Where:

a=Undiluted CO<sub>2</sub> concentration (percent)

b=Diluted CO<sub>2</sub> concentration (percent) c=Diluted NO concentration (ppm) d=Undiluted NO concentration (ppm)

(2) NO<sub>x</sub> analyzer water quench check.
(i) This check applies to wet measurements only. An NO span gas having a concentration of 80 percent to 100 percent of full scale of a normal operating range is passed through the CLD (or HCLD) and the response

where GP is the analyzer's standard operating pressure (pascals).

## § 90.326 Pre- and post-test analyzer calibration.

Calibrate the range of each analyzer used during the engine exhaust emission test prior to and after each test in accordance with the following:

(a) Make the calibration by using a zero gas and a span gas. The span gas value must be between 75 percent and 100 percent of full scale, inclusive, of the measuring range.

(b) Use the same analyzer(s) flow rate and pressure as that used during exhaust emission test sampling.

(c) Warm-up and stabilize the analyzer(s) before the calibration is made.

(d) If necessary clean and/or replace filter elements before calibration is made.

(e) Calibrate analyzer(s) as follows:

(1) Zero the analyzer using the appropriate zero gas. Adjust analyzer zero if necessary. Zero reading should be stable.

(2) Span the analyzer using the appropriate span gas for the range being calibrated. Adjust the analyzer to the calibration set point if necessary.

(3) Re-check zero and span set points.(4) If the response of the zero gas or span gas differs more than one percent of full scale, then repeat paragraphs (e)(1) through (3) of this section.

## § 90.327 Sampling system requirements.

(a) Sample component surface temperature. For sampling systems which use heated components, use engineering judgment to locate the recorded as "D". The NO span gas is then bubbled through water at room temperature and passed through the CLD (or HCLD) and the analyzer's response recorded as AR. Determine and record the analyzer's absolute operating pressure and the bubbler water temperature. (It is important that the NO span gas contains minimal  $NO_2$ concentration for this check. No allowance for absorption of  $NO_2$  in water has been made in the following quench calculations.)

$$Z1 = 100 \times \frac{Pwb}{GP}$$

(iii) Calculate the expected dilute NO span gas and water vapor mixture

$$D1 = D \times \left(1 - \frac{Z1}{100}\right)$$

coolest portion of each component (pump, sample line section, filters, and so forth) in the heated portion of the sampling system that has a separate source of power or heating element. Monitor the temperature at that location. If several components are within an oven, then only the surface temperature of the component with the largest thermal mass and the oven temperature need be measured.

(b) If water is removed by condensation, monitor the sample gas temperature or sample dew point either within the water trap or downstream. It may not exceed  $7^{\circ}$  C.

## § 90.328 Measurement equipment accuracy/calibration frequency table.

(a) The accuracy of measurements must be such that the maximum tolerances shown in Table 2 in Appendix A of this subpart are not exceeded.

(b) All equipment and analyzers must be calibrated according to the frequencies shown in Table 2 in Appendix A of this subpart.

(c) Prior to initial use and after major repairs, bench check each analyzer (see  $\S$  90.323).

(d) Calibrate equipment as specified in § 90.306 and §§ 90.315 through 90.322.

(e) At least monthly, or after any maintenance which could alter calibration, perform the following calibrations and checks.

(1) Leak check the vacuum side of the system (see § 90.324(a)).

(ii) Calculations for water quench must consider dilution of the NO span gas with water vapor and scaling of the water vapor concentration of the mixture to that expected during testing. Determine the mixture's saturated vapor pressure (designated as Pwb) that corresponds to the bubbler water temperature. Calculate the water concentration ("Z1", percent) in the mixture by the following equation:

concentration (designated as D1) by the following equation:

(2) Verify that the automatic data collection system (if used) meets the requirements found in Table 2 in Appendix A of this subpart.

(3) Check the fuel flow measurement instrument to insure that the specifications in Table 2 in Appendix A of this subpart are met.

(f) Verify that all NDIR analyzers meet the water rejection ratio and the  $CO_2$ rejection ratio as specified in § 90.325.

(g) Verify that the dynamometer test stand and power output instrumentation meet the specifications in Table 2 in Appendix A of this subpart.

## § 90.329 Catalyst thermal stress test.

(a) Oven characteristics. The oven used for thermally stressing the test catalyst must be capable of maintaining a temperature of  $500^{\circ}$  C ±  $5^{\circ}$  C and  $1000^{\circ}$  C ±  $10^{\circ}$  C.

(b) *Evaluation gas composition*. (1) A synthetic exhaust gas mixture is used for evaluating the effect of thermal stress on catalyst conversion efficiency.

(2) The synthetic exhaust gas mixture must have the following composition:

Constituent	Volume percent	Parts per million
Carbon Monoxide	1	
Oxygen	1.3	
Carbon Dioxide	3.8	
Water Vapor	10	
Sulfer dioxide		20
Oxides of nitrogen		280
Hydrogen		3500
Hydrocarbon*		4000