Conversion Factors

Volume of Compressed Gas in a Cylinder

To find the volume of gas available from a compressed gas cylinder, we apply the Ideal Gas Law (PV = nRT). In a high-pressure cylinder, the volume will be affected by the content's compressibility factor Z (PV = ZnRT). For example, an AL cylinder of pure helium may contain 134 cu. ft. of gas while the same cylinder of pure air may contain 144 cu. ft. under the same conditions. For these practical calculations, however, we assume ideal gas behavior for simplicity.

The Ideal Gas Law PV = nRT

Where:
P is pressure
V is volume
n is the number of moles
R is the gas constant
T is the absolute temperature

When the temperature is kept constant, we can derive the equation:

$$P(1) \times V(1) = P(2) \times V(2)$$

Where:
P(1) is the pressure of the compressed gas in the cylinder (psi)
V(1) is the internal volume of the cylinder, often referred to as water volume (liter)*
P(2) is the atmospheric pressure (1 atm – 14.7 psi)
V(2) is the volume of gas at pressure P (2) (liter)

For example, an AL sized cylinder is filled with nitrogen at 2000 psi. What is the gas volume of nitrogen from the cylinder?
P(1) is 2000 psi
V(1) is the internal volume of AL cylinder 29.5 liter*
P(2) is 14.7 psi
V(2) is the unknown volume of gas

Solving the equation above for V(2) gives

$$V(2) = [p(1) \times V(1)]/P(2) = (2000 \text{ psi} \times 29.5 \text{ liters})/14.7 \text{ psi} = 4013 \text{ liters}^{**}$$

* The water volume of the high-pressure cylinders can be found on this site under the Gas Supply Modes section.
** Approximately 140 cu. ft.