

(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 either within ± 3 percent of the NIST "true" value torque, or the following accuracies, whichever provides the most accurate readout:

(A) ± 20 ft.-lbs. of the NIST "true" value if the full scale value is 9000 ft.-lbs. or less.

(B) ± 30 ft.-lbs., of the NIST "true" value if the full scale value is greater than 9000 ft.-lbs.

(C) *Option.* Internal dynamometer signals (i.e., armature current, etc.) may be used for torque measurement provided that it can be shown that the engine flywheel torque during the test sequence conforms to the accuracy specifications in paragraph (b)(1)(ii)(A) or (b)(1)(ii)(B) of this section. Such a measurement system must include compensation for increased or decreased flywheel torque due to the armature inertia during accelerations between throttle notch (test mode) settings in the test.

(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.

§ 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 measured, the measurement technique shall conform to the following:

(1) 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 idle. For idle, 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.

(2) Corrections to the measured air mass flowrate 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.

(3) Measurements made in accordance with SAE recommended practice J244 (incorporated by reference at §92.5) are allowed.

(b) *Humidity and temperature measurements.*

(1) Air that has had its absolute humidity altered is considered humidity-conditioned air. For this type of intake air supply, the humidity measurements must be made within the intake air supply system, and after the humidity conditioning has taken place.

(2) Humidity measurements for non-conditioned intake air supply systems shall be made as closely as possible to the point at which the intake air stream enters the locomotive, or downstream of that point.

(3) Temperature measurements of engine intake air, engine intake air after compression and cooling in the charge air cooler(s) (engine testing only), and air used to cool the charge air after compression, and to cool the engine