

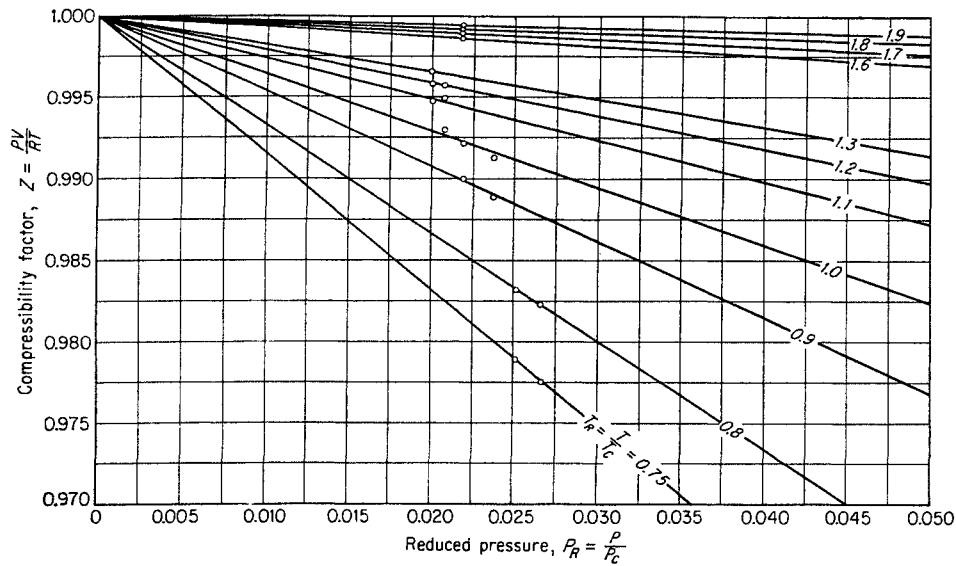


Fig. 4-17. Compressibility factors for natural gas near atmospheric pressure. (McKetta et al., 4-83a.)

Table 4-8. Computation of the Density of a Natural Gas from the Gas-composition and Compressibility-factor Chart
Compute the density of gas *D* with the composition shown at 1,000 psia and 90°F.

Constituent	Computation of pseudocritical point					
	Mole fraction <i>y</i>	Mol wt	Lb/mole	Crit temp, °R		Crit pressure, psia
				<i>T_c</i>	<i>yT_c</i>	
Carbon dioxide...	0.0040	44	0.17	548	2.1	1,073
Methane.....	0.9432	16	15.09	343	323.5	673
Ethane.....	0.0390	30	1.17	550	21.4	708
Propane.....	0.0117	44	0.51	666	7.8	617
Isobutane.....	0.0008	58	0.04	735	0.6	528
<i>n</i> -Butane.....	0.0013	58	0.07	766	1.0	551
	1.0000		17.05		356.4	674.9

Reduced temperature $T/T_c = (90 + 460)/356.4 = 1.54$

Reduced pressure $P/P_c = 1,000/674.9 = 1.48$

Gas gravity = $17.05/29.0 = 0.588$

From Fig. 4-16, at $T_r = 1.54$ and $P_r = 1.48$, compressibility factor $z = 0.872$.

The compressibility factor reported at these conditions by Stevens and Freidman (4-60) is 0.875.

$$\text{Density of natural gas} = \frac{17.05 \times 1,000 \times 520}{379 \times 14.7 \times 550 \times 0.872} = 3.31 \text{ lb/cu ft}$$

Alternative calculation:

$$\rho = \frac{1}{V} = \frac{P}{znRT} = \frac{1,000}{0.872} \frac{17.05}{1} \frac{1}{10.73} \frac{1}{550} = 3.31 \text{ lb/cu ft}$$

Table 4-9. Critical Properties of Natural Gas Constituents

Constituent	Molecular weight	Critical temperature, °R	Critical pressure, psia
Methane.....	16.04	343.3	673.1
Ethane.....	30.07	549.8	708.3
Propane.....	44.09	666.0	617.4
Isobutane.....	58.12	734.7	529.1
<i>n</i> -Butane.....	58.12	765.3	550.7
Isopentane.....	72.15	829.8	483
<i>n</i> -Pentane.....	72.15	845.6	489.5
Isohexane, 121*.....	72.15	880.9	450.5
Isohexane, 140*.....	84.16	896.5	440.1
<i>n</i> -Hexane, 155*.....	84.16	914.1	439.7
Isoheptane, 174*.....	98.18	937.6	417
Isoheptane, 194.....	98.18	955.9	400
<i>n</i> -Heptane, 209.....	98.18	972.3	396.9
Isooctane, 229.....	114.22	999	379
Isooctane, 240.....	118.22	1019	391
<i>n</i> -Octane, 258.....	114.22	1024.9	362.1
<i>n</i> -Nonane.....	128.25	1071	331
<i>n</i> -Decane.....	142.28	1114	306
Helium.....	4.0	9.4	33.2
Air.....	29.0	238.4	547
Nitrogen.....	28.02	226.9	492
Oxygen.....	32.0	277.9	730
Carbon dioxide.....	44.01	547.7	1073
Hydrogen sulfide.....	34.08	672.4	1306

* Number indicates boiling point in degrees Fahrenheit.
SOURCE: (1-15).