that range. For each range calibrated, if the deviation from a least squares best-fit straight line is two percent or less of the value at each data point, concentration values may be calculated by use of a single calibration factor for that range. If the deviation exceeds two percent at any point, the best-fit non-linear equation which represents the data to within two percent of each test point shall be used to determine concentration.

(d) FID response factor to methanol. When the FID analyzer is to be used for the analysis of hydrocarbon samples containing methanol, the methanol response factor of the analyzer shall be established. The methanol response factor shall be determined at several concentrations in the range of concentrations in the exhaust sample, using either bag samples or gas bottles meeting the requirements of Sec. 86.514.

(1) The bag sample, if used, of methanol for analysis in the FID shall be prepared using the apparatus shown in Figure F90-4. A known volume of methanol is injected, using a microliter syringe, into the heated mixing zone (250 [deg]F (121 [deg]C)) of the apparatus. The methanol is vaporized and swept into the sample bag with a known volume of zero grade air measured by a gas flow meter meeting the performance requirements of Sec. 86.120.

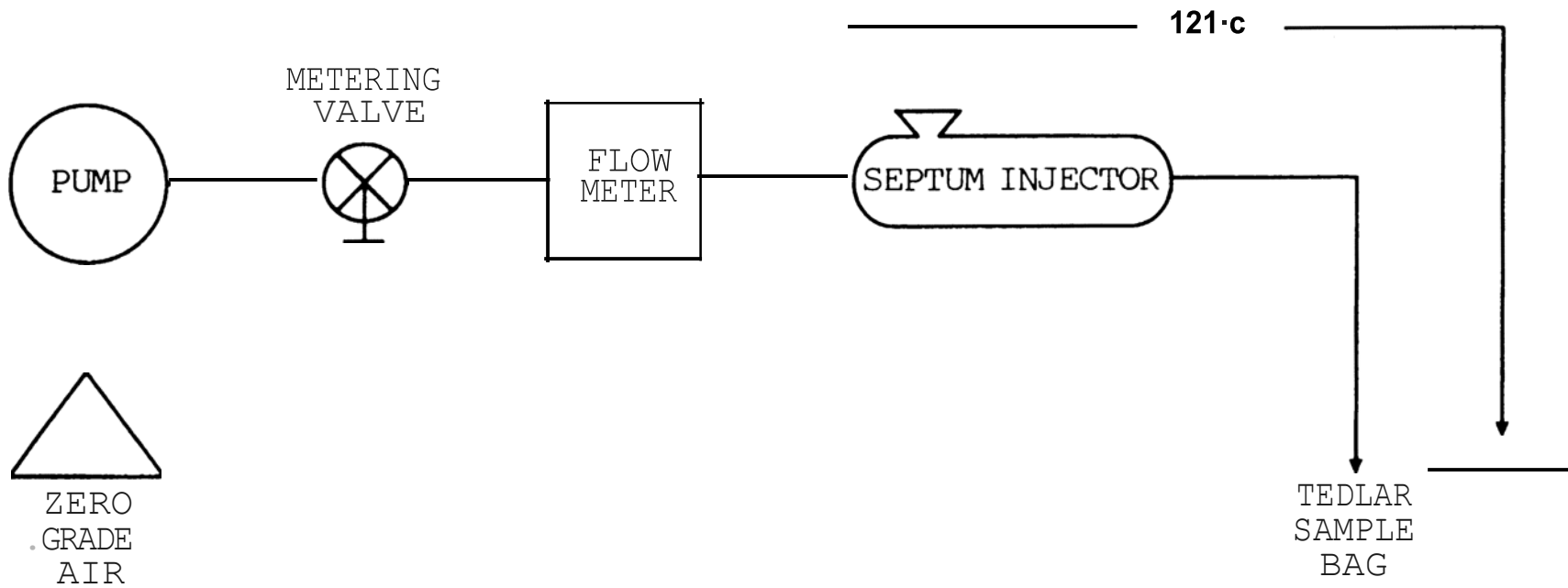


FIGURE F90-4 APPARAIUS FOR PREPARATION OF RO METHANOL RESPONSE CAUBRA110N MIX

(2) The bag sample is analyzed using the FID.

(3) The FID response factor, r , is calculated as follows: $r =$

FID_{ppm}/SAM_{ppm} Where:

- (i) r = FID response factor.
- (ii) FID_{ppm} = FID reading, ppmC.
- (iii) SAM_{ppm} = methanol concentration in the sample bag, or gas bottle, in ppmC. SAM_{ppm} for sample bags:

$$= \frac{0.02406 \times \text{Fuel injected} \times \text{Fuel density}}{\text{Air volume} \times \text{Mol. Wt. } CH_3OH}$$

Where:

- (iv) 0.02406 = Volume of one mole at 101.3 kPa (29.92 in. Hg) and 20 [deg]C (68 [deg]F), m^3 .
- (v) Fuel injected = Volume of methanol injected, ml.
- (vi) Fuel Density = Density of methanol, 0.7914 g/ml
- (vii) Air volume = Volume of zero grade air, m^3
- (viii) Mol. Wt. CH_3OH = 32.04

(e) *FID response factor to methane.* When the FID analyzer is to be used for the analysis of natural gas-fueled motorcycle hydrocarbon samples, the methane response factor of the analyzer shall be established. To determine the total hydrocarbon FID response to methane, known methane in air concentrations traceable to National Institute of Standards and Technology (NIST) shall be analyzed by the FID. Several methane concentrations shall be analyzed by the FID in the range of concentrations in the exhaust sample. The total hydrocarbon FID response to methane is calculated as follows:

$$r_{CH_4} = FID_{ppm}/SAM_{ppm}$$

Where:

- (1) r_{CH_4} = FID response factor to methane.
- (2) FID_{ppm} = FID reading in ppmC.
- (3) SAM_{ppm} = the known methane concentration in ppmC.

Sec. 86.522-78 Carbon monoxide analyzer calibration.

(a) Initial and periodic interference check. Prior to its introduction into service and annually thereafter the NDIR carbon monoxide analyzer shall be checked for response to water vapor and CO_2 :

- (1) Follow the manufacturer's instructions for instrument startup and operation. Adjust the analyzer to optimize performance on the most sensitive range.

(2) Zero the carbon monoxide analyzer with either zero grade air or zero grade nitrogen.

(3) Bubble a mixture of 3 percent CO₂ in N₂ through water at room temperature and record analyzer response.

(4) An analyzer response of more than 1 percent of full scale for ranges above 300 ppm full scale or of more than 3 ppm on ranges below 300 ppm full scale will require corrective action. (Use of conditioning columns is one form of corrective action which may be taken.)

(b) Initial and periodic calibration. Prior to its introduction into service and monthly thereafter the NDIR carbon monoxide analyzer shall be calibrated.

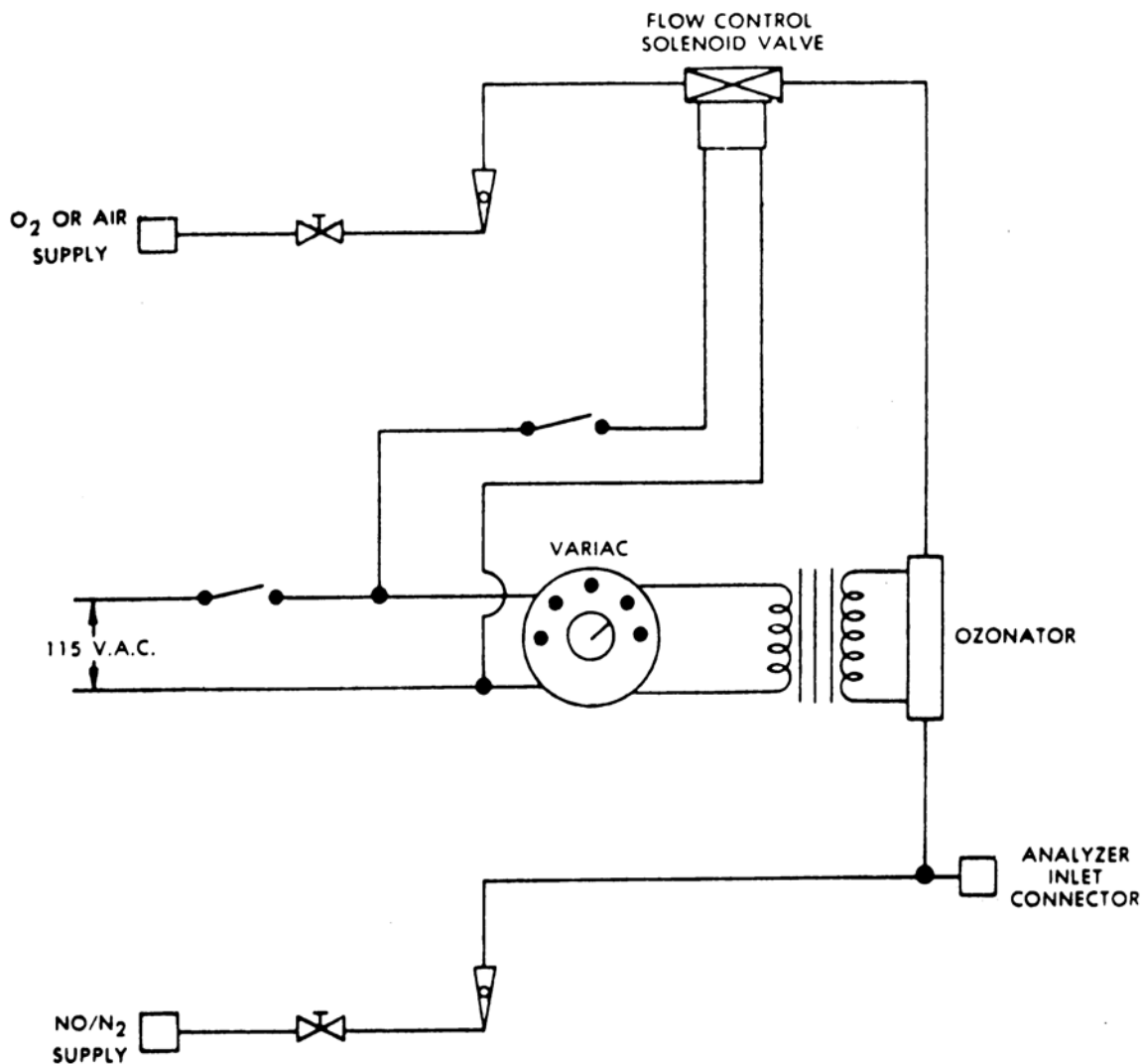
(1) Adjust the analyzer to optimize performance.

(2) Zero the carbon monoxide analyzer with either zero grade air or zero grade nitrogen.

(3) Calibrate on each normally used operating range with carbon monoxide in N₂ calibration gases having nominal concentrations of 15, 30, 45, 60, 75, and 90 percent of that range. Additional calibration points may be generated. For each range calibrated, if the deviation from a least-squares best-fit straight line is 2 percent or less of the value at each data point, concentration values may be calculated by use of a single calibration factor for that range. If the deviation exceeds 2 percent at any point, the best-fit non-linear equation which represents the data to within 2 percent of each test point shall be used to determine concentration.

Sec. 86.523-78 Oxides of nitrogen analyzer calibration.

(a) Prior to introduction into service and at least monthly thereafter, if oxides of nitrogen are measured, the chemiluminescent oxides of nitrogen analyzer must be checked for NO₂ to NO converter efficiency. Figure F78-8 is a reference for paragraphs (a) (1) through (11) of this section.



(SEE FIG F78-3 FOR SYMBOL LEGEND)
FIGURE F78-8—NO_x CONVERTER EFFICIENCY DETECTOR

- (1) Follow the manufacturer's instructions for instrument startup and operation. Adjust the analyzer to optimize performance.
- (2) Zero the oxides of nitrogen analyzer with zero grade air or zero grade nitrogen.
- (3) Connect the outlet of the NO_x generator to the sample inlet of the oxides of nitrogen analyzer which has been set to the most common operating range.
- (4) Introduce into the NO_x generator analyzer-system a NO in nitrogen (N₂) mixture with a NO concentration equal to approximately 80 percent of the most common operating range. The NO₂ content of the gas mixture shall be less than 5 percent of the NO concentration.

(5) With the oxides of nitrogen analyzer in the NO mode, record the concentration of NO indicated by the analyzer.

(6) Turn on the NO_x generator O₂ (or air) supply and adjust the O₂ (or air) flow rate so that the NO indicated by the analyzer is about 10 percent less than indicated in step 5. Record the concentration of NO in this NO+O₂ mixture.

(7) Switch the NO_x generator to the generation mode and adjust the generation rate so that the NO measured on the analyzer is 20 percent of that measured in step 5. There must be at least 10 percent unreacted NO at this point. Record the concentration of residual NO.

(8) Switch the oxides of nitrogen analyzer to the NO_x mode and measure total NO_x. Record this value.

(9) Switch off the NO_x generation but maintain gas flow through the system. The oxides of nitrogen analyzer will indicate the NO_x in the NO+O₂ mixture. Record this value.

(10) Turn off the NO_x generator O₂ (or air) supply. The analyzer will now indicate the NO_x in the original NO in N₂ mixture. This value should be no more than 5 percent above the value indicated in step 4.

(11) Calculate the efficiency of the NO_x converter by substituting the concentrations obtained into the following equation:

$$\text{Percent Efficiency} = [1 + (a-b)/(c-d)] \times 100$$

where:

- a = concentration obtained in step (8).
- b = concentration obtained in step (9).
- c = concentration obtained in step (6).
- d = concentration obtained in step (7).

If converter efficiency is not greater than 90 percent corrective action will be required.

(b) Initial and periodic calibration. Prior to its introduction into service and monthly thereafter, if oxides of nitrogen are measured, the chemiluminescent oxides of nitrogen analyzer shall be calibrated on all normally used instrument ranges. Use the same flow rate as when analyzing samples. Proceed as follows:

- (1) Adjust analyzer to optimize performance.

(2) Zero the oxides of nitrogen analyzer with zero grade air or zero grade nitrogen.

(3) Calibrate on each normally used operating range with NO in N₂ calibration gases with nominal concentrations of 50 and 100 percent of that range. Additional calibration points may be generated.

(c) When testing methanol-fueled motorcycles, it may be necessary to clean the analyzer frequently to prevent interference with NO_x measurements (see EPA/600/S3-88/040).

Sec. 86.524-78 Carbon dioxide analyzer calibration.

(a) Prior to its introduction into service and monthly thereafter the NDIR carbon dioxide analyzer shall be calibrated:

(1) Follow the manufacturer's instructions for instrument startup and operation. Adjust the analyzer to optimize performance.

(2) Zero the carbon dioxide analyzer with either zero grade air or zero grade nitrogen.

(3) Calibrate on each normally used operating range with carbon dioxide in N₂ calibration gases with nominal concentrations of 15, 30, 45, 60, 75, and 90 percent of that range. Additional calibration points may be generated. For each range calibrated, if the deviation from a least-squares best-fit straight line is 2 percent or less of the value at each data point, concentration values may be calculated by use of a single calibration factor for that range. If the deviation exceeds 2 percent at any point, the best-fit non-linear equation which represents the data to within 2 percent of each test point shall be used to determine concentration.

(b) [Reserved]

Sec. 86.526-90 Calibration of other equipment.

Other test equipment used for testing shall be calibrated as often as required by the manufacturer or as necessary according to good practice. Specific equipment requiring calibration is the gas chromatograph and flame ionization detector used in measuring methanol and the high pressure liquid chromatograph (HPLC) and ultraviolet detector for measuring formaldehyde.

Sec. 86.527-90 Test procedures, overview.

(a) The procedures described in this and subsequent sections are used to determine the conformity of motorcycles with the standards set forth in subpart E of this part.

(b) The overall test consists of prescribed sequences of fueling, parking, and operating conditions.

(c) The exhaust emission test is designed to determine hydrocarbon (gasoline-fueled, natural gas-fueled and liquefied petroleum gas-fueled motorcycles), methanol, formaldehyde, and hydrocarbon (methanol-fueled motorcycles), carbon monoxide and oxides of nitrogen mass emissions while simulating an average trip in an urban area. The test consists of engine startups and motorcycle operation on a chassis dynamometer, through a specified driving schedule. A proportional part of the diluted exhaust emissions is collected continuously for subsequent analysis, using a constant volume (variable dilution) sampler.

(d) Except in cases of component malfunction or failure, all emission control systems installed on or incorporated in a new motorcycle shall be functioning during all procedures in this subpart. Maintenance to correct component malfunction or failure shall be authorized in accordance with subpart E of this part.

(e) Background concentrations are measured for all species for which emissions measurements are made. For exhaust testing, this requires sampling and analysis of the dilution air. (When testing methanol-fueled motorcycles, manufacturers may choose not to measure background concentrations of methanol and/or formaldehyde, and then assume that the concentrations are zero during calculations.)

Sec. 86.528-78 Transmissions.

(a) Vehicles equipped with transfer cases, multiple sprockets, etc., shall be tested in the manufacturer's recommended configuration for street or highway use. If more than one configuration is recommended or if the recommendation is deemed unreasonable by the Administrator, the Administrator will specify the test configuration.

(b) All tests shall be conducted with automatic transmissions in "Drive" (highest gear). Automatic clutch-torque converter transmissions may be shifted as manual transmissions at the option of the manufacturer.

(c) Idle modes shall be run with automatic transmissions in "Drive" and the wheels braked, manual transmission shall be in gear with the clutch disengaged; except first idle, see Sec. Sec. 86.536 and 86.537.

(d) The vehicle shall be driven with minimum throttle movement to maintain the desired speed. No simultaneous use of brake and throttle shall be permitted.

(e) Acceleration modes shall be driven smoothly. Automatic transmissions shall shift automatically through the normal sequence of gears; manual transmissions shall be shifted as recommended by the manufacturer to the ultimate purchaser (unless determined to be unreasonable by the Administrator) with the operator closing the throttle during each shift and accomplishing the shift with minimum time. If the vehicle cannot accelerate at the specified rate, the vehicle shall be operated with the throttle fully opened until the vehicle speed reaches the value prescribed for that time in the driving schedule.

(f) The deceleration modes shall be run in gear using brakes or throttle as necessary to maintain the desired speed. Manual transmission vehicles shall be downshifted using the same shift points as when upshifting or as recommended by the manufacturer in the vehicle owner's manual. All downshifts shall be made smoothly, disengaging the clutch while shifting and engaging the clutch once the lower gear has been selected. For those modes which require the vehicle to decelerate to zero, manual transmission clutches shall be disengaged when the speed drops below 15 km/h (9.3 mph) for vehicles with engine displacements equal to or greater than 280 cc (17.1 cu. in.), when the speed drops below 10 km/h (6.2 mph) for vehicles with engine displacements less than 280 cc (17.1 cu. in.), when engine roughness is evident, or when engine stalling is imminent.

(g) If downshifting during deceleration is not permitted in the vehicle owner's manual, manual transmissions will be downshifted at the beginning of or during a power mode if recommended by the manufacturer or if the engine obviously is lugging. For those modes which require these vehicles to decelerate to zero, manual transmission clutches shall be disengaged when the speed drops below 25 km/h (15.5 mph) for vehicles with engine displacement equal to or greater than 280 cc (17.1 cu. in.), when the speed drops below 20 km/h (12.4 mph) for vehicles with engine displacements less than 280 cc (17.1 cu. in.), when engine roughness is evident, or when engine stalling is imminent. While the clutch is disengaged and during these deceleration modes, the vehicle shall be shifted to the appropriate gear for starting the next mode.

(h) If shift speeds are not recommended by the manufacturer, manual transmission vehicles shall be shifted as follows:

(1) For Class I and II motorcycles:

Shift	Speed
1 st to 2 nd gear	19 km/h (11.8 mi/h).
2 nd to 3 rd gear	33 km/h (20.5 mi/h).
3 rd to 4 th gear	44 km/h (27.3 mi/h)
4 th to 5 th gear	53 km/h (32.9 mi/h)

(2) For Class III motorcycles:

Shift	Speed
1 st to 2 nd gear	30 km/h (18.6 mi/h).
2 nd to 3 rd gear	45 km/h (28.0 mi/h).
3 rd to 4 th gear	60 km/h (37.3 mi/h)
4 th to 5 th gear	75 km/h (46.6 mi/h)

(3) Higher gears may be used at the manufacturer's option.

Sec. 86.529-78 Road load force and inertia weight determination.

(a) Road load as a function of speed is given by the following equation:

$$F = A + CV^2$$

The values for coefficients A and C and the test inertia are given in Figure F78-9. Velocity (V) is in km/h and force (F) is in newtons. The forces given by this equation shall be simulated to the best ability of the equipment being used.

(b) The inertia given in Figure F78-9 shall be used. Motorcycles with loaded vehicle mass outside these limits shall be tested at an equivalent inertial mass and road load force specified by the Administrator.

Figure F78-9

Loaded vehicle mass (kg)	Equivalent inertial mass (kg)	Force coefficients		Force at 65 km/h (nt)	70 to 60 km/h coastdown calibration times		
		A (nt)	C (nt/(km/h) ²)		Target time (sec)	Allowable tolerance	
						Longest time (sec)	Shortest time (sec)
95-105.....	100	0.0	.0224	94.8	2.95	3.1	2.8
106-115.....	110	0.82	.0227	96.8	3.18	3.3	3.0
116-125.....	120	1.70	.0230	98.8	3.39	3.6	3.2
126-135.....	130	2.57	.0233	100.9	3.60	3.8	3.4
136-145.....	140	3.44	.0235	102.9	3.80	4.0	3.6
146-155.....	150	4.32	.0238	104.9	3.99	4.2	3.8
156-165.....	160	5.19	.0241	107.0	4.10	4.4	4.0
166-175.....	170	6.06	.0244	109.0	4.36	4.6	4.2
176-185.....	180	6.94	.0246	111.0	4.53	4.7	4.3
186-195.....	190	7.81	.0249	113.1	4.69	4.9	4.5
196-205.....	200	8.69	.0252	115.1	4.85	5.1	4.6
206-215.....	210	9.56	.0255	117.1	5.00	5.2	4.8
216-225.....	220	10.43	.0257	119.2	5.15	5.4	4.9
226-235.....	230	11.31	.0260	121.2	5.30	5.5	5.1
236-245.....	240	12.18	.0263	123.2	5.43	5.7	5.2
246-255.....	250	13.06	.0266	125.3	5.57	5.8	5.4
256-265.....	260	13.90	.0268	127.3	5.70	5.9	5.5
266-275.....	270	14.80	.0271	129.3	5.82	6.1	5.6
276-285.....	280	15.68	.0274	131.4	5.95	6.2	5.7
286-295.....	290	16.55	.0277	133.4	6.06	6.3	5.8
296-305.....	300	17.43	.0279	135.4	6.18	6.4	6.0
306-315.....	310	18.39	.0282	137.5	6.29	6.5	6.1
316-325.....	320	19.17	.0285	139.5	6.40	6.6	6.2
326-335.....	330	20.05	.0288	141.6	6.50	6.7	6.3
336-345.....	340	20.92	.0290	143.6	6.60	6.8	6.4
346-355.....	350	21.80	.0293	145.6	6.70	6.9	6.5
356-365.....	360	22.67	.0296	147.7	6.80	7.0	6.6
366-375.....	370	23.54	.0299	149.7	6.89	7.1	6.7
376-385.....	380	24.42	.0301	151.7	6.98	7.2	6.8
386-395.....	390	25.29	.0304	153.8	7.07	7.3	6.9
396-405.....	400	26.17	.0307	155.8	7.16	7.4	6.9
406-415.....	410	27.04	.0310	157.8	7.24	7.5	7.0
416-425.....	420	27.91	.0312	159.9	7.33	7.6	7.0
426-435.....	430	28.79	.0315	161.9	7.41	7.6	7.2
436-445.....	440	29.66	.0317	163.7	7.49	7.7	7.3
446-455.....	450	30.54	.0318	164.9	7.61	7.8	7.4
456-465.....	460	31.41	.0319	166.0	7.73	8.0	7.5
466-475.....	470	32.28	.0319	167.1	7.84	8.1	7.6
476-485.....	480	33.16	.0320	168.3	7.95	8.2	7.7
486-495.....	490	33.03	.0320	169.4	8.06	8.3	7.8
496-505.....	500	34.90	.0321	170.5	8.17	8.4	7.9
506-515.....	510	35.78	.0322	171.7	8.28	8.5	8.0
516-525.....	520	36.65	.0322	172.8	8.39	8.6	8.2
526-535.....	530	37.53	.0323	173.9	8.49	8.7	8.3
536-545.....	540	38.40	.0323	175.1	8.60	8.8	8.4
546-555.....	550	39.27	.0324	176.2	8.70	9.0	8.5

Figure F78-9 (cont'd.)

Loaded vehicle mass (kg)	Equivalent inertial mass (kg)	Force coefficients		Force at 65 km/h (nt)	70 to 60 km/h coastdown calibration times		
		A (nt)	C (nt/(km/h) ²)		Target time (sec)	Allowable tolerance	
						Longest time (sec)	Shortest time (sec)
556-565.....	560	40.15	.0325	177.3	8.80	9.1	8.6
566-575.....	570	41.02	.0325	178.5	8.90	9.2	8.7
576-585.....	580	41.90	.0326	179.6	9.00	9.3	8.8
586-595.....	590	42.77	.0327	180.8	9.10	9.4	8.9
506-605.....	600	43.64	.0327	181.9	9.19	9.5	8.9
606-615.....	610	44.52	.0328	183.0	9.29	9.5	9.0
616-625.....	620	45.39	.0328	184.2	9.38	9.6	9.1
626-635.....	630	46.27	.0329	185.3	9.47	9.7	9.2
636-645.....	640	47.14	.0330	186.4	9.56	9.8	9.3
646-655.....	650	48.01	.0330	187.6	9.65	9.9	9.4
656-665.....	660	48.89	.0331	188.7	9.74	10.0	9.5
666-675.....	670	49.76	.0332	189.8	9.83	10.1	9.6
676-685.....	680	50.64	.0332	191.0	9.92	10.2	9.7
686-695.....	690	51.91	.0333	192.1	10.01	10.3	9.8
696-705.....	700	52.38	.0333	193.2	10.09	10.4	9.8
706-715.....	710	53.26	.0334	194.4	10.17	10.4	9.9
716-725.....	720	54.13	.0335	195.5	10.26	10.5	10.0
726-735.....	730	55.01	.0335	196.6	10.34	10.6	10.1
736-745.....	740	55.88	.0336	197.8	10.42	10.7	10.2
746-755.....	750	56.75	.0336	198.9	10.50	10.8	10.2
756-760.....	760	57.63	.0337	200.1	10.58	10.9	10.3

(c) The dynamometer shall be adjusted to reproduce the specified road load as determined by the most recent calibration. Alternatively, the actual vehicle road load can be measured and duplicated:

(1) Make at least 5 replicate coastdowns in each direction from 70 to 60 km/h on a smooth, level, track under balanced wind conditions. The driver must have a mass of 80±10 kg and be in the normal driving position. Record the coastdown time.

(2) Average the coastdown times. Adjust the dynamometer load so that the coastdown time is duplicated with the vehicle and driver on the dynamometer.

(3) Alternate procedures may be used if approved in advance by the Administrator.

Sec. 86.530-78 Test sequence, general requirements.

(a) Ambient temperature levels encountered by the test vehicle throughout the test sequence shall not be less than 20 [deg]C (68 [deg]F) nor more than 30 [deg]C (86 [deg]F). The vehicle shall be approximately level during the emission test to prevent abnormal fuel distribution.

(b) [Reserved]

Sec. 86.531-78 Vehicle preparation.

(a) The manufacturer shall provide additional fittings and adapters, as required by the Administrator * * *, such as * * * to accommodate a fuel drain at the lowest point possible in the tank(s) as installed on the vehicle and to provide for exhaust sample collection.

(b) [Reserved]

Sec. 86.532-78 Vehicle preconditioning.

(a) The vehicle shall be moved to the test area and the following operations performed:

(1) The fuel tank(s) shall be drained through the provided fuel tank(s) drain(s) and charged with the specified test fuel, Sec. 86.513, to half the tank(s) capacity.

(2) The vehicle shall be placed, either by being driven or pushed, on a dynamometer and operated through one Urban Dynamometer Driving Schedule test procedure (see Sec. 86.515 and appendix I). The vehicle need not be cold, and may be used to set dynamometer horsepower.

(b) Within five (5) minutes of completion of preconditioning, the vehicle shall be removed from the dynamometer and may be driven or pushed to the soak area to be parked. The vehicle shall be stored for not less than the following times prior to the cold start exhaust test.

	Hours
Class I.....	6
Class II.....	8
Class III.....	12

In no case shall the vehicle be stored for more than 36 hours prior to the cold start exhaust test.

Sec. 86.535-90 Dynamometer procedure.

(a) The dynamometer run consists of two tests, a "cold" start test and a "hot" start test following the "cold" start by 10 minutes. Engine startup (with all accessories turned off), operation over the driving schedule, and engine shutdown make a complete cold start test. Engine startup and operation over the first 505 seconds of the driving schedule complete the hot start test. The exhaust emissions are diluted with ambient air and a continuously proportional sample is collected for analysis during each phase. The composite samples collected in bags are analyzed for hydrocarbons, carbon monoxide, carbon dioxide, and, optionally, for oxides of nitrogen. A parallel sample of the dilution air is similarly analyzed for hydrocarbon, carbon monoxide, carbon dioxide, and, optionally, for oxides of nitrogen. Methanol and formaldehyde samples (exhaust and dilution air) are collected and analyzed for methanol-fueled vehicles (a single dilution air formaldehyde sample covering the total time of the test may be collected in place of individual test phases).

(b) [Reserved]

(c) The vehicle speed, as measured from the dynamometer roll, shall be used. A speed vs. time recording, as evidence of dynamometer test validity, shall be supplied on request of the Administrator.

(d) Practice runs over the prescribed driving schedule may be performed at test points, provided an emission sample is not taken, for the purpose of finding the minimum throttle action to maintain the proper speed-time relationship, or to permit sampling system adjustments.

(e) The drive wheel tires must be inflated to the manufacturer's recommended pressure, ± 15 kPa (2.2 psi). The drive wheel tire pressure shall be reported with the test results.

(f) If the dynamometer has not been operated during the two-hour period immediately preceding the test, it shall be warmed up for 15 minutes by operating at 50 km/h (31 mph) using a nontest vehicle, or as recommended by the dynamometer manufacturer.

(g) If the dynamometer horsepower must be adjusted manually, it shall be set within one hour prior to the exhaust emissions test phase. The test vehicle shall not be used to make this adjustment. Dynamometers using automatic control of preselectable power settings may be set anytime prior to the beginning of the emissions test.

(h) The driving distance, as measured by counting the number of dynamometer roll revolutions, shall be determined for the transient cold start, stabilized cold start, and transient hot start phases of the test.

Sec. 86.536-78 Engine starting and restarting.

(a)(1) The engine shall be started according to the manufacturer's recommended starting procedures. The initial 20 second idle period shall begin when the engine starts.

(2) *Choke operation.*

(i) Vehicles equipped with automatic chokes shall be operated according to the instructions in the manufacturer's operating instructions or owner's manual including choke setting and "kick-down" from cold fast idle. The transmission shall be placed in gear 15 seconds after the engine is started. If necessary, braking may be employed to keep the drive wheels from turning.

(ii) Vehicles equipped with manual chokes shall be operated according to the manufacturer's operating instructions or owner's manual. Where times are provided in the instructions, the Administrator may specify the specific point for operation, within 15 seconds of the recommended time.

(3) The operator may use the choke, throttle etc. where necessary to keep the engine running.

(4) If the manufacturer's operating instructions or owner's manual do not specify a warm engine starting procedure, the engine (automatic and manual choke engines) shall be started by opening the throttle about half way and cranking the engine until it starts.

(b) [Reserved]

(c) If, during the cold start, the vehicle does not start after 10 seconds of cranking, or ten cycles of the manual starting mechanism, cranking shall cease and the reason for failure to start determined. The revolution counter on the constant volume sampler shall be turned off and the sample solenoid valves placed in the "standby" position during this diagnostic period. In addition, either the CVS blower shall be turned off or the exhaust tube disconnected from the tailpipe during the diagnostic period.

(1) If failure to start is an operational error, the vehicle shall be rescheduled for testing from a cold start. If failure to start is caused by vehicle malfunction, corrective action (following the unscheduled maintenance provisions) of less than 30 minutes duration may be taken and the test continued. The sampling system shall be reactivated at the same time cranking is started. When the engine starts, the driving schedule timing sequence shall begin. If failure to start is caused by vehicle malfunction and the vehicle cannot be started, the test shall be voided, the vehicle removed from the dynamometer, corrective action taken (following the unscheduled maintenance provisions), and the vehicle rescheduled for test.

The reason for the malfunction (if determined) and the corrective action taken shall be reported.

(2) If the vehicle does not start during the hot start after ten seconds of cranking, or ten cycles of the manual starting mechanism, cranking shall cease, the test shall be voided, the vehicle removed from the dynamometer, corrective action taken in accordance with Sec. 86.428 or Sec. 86.429, and the vehicle rescheduled for test. The reason for the malfunction (if determined) and the corrective action taken shall be reported.

(d) If the engine “false starts”, the operator shall repeat the recommended starting procedure (such as resetting the choke, etc.)

(e) *Stalling.*

(1) If the engine stalls during an idle period, the engine shall be restarted immediately and the test continued. If the engine cannot be started soon enough to allow the vehicle to follow the next acceleration as prescribed, the driving schedule indicator shall be stopped. When the vehicle restarts, the driving schedule indicator shall be reactivated.

(2) If the engine stalls during some operating mode other than idle, the driving schedule indicator shall be stopped, the vehicle shall then be restarted and accelerated to the speed required at that point in the driving schedule and the test continued. During acceleration to this point, shifting shall be performed in accordance with Sec. 86.528.

(3) If the vehicle will not restart within one minute, the test shall be voided, the vehicle removed from the dynamometer, corrective action taken, and the vehicle rescheduled for test. The reason for the malfunction (if determined) and the corrective action taken shall be reported.

Sec. 86.537-90 Dynamometer test runs.

(a) The vehicle shall be allowed to stand with the engine turned off (see Sec. 86.532 for required time). The vehicle shall be stored prior to the emission test in such a manner that precipitation (e.g., rain or dew) does not occur on the vehicle. The complete dynamometer test consists of a cold start drive of 12.0 km (7.5 mi), (10.9 km (6.8 mi) for Class I motorcycles) and simulates a hot start drive of 12.0 km (7.5 mi), (10.9 km (6.8 mi) for Class I motorcycles). The vehicle is allowed to stand on the dynamometer during the 10-minute period between the cold and hot start tests. The cold start is divided into two periods. The first period, representing the cold start “transient” phase, terminates at the end of the deceleration which is scheduled to occur at 505 seconds of the driving schedule. The second period, representing the “stabilized” phase, consists of the remainder of the driving schedule including engine shutdown. The hot start test similarly

consists of two periods. The period, representing the hot start “transient” phase, terminates at the same point in the driving schedule at the first point of the cold start test. The second period of the hot start test, “stabilized” phase, is assumed to be identical to the second period of the cold start test. Therefore, the hot start test terminates after the first period (505 seconds) is run.

(b) The following steps shall be taken for each test:

(1) Place drive wheel of vehicle on dynamometer without starting engine.

(2) Activate vehicle cooling fan.

(3) For all vehicles, with the sample selector valves in the “standby” position connect evacuated sample collection bags to the dilute exhaust and dilution air sample collection systems.

(4) For methanol-fueled vehicles, with the sample selector valves in the “standby” position, insert fresh sample collection impingers into the methanol sample collection system, fresh impingers or a fresh cartridge into the formaldehyde sample collection system and fresh impingers (or a single cartridge for formaldehyde) into the dilution air sample collection systems for methanol and formaldehyde (background measurements of methanol and formaldehyde may be omitted and concentrations assumed to be zero for calculations in Sec. 86.544).

(5) Start the CVS (if not already on), the sample pumps and the temperature recorder. (The heat exchanger of the constant volume sampler, if used, methanol-fueled vehicle hydrocarbon analyzer and sample lines should be preheated to their respective operating temperatures before the test begins.)

(6) Adjust the sample flow rates to the desired flow rate and set the gas flow measuring devices to zero.

(i) For gaseous bag samples (except hydrocarbon samples), the minimum flow rate is 0.17 cfm (0.08 l/s).

(ii) For hydrocarbon samples, the minimum FID (or HFID in the case of methanol-fueled vehicles) flow rate is 0.066 cfm (0.031 l/s).

(iii) For methanol samples, the flow rates shall be set such that the system meets the design criteria of Sec. 86.509. For samples in which the concentration in the primary impinger exceeds 0.5 mg/l, it is recommended that the mass of methanol collected in the secondary impinger not exceed ten percent of the total mass collected. For samples in which the concentration in the primary impinger does not exceed 0.5 mg/l, secondary impingers do not need to be analyzed.

(iv) For formaldehyde samples, the flow rates shall be set such that the system meets the design criteria of Sec. 86.509. For impinger samples in which the concentration of formaldehyde in the primary impinger exceeds 0.1 mg/l, it is recommended that the mass of formaldehyde collected in the secondary

impinger not exceed ten percent of the total mass collected. For samples in which the concentration in the primary impinger does not exceed 0.1 mg/l, secondary impingers do not need to be analyzed.

(7) Attach the flexible exhaust tube to the vehicle tailpipe(s).

(8) Start the gas flow measuring device, position the sample selector valves to direct the sample flow into the “transient” exhaust sample bag, the “transient” methanol exhaust sample, the “transient” formaldehyde exhaust sample, the “transient” dilution air sample bag, the “transient” methanol dilution air sample and the “transient” formaldehyde dilution air sample, turn the key on, and start cranking the engine.

(9) Fifteen seconds after the engine starts, place the transmission in gear.

(10) Twenty seconds after the engine starts, begin the initial vehicle acceleration of the driving schedule.

(11) Operate the vehicle according to the Urban Dynamometer Driving Schedule (Sec. 86.515).

(12) At the end of the deceleration which is scheduled to occur at 505 seconds, simultaneously switch the sample flows from the “transient” bags and samples to “stabilized” bags and samples, switch off gas flow measuring device No. 1 and, start gas flow measuring device No. 2. Before the acceleration which is scheduled to occur at 510 seconds, record the measured roll or shaft revolutions and reset the counter or switch to a second counter. As soon as possible, transfer the “stabilized” exhaust and dilution air samples to the analytical system and process the samples according to Sec. 86.540, obtaining a stabilized reading of the exhaust bag sample on all analyzers within 20 minutes of the end of the sample collection phase of the test. Obtain methanol and formaldehyde sample analyses, if applicable, within 24 hours of the end of the sample period. (If it is not possible to perform analysis on the methanol and formaldehyde samples within 24 hours, the samples should be stored in a dark cold (4-10 [deg]C) environment until analysis. The samples should be analyzed within fourteen days.)

(13) Turn the engine off 2 seconds after the end of the last deceleration (at 1,369 seconds).

(14) Five seconds after the engine stops running, simultaneously turn off gas flow measuring device No. 2 and position the sample selector valves to the “standby” position (and open the valves isolating particulate filter No. 1, if applicable). Record the measured roll or shaft revolutions (both gas meter or flow measurement instrumentation readings) and re-set the counter. As soon as possible, transfer the “stabilized” exhaust and dilution air samples to the

analytical system and process the samples according to Sec. 86.540, obtaining a stabilized reading of the exhaust bag sample on all analyzers within 20 minutes of the end of the sample collection phase of the test. Obtain methanol and formaldehyde sample analyses, if applicable, within 24 hours of the end of the sample period. (If it is not possible to perform analysis on the methanol and formaldehyde samples within 24 hours, the samples should be stored in a dark cold (4-10 [deg]C) environment until analysis. The samples should be analyzed within fourteen days.)

(15) Immediately after the end of the sample period, turn off the cooling fan.

(16) Turn off the CVS or disconnect the exhaust tube from the tailpipe(s) of the vehicle.

(17) Repeat the steps in paragraph (b) (2) through (11) of this section for the hot start test, except only two evacuated sample bags, two methanol sample impingers, and two formaldehyde sample impingers are required. The step in paragraph (b)(8) of this section shall begin between 9 and 11 minutes after the end of the sample period for the cold start test.

(18) At the end of the deceleration which is scheduled to occur at 505 seconds, simultaneously turn off gas flow measuring device No. 1 and position the sample selector valve to the "standby" position. (Engine shutdown is not part of the hot start test sample period.) Record the measured roll or shaft revolutions.

(19) As soon as possible, transfer the hot start "transient" exhaust and dilution air bag samples to the analytical system and process the samples according to Sec. 86.540 obtaining a stabilized reading of the bag exhaust sample on all analyzers within 20 minutes of the end of the sample collection phase of the test. Obtain methanol and formaldehyde sample analyses, if applicable, within 24 hours of the end of the sample period (if it is not possible to perform analysis on the methanol and formaldehyde samples within 24 hours, the samples should be stored in a dark, cold (0 [deg]C) environment until analysis).

(20) Disconnect the exhaust tube from the vehicle tailpipe(s) and remove the vehicle from dynamometer.

(21) The CVS or CFV may be turned off, if desired.

(22) Continuous monitoring of exhaust emissions will not normally be allowed. Specific written approval must be obtained from the Administrator for continuous monitoring of exhaust emissions.

Sec. 86.540-90 Exhaust sample analysis.

The following sequence of operations shall be performed in conjunction with each series of measurements:

(a) For CO, CO₂, gasoline-fueled, natural gas-fueled, liquefied petroleum gas-fueled and methanol-fueled motorcycle HC and, if appropriate, NO_x:

(1) Zero the analyzers and obtain a stable zero reading. Recheck after tests.

(2) Introduce span gases and set instrument gains. In order to avoid errors, span and calibrate at the same flow rates used to analyze the test sample. Span gases should have concentrations equal to 75 to 100 percent of full scale. If gain has shifted significantly on the analyzers, check the calibrations. Show actual concentrations on chart.

(3) Check zeros; repeat the procedure in paragraphs (a) (1) and (2) of this section if required.

(4) Check flow rates and pressures.

(5) Measure HC, CO, CO₂, and, if appropriate, NO_x, concentrations of samples.

(6) Check zero and span points. If difference is greater than 2 percent of full scale, repeat the procedure in paragraphs (a) (1) through (5) of this section.

(b) For CH₃OH (methanol-fueled vehicles), introduce test samples into the gas chromatograph and measure the concentration. This concentration is CMS in the calculations.

(c) For HCHO (methanol-fueled vehicles), introduce test samples into the high pressure liquid chromatograph and measure the concentration of formaldehyde as a dinitrophenylhydrazine derivative in acetonitrile. This concentration is CFS in the calculations.

Sec. 86.542-90 Records required.

The following information shall be recorded with respect to each test:

(a) Test number.

(b) System or device tested (brief description).

(c) Date and time of day for each part of the test schedule.

(d) Instrument operator.

(e) Driver or operator.

(f) Vehicle: Make, Vehicle identification number, Model year, Transmission type, Odometer reading at initiation of preconditioning, Engine displacement, Engine family, Emission control system, Recommended idle RPM, Nominal fuel tank capacity, Inertial loading, Actual curb mass recorded at 0 kilometers, and Drive wheel tire pressure.

(g) Dynamometer serial number: As an alternative to recording the dynamometer serial number, a reference to a vehicle test cell number may be used, with the advance approval of the Administrator, provided the test cell records show the pertinent instrument information.

(h) All pertinent instrument information such as tuning-gain-serial number-detector number-range. As an alternative, a reference to a vehicle test cell number may be used, with the advance approval of the Administrator, provided test cell calibration records show the pertinent instrument information.

(i) Recorder Charts: Identify zero, span, exhaust gas, and dilution air sample traces.

(j) Test cell barometric pressure, ambient temperature and humidity.

Note: A central laboratory barometer may be used; Provided, that individual test cell barometric pressures are shown to be within 0.1 percent of the barometric pressure at the central barometer location.

(k) [Reserved]

(l) Pressure of the mixture of exhaust and dilution air entering the CVS metering device, the pressure increase across the device, and the temperature at the inlet. The temperature may be recorded continuously or digitally to determine temperature variations.

(m) The number of revolutions of the positive displacement pump accumulated during each test phase while exhaust samples are being collected. The number of standard cubic meters metered by a critical flow venturi during each test phase would be the equivalent record for a CFV-CVS.

(n) The humidity of the dilution air.

Note: If conditioning columns are not used (see Sec. Sec. 86.522 and 86.544) this measurement can be deleted. If the conditioning columns are used and the dilution air is taken from the test cell, the ambient humidity can be used for this measurement.

(o) The driving distance for each of the three phases of test, calculated from the measured roll or shaft revolutions.

(p) Additional required records for methanol-fueled vehicles:

(1) Specification of the methanol fuel, or fuel mixtures, used during testing.

(2) Volume of sample passed through the methanol sampling system and the volume of deionized water in each impinger.

(3) The methanol calibration information from the GC standards.

(4) The concentration of the GC analyses of the test samples (methanol).

(5) Volume of sample passed through the formaldehyde sampling system.

(6) The formaldehyde calibration information from the HPLC standards.

(7) The concentration of the HPLC analysis of the test sample (formaldehyde).

(q) *Additional required records for natural gas-fueled vehicles.* Composition, including all carbon containing compounds; e.g. CO₂, of the natural gas-fuel used during the test. C₁ and C₂ compounds shall be individually reported. C₃ and heavier hydrocarbons and C₆ and heavier compounds may be reported as a group.

(r) Additional required records for liquefied petroleum gas-fueled vehicles. Composition of the liquefied petroleum gas-fuel used during the test. Each hydrocarbon compound present, through C₄ compounds, shall be individually reported. C₅ and heavier hydrocarbons may be reported as a group.

Sec. 86.544-90 Calculations; exhaust emissions.

The final reported test results, with oxides of nitrogen being optional for model years prior to 2006 and required for 2006 and later model years, shall be computed by use of the following formula: (The results of all emission tests shall be rounded, in accordance with ASTM E29-93a (incorporated by reference in Sec. 86.1), to the number of places to the right of the decimal point indicated by expressing the applicable standard to three significant figures.)

$$(a) \quad Y_{wm} = \frac{(Y_{ct} + Y_s)}{0.43(D_{ct} + D_s)} + 0.57 \frac{(Y_{ht} + Y_s)}{(D_{ht} + D_s)}$$

Where:

(1) Y_{wm} = Weighted mass emissions of CO₂ or of each pollutant (i.e., HC, CO, or NO_x) in grams per vehicle kilometer and if appropriate, the weighted carbon mass equivalent of total hydrocarbon equivalent, in grams per vehicle kilometer.

(2) Y_{ct} = Mass emissions as calculated from the “transient” phase of the cold-start test, in grams per test phase.

(3) Y_{ht} = Mass emissions as calculated from the “transient” phase of the hot-start test, in grams per test phase.

(4) Y_s = Mass emissions as calculated from the “stabilized” phase of the cold-start test, in grams per test phase.

(5) D_{ct} = The measured driving distance from the “transient” phase of the cold-start test, in kilometers.

(6) D_{ht} = The measured driving distance from the “transient” phase of the hot-start test, in kilometers.

(7) D_s = The measured driving distance from the “stabilized” phase of the cold-start test, in kilometers.

(b) The mass of each pollutant for each phase of both the cold-start test and the hot-start test is determined from the following:

(1) Hydrocarbon mass:

$$HC_{mass} = V_{mix} \times \text{Density}_{HC} \times (HC_{conc}/1,000,000)$$

(2) Oxides of nitrogen mass:

$$NO_{xmass} = V_{mix} \times \text{Density}_{NO_2} \times K_H \times (NO_{xconc}/1,000,000)$$

(3) Carbon monoxide mass:

$$CO_{mass} = V_{mix} \times \text{Density}_{CO} \times (CO_{conc}/1,000,000)$$

(4) Carbon dioxide mass:

$$CO_{2mass} = V_{mix} \times \text{Density}_{CO_2} \times (CO_{2conc}/100)$$

(5) Methanol mass:

$$CH_3OH_{mass} = V_{mix} \times \text{Density}_{CH_3OH} \times (CH_3OH_{conc}/1,000,000)$$

(6) Formaldehyde mass:

$$\text{HCHO}_{\text{mass}} = V_{\text{mix}} \times \text{Density}_{\text{HCHO}} \times (\text{HCHO}_{\text{conc}}/1,000,000)$$

(7) Total hydrocarbon equivalent:

$$(i) \text{ THCE} = \text{HC}_{\text{mass}} + 13.8756/32.042 \times (\text{CH}_3\text{OH})_{\text{mass}} + 13.8756/30.0262 \times (\text{HCHO})_{\text{mass}}$$

(c) Meaning of symbols:

(1) (i) HC_{mass} = Hydrocarbon emissions, in grams per test phase.

(ii) $\text{Density}_{\text{HC}}$ = Density of HC in exhaust gas.

(A) *For gasoline-fuel*; $\text{Density}_{\text{HC}} = 576.8 \text{ g/m}^3$ -carbon atom (16.33 g/ft³-carbon atom), assuming an average carbon to hydrogen ratio of 1:1.85, at 20 [deg]C (68 [deg]F) and 101.3 kPa (760 mm Hg) pressure.

(B) *For natural gas and liquefied petroleum gas-fuel*; $\text{Density}_{\text{HC}} = 41.57(12.011 + \text{H/C}(1.008)) \text{ g/m}^3$ -carbon atom (1.1771(12.011 + H/C(1.008)) g/ft³-carbon atom) where H/C is the hydrogen to carbon ratio of the hydrocarbon components of test fuel, at 20 [deg]C (68 [deg]F) and 101.3 kPa (760 mm Hg) pressure.

(iii)(A) HC_{conc} = Hydrocarbon concentration of the dilute exhaust sample corrected for background, in ppm carbon equivalent, i.e., equivalent propane x3.

$$(B) \text{ HC}_{\text{conc}} = \text{HC}_e - \text{HC}_d(1 - (1/\text{DF}))$$

Where:

(iv)(A) HC_e = Hydrocarbon concentrations of the dilute exhaust sample as measured, in ppm carbon equivalent (propane ppm x3).

$$(B) \text{ HC}_e = \text{FID HC}_e - (r)\text{C}_{\text{CH}_3\text{OHe}}$$

(v) FID HC_e = Concentration of hydrocarbon (plus methanol if methanol-fueled motorcycle is tested) in dilute exhaust as measured by the FID ppm carbon equivalent.

(vi) r = FID response to methanol.

(vii) $\text{C}_{\text{CH}_3\text{OHe}}$ = Concentration of methanol in dilute exhaust as determined from the dilute exhaust methanol sample, ppm carbon.

(viii)(A) HC_d = Hydrocarbon concentration of the dilution air as measured, ppm carbon equivalent.

$$(B) \text{ HC}_d = \text{FID HC}_d - (r)\text{C}_{\text{CH}_3\text{OHd}}$$

(ix) FID HC_d = Concentration of hydrocarbon (plus methanol if methanol-fueled motorcycle is tested) in dilution air as measured by the FID, ppm carbon equivalent.

(x) $\text{C}_{\text{CH}_3\text{OHd}}$ = Concentration of methanol in dilution air as determined from dilution air methanol sample, ppm carbon.

- (2)(i) NO_{Xmass} = Oxides of nitrogen emissions, grams per test phase.
(ii) $\text{Density}_{\text{NO}_2}$ = Density of oxides of nitrogen in the exhaust gas, assuming they are in the form of nitrogen dioxide, 1913 g/m^3 (54.16 g/ft^3), at 20 [deg]C (68 [deg]F) and 101.3 kPa (760 mm Hg) pressure.
(iii)(A) NO_{Xconc} = Oxides of nitrogen concentration of the dilute exhaust sample corrected for background, ppm.
(B) $\text{NO}_{\text{Xconc}} = \text{NO}_{\text{Xe}} - \text{NO}_{\text{Xd}}(1 - (1/\text{DF}))$

Where:

- (iv) NO_{Xe} = Oxides of nitrogen concentration of the dilute exhaust sample as measured, ppm.
(v) NO_{Xd} = Oxides of nitrogen concentration of the dilution air as measured, ppm.

- (3)(i) CO_{mass} = Carbon monoxide emissions, in grams per test phase.
(ii) $\text{Density}_{\text{CO}}$ = Density of carbon monoxide, 1164 g/m^3 (32.97 g/ft^3), at 20 [deg]C (68 [deg]F) and 101.3 kPa (760 mm Hg) pressure.
(iii)(A) CO_{conc} = Carbon monoxide concentration of the dilute exhaust sample corrected for background, water vapor, and CO_2 extraction, ppm.
(B) $\text{CO}_{\text{conc}} = \text{CO}_e - \text{CO}_d(1 - (1/\text{DF}))$

Where:

- (iv)(A) CO_e = Carbon monoxide concentration of the dilute exhaust sample volume corrected for water vapor and carbon dioxide extraction, in ppm.
(B) $\text{CO}_e = (1 - 0.01925\text{CO}_{2e} - 0.000323\text{R})\text{CO}_{em}$ for gasoline-fueled vehicles with hydrogen to carbon ratio of 1.85:1
(C) $\text{CO}_e = [1 - (0.01+0.005\text{HCR})\text{CO}_{2e} - 0.000323\text{R}]\text{CO}_{em}$ for methanol-fueled, natural gas-fueled or liquefied petroleum gas-fueled motorcycles, where HCR is hydrogen to carbon ratio as measured for the fuel used.
(v) CO_{em} = Carbon monoxide concentration of the dilute exhaust sample as measured, ppm
(vi) CO_{2e} = Carbon dioxide concentration of the dilute exhaust sample, pct.
(vii) R = Relative humidity of the dilution air, pct (see Sec. 86.542(n)).
(viii)(A) CO_d = Carbon monoxide concentration of the dilution air corrected for water vapor extraction, ppm.
(B) $\text{CO}_d = (1 - 0.000323\text{R})\text{CO}_{dm}$

Where:

- (ix) CO_{dm} = Carbon monoxide concentration of the dilution air sample as measured, ppm.

Note: If a CO instrument which meets the criteria specified in Sec. 86.511 is used and the conditioning column has been deleted, CO_{em} can be substituted directly for CO_e and CO_{dm} must be substituted directly for CO_d .

- (4)(i) CO_{2mass} = Carbon dioxide emissions, grams per test phase.
(ii) $Density_{CO_2}$ = Density of carbon dioxide, 1830 g/m³ (51.81 g/ft³), at 20 [deg]C (68 [deg]F) and 101.3 kPa (760 mm Hg) pressure.
(iii)(A) CO_{2conc} = carbon dioxide concentration of the dilute exhaust sample corrected for background, in percent.
(B) $CO_{2conc} = CO_{2e} - CO_{2d}(1 - 1/DF)$

Where:

- (iv) CO_{2d} = Carbon dioxide concentration of the dilution air as measured, in percent.

(5)(i) CH_3OH_{mass} = Methanol emissions corrected for background, grams per test phase.

- (ii) $Density_{CH_3OH}$ = Density of methanol is 1332 g/m³ (37.71 g/ft³), at 20 [deg]C (68 [deg]F) and 101.3 kPa (760 mm Hg) pressure.
(iii)(A) CH_3OH_{conc} = Methanol concentration of the dilute exhaust corrected for background, ppm.
(B) $CH_3OH_{conc} = C_{CH_3OHe} - C_{CH_3OHd}(1 - (1/DF))$

Where:

- (iv)(A) C_{CH_3OHe} = Methanol concentration in the dilute exhaust, ppm.

$$(B) C_{CH_3OHe} = \frac{3.813 \times 10^{-2} \times T_{EM} [(C_{S1} \times AV_{S1}) + (C_{S2} \times AV_{S2})]}{P_B \times V_{EM}}$$

- (v)(A) C_{CH_3OHd} = Methanol concentration in the dilution air, ppm.

$$(B) C_{CH_3OHd} = \frac{3.813 \times 10^{-2} \times T_{DM} [(C_{D1} \times AV_{D1}) + (C_{D2} \times AV_{D2})]}{P_B \times V_{DM}}$$

(vi) T_{EM} = Temperature of methanol sample withdrawn from dilute exhaust, [deg]R.

(vii) T_{DM} = Temperature of methanol sample withdrawn from dilution air, [deg]R.

(viii) P_B = Barometric pressure during test, mm Hg.

(ix) V_{EM} = Volume of methanol sample withdrawn from dilute exhaust, ft³.

(x) V_{DM} = Volume of methanol sample withdrawn from dilution air, ft³.

(xi) C_s = GC concentration of sample drawn from dilute exhaust, [mu]g/ml.

(xii) C_D = GC concentration of sample drawn from dilution air, [mu]g/ml.

(xiii) AV_s = Volume of absorbing reagent (deionized water) in impinger through which methanol sample from dilute exhaust is drawn, ml.

(xiv) AV_D = Volume of absorbing reagent (deionized water) in impinger through which methanol sample from dilution air is drawn, ml.

(xv) 1 = first impinger.

(xvi) 2 = second impinger.

(6)(i) $HCHO_{mass}$ = Formaldehyde emissions corrected for background, grams per test phase.

(ii) $Density_{HCHO}$ = Density of formaldehyde is 1249 g/m³ (35.36 g/ft³), at 20 [deg]C (68 [deg]F) and 101.3 kPa (760 mm Hg) pressure.

(iii)(A) $HCHO_{conc}$ = Formaldehyde concentration of the dilute exhaust corrected for background, ppm.

$$(B) HCHO_{conc} = C_{HCHOe} - C_{HCHOd} (1 - (1/DF))$$

Where:

(iv)(A) C_{HCHOe} = Formaldehyde concentration in dilute exhaust, ppm.

$$(B) C_{HCHOe} = \frac{4.069 \times 10^{-2} \times C_{FDE} \times V_{AE} \times Q \times T_{EF}}{V_{SE} \times P_B}$$

(v)(A) C_{HCHOd} = Formaldehyde concentration in dilution air, ppm.

$$(B) C_{HCHOd} = \frac{4.069 \times 10^{-2} \times C_{FDA} \times V_{AA} \times Q \times T_{DF}}{V_{SA} \times P_B}$$

(vi) C_{FDE} = Concentration of DNPH derivative of formaldehyde from dilute exhaust sample in sampling solution, [mu]g/ml.

(vii) V_{AE} = Volume of sampling solution for dilute exhaust formaldehyde sample, ml.

(viii)(A) Q = Ratio of molecular weights of formaldehyde to its DNPH derivative.

$$(B) Q = 0.1429$$

(ix) T_{EF} = Temperature of formaldehyde sample withdrawn from dilute exhaust, [deg]R.

(x) V_{SE} = Volume of formaldehyde sample withdrawn from dilute exhaust, ft³.

(xi) P_B = Barometric pressure during test, mm Hg.

(xii) C_{FDA} = Concentration of DNPH derivative of formaldehyde from dilution air sample in sampling solution, [mu]g/ml.

(xiii) V_{AA} = Volume of sampling solution for dilution air formaldehyde sample, ml.

(xiv) T_{DF} = Temperature of formaldehyde sample withdrawn from dilution air, [deg]R.

(xv) V_{SA} = Volume of formaldehyde sample withdrawn from dilution air, ft³.

(7)(i) $DF = 13.4 / [CO_{2e} + (HC_e = CO_e)10^{-4}]$ for gasoline-fueled vehicles.

(ii) For methanol-fueled, natural gas-fueled or liquefied petroleum gas-fueled motorcycles, where fuel composition is $C_x H_y O_z$ as measured, or calculated, for the fuel used (for natural gas and liquefied petroleum gas-fuel, $Z=0$):

$$DF = \frac{(100) \left(\frac{x}{(x + y/2 + 3.76)(x + y/2 - z/2)} \right)}{CO_{2e} + (HC_e + CO_e + CH_3OH_e = HCHO_e) \times 10^{-4}}$$

(iii)(A) V_{mix} = Total dilute exhaust volume in cubic meters per test phase corrected to standard conditions (293 [deg]K (528 [deg]R) and 101.3 kPa (760 mm Hg)).

$$(B) V_{mix} = \frac{V_o \times N \times (P_B - P_i) \times 293}{101.3 \times T_p}$$

Where:

(iv) V_o = Volume of gas pumped by the positive displacement pump, in cubic meters per revolution. This volume is dependent on the pressure differential across the positive displacement pump. (See calibration techniques in Sec. 86.519.)

(v) N = Number of revolutions of the positive displacement pump during the test phase while samples are being collected.

(vi) P_B = Barometric pressure, kPa.

(vii) P_i = Pressure depression below atmospheric measured at the inlet to the positive displacement pump, kPa.

(viii) T_p = Average temperature of dilute exhaust entering positive displacement pump during test while samples are being collected, [deg]K.

(ix)(A) K_h = Humidity correction factor.

(B) $K_h = 1/[1 - 0.0329(H - 10.71)]$

Where:

(x)(A) H = Absolute humidity in grams of water per kilogram of dry air.

(B) $H = [(6.211)R_a \times P_d]/[P_B - (P_d \times R_a/100)]$

(xi) R_a = Relative humidity of the ambient air, pct.

(xii) P_d = Saturated vapor pressure, in kPa at the ambient dry bulb temperature.

(xiii) P_B = Barometric pressure, kPa.

(d) Sample calculation of mass emission values for gasoline-fueled vehicles with engine displacements equal to or greater than 170 cc (10.4 cu. in.):

(1) For the "transient" phase of the cold-start test, assume $V_o = 0.0077934 \text{ m}^3$ per rev; $N = 12,115$; $R = 20.5$ pct; $R_a = 20.5$ pct; $P_B = 99.05$ kPa; $P_d = 3.382$ kPa; $P_i = 9.851$ kPa; $T_p = 309.8$ [deg]K; $HC_e = 249.75$ ppm carbon equivalent; $NO_{Xe} = 38.30$ ppm; $CO_{em} = 311.23$ ppm; $CO_{2e} = 0.415$ percent; $HC_d = 4.90$ ppm; $NO_{Xd} = 0.30$ ppm; $CO_{dm} = 8.13$ ppm; $CO_{2d} = 0.037$ pct; $D_{ct} = 5.650$ km.

Then:

(i) $V_{mix} = [(0.0077934)(12,115)(99.05-9.851)(293.15)] / [(101.325)(309.8)]$
= 78.651 m³ per test phase.

(ii) $H = [(6.211)(20.5)(3.382)] / [(99.05) - (3.382)(20.5/100)] = 4.378$ grams
H₂O per kg dry air.

(iii) $K_h = 1 / [1 - 0.0329(4.378 - 10.71)] = 0.8276$

(iv) $CO_e = [1 - 0.01925(0.415) - 0.000323(20.5)](311.23) = 306.68$ ppm.

(v) $CO_d = [1 - 0.000323(20.5)](8.13) = 8.08$ ppm.

(vi) $DF = 13.4 / [0.415 + (249.75 + 306.68)10^{-4}] = 28.472$

(vii) $HC_{conc} = 249.75 - 4.90(1 - 1/28.472) = 245.02$ ppm.

(viii) $HC_{mass} = (78.651)(576.8)(245.02)10^{-6} = 11.114$ grams per test

phase.

(ix) $NO_{Xconc} = 38.30 - 0.30(1 - 1/28.472) = 38.01$ ppm.

(x) $NO_{Xmass} = (78.651)(1913)(38.01)(0.8276) \times 10^{-6} = 4.733$ grams per test

phase.

(xi) $CO_{conc} = 306.68 - 8.08(1 - 1/28.472) = 298.88$ ppm.

(xii) $CO_{mass} = (78.651)(1164)(298.88)(10^{-6}) = 27.362$ grams per test

phase.

(xiii) $CO_{2conc} = 0.415 - 0.037(1 - 1/28.472) = 0.3793$ percent.

(xiv) $CO_{2mass} = (78.651)(1843)(0.3793)/100 = 549.81$ grams per test

phase.

(2) For the “stabilized” portion of the cold-start test, assume that similar calculations resulted in $HC_{mass} = 7.184$ grams per test phase; $NO_{Xmass} = 2.154$ grams per test phase; $CO_{mass} = 64.541$ grams per test phase; and $CO_{2mass} = 529.52$ grams per test phase. $D_s = 6.070$ km.

(3) For the “transient” portion of the hot-start test, assume that similar calculations resulted in $HC_{mass} = 6.122$ grams per test phase; $NO_{Xmass} = 7.056$ grams per test phase; $CO_{mass} = 34.964$ grams per test phase; and $CO_{2mass} = 480.93$ grams per test phase. $D_{ht} = 5.660$ km.

(4) For a 1978 motorcycle with an engine displacement equal to or greater than 170 cc (10.4 cu. in):

(i) $HC_{wm} = 0.43 [(11.114 + 7.184)/(5.650 + 6.070)] + 0.57 [(6.122 + 7.184)/(5.660 + 6.070)] = 1.318$ grams per vehicle kilometer.

(ii) $NO_{Xwm} = 0.43 [(4.733 + 2.154)/(5.650 + 6.070)] + 0.57 [(7.056 + 2.154)/(5.660 + 6.070)] = 0.700$ gram per vehicle kilometer.

(iii) $CO_{wm} = 0.43 [(27.362 + 64.541)/(5.650 + 6.070)] + 0.57 [(34.964 + 64.541)/(5.660 + 6.070)] = 8.207$ grams per vehicle kilometer.

(iv) $CO_{2wm} = 0.43 [(549.81 + 529.52)/(5.650 + 6.070)] + 0.57 [(480.93 + 529.52)/(5.660 + 6.070)] = 88.701$ grams per vehicle kilometer.