$$f = \left(\frac{99}{p_s}\right)^{0.7} \times \left(\frac{T}{298}\right)^{1.5}$$

(3) For a test to be recognized as valid, the parameter *f* must be between the limits as shown below:

$$0.96 < f < 1.04$$

§91.312 Analytical gases.

(a) The shelf life of a calibration gas may not be exceeded. Record the expiration date stated by the gas supplier for each calibration gas.

(b) *Pure gases.* The required purity of the gases is defined by the contamination limits given in parenthesis. The following gases must be available for operation.

(1) Purified nitrogen, also referred to as "zero-grade nitrogen" (Contamination≤1 ppm C, ≤1 ppm CO, ≤400 ppm CO_2, ≤0.1 ppm NO)

(2) Purified oxygen (Purity 99.5 percent vol O_2)

(3) Hydrogen-helium mixture (40±2 percent hydrogen, balance helium) (Contamination≤1 ppm C, ≤400 ppm CO)

(4) Purified synthetic air, also referred to as "zero gas" (Contamination≤1 ppm C, ≤1 ppm CO, ≤400 ppm CO_2, ≤0.1 ppm NO) (Oxygen content between 18–21 percent vol.)

(c) *Calibration and span gases.* (1) Calibration gas values are to be derived from NIST "Standard Reference Materials" (SRM's) or other local gas standards and are to be single blends as specified in this subsection.

(2) Mixtures of gases having the following chemical compositions must be available:

$C_3 H_8$ and purified synthetic air (dilute measurements); $C_3 H_8$ and purified nitrogen (raw measurements);
CO and purified nitrogen;
NO_X and purified nitrogen (the amount of NO_2 contained in this calibration gas must not exceed five percent of the NO content);
CO_2 and purified nitrogen.

NOTE: For the HFID or FID, the manufacturer may choose to use as a diluent span gas and the calibration gas either purified synthetic air or purified nitrogen. Any mixture of $C_3 H_8$ and purified synthetic air which contains a concentration of propane higher than what a gas supplier considers to be safe may be substituted with a mixture of $C_3 H_8$ and purified nitrogen. However, the manufacturer must be consistent in the choice of diluent (zero air or purified nitrogen) between the calibration and span gases. If a manufacturer chooses to use $C_3 H_8$ and purified nitrogen for the calibration gases, then purified nitrogen must be the diluent for the span gases.

(3) The true concentration of a span gas must be within ± 2 percent of the NIST gas standard. The true concentration of a calibration gas must be within ± 1 percent of the NIST gas standard. The use of precision blending devices (gas dividers) to obtain the required calibration gas concentrations is acceptable. Give all concentrations of calibration gas on a volume basis (volume percent or volume ppm).

(4) The gas concentrations used for calibration and span may also be obtained by means of a gas divider, diluting with purified N_2 or with purified synthetic air. The accuracy of the mixing device must be such that the concentration of the diluted gases may be determined to within ± 2 percent.

(d) Oxygen interference check gases must contain propane with 350 ppmC ± 75 ppmC hydrocarbon. Determine the concentration value to calibration gas tolerances by chromatographic analysis of total hydrocarbons plus impurities or by dynamic blending. Use nitrogen as the predominant diluent with the balance oxygen.

(e) Fuel for the hydrocarbon flame ionization detector (HC–FID) must be a blend of 40±2 percent hydrogen with the balance being helium. The mixture shall contain less than one ppm equivalent carbon response; 98 to 100 percent hydrogen fuel may be used with advance approval of the Administrator.

(f) *Hydrocarbon analyzer burner air.* The concentration of oxygen must be within one mole percent of the oxygen concentration of the burner air used in the latest oxygen interference check (percent O_2 I), see §91.316(d). If the difference in oxygen concentration is greater than one mole percent, then the oxygen interference must be checked and the analyzer adjusted if necessary, to meet the percent O_2 I requirements. The burner air must contain less than two ppmC hydrocarbon.