Standard Conditions

- Often it is useful to pretend that a gas is at a different temperature and pressure than it is actually at
  - You can only add gas volumes that are at the same temperature and pressure
  - Equipment sizing requires a basis for the handoff from one machine to another
- Units are Standard Cubic Feet (SCF) or Standard Cubic Metre (SCM)
- Science and Industry use "Standard Temperature and Pressure (STP)" as the pretend conditions
- "Standard" is anything but standard
  - Each regulating body can specify their definition
  - Each contract has the obligation to define it
  - No one has any obligation to follow anyone else's standards

STP

	Pressure	Temperature
Undergrad Chemistry Texts	14.696 psia (101.325 kPa)	60°F (15.56°C)
Gas Measurement (USA)	14.73 psia (101.56 kPa)	60°F (15.56°C)
EPA Reporting	14.696 psia (101.325 kPa)	20°C (68°F)
NM and LA State Reporting	15.025 psia (103.59 kPa	60°F (15.56°C)
ISO	101.33 kPa (14.696 psia)	0°C (32°F)
Gas Measurement (Europe)	100.0 kPa (14.5 psia)	15°C (59°F)
Gas Measurement (Queensland)	101.325 kPa (14.696 psia)	15°C (59°F)

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Standard Volume Conversion

$$mass = V_1\rho_1 = V_2\rho_2 \rightarrow V_2 = \frac{V_1\rho_1}{\rho_2}$$

- So if you know an actual volume and density, you can convert it to "standard" by dividing the product by the density at "standard" conditions
- More often, you have standard and need actual (because calculating velocity at imaginary conditions is meaningless)

Example

- The nitrogen (SG 0.967) in a tank is sold by the Standard Cubic Foot (SCF)
- How many SCF are there in a tank:
  - V → 5ft^3
  - P → 2,000 psia
  - T → 80°F
  - STP →14.73 psia at 60°F
- Therefore, you would have to have a vessel with 654 ft^3 to hold the same volume at STP as a 5 ft^3 tank holds at 2,000 psia and 80°F

N_2 approximates an ideal gas so Z=1.0

$$\rho_{stp} = \frac{P \cdot SG}{R_{air} \cdot T} = \frac{14.73\frac{lbf}{in^2}0.967\frac{144in^2}{ft^2}}{53.355\frac{ft \cdot lbf}{lbm \cdot R} \cdot 520R} = 0.0739\frac{lbm}{ft^3}$$

$$\rho_{2000} = \frac{2000\frac{lbf}{in^2}0.967\frac{144in^2}{ft^2}}{53.355\frac{ft \cdot lbf}{lbm \cdot R} \cdot (80+460)R} = 9.666\frac{lbm}{ft^3}$$

$$V_{stp} = V_{physical}\frac{\rho_{2000}}{\rho_{stp}} = 5\,ft^3\left(\frac{9.666\frac{lbm}{ft^3}}{0.0739\frac{lbm}{ft^3}}\right) = 654SCF$$

