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

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 nonconditioned 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 shall be made as closely as possible to obtain accurate results based on engineering judgement. Measurement of ambient temperature for locomotive testing shall be made within 48 inches of the locomotive, at a location that minimizes the effect of heat generated by the locomotive on the measured temperature.

(4) Temperature measurements shall comply with the requirements of §92.105(c).

(5) Humidity measurements shall be accurate within 2 percent of the measured absolute humidity.

§92.109 Analyzer specifications.

(a) *General analyzer specifications*—(1) *Analyzer response time.* Analyzers for THC, CO_2, CO, and NO_X 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.

(2) *Precision.* The precision of the analyzers for THC, CO_2, CO, and NO_X must be no greater than ±1 percent of full-scale concentration for each range used above 155 ppm (or ppmC), or ±2 percent for each range used below 155 ppm (or ppmC). The precision is defined as 2.5 times the standard deviation(s) of 10 repetitive responses to a given calibration or span gas.

(3) *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.

(4) *Zero drift.* For THC, CO_2, CO, and NO_X analyzers, the 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.

(5) *Span drift.* For THC, CO_2, CO, and NO_X analyzers, the span drift during a 1-hour period shall be less than 2 percent of full-scale chart deflection on the lowest range used. The analyzer span is defined as the difference between the span-response and the zero-response. The span-response is defined as the mean response including noise to a span gas during a 30-second time interval.

(b) *Carbon monoxide and carbon dioxide analyzer specifications.* (1) Carbon monoxide and carbon dioxide measurements are to be made with nondispersive infrared (NDIR) analyzers.