

Environmental Protection Agency

§ 92.116

§ 92.115 Calibrations; frequency and overview.

(a) Calibrations shall be performed as specified in §§ 92.116 through 92.122.

(b) At least monthly or after any maintenance which could alter calibration, perform the periodic calibrations required by § 92.118(a)(2) (certain analyzers may require more frequent calibration depending on the equipment and use). Exception: the water rejection ratio and the CO₂ rejection ratio on all NDIR analyzers is only required to be performed quarterly.

(c) At least monthly or after any maintenance which could alter calibration, calibrate the engine dynamometer flywheel torque and speed measurement transducers, as specified in § 92.116.

(d) At least monthly or after any maintenance which could alter calibration, check the oxides of nitrogen converter efficiency, as specified in § 92.121.

(e) At least weekly or after any maintenance which could alter calibration, check the dynamometer (if used) shaft torque feedback signal at steady-state conditions by comparing:

(1) Shaft torque feedback to dynamometer beam load; or

(2) By comparing in-line torque to armature current; or

(3) By checking the in-line torque meter with a dead weight per § 92.116(b)(1).

(f) At least quarterly or after any maintenance which could alter calibration, calibrate the fuel flow measurement system as specified in § 92.107.

(g) At least annually or after any maintenance which could alter calibration, calibrate the electrical output measurement system for the electrical load bank used for locomotive testing.

(h) 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.

(i) For equipment not addressed in §§ 92.116 through 92.122 calibrations shall be performed at least as often as required by the equipment manufacturer or as necessary according to good practices. The calibrations shall be performed in accordance with proce-

dures specified by the equipment manufacturer.

(j) Where testing is conducted intermittently, calibrations are not required during period in which no testing is conducted, provided that times between the most recent calibrations and the date of any test does not exceed the calibration period. For example, if it has been more than one month since the analyzers have been calibrated (as specified in paragraph (c) of this section) then they must be calibrated prior to the start of testing.

§ 92.116 Engine output measurement system calibrations.

(a) *General requirements for dynamometer calibration.* (1) The engine flywheel torque and engine speed measurement transducers shall be calibrated with the calibration equipment described in this section.

(2) The engine flywheel torque feedback signals to the cycle verification equipment shall be electronically checked before each test, and adjusted as necessary.

(3) Other engine dynamometer system calibrations shall be performed as dictated by good engineering practice.

(4) When calibrating the engine flywheel torque transducer, any lever arm used to convert a weight or a force through a distance into a torque shall be used in a horizontal position (± 5 degrees).

(5) Calibrated resistors may not be used for engine flywheel torque transducer calibration, but may be used to span the transducer prior to engine testing.

(b) *Dynamometer calibration equipment—(1) Torque calibration equipment.* Two techniques are allowed for torque calibration. Alternate techniques may be used if shown to yield equivalent accuracies. The NIST “true” value torque is defined as the torque calculated by taking the product of an NIST traceable weight or force and a sufficiently accurate horizontal lever arm distance, corrected for the hanging torque of the lever arm.

(i) The lever-arm dead-weight technique involves the placement of known weights at a known horizontal distance from the center of rotation of the

torque measuring device. The equipment required is:

(A) *Calibration weights.* A minimum of six calibration weights for each range of torque measuring device used are required. The weights must be approximately equally spaced and each must be traceable to NIST weights within 0.1 percent. Laboratories located in foreign countries may certify calibration weights to local government bureau standards. Certification of weight by state government Bureau of Weights and Measures is acceptable. Effects of changes in gravitational constant at the test site may be accounted for if desired.

(B) *Lever arm.* A lever arm with a minimum length of 24 inches is required. The horizontal distance from the centerline of the engine torque measurement device to the point of weight application shall be accurate to within ± 0.10 inches. The arm must be balanced, or the hanging torque of the arm must be known to within ± 0.1 ft-lbs.

(ii) The transfer technique involves the calibration of a master load cell (i.e., dynamometer case load cell). This calibration can be done with known calibration weights at known horizontal distances, or by using a hydraulically actuated precalibrated master load cell. This calibration is then transferred to the flywheel torque measuring device. The technique involves the following steps:

(A) A master load cell shall be either precalibrated or be calibrated per paragraph (b)(1)(i)(A) of this section with known weights traceable to NIST within 0.1 percent, and used with the lever arm(s) specified in this section. The dynamometer should be either running or vibrated during this calibration to minimize static hysteresis.

(B) Transfer of calibration from the case or master load cell to the flywheel torque measuring device shall be performed with the dynamometer operating at a constant speed. The flywheel torque measurement device readout shall be calibrated to the master load cell torque readout at a minimum of six loads approximately equally spaced across the full useful ranges of both measurement devices. (Note that good engineering practice requires that both

devices have approximately equal useful ranges of torque measurement.) The transfer calibration shall be performed in a manner such that the accuracy requirements of §92.106(b)(1)(ii) for the flywheel torque measurement device readout be met or exceeded.

(iii) Other techniques may be used if shown to yield equivalent accuracy.

(2) *Speed calibration equipment.* A 60 (or greater) tooth wheel in combination with a common mode rejection frequency counter is considered an absolute standard for engine or dynamometer speed.

(c) *Dynamometer calibration.* (1) If necessary, follow the manufacturer's instructions for initial start-up and basic operating adjustments.

(2) Check the dynamometer torque measurement for each range used by the following:

(i) Warm up the dynamometer following the equipment manufacturer's specifications.

(ii) Determine the dynamometer calibration moment arm. Equipment manufacturer's data, actual measurement, or the value recorded from the previous calibration used for this subpart may be used.

(iii) Calculate the indicated torque (IT) for each calibration weight to be used by:

$IT = \text{calibration weight (lb)} \times \text{calibration moment arm (ft)}$

(iv) Attach each calibration weight specified in paragraph (b)(1)(i)(A) of this section to the moment arm at the calibration distance determined in paragraph (b)(2)(ii)(B) of this section. Record the power measurement equipment response (ft-lb) to each weight.

(v) For each calibration weight, compare the torque value measured in paragraph (b)(2)(iv) of this section to the calculated torque determined in paragraph (b)(2)(iii) of this section.

(vi) The measured torque must be within 2 percent of the calculated torque.

(vii) If the measured torque is not within 2 percent of the calculated torque, adjust or repair the system. Repeat the steps in paragraphs (b)(2)(i) through (b)(2)(vi) of this section with the adjusted or repaired system.

(3) *Option.* A master load-cell or transfer standard may be used to verify the in-use torque measurement system.

(i) The master load-cell and read out system must be calibrated with weights at each test weight specified in paragraph (b)(1)(i)(A) of this section. The calibration weights must be traceable to within 0.1 percent of NIST weights.

(ii) Warm up the dynamometer following the equipment manufacturer's specifications.

(iii) Attach the master load-cell and loading system.

(iv) Load the dynamometer to a minimum of 6 equally spaced torque values as indicated by the master load-cell for each in-use range used.

(v) The in-use torque measurement must be within 2 percent of the torque measured by the master system for each load used.

(vi) If the in-use torque is not within 2 percent of the master torque, adjust or repair the system. Repeat steps in paragraphs (b)(3)(ii) through (b)(3)(vi) of this section with the adjusted or repaired system.

(4) The dynamometer calibration must be completed within 2 hours from the completion of the dynamometer warm-up.

(d) *Electrical load banks.* Equipment used to measure the electrical power output dissipated by electrical load banks shall be calibrated as frequently as required by § 92.115, using a calibration procedure that is consistent with good engineering practice and approved by the Administrator.

§ 92.117 Gas meter or flow instrumentation calibration, particulate measurement.

(a) Sampling for particulate emissions requires the use of gas meters or flow instrumentation to determine flow through the particulate filters. These instruments shall receive initial and monthly calibrations as follows:

(1)(i) Install a calibration device in series with the instrument. A critical flow orifice, a bellmouth nozzle, or a laminar flow element or an NIST traceable flow calibration device is required as the standard device.

(ii) The flow system should be checked for leaks between the calibra-

tion and sampling meters, including any pumps that may be part of the system, using good engineering practice.

(2) Flow air through the calibration system at the sample flow rate used for particulate testing and at the backpressure which occurs during the sample test.

(3) When the temperature and pressure in the system have stabilized, measure the indicated gas volume over a time period of at least five minutes or until a gas volume of at least ± 1 percent accuracy can be determined by the standard device. Record the stabilized air temperature and pressure upstream of the instrument and as required for the standard device.

(4) Calculate air flow at standard conditions as measured by both the standard device and the instrument(s).

(5) Repeat the procedures of paragraphs (a)(2) through (4) of this section using at least two flow rates which bracket the typical operating range.

(6) If the air flow at standard conditions measured by the instrument differs by ± 1.0 percent of the maximum operating range or ± 2.0 percent of the point (whichever is smaller), then a correction shall be made by either of the following two methods:

(i) Mechanically adjust the instrument so that it agrees with the calibration measurement at the specified flow rates using the criteria of paragraph (a)(6) of this section; or

(ii) Develop a continuous best fit calibration curve for the instrument (as a function of the calibration device flow measurement) from the calibration points to determine corrected flow. The points on the calibration curve relative to the calibration device measurements must be within ± 1.0 percent of the maximum operating range of ± 2.0 percent of the point through the filter.

(b) *Other systems.* A bell prover may be used to calibrate the instrument if the procedure outlined in ANSI B109.1-1992 (incorporated by reference at § 92.5) is used. Prior approval by the Administrator is not required to use the bell prover.