

intervals are required for smoke measurements during the acceleration phases of the test sequence.)

(b) *Automatic data collection.* (1) In lieu of the use of chart recorders, automatic data collection equipment may be used to record all required data. The automatic data collection equipment must be capable of sampling at least two records per second.

(2) Other means may be used provided they produce a permanent visual data record of a quality equal to or better than those required by this subpart (e.g., tabulated data, traces, or plots).

(c) *Temperature measurements.* (1) The following temperature measurements shall be accurate to within 1.0 °F (0.6 °C):

(i) Temperature measurements used in calculating the engine intake humidity;

(ii) The temperature of the fuel, in volume measuring flow rate devices;

(iii) The temperature of the sample within the water trap(s);

(iv) Temperature measurements used to correct gas volumes (e.g., to standard conditions) or to calculate mass or moles of a sample.

(2) All other temperature measurements shall be accurate within 3.0 °F (1.7 °C).

(d) *Electrical measurements.* Instruments used to measure engine power output shall comply with the requirements of § 92.106.

(e) *Pressure measurements.* (1) Gauges and transducers used to measure any pressures used to correct gas volumes (e.g., to standard conditions) or to calculate mass or moles of a sample shall have an accuracy and precision of 0.1 percent of absolute pressure at point or better.

(2) Gauges and transducers used to measure any other pressures shall have an accuracy and precision of 1 percent of absolute pressure at point or better.

[63 FR 18998, Apr. 16, 1998, as amended at 70 FR 40453, July 13, 2005]

§ 92.106 Equipment for loading the engine.

For purposes of placing the required load on the engine during an emissions test, either the equipment specified in paragraph (a) of this section, or the

equipment specified in paragraph (b) of this section may be used.

(a) *Locomotive testing.* (1) The equipment required for loading the locomotive engine-alternator/generator assembly electrically, and for measurement of the electrical power output from the alternator/generator consists of the following, either in total or in part: electrical resistance load bank; fans or other means for cooling of the load bank; wattmeter, including phase angle compensation; meter(s) for measurement of the current through the load bank (a calibrated electrical shunt and voltmeter is allowed for current measurement); meter(s) to measure the voltage across the load bank; and electrical cable to connect the alternator/generator to the load bank. Many locomotives are equipped with an internal electrical resistance load bank and fans for cooling of the load bank; when so equipped, the locomotive load bank may be used for purposes of loading the engine during emissions tests.

(2) The combination of instruments (meters) used to measure engine or alternator/generator power output (wattmeter, ammeter, voltmeter) shall have accuracy and precision such that the accuracy of the measured alternator/generator power out is better than:

(i) 2 percent of point at all power settings except idle and dynamic brake; and

(ii) Less accuracy and precision is allowed at idle and dynamic brake, consistent with good engineering practice. Equipment with accuracy or precision worse than 20 percent of point is not allowed.

(3) The efficiency curve for the alternator/generator, shall specify the efficiency at each test point. The manufacturer or remanufacturer shall provide EPA with a detailed description of the procedures used to establish the alternator/generator efficiency.

(b) *Engine testing.* (1) For engine testing using a dynamometer, the engine dynamometer system must be capable of controlling engine torque and speed simultaneously under steady speed operation, during accelerations where the rate of change in torque and speed is representative of those changes which occur when the engine is operating in a

locomotive. It must also be capable of performing the test sequence described in this subpart. In addition to these general requirements, the engine or dynamometer readout signals for speed and torque shall meet the following accuracy specifications:

(i) Engine speed readout shall be accurate to within ± 2 percent of the absolute standard value, as defined in § 92.116 of this part.

(ii) Engine flywheel torque readout shall be accurate to within ± 2 percent of the NIST "true" value torque at all power settings above 10 percent of full-scale, and accurate to within ± 5 percent of the NIST "true" value torque at power settings at or below 10 percent of full-scale.

(2) For engine testing using a locomotive alternator/generator instead of a dynamometer, the equipment used shall comply with the requirements of paragraph (a) of this section.

[63 FR 18998, Apr. 16, 1998, as amended at 70 FR 40453, July 13, 2005]

§ 92.107 Fuel flow measurement.

(a) *Fuel flow measurement for locomotive and engine testing.* The rate of fuel consumption by the engine must be measured with equipment conforming to the following:

(1) The fuel flow rate measurement instrument must have a minimum accuracy of ± 2 percent of measurement flow rate for each measurement range used. An exception is allowed at idle where the minimum accuracy is ± 10 percent of measured flow rate for each measurement range used. The measurement instrument must be able to comply with this requirement with an averaging time of one minute or less, except for idle, dynamic brake, and notches 1 and 2 where the instrument must be able to comply with this requirement with an averaging time of three minutes or less.

(2) The controlling parameters are the elapsed time measurement of the event and the weight or volume measurement. Restrictions on these parameters are:

(i) 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.

(ii) 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 is allowed at idle, where the error in the actual weight of the fuel consumed must not be greater than ± 2 percent of the measuring weight.

(iii) 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.

(iv) 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.

(3) For devices that have varying mass scales (electronic weight, volume, density, etc.), compliance with the requirements of paragraph (a)(1) of this section may require a separate flow measurement system for low flow rates.

(b) *Calibration.* Fuel flow rate measurement devices shall be calibrated against an independent measurement of the total mass of fuel dispensed during a fixed amount of time in accordance with the following provisions:

(1) Measurement of the total mass shall have an accuracy and precision of 1 percent of point, or better.

(2) Fuel measurements shall be performed for at least 10 flow rates evenly distributed over the entire range of fuel flow rates used during testing.

(3) For each flow rate, either the total mass of fuel dispense must exceed 5.0 kilograms (11.0 pounds), or the length of time during which the fuel is dispensed must exceed 30 minutes. In all cases, the length of time during which fuel is dispensed must be at least 180 seconds.

§ 92.108 Intake and cooling air measurements.

(a) *Intake air flow measurement.* Measurement of the flow rate of intake air into the engine is allowed for engine testing, but not required. When it is