(2) *Dynamometer calibration weights.* A minimum of 6 calibration weights for each range used are required. The weights must be equally spaced and traceable to within 0.5 percent of NBS weights. Laboratories located in foreign countries may certify calibration weights to local government bureau standards.

(b) *Engine cooling.* Means of engine cooling which will maintain the engine operating temperatures (e.g., intake air, oil, water, etc.) at approximately the same temperature as specified by the manufacturer shall be used. Auxiliary fan(s) may be used to maintain engine cooling during operation on the dynamometer.

(c) *Exhaust system.* (1) When testing gasoline-fueled engines:

(i) A chassis-type exhaust system including muffler(s) shall be used. The exhaust system must have a single tail pipe. For engines designed for a dual exhaust system, a standard or specially fabricated ''Y'' pipe may be used. The ''Y'' pipe may be located upstream of a single muffler or downstream of a single muffler or downstream of dual mufflers. The potential increase in backpressure due to the use of a single tail pipe instead of dual pipes may be compensated for by using larger than standard exhaust system components downstream of the ''Y'' pipe. For systems with the ''Y'' pipe upstream of the muffler, the backpressure at the exhaust manifold exit with the single exhaust system must be comparable to the standard dual exhaust system under the test conditions specified in § 86.335.

(ii) For all catalyst systems the distance from the exhaust manifold flange(s) to the catalyst shall be the same as in the vehicle configuration unless the manufacturer provides temperature data showing equivalent performance at another location.

(iii) For catalyst systems, the probe shall be located in the single exhaust pipe and from 2 to 10 feet downstream of the catalyst(s) and at least 2 feet downstream of the ''Y'' intersection of any ''Y'' pipe (if used).

(iv) For noncatalyst systems, the probe shall be located in the single exhaust pipe downstream of the muffler(s) and from 3 to 20 feet downstream from the exhaust manifold flange or turbocharger exit flange. The probe shall also be at least 2 feet downstream of the ''Y'' intersection of any ''Y'' pipe (if used).

(v) For all exhaust systems, the probe shall be located at least 24 inches from the end of the tail pipe. Additional exhaust pipe may be added to the tail pipe to meet the specification.

(2) When testing Diesel engines, a noninsulated exhaust system extending 15 ±5 feet from the exhaust manifold, or the crossover junction in the case of Vee engines, shall be used. The exhaust back pressure must be within 0.2 inch Hg. of the upper limit at maximum rated horsepower, as established by the engine manufacturer in his sales and service literature for vehicle application. A conventional automotive muffler of a size and type commonly used with the engine being tested shall be employed in the exhaust system during smoke emission testing. The terminal 2 feet of the exhaust pipe shall be a circular cross section and be free of elbows and bends. The end of the pipe shall be cut off squarely. The terminal 2 feet of the exhaust pipe shall have a nominal inside diameter in accordance with the engine being tested, as specified below:

Maximum rated horsepower	Exhaust pipe inside diameter (inches)
Less than 101	2
101 to 200	3
201 to 300	4
301 or more	5

[42 FR 45154, Sept. 8, 1977, as amended at 43 FR 52922, Nov. 14, 1978]

§ 86.313–79 Air flow measurement specifications; diesel engines.

(a) The air flow measurement method used must have a range large enough to accurately measure the air flow over the engine operating range during the test. Overall measurement accuracy must be ±2 percent of full-scale value of the measurement device for all modes except the idle and 2-percent modes. For the idle and 2-percent modes, the measurement accuracy shall be ±5 percent or less of the full-scale value. The Administrator must be advised of the method used prior to testing.

(b) Corrections to the measured air mass-flow-rate shall be made when an engine system incorporates devices that add or subtract air mass (air injection, bleed air, etc.). The method used to determine the air mass from these devices shall be approved by the Administrator.

(c) An engine air inlet system presenting an air inlet restriction within 1 inch of water of the upper limit for the engine operating condition which results in maximum air flow, as established by the engine manufacturer in his sales and service literature, for the Diesel engine being tested shall be used.

§ 86.314–79 Fuel flow measurement specifications.

(a) The fuel flow rate measurement instrument must have a minimum accuracy of ±1 percent of full-scale flow rate for each measurement range used. An exception for Diesel engines is allowed at the idle and 2-percent power points. For these modes, the minimum accuracy is ±2 percent of full-scale flow rate for each measurement range used. The controlling parameters are the elapsed time measurement of the event and the weight or volume measurement. Restrictions on these parameters are:

(1) The error in the elapsed time measurement of the event must not be greater than 1 percent of the absolute event time. This includes errors in starting and stopping the clock as well as the period of the clock.

(2) For Diesel engines only, if the mass of fuel consumed is measured by discrete weights, then the error in the actual weight of the fuel consumed must not be greater than ±1 percent of the measuring weight. An exception for Diesel engines is allowed at the idle and 2-percent power points. For these modes the error in the actual weight of the fuel consumed must not be greater than ±2 percent of the measuring weight.

(3) If the mass of fuel consumed is measured electronically (load cell, load beam, etc.), the error in the actual weight of fuel consumed must not be greater than ±1 percent of the full-scale value of the electronic device.

(4) If the mass of fuel consumed is measured by volume flow and density, the error in the actual volume consumed must not be greater than ±1 percent of the full-scale value of the volume measuring device.

(b) For the devices that have varying mass scales (electronic weight, volume, density, etc.), measurements may not be used for calculations if the measurement is less than 20 percent of full scale.

(c) *Option.* Complete flow-rate measurement systems may be used below 20 percent of full-scale measurement as long as the combination of mass and time measurements indicate a flow rate that has an error of less than 5 percent of the absolute flow rate.

§ 86.315–79 General analyzer specifications.

(a) *Analyzer response time.* The analyzer must respond to an instantaneous step change at the entrance to the analyzer with a response equal to 95 percent of that step change in 6.0 seconds or less on all ranges used. The step change shall be at least 60 percent of full-scale chart deflection. For NO_X analyzers using a water trap, the response time increase due to the water trap and associated plumbing need not be included in the analyzer response time.

(b) *Precision.* The precision of the analyzer must be no greater than ±1 percent of full-scale concentration for each range used above 155 ppm (or ppm C), or ±2 percent for each range used below 155 ppm (or ppm C). The precision is defined as 2.5 times the standard deviation(s) of 10 repetitive responses to a given calibration or span gas.

(c) *Noise.* The analyzer peak-to-peak response to zero and calibration or span gases over any 10-second period shall not exceed 2 percent of full/scale chart deflection on all ranges used.

(d) *Zero drift.* The analyzer zero-response drift during a 1-hour period shall be less than 2 percent of full-scale chart deflection on the lowest range used. The zero-response is defined as the mean response including noise to a zero-gas during a 30-second time interval.

(e) *Span drift.* The analyzer span drift during a 1-hour period shall be less