Nitrogen
Engineering
Handbook

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INTRODUCTION TO NITROGEN

Nitrogen Services equipment normally converts liquid nitrogen to gaseous nitrogen for various applications. Since liquid nitrogen and gaseous nitrogen will both be present at the well site, it is important that the individual(s) who will be on site familiarize themselves with these products. The following information and general safety precautions regarding liquid and high-pressure, gaseous nitrogen are provided for this purpose.

GENERAL INFORMATION

Nitrogen is a colorless, odorless and tasteless gas that makes up four-fifths of the earth's atmosphere by volume. Nitrogen was discovered in 1772 by the Swedish druggist Carl Wilhelm Scheele and Scottish botanist Daniel Rutherford. Nitrogen is an extremely inert gas, but it does combine with lithium, calcium, magnesium and hydrogen at high temperatues. Nitrogen is an essential component of all living plant and animal matter.

History

It was over 100 years after the discovery of nitrogen that a method was devised in 1883 by Wroblewski and Olszewski to liquefy nitrogen. Commercial production today of liquid nitrogen is obtained from fractional distillation of liquid air. Air is liquefied by compression and progressive refrigeration, and liquid nitrogen boils off at -320.45°F.

Only within recent years have materials and equipment been developed to handle very cold liquids like nitrogen on a commercial scale. The field of science that deals with the technology of handling liquids colder than -187°F is called cryogenics. All the liquids and the equipment to handle these cold liquids are labeled cryogenic liquids and cryogenic equipment. Special steels and aluminum are the most widely used cryogenic construction materials; however, copper and bronze alloys have found use for specific applications.

Interest in nitrogen for oil and gas well stimulation work is focused on the compact source of high energy gas available at reasonable cost. Without expensive compressor equipment, gas at 15,000-psi pressure is available for well stimulation use through liquid nitrogen and its cryogenic handling devices.

Field Supply of Liquid Nitrogen

Location of plant facilities to manufacture liquid nitrogen is only limited by the availability of power, since the raw material is air. A liquid nitrogen plant will also produce liquid oxygen and other rare gases found in the air. Rail cars to transport liquid nitrogen from plant to user are available from the larger suppliers. This means widespread distribution has a stabilizing effect on the market price.

The rail cars and the truck transports used to transport liquid nitrogen are vacuum-jacketed cryogenic tanks. An inner tank made of stainless steel and tested to 50 psi holds the liquid nitrogen. An outer shell of mild steel provides an evacuated space for insulating purposes. The tanks are provided with pressure-release valves to release nitrogen gas as pressure builds up in the tank due to gas expansion by heat. As pressure is released, the remaining liquid nitrogen is cooled. Liquid nitrogen in storage loses product continuously.

Rail cars will hold 12,900 gal of liquid nitrogen (1,200,000 SCF). Commercial truck tanks carry 7,000 gal of liquid nitrogen or 651,840 SCF.

SAFETY CONSIDERATIONS

Safety Hazards

The safety hazards associated with the use of liquid or gaseous nitrogen are (1) exposure to cold temperature, (2) asphyxiation and (3) overpressurization of containers or piping.

Due to its extremely low temperature (-320°F), liquid nitrogen can produce an effect on the skin similar to a thermal burn. The vapors from cold nitrogen can also have the same effect. Delicate tissues,

such as those of the eyes, can be damaged by an exposure to vapors which is too brief to affect the skin of the face or hands.

Aside from the general low temperature, nitrogen has the additional hazard of asphyxiation. Gaseous nitrogen will displace air and suffocation can result. Dizziness may not be noticed before an individual becomes unconscious. If one remains in such an oxygen-deficient atmosphere long enough, death can result. Most hazardous situations develop in closed areas. Therefore, stay out of closed areas with liquid nitrogen. **Good ventilation is a must**. Nitrogen, being heavier than air when cold, will settle. Therefore, proper care must be exercised when going into a cellar or any other low spot that is not well ventilated. Safety rules should be observed in this case just as when hydrogen sulfide is suspected. NOTE: Nitrogen gas, unlike H_2S, has no odor.

The inherent hazard of pressurized gas systems comes from the containment of pressure and hence potential energy within the system. A sudden, accidental release of this pressure is a possibility. Due to liquid-to-gas expansion, any liquid or cold vapor trapped between two points in a treating line has the potential to develop excessive pressure. Violent rupture of a container or piping would result in a dangerous, high-pressure release of liquid and/or gaseous nitrogen.

Safety Precautions

Avoid contact with liquid nitrogen or its vapors. Stand clear of boiling liquid nitrogen to avoid spatter and vapors. Do not touch frosted pipes or valves without adequate protective equipment.

Stay out of closed areas with liquid nitrogen. **Good ventilation is a must** to avoid concentration of gaseous nitrogen in the air. **Do not rely on the absence of a visible plume or vapor cloud as evidence of a normal air content**. Personnel should not work in or enter areas where suspected oxygen content is less than 19% unless equipped with a self-contained breathing apparatus (Scott Air-Pak).

First Aid

1. If any liquid nitrogen or nitrogen vapor contacts the skin or eyes, flush immediately with large quantities of **unheated water**. Apply

cold compresses. If the skin is blistered or there is any chance of the eye being affected, the individual should seek immediate treatment by a physician.

2. Persons suffering from an oxygen deficiency (asphyxiation) should be quickly moved to an area of normal oxygen concentration. Artificial respiration and supplemental oxygen should be administered if the victim is not breathing. Note: Coma due to lack of oxygen is not always fatal. Cardiopulmonary resuscitation (CPR) techniques should be administered and continued until the victim is revived or is in the care of a trained physician.

CONVERSION DATA FOR N_2

	lb	Gas (SCF)	Liquid (gal)	Liquid (cu ft)	Liquid (L)
1 lb	1.0000	13.80	0.14830	0.019820	0.56130
1 SCF Gas	0.0724	1.00	0.01075	0.001436	0.04068
1 gal Liquid	6.7430	93.05	1.00000	0.133700	3.78500
1 cu ft Liquid	50.4500	696.10	7.48100	1.000000	28.32000
1 L Liquid	2.782	24.58	0.26420	0.035310	1.00000

NOTE: Standard conditions for nitrogen are 14.7 psia and 60°F.

PHYSICAL PROPERTIES OF LIQUID AND GASEOUS NITROGEN

Chemical Symbol	N_2
Molecular Weight	28.016
Triple Point	-345.9°F at 1.82 psig
Normal Boiling Point	-320.45°F
Latent Heat of Evaporation	85.67 BTU/lb
Critical Temperature	-232.87°F
Critical Pressure	492.3 psig
Specific Heat (cp) @ 77°F	0.4471 BTU/(lb)(°F)
Specific Heat (Cv) @ 70°F	0.3197 BTU/(lb)(°F)
Ratio of Specific Heat	1.401
Thermal Conductivity @ 60°F	0.01462 BTU/sq ft hr (°F/ft)
Density of Saturated Vapor @ 14.7 psia	0.03635 lb/cu ft
Specific Gravity of Saturated Vapor @ 14.7 psia (air = 1.0)	0.967
Density of Liquid Nitrogen @ Normal Boiling Point	50.443 lb/cu ft

DISPLACEMENT WITH NITROGEN

It is often appropriate to use nitrogen gas in displacing the final stage of a treating fluid to the formation. Also, production that has been slowed or killed due to excessive hydrostatic fluid pressure may be "kicked-off" again by using nitrogen gas to displace the wellbore fluids.

The following sections contain methods and tables for determining nitrogen volumes as required for fluid displacement under various circumstances. Nitrogen requirements are determined by pipe size(s), well depth, average pressure, average temperature and the displacement technique selected. Average temperature and pressure are the arithmetic averages of bottom-hole and wellhead conditions.

$$P_{AVG} = \frac{WHP + BHP}{2}$$

$$T_{AVG} =$$

$$\frac{(\text{Temperature Gradient, °F/ft})(\text{Depth, ft}) + 2(\text{Surface Temperature, °F})}{2}$$

or

$$\frac{(\text{BHST, °F} + \text{Surface Temperature, °F})}{2}$$

Section 205 presents the various techniques and calculations used to determine volume requirements when displacing with gaseous nitrogen. It covers displacement to the perforations and displacement of the entire wellbore. The latter uses a technique known as "U-Tubing" and can be employed when displacing down either the tubing or annulus.

Sections 210 through 225 contain displacement estimating tables which minimize the calculations required to determine displacement volumes.

The nitrogen volumes in these sections were calculated using the following pipe sizes and capacities.

Pipe Size (in.)	Weight (lb/ft)	Capacity (BBL/lin ft)	Tubing Annulus (in.)	Casing Weight (lb/ft)	Capacity (BBL/lin ft)
1 ID	1.70	.00107	2⅜ — 4½	9.50	.0108
1½ ID	2.40	.00264	2⅞ — 5½	14.00	.0164
2⅜ OD	4.60	.00387	2⅜ — 5½	14.00	.0189
2⅞ OD	6.40	.0058	2⅞ — 7	20.00	.0324
3½ ID	9.50	.01223	2⅜ — 7	20.00	.0350
4½ OD	9.50	.0162			
5½ OD	14.00	.0244			
7 OD	20.00	.0405			

If the pipe being used differs in weight from those used in calculating these tables (reflecting different capacities), use the following equation to calculate the correct nitrogen volume for the pipe size(s) in question.

N_2 Volume in 100 SCF =
(pipe not in table)

$$\frac{[N_2 \text{ volume from Table (100 SCF)}] \times [\text{Capacity of Pipe (BBL/lin ft)}].}{\text{Pipe Capacity used in Tables (BBL/lin ft)}}$$

Example — Nitrogen Volume for Pipe Size not in Table

Well Depth — 10,000 ft

Wellhead Pressure — 4,000 psi

5-1/2-in., 23.00 lb/ft Casing — .0212 BBL/lin ft

$$N_2 \text{ Volume} = \frac{[3{,}190\ (100 \text{ SCF})]\ (.0212 \text{ BBL/lin ft})}{(.0244 \text{ BBL/lin ft})}$$

N_2 Volume = 2,772 x 100 SCF = 277,200 SCF

DISPLACEMENT TO PERFORATIONS USING GASEOUS NITROGEN

The objective in this instance is to displace the contents of the tubing and/or casing to the perforations, leaving a column of gaseous nitrogen in its place. To accomplish this, it is necessary to determine the volume of N_2 and the resulting wellhead pressure required to produce a bottom-hole pressure equivalent to that of the original fluid.

The following examples illustrate three different methods which may be used to calculate the required N_2 volume. There are advantages to each, so familiarity with all three will allow the use of that method offering the quickest solution with the degree of accuracy desired.

Example

How much N_2 is required to displace 8,000 ft of 2-3/8-in. tubing filled with 10 lb/gal brine? (Casing = 4-1/2 in.). Assume the average well temperature is 120°F (Calculated Average Temperature = 116°F).

METHOD 1

Calculation of Gaseous N_2 Displacement (Example)

1. Determine Bottom-Hole Pressure (BHP).

$$\text{Hydrostatic Pressure} = .052 \underbrace{(10)}_{\substack{\text{Fluid Density,} \\ \text{lb/gal}}} \underbrace{(8{,}000)}_{\substack{\text{Fluid Height,} \\ \text{ft}}} = 4{,}160 \text{ psi.}$$

$$\text{BHP} = \underbrace{0}_{\substack{\text{Wellhead Pressure,} \\ \text{psi}}} + \underbrace{4{,}160}_{\substack{\text{Hydrostatic Pressure,} \\ \text{psi}}} = 4{,}160 \text{ psi.}$$

NOTE: If BHP exceeds hydrostatic pressure, wellhead pressure will be greater than zero.

2. Average Pressure =

$$[\ \underset{\text{BHP, psi}}{(\ 4{,}160\ )}\ +\ \underset{\substack{N_2\text{ Wellhead}\\ \text{Pressure, psi}}}{(\ 3{,}300\ )}\ ]/2 = 3{,}730 \text{ psi.}$$

NOTE: The N_2 wellhead pressure is that developed by a column of gaseous nitrogen producing a BHP equivalent to that determined in Step 1. The correct N_2 wellhead pressure can be obtained from Section 210 of this Handbook.

Locate the "Wellhead Pressure" table (Section 210) which lists a bottom-hole pressure value (Column 2) at the given well depth that closely approximates the BHP calculated in Step 1. For this example, at 8,000 ft, the closest BHP falls between the values given for wellhead pressures of 3,200 psi (BHP = 4,023 psi) and 3,400 psi (BHP = 4,263 psi). Interpolation to a BHP of 4,160 psi yields a corresponding wellhead pressure of 3,314 psi.

N_2 Volume Factor (BN_2) = 1,150 SCF/BBL of Space (from p. 305.06).

3. Using the average pressure from Step 2 and the average temperature, determine the nitrogen volume factor (BN_2) from the tables presented in Section 305.

N_2 Volume Factor (BN_2) = 1,150 SCF/BBL of Space.

4. Displacement Volume in BBL =

$$\underset{\substack{\text{Tubular Volume,}\\ \text{BBL/lin ft}}}{(\ .00387\ )}\quad \underset{\text{Depth, ft}}{(\ 8{,}000\ )} = 30.96 \text{ BBL.}$$

5. Nitrogen Volume =

$$\underset{\substack{N_2\text{ Vol Factor,}\\ \text{SCF/BBL}}}{(\ 1{,}150\ )}\quad \underset{\substack{\text{Displacement}\\ \text{Volume, BBL}}}{(\ 30.96\ )} = 35{,}604 \text{ SCF.}$$

METHOD 1

Calculation of Gaseous N_2 Displacement (Worksheet)

1. Determine Bottom-Hole Pressure (BHP).

   Hydrostatic Pressure =

   .052 (_____) (_____) = _____ psi.
   Fluid Density, lb/gal; Fluid Height, ft

   BHP = _____ + _____ = _____ psi.
   Wellhead Pressure, psi; Hydrostatic Pressure, psi

   NOTE: If BHP exceeds hydrostatic pressure, wellhead pressure will be greater than zero.

2. Average Pressure = [(_____) + (_____)]/2 = _____ psi.
   BHP, psi; N_2 Wellhead Pressure, psi

   NOTE: The N_2 wellhead pressure is that developed by a column of gaseous nitrogen producing a BHP equivalent to that determined in Step 1. The correct N_2 wellhead pressure can be obtained from Section 210 of this Handbook.

   Locate the "Wellhead Pressure" table (Section 210) which lists a bottom-hole pressure value (Column 2) at the given well depth that closely approximates the BHP calculated in Step 1.

3. Using the average pressure from Step 2 and the average temperature, determine the nitrogen volume factor (BN_2) from the tables presented in Section 305.

   N_2 Volume Factor (BN_2) = SCF/BBL of Space.

4. Displacement Volume in BBL = (_____) (_____) = _____ BBL.
   Tubular Vol, BBL/lin ft; Depth, ft

5. Nitrogen Volume = (_____) (_____) = _____ SCF.
   N_2 Volume Factor, SCF/BBL; Displacement Volume, BBL

METHOD 2

Using Displacement Estimating Tables (Section 210) given nitrogen wellhead pressure and depth or BHP.

1. Determine Bottom-Hole Pressure (BHP).

$$\text{Hydrostatic Pressure} = .052 \times (\underset{\text{Fluid Density lb/gal}}{10}) \times (\underset{\text{Fluid Height, ft}}{8{,}000}) = 4{,}160 \text{ psi.}$$

$$\text{BHP} = \underset{\text{Wellhead Pressure, psi}}{0} + \underset{\text{Hydrostatic Pressure, psi}}{4{,}160} = 4{,}160 \text{ psi.}$$

   NOTE: If BHP exceeds hydrostatic pressure, wellhead pressure will be greater than zero.

2. Locate the "Wellhead Pressure" table (Section 210) which lists a bottom-hole pressure value (Column 2) at the given well depth that closely approximates the BHP calculated in Step 1. For this example, at 8,000 ft, the closest BHP falls between the values given for wellhead pressures of 3,200 psi (BHP = 4,023 psi) and 3,400 psi (BHP = 4,263 psi). Interpolation to a BHP of 4,160 psi yields a corresponding wellhead pressure of 3,314 psi.

3. Move horizontally across the table until the appropriate pipe-size column is reached. For 2-3/8-in. tubing, the corresponding nitrogen volume read from the 3,200-psi table is 342.2 (100 SCF). The 3,400-psi table yields 359.3 (100 SCF). Interpolating to a wellhead pressure of 3,314 psi gives a nitrogen volume of 351.96 (100 SCF) or 35,196 SCF.

METHOD 3

Using Displacement Estimating Tables (Section 215) given fluid weight and depth.

1. Locate the table corresponding to the density of the wellbore fluid to be displaced. Refer to Method 1 or 2 if fluid density is not represented in these tables.

   In the case of the example, the correct table is for a 10 lb/gal mud or brine with a hydrostatic pressure gradient of .0521 psi/ft.

2. In the first column, locate the depth closest to the given well depth.

3. Move horizontally across the table until the appropriate pipe-size column is intersected. The nitrogen volume is read directly from the table in 100 SCF.

   Obtaining a solution to the example problem, a well depth of 8,000 ft and 2-3/8-in. tubing yields a nitrogen volume of 362.5 (100 SCF) or 36,250 SCF.

DISPLACEMENT OF THE ENTIRE WELLBORE WITH GASEOUS NITROGEN

It is often desirable to displace the entire wellbore with gaseous nitrogen. This is the case when nitrogen is used to "kick off" production that has been slowed or killed by excessive hydrostatic pressure from the wellbore fluid. This is generally accomplished by a technique known as "U-Tubing." It involves the pumping of nitrogen down either the annulus or tubing with the displaced fluid returning up the other. There is generally no packer in the hole or the packer is not set. Enough nitrogen is pumped to reach an "overbalance" point. Beyond this point, the wellbore will continue to unload due to the expansive energy of the nitrogen.

The tables in this section can be used to determine the volume of N_2 required to displace the entire hole starting down the tubing (Section 220) or starting down the annulus (Section 225). An alternate method is also presented for those situations where the tables are inadequate.

U-Tube Down Tubing

When displacing down the tubing, enough nitrogen must be pumped to displace the tubing and a portion of the annulus until the overbalance point is reached. The wellhead pressure reported is the maximum pressure on the wellhead. It occurs just before the nitrogen turns the corner and starts up the annulus. The bottom-hole pressure reported is the maximum hydrostatic pressure due to a column of fluid in the hole.

Example

Determine the nitrogen volume required to completely displace the following well going down the tubing. Assume a surface temperature of 70°F and temperature gradient of 1.1°F/100 ft of depth.

Tubing	2-7/8 in., 6.5 lb/ft
Casing	5-1/2 in., 14.00 lb/ft
Fluid in Wellbore	10 lb/gal Brine
Depth	8,000 ft

1. Find the table in Section 220, **U-Tube Down Tubing**, that corresponds to the fluid in the well (Example — 10 lb/gal brine).

2. Read down the depth column to the value closest to the actual well depth. Intermediate depths can be interpolated.

3. Read horizontally to find the maximum wellhead pressure, maximum bottom-hole pressure and the required N_2 volume for the particular tubular dimensions.

   For the example, the table (p. 220.08) gives the following.

   Maximum WHP — 3,318 psi
   Maximum BHP — 4,160 psi
   N_2 Volume Required — 839.4 (100 SCF) = 83,940 SCF

ALTERNATE METHOD

DISPLACEMENT DOWN THE TUBING (Example)

Tubing Volume .0058 BBL/ft Depth 8,000 ft

Annulus Volume .0164 BBL/ft Fluid S.G. 1.19

BHST 158 °F

1. Overbalance Ratio = .5 [1 + (.0058) / (.0164)] = .6768.
   (.0058) Tubing Volume; (.0164) Annulus Volume

   Overbalance (OB) ratio is the percent of total annular length that still contains fluid to be displaced.

2. Pseudo Well Depth = (.6768) (8,000) = 5414.4 ft.
   (.6768) OB Ratio; (8,000) Depth, ft

3. Pseudo Bottom-Hole Pressure =

   [.433 (5414.4) (1.19)] + (0) = 2,790 psi.
   (5414.4) Pseudo Well Depth, ft; (1.19) S.G.; (0) Annulus Backflow Pressure, psi

4. Enter graph on Gaseous Nitrogen Column Bottom-Hole Pressures (Section 315) with the calculated pseudo bottom-hole pressure and pseudo well depth, and determine wellhead pressure. Choose the graph with the appropriate geothermal gradient.

With that wellhead pressure, determine the **actual** bottom-hole pressure at the **actual** well depth using the same graph.

Wellhead Pressure, WHP = 2,350 psi.

Actual BHP = 3,046 psi.

5. Average Pressure = [(3,046) + (2,790)] / 2 = 2,918 psi.
   (Actual BHP; Pseudo BHP)

   Average Temperature = [70 + 158] / 2 = 114°F.
   (Surface Temperature, °F; BHST, °F)

   At average pressure and average temperature, determine the Nitrogen Volume Factor (Section 305).

   Nitrogen Volume Factor = 946 SCF/BBL (from p. 305.06).

7. Nitrogen Volume =

   [(.0164) (5414.4) (946)] / 100 = 840 (100 SCF)
   (Annulus Volume, BBL/ft; Pseudo Well Depth, ft; N_2 Volume Factor, SCF/BBL)

ALTERNATE METHOD

DISPLACEMENT DOWN THE TUBING (Worksheet)

Tubing Volume _____ BBL/ft Depth _____ ft

Annulus Volume _____ BBL/ft Fluid S.G. _____

BHST _____ °F

1. Overbalance Ratio = .5 [1 + (_____) / (_____)] = ___.
   (_____) = Tubing Volume; (_____) = Annulus Volume

   Overbalance (OB) ratio is the percent of total annular length that still contains fluid to be displaced.

2. Pseudo Well Depth = (_____) (_____) = _____ ft.
   (_____) = OB Ratio; (_____) = Depth, ft

3. Pseudo Bottom-Hole Pressure =

   [.433 (_____) (___)] + (_____) = ____ psi.
   (_____) = Pseudo Well Depth, ft; (___) = S.G.; (_____) = Annulus Backflow Pressure, psi

4. Enter graph on Gaseous Nitrogen Column Bottom-Hole Pressures (Section 315) with the calculated pseudo bottom-hole pressure and pseudo well depth, and determine wellhead pressure. Choose the graph with the appropriate geothermal gradient. With that wellhead pressure, determine the **actual** bottom-hole pressure at the **actual** well depth using the same graph.

   Wellhead Pressure, WHP = _____ psi.

   Actual BHP = _____ psi.

5. Average Pressure = [(_____) + (_____)]/2 = ___ psi.
   (_____) = Actual BHP; (_____) = Pseudo BHP

   Average Temperature = [_____ + _____]/2 = ___°F.
   _____ = Surface Temperature, °F; _____ = BHST, °F

At average pressure and average temperature, determine the Nitrogen Volume Factor (Section 305).

Nitrogen Volume Factor = ____ SCF/BBL.

6. Nitrogen Volume =

[(_____) (_____) (_____)]/100 = __ (100 SCF)

Annulus Volume BBL/ft	Pseudo Well Depth, ft	N_2 Volume Factor SCF/BBL

U-Tube Down Casing

Nitrogen requirements for displacement down the casing can be determined using the appropriate **U-Tube Down Casing** table (Section 225). If a table is not available, the alternate calculation method presented here can be used.

Example

Determine the nitrogen volume required to completely displace the following well going down the casing. Assume a surface temperature of 70°F and temperature gradient of 1.1°F/100 ft of depth.

Tubing	2-3/8 in.
Casing	5-1/2 in., 14.00 lb/ft
Fluid in Wellbore	12 lb/gal Mud
Depth	13,000 ft

1. Find the correct table corresponding to the fluid in the well (Section 225).

2. Read down the depth column to the value closest to the actual well depth (intermediate depths can be interpolated).

3. Read horizontally to find the maximum wellhead pressure, maximum bottom-hole pressure and the N_2 volume required for the particular tubular dimensions.

   For the example, the table (see p. 315.08) gives the following.

   Maximum WHP — 6,052 psi
   Maximum BHP — 8,113 psi
   N_2 Volume Required — 4238.5 (100 SCF) = 423,850 SCF

ALTERNATE METHOD

DISPLACEMENT DOWN THE CASING (Example)

Tubing Depth 13,000 ft BHST 213 °F

Annulus Capacity .0189 BBL/ft Fluid S.G. 1.44

1. Bottom-Hole Pressure, BHP = 0.433 (1.44) (13,000) = 8,106 psi.
   S.G. Tubing Depth, ft

2. Determine Wellhead Pressure, WHP, at complete annulus displacement (Section 315) from tables on "Gaseous Nitrogen Column — Bottom-Hole Pressure" — Wellhead Pressure = 6,100 psi (from p. 315.08).

3. Average Pressure = [(8,106) + (6,100)]/2 = 7,103 psi.
   BHP WHP

4. Average Temperature = [(70) + (213)]/2 = 142 °F.
   Surface Temperature Bottom-Hole Temperature

5. Determine nitrogen volume factor at average temperature and pressure (Section 305). Nitrogen Volume Factor = 1,748 SCF/BBL.

6. Nitrogen Volume =

   (13,000) (.0189) (1,748)]/100 = 4,295 (100 SCF)
   Tubing Depth; Annulus Capacity; N_2 Volume Factor SCF/BBL

ALTERNATE METHOD

DISPLACEMENT DOWN THE CASING (Worksheet)

Tubing Depth _____ ft BHST _____ °F

Annulus Capacity _____ BBL/ft Fluid S.G. _____

1. Bottom-Hole Pressure, BHP = 0.433 (___) (_____) = ____ psi.
   S.G. Tubing Depth, ft

2. Determine Wellhead Pressure, WHP, at complete annulus displacement (Section 315) from tables on "Gaseous Nitrogen Column — Bottom-Hole Pressure" — Wellhead Pressure = _____ psi.

3. Average Pressure = [(____) + (____)]/2 = ____ psi.
   BHP WHP

4. Average Temperature = [(_____) + (_____)]/2 = __ °F.
   Surface Temperature Bottom-Hole Temperature

5. Determine nitrogen volume factor at average temperature and pressure (Section 305). Nitrogen Volume Factor = ____ SCF/BBL.

6. Nitrogen Volume =

   (_____) (_____) (_____)]/100 = ____ (100 SCF)
   Tubing Depth Annulus Capacity N_2 Volume Factor, SCF/BBL

N_2 DISPLACEMENT TABLES

GIVEN N_2 WELLHEAD PRESSURE AND
DEPTH OR BOTTOM-HOLE PRESSURE

WELLHEAD PRESSURE • **200 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	206	0.8	2.0	2.9	4.3	6.5	12.1	18.3	30.3	8.1	12.3	14.1	24.2	26.2
2000	213	1.6	4.0	5.8	8.7	13.0	24.3	36.6	60.7	16.2	24.6	28.3	48.6	52.5
3000	220	2.4	6.0	8.7	13.1	19.6	36.5	55.0	91.3	24.3	37.0	42.6	73.0	78.9
4000	227	3.2	7.9	11.7	17.5	26.2	48.8	73.5	122.0	32.5	49.4	56.9	97.6	105.4
5000	235	4.0	10.0	14.6	21.9	32.8	61.1	92.0	152.7	40.7	61.9	71.3	122.2	132.0
6000	242	4.9	12.0	17.5	26.3	39.4	73.5	110.6	183.6	49.0	74.4	85.7	146.9	158.7
7000	249	5.7	14.0	20.5	30.7	46.1	85.9	129.3	214.7	57.2	86.9	100.2	171.7	185.5
8000	257	6.5	16.0	23.5	35.2	52.8	98.3	148.1	245.8	65.5	99.5	114.7	196.6	212.4
9000	264	7.3	18.1	26.5	39.7	59.5	110.8	166.9	277.0	73.9	112.2	129.3	221.6	239.4
10000	272	8.1	20.1	29.5	44.2	66.2	123.3	185.7	308.3	82.2	124.8	143.9	246.6	266.4
11000	279	9.0	22.1	32.5	48.7	73.0	135.9	204.7	339.7	90.6	137.6	158.5	271.8	293.6
12000	287	9.8	24.2	35.5	53.2	79.7	148.5	223.7	371.2	99.0	150.3	173.2	297.0	320.8
13000	295	10.6	26.3	38.5	57.7	86.5	161.1	242.7	402.8	107.4	163.1	188.0	322.3	348.1
14000	303	11.5	28.3	41.5	62.2	93.3	173.8	261.8	434.5	115.9	176.0	202.8	347.6	375.5
15000	311	12.3	30.4	44.6	66.8	100.2	186.5	280.9	466.3	124.3	188.8	217.6	373.0	403.0
16000	319	13.2	32.5	47.6	71.3	107.0	199.3	300.1	498.2	132.8	201.7	232.5	398.5	430.5
17000	327	14.0	34.6	50.7	75.9	113.9	212.0	319.4	530.1	141.4	214.7	247.4	424.1	458.1
18000	335	14.9	36.6	53.7	80.5	120.8	224.9	338.7	562.1	149.9	227.6	262.3	449.7	485.8
19000	343	15.7	38.7	56.8	85.1	127.7	237.7	358.0	594.2	158.5	240.6	277.3	475.4	513.5
20000	351	16.5	40.8	59.9	89.7	134.6	250.6	377.4	626.4	167.0	253.7	292.3	501.1	541.4

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **400 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜' 7" ANI
1000	413	1.6	4.0	5.8	8.7	13.0	24.2	36.5	60.6	16.2	24.5	28.3	48.5	5
2000	427	3.2	7.9	11.6	17.4	26.1	48.6	73.2	121.5	32.4	49.2	56.7	97.2	10
3000	441	4.8	11.9	17.4	26.1	39.2	73.0	110.0	182.6	48.7	73.9	85.2	146.1	15
4000	455	6.4	15.9	23.3	34.9	52.4	97.6	146.9	243.9	65.0	98.8	113.8	195.1	21
5000	470	8.1	19.9	29.2	43.7	65.6	122.2	184.0	305.5	81.5	123.7	142.6	244.4	26
6000	484	9.7	23.9	35.1	52.6	78.9	146.9	221.3	367.3	97.9	148.7	171.4	293.8	31
7000	499	11.3	28.0	41.0	61.5	92.2	171.7	258.6	429.3	114.5	173.8	200.3	343.4	37
8000	514	13.0	32.0	47.0	70.4	105.6	196.6	296.1	491.5	131.1	199.0	229.4	393.2	42
9000	529	14.6	36.1	52.9	79.3	119.0	221.6	333.8	554.0	147.7	224.3	258.5	443.2	47
10000	544	16.3	40.2	58.9	88.3	132.5	246.6	371.5	616.6	164.4	249.7	287.7	493.3	53
11000	559	18.0	44.3	64.9	97.3	146.0	271.8	409.3	679.4	181.2	275.1	317.1	543.6	58
12000	575	19.6	48.4	70.9	106.3	159.5	297.0	447.3	742.5	198.0	300.6	346.5	594.0	64
13000	590	21.3	52.5	77.0	115.4	173.1	322.3	485.4	805.7	214.8	326.2	376.0	644.5	69
14000	606	23.0	56.6	83.0	124.5	186.7	347.6	523.6	869.0	231.7	351.9	405.6	695.2	75
15000	622	24.6	60.8	89.1	133.6	200.3	373.0	561.9	932.6	248.7	377.6	435.2	746.1	80
16000	638	26.3	64.9	95.2	142.7	214.0	398.5	600.3	996.3	265.7	403.5	465.0	797.1	86
17000	654	28.0	69.1	101.3	151.8	227.8	424.1	638.8	1060.2	282.7	429.3	494.8	848.2	91
18000	670	29.7	73.3	107.4	161.0	241.5	449.7	677.3	1124.3	299.8	455.3	524.7	899.4	97
19000	686	31.4	77.5	113.6	170.2	255.3	475.4	716.0	1188.5	316.9	481.3	554.6	950.8	102
20000	700	32.9	81.1	118.9	178.1	267.2	497.6	749.4	1244.0	331.7	503.7	580.5	995.2	107

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **600 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	620	2.4	5.9	8.7	13.1	19.6	36.5	54.9	91.2	24.3	36.9	42.5	72.9	78.8
2000	641	4.8	11.9	17.4	26.1	39.2	73.0	110.0	182.6	48.7	73.9	85.2	146.1	157.8
3000	662	7.2	17.9	26.2	39.3	58.9	109.7	165.2	274.2	73.1	111.0	128.0	219.4	237.0
4000	683	9.7	23.9	35.0	52.4	78.6	146.4	220.5	366.0	97.6	148.2	170.8	292.8	316.3
5000	705	12.1	29.9	43.8	65.6	98.4	183.2	276.0	458.1	122.2	185.5	213.8	366.5	395.9
6000	727	14.5	35.9	52.6	78.8	118.2	220.1	331.6	550.3	146.8	222.9	256.8	440.3	475.6
7000	749	17.0	41.9	61.4	92.0	138.1	257.1	387.2	642.8	171.4	260.3	300.0	514.2	555.5
8000	771	19.4	47.9	70.3	105.3	158.0	294.1	443.0	735.3	196.1	297.8	343.2	588.3	635.5
9000	793	21.9	54.0	79.1	118.6	177.9	331.2	498.9	828.1	220.8	335.3	386.4	662.5	715.6
10000	815	24.3	60.0	88.0	131.9	197.8	368.4	554.9	921.0	245.6	373.0	429.8	736.8	795.9
11000	838	26.8	66.1	96.9	145.2	217.8	405.6	610.9	1014.1	270.4	410.6	473.2	811.3	876.4
12000	861	29.3	72.2	105.8	158.6	237.9	442.9	667.1	1107.3	295.3	448.4	516.7	885.8	956.9
13000	884	31.7	78.3	114.7	171.9	257.9	480.2	723.3	1200.6	320.2	486.2	560.3	960.5	1037.6
14000	907	34.2	84.4	123.7	185.3	278.0	517.6	779.6	1294.1	345.1	524.0	603.9	1035.3	1118.3
15000	930	36.7	90.5	132.6	198.7	298.1	555.1	836.0	1387.7	370.0	561.9	647.6	1110.1	1199.2
16000	953	39.1	96.6	141.6	212.1	318.2	592.5	892.5	1481.4	395.0	599.9	691.3	1185.1	1280.2
17000	977	41.6	102.7	150.5	225.6	338.4	630.1	949.0	1575.2	420.1	637.9	735.1	1260.2	1361.3
18000	1000	44.1	108.8	159.5	239.0	358.6	667.7	1005.6	1669.1	445.1	675.9	778.9	1335.3	1442.5
19000	1024	46.6	114.9	168.5	252.5	378.8	705.3	1062.3	1763.2	470.2	714.0	822.8	1410.6	1523.7
20000	1047	49.1	121.1	177.5	266.0	399.0	742.9	1119.0	1857.3	495.3	752.1	866.8	1485.9	1605.1

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **800 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	827	3.2	7.9	11.6	17.4	26.1	48.6	73.2	121.5	32.4	49.2	56.7	97.2	105.0
2000	855	6.4	15.9	23.2	34.8	52.2	97.3	146.5	243.2	64.8	98.5	113.5	194.5	210.2
3000	883	9.6	23.8	34.9	52.3	78.4	146.1	220.0	365.1	97.4	147.9	170.4	292.1	315.6
4000	911	12.9	31.8	46.6	69.8	104.7	194.9	293.6	487.3	130.0	197.3	227.4	389.9	421.1
5000	940	16.1	39.7	58.3	87.3	131.0	243.9	367.3	609.7	162.6	246.9	284.5	487.8	526.9
6000	969	19.3	47.7	70.0	104.9	157.3	292.9	441.2	732.3	195.3	296.5	341.7	585.8	632.9
7000	998	22.6	55.7	81.7	122.5	183.7	342.0	515.2	855.1	228.0	346.3	399.0	684.1	739.0
8000	1027	25.8	63.8	93.5	140.1	210.1	391.2	589.2	978.0	260.8	396.0	456.4	782.4	845.2
9000	1057	29.1	71.8	105.2	157.7	236.5	440.4	663.4	1101.1	293.6	445.9	513.9	880.9	951.6
10000	1086	32.3	79.8	117.0	175.3	263.0	489.7	737.6	1224.4	326.5	495.8	571.4	979.5	1058.1
11000	1116	35.6	87.9	128.8	193.0	289.5	539.1	812.0	1347.7	359.4	545.8	628.9	1078.2	1164.7
12000	1146	38.9	95.9	140.6	210.7	316.0	588.5	886.4	1471.3	392.3	595.8	686.6	1177.0	1271.5
13000	1177	42.1	104.0	152.4	228.4	342.6	638.0	960.9	1594.9	425.3	645.8	744.3	1275.9	1378.3
14000	1207	45.4	112.0	164.2	246.1	369.2	687.5	1035.4	1718.6	458.3	695.9	802.0	1374.9	1485.3
15000	1238	48.7	120.1	176.1	263.9	395.8	737.0	1110.1	1842.5	491.3	746.1	859.8	1474.0	1592.3
16000	1268	52.0	128.2	187.9	281.6	422.4	786.6	1184.7	1966.5	524.4	796.3	917.7	1573.2	1699.4
17000	1299	55.2	136.3	199.8	299.4	449.1	836.2	1259.5	2090.6	557.5	846.5	975.6	1672.4	1806.7
18000	1330	58.5	144.4	211.6	317.2	475.8	885.9	1334.3	2214.7	590.6	896.8	1033.5	1771.8	1914.0
19000	1361	61.8	152.5	223.5	335.0	502.5	935.6	1409.2	2339.0	623.7	947.1	1091.5	1871.2	2021.4
20000	1393	65.1	160.6	235.4	352.8	529.2	985.3	1484.1	2463.4	656.9	997.5	1149.6	1970.7	2128.8

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **1000 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	1034	4.0	9.9	14.5	21.7	32.6	60.6	91.3	151.6	40.4	61.4	70.7	121.3	131.0
2000	1068	8.0	19.8	29.0	43.5	65.2	121.4	182.8	303.4	80.9	122.9	141.6	242.7	262.2
3000	1103	12.0	29.7	43.5	65.2	97.8	182.2	274.4	455.5	121.5	184.4	212.6	364.4	393.6
4000	1139	16.1	39.6	58.1	87.0	130.5	243.1	366.1	607.7	162.1	246.1	283.6	486.2	525.2
5000	1174	20.1	49.6	72.6	108.9	163.3	304.1	458.0	760.2	202.7	307.8	354.8	608.1	656.9
6000	1210	24.1	59.5	87.2	130.7	196.1	365.1	549.9	912.8	243.4	369.6	426.0	730.2	788.8
7000	1246	28.2	69.5	101.8	152.6	228.9	426.2	642.0	1065.6	284.2	431.5	497.3	852.5	920.9
8000	1283	32.2	79.4	116.4	174.5	261.8	487.4	734.1	1218.5	324.9	493.4	568.6	974.8	1053.0
9000	1319	36.2	89.4	131.1	196.4	294.6	548.6	826.3	1371.6	365.7	555.4	640.1	1097.2	1185.3
10000	1356	40.3	99.4	145.7	218.4	327.5	609.9	918.6	1524.7	406.6	617.4	711.5	1219.8	1317.7
11000	1393	44.3	109.4	160.3	240.3	360.5	671.2	1010.9	1678.0	447.5	679.5	783.1	1342.4	1450.1
12000	1431	48.4	119.4	175.0	262.3	393.4	732.5	1103.3	1831.3	488.4	741.6	854.6	1465.1	1582.6
13000	1468	52.4	129.4	189.7	284.2	426.4	793.9	1195.8	1984.8	529.3	803.7	926.2	1587.8	1715.2
14000	1506	56.5	139.4	204.3	306.2	459.3	855.3	1288.3	2138.3	570.2	865.9	997.9	1710.6	1847.9
15000	1544	60.6	149.4	219.0	328.2	492.3	916.8	1380.8	2291.9	611.2	928.1	1069.6	1833.5	1980.7
16000	1582	64.6	159.4	233.7	350.2	525.3	978.2	1473.4	2445.6	652.2	990.3	1141.3	1956.5	2113.4
17000	1620	68.7	169.4	248.4	372.2	558.4	1039.7	1566.0	2599.3	693.1	1052.5	1213.0	2079.4	2246.3
18000	1658	72.7	179.5	263.1	394.3	591.4	1101.2	1658.6	2753.1	734.2	1114.8	1284.8	2202.5	2379.2
19000	1697	76.8	189.5	277.8	416.3	624.4	1162.8	1751.3	2906.9	775.2	1177.1	1356.6	2325.5	2512.1
20000	1735	80.9	199.5	292.5	438.3	657.5	1224.3	1844.0	3060.8	816.2	1239.4	1428.4	2448.6	2645.1

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **1200 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	1241	4.8	11.8	17.3	26.0	39.0	72.6	109.3	181.4	48.4	73.5	84.7	145.2	156.8
2000	1282	9.6	23.7	34.7	52.0	78.0	145.2	218.8	363.1	96.8	147.0	169.4	290.5	313.8
3000	1324	14.4	35.5	52.1	78.0	117.1	218.0	328.3	545.0	145.3	220.7	254.3	436.0	470.9
4000	1366	19.2	47.4	69.5	104.1	156.2	290.8	438.0	727.0	193.9	294.4	339.3	581.6	628.2
5000	1409	24.0	59.3	86.9	130.2	195.3	363.6	547.7	909.1	242.4	368.1	424.3	727.3	785.7
6000	1451	28.8	71.1	104.3	156.3	234.5	436.6	657.5	1091.4	291.0	442.0	509.3	873.1	943.2
7000	1494	33.7	83.0	121.7	182.4	273.6	509.5	767.4	1273.8	339.7	515.8	594.4	1019.0	1100.8
8000	1538	38.5	94.9	139.2	208.6	312.8	582.5	877.4	1456.3	388.3	589.7	679.6	1165.0	1258.5
9000	1582	43.3	106.8	156.6	234.7	352.0	655.5	987.3	1638.8	437.0	663.6	764.8	1311.0	1416.3
10000	1626	48.1	118.7	174.0	260.8	391.3	728.6	1097.3	1821.4	485.7	737.6	850.0	1457.1	1574.1
11000	1670	52.9	130.6	191.5	287.0	430.5	801.6	1207.4	2004.1	534.4	811.5	935.2	1603.3	1731.9
12000	1714	57.8	142.5	209.0	313.2	469.7	874.7	1317.4	2186.7	583.1	885.5	1020.5	1749.4	1889.8
13000	1759	62.6	154.5	226.4	339.3	509.0	947.8	1427.5	2369.4	631.9	959.5	1105.7	1895.6	2047.7
14000	1803	67.4	166.4	243.9	365.5	548.2	1020.9	1537.6	2552.2	680.6	1033.5	1191.0	2041.7	2205.6
15000	1848	72.3	178.3	261.3	391.7	587.5	1094.0	1647.7	2734.9	729.3	1107.5	1276.3	2187.9	2363.5
16000	1893	77.1	190.2	278.8	417.8	626.8	1167.1	1757.8	2917.6	778.0	1181.5	1361.6	2334.1	2521.4
17000	1938	81.9	202.1	296.3	444.0	666.0	1240.2	1867.9	3100.4	826.8	1255.5	1446.8	2480.3	2679.3
18000	1984	86.7	214.0	313.7	470.2	705.3	1313.2	1978.0	3283.1	875.5	1329.5	1532.1	2626.5	2837.3
19000	2029	91.6	225.9	331.2	496.3	744.5	1386.3	2088.1	3465.9	924.2	1403.5	1617.4	2772.7	2995.2
20000	2075	96.4	237.8	348.6	522.5	783.8	1459.4	2198.2	3648.6	973.0	1477.5	1702.7	2918.9	3153.1

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **1400 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	1447	5.6	13.8	20.2	30.2	45.3	84.4	127.1	211.0	56.3	85.4	98.5	168.8	182.3
2000	1495	11.2	27.5	40.3	60.5	90.7	168.8	254.3	422.1	112.6	170.9	197.0	337.7	364.8
3000	1544	16.7	41.3	60.5	90.7	136.1	253.4	381.6	633.4	168.9	256.5	295.6	506.7	547.4
4000	1593	22.3	55.1	80.7	121.0	181.5	337.9	508.9	844.7	225.3	342.1	394.2	675.8	730.0
5000	1642	27.9	68.8	100.9	151.3	226.9	422.5	636.3	1056.2	281.7	427.7	492.9	845.0	912.8
6000	1692	33.5	82.6	121.1	181.5	272.3	507.1	763.7	1267.7	338.1	513.3	591.6	1014.2	1095.5
7000	1742	39.1	96.4	141.3	211.8	317.8	591.7	891.2	1479.2	394.5	599.0	690.3	1183.4	1278.3
8000	1792	44.7	110.2	161.6	242.1	363.2	676.3	1018.6	1690.8	450.9	684.7	789.0	1352.6	1461.2
9000	1843	50.3	124.0	181.8	272.4	408.6	760.9	1146.1	1902.3	507.3	770.3	887.7	1521.8	1644.0
10000	1893	55.8	137.8	202.0	302.7	454.1	845.5	1273.5	2113.8	563.7	856.0	986.4	1691.1	1826.8
11000	1945	61.4	151.6	222.2	333.0	499.5	930.1	1400.9	2325.3	620.1	941.6	1085.1	1860.2	2009.5
12000	1996	67.0	165.4	242.4	363.3	544.9	1014.7	1528.3	2536.7	676.5	1027.2	1183.8	2029.4	2192.2
13000	2047	72.6	179.1	262.6	393.6	590.3	1099.2	1655.6	2748.1	732.8	1112.8	1282.4	2198.5	2374.9
14000	2099	78.2	192.9	282.8	423.8	635.7	1183.8	1783.0	2959.4	789.2	1198.4	1381.1	2367.5	2557.5
15000	2150	83.8	206.7	303.0	454.1	681.1	1268.3	1910.2	3170.7	845.5	1283.9	1479.6	2536.5	2740.1
16000	2202	89.3	220.4	323.2	484.3	726.5	1352.7	2037.4	3381.8	901.8	1369.4	1578.2	2705.5	2922.6
17000	2254	94.9	234.2	343.3	514.5	771.8	1437.2	2164.6	3592.9	958.1	1454.9	1676.7	2874.3	3105.0
18000	2306	100.5	248.0	363.5	544.8	817.1	1521.6	2291.7	3803.9	1014.4	1540.4	1775.2	3043.1	3287.3
19000	2359	106.1	261.7	383.6	575.0	862.4	1605.9	2418.8	4014.8	1070.6	1625.8	1873.6	3211.9	3469.6
20000	2411.	111.6	275.5	403.8	605.2	907.7	1690.3	2545.9	4225.7	1126.9	1711.1	1972.0	3380.6	3651.8

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **1600 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	1654	6.3	15.7	22.9	34.4	51.6	96.0	144.7	240.1	64.0	97.2	112.0	192.1	207.5
2000	1709	12.7	31.3	45.9	68.8	103.2	192.1	289.4	480.3	128.1	194.5	224.1	384.2	415.1
3000	1764	19.0	47.0	68.9	103.2	154.8	288.2	434.1	720.5	192.1	291.8	336.2	576.4	622.7
4000	1819	25.4	62.6	91.8	137.6	206.4	384.3	578.8	960.8	256.2	389.1	448.4	768.6	830.3
5000	1875	31.7	78.3	114.8	172.0	258.0	480.4	723.6	1201.0	320.3	486.3	560.5	960.8	1037.9
6000	1932	38.1	93.9	137.7	206.4	309.6	576.5	868.3	1441.3	384.3	583.6	672.6	1153.0	1245.5
7000	1988	44.4	109.6	160.7	240.8	361.2	672.6	1013.0	1681.4	448.4	680.9	784.7	1345.1	1453.1
8000	2045	50.8	125.3	183.6	275.2	412.8	768.6	1157.6	1921.5	512.4	778.1	896.7	1537.2	1660.5
9000	2103	57.1	140.9	206.5	309.5	464.3	864.6	1302.2	2161.5	576.4	875.3	1008.7	1729.2	1867.9
10000	2160	63.4	156.5	229.5	343.9	515.8	960.5	1446.7	2401.3	640.3	972.4	1120.6	1921.0	2075.2
11000	2218	69.8	172.2	252.4	378.2	567.3	1056.4	1591.1	2641.0	704.3	1069.5	1232.5	2112.8	2282.4
12000	2276	76.1	187.8	275.3	412.5	618.8	1152.2	1735.5	2880.6	768.2	1166.5	1344.3	2304.5	2489.4
13000	2334	82.4	203.4	298.1	446.8	670.2	1248.0	1879.7	3120.0	832.0	1263.4	1456.0	2496.0	2696.3
14000	2392	88.8	219.0	321.0	481.1	721.6	1343.7	2023.9	3359.3	895.8	1360.3	1567.7	2687.4	2903.1
15000	2450	95.1	234.6	343.8	515.3	773.0	1439.3	2167.9	3598.3	959.6	1457.1	1679.2	2878.7	3109.7
16000	2509	101.4	250.1	366.7	549.5	824.3	1534.9	2311.8	3837.2	1023.3	1553.8	1790.7	3069.8	3316.1
17000	2567	107.7	265.7	389.5	583.7	875.6	1630.4	2455.6	4076.0	1086.9	1650.5	1902.1	3260.8	3522.4
18000	2626	114.0	281.2	412.3	617.9	926.8	1725.8	2599.4	4314.5	1150.5	1747.1	2013.4	3451.6	3728.6
19000	2685	120.3	296.8	435.1	652.0	978.0	1821.2	2743.0	4552.9	1214.1	1843.6	2124.7	3642.3	3934.6
20000	2744	126.6	312.3	457.8	686.1	1029.2	1916.5	2886.5	4791.1	1277.6	1940.1	2235.9	3832.9	4140.5

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **1800 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	1860	7.1	17.5	25.7	38.5	57.7	107.5	161.9	268.8	71.7	108.8	125.4	215.0	232.3
2000	1922	14.2	35.0	51.4	77.0	115.5	215.0	323.8	537.5	143.3	217.7	250.8	430.0	464.5
3000	1983	21.3	52.6	77.0	115.5	173.2	322.5	485.7	806.2	215.0	326.5	376.2	645.0	696.7
4000	2045	28.4	70.1	102.7	153.9	230.9	429.9	647.6	1074.8	286.6	435.2	501.6	859.9	928.9
5000	2108	35.5	87.6	128.4	192.4	288.6	537.3	809.3	1343.4	358.2	544.0	626.9	1074.7	1160.9
6000	2171	42.6	105.1	154.0	230.8	346.2	644.7	971.0	1611.7	429.8	652.7	752.1	1289.4	1392.9
7000	2234	49.7	122.5	179.6	269.2	403.8	752.0	1132.6	1879.9	501.3	761.3	877.3	1504.0	1624.6
8000	2298	56.7	140.0	205.2	307.6	461.4	859.2	1294.1	2148.0	572.8	869.8	1002.4	1718.4	1856.3
9000	2361	63.8	157.5	230.8	346.0	518.9	966.3	1455.4	2415.8	644.2	978.2	1127.4	1932.6	2087.7
10000	2425	70.9	174.9	256.4	384.3	576.4	1073.3	1616.6	2683.3	715.6	1086.6	1252.2	2146.7	2318.9
11000	2490	78.0	192.3	281.9	422.6	633.8	1180.3	1777.7	2950.6	786.8	1194.8	1377.0	2360.5	2549.9
12000	2554	85.0	209.7	307.5	460.8	691.2	1287.1	1938.6	3217.7	858.1	1303.0	1501.6	2574.2	2780.7
13000	2618	92.1	227.1	333.0	499.0	748.5	1393.8	2099.3	3484.5	929.2	1411.0	1626.1	2787.6	3011.3
14000	2683	99.1	244.5	358.4	537.2	805.8	1500.4	2259.8	3751.0	1000.3	1518.9	1750.5	3000.8	3241.6
15000	2748	106.1	261.9	383.9	575.3	863.0	1606.9	2420.2	4017.2	1071.3	1626.7	1874.7	3213.8	3471.7
16000	2813	113.2	279.2	409.3	613.4	920.1	1713.3	2580.5	4283.1	1142.2	1734.4	1998.8	3426.5	3701.5
17000	2878	120.2	296.5	434.7	651.4	977.1	1819.5	2740.5	4548.8	1213.0	1842.0	2122.8	3639.0	3931.0
18000	2942	127.2	313.8	460.0	689.4	1034.1	1925.6	2900.4	4814.1	1283.8	1949.4	2246.6	3851.3	4160.4
19000	3007	134.2	331.1	485.3	727.4	1091.1	2031.7	3060.1	5079.2	1354.5	2056.8	2370.3	4063.4	4389.4
20000	3072	141.2	348.4	510.6	765.3	1148.0	2137.6	3219.6	5344.0	1425.1	2164.0	2493.9	4275.2	4618.3

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **2000 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	2067	7.8	19.4	28.4	42.5	63.8	118.8	178.9	296.9	79.2	120.2	138.5	237.5	256.6
2000	2134	15.7	38.7	56.7	85.0	127.5	237.5	357.7	593.6	158.3	240.4	277.0	474.9	513.0
3000	2202	23.5	58.0	85.1	127.5	191.2	356.1	536.4	890.3	237.4	360.5	415.5	712.2	769.4
4000	2271	31.4	77.4	113.4	169.9	254.9	474.7	714.9	1186.7	316.4	480.5	553.8	949.3	1025.5
5000	2340	39.2	96.7	141.7	212.4	318.5	593.1	893.4	1482.9	395.4	600.5	692.0	1186.3	1281.5
6000	2409	47.0	115.9	170.0	254.7	382.1	711.5	1071.7	1778.8	474.3	720.3	830.1	1423.0	1537.2
7000	2479	54.8	135.2	198.2	297.1	445.6	829.8	1249.8	2074.4	553.2	840.0	968.1	1659.5	1792.7
8000	2548	62.6	154.5	226.4	339.4	509.1	947.9	1427.7	2369.7	631.9	959.6	1105.9	1895.8	2047.9
9000	2619	70.4	173.7	254.6	381.6	572.4	1065.9	1605.4	2664.7	710.6	1079.0	1243.5	2131.8	2302.8
10000	2689	78.2	192.9	282.8	423.8	635.7	1183.7	1782.9	2959.3	789.2	1198.3	1381.0	2367.5	2557.4
11000	2759	86.0	212.1	310.9	465.9	698.9	1301.4	1960.2	3253.6	867.6	1317.5	1518.3	2602.8	2811.7
12000	2830	93.7	231.2	339.0	508.0	762.0	1419.0	2137.2	3547.4	946.0	1436.5	1655.5	2837.9	3065.7
13000	2901	101.5	250.4	367.0	550.1	825.1	1536.3	2314.0	3840.9	1024.2	1555.3	1792.4	3072.7	3319.3
14000	2972	109.2	269.5	395.0	592.0	888.0	1653.6	2490.5	4133.9	1102.4	1674.0	1929.2	3307.1	3572.5
15000	3042	116.9	288.5	423.0	633.9	950.9	1770.6	2666.8	4426.5	1180.4	1792.5	2065.7	3541.2	3825.4
16000	3113	124.7	307.6	450.9	675.8	1013.7	1887.5	2842.9	4718.7	1258.3	1910.8	2202.1	3775.0	4077.9
17000	3184	132.4	326.6	478.8	717.6	1076.3	2004.2	3018.7	5010.5	1336.1	2029.0	2338.3	4008.4	4330.1
18000	3255	140.1	345.6	506.6	759.3	1138.9	2120.8	3194.2	5301.9	1413.8	2147.0	2474.2	4241.5	4581.9
19000	3326	147.8	364.6	534.4	801.0	1201.4	2237.2	3369.6	5592.9	1491.4	2264.8	2610.0	4474.3	4833.4
20000	3397	155.4	383.5	562.2	842.6	1263.9	2353.4	3544.6	5883.5	1568.9	2382.5	2745.6	4706.8	5084.5

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **2200 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	2273	8.6	21.1	31.0	46.5	69.7	129.8	195.4	324.4	86.5	131.4	151.4	259.5	280.3
2000	2347	17.1	42.3	62.0	92.9	139.3	259.4	390.7	648.6	173.0	262.6	302.7	518.9	560.5
3000	2421	25.7	63.4	92.9	139.3	208.9	389.0	585.9	972.5	259.3	393.8	453.8	778.0	840.4
4000	2496	34.2	84.5	123.8	185.6	278.4	518.4	780.8	1296.0	345.6	524.8	604.8	1036.8	1120.0
5000	2571	42.8	105.5	154.7	231.9	347.8	647.7	975.5	1619.2	431.8	655.7	755.6	1295.4	1399.3
6000	2646	51.3	126.6	185.6	278.1	417.2	776.8	1170.0	1942.0	517.9	786.4	906.3	1553.6	1678.3
7000	2722	59.8	147.6	216.4	324.3	486.4	905.8	1364.3	2264.4	603.9	917.0	1056.7	1811.6	1956.9
8000	2798	68.3	168.6	247.1	370.4	555.6	1034.6	1558.2	2586.4	689.7	1047.3	1207.0	2069.1	2235.1
9000	2874	76.8	189.5	277.9	416.4	624.6	1163.1	1751.9	2907.8	775.4	1177.5	1357.0	2326.3	2513.0
10000	2951	85.3	210.5	308.5	462.4	693.6	1291.5	1945.3	3228.8	861.0	1307.5	1506.8	2583.1	2790.3
11000	3027	93.8	231.4	339.2	508.3	762.4	1419.7	2138.3	3549.3	946.5	1437.2	1656.3	2839.4	3067.3
12000	3104	102.2	252.2	369.7	554.1	831.2	1547.7	2331.1	3869.2	1031.8	1566.8	1805.6	3095.4	3343.8
13000	3181	110.7	273.0	400.2	599.8	899.8	1675.4	2523.5	4188.6	1117.0	1696.1	1954.7	3350.9	3619.8
14000	3257	119.1	293.8	430.7	645.5	968.3	1803.0	2715.6	4507.4	1202.0	1825.2	2103.5	3605.9	3895.3
15000	3334	127.5	314.6	461.1	691.1	1036.6	1930.3	2907.3	4825.7	1286.9	1954.1	2252.0	3860.6	4170.4
16000	3411	135.9	335.3	491.5	736.6	1104.9	2057.4	3098.8	5143.4	1371.6	2082.8	2400.3	4114.7	4444.9
17000	3488	144.3	356.0	521.8	782.0	1173.0	2184.2	3289.8	5460.6	1456.2	2211.2	2548.3	4368.5	4719.0
18000	3565	152.6	376.6	552.0	827.4	1241.0	2310.9	3480.6	5777.2	1540.6	2339.4	2696.0	4621.8	4992.7
19000	3641	161.0	397.2	582.3	872.6	1308.9	2437.3	3671.1	6093.3	1624.9	2467.4	2843.6	4874.7	5265.9
20000	3718	169.3	417.8	612.4	917.8	1376.7	2563.6	3861.2	6408.9	1709.0	2595.2	2990.8	5127.1	5538.6

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **2400 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	2479	9.3	22.9	33.6	50.3	75.5	140.5	211.6	351.3	93.7	142.2	163.9	281.0	303.6
2000	2559	18.6	45.8	67.1	100.6	150.8	280.9	423.0	702.2	187.2	284.3	327.7	561.7	606.8
3000	2639	27.8	68.6	100.6	150.8	226.1	421.1	634.2	1052.7	280.7	426.3	491.2	842.1	909.7
4000	2720	37.1	91.4	134.0	200.9	301.3	561.1	845.1	1402.7	374.1	568.0	654.6	1122.2	1212.2
5000	2801	46.3	114.2	167.4	250.9	376.4	700.9	1055.7	1752.2	467.3	709.5	817.7	1401.8	1514.3
6000	2883	55.5	137.0	200.8	300.9	451.4	840.5	1265.9	2101.2	560.3	850.9	980.6	1681.0	1815.9
7000	2964	64.7	159.7	234.1	350.8	526.2	979.9	1475.9	2449.7	653.3	992.0	1143.2	1959.8	2117.0
8000	3046	73.9	182.4	267.3	400.6	601.0	1119.0	1685.4	2797.5	746.0	1132.8	1305.5	2238.0	2417.6
9000	3128	83.1	205.0	300.5	450.4	675.5	1257.9	1894.6	3144.8	838.6	1273.4	1467.6	2515.8	2717.3
10000	3211	92.2	227.6	333.6	500.0	750.0	1396.5	2103.4	3491.4	931.0	1413.8	1629.3	2793.1	3017.2
11000	3293	101.4	250.1	366.7	549.5	824.3	1534.9	2311.9	3837.3	1023.3	1553.9	1790.7	3069.8	3316.2
12000	3376	110.5	272.6	399.7	599.0	898.5	1673.0	2519.9	4182.5	1115.3	1693.7	1951.9	3346.0	3614.5
13000	3458	119.6	295.1	432.6	648.3	972.5	1810.8	2727.4	4527.1	1207.2	1833.2	2112.7	3621.7	3912.3
14000	3541	128.7	317.5	465.4	697.6	1046.4	1948.4	2934.6	4871.0	1298.9	1972.4	2273.1	3896.8	4209.5
15000	3623	137.8	339.9	498.2	746.7	1120.1	2085.7	3141.4	5214.1	1390.4	2111.4	2433.3	4171.3	4506.6
16000	3705	146.8	362.2	531.0	795.8	1193.6	2222.6	3347.7	5556.6	1481.8	2250.1	2593.1	4445.3	4802.6
17000	3788	155.8	384.5	563.6	844.7	1267.1	2359.3	3553.6	5898.4	1572.9	2388.5	2752.6	4718.7	5097.3
18000	3870	164.8	406.7	596.2	893.6	1340.3	2495.8	3759.1	6239.4	1663.9	2526.6	2911.7	4991.6	5392.1
19000	3952	173.8	428.9	628.7	942.3	1413.4	2631.9	3964.2	6579.9	1754.6	2664.4	3070.6	5263.9	5686.3
20000	4034	182.8	451.1	661.2	991.0	1486.4	2767.8	4168.9	6919.6	1845.2	2802.0	3229.2	5535.7	5979.9

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **2600 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	2685	10.0	24.6	36.1	54.0	81.1	151.0	227.4	377.4	100.6	152.8	176.1	301.9	326.2
2000	2771	19.9	49.2	72.1	108.0	162.0	301.7	454.5	754.3	201.2	305.5	352.0	603.5	651.9
3000	2857	29.9	73.7	108.0	161.9	242.9	452.3	681.2	1130.7	301.5	457.9	527.7	904.6	977.2
4000	2944	39.8	98.2	144.0	215.7	323.6	602.6	907.6	1506.5	401.7	610.0	703.0	1205.2	1301.9
5000	3030	49.7	122.7	179.8	269.5	404.2	752.7	1133.6	1881.6	501.8	761.9	878.1	1505.3	1626.1
6000	3118	59.6	147.1	215.6	323.1	484.6	902.4	1359.2	2256.1	601.6	913.6	1052.8	1804.9	1949.7
7000	3205	69.5	171.4	251.3	376.6	564.9	1051.9	1584.4	2629.9	701.3	1064.9	1227.3	2103.9	2272.7
8000	3293	79.3	195.7	286.9	430.0	645.1	1201.2	1809.1	3002.9	800.8	1216.0	1401.3	2402.3	2595.1
9000	3381	89.2	220.0	322.5	483.4	725.0	1350.0	2033.4	3375.1	900.0	1366.7	1575.1	2700.1	2916.8
10000	3469	99.0	244.2	358.0	536.5	804.8	1498.6	2257.2	3746.6	999.1	1517.1	1748.4	2997.3	3237.8
11000	3557	108.8	268.4	393.4	589.6	884.4	1646.9	2480.5	4117.2	1097.9	1667.2	1921.4	3293.8	3558.1
12000	3645	118.5	292.5	428.8	642.6	963.9	1794.8	2703.3	4487.0	1196.5	1817.0	2093.9	3589.6	3877.7
13000	3733	128.3	316.5	464.0	695.4	1043.1	1942.4	2925.6	4856.0	1294.9	1966.4	2266.1	3884.8	4196.5
14000	3821	138.0	340.5	499.2	748.1	1122.2	2089.6	3147.3	5224.1	1393.1	2115.4	2437.9	4179.3	4514.6
15000	3909	147.7	364.5	534.3	800.7	1201.1	2236.5	3368.6	5591.3	1491.0	2264.1	2609.3	4473.1	4832.0
16000	3996	157.4	388.4	569.3	853.2	1279.8	2383.1	3589.3	5957.7	1588.7	2412.5	2780.3	4766.2	5148.6
17000	4084	167.1	412.2	604.2	905.6	1358.3	2529.3	3809.6	6323.3	1686.2	2560.5	2950.9	5058.6	5464.6
18000	4171	176.7	436.0	639.1	957.8	1436.7	2675.2	4029.3	6688.0	1783.5	2708.2	3121.1	5350.4	5779.7
19000	4259	186.3	459.7	673.8	1009.9	1514.9	2820.8	4248.5	7051.9	1880.5	2855.6	3290.9	5641.5	6094.2
20000	4346	195.9	483.3	708.5	1061.9	1592.9	2966.0	4467.3	7415.0	1977.3	3002.6	3460.3	5932.0	6408.0

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **2800 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	2891	10.6	26.3	38.5	57.7	86.5	161.1	242.7	402.8	107.4	163.1	188.0	322.3	348.1
2000	2982	21.3	52.5	76.9	115.3	172.9	322.0	485.0	805.0	214.7	326.0	375.7	644.0	695.7
3000	3074	31.9	78.6	115.3	172.8	259.2	482.6	726.9	1206.5	321.7	488.6	563.0	965.2	1042.6
4000	3166	42.5	104.8	153.6	230.2	345.3	642.9	968.3	1607.2	428.6	650.8	750.0	1285.8	1389.0
5000	3259	53.0	130.8	191.8	287.5	431.2	802.9	1209.3	2007.2	535.3	812.8	936.7	1605.8	1734.6
6000	3352	63.6	156.9	229.9	344.6	516.9	962.6	1449.8	2406.4	641.7	974.4	1123.0	1925.1	2079.6
7000	3445	74.1	182.8	268.0	401.7	602.5	1121.9	1689.7	2804.7	747.9	1135.7	1308.8	2243.7	2423.8
8000	3538	84.6	208.7	306.0	458.6	687.9	1280.8	1929.2	3202.1	853.9	1296.6	1494.3	2561.7	2767.2
9000	3631	95.1	234.6	343.9	515.3	773.0	1439.4	2168.0	3598.5	959.6	1457.2	1679.3	2878.8	3109.9
10000	3725	105.5	260.4	381.7	572.0	858.0	1597.6	2406.3	3994.1	1065.1	1617.4	1863.9	3195.3	3451.7
11000	3818	115.9	286.1	419.4	628.5	942.7	1755.4	2644.0	4388.6	1170.3	1777.1	2048.0	3510.9	3792.6
12000	3911	126.3	311.7	457.0	684.9	1027.3	1912.9	2881.1	4782.2	1275.3	1936.5	2231.7	3825.8	4132.8
13000	4005	136.7	337.3	494.5	741.1	1111.6	2069.9	3117.6	5174.7	1379.9	2095.5	2414.9	4139.8	4472.0
14000	4098	147.1	362.8	531.9	797.1	1195.7	2226.5	3353.5	5566.3	1484.3	2254.0	2597.6	4453.0	4810.4
15000	4191	157.4	388.3	569.2	853.1	1279.6	2382.7	3588.8	5956.8	1588.5	2412.2	2779.9	4765.5	5147.9
16000	4284	167.7	413.7	606.4	908.9	1363.3	2538.5	3823.5	6346.4	1692.4	2569.9	2961.6	5077.1	5484.5
17000	4376	177.9	439.0	643.6	964.5	1446.8	2694.0	4057.6	6734.9	1796.0	2727.2	3142.9	5387.9	5820.3
18000	4469	188.2	464.3	680.6	1020.0	1530.0	2849.0	4291.0	7122.4	1899.3	2884.1	3323.8	5697.9	6155.2
19000	4561	198.4	489.5	717.5	1075.4	1613.0	3003.6	4523.9	7509.0	2002.4	3040.7	3504.2	6007.2	6489.2
20000	4653	208.6	514.6	754.4	1130.6	1695.9	3157.8	4756.3	7894.6	2105.2	3196.8	3684.2	6315.7	6822.5

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **3000 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	3096	11.3	27.9	40.8	61.2	91.8	171.0	257.5	427.4	114.0	173.1	199.5	341.9	369.4
2000	3193	22.6	55.7	81.6	122.3	183.5	341.6	514.5	854.1	227.7	345.8	398.6	683.2	738.1
3000	3291	33.8	83.4	122.3	183.3	274.9	511.9	771.1	1279.9	341.3	518.3	597.3	1023.9	1106.1
4000	3388	45.0	111.1	162.9	244.1	366.2	681.9	1027.1	1704.8	454.6	690.3	795.6	1363.8	1473.3
5000	3486	56.2	138.8	203.4	304.9	457.3	851.5	1282.5	2128.8	567.7	862.0	993.4	1703.1	1839.7
6000	3585	67.4	166.3	243.8	365.5	548.2	1020.7	1537.4	2551.9	680.5	1033.3	1190.9	2041.5	2205.3
7000	3683	78.6	193.9	284.2	425.9	638.8	1189.6	1791.7	2973.9	793.0	1204.2	1387.8	2379.1	2570.0
8000	3782	89.7	221.3	324.4	486.2	729.3	1357.9	2045.3	3394.9	905.3	1374.7	1584.3	2715.9	2933.8
9000	3880	100.8	248.7	364.5	546.3	819.5	1525.9	2298.3	3814.8	1017.3	1544.7	1780.2	3051.8	3296.7
10000	3979	111.8	276.0	404.5	606.3	909.4	1693.4	2550.6	4233.6	1128.9	1714.3	1975.7	3386.8	3658.6
11000	4077	122.9	303.2	444.5	666.1	999.2	1860.5	2802.2	4651.2	1240.3	1883.5	2170.6	3721.0	4019.6
12000	4176	133.9	330.3	484.3	725.8	1088.6	2027.1	3053.2	5067.7	1351.4	2052.1	2364.9	4054.2	4379.5
13000	4274	144.9	357.4	523.9	785.2	1177.9	2193.2	3303.4	5483.1	1462.2	2220.3	2558.8	4386.5	4738.5
14000	4372	155.8	384.4	563.5	844.5	1266.8	2358.9	3552.9	5897.3	1572.6	2388.0	2752.1	4717.8	5096.4
15000	4470	166.7	411.3	603.0	903.7	1355.5	2524.1	3801.8	6310.3	1682.7	2555.3	2944.8	5048.2	5453.3
16000	4568	177.6	438.2	642.3	962.7	1444.0	2688.8	4049.9	6722.1	1792.6	2722.0	3137.0	5377.7	5809.2
17000	4665	188.4	465.0	681.6	1021.5	1532.2	2853.1	4297.3	7132.8	1902.1	2888.3	3328.6	5706.2	6164.2
18000	4762	199.3	491.6	720.7	1080.1	1620.2	3016.9	4544.0	7542.3	2011.3	3054.2	3519.8	6033.9	6518.1
19000	4859	210.1	518.3	759.7	1138.6	1707.9	3180.3	4790.1	7950.7	2120.2	3219.6	3710.3	6360.6	6871.0
20000	4955	220.8	544.8	798.7	1197.0	1795.4	3343.2	5035.5	8358.0	2228.8	3384.5	3900.4	6686.4	7223.0

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **3200 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	3301	11.9	29.4	43.1	64.6	96.9	180.5	271.8	451.2	120.3	182.7	210.6	360.9	389.9
2000	3404	23.8	58.8	86.1	129.1	193.6	360.6	543.1	901.5	240.4	365.0	420.7	721.2	779.0
3000	3507	35.7	88.0	129.1	193.4	290.2	540.3	813.8	1350.8	360.2	547.0	630.4	1080.6	1167.3
4000	3610	47.5	117.3	171.9	257.6	386.5	719.6	1083.9	1799.0	479.7	728.5	839.6	1439.2	1554.7
5000	3713	59.3	146.4	214.6	321.7	482.5	898.5	1353.3	2246.3	599.0	909.6	1048.3	1797.0	1941.2
6000	3816	71.1	175.5	257.3	385.6	578.4	1076.9	1622.1	2692.4	718.0	1090.2	1256.4	2153.9	2326.7
7000	3920	82.9	204.5	299.8	449.3	673.9	1254.9	1890.1	3137.3	836.6	1270.4	1464.1	2509.8	2711.2
8000	4023	94.6	233.4	342.2	512.8	769.3	1432.4	2157.5	3581.0	954.9	1450.1	1671.2	2864.8	3094.7
9000	4127	106.3	262.3	384.5	576.2	864.3	1609.4	2424.1	4023.5	1072.9	1629.3	1877.7	3218.8	3477.1
10000	4230	118.0	291.0	426.6	639.4	959.1	1785.9	2689.9	4464.8	1190.6	1808.0	2083.6	3571.8	3858.5
11000	4334	129.6	319.7	468.7	702.4	1053.6	1961.9	2955.0	4904.7	1307.9	1986.1	2288.9	3923.8	4238.7
12000	4437	141.2	348.3	510.6	765.2	1147.8	2137.4	3219.2	5343.4	1424.9	2163.7	2493.6	4274.7	4617.7
13000	4540	152.7	376.8	552.4	827.9	1241.8	2312.3	3482.7	5780.7	1541.5	2340.8	2697.7	4624.6	4995.7
14000	4643	164.2	405.2	594.0	890.3	1335.4	2486.7	3745.4	6216.7	1657.8	2517.4	2901.1	4973.4	5372.5
15000	4745	175.7	433.6	635.6	952.5	1428.8	2660.5	4007.2	6651.4	1773.7	2693.4	3104.0	5321.1	5748.1
16000	4848	187.2	461.8	677.0	1014.6	1521.9	2833.9	4268.3	7084.7	1889.3	2868.9	3306.2	5667.8	6122.6
17000	4950	198.6	490.0	718.3	1076.5	1614.7	3006.7	4528.6	7516.7	2004.5	3043.8	3507.8	6013.4	6495.9
18000	5051	210.0	518.1	759.4	1138.1	1707.2	3179.0	4788.1	7947.4	2119.3	3218.2	3708.8	6357.9	6868.1
19000	5152	221.3	546.0	800.5	1199.6	1799.5	3350.7	5046.8	8376.8	2233.8	3392.1	3909.2	6701.5	7239.2
20000	5251	232.5	573.7	840.9	1260.3	1890.5	3520.2	5302.1	8800.6	2346.8	3563.7	4106.9	7040.5	7605.5

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **3400 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	3507	12.5	30.9	45.3	67.9	101.8	189.6	285.6	474.1	126.4	192.0	221.2	379.3	409.7
2000	3614	25.0	61.7	90.5	135.6	203.5	378.8	570.6	947.1	252.6	383.5	442.0	757.7	818.5
3000	3722	37.5	92.5	135.6	203.2	304.8	567.6	854.9	1419.1	378.4	574.6	662.2	1135.2	1226.4
4000	3830	49.9	123.2	180.6	270.6	406.0	755.9	1138.6	1889.8	504.0	765.3	881.9	1511.9	1633.2
5000	3938	62.3	153.8	225.5	337.9	506.8	943.8	1421.5	2359.4	629.2	955.4	1101.1	1887.5	2039.0
6000	4047	74.7	184.3	270.2	405.0	607.4	1131.1	1703.6	2827.7	754.1	1145.1	1319.6	2262.2	2443.7
7000	4155	87.0	214.8	314.8	471.8	707.8	1317.9	1985.0	3294.7	878.6	1334.2	1537.5	2635.8	2847.3
8000	4263	99.3	245.1	359.3	538.5	807.8	1504.2	2265.5	3760.4	1002.8	1522.7	1754.8	3008.3	3249.7
9000	4372	111.6	275.4	403.7	605.0	907.5	1689.9	2545.2	4224.7	1126.6	1710.7	1971.5	3379.7	3650.9
10000	4480	123.8	305.6	447.9	671.3	1006.9	1875.0	2824.1	4687.5	1250.0	1898.2	2187.5	3750.0	4050.9
11000	4588	136.0	335.6	492.0	737.4	1106.1	2059.6	3102.1	5148.9	1373.1	2085.0	2402.8	4119.2	4449.7
12000	4696	148.2	365.6	536.0	803.2	1204.9	2243.6	3379.2	5608.9	1495.7	2271.3	2617.5	4487.1	4847.2
13000	4803	160.3	395.5	579.8	868.9	1303.4	2427.0	3655.4	6067.4	1618.0	2456.9	2831.4	4853.9	5243.4
14000	4911	172.4	425.3	623.4	934.4	1401.5	2609.7	3930.7	6524.3	1739.8	2642.0	3044.7	5219.5	5638.3
15000	5015	184.1	454.3	666.0	998.2	1497.2	2788.0	4199.2	6969.9	1858.6	2822.4	3252.6	5575.9	6023.4
16000	5121	196.1	483.9	709.3	1063.0	1594.5	2969.1	4472.0	7422.8	1979.4	3005.8	3464.0	5938.2	6414.8
17000	5227	208.0	513.3	752.5	1127.7	1691.6	3149.9	4744.3	7874.7	2099.9	3188.8	3674.9	6299.8	6805.3
18000	5332	220.0	542.7	795.6	1192.3	1788.5	3330.3	5016.0	8325.7	2220.2	3371.4	3885.3	6660.6	7195.1
19000	5438	231.9	572.1	838.6	1256.8	1885.2	3510.3	5287.2	8775.9	2340.2	3553.7	4095.4	7020.7	7584.1
20000	5543	243.7	601.3	881.5	1321.1	1981.7	3690.1	5557.9	9225.2	2460.1	3735.7	4305.1	7380.2	7972.4

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **3600 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	3712	13.1	32.3	47.4	71.0	106.6	198.4	298.9	496.1	132.3	200.9	231.5	396.9	428.7
2000	3824	26.2	64.6	94.7	141.9	212.9	396.4	597.1	991.0	264.3	401.3	462.5	792.8	856.4
3000	3937	39.2	96.8	141.9	212.6	318.9	593.9	894.5	1484.7	395.9	601.2	692.9	1187.8	1283.1
4000	4049	52.2	128.9	188.9	283.1	424.7	790.8	1191.1	1977.1	527.2	800.6	922.7	1581.7	1708.6
5000	4163	65.2	160.9	235.8	353.5	530.2	987.3	1487.0	2468.2	658.2	999.5	1151.8	1974.5	2133.0
6000	4276	78.1	192.8	282.6	423.6	635.4	1183.1	1782.0	2957.8	788.8	1197.7	1380.3	2366.3	2556.1
7000	4389	91.0	224.6	329.3	493.5	740.3	1378.4	2076.1	3446.0	918.9	1395.4	1608.2	2756.8	2978.1
8000	4502	103.9	256.4	375.8	563.2	844.8	1573.1	2369.4	3932.8	1048.7	1592.5	1835.3	3146.2	3398.7
9000	4614	116.6	287.8	421.9	632.3	948.4	1766.0	2659.8	4414.9	1177.3	1787.8	2060.3	3531.9	3815.3
10000	4726	129.4	319.1	467.8	701.2	1051.7	1958.4	2949.7	4896.0	1305.6	1982.6	2284.8	3916.8	4231.1
11000	4838	142.0	350.4	513.7	769.8	1154.8	2150.2	3238.6	5375.6	1433.5	2176.8	2508.6	4300.5	4645.6
12000	4949	154.7	381.6	559.4	838.3	1257.5	2341.5	3526.7	5853.8	1561.0	2370.4	2731.8	4683.0	5058.8
13000	5061	167.3	412.7	604.9	906.6	1359.9	2532.3	3814.0	6330.7	1688.2	2563.5	2954.3	5064.5	5471.0
14000	5172	179.8	443.7	650.4	974.7	1462.1	2722.5	4100.6	6806.3	1815.0	2756.1	3176.3	5445.1	5882.0
15000	5282	192.4	474.6	695.7	1042.7	1564.0	2912.3	4386.5	7280.8	1941.6	2948.3	3397.7	5824.7	6292.1
16000	5393	204.9	505.5	741.0	1110.5	1665.7	3101.7	4671.7	7754.2	2067.8	3140.0	3618.6	6203.4	6701.2
17000	5503	217.3	536.3	786.1	1178.1	1767.2	3290.7	4956.3	8226.7	2193.8	3331.3	3839.1	6581.3	7109.5
18000	5612	229.8	567.0	831.2	1245.7	1868.5	3479.3	5240.4	8698.1	2319.5	3522.2	4059.1	6958.5	7516.9
19000	5722	242.2	597.7	876.1	1313.1	1969.6	3667.5	5523.9	9168.8	2445.0	3712.8	4278.8	7335.0	7923.6
20000	5831	254.6	628.3	921.0	1380.3	2070.5	3855.4	5807.0	9638.6	2570.3	3903.0	4498.0	7710.9	8329.7

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **3800 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	3916	13.7	33.7	49.4	74.1	111.1	206.9	311.6	517.2	137.9	209.4	241.4	413.8	447.0
2000	4033	27.3	67.3	98.7	147.9	221.9	413.2	622.4	1033.1	275.5	418.3	482.1	826.5	892.8
3000	4151	40.9	100.9	147.9	221.6	332.5	619.1	932.4	1547.6	412.7	626.7	722.2	1238.1	1337.5
4000	4268	54.4	134.3	196.9	295.1	442.7	824.3	1241.6	2060.8	549.5	834.5	961.7	1648.6	1780.9
5000	4386	68.0	167.9	246.1	368.8	553.2	1030.0	1551.4	2575.0	686.7	1042.7	1201.7	2060.0	2225.3
6000	4504	81.5	201.0	294.6	441.6	662.4	1233.4	1857.6	3083.4	822.2	1248.6	1438.9	2466.7	2664.7
7000	4620	94.8	234.0	343.0	514.1	771.1	1435.9	2162.7	3589.8	957.3	1453.6	1675.2	2871.8	3102.3
8000	4737	108.2	266.9	391.2	586.4	879.5	1637.7	2466.7	4094.4	1091.8	1658.0	1910.7	3275.5	3538.3
9000	4854	121.5	299.7	439.3	658.4	987.5	1838.9	2769.7	4597.2	1225.9	1861.6	2145.4	3677.8	3972.9
10000	4970	134.7	332.3	487.2	730.1	1095.2	2039.4	3071.6	5098.4	1359.6	2064.5	2379.3	4078.7	4406.0
11000	5086	147.9	364.9	534.9	801.7	1202.6	2239.2	3372.7	5598.1	1492.8	2266.9	2612.5	4478.5	4837.9
12000	5202	161.1	397.4	582.5	873.1	1309.6	2438.6	3672.9	6096.4	1625.7	2468.7	2845.0	4877.1	5268.5
13000	5317	174.2	429.8	630.0	944.2	1416.3	2637.3	3972.3	6593.3	1758.2	2669.9	3076.9	5274.6	5697.9
14000	5433	187.3	462.1	677.4	1015.2	1522.8	2835.6	4270.9	7089.0	1890.4	2870.6	3308.2	5671.2	6126.3
15000	5547	200.4	494.3	724.6	1086.0	1629.1	3033.4	4568.8	7583.5	2022.3	3070.9	3539.0	6066.8	6553.7
16000	5662	213.4	526.5	771.8	1156.7	1735.0	3230.8	4866.1	8076.9	2153.8	3270.7	3769.2	6461.5	6980.1
17000	5776	226.4	558.6	818.8	1227.2	1840.8	3427.7	5162.8	8569.3	2285.2	3470.1	3999.0	6855.5	7405.6
18000	5890	239.4	590.6	865.8	1297.6	1946.4	3624.3	5458.9	9060.8	2416.2	3669.1	4228.4	7248.6	7830.3
19000	6003	252.3	622.6	912.7	1367.9	2051.8	3820.6	5754.4	9551.4	2547.0	3867.7	4457.3	7641.1	8254.3
20000	6116	265.3	654.5	959.5	1438.0	2157.0	4016.5	6049.5	10041.2	2677.7	4066.1	4685.9	8033.0	8677.6

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **4000 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	4121	14.3	35.2	51.6	77.3	115.9	215.9	325.2	539.7	143.9	218.6	251.9	431.8	466.4
2000	4243	28.5	70.2	102.9	154.2	231.3	430.7	648.8	1076.9	287.2	436.1	502.5	861.5	930.6
3000	4365	42.6	105.0	154.0	230.8	346.2	644.6	970.9	1611.5	429.7	652.6	752.0	1289.2	1392.7
4000	4487	56.6	139.7	204.9	307.0	460.5	857.5	1291.6	2143.8	571.7	868.1	1000.5	1715.1	1852.7
5000	4608	70.6	174.3	255.5	382.9	574.4	1069.6	1611.0	2673.9	713.0	1082.8	1247.8	2139.1	2310.8
6000	4730	84.6	208.7	306.0	458.6	687.8	1280.8	1929.1	3202.0	853.9	1296.6	1494.2	2561.6	2767.1
7000	4851	98.5	243.0	356.2	533.9	800.8	1491.2	2246.0	3728.0	994.1	1509.6	1739.7	2982.4	3221.7
8000	4972	112.3	277.2	406.3	609.0	913.4	1700.9	2561.8	4252.2	1133.9	1721.9	1984.4	3401.8	3674.7
9000	5093	126.1	311.2	456.2	683.8	1025.7	1909.9	2876.6	4774.7	1273.2	1933.4	2228.2	3819.7	4126.2
10000	5213	139.9	345.2	506.0	758.4	1137.5	2118.2	3190.4	5295.5	1412.1	2144.3	2471.2	4236.4	4576.3
11000	5333	153.6	379.0	555.6	832.7	1249.1	2325.9	3503.2	5814.7	1550.6	2354.6	2713.5	4651.8	5025.1
12000	5453	167.3	412.8	605.1	906.9	1360.3	2533.0	3815.2	6332.6	1688.7	2564.3	2955.2	5066.0	5472.6
13000	5573	180.9	446.5	654.5	980.8	1471.3	2739.6	4126.3	6849.0	1826.4	2773.4	3196.2	5479.2	5918.9
14000	5692	194.6	480.0	703.7	1054.6	1581.9	2945.7	4436.7	7364.2	1963.8	2982.1	3436.6	5891.4	6364.2
15000	5811	208.1	513.5	752.8	1128.2	1692.4	3151.3	4746.4	7878.3	2100.9	3190.2	3676.5	6302.6	6808.4
16000	5929	221.7	547.0	801.8	1201.7	1802.6	3356.5	5055.4	8391.2	2237.7	3397.9	3915.9	6713.0	7251.7
17000	6047	235.2	580.4	850.7	1275.0	1912.5	3561.2	5363.8	8903.1	2374.2	3605.2	4154.8	7122.5	7694.0
18000	6165	248.7	613.7	899.6	1348.2	2022.3	3765.6	5671.7	9414.1	2510.4	3812.1	4393.2	7531.3	8135.6
19000	6282	262.2	646.9	948.3	1421.2	2131.9	3969.7	5979.0	9924.1	2646.4	4018.7	4631.3	7939.3	8576.4
20000	6399	275.6	680.1	997.0	1494.2	2241.2	4173.4	6285.8	10433.4	2782.2	4224.9	4868.9	8346.7	9016.5

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **4200 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	4326	14.8	36.4	53.4	80.1	120.1	223.6	336.8	559.0	149.1	226.4	260.9	447.2	483.1
2000	4452	29.5	72.7	106.6	159.7	239.6	446.2	672.0	1115.5	297.5	451.7	520.5	892.4	964.0
3000	4578	44.1	108.8	159.5	239.1	358.6	667.7	1005.7	1669.4	445.2	676.0	779.0	1335.5	1442.7
4000	4704	58.7	144.8	212.2	318.1	477.1	888.4	1338.0	2220.9	592.2	899.3	1036.4	1776.7	1919.3
5000	4830	73.2	180.6	264.7	396.7	595.1	1108.1	1668.9	2770.2	738.7	1121.8	1292.8	2216.1	2394.0
6000	4955	87.6	216.2	317.0	475.1	712.6	1326.9	1998.6	3317.4	884.6	1343.3	1548.1	2653.9	2866.9
7000	5081	102.0	251.8	369.1	553.2	829.7	1545.0	2327.1	3862.6	1030.0	1564.1	1802.5	3090.0	3338.0
8000	5206	116.4	287.2	421.0	631.0	946.4	1762.4	2654.4	4405.9	1174.9	1784.1	2056.1	3524.7	3807.6
9000	5330	130.7	322.5	472.8	708.5	1062.8	1979.0	2980.7	4947.4	1319.3	2003.4	2308.8	3958.0	4275.6
10000	5455	145.0	357.7	524.3	785.8	1178.8	2194.9	3306.0	5487.3	1463.3	2222.0	2560.8	4389.9	4742.1
11000	5579	159.2	392.8	575.8	862.9	1294.4	2410.3	3630.3	6025.7	1606.9	2440.0	2812.0	4820.6	5207.4
12000	5703	173.4	427.8	627.1	939.8	1409.7	2625.0	3953.8	6562.6	1750.0	2657.4	3062.5	5250.1	5671.4
13000	5826	187.5	462.7	678.3	1016.5	1524.8	2839.2	4276.4	7098.1	1892.8	2874.3	3312.5	5678.5	6134.2
14000	5949	201.6	497.5	729.3	1093.0	1639.5	3052.9	4598.3	7632.4	2035.3	3090.6	3561.8	6105.9	6595.9
15000	6072	215.7	532.3	780.3	1169.4	1754.1	3266.2	4919.4	8165.4	2177.4	3306.5	3810.5	6532.3	7056.5
16000	6194	229.8	566.9	831.1	1245.6	1868.3	3479.0	5239.9	8697.4	2319.3	3521.9	4058.8	6957.9	7516.3
17000	6316	243.8	601.5	881.8	1321.6	1982.4	3691.3	5559.8	9228.3	2460.9	3736.9	4306.5	7382.7	7975.1
18000	6437	257.8	636.1	932.5	1397.5	2096.2	3903.3	5879.1	9758.3	2602.2	3951.5	4553.9	7806.6	8433.1
19000	6558	271.8	670.6	983.0	1473.3	2209.9	4114.9	6197.8	10287.4	2743.3	4165.7	4800.8	8229.9	8890.3
20000	6679	285.7	705.0	1033.5	1548.9	2323.4	4326.2	6516.1	10815.6	2884.2	4379.7	5047.3	8652.5	9346.8

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **4400 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	4530	15.3	37.7	55.2	82.8	124.1	231.1	348.1	577.9	154.1	234.0	269.7	462.3	499.4
2000	4660	30.5	75.2	110.2	165.1	247.7	461.2	694.7	1153.0	307.5	466.9	538.1	922.4	996.4
3000	4790	45.6	112.5	164.9	247.1	370.7	690.3	1039.7	1725.7	460.2	698.8	805.3	1380.5	1491.3
4000	4920	60.7	149.7	219.4	328.8	493.2	918.4	1383.2	2295.9	612.2	929.7	1071.4	1836.7	1984.1
5000	5050	75.7	186.7	273.7	410.1	615.2	1145.6	1725.4	2863.9	763.7	1159.7	1336.5	2291.1	2475.0
6000	5180	90.6	223.6	327.7	491.2	736.8	1371.9	2066.3	3429.8	914.6	1388.8	1600.6	2743.8	2964.0
7000	5309	105.5	260.3	381.6	571.9	857.9	1597.4	2406.0	3993.6	1065.0	1617.2	1863.7	3194.9	3451.3
8000	5438	120.4	297.0	435.3	652.4	978.6	1822.2	2744.6	4555.6	1214.8	1844.7	2125.9	3644.4	3936.9
9000	5567	135.2	333.5	488.8	732.6	1098.9	2046.3	3082.1	5115.7	1364.2	2071.6	2387.3	4092.6	4421.0
10000	5695	149.9	369.9	542.2	812.6	1218.9	2269.7	3418.6	5674.3	1513.1	2297.7	2648.0	4539.4	4903.7
11000	5823	164.6	406.2	595.4	892.4	1338.6	2492.5	3754.1	6231.2	1661.7	2523.3	2907.9	4985.0	5385.0
12000	5951	179.3	442.4	648.5	971.9	1457.9	2714.7	4088.8	6786.7	1809.8	2748.2	3167.1	5429.4	5865.0
13000	6078	193.9	478.5	701.5	1051.3	1576.9	2936.3	4422.6	7340.8	1957.5	2972.6	3425.7	5872.6	6343.9
14000	6205	208.5	514.5	754.3	1130.4	1695.7	3157.5	4755.7	7893.6	2105.0	3196.4	3683.7	6314.9	6821.7
15000	6331	223.1	550.5	807.0	1209.4	1814.2	3378.1	5088.0	8445.3	2252.1	3419.8	3941.1	6756.2	7298.4
16000	6457	237.7	586.4	859.6	1288.3	1932.4	3598.3	5419.7	8995.8	2398.9	3642.7	4198.0	7196.6	7774.1
17000	6583	252.2	622.2	912.1	1367.0	2050.5	3818.1	5750.7	9545.3	2545.4	3865.3	4454.5	7636.2	8249.0
18000	6707	266.7	658.0	964.5	1445.5	2168.3	4037.5	6081.2	10093.8	2691.7	4087.4	4710.4	8075.0	8723.0
19000	6832	281.1	693.7	1016.8	1524.0	2285.9	4256.6	6411.1	10641.4	2837.7	4309.1	4966.0	8513.1	9196.3
20000	6956	295.6	729.3	1069.1	1602.3	2403.4	4475.3	6740.6	11188.2	2983.5	4530.5	5221.2	8950.6	9668.8

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **4600 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	4734	15.8	38.9	57.0	85.4	128.1	238.5	359.2	596.2	159.0	241.4	278.2	476.9	515.2
2000	4868	31.4	77.5	113.7	170.4	255.5	475.8	716.7	1189.6	317.2	481.7	555.2	951.7	1028.1
3000	5003	47.0	116.1	170.1	255.0	382.5	712.2	1072.7	1780.5	474.8	721.0	830.9	1424.4	1538.7
4000	5137	62.6	154.4	226.4	339.3	508.9	947.6	1427.2	2369.0	631.7	959.3	1105.5	1895.2	2047.3
5000	5270	78.1	192.6	282.4	423.2	634.8	1182.1	1780.4	2955.2	788.0	1196.7	1379.1	2364.1	2553.9
6000	5404	93.5	230.7	338.2	506.9	760.3	1415.7	2132.3	3539.2	943.8	1433.2	1651.6	2831.4	3058.6
7000	5537	108.9	268.6	393.8	590.2	885.3	1648.5	2482.9	4121.3	1099.0	1668.9	1923.3	3297.0	3561.6
8000	5670	124.2	306.5	449.2	673.3	1009.9	1880.6	2832.4	4701.4	1253.7	1903.8	2194.0	3761.1	4062.9
9000	5803	139.5	344.2	504.5	756.1	1134.2	2111.9	3180.9	5279.7	1407.9	2138.0	2463.9	4223.8	4562.7
10000	5935	154.7	381.8	559.6	838.7	1258.0	2342.6	3528.3	5856.4	1561.7	2371.5	2733.0	4685.1	5061.1
11000	6066	169.9	419.2	614.6	921.1	1381.6	2572.6	3874.8	6431.5	1715.1	2604.4	3001.4	5145.2	5558.1
12000	6198	185.1	456.6	669.4	1003.2	1504.8	2802.0	4220.4	7005.1	1868.0	2836.6	3269.1	5604.1	6053.8
13000	6328	200.2	493.9	724.1	1085.2	1627.7	3030.9	4565.1	7577.4	2020.6	3068.4	3536.1	6061.9	6548.3
14000	6459	215.3	531.1	778.6	1166.9	1750.4	3259.3	4909.1	8148.3	2172.9	3299.6	3802.5	6518.7	7041.8
15000	6589	230.3	568.3	833.1	1248.5	1872.8	3487.2	5252.4	8718.1	2324.8	3530.3	4068.4	6974.5	7534.1
16000	6718	245.4	605.4	887.4	1329.9	1994.9	3714.7	5595.0	9286.7	2476.5	3760.5	4333.8	7429.4	8025.6
17000	6847	260.3	642.4	941.6	1411.2	2116.9	3941.7	5936.9	9854.3	2627.8	3990.4	4598.7	7883.5	8516.1
18000	6976	275.3	679.3	995.8	1492.4	2238.6	4168.4	6278.3	10421.0	2778.9	4219.8	4863.1	8336.8	9005.8
19000	7104	290.3	716.2	1049.8	1573.4	2360.1	4394.7	6619.1	10986.7	2929.8	4448.9	5127.1	8789.3	9494.7
20000	7231	305.2	753.0	1103.8	1654.3	2481.5	4620.6	6959.5	11551.6	3080.4	4677.7	5390.7	9241.3	9982.9

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **4800 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	4938	16.2	40.0	58.7	87.9	131.9	245.6	369.9	614.0	163.7	248.6	286.5	491.2	530.6
2000	5076	32.4	79.9	117.1	175.5	263.2	490.1	738.2	1225.2	326.7	496.1	571.8	980.2	1058.9
3000	5215	48.5	119.5	175.2	262.6	394.0	733.6	1104.9	1833.9	489.0	742.6	855.8	1467.1	1584.9
4000	5352	64.5	159.1	233.2	349.5	524.2	976.1	1470.1	2440.2	650.7	988.1	1138.7	1952.1	2108.8
5000	5490	80.4	198.4	290.9	435.9	653.9	1217.6	1834.0	3044.1	811.8	1232.7	1420.6	2435.3	2630.7
6000	5627	96.3	237.7	348.4	522.1	783.2	1458.4	2196.5	3645.9	972.2	1476.4	1701.4	2916.7	3150.8
7000	5764	112.2	276.8	405.7	608.0	912.0	1698.3	2557.9	4245.7	1132.2	1719.2	1981.3	3396.5	3669.1
8000	5901	128.0	315.7	462.8	693.6	1040.5	1937.4	2918.1	4843.5	1291.6	1961.3	2260.3	3874.8	4185.7
9000	6037	143.7	354.6	519.8	779.0	1168.5	2175.8	3277.2	5439.6	1450.6	2202.7	2538.5	4351.7	4700.9
10000	6173	159.4	393.3	576.6	864.1	1296.2	2413.6	3635.3	6033.9	1609.0	2443.4	2815.8	4827.1	5214.5
11000	6308	175.1	432.0	633.2	949.0	1423.5	2650.7	3992.4	6626.7	1767.1	2683.4	3092.5	5301.4	5726.8
12000	6443	190.7	470.5	689.7	1033.7	1550.5	2887.2	4348.6	7218.1	1924.8	2922.9	3368.4	5774.4	6237.8
13000	6577	206.3	509.0	746.1	1118.2	1677.3	3123.2	4704.1	7808.0	2082.1	3161.8	3643.7	6246.4	6747.6
14000	6711	221.8	547.3	802.3	1202.5	1803.7	3358.7	5058.7	8396.6	2239.1	3400.1	3918.4	6717.3	7256.4
15000	6845	237.4	585.6	858.5	1286.6	1929.9	3593.6	5412.6	8984.1	2395.8	3638.0	4192.6	7187.3	7764.0
16000	6977	252.8	623.8	914.5	1370.6	2055.9	3828.2	5765.9	9570.4	2552.1	3875.4	4466.2	7656.3	8270.7
17000	7110	268.3	662.0	970.4	1454.4	2181.6	4062.3	6118.5	10155.7	2708.2	4112.4	4739.3	8124.6	8776.5
18000	7242	283.7	700.1	1026.3	1538.1	2307.1	4296.0	6470.5	10740.0	2864.0	4349.0	5012.0	8592.0	9281.5
19000	7373	299.2	738.1	1082.0	1621.6	2432.4	4529.4	6822.0	11323.4	3019.6	4585.3	5284.3	9058.8	9785.7
20000	7504	314.6	776.1	1137.7	1705.1	2557.6	4762.4	7173.0	11906.0	3174.9	4821.2	5556.2	9524.8	10289.2

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **5000 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	5142	16.7	41.2	60.3	90.4	135.6	252.5	380.4	631.4	168.4	255.7	294.6	505.1	545.6
2000	5284	33.3	82.1	120.4	180.4	270.7	504.0	759.1	1260.0	336.0	510.2	588.0	1008.0	1088.9
3000	5426	49.8	122.9	180.2	270.1	405.1	754.4	1136.2	1886.0	502.9	763.7	880.1	1508.8	1629.9
4000	5568	66.3	163.6	239.8	359.4	539.1	1003.8	1511.9	2509.5	669.2	1016.2	1171.1	2007.6	2168.7
5000	5709	82.7	204.1	299.2	448.4	672.5	1252.3	1886.2	3130.8	834.9	1267.8	1461.0	2504.6	2705.6
6000	5850	99.1	244.4	358.3	537.0	805.5	1500.0	2259.2	3749.9	1000.0	1518.5	1749.9	2999.9	3240.6
7000	5991	115.4	284.7	417.3	625.4	938.1	1746.8	2630.9	4366.9	1164.5	1768.3	2037.9	3493.6	3773.9
8000	6131	131.6	324.8	476.1	713.5	1070.2	1992.8	3001.5	4982.1	1328.6	2017.4	2325.0	3985.7	4305.5
9000	6271	147.8	364.7	534.7	801.3	1202.0	2238.2	3371.1	5595.4	1492.1	2265.8	2611.2	4476.3	4835.5
10000	6410	164.0	404.6	593.1	888.9	1333.4	2482.8	3739.6	6207.1	1655.2	2513.5	2896.6	4965.6	5364.1
11000	6549	180.1	444.4	651.4	976.3	1464.4	2726.8	4107.1	6817.1	1817.9	2760.5	3181.3	5453.7	5891.3
12000	6687	196.2	484.0	709.6	1063.4	1595.2	2970.3	4473.8	7425.7	1980.2	3007.0	3465.3	5940.6	6417.3
13000	6825	212.2	523.6	767.6	1150.4	1725.6	3213.2	4839.6	8032.9	2142.1	3252.8	3748.7	6426.3	6942.0
14000	6962	228.2	563.1	825.5	1237.2	1855.8	3455.5	5204.6	8638.9	2303.7	3498.2	4031.5	6911.1	7465.7
15000	7099	244.2	602.5	883.3	1323.8	1985.7	3697.4	5569.0	9243.6	2465.0	3743.1	4313.7	7394.9	7988.3
16000	7235	260.2	641.9	941.0	1410.2	2115.3	3938.9	5932.6	9847.2	2625.9	3987.5	4595.4	7877.8	8509.9
17000	7371	276.1	681.2	998.5	1496.5	2244.8	4179.9	6295.7	10449.8	2786.6	4231.5	4876.6	8359.8	9030.7
18000	7506	292.0	720.4	1056.0	1582.7	2374.0	4420.5	6658.1	11051.3	2947.0	4475.1	5157.3	8841.1	9550.6
19000	7640	307.8	759.5	1113.4	1668.7	2503.0	4660.8	7020.0	11652.0	3107.2	4718.4	5437.6	9321.6	10069.7
20000	7774	323.7	798.6	1170.7	1754.6	2631.9	4900.8	7381.4	12251.9	3267.2	4961.3	5717.6	9801.5	10588.1

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **5200 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	5346	17.1	42.3	61.9	92.8	139.3	259.3	390.6	648.3	172.9	262.5	302.5	518.6	560.3
2000	5492	34.2	84.3	123.6	185.3	277.9	517.5	779.5	1293.8	345.0	523.9	603.8	1035.1	1118.1
3000	5637	51.2	126.2	185.1	277.4	416.0	774.7	1166.8	1936.7	516.5	784.3	903.8	1549.4	1673.7
4000	5783	68.1	168.0	246.3	369.1	553.6	1030.9	1552.7	2577.2	687.2	1043.6	1202.7	2061.7	2227.2
5000	5928	84.9	209.6	307.2	460.5	690.7	1286.1	1937.1	3215.3	857.4	1302.0	1500.5	2572.3	2778.7
6000	6072	101.8	251.0	368.0	551.5	827.3	1540.5	2320.3	3851.3	1027.0	1559.5	1797.3	3081.0	3328.3
7000	6216	118.5	292.4	428.6	642.3	963.5	1794.1	2702.2	4485.2	1196.1	1816.2	2093.1	3588.2	3876.1
8000	6360	135.2	333.6	489.0	732.8	1099.3	2046.9	3083.0	5117.2	1364.6	2072.2	2388.0	4093.8	4422.3
9000	6503	151.8	374.6	549.2	823.1	1234.6	2299.0	3462.6	5747.4	1532.6	2327.3	2682.1	4597.9	4966.9
10000	6646	168.5	415.6	609.3	913.1	1369.6	2550.4	3841.3	6375.9	1700.2	2581.9	2975.4	5100.7	5510.1
11000	6788	185.0	456.5	669.2	1002.9	1504.3	2801.1	4219.0	7002.9	1867.4	2835.7	3268.0	5602.3	6051.8
12000	6930	201.5	497.3	728.9	1092.4	1638.7	3051.3	4595.8	7628.3	2034.2	3089.0	3559.9	6102.7	6592.4
13000	7071	218.0	537.9	788.6	1181.8	1772.7	3301.0	4971.8	8252.4	2200.6	3341.7	3851.1	6601.9	7131.7
14000	7212	234.5	578.5	848.1	1271.0	1906.5	3550.1	5347.0	8875.2	2366.7	3593.9	4141.8	7100.2	7669.9
15000	7352	250.9	619.1	907.5	1360.0	2040.1	3798.7	5721.5	9496.8	2532.5	3845.6	4431.8	7597.4	8207.1
16000	7491	267.3	659.5	966.8	1448.9	2173.3	4046.9	6095.3	10117.3	2697.9	4096.9	4721.4	8093.8	8743.3
17000	7630	283.7	699.9	1026.0	1537.6	2306.4	4294.7	6468.5	10736.7	2863.1	4347.7	5010.5	8589.4	9278.6
18000	7768	300.0	740.2	1085.1	1626.2	2439.3	4542.1	6841.1	11355.2	3028.0	4598.1	5299.1	9084.1	9813.1
19000	7906	316.3	780.4	1144.1	1714.6	2571.9	4789.1	7213.2	11972.7	3192.7	4848.2	5587.3	9578.2	10346.8
20000	8042	332.6	820.6	1203.0	1802.9	2704.4	5035.8	7584.8	12589.5	3357.2	5098.0	5875.1	10071.6	10879.8

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **5400 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	5549	17.6	43.3	63.5	95.2	142.8	265.9	400.5	664.8	177.3	269.2	310.2	531.8	574.5
2000	5699	35.1	86.5	126.8	190.0	285.0	530.7	799.4	1326.8	353.8	537.3	619.2	1061.5	1146.6
3000	5848	52.5	129.5	189.8	284.4	426.7	794.5	1196.6	1986.2	529.7	804.3	926.9	1589.0	1716.5
4000	5997	69.8	172.3	252.6	378.5	567.8	1057.3	1592.4	2643.1	704.8	1070.3	1233.5	2114.5	2284.2
5000	6146	87.1	215.0	315.1	472.3	708.4	1319.1	1986.8	3297.8	879.4	1335.4	1539.0	2638.2	2849.9
6000	6294	104.4	257.5	377.5	565.7	848.6	1580.1	2379.9	3950.2	1053.4	1599.6	1843.4	3160.1	3413.7
7000	6441	121.5	299.9	439.6	658.8	988.3	1840.2	2771.7	4600.6	1226.8	1862.9	2146.9	3680.5	3975.8
8000	6588	138.7	342.2	501.6	751.7	1127.6	2099.6	3162.4	5249.0	1399.7	2125.5	2449.5	4199.2	4536.2
9000	6735	155.8	384.3	563.4	844.3	1266.5	2358.3	3552.0	5895.7	1572.2	2387.4	2751.3	4716.6	5095.0
10000	6881	172.8	426.4	625.0	936.7	1405.0	2616.3	3940.6	6540.7	1744.2	2648.6	3052.3	5232.5	5652.4
11000	7027	189.8	468.3	686.5	1028.8	1543.2	2873.6	4328.2	7184.1	1915.8	2909.1	3352.6	5747.3	6208.5
12000	7171	206.8	510.1	747.8	1120.8	1681.1	3130.4	4714.9	7826.0	2086.9	3169.0	3652.1	6260.8	6763.2
13000	7316	223.7	551.9	809.0	1212.5	1818.7	3386.6	5100.8	8466.6	2257.7	3428.4	3951.1	6773.2	7316.8
14000	7460	240.6	593.6	870.1	1304.0	1956.1	3642.3	5486.0	9105.8	2428.2	3687.3	4249.4	7284.7	7869.2
15000	7603	257.4	635.2	931.1	1395.4	2093.1	3897.6	5870.4	9743.9	2598.4	3945.7	4547.2	7795.1	8420.7
16000	7745	274.3	676.7	992.0	1486.6	2230.0	4152.4	6254.2	10380.9	2768.2	4203.6	4844.4	8304.7	8971.1
17000	7887	291.1	718.1	1052.7	1577.7	2366.6	4406.7	6637.3	11016.8	2937.8	4461.1	5141.2	8813.5	9520.7
18000	8028	307.8	759.5	1113.4	1668.7	2503.0	4660.7	7019.8	11651.8	3107.1	4718.3	5437.5	9321.4	10069.4
19000	8169	324.6	800.9	1174.0	1759.5	2639.2	4914.3	7401.8	12285.8	3276.2	4975.0	5733.4	9828.7	10617.4
20000	8309	341.3	842.1	1234.5	1850.1	2775.2	5167.6	7783.4	12919.1	3445.1	5231.4	6028.9	10335.3	11164.6

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **5600 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	5753	18.0	44.4	65.1	97.5	146.3	272.4	410.2	680.9	181.6	275.7	317.8	544.7	588.4
2000	5906	35.9	88.6	129.9	194.6	291.9	543.6	818.8	1359.0	362.4	550.3	634.2	1087.2	1174.4
3000	6059	53.8	132.6	194.4	291.4	437.0	813.8	1225.7	2034.5	542.5	823.8	949.4	1627.6	1758.2
4000	6211	71.5	176.5	258.7	387.7	581.6	1083.0	1631.2	2707.5	722.0	1096.4	1263.5	2166.0	2339.8
5000	6363	89.3	220.2	322.8	483.8	725.7	1351.3	2035.2	3378.2	900.8	1368.0	1576.5	2702.5	2919.4
6000	6515	106.9	263.8	386.7	579.5	869.3	1618.7	2438.0	4046.7	1079.1	1638.7	1888.4	3237.3	3497.1
7000	6666	124.5	307.2	450.4	675.0	1012.5	1885.3	2839.5	4713.1	1256.8	1908.5	2199.5	3770.5	4073.1
8000	6816	142.1	350.5	513.9	770.1	1155.2	2151.1	3239.9	5377.7	1434.0	2177.6	2509.6	4302.1	4647.4
9000	6966	159.6	393.7	577.2	865.0	1297.6	2416.2	3639.2	6040.4	1610.8	2446.0	2818.9	4832.3	5220.1
10000	7115	177.1	436.8	640.4	959.7	1439.6	2680.6	4037.4	6701.5	1787.1	2713.7	3127.4	5361.2	5791.4
11000	7264	194.5	479.8	703.4	1054.2	1581.2	2944.4	4434.7	7361.0	1962.9	2980.7	3435.1	5888.8	6361.3
12000	7412	211.9	522.7	766.3	1148.4	1722.6	3207.6	4831.2	8019.0	2138.4	3247.2	3742.2	6415.2	6930.0
13000	7559	229.2	565.5	829.0	1242.4	1863.7	3470.3	5226.8	8675.6	2313.5	3513.1	4048.6	6940.5	7497.5
14000	7706	246.5	608.2	891.6	1336.3	2004.4	3732.4	5621.7	9331.0	2488.3	3778.5	4354.5	7464.8	8063.8
15000	7852	263.8	650.9	954.1	1430.0	2145.0	3994.1	6015.8	9985.2	2662.7	4043.4	4659.8	7988.2	8629.2
16000	7998	281.1	693.5	1016.5	1523.5	2285.3	4255.3	6409.2	10638.3	2836.9	4307.8	4964.5	8510.6	9193.6
17000	8143	298.3	736.0	1078.9	1616.9	2425.3	4516.1	6802.1	11290.3	3010.8	4571.9	5268.8	9032.3	9757.1
18000	8287	315.5	778.4	1141.1	1710.1	2565.2	4776.6	7194.3	11941.4	3184.4	4835.5	5572.7	9553.1	10319.8
19000	8430	332.7	820.8	1203.2	1803.2	2704.9	5036.6	7586.1	12591.6	3357.8	5098.8	5876.1	10073.3	10881.6
20000	8573	349.8	863.1	1265.2	1896.2	2844.4	5296.4	7977.3	13241.0	3530.9	5361.8	6179.1	10592.8	11442.8

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **5800 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	5957	18.4	45.4	66.6	99.8	149.6	278.6	419.7	696.6	185.8	282.1	325.1	557.3	602.0
2000	6113	36.7	90.6	132.9	199.1	298.7	556.2	837.7	1390.4	370.8	563.0	648.9	1112.3	1201.6
3000	6269	55.0	135.7	198.9	298.1	447.2	832.6	1254.1	2081.6	555.1	842.9	971.4	1665.3	1798.9
4000	6425	73.2	180.6	264.7	396.7	595.1	1108.1	1669.0	2770.3	738.7	1121.8	1292.8	2216.2	2394.1
5000	6580	91.3	225.3	330.3	495.0	742.5	1382.7	2082.5	3456.7	921.8	1399.7	1613.1	2765.3	2987.2
6000	6735	109.4	269.9	395.7	593.0	889.5	1656.3	2494.7	4140.9	1104.2	1676.8	1932.4	3312.7	3578.5
7000	6889	127.4	314.4	460.9	690.7	1036.1	1929.2	2905.7	4823.0	1286.1	1953.0	2250.7	3858.4	4168.0
8000	7043	145.4	358.7	525.9	788.1	1182.2	2201.3	3315.5	5503.2	1467.5	2228.5	2568.2	4402.6	4755.9
9000	7196	163.3	403.0	590.7	885.3	1327.9	2472.7	3724.3	6181.7	1648.4	2503.2	2884.8	4945.3	5342.2
10000	7348	181.2	447.1	655.4	982.2	1473.3	2743.4	4132.0	6858.5	1828.9	2777.2	3200.6	5486.8	5927.1
11000	7500	199.0	491.1	719.9	1078.9	1618.3	3013.5	4538.8	7533.7	2009.0	3050.7	3515.7	6026.9	6510.6
12000	7651	216.8	535.0	784.3	1175.4	1763.1	3283.0	4944.7	8207.4	2188.6	3323.5	3830.1	6565.9	7092.8
13000	7802	234.6	578.8	848.5	1271.7	1907.5	3551.9	5349.8	8879.8	2367.9	3595.8	4143.9	7103.8	7673.9
14000	7952	252.3	622.6	912.6	1367.8	2051.7	3820.4	5754.1	9550.9	2546.9	3867.5	4457.1	7640.7	8253.9
15000	8101	270.0	666.2	976.7	1463.7	2195.6	4088.3	6157.7	10220.8	2725.6	4138.8	4769.7	8176.7	8832.8
16000	8249	287.7	709.8	1040.6	1559.5	2339.3	4355.9	6560.7	10889.7	2903.9	4409.6	5081.8	8711.7	9410.8
17000	8397	305.3	753.4	1104.4	1655.1	2482.7	4623.0	6963.0	11557.5	3082.0	4680.1	5393.5	9246.0	9987.9
18000	8544	323.0	796.8	1168.1	1750.6	2626.0	4889.7	7364.8	12224.3	3259.8	4950.1	5704.7	9779.5	10564.2
19000	8690	340.6	840.3	1231.7	1846.0	2769.0	5156.1	7766.0	12890.3	3437.4	5219.8	6015.5	10312.2	11139.8
20000	8836	358.1	883.6	1295.3	1941.3	2911.9	5422.2	8166.7	13555.4	3614.8	5489.1	6325.9	10844.3	11714.6

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **6000 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	6160	18.8	46.4	68.0	102.0	152.9	284.8	428.9	711.9	189.8	288.3	332.2	569.5	615.2
2000	6320	37.5	92.6	135.8	203.5	305.3	568.4	856.1	1421.1	378.9	575.4	663.2	1136.8	1228.1
3000	6479	56.2	138.7	203.3	304.7	457.0	851.0	1281.8	2127.6	567.3	861.5	992.9	1702.0	1838.6
4000	6639	74.8	184.6	270.6	405.5	608.3	1132.6	1705.9	2831.6	755.1	1146.6	1321.4	2265.3	2447.0
5000	6797	93.3	230.3	337.6	506.0	759.0	1413.3	2128.7	3533.3	942.2	1430.8	1648.9	2826.6	3053.4
6000	6955	111.8	275.9	404.5	606.2	909.3	1693.1	2550.1	4232.8	1128.7	1714.0	1975.3	3386.2	3658.0
7000	7112	130.3	321.4	471.1	706.1	1059.1	1972.1	2970.3	4930.3	1314.7	1996.5	2300.8	3944.2	4260.7
8000	7269	148.6	366.7	537.6	805.7	1208.5	2250.3	3389.4	5625.8	1500.2	2278.1	2625.4	4500.7	4861.8
9000	7425	167.0	411.9	603.9	905.0	1357.6	2527.9	3807.4	6319.6	1685.2	2559.1	2949.2	5055.7	5461.4
10000	7581	185.2	457.1	670.0	1004.2	1506.2	2804.7	4224.4	7011.8	1869.8	2839.3	3272.2	5609.4	6059.5
11000	7736	203.5	502.1	736.0	1103.0	1654.6	3080.9	4640.4	7702.3	2054.0	3119.0	3594.4	6161.9	6656.3
12000	7890	221.7	547.0	801.8	1201.7	1802.6	3356.6	5055.6	8391.4	2237.7	3398.0	3916.0	6713.1	7251.9
13000	8043	239.9	591.8	867.6	1300.2	1950.3	3631.7	5469.9	9079.2	2421.1	3676.5	4237.0	7263.4	7846.2
14000	8196	258.0	636.6	933.2	1398.5	2097.8	3906.3	5883.5	9765.7	2604.2	3954.5	4557.3	7812.6	8439.5
15000	8348	276.1	681.3	998.7	1496.7	2245.0	4180.4	6296.4	10451.0	2786.9	4232.0	4877.2	8360.8	9031.8
16000	8499	294.2	725.9	1064.0	1594.7	2392.0	4454.1	6708.7	11135.3	2969.4	4509.1	5196.5	8908.2	9623.1
17000	8650	312.2	770.4	1129.3	1692.5	2538.8	4727.4	7120.3	11818.5	3151.6	4785.8	5515.3	9454.8	10213.5
18000	8799	330.3	814.9	1194.5	1790.2	2685.3	5000.3	7531.3	12500.8	3333.5	5062.0	5833.7	10000.6	10803.1
19000	8948	348.3	859.3	1259.6	1887.8	2831.7	5272.9	7941.8	13182.2	3515.2	5338.0	6151.7	10545.7	11392.0
20000	9097	366.2	903.6	1324.7	1985.3	2977.9	5545.1	8351.9	13862.7	3696.7	5613.5	6469.3	11090.2	11980.1

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **6200 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	6363	19.2	47.4	69.5	104.1	156.1	290.8	437.9	726.9	193.8	294.3	339.2	581.5	628.2
2000	6527	38.3	94.6	138.6	207.8	311.7	580.4	874.2	1451.0	386.9	587.6	677.1	1160.8	1253.9
3000	6689	57.4	141.6	207.6	311.1	466.7	869.0	1308.8	2172.4	579.3	879.7	1013.8	1737.9	1877.4
4000	6852	76.4	188.5	276.3	414.1	621.1	1156.6	1742.0	2891.4	771.0	1170.8	1349.3	2313.1	2498.8
5000	7013	95.3	235.2	344.8	516.7	775.1	1443.2	2173.8	3608.1	962.2	1461.0	1683.8	2886.5	3118.1
6000	7174	114.2	281.8	413.0	619.0	928.6	1729.0	2604.2	4322.6	1152.7	1750.4	2017.2	3458.1	3735.6
7000	7335	133.0	328.2	481.1	721.1	1081.6	2014.0	3033.5	5035.0	1342.7	2038.9	2349.7	4028.0	4351.3
8000	7495	151.8	374.5	549.0	822.8	1234.2	2298.2	3461.5	5745.6	1532.2	2326.6	2681.3	4596.5	4965.3
9000	7654	170.5	420.7	616.8	924.3	1386.5	2581.7	3888.6	6454.4	1721.2	2613.6	3012.0	5163.5	5577.9
10000	7812	189.2	466.8	684.3	1025.6	1538.4	2864.6	4314.6	7161.5	1909.7	2900.0	3342.0	5729.2	6189.0
11000	7970	207.8	512.8	751.7	1126.6	1690.0	3146.8	4739.7	7867.1	2097.9	3185.7	3671.3	6293.7	6798.7
12000	8127	226.4	558.7	819.0	1227.5	1841.2	3428.5	5163.9	8571.2	2285.7	3470.8	3999.9	6857.0	7407.2
13000	8283	245.0	604.5	886.2	1328.1	1992.2	3709.6	5587.3	9274.0	2473.1	3755.4	4327.9	7419.2	8014.6
14000	8439	263.6	650.3	953.2	1428.6	2142.9	3990.2	6010.0	9975.6	2660.2	4039.5	4655.3	7980.5	8620.9
15000	8594	282.1	695.9	1020.1	1528.9	2293.4	4270.4	6431.9	10676.0	2846.9	4323.1	4982.1	8540.8	9226.2
16000	8748	300.5	741.5	1087.0	1629.1	2443.6	4550.1	6853.2	11375.3	3033.4	4606.3	5308.5	9100.2	9830.5
17000	8901	319.0	787.0	1153.7	1729.1	2593.6	4829.4	7273.9	12073.6	3219.6	4889.0	5634.3	9658.8	10433.9
18000	9053	337.4	832.5	1220.3	1828.9	2743.4	5108.4	7694.1	12770.9	3405.6	5171.4	5959.8	10216.7	11036.6
19000	9205	355.8	877.9	1286.9	1928.7	2893.0	5387.0	8113.7	13467.4	3591.3	5453.5	6284.8	10773.9	11638.5
20000	9356	374.2	923.2	1353.4	2028.3	3042.4	5665.2	8532.8	14163.0	3776.8	5735.2	6609.4	11330.4	12239.7

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **6400 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	6567	19.6	48.3	70.9	106.2	159.3	296.6	446.7	741.5	197.7	300.3	346.0	593.2	640.8
2000	6733	39.1	96.5	141.4	212.0	318.0	592.1	891.8	1480.2	394.7	599.4	690.8	1184.2	1279.2
3000	6899	58.6	144.5	211.8	317.4	476.1	886.5	1335.2	2216.3	591.0	897.5	1034.3	1773.0	1915.3
4000	7064	77.9	192.3	281.9	422.5	633.7	1179.9	1777.2	2949.9	786.6	1194.5	1376.6	2359.9	2549.3
5000	7229	97.3	240.0	351.8	527.2	790.8	1472.5	2217.8	3681.2	981.6	1490.6	1717.9	2944.9	3181.2
6000	7393	116.5	287.5	421.4	631.6	947.4	1764.1	2657.1	4410.3	1176.1	1785.9	2058.1	3528.2	3811.3
7000	7557	135.7	334.9	490.9	735.7	1103.6	2054.9	3095.1	5137.4	1370.0	2080.3	2397.4	4109.9	4439.7
8000	7720	154.9	382.2	560.2	839.6	1259.4	2345.0	3532.0	5862.6	1563.4	2374.0	2735.9	4690.1	5066.4
9000	7882	174.0	429.3	629.3	943.2	1414.8	2634.4	3967.9	6586.0	1756.3	2666.9	3073.5	5268.8	5691.6
10000	8043	193.1	476.4	698.3	1046.6	1569.8	2923.1	4402.7	7307.8	1948.8	2959.2	3410.3	5846.3	6315.4
11000	8203	212.1	523.3	767.1	1149.7	1724.6	3211.2	4836.7	8028.1	2140.8	3250.9	3746.4	6422.5	6937.8
12000	8363	231.1	570.2	835.8	1252.6	1879.0	3498.8	5269.7	8746.9	2332.5	3542.0	4081.9	6997.5	7559.1
13000	8522	250.0	616.9	904.4	1355.4	2033.1	3785.8	5702.0	9464.4	2523.8	3832.5	4416.7	7571.5	8179.1
14000	8681	269.0	663.6	972.8	1458.0	2187.0	4072.3	6133.6	10180.7	2714.9	4122.6	4751.0	8144.6	8798.1
15000	8838	287.9	710.2	1041.2	1560.4	2340.6	4358.3	6564.4	10895.8	2905.6	4412.1	5084.7	8716.7	9416.1
16000	8995	306.7	756.8	1109.4	1662.6	2494.0	4643.9	6994.6	11609.8	3096.0	4701.3	5417.9	9287.9	10033.2
17000	9151	325.6	803.3	1177.5	1764.8	2647.1	4929.2	7424.2	12322.9	3286.1	4990.0	5750.7	9858.3	10649.4
18000	9306	344.4	849.7	1245.6	1866.7	2800.1	5214.0	7853.2	13035.0	3476.0	5278.4	6083.0	10428.0	11264.8
19000	9460	363.2	896.1	1313.5	1968.6	2952.9	5498.5	8281.7	13746.3	3665.7	5566.4	6414.9	10997.0	11879.5
20000	9611	381.7	941.8	1380.6	2069.2	3103.8	5779.4	8704.8	14448.5	3852.9	5850.7	6742.6	11558.8	12486.4

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **6600 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	6770	20.0	49.3	72.2	108.2	162.4	302.3	455.3	755.8	201.5	306.0	352.7	604.6	653.1
2000	6939	39.9	98.3	144.2	216.1	324.1	603.5	909.0	1508.7	402.3	610.9	704.1	1207.0	1303.9
3000	7108	59.7	147.3	215.9	323.5	485.3	903.6	1361.0	2259.1	602.4	914.8	1054.2	1807.3	1952.3
4000	7277	79.4	196.0	287.3	430.6	645.9	1202.8	1811.6	3007.0	801.9	1217.6	1403.3	2405.6	2598.6
5000	7445	99.1	244.6	358.6	537.4	806.1	1501.0	2260.8	3752.5	1000.7	1519.5	1751.2	3002.0	3242.9
6000	7612	118.8	293.1	429.6	643.9	965.8	1798.4	2708.7	4496.0	1198.9	1820.6	2098.1	3596.8	3885.4
7000	7778	138.4	341.4	500.5	750.0	1125.1	2094.9	3155.4	5237.4	1396.6	2120.8	2444.1	4189.9	4526.1
8000	7944	157.9	389.6	571.1	856.0	1283.9	2390.8	3600.9	5976.9	1593.8	2420.3	2789.2	4781.5	5165.2
9000	8109	177.4	437.7	641.6	961.6	1442.4	2685.9	4045.4	6714.7	1790.6	2719.0	3133.5	5371.7	5802.8
10000	8273	196.8	485.7	712.0	1067.0	1600.5	2980.3	4488.9	7450.8	1986.9	3017.1	3477.0	5960.7	6439.0
11000	8436	216.3	533.6	782.2	1172.2	1758.4	3274.2	4931.5	8185.4	2182.8	3314.6	3819.9	6548.4	7073.8
12000	8599	235.6	581.4	852.2	1277.2	1915.9	3567.5	5373.2	8918.7	2378.3	3611.5	4162.0	7134.9	7707.5
13000	8760	255.0	629.1	922.2	1382.1	2073.1	3860.2	5814.1	9650.5	2573.5	3907.9	4503.6	7720.4	8340.0
14000	8921	274.3	676.7	992.0	1486.7	2230.0	4152.5	6254.4	10381.2	2768.3	4203.7	4844.6	8305.0	8971.4
15000	9081	293.5	724.3	1061.7	1591.2	2386.8	4444.3	6693.9	11110.7	2962.9	4499.2	5185.0	8888.6	9601.9
16000	9241	312.8	771.7	1131.3	1695.5	2543.2	4735.7	7132.8	11839.2	3157.1	4794.1	5525.0	9471.4	10231.4
17000	9398	331.9	818.8	1200.3	1798.9	2698.4	5024.6	7567.9	12561.5	3349.7	5086.6	5862.0	10049.2	10855.6
18000	9554	350.9	865.7	1269.1	1901.9	2852.9	5312.3	8001.3	13280.8	3541.6	5377.9	6197.7	10624.6	11477.2
19000	9708	369.8	912.5	1337.7	2004.8	3007.2	5599.5	8433.9	13998.8	3733.0	5668.7	6532.8	11199.0	12097.7
20000	9862	388.8	959.2	1406.2	2107.4	3161.1	5886.2	8865.7	14715.6	3924.1	5958.9	6867.3	11772.4	12717.1

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **6800 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	6973	20.3	50.2	73.6	110.2	165.3	307.9	463.7	769.7	205.3	311.7	359.2	615.8	665.2
2000	7146	40.6	100.2	146.8	220.1	330.1	614.7	925.8	1536.6	409.8	622.2	717.1	1229.3	1328.0
3000	7318	60.8	150.0	219.9	329.5	494.3	920.4	1386.2	2300.9	613.6	931.7	1073.8	1840.7	1988.5
4000	7489	80.9	199.6	292.7	438.6	657.9	1225.1	1845.2	3062.8	816.7	1240.2	1429.3	2450.2	2646.8
5000	7660	101.0	249.2	365.2	547.4	821.1	1528.9	2302.8	3822.3	1019.3	1547.8	1783.7	3057.8	3303.2
6000	7830	121.0	298.5	437.6	655.9	983.8	1831.9	2759.1	4579.7	1221.3	1854.5	2137.2	3663.8	3957.8
7000	7999	141.0	347.8	509.8	764.0	1146.1	2134.0	3214.2	5335.1	1422.7	2160.4	2489.7	4268.1	4610.6
8000	8167	160.9	396.9	581.8	872.0	1307.9	2435.5	3668.2	6088.6	1623.6	2465.5	2841.4	4870.9	5261.8
9000	8335	180.7	445.9	653.6	979.6	1469.4	2736.2	4121.2	6840.4	1824.1	2770.0	3192.2	5472.4	5911.5
10000	8502	200.5	494.8	725.3	1087.1	1630.6	3036.2	4573.1	7590.6	2024.2	3073.7	3542.3	6072.5	6559.8
11000	8668	220.3	543.6	796.9	1194.3	1791.4	3335.7	5024.2	8339.3	2223.8	3376.9	3891.7	6671.4	7206.8
12000	8833	240.1	592.3	868.3	1301.3	1951.9	3634.6	5474.4	9086.6	2423.1	3679.5	4240.4	7269.2	7852.6
13000	8998	259.8	640.9	939.6	1408.1	2112.2	3933.0	5923.8	9832.5	2622.0	3981.6	4588.5	7866.0	8497.2
14000	9161	279.4	689.5	1010.7	1514.8	2272.2	4230.9	6372.5	10577.3	2820.6	4283.2	4936.1	8461.8	9140.9
15000	9322	298.9	737.5	1081.1	1620.2	2430.3	4525.4	6816.1	11313.6	3017.0	4581.3	5279.7	9050.9	9777.2
16000	9482	318.3	785.4	1151.3	1725.5	2588.3	4819.6	7259.2	12049.0	3213.1	4879.1	5622.9	9639.2	10412.7
17000	9641	337.7	833.3	1221.5	1830.6	2745.9	5113.1	7701.3	12782.8	3408.8	5176.3	5965.3	10226.3	11046.9
18000	9798	357.1	881.0	1291.5	1935.5	2903.3	5406.1	8142.5	13515.2	3604.1	5472.8	6307.1	10812.2	11679.8
19000	9955	376.4	928.6	1361.3	2040.2	3060.3	5698.5	8582.9	14246.3	3799.0	5768.9	6648.3	11397.0	12311.6
20000	10111	395.7	976.2	1431.0	2144.7	3217.1	5990.4	9022.6	14976.1	3993.6	6064.4	6988.8	11980.9	12942.3

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **7000 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	7176	20.7	51.1	74.9	112.2	168.3	313.3	471.9	783.3	208.9	317.2	365.6	626.7	677.0
2000	7352	41.3	101.9	149.4	224.0	335.9	625.6	942.2	1563.9	417.0	633.3	729.8	1251.1	1351.5
3000	7527	61.9	152.7	223.8	335.4	503.1	936.7	1410.9	2341.8	624.5	948.3	1092.8	1873.5	2023.8
4000	7701	82.4	203.2	297.9	446.4	669.6	1246.9	1878.1	3117.3	831.3	1262.3	1454.7	2493.8	2694.0
5000	7875	102.8	253.6	371.8	557.2	835.7	1556.2	2343.9	3890.5	1037.5	1575.4	1815.6	3112.4	3362.2
6000	8047	123.2	303.9	445.4	667.6	1001.4	1864.6	2808.5	4661.6	1243.1	1887.7	2175.4	3729.3	4028.5
7000	8219	143.5	354.0	518.9	777.7	1166.6	2172.3	3271.8	5430.7	1448.2	2199.1	2534.3	4344.5	4693.2
8000	8391	163.7	404.0	592.2	887.6	1331.4	2479.2	3734.0	6197.9	1652.8	2509.8	2892.4	4958.3	5356.2
9000	8561	184.0	453.9	665.4	997.2	1495.8	2785.4	4195.2	6963.4	1856.9	2819.8	3249.6	5570.7	6017.8
10000	8730	204.2	503.7	738.4	1106.6	1659.9	3090.9	4655.5	7727.3	2060.6	3129.1	3606.1	6181.9	6677.9
11000	8899	224.3	553.4	811.2	1215.8	1823.7	3395.9	5114.8	8489.7	2263.9	3437.8	3961.9	6791.8	7336.8
12000	9066	244.4	602.9	883.8	1324.6	1986.9	3699.7	5572.4	9249.3	2466.5	3745.4	4316.3	7399.4	7993.2
13000	9232	264.3	652.0	955.8	1432.5	2148.7	4001.1	6026.4	10002.8	2667.4	4050.5	4668.0	8002.2	8644.4
14000	9396	284.1	701.0	1027.6	1540.1	2310.2	4301.7	6479.2	10754.3	2867.8	4354.8	5018.7	8603.5	9293.9
15000	9559	303.9	749.9	1099.3	1647.5	2471.3	4601.6	6930.9	11504.1	3067.8	4658.5	5368.6	9203.3	9941.8
16000	9721	323.7	798.7	1170.8	1754.6	2632.0	4900.9	7381.6	12252.2	3267.3	4961.4	5717.7	9801.8	10588.3
17000	9882	343.4	847.3	1242.1	1861.6	2792.3	5199.5	7831.4	12998.8	3466.3	5263.7	6066.1	10399.0	11233.5
18000	10042	363.1	895.9	1313.3	1968.3	2952.4	5497.6	8280.3	13743.9	3665.0	5565.4	6413.8	10995.1	11877.5
19000	10201	382.8	944.4	1384.4	2074.8	3112.2	5795.1	8728.4	14487.7	3863.4	5866.6	6760.9	11590.2	12520.3
20000	10359	402.4	992.8	1455.3	2181.1	3271.7	6092.1	9175.8	15230.3	4061.4	6167.3	7107.5	12184.2	13162.0

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **7200 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	7379	21.0	51.9	76.1	114.1	171.1	318.7	480.0	796.7	212.4	322.6	371.8	637.3	688.5
2000	7558	42.0	103.7	152.0	227.8	341.7	636.2	958.2	1590.5	424.1	644.1	742.2	1272.4	1374.5
3000	7735	62.9	155.3	227.6	341.1	511.6	952.7	1435.0	2381.8	635.1	964.5	1111.5	1905.4	2058.3
4000	7913	83.8	206.7	303.0	454.1	681.1	1268.3	1910.2	3170.6	845.5	1283.9	1479.6	2536.5	2740.0
5000	8089	104.5	258.0	378.1	566.7	850.1	1582.9	2384.1	3957.2	1055.2	1602.4	1846.7	3165.8	3419.8
6000	8265	125.3	309.1	453.1	679.0	1018.6	1896.7	2856.7	4741.6	1264.4	1920.1	2212.8	3793.3	4097.7
7000	8439	145.9	360.1	527.9	791.1	1186.7	2209.6	3328.1	5524.1	1473.1	2236.9	2577.9	4419.3	4773.9
8000	8613	166.6	411.0	602.5	902.9	1354.4	2521.9	3798.4	6304.7	1681.3	2553.0	2942.2	5043.8	5448.5
9000	8787	187.2	462.0	677.2	1015.0	1522.5	2834.9	4269.9	7087.4	1890.0	2869.9	3307.4	5669.9	6124.9
10000	8958	207.7	512.3	751.1	1125.6	1688.4	3143.9	4735.3	7859.9	2096.0	3182.8	3667.9	6287.9	6792.5
11000	9128	228.0	562.5	824.6	1235.9	1853.9	3452.0	5199.3	8630.0	2301.3	3494.6	4027.3	6904.0	7458.0
12000	9296	248.3	612.6	898.0	1345.9	2018.8	3759.2	5662.0	9397.9	2506.1	3805.6	4385.7	7518.4	8121.7
13000	9464	268.5	662.5	971.2	1455.6	2183.3	4065.5	6123.4	10163.9	2710.4	4115.7	4743.1	8131.1	8783.6
14000	9630	288.7	712.3	1044.2	1565.0	2347.5	4371.1	6583.7	10927.8	2914.1	4425.1	5099.7	8742.3	9443.8
15000	9795	308.8	762.0	1117.0	1674.1	2511.2	4676.0	7042.9	11690.0	3117.3	4733.7	5455.3	9352.0	10102.5
16000	9959	328.9	811.6	1189.7	1783.0	2674.6	4980.2	7501.1	12450.6	3320.2	5041.7	5810.3	9960.5	10759.7
17000	10122	349.0	861.1	1262.2	1891.7	2837.6	5283.8	7958.4	13209.6	3522.6	5349.1	6164.5	10567.7	11415.7
18000	10284	369.0	910.5	1334.6	2000.2	3000.4	5586.9	8414.8	13967.2	3724.6	5655.8	6518.0	11173.7	12070.4
19000	10445	389.0	959.7	1406.9	2108.5	3162.8	5889.4	8870.4	14723.4	3926.2	5962.1	6870.9	11778.7	12723.9
20000	10605	408.9	1009.0	1479.1	2216.7	3325.0	6191.4	9325.3	15478.5	4127.6	6267.8	7223.3	12382.8	13376.4

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **7400 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	7582	21.4	52.8	77.4	116.0	173.9	323.9	487.8	809.7	215.9	327.9	377.8	647.7	699.7
2000	7763	42.7	105.4	154.5	231.5	347.3	646.6	973.9	1616.6	431.1	654.6	754.4	1293.3	1397.0
3000	7944	64.0	157.8	231.3	346.7	520.0	968.4	1458.5	2420.9	645.6	980.3	1129.7	1936.7	2092.1
4000	8124	85.1	210.1	308.0	461.5	692.3	1289.1	1941.6	3222.8	859.4	1305.0	1504.0	2578.2	2785.1
5000	8303	106.3	262.2	384.4	576.0	864.1	1609.0	2423.4	4022.4	1072.6	1628.8	1877.1	3217.9	3476.2
6000	8481	127.3	314.2	460.6	690.3	1035.4	1928.0	2903.9	4819.9	1285.3	1951.8	2249.3	3855.9	4165.4
7000	8660	148.5	366.3	537.0	804.7	1207.1	2247.7	3385.5	5619.3	1498.5	2275.5	2622.3	4495.4	4856.2
8000	8835	169.3	417.8	612.4	917.8	1376.8	2563.6	3861.3	6409.1	1709.1	2595.3	2990.9	5127.3	5538.7
9000	9009	190.1	469.1	687.6	1030.6	1545.8	2878.5	4335.5	7196.2	1919.0	2914.0	3358.2	5756.9	6218.9
10000	9182	210.8	520.2	762.6	1142.9	1714.4	3192.3	4808.2	7980.8	2128.2	3231.7	3724.4	6384.6	6897.0
11000	9354	231.5	571.2	837.4	1254.9	1882.4	3505.2	5279.4	8763.0	2336.8	3548.5	4089.4	7010.4	7573.0
12000	9525	252.1	622.1	911.9	1366.7	2050.0	3817.2	5749.4	9543.0	2544.8	3864.3	4453.4	7634.4	8247.1
13000	9695	272.7	672.8	986.2	1478.1	2217.1	4128.4	6218.1	10321.1	2752.3	4179.4	4816.5	8256.8	8919.4
14000	9863	293.2	723.4	1060.4	1589.2	2383.8	4438.9	6685.7	11097.2	2959.2	4493.7	5178.7	8877.7	9590.2
15000	10031	313.6	773.8	1134.4	1700.1	2550.2	4748.6	7152.2	11871.5	3165.7	4807.2	5540.0	9497.2	10259.3
16000	10197	334.1	824.2	1208.2	1810.8	2716.2	5057.7	7617.7	12644.2	3371.8	5120.1	5900.6	10115.3	10927.1
17000	10362	354.4	874.5	1281.9	1921.2	2881.8	5366.1	8082.3	13415.3	3577.4	5432.4	6260.5	10732.3	11593.5
18000	10525	374.8	924.7	1355.5	2031.4	3047.2	5674.0	8546.1	14185.1	3782.7	5744.1	6619.7	11348.1	12258.7
19000	10688	395.1	974.7	1428.9	2141.5	3212.2	5981.4	9009.0	14953.5	3987.6	6055.3	6978.3	11962.8	12922.8
20000	10850	415.3	1024.8	1502.2	2251.4	3377.1	6288.3	9471.3	15720.8	4192.2	6365.9	7336.4	12576.6	13585.8

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **7600 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	7785	21.7	53.6	78.6	117.8	176.7	329.0	495.5	822.4	219.3	333.0	383.8	657.9	710.7
2000	7969	43.4	107.0	156.9	235.2	352.7	656.8	989.3	1642.1	437.9	664.9	766.3	1313.6	1419.1
3000	8152	65.0	160.3	235.0	352.2	528.3	983.6	1481.5	2459.1	655.8	995.8	1147.6	1967.3	2125.2
4000	8335	86.5	213.4	312.8	468.8	703.3	1309.5	1972.4	3273.8	873.0	1325.7	1527.8	2619.0	2829.2
5000	8518	108.1	266.6	390.8	585.7	878.6	1636.0	2464.1	4090.0	1090.7	1656.2	1908.7	3272.0	3534.6
6000	8698	129.4	319.2	468.0	701.4	1052.0	1959.0	2950.6	4897.5	1306.0	1983.2	2285.5	3918.0	4232.4
7000	8877	150.6	371.7	544.8	816.6	1224.8	2280.8	3435.2	5701.9	1520.5	2308.9	2660.9	4561.5	4927.6
8000	9055	171.8	423.9	621.4	931.4	1397.0	2601.4	3918.1	6503.5	1734.3	2633.5	3034.9	5202.8	5620.3
9000	9231	192.9	476.0	697.8	1045.8	1568.7	2920.9	4399.4	7302.4	1947.3	2957.0	3407.8	5841.9	6310.7
10000	9406	214.0	527.9	773.9	1159.8	1739.7	3239.5	4879.3	8098.8	2159.7	3279.5	3779.4	6479.0	6998.9
11000	9581	234.9	579.7	849.8	1273.5	1910.3	3557.1	5357.7	8892.8	2371.4	3601.0	4150.0	7114.3	7685.2
12000	9753	255.9	631.3	925.4	1386.9	2080.4	3873.9	5834.7	9684.7	2582.6	3921.7	4519.5	7747.8	8369.5
13000	9925	276.7	682.8	1000.9	1500.1	2250.1	4189.8	6310.6	10474.5	2793.2	4241.5	4888.1	8379.6	9052.1
14000	10096	297.6	734.1	1076.2	1612.9	2419.4	4505.0	6785.3	11262.5	3003.3	4560.6	5255.8	9010.0	9733.0
15000	10265	318.3	785.4	1151.3	1725.5	2588.2	4819.5	7259.0	12048.7	3213.0	4879.0	5622.7	9639.0	10412.5
16000	10433	339.1	836.5	1226.3	1837.8	2756.8	5133.3	7731.6	12833.2	3422.2	5196.7	5988.9	10266.6	11090.5
17000	10600	359.7	887.6	1301.1	1950.0	2925.0	5446.5	8203.4	13616.3	3631.0	5513.8	6354.3	10893.0	11767.2
18000	10765	380.4	938.5	1375.8	2061.9	3092.9	5759.2	8674.3	14397.9	3839.4	5830.3	6719.0	11518.3	12442.7
19000	10930	401.0	989.4	1450.4	2173.7	3260.5	6071.3	9144.4	15178.3	4047.5	6146.3	7083.2	12142.6	13117.0
20000	11093	421.6	1040.2	1524.8	2285.3	3427.9	6383.0	9613.9	15957.4	4255.3	6461.8	7446.8	12765.9	13790.4

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **7800 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	7987	22.1	54.4	79.8	119.6	179.3	333.9	503.0	834.9	222.6	338.1	389.6	667.9	721.5
2000	8174	44.0	108.7	159.3	238.7	358.1	666.8	1004.3	1667.0	444.5	675.0	777.9	1333.6	1440.6
3000	8361	66.0	162.9	238.9	358.0	537.0	999.9	1506.0	2499.8	666.6	1012.3	1166.6	1999.8	2160.3
4000	8546	87.9	216.8	317.8	476.2	714.3	1330.2	2003.5	3325.4	886.8	1346.6	1551.9	2660.3	2873.8
5000	8730	109.6	270.4	396.3	594.0	891.0	1659.0	2498.8	4147.6	1106.0	1679.5	1935.6	3318.1	3584.4
6000	8912	131.2	323.7	474.6	711.3	1066.9	1986.6	2992.2	4966.6	1324.4	2011.2	2317.7	3973.3	4292.1
7000	9094	152.8	376.9	552.6	828.1	1242.2	2313.0	3483.8	5782.5	1542.0	2341.6	2698.5	4626.0	4997.2
8000	9274	174.3	429.9	630.2	944.6	1416.8	2638.2	3973.7	6595.6	1758.8	2670.8	3078.0	5276.5	5699.9
9000	9452	195.7	482.8	707.7	1060.6	1590.9	2962.4	4461.9	7406.0	1974.9	2999.0	3456.2	5924.8	6400.3
10000	9630	217.0	535.4	784.9	1176.3	1764.5	3285.6	4948.7	8214.0	2190.4	3326.2	3833.2	6571.2	7098.5
11000	9806	238.3	587.9	861.9	1291.7	1937.5	3607.8	5434.0	9019.6	2405.2	3652.4	4209.1	7215.7	7794.7
12000	9981	259.5	640.3	938.6	1406.8	2110.1	3929.2	5918.1	9823.0	2619.5	3977.7	4584.1	7858.4	8489.0
13000	10155	280.7	692.6	1015.2	1521.5	2282.3	4249.8	6400.9	10624.4	2833.2	4302.2	4958.1	8499.6	9181.6
14000	10327	301.8	744.7	1091.6	1636.0	2454.0	4569.6	6882.6	11424.0	3046.4	4626.0	5331.2	9139.2	9872.6
15000	10498	322.9	796.7	1167.9	1750.3	2625.4	4888.7	7363.2	12221.8	3259.1	4949.1	5703.5	9777.4	10562.0
16000	10668	343.9	848.6	1243.9	1864.3	2796.4	5207.2	7842.9	13017.9	3471.4	5271.5	6075.0	10414.3	11250.0
17000	10837	364.9	900.4	1319.9	1978.1	2967.1	5525.0	8321.7	13812.6	3683.4	5593.2	6445.9	11050.1	11936.8
18000	11004	385.9	952.1	1395.7	2091.7	3137.5	5842.3	8799.6	14605.8	3894.9	5914.5	6816.1	11684.7	12622.3
19000	11171	406.8	1003.7	1471.3	2205.1	3307.7	6159.1	9276.7	15397.8	4106.1	6235.2	7185.7	12318.3	13306.8
20000	11336	427.7	1055.3	1546.9	2318.4	3477.6	6475.4	9753.1	16188.6	4317.0	6555.4	7554.7	12950.9	13990.2

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **8000 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	8190	22.4	55.3	81.1	121.5	182.3	339.4	511.2	848.5	226.3	343.6	396.0	678.8	733.3
2000	8380	44.7	110.4	161.8	242.5	363.7	677.2	1020.0	1693.0	451.5	685.5	790.1	1354.4	1463.1
3000	8569	66.9	165.1	242.1	362.8	544.2	1013.4	1526.4	2533.5	675.6	1025.9	1182.3	2026.8	2189.5
4000	8756	89.0	219.7	322.1	482.7	724.0	1348.2	2030.6	3370.4	898.8	1364.8	1572.9	2696.3	2912.7
5000	8942	111.1	274.0	401.7	602.0	903.0	1681.5	2532.7	4203.9	1121.0	1702.3	1961.8	3363.1	3633.0
6000	9127	133.0	328.1	481.0	720.9	1081.4	2013.6	3032.9	5034.1	1342.4	2038.5	2349.2	4027.3	4350.4
7000	9310	154.9	382.1	560.1	839.4	1259.1	2344.5	3531.2	5861.3	1563.0	2373.4	2735.3	4689.0	5065.3
8000	9492	176.6	435.8	638.8	957.4	1436.2	2674.2	4027.9	6685.6	1782.8	2707.3	3120.0	5348.5	5777.7
9000	9673	198.3	489.4	717.4	1075.1	1612.7	3002.9	4522.9	7507.3	2002.0	3040.0	3503.4	6005.9	6487.8
10000	9852	220.0	542.8	795.6	1192.4	1788.7	3330.6	5016.5	8326.5	2220.4	3371.7	3885.7	6661.2	7195.8
11000	10031	241.6	596.0	873.7	1309.4	1964.1	3657.4	5508.6	9143.4	2438.2	3702.5	4266.9	7314.7	7901.7
12000	10208	263.1	649.1	951.6	1426.1	2139.2	3983.3	5999.5	9958.2	2655.5	4032.4	4647.1	7966.5	8605.8
13000	10383	284.6	702.1	1029.2	1542.5	2313.7	4308.4	6489.1	10770.9	2872.2	4361.5	5026.4	8616.7	9308.2
14000	10558	306.0	755.0	1106.7	1658.6	2487.9	4632.7	6977.6	11581.7	3088.5	4689.9	5404.8	9265.4	10008.9
15000	10731	327.4	807.7	1184.0	1774.5	2661.7	4956.3	7465.1	12390.8	3304.2	5017.5	5782.4	9912.7	10708.1
16000	10902	348.7	860.3	1261.2	1890.1	2835.2	5279.3	7951.6	13198.3	3519.6	5344.5	6159.2	10558.7	11406.0
17000	11073	370.0	912.9	1338.2	2005.6	3008.3	5601.7	8437.2	14004.4	3734.5	5670.9	6535.4	11203.5	12102.5
18000	11242	391.2	965.3	1415.1	2120.8	3181.2	5923.6	8922.0	14809.0	3949.1	5996.7	6910.9	11847.2	12797.9
19000	11410	412.5	1017.7	1491.8	2235.8	3353.8	6244.9	9406.0	15612.4	4163.3	6322.0	7285.8	12489.9	13492.2
20000	11577	433.7	1070.0	1568.5	2350.7	3526.1	6565.8	9889.3	16414.5	4377.2	6646.9	7660.1	13131.6	14185.4

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **8200 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	8393	22.7	56.0	82.1	123.1	184.6	343.8	517.8	859.5	229.2	348.1	401.1	687.6	742.8
2000	8585	45.3	111.8	163.9	245.6	368.4	686.0	1033.2	1714.9	457.3	694.4	800.3	1372.0	1482.0
3000	8776	67.8	167.3	245.2	367.5	551.3	1026.6	1546.2	2566.5	684.4	1039.3	1197.7	2053.2	2217.9
4000	8965	90.2	222.6	326.3	489.0	733.4	1365.7	2057.0	3414.3	910.5	1382.6	1593.4	2731.5	2950.7
5000	9154	112.5	277.6	406.9	609.9	914.8	1703.5	2565.8	4258.8	1135.7	1724.5	1987.4	3407.0	3680.4
6000	9341	134.7	332.4	487.3	730.4	1095.6	2040.0	3072.6	5100.0	1360.0	2065.2	2380.0	4080.0	4407.4
7000	9526	156.9	387.1	567.4	850.4	1275.6	2375.3	3577.6	5938.2	1583.5	2404.6	2771.1	4750.5	5131.7
8000	9710	179.0	441.5	647.2	970.0	1455.1	2709.4	4080.8	6773.5	1806.3	2742.9	3161.0	5418.8	5853.7
9000	9893	201.0	495.8	726.8	1089.3	1633.9	3042.5	4582.5	7606.2	2028.3	3080.1	3549.6	6085.0	6573.3
10000	10075	222.9	549.9	806.2	1208.2	1812.3	3374.6	5082.7	8436.5	2249.7	3416.3	3937.0	6749.2	7290.8
11000	10255	244.8	603.9	885.3	1326.8	1990.1	3705.8	5581.5	9264.4	2470.5	3751.5	4323.4	7411.5	8006.3
12000	10434	266.6	657.7	964.2	1445.0	2167.5	4036.1	6079.0	10090.2	2690.7	4085.9	4708.7	8072.1	8719.9
13000	10611	288.3	711.4	1042.9	1563.0	2344.5	4365.6	6575.3	10914.0	2910.4	4419.5	5093.2	8731.2	9431.8
14000	10787	310.1	765.0	1121.4	1680.7	2521.0	4694.4	7070.5	11735.9	3129.6	4752.3	5476.8	9388.7	10142.1
15000	10962	331.7	818.5	1199.8	1798.2	2697.2	5022.4	7564.6	12556.1	3348.3	5084.4	5859.5	10044.9	10850.9
16000	11136	353.4	871.8	1278.0	1915.4	2873.1	5349.9	8057.8	13374.7	3566.6	5415.9	6241.5	10699.7	11558.4
17000	11308	374.9	925.1	1356.1	2032.4	3048.6	5676.7	8550.1	14191.8	3784.5	5746.8	6622.8	11353.4	12264.5
18000	11479	396.5	978.3	1434.1	2149.2	3223.8	6003.0	9041.6	15007.6	4002.0	6077.1	7003.5	12006.0	12969.5
19000	11649	418.0	1031.4	1511.9	2265.9	3398.8	6328.8	9532.3	15822.1	4219.2	6407.0	7383.6	12657.6	13673.4
20000	11817	439.5	1084.4	1589.6	2382.4	3573.5	6654.2	10022.3	16635.4	4436.1	6736.3	7763.2	13308.3	14376.3

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **8400 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	8595	23.0	56.7	83.2	124.6	186.9	348.1	524.3	870.3	232.1	352.4	406.1	696.2	752.1
2000	8790	45.9	113.2	165.9	248.7	373.0	694.6	1046.1	1736.4	463.0	703.1	810.3	1389.1	1500.6
3000	8983	68.7	169.4	248.3	372.2	558.2	1039.5	1565.6	2598.7	693.0	1052.3	1212.7	2078.9	2245.8
4000	9175	91.3	225.4	330.4	495.1	742.7	1382.9	2082.9	3457.3	921.9	1400.0	1613.4	2765.8	2987.8
5000	9365	113.9	281.1	412.1	617.6	926.4	1725.0	2598.1	4312.4	1150.0	1746.3	2012.5	3449.9	3726.8
6000	9554	136.4	336.6	493.5	739.6	1109.4	2065.8	3111.4	5164.4	1377.2	2091.3	2410.0	4131.5	4463.0
7000	9742	158.9	392.0	574.6	861.2	1291.8	2405.3	3622.8	6013.3	1603.6	2435.0	2806.2	4810.7	5196.7
8000	9928	181.2	447.1	655.5	982.3	1473.5	2743.8	4132.6	6859.4	1829.2	2777.6	3201.1	5487.6	5927.9
9000	10113	203.5	502.1	736.1	1103.1	1654.7	3081.2	4640.8	7702.9	2054.1	3119.2	3594.7	6162.3	6656.8
10000	10296	225.7	556.9	816.4	1223.6	1835.4	3417.6	5147.5	8543.9	2278.4	3459.8	3987.2	6835.1	7383.6
11000	10478	247.9	611.6	896.6	1343.7	2015.5	3753.1	5652.8	9382.7	2502.0	3799.4	4378.6	7506.1	8108.5
12000	10659	270.0	666.1	976.5	1463.5	2195.2	4087.7	6156.8	10219.2	2725.1	4138.1	4769.0	8175.4	8831.4
13000	10838	292.0	720.5	1056.3	1583.0	2374.5	4421.5	6659.6	11053.8	2947.7	4476.1	5158.4	8843.1	9552.7
14000	11016	314.0	774.8	1135.8	1702.3	2553.4	4754.6	7161.3	11886.6	3169.8	4813.3	5547.1	9509.3	10272.4
15000	11193	336.0	829.0	1215.2	1821.3	2731.9	5087.0	7662.0	12717.6	3391.4	5149.8	5934.9	10174.1	10990.5
16000	11368	357.9	883.1	1294.5	1940.1	2910.1	5418.8	8161.7	13547.0	3612.5	5485.7	6322.0	10837.6	11707.3
17000	11542	379.8	937.0	1373.6	2058.6	3088.0	5750.0	8660.5	14375.0	3833.3	5821.0	6708.4	11500.0	12422.9
18000	11715	401.6	990.9	1452.6	2177.0	3265.5	6080.7	9158.5	15201.7	4053.8	6155.7	7094.1	12161.3	13137.3
19000	11886	423.4	1044.7	1531.5	2295.2	3442.9	6410.8	9655.8	16027.1	4273.9	6490.0	7479.3	12821.7	13850.6
20000	12056	445.2	1098.5	1610.2	2413.3	3619.9	6740.5	10152.4	16851.3	4493.7	6823.7	7863.9	13481.0	14562.9

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **8600 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	8798	23.3	57.4	84.2	126.1	189.2	352.3	530.6	880.8	234.9	356.6	411.0	704.6	761.1
2000	8994	46.4	114.6	167.9	251.7	377.5	702.9	1058.8	1757.4	468.6	711.6	820.1	1405.9	1518.7
3000	9190	69.5	171.4	251.3	376.7	565.0	1052.0	1584.6	2630.1	701.4	1065.0	1227.4	2104.1	2272.9
4000	9384	92.4	228.1	334.4	501.1	751.7	1399.7	2108.2	3499.2	933.1	1417.0	1633.0	2799.4	3024.0
5000	9576	115.3	284.5	417.1	625.1	937.6	1745.9	2629.7	4364.9	1164.0	1767.5	2036.9	3491.9	3772.1
6000	9767	138.1	340.7	499.5	748.6	1122.9	2090.9	3149.3	5227.3	1394.0	2116.7	2439.4	4181.9	4517.4
7000	9957	160.8	396.8	581.6	871.7	1307.5	2434.7	3667.1	6086.8	1623.1	2464.8	2840.5	4869.4	5260.2
8000	10145	183.4	452.6	663.5	994.4	1491.5	2777.4	4183.2	6943.4	1851.6	2811.6	3240.3	5554.7	6000.5
9000	10332	206.0	508.3	745.1	1116.7	1675.0	3119.0	4697.7	7797.4	2079.3	3157.5	3638.8	6237.9	6738.5
10000	10517	228.5	563.8	826.5	1238.6	1857.9	3459.6	5210.7	8649.0	2306.4	3502.3	4036.2	6919.2	7474.4
11000	10701	250.9	619.1	907.6	1360.2	2040.4	3799.3	5722.4	9498.2	2532.9	3846.2	4432.5	7598.6	8208.4
12000	10884	273.3	674.4	988.6	1481.6	2222.3	4138.1	6232.8	10345.4	2758.8	4189.2	4827.8	8276.3	8940.4
13000	11065	295.7	729.5	1069.3	1602.6	2403.9	4476.2	6742.0	11190.5	2984.1	4531.5	5222.3	8952.4	9670.8
14000	11245	317.9	784.4	1149.9	1723.4	2585.1	4813.6	7250.0	12033.9	3209.0	4873.0	5615.8	9627.1	10399.7
15000	11423	340.2	839.3	1230.3	1843.9	2765.9	5150.2	7757.1	12875.5	3433.5	5213.8	6008.6	10300.4	11127.0
16000	11600	362.4	894.1	1310.6	1964.2	2946.3	5486.2	8263.2	13715.6	3657.5	5554.0	6400.6	10972.5	11853.0
17000	11775	384.5	948.7	1390.7	2084.3	3126.5	5821.7	8768.5	14554.2	3881.1	5893.6	6792.0	11643.4	12577.7
18000	11950	406.6	1003.3	1470.7	2204.2	3306.3	6156.6	9272.9	15391.5	4104.4	6232.6	7182.7	12313.2	13301.3
19000	12123	428.7	1057.8	1550.6	2323.9	3485.9	6491.0	9776.6	16227.6	4327.3	6571.2	7572.9	12982.0	14023.8
20000	12294	450.8	1112.2	1630.4	2443.5	3665.3	6825.0	10279.6	17062.5	4550.0	6909.2	7962.5	13650.0	14745.3

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **8800 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	9000	23.5	58.1	85.1	127.6	191.4	356.4	536.8	891.0	237.6	360.8	415.8	712.8	770.0
2000	9199	47.0	115.9	169.9	254.6	381.9	711.1	1071.1	1777.9	474.1	719.9	829.7	1422.3	1536.4
3000	9396	70.3	173.4	254.3	381.1	571.6	1064.3	1603.1	2660.9	709.6	1077.5	1241.7	2128.7	2299.5
4000	9592	93.5	230.8	338.3	507.0	760.5	1416.1	2132.9	3540.2	944.1	1433.6	1652.1	2832.2	3059.4
5000	9787	116.7	287.9	422.0	632.4	948.7	1766.5	2660.6	4416.1	1177.6	1788.3	2060.9	3532.9	3816.4
6000	9980	139.7	344.8	505.4	757.4	1136.1	2115.5	3186.4	5288.9	1410.4	2141.7	2468.1	4231.1	4570.6
7000	10172	162.7	401.4	588.5	882.0	1323.0	2463.4	3710.4	6158.6	1642.3	2493.8	2874.0	4926.9	5322.2
8000	10362	185.6	458.0	671.3	1006.1	1509.2	2810.2	4232.6	7025.5	1873.5	2844.9	3278.6	5620.4	6071.4
9000	10551	208.4	514.3	753.9	1129.9	1694.8	3155.9	4753.4	7889.8	2103.9	3194.9	3681.9	6311.8	6818.3
10000	10738	231.2	570.5	836.3	1253.3	1880.0	3500.7	5272.6	8751.7	2333.8	3543.9	4084.1	7001.3	7563.2
11000	10923	253.9	626.5	918.4	1376.4	2064.6	3844.5	5790.5	9611.3	2563.0	3892.0	4485.2	7689.0	8306.0
12000	11108	276.6	682.4	1000.3	1499.2	2248.8	4187.5	6307.1	10468.7	2791.7	4239.2	4885.4	8375.0	9047.0
13000	11291	299.2	738.2	1082.1	1621.7	2432.6	4529.7	6822.5	11324.2	3019.8	4585.6	5284.6	9059.4	9786.4
14000	11472	321.7	793.8	1163.7	1744.0	2616.0	4871.2	7336.8	12178.0	3247.5	4931.3	5683.1	9742.4	10524.2
15000	11652	344.2	849.4	1245.1	1866.0	2799.0	5212.0	7850.2	13030.0	3474.7	5276.3	6080.7	10424.0	11260.5
16000	11831	366.7	904.8	1326.4	1987.8	2981.7	5552.2	8362.5	13880.4	3701.4	5620.7	6477.5	11104.3	11995.4
17000	12008	389.1	960.1	1407.5	2109.4	3164.1	5891.8	8874.1	14729.5	3927.9	5964.5	6873.8	11783.6	12729.2
18000	12184	411.5	1015.4	1488.5	2230.8	3346.2	6230.9	9384.8	15577.2	4153.9	6307.8	7269.3	12461.7	13461.7
19000	12358	433.9	1070.6	1569.4	2352.0	3528.0	6569.5	9894.8	16423.7	4379.6	6650.6	7664.4	13138.9	14193.3
20000	12531	456.2	1125.7	1650.2	2473.1	3709.6	6907.6	10404.1	17269.0	4605.1	6992.9	8058.9	13815.2	14923.9

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **9000 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	9202	23.8	58.7	86.1	129.0	193.6	360.4	542.8	901.0	240.3	364.9	420.5	720.8	778.7
2000	9403	47.5	117.2	171.8	257.5	386.2	719.2	1083.2	1797.9	479.4	728.0	839.0	1438.3	1553.7
3000	9603	71.1	175.4	257.1	385.4	578.0	1076.4	1621.2	2690.9	717.6	1089.7	1255.8	2152.7	2325.5
4000	9801	94.6	233.4	342.1	512.7	769.1	1432.1	2157.0	3580.3	954.7	1449.8	1670.8	2864.2	3094.1
5000	9998	118.0	291.1	426.8	639.6	959.4	1786.5	2690.8	4466.3	1191.0	1808.6	2084.3	3573.0	3859.7
6000	10193	141.3	348.7	511.1	766.0	1149.0	2139.6	3222.6	5349.0	1426.4	2166.0	2496.2	4279.2	4622.6
7000	10386	164.6	406.0	595.2	892.0	1338.0	2491.5	3752.7	6228.8	1661.0	2522.3	2906.8	4983.0	5382.9
8000	10578	187.7	463.2	679.0	1017.6	1526.4	2842.3	4281.0	7105.8	1894.9	2877.4	3316.0	5684.6	6140.8
9000	10769	210.8	520.2	762.5	1142.8	1714.3	3192.1	4807.8	7980.1	2128.0	3231.5	3724.1	6384.1	6896.4
10000	10958	233.9	577.0	845.9	1267.7	1901.6	3540.8	5333.1	8852.1	2360.6	3584.6	4131.0	7081.7	7650.0
11000	11145	256.8	633.7	929.0	1392.3	2088.4	3888.7	5857.1	9721.8	2592.5	3936.7	4536.8	7777.4	8401.5
12000	11331	279.8	690.3	1011.9	1516.5	2274.8	4235.7	6379.8	10589.4	2823.8	4288.0	4941.7	8471.5	9151.3
13000	11516	302.6	746.7	1094.6	1640.5	2460.7	4582.0	6901.3	11455.0	3054.7	4638.6	5345.7	9164.0	9899.4
14000	11699	325.5	803.0	1177.1	1764.2	2646.3	4927.6	7421.7	12318.9	3285.0	4988.4	5748.8	9855.1	10645.9
15000	11881	348.2	859.2	1259.5	1887.7	2831.5	5272.4	7941.2	13181.1	3514.9	5337.5	6151.2	10544.8	11391.0
16000	12061	371.0	915.3	1341.8	2010.9	3016.4	5616.7	8459.7	14041.7	3744.5	5686.0	6552.8	11233.4	12134.8
17000	12239	393.7	971.3	1423.9	2134.0	3200.9	5960.4	8977.3	14900.9	3973.6	6034.0	6953.8	11920.7	12877.3
18000	12417	416.3	1027.2	1505.8	2256.8	3385.2	6303.5	9494.2	15758.8	4202.4	6381.4	7354.1	12607.1	13618.7
19000	12593	439.0	1083.1	1587.7	2379.5	3569.3	6646.2	10010.4	16615.5	4430.8	6728.3	7753.9	13292.4	14359.1
20000	12767	461.6	1138.9	1669.5	2502.0	3753.1	6988.5	10525.8	17471.1	4659.0	7074.7	8153.2	13976.9	15098.5

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **9200 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	9404	24.1	59.4	87.0	130.4	195.7	364.3	548.7	910.8	242.9	368.8	425.0	728.6	787.1
2000	9608	48.0	118.5	173.7	260.3	390.4	727.0	1095.0	1817.5	484.7	736.0	848.2	1454.0	1570.7
3000	9809	71.9	177.3	259.9	389.6	584.4	1088.1	1638.9	2720.3	725.4	1101.6	1269.5	2176.3	2350.9
4000	10009	95.6	235.9	345.9	518.3	777.5	1447.8	2180.6	3619.5	965.2	1465.7	1689.1	2895.6	3128.0
5000	10208	119.3	294.3	431.5	646.6	969.9	1806.1	2720.3	4515.3	1204.1	1828.4	2107.1	3612.2	3902.1
6000	10405	142.9	352.5	516.8	774.5	1161.7	2163.1	3258.1	5407.9	1442.1	2189.8	2523.7	4326.3	4673.5
7000	10600	166.4	410.5	601.8	901.9	1352.8	2519.0	3794.0	6297.5	1679.3	2550.1	2938.8	5038.0	5442.2
8000	10794	189.8	468.3	686.5	1028.9	1543.3	2873.7	4328.3	7184.3	1915.8	2909.2	3352.7	5747.4	6208.6
9000	10987	213.2	525.9	771.0	1155.5	1733.2	3227.4	4861.0	8068.5	2151.6	3267.3	3765.3	6454.8	6972.8
10000	11177	236.5	583.4	855.3	1281.8	1922.7	3580.1	5392.3	8950.4	2386.8	3624.3	4176.8	7160.3	7734.9
11000	11367	259.7	640.8	939.3	1407.7	2111.6	3932.0	5922.2	9829.9	2621.3	3980.5	4587.3	7863.9	8495.0
12000	11554	282.9	698.0	1023.2	1533.4	2300.1	4283.0	6450.9	10707.4	2855.3	4335.8	4996.8	8565.9	9253.3
13000	11740	306.0	755.0	1106.8	1658.8	2488.2	4633.2	6978.4	11583.0	3088.8	4690.4	5405.4	9266.4	10010.0
14000	11925	329.1	812.0	1190.3	1783.9	2675.9	4982.7	7504.8	12456.8	3321.8	5044.2	5813.2	9965.4	10765.1
15000	12108	352.1	868.8	1273.6	1908.8	2863.2	5331.6	8030.2	13328.9	3554.4	5397.4	6220.1	10663.1	11518.8
16000	12290	375.1	925.6	1356.8	2033.5	3050.3	5679.8	8554.8	14199.5	3786.5	5749.9	6626.4	11359.6	12271.2
17000	12470	398.1	982.3	1439.9	2158.0	3237.0	6027.5	9078.4	15068.7	4018.3	6101.9	7032.1	12055.0	13022.3
18000	12649	421.0	1038.8	1522.8	2282.3	3423.4	6374.6	9601.3	15936.6	4249.8	6453.3	7437.1	12749.3	13772.4
19000	12826	443.9	1095.3	1605.7	2406.4	3609.6	6721.3	10123.5	16803.3	4480.9	6804.3	7841.6	13442.7	14521.4
20000	13002	466.8	1151.8	1688.4	2530.4	3795.5	7067.6	10645.0	17668.9	4711.7	7154.8	8245.5	14135.2	15269.5

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **9400 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	9606	24.3	60.0	87.9	131.8	197.7	368.2	554.5	920.4	245.4	372.7	429.5	736.3	795.4
2000	9812	48.5	119.7	175.5	263.0	394.5	734.7	1106.5	1836.7	489.8	743.7	857.1	1469.3	1587.2
3000	10016	72.6	179.2	262.7	393.7	590.5	1099.6	1656.2	2749.1	733.1	1113.2	1282.9	2199.3	2375.7
4000	10218	96.6	238.4	349.5	523.8	785.8	1463.1	2203.7	3657.8	975.4	1481.2	1707.0	2926.3	3161.1
5000	10418	120.6	297.5	436.0	653.5	980.2	1825.3	2749.2	4563.2	1216.9	1847.8	2129.5	3650.6	3943.5
6000	10617	144.4	356.3	522.3	782.7	1174.1	2186.2	3292.7	5465.4	1457.4	2213.2	2550.5	4372.3	4723.2
7000	10814	168.2	414.9	608.2	911.5	1367.2	2545.9	3834.5	6364.6	1697.2	2577.3	2970.2	5091.7	5500.3
8000	11010	191.8	473.3	693.8	1039.9	1559.8	2904.4	4374.6	7261.1	1936.3	2940.3	3388.5	5808.9	6275.0
9000	11204	215.5	531.6	779.3	1167.9	1751.8	3262.0	4913.1	8155.0	2174.7	3302.3	3805.7	6524.0	7047.5
10000	11396	239.0	589.7	864.4	1295.5	1943.3	3618.6	5450.2	9046.5	2412.4	3663.3	4221.7	7237.2	7818.0
11000	11587	262.5	647.7	949.4	1422.9	2134.3	3974.3	5986.0	9935.7	2649.5	4023.4	4636.7	7948.6	8586.4
12000	11777	285.9	705.5	1034.2	1549.9	2324.9	4329.2	6520.5	10822.9	2886.1	4382.6	5050.7	8658.3	9353.1
13000	11964	309.3	763.2	1118.8	1676.7	2515.1	4683.3	7053.8	11708.2	3122.2	4741.1	5463.8	9366.6	10118.2
14000	12151	332.7	820.8	1203.2	1803.3	2704.9	5036.7	7586.1	12591.7	3357.8	5098.9	5876.1	10073.4	10881.7
15000	12335	356.0	878.3	1287.5	1929.5	2894.3	5389.4	8117.4	13473.6	3593.0	5456.0	6287.7	10778.9	11643.8
16000	12519	379.2	935.7	1371.6	2055.6	3083.4	5741.6	8647.8	14353.9	3827.7	5812.5	6698.5	11483.1	12404.6
17000	12700	402.4	993.0	1455.6	2181.5	3272.3	6093.2	9177.4	15232.9	4062.1	6168.4	7108.7	12186.3	13164.2
18000	12881	425.6	1050.2	1539.5	2307.2	3460.8	6444.2	9706.1	16110.6	4296.2	6523.8	7518.3	12888.5	13922.7
19000	13059	448.8	1107.3	1623.2	2432.7	3649.1	6794.9	10234.2	16987.1	4529.9	6878.7	7927.3	13589.7	14680.2
20000	13237	471.9	1164.4	1706.9	2558.1	3837.1	7145.0	10761.6	17862.6	4763.4	7233.2	8335.9	14290.1	15436.8

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **9600 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	9809	24.6	60.6	88.8	133.2	199.7	371.9	560.2	929.8	247.9	376.5	433.9	743.8	803.5
2000	10016	49.0	120.9	177.3	265.7	398.6	742.2	1117.8	1855.4	494.8	751.3	865.9	1484.3	1603.4
3000	10222	73.4	181.0	265.4	397.7	596.6	1110.9	1673.2	2777.2	740.6	1124.6	1296.0	2221.8	2400.0
4000	10426	97.6	240.9	353.1	529.2	793.8	1478.1	2226.3	3695.4	985.4	1496.4	1724.5	2956.3	3193.5
5000	10628	121.8	300.5	440.5	660.2	990.3	1844.1	2777.5	4610.1	1229.4	1866.8	2151.4	3688.1	3984.1
6000	10829	145.9	359.9	527.6	790.8	1186.2	2208.7	3326.7	5521.7	1472.5	2236.0	2576.8	4417.4	4771.9
7000	11028	169.9	419.2	614.5	920.9	1381.3	2572.2	3874.1	6430.4	1714.8	2603.9	3000.9	5144.3	5557.1
8000	11225	193.8	478.2	701.0	1050.6	1575.9	2934.5	4419.9	7336.3	1956.3	2970.7	3423.6	5869.0	6340.0
9000	11421	217.7	537.1	787.3	1180.0	1770.0	3295.9	4964.1	8239.6	2197.2	3336.5	3845.2	6591.7	7120.7
10000	11615	241.5	595.8	873.4	1309.0	1963.5	3656.2	5506.9	9140.6	2437.5	3701.4	4265.6	7312.5	7899.3
11000	11808	265.2	654.4	959.3	1437.7	2156.6	4015.7	6048.4	10039.3	2677.2	4065.3	4685.0	8031.5	8675.9
12000	11998	288.9	712.9	1045.0	1566.1	2349.2	4374.4	6588.6	10936.0	2916.3	4428.4	5103.5	8748.8	9450.8
13000	12188	312.6	771.2	1130.5	1694.3	2541.4	4732.3	7127.7	11830.8	3154.9	4790.7	5521.0	9464.6	10224.1
14000	12376	336.2	829.4	1215.8	1822.2	2733.3	5089.5	7665.7	12723.8	3393.0	5152.4	5937.8	10179.0	10995.9
15000	12562	359.7	887.5	1301.0	1949.8	2924.7	5446.1	8202.7	13615.2	3630.7	5513.3	6353.8	10892.2	11766.2
16000	12746	383.2	945.5	1386.0	2077.3	3115.9	5802.0	8738.9	14505.1	3868.0	5873.7	6769.1	11604.1	12535.3
17000	12930	406.7	1003.4	1471.0	2204.5	3306.8	6157.5	9274.2	15393.7	4105.0	6233.5	7183.7	12314.9	13303.2
18000	13111	430.1	1061.3	1555.7	2331.6	3497.4	6512.4	9808.8	16281.0	4341.6	6592.8	7597.8	13024.8	14070.0
19000	13291	453.6	1119.0	1640.4	2458.5	3687.7	6866.8	10342.6	17167.1	4577.9	6951.6	8011.3	13733.7	14835.8
20000	13470	476.9	1176.7	1725.0	2585.2	3877.9	7220.9	10875.9	18052.1	4813.9	7310.0	8424.3	14441.7	15600.6

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **9800 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	10011	24.8	61.2	89.7	134.5	201.7	375.6	565.7	938.9	250.4	380.2	438.2	751.1	811.4
2000	10220	49.5	122.1	179.0	268.3	402.5	749.5	1128.9	1873.8	499.7	758.8	874.4	1499.0	1619.3
3000	10428	74.1	182.8	268.0	401.7	602.5	1121.9	1689.8	2804.7	747.9	1135.7	1308.9	2243.8	2423.8
4000	10633	98.6	243.3	356.6	534.5	801.7	1492.8	2248.5	3732.1	995.2	1511.3	1741.6	2985.7	3225.3
5000	10838	123.0	303.5	444.9	666.8	1000.2	1862.4	2805.1	4656.1	1241.6	1885.4	2172.8	3724.8	4023.8
6000	11040	147.3	363.5	532.9	798.7	1198.0	2230.7	3359.9	5576.9	1487.2	2258.3	2602.5	4461.5	4819.5
7000	11241	171.6	423.4	620.6	930.1	1395.2	2597.9	3912.9	6494.7	1731.9	2630.0	3030.9	5195.8	5612.7
8000	11440	195.8	483.0	708.1	1061.2	1591.8	2964.0	4464.2	7409.9	1976.0	3000.5	3457.9	5927.9	6403.6
9000	11637	219.9	542.5	795.3	1191.9	1787.8	3329.0	5014.0	8322.5	2219.3	3370.1	3883.8	6658.0	7192.3
10000	11833	243.9	601.8	882.2	1322.2	1983.3	3693.1	5562.4	9232.7	2462.0	3738.7	4308.6	7386.1	7978.9
11000	12027	267.9	661.0	969.0	1452.2	2178.4	4056.3	6109.5	10140.7	2704.2	4106.4	4732.3	8112.6	8763.6
12000	12220	291.8	720.1	1055.6	1582.0	2373.0	4418.7	6655.3	11046.7	2945.8	4473.2	5155.1	8837.3	9546.5
13000	12411	315.7	779.0	1142.0	1711.5	2567.2	4780.3	7200.0	11950.8	3186.9	4839.3	5577.0	9560.6	10327.8
14000	12600	339.6	837.8	1228.2	1840.7	2761.0	5141.3	7743.6	12853.1	3427.5	5204.7	5998.1	10282.5	11107.6
15000	12788	363.4	896.5	1314.3	1969.7	2954.5	5501.6	8286.3	13753.9	3667.7	5569.5	6418.5	11003.1	11886.1
16000	12974	387.1	955.2	1400.2	2098.5	3147.7	5861.3	8828.1	14653.2	3907.5	5933.6	6838.1	11722.5	12663.2
17000	13158	410.9	1013.7	1486.0	2227.1	3340.6	6220.4	9369.1	15551.1	4147.0	6297.2	7257.2	12440.9	13439.2
18000	13341	434.5	1072.2	1571.7	2355.5	3533.2	6579.1	9909.3	16447.8	4386.1	6660.3	7675.6	13158.2	14214.1
19000	13523	458.2	1130.5	1657.3	2483.7	3725.6	6937.3	10448.8	17343.3	4624.9	7023.0	8093.6	13874.7	14988.1
20000	13703	481.8	1188.8	1742.7	2611.8	3917.8	7295.1	10987.7	18237.8	4863.4	7385.2	8511.0	14590.2	15761.1

Temperature Gradient 1.1°F/100 ft

WELLHEAD PRESSURE • **10000 PSI**

N_2 VOLUMES IN 100 SCF

DEPTH FT	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	10213	25.0	61.8	90.6	135.7	203.6	379.2	571.1	947.9	252.8	383.8	442.4	758.3	819.2
2000	10424	50.0	123.3	180.8	270.9	406.4	756.7	1139.7	1891.7	504.5	766.0	882.8	1513.4	1634.8
3000	10633	74.8	184.6	270.6	405.5	608.3	1132.7	1706.0	2831.7	755.1	1146.6	1321.4	2265.3	2447.1
4000	10841	99.6	245.6	360.1	539.6	809.4	1507.2	2270.1	3768.0	1004.8	1525.8	1758.4	3014.4	3256.3
5000	11047	124.2	306.4	449.2	673.2	1009.8	1880.4	2832.2	4701.0	1253.6	1903.6	2193.8	3760.8	4062.6
6000	11251	148.8	367.0	538.1	806.4	1209.6	2252.3	3392.4	5630.8	1501.6	2280.1	2627.7	4504.7	4866.2
7000	11454	173.3	427.5	626.6	939.1	1408.7	2623.1	3950.8	6557.8	1748.7	2655.5	3060.3	5246.2	5667.2
8000	11655	197.7	487.7	714.9	1071.5	1607.2	2992.8	4507.6	7481.9	1995.2	3029.7	3491.6	5985.5	6465.9
9000	11854	222.0	547.8	803.0	1203.5	1805.2	3361.4	5062.9	8403.6	2241.0	3402.9	3921.7	6722.9	7262.4
10000	12051	246.3	607.7	890.9	1335.1	2002.7	3729.1	5616.7	9322.9	2486.1	3775.2	4350.7	7458.3	8056.8
11000	12247	270.5	667.5	978.5	1466.5	2199.7	4096.0	6169.3	10240.0	2730.7	4146.6	4778.7	8192.0	8849.4
12000	12441	294.7	727.1	1065.9	1597.5	2396.3	4462.0	6720.6	11155.0	2974.7	4517.1	5205.7	8924.0	9640.2
13000	12633	318.8	786.7	1153.2	1728.3	2592.4	4827.3	7270.8	12068.3	3218.2	4886.9	5631.9	9654.6	10429.4
14000	12824	342.9	846.1	1240.3	1858.8	2788.3	5191.9	7819.9	12979.8	3461.3	5256.0	6057.2	10383.8	11217.1
15000	13013	367.0	905.4	1327.2	1989.1	2983.7	5555.9	8368.1	13889.7	3703.9	5624.5	6481.9	11111.8	12003.4
16000	13200	391.0	964.6	1414.0	2119.2	3178.9	5919.3	8915.4	14798.2	3946.2	5992.3	6905.8	11838.5	12788.5
17000	13386	414.9	1023.8	1500.7	2249.2	3373.7	6282.1	9461.9	15705.3	4188.1	6359.7	7329.1	12564.2	13572.5
18000	13570	438.9	1082.8	1587.3	2378.9	3568.3	6644.5	10007.7	16611.2	4429.6	6726.5	7751.9	13288.9	14355.3
19000	13753	462.8	1141.8	1673.7	2508.5	3762.7	7006.4	10552.8	17516.0	4670.9	7092.9	8174.1	14012.8	15137.2
20000	13935	486.6	1200.7	1760.1	2637.9	3956.8	7367.9	11097.3	18419.7	4911.9	7458.8	8595.9	14735.7	15918.2

Temperature Gradient 1.1°F/100 ft

N_2 DISPLACEMENT TABLES

GIVEN FLUID DENSITY
IN WELLBORE AND DEPTH

FLUID • API 60 OIL

N_2 VOLUMES IN 100 SCF

DEPTH FT	PW PSI	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG
1000	308	319	1.2	3.1	4.5	6.8	10.1	18.9	28.4	47.1
2000	597	639	4.9	12.1	17.7	26.5	39.8	74.0	111.5	185.1
3000	868	959	10.7	26.5	38.8	58.2	87.3	162.5	244.8	406.3
4000	1123	1279	18.6	45.8	67.2	100.7	151.1	281.3	423.7	703.3
5000	1362	1599	28.2	69.6	102.1	153.0	229.5	427.3	643.5	1068.2
6000	1589	1919	39.5	97.3	142.7	213.8	320.8	597.3	899.6	1493.2
7000	1804	2239	52.1	128.5	188.3	282.3	423.4	788.4	1187.5	1971.1
8000	2009	2559	65.9	162.6	238.4	357.3	535.9	997.9	1503.1	2494.8
9000	2206	2879	80.8	199.3	292.2	437.9	656.9	1223.2	1842.4	3058.1
10000	2395	3199	96.6	238.3	349.3	523.4	785.2	1462.0	2202.1	3655.1
11000	2576	3519	113.1	279.0	409.0	613.0	919.5	1712.3	2579.0	4280.7
12000	2752	3839	130.3	321.4	471.1	706.1	1059.1	1972.1	2970.3	4930.2
13000	2923	4159	147.9	365.0	535.1	801.9	1202.9	2239.9	3373.7	5599.8
14000	3089	4479	166.1	409.7	600.6	900.2	1350.3	2514.3	3786.9	6285.7
15000	3253	4799	184.3	454.7	666.5	998.9	1498.3	2790.0	4202.2	6974.9
16000	3412	5119	202.9	500.6	733.9	1099.9	1649.8	3072.1	4627.1	7680.2
17000	3567	5439	221.9	547.5	802.5	1202.7	1804.1	3359.4	5059.8	8398.5
18000	3719	5759	241.2	595.0	872.2	1307.2	1960.9	3651.3	5499.4	9128.2
19000	3867	6079	260.7	643.2	942.9	1413.2	2119.8	3947.2	5945.2	9868.0
20000	4011	6399	280.5	692.1	1014.5	1520.4	2280.7	4246.7	6396.3	10616.9

Temperature Gradient 1.1°F/100 ft

FLUID • API 40 OIL

N_2 VOLUMES IN 100 SCF

DEPTH FT	PW PSI	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG
1000	345	357	1.4	3.4	5.0	7.6	11.3	21.1	31.8	52.8
2000	667	714	5.5	13.5	19.8	29.6	44.4	82.7	124.5	206.7
3000	971	1072	12.0	29.6	43.3	65.0	97.4	181.5	273.3	453.6
4000	1255	1429	20.7	51.1	74.9	112.2	168.4	313.5	472.2	783.8
5000	1524	1787	31.4	77.5	113.6	170.2	255.4	475.5	716.2	1188.8
6000	1777	2144	43.8	108.1	158.5	237.5	356.2	663.3	999.0	1658.3
7000	2019	2501	57.7	142.4	208.7	312.8	469.2	873.6	1315.8	2184.0
8000	2251	2859	72.9	179.8	263.6	395.1	592.6	1103.5	1662.0	2758.7
9000	2472	3216	89.1	219.9	322.3	483.1	724.7	1349.4	2032.4	3373.4
10000	2687	3574	106.3	262.2	384.4	576.2	864.2	1609.2	2423.8	4023.1
11000	2893	3931	124.2	306.4	449.1	673.1	1009.7	1880.1	2831.7	4700.2
12000	3094	4288	142.7	352.0	516.0	773.4	1160.1	2160.2	3253.6	5400.5
13000	3290	4646	161.7	399.0	584.8	876.5	1314.8	2448.2	3687.4	6120.5
14000	3484	5003	180.7	445.9	653.6	979.6	1469.4	2736.1	4121.0	6840.3
15000	3672	5361	200.4	494.5	724.9	1086.4	1629.6	3034.4	4570.4	7586.1
16000	3854	5718	220.5	544.0	797.5	1195.2	1792.8	3338.4	5028.1	8345.9
17000	4032	6075	240.9	594.4	871.4	1305.9	1958.9	3647.6	5493.9	9119.0
18000	4206	6433	261.7	645.7	946.5	1418.5	2127.8	3962.0	5967.5	9905.1
19000	4376	6790	282.7	697.5	1022.5	1532.4	2298.6	4280.2	6446.7	10700.4
20000	4543	7148	304.0	750.0	1099.5	1647.8	2471.7	4602.5	6932.1	11506.2

Temperature Gradient 1.1°F/100 ft

FLUID • WATER

N_2 VOLUMES IN 100 SCF

DEPTH FT	PW PSI	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG
1000	418	433	1.7	4.2	6.1	9.2	13.7	25.6	38.6	64.0
2000	810	866	6.6	16.3	23.9	35.9	53.8	100.2	150.9	250.5
3000	1177	1299	14.5	35.7	52.4	78.5	117.7	219.2	330.1	548.0
4000	1522	1732	24.9	61.5	90.2	135.2	202.8	377.6	568.8	944.1
5000	1849	2165	37.7	92.9	136.3	204.2	306.3	570.3	859.0	1425.9
6000	2160	2598	52.3	129.1	189.3	283.7	425.5	792.3	1193.3	1980.7
7000	2457	3031	68.6	169.3	248.1	371.9	557.8	1038.7	1564.5	2596.8
8000	2743	3464	86.2	212.7	311.8	467.3	701.0	1305.3	1966.1	3263.3
9000	3019	3897	104.9	258.8	379.4	568.6	853.0	1588.3	2392.2	3970.7
10000	3286	4330	124.5	307.1	450.1	674.6	1011.9	1884.3	2838.0	4710.7
11000	3550	4764	144.4	356.4	522.4	783.0	1174.5	2187.0	3294.0	5467.4
12000	3806	5197	165.1	407.4	597.2	895.1	1342.6	2500.1	3765.6	6250.2
13000	4055	5630	186.4	460.0	674.3	1010.5	1515.8	2822.5	4251.2	7056.3
14000	4298	6063	208.3	513.8	753.2	1128.9	1693.3	3153.1	4749.1	7882.7
15000	4535	6496	230.6	568.9	833.9	1249.8	1874.7	3490.8	5257.7	8726.9
16000	4767	6929	253.3	624.9	916.1	1372.9	2059.4	3834.8	5775.8	9587.0
17000	4994	7362	276.4	681.9	999.6	1498.1	2247.1	4184.3	6302.3	10460.8
18000	5217	7795	299.8	739.7	1084.3	1625.0	2437.5	4538.8	6836.2	11346.9
19000	5435	8228	323.5	798.1	1170.0	1753.4	2630.1	4897.5	7376.5	12243.8
20000	5648	8661	347.4	857.2	1256.6	1883.2	2824.8	5260.0	7922.5	13150.1

Temperature Gradient 1.1°F/100 ft

FLUID • 2% KCl WATER

N_2 VOLUMES IN 100 SCF

DEPTH FT	PW PSI	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG
1000	422	437	1.7	4.2	6.2	9.2	13.9	25.8	38.9	64.6
2000	818	875	6.7	16.5	24.2	36.2	54.4	101.2	152.5	253.1
3000	1189	1313	14.6	36.1	52.9	79.3	119.0	221.5	333.6	553.8
4000	1538	1750	25.2	62.2	91.1	136.5	204.8	381.4	574.4	953.5
5000	1869	2188	38.0	93.9	137.6	206.2	309.3	576.0	867.6	1440.0
6000	2183	2626	52.8	130.4	191.1	286.4	429.7	800.1	1205.0	2000.1
7000	2483	3063	69.2	170.8	250.4	375.3	563.0	1048.4	1579.0	2620.9
8000	2773	3501	87.0	214.6	314.7	471.6	707.4	1317.2	1983.9	3292.9
9000	3053	3939	105.8	261.1	382.8	573.7	860.5	1602.3	2413.3	4005.7
10000	3323	4376	125.5	309.6	453.9	680.3	1020.4	1900.0	2861.8	4750.1
11000	3590	4814	145.6	359.2	526.6	789.1	1183.7	2204.2	3319.8	5510.4
12000	3849	5252	166.4	410.6	601.9	902.1	1353.1	2519.6	3795.0	6299.0
13000	4102	5690	187.9	463.5	679.5	1018.4	1527.5	2844.4	4284.1	7110.9
14000	4348	6127	209.8	517.7	758.9	1137.4	1706.1	3176.9	4785.0	7942.3
15000	4588	6565	232.3	573.1	840.2	1259.2	1888.8	3517.0	5297.3	8792.6
16000	4824	7003	255.2	629.6	922.9	1383.2	2074.8	3863.4	5819.0	9658.6
17000	5053	7440	278.4	686.9	1006.9	1509.1	2263.6	4215.0	6348.6	10537.6
18000	5279	7878	302.0	745.0	1092.2	1636.8	2455.3	4571.9	6886.1	11429.7
19000	5500	8316	325.8	803.9	1178.5	1766.2	2649.2	4933.1	7430.0	12332.6
20000	5717	8753	349.9	863.3	1265.5	1896.7	2845.0	5297.6	7979.1	13244.0

Temperature Gradient 1.1°F/100 ft

FLUID • 9 LB/GAL MUD OR BRINE

N_2 VOLUMES IN 100 SCF

DEPTH FT	PW PSI	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG
1000	451	467	1.8	4.5	6.6	9.9	14.8	27.6	41.6	69.0
2000	874	935	7.1	17.6	25.8	38.7	58.1	108.1	162.9	270.3
3000	1271	1403	15.6	38.5	56.5	84.6	126.9	236.3	355.9	590.8
4000	1645	1871	26.9	66.3	97.1	145.6	218.3	406.6	612.4	1016.4
5000	1999	2339	40.5	99.9	146.4	219.4	329.2	612.9	923.1	1532.3
6000	2337	2807	56.1	138.5	203.0	304.2	456.3	849.6	1279.6	2124.0
7000	2660	3275	73.4	181.1	265.5	397.9	596.8	1111.2	1673.7	2778.1
8000	2972	3743	92.0	227.0	332.8	498.7	748.1	1393.1	2098.2	3482.6
9000	3274	4211	111.7	275.5	403.9	605.4	908.0	1690.8	2546.7	4227.0
10000	3570	4679	132.0	325.6	477.3	715.3	1073.0	1997.9	3009.2	4994.8
11000	3858	5147	153.0	377.5	553.4	829.3	1244.0	2316.4	3488.9	5791.1
12000	4138	5615	174.7	431.2	632.0	947.2	1420.9	2645.7	3984.9	6614.4
13000	4412	6083	197.1	486.4	713.0	1068.5	1602.8	2984.5	4495.2	7461.3
14000	4679	6551	220.0	542.9	795.9	1192.8	1789.2	3331.6	5017.9	8328.9
15000	4941	7019	243.4	600.7	880.5	1319.6	1979.4	3685.9	5551.6	9214.7
16000	5196	7487	267.3	659.4	966.7	1448.8	2173.1	4046.5	6094.8	10116.3
17000	5447	7955	291.5	719.1	1054.2	1579.9	2369.8	4412.8	6646.4	11032.0
18000	5693	8423	316.0	779.6	1142.8	1712.8	2569.2	4784.0	7205.5	11960.0
19000	5934	8891	340.8	840.8	1232.6	1847.2	2770.9	5159.5	7771.1	12898.8
20000	6171	9359	365.8	902.6	1323.2	1983.0	2974.6	5538.9	8342.5	13847.1

Temperature Gradient 1.1°F/100 ft

FLUID • 10 LB/GAL MUD OR BRINE

N_2 VOLUMES IN 100 SCF

DEPTH FT	PW PSI	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG
1000	502	520	2.0	5.0	7.4	11.0	16.6	30.8	46.4	77.1
2000	972	1040	7.9	19.6	28.7	43.0	64.5	120.2	181.0	300.4
3000	1414	1560	17.3	42.7	62.6	93.8	140.7	262.0	394.6	655.0
4000	1830	2080	29.7	73.2	107.4	160.9	241.4	449.4	676.9	1123.6
5000	2225	2600	44.6	110.0	161.3	241.8	362.7	675.3	1017.1	1688.2
6000	2603	3120	61.6	152.0	222.8	333.9	500.9	932.7	1404.8	2331.7
7000	2967	3640	80.3	198.0	290.3	435.1	652.6	1215.3	1830.4	3038.2
8000	3318	4160	100.2	247.3	362.5	543.3	814.9	1517.5	2285.6	3793.7
9000	3662	4680	121.0	298.6	437.7	656.0	983.9	1832.2	2759.5	4580.4
10000	3997	5200	142.7	352.0	516.0	773.4	1160.1	2160.1	3253.5	5400.3
11000	4324	5721	165.2	407.6	597.5	895.5	1343.2	2501.2	3767.2	6253.0
12000	4642	6241	188.4	464.9	681.6	1021.5	1532.2	2853.0	4297.1	7132.5
13000	4953	6761	212.3	523.8	767.9	1150.9	1726.3	3214.5	4841.6	8036.2
14000	5257	7281	236.7	584.1	856.3	1283.3	1924.9	3584.3	5398.6	8960.8
15000	5555	7801	261.7	645.6	946.4	1418.3	2127.5	3961.5	5966.8	9903.8
16000	5847	8321	287.0	708.1	1038.0	1555.7	2333.5	4345.2	6544.6	10862.9
17000	6134	8841	312.7	771.5	1131.0	1695.0	2542.6	4734.4	7130.9	11836.1
18000	6415	9361	338.7	835.8	1225.2	1836.2	2754.3	5128.7	7724.6	12821.6
19000	6692	9881	365.1	900.7	1320.4	1978.9	2968.3	5527.2	8325.0	13818.1
20000	6970	10401	390.7	964.1	1413.3	2118.1	3177.1	5916.0	8910.5	14790.0

Temperature Gradient 1.1°F/100 ft

FLUID • 11 LB/GAL MUD

N_2 VOLUMES IN 100 SCF

DEPTH FT	PW PSI	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG
1000	552	572	2.2	5.5	8.1	12.1	18.2	33.9	51.1	84.8
2000	1070	1144	8.7	21.5	31.5	47.3	70.9	132.0	198.8	330.0
3000	1556	1716	19.0	46.8	68.6	102.8	154.2	287.2	432.6	718.0
4000	2015	2288	32.4	80.1	117.4	175.9	263.8	491.3	739.9	1228.1
5000	2452	2860	48.6	119.9	175.7	263.4	395.0	735.6	1107.9	1839.0
6000	2871	3432	66.8	164.9	241.8	362.4	543.5	1012.1	1524.4	2530.2
7000	3275	4004	86.8	214.0	313.8	470.2	705.4	1313.4	1978.3	3283.6
8000	3669	4576	107.8	265.9	389.8	584.3	876.4	1631.9	2457.9	4079.8
9000	4053	5148	129.8	320.2	469.4	703.6	1055.3	1965.1	2959.8	4912.8
10000	4427	5720	152.8	377.0	552.7	828.3	1242.4	2313.5	3484.5	5783.7
11000	4793	6293	176.7	435.9	639.1	957.8	1436.6	2675.1	4029.2	6687.8
12000	5150	6865	201.3	496.7	728.1	1091.1	1636.7	3047.7	4590.3	7619.2
13000	5499	7437	226.6	559.0	819.4	1228.0	1842.0	3430.0	5166.2	8575.0
14000	5841	8009	252.4	622.6	912.7	1367.9	2051.9	3820.8	5754.8	9552.0
15000	6177	8581	278.7	687.5	1007.9	1510.5	2265.7	4219.0	6354.5	10547.4
16000	6506	9153	305.4	753.5	1104.5	1655.4	2483.0	4623.6	6963.9	11559.0
17000	6831	9725	332.3	819.9	1201.9	1801.3	2702.0	5031.3	7578.0	12578.2
18000	7155	10297	359.0	885.6	1298.3	1945.7	2918.6	5434.6	8185.4	13586.5
19000	7474	10869	385.8	951.9	1395.4	2091.3	3137.0	5841.3	8798.0	14603.2
20000	7789	11441	412.9	1018.7	1493.3	2238.0	3357.0	6250.9	9414.9	15627.2

Temperature Gradient 1.1°F/100 ft

FLUID • 12 LB/GAL MUD

N_2 VOLUMES IN 100 SCF

DEPTH FT	PW PSI	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG
1000	603	624	2.4	6.0	8.8	13.2	19.9	37.0	55.7	92.5
2000	1167	1248	9.5	23.4	34.4	51.5	77.2	143.8	216.6	359.5
3000	1698	1872	20.6	50.9	74.6	111.7	167.6	312.1	470.1	780.3
4000	2200	2496	35.1	86.7	127.1	190.5	285.8	532.2	801.5	1330.4
5000	2679	3120	52.4	129.4	189.7	284.2	426.4	793.9	1195.7	1984.7
6000	3140	3744	71.9	177.3	259.9	389.5	584.2	1087.9	1638.5	2719.7
7000	3586	4368	92.9	229.1	335.8	503.3	755.0	1405.8	2117.4	3514.6
8000	4023	4992	114.9	283.5	415.6	622.8	934.3	1739.7	2620.3	4349.2
9000	4447	5616	138.1	340.9	499.7	748.8	1123.3	2091.6	3150.3	5229.0
10000	4862	6241	162.4	400.8	587.5	880.4	1320.7	2459.2	3704.0	6148.0
11000	5267	6865	187.6	462.8	678.4	1016.7	1525.0	2839.6	4277.0	7099.1
12000	5663	7489	213.4	526.6	772.0	1156.9	1735.4	3231.4	4867.1	8078.6
13000	6052	8113	240.0	592.0	867.9	1300.7	1951.1	3633.0	5471.9	9082.5
14000	6433	8737	267.0	658.9	965.8	1447.5	2171.3	4043.1	6089.6	10107.7
15000	6807	9361	294.6	726.9	1065.6	1597.0	2395.5	4460.5	6718.3	11151.3
16000	7180	9985	321.9	794.3	1164.4	1745.1	2617.7	4874.3	7341.5	12185.7
17000	7548	10609	349.4	862.2	1263.9	1894.2	2841.2	5290.6	7968.5	13226.5
18000	7911	11233	377.2	930.6	1364.2	2044.6	3066.9	5710.7	8601.3	14276.7
19000	8268	11857	405.2	999.6	1465.4	2196.2	3294.2	6134.1	9239.0	15335.3
20000	8622	12482	433.3	1069.1	1567.3	2348.9	3523.3	6560.7	9881.5	16401.7

Temperature Gradient 1.1°F/100 ft

FLUID • 14 LB/GAL MUD

N_2 VOLUMES IN 100 SCF

DEPTH FT	PW PSI	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG
1000	702	727	2.8	7.0	10.3	15.4	23.1	43.1	64.9	107.7
2000	1361	1455	11.0	27.2	39.9	59.8	89.7	167.1	251.6	417.7
3000	1982	2183	23.8	58.8	86.2	129.2	193.7	360.8	543.4	901.9
4000	2571	2911	40.3	99.5	145.9	218.7	328.0	610.8	920.0	1527.1
5000	3136	3639	59.7	147.3	215.9	323.6	485.4	903.9	1361.4	2259.8
6000	3682	4366	81.1	200.1	293.4	439.7	659.5	1228.1	1849.7	3070.2
7000	4216	5094	103.9	256.4	375.8	563.3	844.9	1573.3	2369.7	3933.3
8000	4736	5822	128.2	316.3	463.6	694.8	1042.2	1940.6	2923.0	4851.6
9000	5243	6550	153.7	379.1	555.8	832.9	1249.4	2326.5	3504.1	5816.3
10000	5740	7278	180.2	444.6	651.7	976.7	1465.0	2728.0	4108.8	6820.0
11000	6225	8005	207.6	512.1	750.7	1125.1	1687.6	3142.5	4733.1	7856.2
12000	6703	8733	235.7	581.6	852.5	1277.7	1916.5	3568.6	5374.9	8921.5
13000	7173	9461	264.3	652.1	955.9	1432.6	2148.9	4001.4	6026.8	10003.5
14000	7641	10189	292.7	722.3	1058.8	1586.8	2380.2	4432.2	6675.6	11080.4
15000	8102	10917	321.6	793.4	1163.1	1743.1	2614.7	4868.7	7333.1	12171.7
16000	8556	11644	350.7	865.3	1268.5	1901.1	2851.6	5309.9	7997.6	13274.8
17000	9006	12372	380.2	938.0	1375.0	2060.6	3091.0	5755.6	8668.9	14389.0
18000	9449	13100	409.8	1011.2	1482.3	2221.5	3332.3	6204.9	9345.7	15512.4
19000	9887	13828	439.7	1084.9	1590.4	2383.5	3575.3	6657.4	10027.3	16643.6
20000	10320	14556	469.8	1159.1	1699.1	2546.5	3819.8	7112.9	10712.9	17781.6

Temperature Gradient 1.1°F/100 ft

FLUID • 16 LB/GAL MUD

N_2 VOLUMES IN 100 SCF

DEPTH FT	PW PSI	BHP PSI	1" ETU	1½" TBG	2⅜" TBG	2⅞" TBG	3½" TBG	4½" CSG	5½" CSG	7" CSG
1000	804	832	3.3	8.0	11.8	17.6	26.5	49.3	74.2	123.2
2000	1557	1664	12.6	31.0	45.4	68.1	102.2	190.2	286.5	475.6
3000	2268	2496	27.0	66.5	97.5	146.1	219.2	408.1	614.7	1020.4
4000	2946	3328	45.3	111.7	163.8	245.4	368.1	685.5	1032.5	1713.7
5000	3600	4160	66.4	163.8	240.1	359.9	539.8	1005.2	1514.0	2513.0
6000	4236	4992	89.4	220.7	323.5	484.8	727.1	1354.0	2039.4	3385.0
7000	4856	5824	114.2	281.7	412.9	618.9	928.3	1728.6	2603.6	4321.5
8000	5461	6656	140.4	346.4	507.8	761.1	1141.6	2125.7	3201.7	5314.3
9000	6054	7488	167.9	414.2	607.1	909.9	1364.9	2541.5	3827.9	6353.7
10000	6635	8320	196.4	484.5	710.2	1064.4	1596.6	2972.9	4477.7	7432.3
11000	7206	9153	225.7	557.0	816.5	1223.7	1835.5	3417.8	5147.8	8544.5
12000	7774	9985	254.9	629.0	922.1	1381.9	2072.9	3859.9	5813.6	9649.7
13000	8334	10817	284.6	702.3	1029.5	1542.9	2314.4	4309.6	6491.0	10773.9
14000	8887	11649	314.8	776.6	1138.5	1706.3	2559.4	4765.8	7178.1	11914.4
15000	9433	12481	345.3	851.9	1248.8	1871.6	2807.3	5227.5	7873.5	13068.7
16000	9972	13313	376.1	927.9	1360.2	2038.5	3057.8	5693.9	8575.9	14234.6
17000	10505	14145	407.1	1004.5	1472.6	2207.0	3310.4	6164.3	9284.5	15410.7
18000	11032	14977	438.4	1081.8	1585.8	2376.6	3564.9	6638.2	9998.2	16595.4
19000	11554	15809	469.9	1159.5	1699.7	2547.4	3821.0	7115.0	10716.4	17787.6
20000	12070	16641	501.6	1237.6	1814.2	2719.0	4078.5	7594.4	11438.5	18986.1

Temperature Gradient 1.1°F/100 ft

N_2 DISPLACEMENT TABLES

U-TUBE DOWN TUBING

FLUID • API 60 OIL
U-TUBE DOWN TUBING

N_2 VOLUMES IN 100 SCF

DEPTH FT	MAX. PRESSURE PW PSI	BHP PSI	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	308	319	5.9	8.9	8.2	13.4	12.9
2000	597	639	23.6	35.5	32.5	53.4	51.3
3000	868	959	52.8	79.7	73.0	120.0	115.2
4000	1123	1279	93.2	140.6	129.1	212.1	203.8
5000	1362	1599	144.3	217.7	200.3	329.2	316.6
6000	1589	1919	205.6	310.2	286.0	470.3	452.8
7000	1804	2239	276.6	417.4	385.6	634.4	611.4
8000	2009	2559	356.7	538.2	498.4	820.3	791.4
9000	2206	2879	445.3	671.9	623.7	1026.8	991.7
10000	2395	3199	541.7	817.5	760.6	1252.8	1211.3
11000	2576	3519	645.3	973.9	908.4	1496.8	1448.8
12000	2752	3839	755.6	1140.4	1066.2	1757.6	1703.2
13000	2923	4159	871.8	1315.9	1233.3	2033.9	1973.2
14000	3089	4479	993.4	1499.7	1408.9	2324.5	2257.7
15000	3253	4799	1120.0	1690.8	1592.3	2628.1	2555.6
16000	3412	5119	1250.8	1888.5	1782.7	2943.6	2865.6
17000	3567	5439	1385.5	2092.0	1979.4	3269.9	3186.8
18000	3719	5759	1521.3	2297.3	2181.9	3605.8	3518.0
19000	3867	6079	1662.4	2510.4	2387.4	3950.3	3858.4
20000	4011	6399	1807.3	2729.3	2598.6	4298.3	4207.1

Temperature Gradient 1.1°F/100 ft

FLUID • API 40 OIL
U-TUBE DOWN TUBING

N_2 VOLUMES IN 100 SCF

DEPTH FT	MAX. PRESSURE PW PSI	BHP PSI	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	345	357	6.6	10.0	9.1	15.0	14.4
2000	667	714	26.3	39.7	36.3	59.7	57.3
3000	971	1072	59.0	88.9	81.5	134.0	128.7
4000	1255	1429	103.9	156.8	144.0	236.7	227.5
5000	1524	1787	160.8	242.6	223.3	367.1	353.2
6000	1777	2144	228.9	345.3	318.6	523.9	504.6
7000	2019	2501	307.5	463.9	429.1	705.9	680.6
8000	2251	2859	395.9	597.4	553.9	911.6	880.0
9000	2472	3216	493.3	744.5	692.0	1139.6	1101.3
10000	2687	3574	599.0	904.1	842.6	1388.2	1343.2
11000	2893	3931	712.2	1075.0	1004.6	1655.8	1604.2
12000	3094	4288	832.2	1256.1	1177.0	1941.0	1882.8
13000	3290	4646	958.2	1446.4	1359.0	2242.1	2177.6
14000	3484	5003	1089.5	1644.8	1549.5	2557.7	2487.3
15000	3672	5361	1225.5	1850.3	1747.8	2886.3	2810.4
16000	3854	5718	1363.3	2058.6	1952.9	3226.5	3145.5
17000	4032	6075	1506.5	2275.0	2164.0	3577.0	3491.6
18000	4206	6433	1654.2	2498.0	2376.8	3931.0	3847.3
19000	4376	6790	1806.0	2727.3	2598.2	4298.2	4206.2
20000	4543	7148	1962.1	2963.2	2825.7	4675.4	4578.3

Temperature Gradient 1 1°F/100 ft

FLUID • WATER
U-TUBE DOWN TUBING

N_2 VOLUMES IN 100 SCF

DEPTH FT	MAX. PRESSURE PW PSI	BHP PSI	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	418	433	8.0	12.1	11.0	18.1	17.4
2000	810	866	32.0	48.2	44.1	72.5	69.4
3000	1177	1299	71.4	107.7	98.7	162.2	155.8
4000	1522	1732	125.6	189.5	174.2	286.2	275.2
5000	1849	2165	193.8	292.4	269.5	443.1	426.5
6000	2160	2598	275.1	415.1	383.6	631.0	608.1
7000	2457	3031	368.4	555.9	515.2	848.0	818.4
8000	2743	3464	472.6	713.3	663.1	1092.0	1055.2
9000	3019	3897	586.7	885.5	825.8	1360.6	1316.8
10000	3286	4330	709.4	1070.8	1001.9	1651.7	1600.9
11000	3550	4764	839.8	1267.7	1190.0	1963.0	1905.5
12000	3806	5197	976.8	1474.7	1388.9	2292.3	2228.5
13000	4055	5630	1117.8	1687.8	1597.1	2637.4	2568.0
14000	4298	6063	1264.2	1909.0	1813.4	2996.5	2922.1
15000	4535	6496	1416.2	2138.6	2032.8	3361.4	3288.8
16000	4767	6929	1573.7	2376.5	2262.0	3741.4	3659.8
17000	4994	7362	1735.9	2621.6	2498.7	4134.1	4046.9
18000	5217	7795	1902.6	2873.5	2743.0	4539.2	4446.0
19000	5435	8228	2073.1	3131.1	2993.6	4955.2	4857.0
20000	5648	8661	2247.7	3394.9	3250.4	5381.6	5278.5

Temperature Gradient 1.1°F/100 ft

FLUID • 2% KCl WATER
U-TUBE DOWN TUBING

N_2 VOLUMES IN 100 SCF

DEPTH FT	MAX. PRESSURE PW PSI	BHP PSI	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	422	437	8.1	12.2	11.2	18.3	17.6
2000	818	875	32.3	48.7	44.6	73.2	70.1
3000	1189	1313	72.1	108.8	99.8	163.9	157.4
4000	1538	1750	126.9	191.4	176.0	289.2	278.1
5000	1869	2188	195.8	295.4	272.3	447.7	430.9
6000	2183	2626	277.9	419.3	387.5	637.5	614.4
7000	2483	3063	372.1	561.4	520.4	856.5	826.6
8000	2773	3501	477.2	720.1	669.6	1102.7	1065.7
9000	3053	3939	592.2	893.8	833.7	1373.7	1329.6
10000	3323	4376	715.9	1080.6	1011.3	1667.2	1616.1
11000	3590	4814	847.2	1278.9	1200.9	1981.0	1923.2
12000	3849	5252	985.1	1487.3	1401.2	2312.7	2248.7
13000	4102	5690	1126.8	1701.4	1610.8	2660.3	2590.7
14000	4348	6127	1274.2	1924.1	1828.6	3021.6	2947.1
15000	4588	6565	1427.3	2155.3	2049.1	3388.4	3316.2
16000	4824	7003	1585.9	2394.9	2279.9	3771.1	3689.2
17000	5053	7440	1749.1	2641.5	2518.2	4166.4	4078.9
18000	5279	7878	1916.8	2894.9	2764.1	4574.3	4480.7
19000	5500	8316	2088.3	3154.1	3016.3	4993.0	4894.6
20000	5717	8753	2263.9	3419.5	3274.7	5422.0	5318.8

Temperature Gradient 1.1°F/100 ft

FLUID • 9 LB/GAL MUD
U-TUBE DOWN TUBING

N_2 VOLUMES IN 100 SCF

DEPTH FT	MAX. PRESSURE PW PSI	BHP PSI	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	451	467	8.7	13.1	11.9	19.6	18.8
2000	874	935	34.5	52.1	47.7	78.3	75.2
3000	1271	1403	77.1	116.2	106.6	175.2	168.3
4000	1645	1871	135.5	204.4	188.0	308.9	297.1
5000	1999	2339	208.8	315.1	290.5	477.8	460.0
6000	2337	2807	296.0	446.6	413.1	679.6	655.2
7000	2660	3275	395.8	597.2	554.1	912.1	880.7
8000	2972	3743	506.8	764.8	712.0	1172.8	1134.0
9000	3274	4211	627.8	947.6	885.2	1459.0	1413.0
10000	3570	4679	757.6	1143.6	1072.1	1768.0	1715.1
11000	3858	5147	894.9	1351.0	1271.1	2097.4	2038.0
12000	4138	5615	1037.2	1566.0	1480.5	2444.6	2379.3
13000	4412	6083	1185.0	1789.4	1699.1	2807.3	2736.9
14000	4679	6551	1339.0	2022.0	1921.5	3177.1	3108.4
15000	4941	7019	1498.9	2263.6	2154.2	3563.0	3485.0
16000	5196	7487	1663.9	2512.9	2395.3	3962.6	3878.9
17000	5447	7955	1833.4	2769.0	2644.1	4375.6	4285.7
18000	5693	8423	2007.5	3032.1	2899.9	4800.3	4705.5
19000	5934	8891	2185.9	3301.6	3162.2	5235.9	5136.4
20000	6171	9359	2368.3	3577.2	3430.1	5681.0	5577.7

Temperature Gradient 1.1°F/100 ft

FLUID • 10 LB/GAL MUD OR BRINE
U-TUBE DOWN TUBING

N_2 VOLUMES IN 100 SCF

DEPTH FT	MAX. PRESSURE PW PSI	BHP PSI	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	502	520	9.6	14.5	13.3	21.8	20.9
2000	972	1040	38.4	57.9	53.0	87.0	83.5
3000	1414	1560	85.5	129.0	118.4	194.5	186.9
4000	1830	2080	150.2	226.5	208.4	342.6	329.5
5000	2225	2600	231.0	348.5	321.7	529.1	509.6
6000	2603	3120	326.7	492.9	456.5	751.2	724.7
7000	2967	3640	435.6	657.3	611.0	1006.1	972.1
8000	3318	4160	556.1	839.4	783.2	1290.5	1249.1
9000	3662	4680	686.8	1036.7	971.1	1601.3	1552.7
10000	3997	5200	826.1	1247.1	1172.8	1935.2	1879.9
11000	4324	5721	971.1	1466.2	1386.4	2289.2	2227.9
12000	4642	6241	1122.5	1694.9	1607.9	2660.3	2593.9
13000	4953	6761	1280.8	1934.1	1838.1	3039.4	2970.5
14000	5257	7281	1445.4	2182.7	2078.0	3437.1	3362.3
15000	5555	7801	1615.2	2439.4	2327.0	3850.2	3769.2
16000	5847	8321	1790.4	2704.1	2584.2	4277.0	4190.8
17000	6134	8841	1970.6	2976.4	2848.3	4715.8	4625.3
18000	6415	9361	2155.4	3255.5	3119.9	5166.7	5072.0
19000	6692	9881	2344.4	3541.2	3398.2	5629.0	5528.7
20000	6970	10401	2537.5	3833.0	3682.8	6101.9	5997.1

Temperature Gradient 1.1°F/100 ft

FLUID • 11 LB/GAL MUD
U-TUBE DOWN TUBING

N_2 VOLUMES IN 100 SCF

DEPTH FT	MAX. PRESSURE PW PSI	BHP PSI	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	552	572	10.6	16.0	14.6	24.0	23.0
2000	1070	1144	42.2	63.6	58.3	95.7	91.9
3000	1556	1716	93.9	141.7	130.1	213.7	205.4
4000	2015	2288	164.6	248.4	228.7	376.0	361.8
5000	2452	2860	252.8	381.4	352.4	579.6	558.6
6000	2871	3432	356.5	538.0	499.0	821.4	792.8
7000	3275	4004	474.0	715.4	666.3	1097.5	1061.3
8000	3669	4576	603.4	910.7	851.9	1404.2	1360.6
9000	4053	5148	742.7	1121.2	1053.3	1737.6	1687.0
10000	4427	5720	889.1	1342.5	1268.3	2093.9	2037.1
11000	4793	6293	1042.4	1574.0	1492.8	2469.5	2407.5
12000	5150	6865	1203.4	1817.1	1726.8	2855.2	2790.3
13000	5499	7437	1371.1	2070.6	1971.5	3260.9	3189.9
14000	5841	8009	1544.6	2332.7	2226.1	3683.3	3606.3
15000	6177	8581	1724.1	2604.0	2489.0	4120.6	4038.2
16000	6506	9153	1909.0	2883.3	2760.3	4570.4	4483.4
17000	6831	9725	2098.8	3170.2	3039.5	5034.0	4942.0
18000	7155	10297	2293.2	3464.0	3325.9	5509.8	5413.0
19000	7474	10869	2491.9	3764.3	3619.1	5996.9	5895.7
20000	7789	11441	2687.7	4060.7	3918.5	6494.7	6389.3

Temperature Gradient 1.1°F/100 ft

FLUID • 12 LB/GAL MUD
U-TUBE DOWN TUBING

N_2 VOLUMES IN 100 SCF

DEPTH FT	MAX. PRESSURE PW PSI	BHP PSI	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	603	624	11.5	17.4	15.9	26.1	25.1
2000	1167	1248	46.0	69.4	63.5	104.4	100.2
3000	1698	1872	102.3	154.3	141.7	232.9	223.8
4000	2200	2496	179.0	270.0	248.8	409.1	393.7
5000	2679	3120	274.1	413.6	382.6	629.5	606.9
6000	3140	3744	385.6	581.9	540.6	890.1	859.8
7000	3586	4368	511.1	771.5	720.0	1186.5	1148.4
8000	4023	4992	648.5	978.9	918.0	1513.9	1468.5
9000	4447	5616	795.4	1200.9	1131.7	1867.9	1816.0
10000	4862	6241	948.5	1432.1	1358.5	2244.2	2186.7
11000	5267	6865	1110.4	1676.8	1592.8	2633.5	2573.1
12000	5663	7489	1279.7	1932.6	1840.1	3043.4	2976.8
13000	6052	8113	1455.9	2198.8	2098.2	3471.6	3399.0
14000	6433	8737	1638.4	2474.6	2365.3	3915.2	3838.1
15000	6807	9361	1826.8	2759.2	2641.9	4374.3	4291.3
16000	7180	9985	2020.5	3051.9	2926.8	4847.6	4759.5
17000	7548	10609	2219.1	3352.1	3219.6	5334.0	5241.2
18000	7911	11233	2419.0	3654.7	3519.6	5832.6	5735.3
19000	8268	11857	2619.5	3957.7	3826.3	6342.5	6241.0
20000	8622	12482	2823.2	4265.6	4131.8	6856.0	6757.7

Temperature Gradient 1.1°F/100 ft

FLUID • 14 LB/GAL MUD
U-TUBE DOWN TUBING

N_2 VOLUMES IN 100 SCF

DEPTH FT	MAX. PRESSURE PW PSI	BHP PSI	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	702	727	13.5	20.3	18.6	30.5	29.2
2000	1361	1455	53.6	80.8	74.0	121.6	116.7
3000	1982	2183	118.8	179.2	164.7	270.8	260.3
4000	2571	2911	207.0	312.3	288.3	474.1	456.7
5000	3136	3639	315.4	476.0	441.5	726.7	701.4
6000	3682	4366	441.1	665.7	620.7	1022.7	989.4
7000	4216	5094	580.9	876.8	822.2	1355.8	1315.0
8000	4736	5822	731.2	1104.0	1042.0	1720.0	1672.6
9000	5243	6550	890.4	1344.5	1274.9	2107.2	2056.6
10000	5740	7278	1059.0	1599.2	1520.5	2514.4	2457.6
11000	6225	8005	1236.1	1866.8	1779.3	2943.9	2880.8
12000	6703	8733	1421.0	2146.1	2049.9	3392.6	3324.1
13000	7173	9461	1612.8	2435.9	2331.4	3860.0	3785.8
14000	7641	10189	1810.9	2735.4	2622.9	4344.1	4264.7
15000	8102	10917	2014.9	3043.6	2923.5	4843.5	4759.3
16000	8556	11644	2218.6	3351.9	3232.6	5357.2	5268.4
17000	9006	12372	2425.1	3664.1	3546.7	5883.8	5790.9
18000	9449	13100	2635.3	3981.9	3859.9	6405.6	6325.8
19000	9887	13828	2849.0	4304.8	4178.5	6936.2	6852.2
20000	10320	14556	3066.1	4633.0	4502.2	7475.2	7389.7

Temperature Gradient 1 1°F/100 ft

FLUID • 16 LB/GAL MUD
U-TUBE DOWN TUBING

N_2 VOLUMES IN 100 SCF

DEPTH FT	MAX. PRESSURE PW PSI	BHP PSI	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	804	832	15.4	23.3	21.3	34.9	33.4
2000	1557	1664	61.1	92.2	84.5	138.9	133.3
3000	2268	2496	135.1	203.9	187.6	308.4	296.7
4000	2946	3328	234.4	353.6	327.1	538.1	518.7
5000	3600	4160	355.1	535.9	498.5	821.0	793.5
6000	4236	4992	493.3	744.5	697.1	1149.2	1113.8
7000	4856	5824	644.7	973.4	917.7	1514.6	1472.3
8000	5461	6656	806.3	1217.5	1154.3	1907.8	1861.8
9000	6054	7488	978.7	1478.0	1405.6	2324.3	2272.1
10000	6635	8320	1160.8	1753.1	1671.6	2765.7	2707.5
11000	7206	9153	1351.6	2041.3	1951.1	3229.5	3165.2
12000	7774	9985	1550.1	2341.2	2242.7	3713.7	3643.8
13000	8334	10817	1755.5	2651.7	2545.3	4216.3	4141.3
14000	8887	11649	1963.3	2966.1	2857.8	4735.6	4655.9
15000	9433	12481	2173.0	3283.2	3177.6	5270.3	5186.2
16000	9972	13313	2387.0	3606.7	3496.4	5802.5	5728.2
17000	10505	14145	2605.1	3936.4	3821.5	6343.8	6267.6
18000	11032	14977	2826.9	4271.6	4152.2	6894.7	6817.0
19000	11554	15809	3051.2	4610.7	4488.7	7454.8	7375.6
20000	12070	16641	3278.3	4954.2	4830.1	8023.8	7943.0

Temperature Gradient 1.1°F/100 ft

N_2 DISPLACEMENT TABLES

U-TUBE DOWN CASING

FLUID • API 60 OIL
U-TUBE DOWN CASING

N_2 VOLUMES IN 100 SCF

DEPTH FT	MAX. PRESSURE PW PSI	BHP PSI	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	308	319	12.6	19.1	22.0	37.7	40.7
2000	597	639	49.4	74.9	86.4	148.1	159.9
3000	868	959	108.3	164.5	189.6	325.0	351.1
4000	1123	1279	187.5	284.8	328.2	562.6	607.8
5000	1362	1599	284.8	432.5	498.5	854.5	923.1
6000	1589	1919	398.2	604.7	696.8	1194.6	1290.4
7000	1804	2239	525.6	798.2	919.8	1576.9	1703.4
8000	2009	2559	665.3	1010.2	1164.2	1995.9	2156.0
9000	2206	2879	815.5	1238.3	1427.1	2446.5	2642.8
10000	2395	3199	974.7	1480.1	1705.7	2924.1	3158.7
11000	2576	3519	1141.5	1733.4	1997.6	3424.5	3699.3
12000	2752	3839	1314.7	1996.4	2300.8	3944.2	4260.7
13000	2923	4159	1493.3	2267.6	2613.2	4479.8	4839.3
14000	3089	4479	1676.2	2545.3	2933.3	5028.6	5432.1
15000	3253	4799	1860.0	2824.4	3255.0	5579.9	6027.7
16000	3412	5119	2048.1	3110.0	3584.1	6144.2	6637.2
17000	3567	5439	2239.6	3400.9	3919.3	6718.8	7257.9
18000	3719	5759	2434.2	3696.3	4259.8	7302.5	7888.5
19000	3867	6079	2631.5	3995.9	4605.1	7894.4	8527.9
20000	4011	6399	2831.2	4299.2	4954.5	8493.5	9175.1

Temperature Gradient 1.1°F/100 ft

FLUID • API 40 OIL
U-TUBE DOWN CASING

N_2 VOLUMES IN 100 SCF

DEPTH FT	MAX. PRESSURE PW PSI	BHP PSI	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	345	357	14.1	21.4	24.6	42.2	45.6
2000	667	714	55.1	83.7	96.5	165.4	178.7
3000	971	1072	121.0	183.7	211.7	362.9	392.0
4000	1255	1429	209.0	317.4	365.8	627.0	677.3
5000	1524	1787	317.0	481.4	554.8	951.0	1027.3
6000	1777	2144	442.2	671.5	773.9	1326.6	1433.1
7000	2019	2501	582.4	884.4	1019.2	1747.2	1887.4
8000	2251	2859	735.7	1117.1	1287.4	2207.0	2384.1
9000	2472	3216	899.6	1366.0	1574.2	2698.7	2915.3
10000	2687	3574	1072.8	1629.1	1877.5	3218.5	3476.8
11000	2893	3931	1253.4	1903.3	2193.4	3760.2	4061.9
12000	3094	4288	1440.1	2186.9	2520.2	4320.4	4667.1
13000	3290	4646	1632.1	2478.4	2856.2	4896.4	5289.3
14000	3484	5003	1824.1	2769.9	3192.1	5472.2	5911.3
15000	3672	5361	2023.0	3071.9	3540.2	6068.9	6555.9
16000	3854	5718	2225.6	3379.6	3894.7	6676.7	7212.5
17000	4032	6075	2431.7	3692.6	4255.5	7295.2	7880.6
18000	4206	6433	2641.4	4010.9	4622.4	7924.1	8559.9
19000	4376	6790	2853.5	4333.0	4993.5	8560.4	9247.3
20000	4543	7148	3068.3	4659.3	5369.5	9204.9	9943.6

Temperature Gradient 1.1°F/100 ft

FLUID • 2% KCl WATER
U-TUBE DOWN CASING

N_2 VOLUMES IN 100 SCF

DEPTH FT	MAX. PRESSURE PW PSI	BHP PSI	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	422	437	17.2	26.2	30.1	51.7	55.8
2000	818	875	67.5	102.5	118.1	202.5	218.7
3000	1189	1313	147.7	224.2	258.4	443.0	478.6
4000	1538	1750	254.3	386.1	445.0	762.8	824.0
5000	1869	2188	384.0	583.1	672.0	1152.0	1244.5
6000	2183	2626	533.4	809.9	933.4	1600.1	1728.5
7000	2483	3063	698.9	1061.3	1223.1	2096.7	2265.0
8000	2773	3501	878.1	1333.4	1536.7	2634.3	2845.7
9000	3053	3939	1068.2	1622.1	1869.3	3204.6	3461.7
10000	3323	4376	1266.7	1923.5	2216.7	3800.0	4105.0
11000	3590	4814	1469.4	2231.4	2571.5	4408.3	4762.1
12000	3849	5252	1679.7	2550.7	2939.5	5039.2	5443.6
13000	4102	5690	1896.2	2879.5	3318.4	5688.7	6145.2
14000	4348	6127	2118.0	3216.2	3706.4	6353.9	6863.7
15000	4588	6565	2344.7	3560.5	4103.2	7034.1	7598.5
16000	4824	7003	2575.6	3911.1	4507.3	7726.9	8346.9
17000	5053	7440	2810.0	4267.1	4917.5	8430.0	9106.5
18000	5279	7878	3047.9	4628.3	5333.9	9143.8	9877.5
19000	5500	8316	3288.7	4994.0	5755.2	9866.1	10657.8
20000	5717	8753	3531.7	5363.0	6180.6	10595.2	11445.5

Temperature Gradient 1.1°F/100 ft

FLUID • WATER
U-TUBE DOWN CASING

N_2 VOLUMES IN 100 SCF

DEPTH FT	MAX. PRESSURE PW PSI	BHP PSI	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	418	433	17.1	25.9	29.9	51.2	55.3
2000	810	866	66.8	101.4	116.9	200.4	216.5
3000	1177	1299	146.1	221.9	255.7	438.4	473.6
4000	1522	1732	251.8	382.3	440.6	755.3	815.9
5000	1849	2165	380.2	577.4	665.4	1140.7	1232.2
6000	2160	2598	528.2	802.1	924.3	1584.6	1711.8
7000	2457	3031	692.5	1051.6	1211.8	2077.5	2244.2
8000	2743	3464	870.2	1321.4	1522.9	2610.7	2820.2
9000	3019	3897	1058.9	1607.9	1853.0	3176.6	3431.5
10000	3286	4330	1256.2	1907.5	2198.3	3768.5	4070.9
11000	3550	4764	1458.0	2214.0	2551.5	4373.9	4724.9
12000	3806	5197	1666.7	2531.0	2916.8	5000.2	5401.4
13000	4055	5630	1881.7	2857.4	3292.9	5645.0	6098.0
14000	4298	6063	2102.0	3192.0	3678.6	6306.1	6812.2
15000	4535	6496	2327.2	3533.9	4072.6	6981.6	7541.8
16000	4767	6929	2556.5	3882.1	4473.9	7669.6	8285.0
17000	4994	7362	2789.6	4236.0	4881.7	8368.7	9040.2
18000	5217	7795	3025.8	4594.8	5295.2	9077.5	9806.0
19000	5435	8228	3265.0	4958.0	5713.8	9795.0	10581.0
20000	5648	8661	3506.7	5325.0	6136.7	10520.1	11364.3

Temperature Gradient 1.1°F/100 ft

FLUID • 9 LB/GAL MUD OR BRINE
U-TUBE DOWN CASING

N_2 VOLUMES IN 100 SCF

DEPTH FT	MAX. PRESSURE PW PSI	BHP PSI	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	451	467	18.4	27.9	32.2	55.2	59.6
2000	874	935	72.1	109.5	126.2	216.3	233.6
3000	1271	1403	157.6	239.2	275.7	472.7	510.6
4000	1645	1871	271.0	411.6	474.3	813.1	878.4
5000	1999	2339	408.6	620.5	715.1	1225.8	1324.2
6000	2337	2807	566.4	860.1	991.2	1699.2	1835.5
7000	2660	3275	740.8	1125.0	1296.4	2222.5	2400.8
8000	2972	3743	928.7	1410.3	1625.2	2786.1	3009.7
9000	3274	4211	1127.2	1711.7	1972.6	3381.6	3653.0
10000	3570	4679	1332.0	2022.6	2330.9	3995.9	4316.5
11000	3858	5147	1544.3	2345.0	2702.5	4632.8	5004.6
12000	4138	5615	1763.8	2678.4	3086.7	5291.5	5716.1
13000	4412	6083	1989.7	3021.4	3481.9	5969.0	6448.0
14000	4679	6551	2221.0	3372.7	3886.8	6663.1	7197.8
15000	4941	7019	2457.2	3731.4	4300.2	7371.7	7963.3
16000	5196	7487	2697.7	4096.5	4721.0	8093.1	8742.5
17000	5447	7955	2941.9	4467.3	5148.3	8825.6	9533.8
18000	5693	8423	3189.3	4843.1	5581.3	9568.0	10335.8
19000	5934	8891	3439.7	5223.2	6019.5	10319.1	11147.1
20000	6171	9359	3692.6	5607.2	6462.0	11077.7	11966.7

Temperature Gradient 1.1°F/100 ft

FLUID • 10 LB/GAL MUD OR BRINE
U-TUBE DOWN CASING

N_2 VOLUMES IN 100 SCF

DEPTH FT	MAX. PRESSURE PW PSI	BHP PSI	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	502	520	20.6	31.2	36.0	61.7	66.6
2000	972	1040	80.1	121.6	140.2	240.3	259.6
3000	1414	1560	174.7	265.2	305.7	524.0	566.0
4000	1830	2080	299.6	455.0	524.3	898.9	971.0
5000	2225	2600	450.2	683.6	787.8	1350.6	1459.0
6000	2603	3120	621.8	944.2	1088.1	1865.4	2015.1
7000	2967	3640	810.2	1230.3	1417.8	2430.5	2625.6
8000	3318	4160	1011.7	1536.2	1770.4	3035.0	3278.5
9000	3662	4680	1221.4	1854.8	2137.5	3664.3	3958.4
10000	3997	5200	1440.1	2186.8	2520.2	4320.3	4666.9
11000	4324	5721	1667.5	2532.1	2918.1	5002.4	5403.8
12000	4642	6241	1902.0	2888.2	3328.5	5706.0	6163.9
13000	4953	6761	2143.0	3254.2	3750.2	6429.0	6944.9
14000	5257	7281	2389.6	3628.6	4181.7	7168.7	7743.9
15000	5555	7801	2641.0	4010.4	4621.8	7923.1	8558.9
16000	5847	8321	2896.8	4398.8	5069.4	8690.3	9387.7
17000	6134	8841	3156.3	4792.9	5523.5	9468.9	10228.7
18000	6415	9361	3419.1	5192.0	5983.4	10257.3	11080.4
19000	6692	9881	3684.8	5595.5	6448.4	11054.4	11941.5
20000	6970	10401	3944.0	5989.0	6902.0	11832.0	12781.5

Temperature Gradient 1.1°F/100 ft

FLUID • 11 LB/GAL MUD
U-TUBE DOWN CASING

N_2 VOLUMES IN 100 SCF

DEPTH FT	MAX. PRESSURE PW PSI	MAX. PRESSURE BHP PSI	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	552	572	22.6	34.3	39.6	67.8	73.3
2000	1070	1144	88.0	133.6	154.0	264.0	285.2
3000	1556	1716	191.5	290.8	335.1	574.4	620.5
4000	2015	2288	327.5	497.3	573.1	982.5	1061.3
5000	2452	2860	490.4	744.7	858.2	1471.2	1589.2
6000	2871	3432	674.7	1024.6	1180.8	2024.2	2186.6
7000	3275	4004	875.6	1329.7	1532.3	2626.9	2837.7
8000	3669	4576	1087.9	1652.1	1903.9	3263.8	3525.7
9000	4053	5148	1310.1	1989.4	2292.6	3930.2	4245.6
10000	4427	5720	1542.3	2342.0	2699.0	4626.9	4998.2
11000	4793	6293	1783.4	2708.1	3121.0	5350.2	5779.6
12000	5150	6865	2031.8	3085.3	3555.6	6095.4	6584.5
13000	5499	7437	2286.7	3472.4	4001.7	6860.0	7410.5
14000	5841	8009	2547.2	3868.0	4457.6	7641.6	8254.8
15000	6177	8581	2812.6	4271.1	4922.1	8437.9	9115.1
16000	6506	9153	3082.4	4680.7	5394.2	9247.2	9989.2
17000	6831	9725	3354.2	5093.4	5869.8	10062.6	10870.0
18000	7155	10297	3623.1	5501.7	6340.4	10869.2	11741.4
19000	7474	10869	3894.2	5913.4	6814.8	11682.6	12620.1
20000	7789	11441	4167.3	6328.1	7292.7	12501.8	13505.0

Temperature Gradient 1.1°F/100 ft

FLUID • 12 LB/GAL MUD
U-TUBE DOWN CASING

N_2 VOLUMES IN 100 SCF

DEPTH FT	MAX. PRESSURE PW PSI	BHP PSI	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	603	624	24.7	37.5	43.2	74.0	79.9
2000	1167	1248	95.9	145.6	167.8	287.6	310.7
3000	1698	1872	208.1	316.0	364.1	624.2	674.3
4000	2200	2496	354.8	538.7	620.9	1064.3	1149.8
5000	2679	3120	529.3	803.7	926.2	1587.8	1715.2
6000	3140	3744	725.3	1101.3	1269.2	2175.8	2350.4
7000	3586	4368	937.2	1423.2	1640.1	2811.6	3037.3
8000	4023	4992	1159.8	1761.2	2029.6	3479.4	3758.6
9000	4447	5616	1394.4	2117.4	2440.2	4183.2	4518.9
10000	4862	6241	1639.5	2489.5	2869.0	4918.4	5313.0
11000	5267	6865	1893.1	2874.7	3312.9	5679.3	6135.0
12000	5663	7489	2154.3	3271.3	3770.0	6462.9	6981.5
13000	6052	8113	2422.0	3677.9	4238.5	7266.0	7849.1
14000	6433	8737	2695.4	4093.0	4716.9	8086.2	8735.0
15000	6807	9361	2973.7	4515.6	5204.0	8921.1	9637.0
16000	7180	9985	3249.5	4934.5	5686.7	9748.6	10530.9
17000	7548	10609	3527.1	5355.9	6172.4	10581.2	11430.3
18000	7911	11233	3807.1	5781.2	6662.5	11421.4	12337.9
19000	8268	11857	4089.4	6209.8	7156.5	12268.2	13252.7
20000	8622	12482	4373.8	6641.7	7654.1	13121.3	14174.3

Temperature Gradient 1.1°F/100 ft

FLUID • 14 LB/GAL MUD
U-TUBE DOWN CASING

N_2 VOLUMES IN 100 SCF

DEPTH FT	MAX. PRESSURE PW PSI	BHP PSI	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	702	727	28.7	43.6	50.3	86.2	93.1
2000	1361	1455	111.4	169.1	194.9	334.1	361.0
3000	1982	2183	240.5	365.2	420.9	721.5	779.4
4000	2571	2911	407.2	618.4	712.6	1221.7	1319.7
5000	3136	3639	602.6	915.1	1054.6	1807.8	1952.9
6000	3682	4366	818.7	1243.2	1432.7	2456.1	2653.2
7000	4216	5094	1048.9	1592.7	1835.5	3146.6	3399.1
8000	4736	5822	1293.8	1964.6	2264.1	3881.3	4192.8
9000	5243	6550	1551.0	2355.2	2714.3	4653.0	5026.4
10000	5740	7278	1818.7	2761.7	3182.7	5456.0	5893.8
11000	6225	8005	2095.0	3181.3	3666.2	6285.0	6789.3
12000	6703	8733	2379.1	3612.7	4163.4	7137.2	7710.0
13000	7173	9461	2667.6	4050.8	4668.3	8002.8	8645.0
14000	7641	10189	2954.8	4486.9	5170.9	8864.3	9575.7
15000	8102	10917	3245.8	4928.8	5680.1	9737.4	10518.8
16000	8556	11644	3539.9	5375.5	6194.9	10619.8	11472.0
17000	9006	12372	3837.1	5826.7	6714.9	11511.2	12434.9
18000	9449	13100	4136.6	6281.6	7239.1	12409.9	13405.7
19000	9887	13828	4438.3	6739.6	7767.0	13314.9	14383.4
20000	10320	14556	4741.8	7200.4	8298.1	14225.3	15366.8

Temperature Gradient 1.1°F/100 ft

FLUID • 16 LB/GAL MUD
U-TUBE DOWN CASING

N_2 VOLUMES IN 100 SCF

DEPTH FT	MAX. PRESSURE PW PSI	BHP PSI	2⅜" 4½" ANN	2⅞" 5½" ANN	2⅜" 5½" ANN	2⅞" 7" ANN	2⅜" 7" ANN
1000	804	832	32.9	49.9	57.5	98.6	106.5
2000	1557	1664	126.8	192.6	222.0	380.5	411.0
3000	2268	2496	272.1	413.2	476.2	816.3	881.8
4000	2946	3328	457.0	693.9	799.7	1371.0	1481.0
5000	3600	4160	670.1	1017.6	1172.7	2010.4	2171.8
6000	4236	4992	902.7	1370.7	1579.7	2708.0	2925.3
7000	4856	5824	1152.4	1750.0	2016.7	3457.2	3734.7
8000	5461	6656	1417.1	2152.0	2480.0	4251.4	4592.6
9000	6054	7488	1694.3	2572.9	2965.1	5083.0	5490.9
10000	6635	8320	1981.9	3009.6	3468.4	5945.8	6423.0
11000	7206	9153	2278.5	3460.0	3987.4	6835.6	7384.1
12000	7774	9985	2573.2	3907.5	4503.2	7719.7	8339.2
13000	8334	10817	2873.1	4362.8	5027.8	8619.2	9310.8
14000	8887	11649	3177.2	4824.6	5560.1	9531.5	10296.4
15000	9433	12481	3485.0	5292.0	6098.7	10454.9	11293.9
16000	9972	13313	3795.9	5764.1	6642.8	11387.7	12301.5
17000	10505	14145	4109.5	6240.4	7191.7	12328.5	13317.9
18000	11032	14977	4425.4	6720.1	7744.5	13276.3	14341.7
19000	11554	15809	4743.3	7202.9	8300.9	14230.0	15372.0
20000	12070	16641	5063.0	7688.2	8860.2	15188.9	16407.7

Temperature Gradient 1.1°F/100 ft

NITROGEN VOLUME FACTORS

NITROGEN VOLUME FACTOR (BN_2)

The following tables provide nitrogen volume factors (BN_2) for various temperatures and pressures. They are in units of standard cubic feet per barrel of space (SCF/BBL) and are based on standard conditions of 14.7 psia and 60°F.

$$\frac{SCF}{BBL} = 198.6 \frac{P}{ZT}$$

where P = Pressure, psi,
T = Temperature, °Rankine,
Z = Nitrogen Deviation Factor.

SCF* OF NITROGEN PER BARREL OF SPACE

Pressure	Temperature Degrees Fahrenheit													
PSIG	40	60	80	100	120	140	160	180	200	220	240	260	280	300
100	39	38	36	35	34	33	32	31	30	29	28	27	26	26
200	79	76	73	70	68	66	64	62	60	58	56	55	53	52
300	119	114	110	106	102	99	96	93	90	87	85	82	80	78
400	158	152	147	141	136	132	128	124	120	116	113	110	107	104
500	198	190	183	177	171	165	160	155	150	146	141	137	134	130
600	240	230	221	212	204	197	190	184	178	173	168	163	158	154
700	280	268	258	248	238	230	222	214	208	201	195	189	184	179
800	320	307	294	283	272	262	253	245	237	229	222	216	210	204
900	360	345	331	318	306	295	284	275	266	257	250	242	236	229
1000	400	383	367	353	339	327	315	305	295	285	277	269	261	254
1100	440	421	404	388	373	359	346	334	323	313	304	295	287	279
1200	480	459	440	422	406	391	377	364	352	341	330	321	312	303
1300	519	496	476	457	439	423	407	393	380	368	357	346	337	328
1400	558	534	511	491	472	454	438	423	408	395	383	372	361	352
1500	597	571	547	525	504	485	468	452	436	422	409	397	386	376
1600	636	608	582	559	537	516	498	480	464	449	435	422	411	400
1700	674	644	617	592	569	547	527	509	492	476	461	447	435	423
1800	712	681	652	625	601	578	557	537	519	502	487	472	459	447
1900	749	717	686	658	632	608	586	565	546	528	512	497	483	470
2000	787	752	720	691	663	638	615	593	573	554	537	521	506	493

*Reference conditions for the SCF of gas are 60°F and 14.7 psi

SCF* OF NITROGEN PER BARREL OF SPACE

Pressure	Temperature Degrees Fahrenheit													
PSIG	40	60	80	100	120	140	160	180	200	220	240	260	280	300
2100	823	787	754	723	694	668	643	621	600	580	562	545	530	516
2200	860	822	787	755	725	697	672	648	626	606	587	569	553	538
2300	895	856	820	787	755	727	700	675	652	631	611	593	576	561
2400	930	890	853	818	785	756	728	702	678	656	635	616	599	583
2500	965	923	885	849	815	784	755	728	704	681	659	640	622	605
2600	999	956	916	879	845	812	782	755	729	705	683	663	644	627
2700	1033	989	948	909	873	840	809	781	754	729	707	686	666	649
2800	1066	1021	978	939	902	868	836	806	779	753	730	708	688	670
2900	1098	1052	1009	968	930	895	862	832	803	777	753	731	710	691
3000	1130	1083	1038	997	958	922	888	857	828	801	776	753	732	713
3100	1161	1113	1068	1025	986	948	914	882	852	824	798	775	753	733
3200	1192	1143	1096	1053	1013	975	939	906	875	847	820	796	774	754
3300	1222	1172	1125	1081	1039	1000	964	930	899	869	842	818	795	774
3400	1251	1200	1153	1108	1065	1026	989	954	922	892	864	839	816	795
3500	1279	1228	1180	1134	1091	1051	1013	978	945	914	886	860	836	815
3600	1307	1255	1207	1160	1117	1075	1037	1001	967	936	907	880	856	834
3700	1334	1282	1233	1186	1142	1100	1060	1024	989	957	928	901	876	854
3800	1361	1308	1258	1211	1166	1124	1084	1046	1011	979	949	921	896	873
3900	1386	1334	1284	1236	1190	1147	1106	1068	1033	1000	969	941	915	892
4000	1411	1359	1308	1260	1214	1170	1129	1090	1054	1020	989	961	935	911

*Reference conditions for the SCF of gas are 60°F and 14.7 psi

SCF* OF NITROGEN PER BARREL OF SPACE

Pressure	Temperature Degrees Fahrenheit													
PSIG	40	60	80	100	120	140	160	180	200	220	240	260	280	300
4100	1457	1395	1337	1284	1236	1191	1149	1111	1075	1042	1011	982	955	930
4200	1482	1419	1361	1307	1258	1213	1171	1132	1096	1062	1031	1001	974	949
4300	1506	1442	1384	1330	1280	1234	1192	1153	1116	1082	1050	1020	993	967
4400	1530	1466	1407	1352	1302	1256	1213	1173	1136	1101	1069	1039	1011	985
4500	1554	1489	1429	1374	1324	1277	1234	1193	1156	1121	1088	1058	1029	1003
4600	1577	1512	1452	1396	1345	1298	1254	1213	1176	1140	1107	1076	1048	1021
4700	1600	1534	1474	1418	1366	1319	1274	1233	1195	1159	1126	1095	1066	1038
4800	1622	1556	1495	1439	1387	1339	1294	1253	1214	1178	1144	1113	1083	1056
4900	1645	1578	1517	1460	1408	1359	1314	1272	1233	1197	1163	1131	1101	1073
5000	1667	1600	1538	1481	1428	1379	1334	1292	1252	1215	1181	1149	1119	1090
5100	1688	1621	1559	1501	1448	1399	1353	1311	1271	1234	1199	1166	1136	1107
5200	1710	1642	1579	1522	1468	1419	1373	1330	1289	1252	1217	1184	1153	1124
5300	1731	1663	1600	1542	1488	1438	1392	1348	1308	1270	1235	1201	1170	1141
5400	1752	1683	1620	1561	1507	1457	1410	1367	1326	1288	1252	1218	1187	1157
5500	1772	1703	1640	1581	1527	1476	1429	1385	1344	1305	1269	1236	1204	1174
5600	1792	1723	1659	1600	1546	1495	1447	1403	1362	1323	1287	1252	1220	1190
5700	1812	1743	1679	1619	1564	1513	1466	1421	1379	1340	1304	1269	1237	1206
5800	1832	1762	1698	1638	1583	1532	1484	1439	1397	1357	1321	1286	1253	1222
5900	1851	1782	1717	1657	1601	1550	1501	1456	1414	1374	1337	1302	1269	1238
6000	1871	1800	1736	1675	1620	1568	1519	1474	1431	1391	1354	1319	1285	1254

*Reference conditions for the SCF of gas are 60°F and 14.7 psi

SCF* OF NITROGEN PER BARREL OF SPACE

Pressure	Temperature Degrees Fahrenheit													
PSIG	40	60	80	100	120	140	160	180	200	220	240	260	280	300
6100	1890	1819	1754	1694	1638	1585	1537	1491	1448	1408	1370	1335	1301	1269
6200	1908	1838	1772	1712	1655	1603	1554	1508	1465	1425	1387	1351	1317	1285
6300	1927	1856	1790	1730	1673	1620	1571	1525	1482	1441	1403	1367	1333	1300
6400	1945	1874	1808	1747	1690	1638	1588	1542	1498	1457	1419	1382	1348	1316
6500	1963	1892	1826	1765	1708	1655	1605	1558	1515	1473	1435	1398	1363	1331
6600	1981	1909	1843	1782	1725	1671	1621	1575	1531	1489	1450	1413	1379	1346
6700	1999	1927	1861	1799	1742	1688	1638	1591	1547	1505	1466	1429	1394	1361
6800	2016	1944	1878	1816	1758	1705	1654	1607	1563	1521	1481	1444	1409	1375
6900	2033	1961	1894	1833	1775	1721	1670	1623	1578	1536	1497	1459	1424	1390
7000	2050	1978	1911	1849	1791	1737	1686	1639	1594	1552	1512	1474	1438	1404
7100	2067	1995	1928	1865	1807	1753	1702	1654	1609	1567	1527	1489	1453	1419
7200	2083	2011	1944	1882	1823	1769	1718	1670	1625	1582	1542	1504	1468	1433
7300	2100	2027	1960	1898	1839	1785	1733	1685	1640	1597	1557	1518	1482	1447
7400	2116	2043	1976	1913	1855	1800	1749	1701	1655	1612	1571	1533	1496	1461
7500	2132	2059	1992	1929	1870	1816	1764	1716	1670	1627	1586	1547	1510	1475
7600	2147	2075	2007	1944	1886	1831	1779	1731	1685	1641	1600	1561	1524	1489
7700	2163	2090	2023	1960	1901	1846	1794	1745	1699	1656	1615	1576	1538	1503
7800	2178	2106	2038	1975	1916	1861	1809	1760	1714	1670	1629	1590	1552	1516
7900	2194	2121	2053	1990	1931	1876	1824	1775	1728	1685	1643	1603	1566	1530
8000	2209	2136	2068	2005	1946	1890	1838	1789	1743	1699	1657	1617	1580	1543

*Reference conditions for the SCF of gas are 60°F and 14.7 psi

SCF* OF NITROGEN PER BARREL OF SPACE

Pressure	Temperature Degrees Fahrenheit													
PSIG	40	60	80	100	120	140	160	180	200	220	240	260	280	300
8100	2232	2156	2086	2021	1960	1904	1851	1801	1755	1711	1670	1630	1594	1559
8200	2246	2170	2100	2035	1974	1917	1864	1815	1768	1724	1682	1643	1606	1571
8300	2259	2183	2113	2048	1987	1930	1877	1828	1781	1737	1695	1656	1619	1583
8400	2272	2196	2126	2061	2000	1943	1890	1840	1794	1749	1708	1668	1631	1596
8500	2285	2209	2139	2074	2013	1956	1903	1853	1806	1762	1720	1681	1643	1608
8600	2298	2222	2152	2087	2026	1969	1916	1866	1819	1775	1733	1693	1656	1620
8700	2311	2235	2165	2099	2039	1982	1928	1878	1831	1787	1745	1705	1668	1632
8800	2323	2248	2177	2112	2051	1994	1941	1891	1844	1799	1757	1718	1680	1644
8900	2336	2260	2190	2124	2064	2007	1953	1903	1856	1811	1769	1730	1692	1656
9000	2348	2272	2202	2137	2076	2019	1965	1915	1868	1823	1781	1741	1704	1668
9100	2360	2284	2214	2149	2088	2031	1978	1927	1880	1835	1793	1753	1715	1679
9200	2372	2296	2226	2161	2100	2043	1990	1939	1892	1847	1805	1765	1727	1691
9300	2384	2308	2238	2173	2112	2055	2001	1951	1904	1859	1817	1776	1738	1702
9400	2396	2320	2250	2185	2124	2067	2013	1963	1915	1871	1828	1788	1750	1713
9500	2407	2332	2262	2196	2135	2078	2025	1974	1927	1882	1840	1799	1761	1725
9600	2419	2343	2273	2208	2147	2090	2036	1986	1938	1894	1851	1811	1772	1736
9700	2430	2355	2284	2219	2158	2101	2048	1997	1950	1905	1862	1822	1783	1747
9800	2441	2366	2296	2230	2170	2113	2059	2009	1961	1916	1873	1833	1795	1758
9900	2452	2377	2307	2242	2181	2124	2070	2020	1972	1927	1885	1844	1805	1769
10000	2463	2388	2318	2253	2192	2135	2081	2031	1983	1938	1896	1855	1816	1779

*Reference conditions for the SCF of gas are 60°F and 14.7 psi

SCF* OF NITROGEN PER BARREL OF SPACE

Pressure	Temperature Degrees Fahrenheit													
PSIG	40	60	80	100	120	140	160	180	200	220	240	260	280	300
10100	2474	2399	2329	2264	2203	2146	2092	2042	1994	1949	1906	1866	1827	1790
10200	2485	2410	2340	2275	2214	2157	2103	2053	2005	1960	1917	1877	1838	1801
10300	2495	2420	2350	2285	2224	2168	2114	2064	2016	1971	1928	1887	1848	1811
10400	2506	2431	2361	2296	2235	2178	2125	2074	2027	1981	1939	1898	1859	1822
10500	2516	2441	2371	2306	2246	2189	2135	2085	2037	1992	1949	1908	1869	1832
10600	2526	2451	2382	2317	2256	2199	2146	2095	2048	2002	1960	1919	1880	1843
10700	2537	2462	2392	2327	2266	2210	2156	2106	2058	2013	1970	1929	1890	1853
10800	2547	2472	2402	2337	2277	2220	2166	2116	2068	2023	1980	1939	1900	1863
10900	2556	2482	2412	2347	2287	2230	2177	2126	2079	2033	1990	1949	1910	1873
11000	2566	2492	2422	2357	2297	2240	2187	2136	2089	2043	2000	1960	1920	1883
11100	2576	2501	2432	2367	2307	2250	2197	2146	2099	2054	2011	1970	1930	1893
11200	2586	2511	2442	2377	2317	2260	2207	2156	2109	2063	2020	1979	1940	1903
11300	2595	2521	2451	2387	2327	2270	2217	2166	2119	2073	2030	1989	1950	1912
11400	2605	2530	2461	2397	2336	2280	2226	2176	2128	2083	2040	1999	1960	1922
11500	2614	2540	2470	2406	2346	2289	2236	2186	2138	2093	2050	2009	1969	1932
11600	2623	2549	2480	2416	2355	2299	2246	2195	2148	2103	2059	2018	1979	1941
11700	2632	2558	2489	2425	2365	2308	2255	2205	2157	2112	2069	2028	1989	1951
11800	2641	2567	2498	2434	2374	2318	2265	2214	2167	2122	2079	2037	1998	1960
11900	2650	2576	2507	2443	2383	2327	2274	2224	2176	2131	2088	2047	2007	1970
12000	2659	2585	2517	2452	2393	2336	2283	2233	2186	2140	2097	2056	2017	1979

*Reference conditions for the SCF of gas are 60°F and 14.7 psi

SCF* OF NITROGEN PER BARREL OF SPACE

Pressure	Temperature Degrees Fahrenheit													
PSIG	40	60	80	100	120	140	160	180	200	220	240	260	280	300
12100	2668	2594	2525	2461	2402	2345	2292	2242	2195	2150	2107	2065	2026	1988
12200	2676	2603	2534	2470	2411	2354	2301	2251	2204	2159	2116	2075	2035	1997
12300	2685	2611	2543	2479	2420	2363	2310	2260	2213	2168	2125	2084	2044	2006
12400	2693	2620	2552	2488	2428	2372	2319	2269	2222	2177	2134	2093	2053	2015
12500	2702	2629	2560	2497	2437	2381	2328	2278	2231	2186	2143	2102	2062	2024
12600	2710	2637	2569	2505	2446	2390	2337	2287	2240	2195	2152	2111	2071	2033
12700	2718	2645	2577	2514	2454	2399	2346	2296	2249	2204	2161	2119	2080	2042
12800	2727	2654	2586	2522	2463	2407	2355	2305	2257	2212	2169	2128	2089	2051
12900	2735	2662	2594	2531	2471	2416	2363	2313	2266	2221	2178	2137	2097	2059
13000	2743	2670	2602	2539	2480	2424	2372	2322	2275	2230	2187	2146	2106	2068
13100	2751	2678	2610	2547	2488	2433	2380	2330	2283	2238	2195	2154	2115	2076
13200	2759	2686	2618	2555	2496	2441	2388	2339	2292	2247	2204	2163	2123	2085
13300	2766	2694	2626	2564	2505	2449	2397	2347	2300	2255	2212	2171	2132	2093
13400	2774	2702	2634	2572	2513	2457	2405	2356	2308	2264	2221	2180	2140	2102
13500	2782	2709	2642	2580	2521	2465	2413	2364	2317	2272	2229	2188	2148	2110
13600	2789	2717	2650	2587	2529	2473	2421	2372	2325	2280	2237	2196	2157	2118
13700	2797	2725	2658	2595	2537	2481	2429	2380	2333	2288	2246	2204	2165	2127
13800	2804	2732	2665	2603	2544	2489	2437	2388	2341	2296	2254	2213	2173	2135
13900	2812	2740	2673	2611	2552	2497	2445	2396	2349	2305	2262	2221	2181	2143
14000	2819	2747	2681	2618	2560	2505	2453	2404	2357	2313	2270	2229	2189	2151

*Reference conditions for the SCF of gas are 60°F and 14.7 psi

SCF* OF NITROGEN PER BARREL OF SPACE

Pressure	Temperature Degrees Fahrenheit													
PSIG	40	60	80	100	120	140	160	180	200	220	240	260	280	300
14100	2826	2755	2688	2626	2568	2513	2461	2412	2365	2320	2278	2237	2197	2159
14200	2833	2762	2695	2633	2575	2520	2469	2420	2373	2328	2286	2245	2205	2167
14300	2840	2769	2703	2641	2583	2528	2476	2427	2381	2336	2294	2252	2213	2175
14400	2847	2776	2710	2648	2590	2536	2484	2435	2388	2344	2301	2260	2221	2182
14500	2854	2783	2717	2655	2598	2543	2491	2443	2396	2352	2309	2268	2229	2190
14600	2861	2790	2724	2663	2605	2550	2499	2450	2404	2359	2317	2276	2236	2198
14700	2868	2797	2731	2670	2612	2558	2506	2458	2411	2367	2324	2283	2244	2206
14800	2875	2804	2738	2677	2619	2565	2514	2465	2419	2374	2332	2291	2252	2213
14900	2882	2811	2745	2684	2627	2572	2521	2473	2426	2382	2340	2299	2259	2221
15000	2888	2818	2752	2691	2634	2580	2528	2480	2434	2389	2347	2306	2267	2228
15100	2895	2825	2759	2698	2641	2587	2536	2487	2441	2397	2354	2314	2274	2236
15200	2902	2831	2766	2705	2648	2594	2543	2494	2448	2404	2362	2321	2282	2243
15300	2908	2838	2773	2712	2655	2601	2550	2502	2456	2411	2369	2328	2289	2251
15400	2915	2845	2779	2719	2661	2608	2557	2509	2463	2419	2376	2336	2296	2258
15500	2921	2851	2786	2725	2668	2615	2564	2516	2470	2426	2384	2343	2303	2265
15600	2927	2857	2793	2732	2675	2622	2571	2523	2477	2433	2391	2350	2311	2272
15700	2934	2864	2799	2739	2682	2628	2578	2530	2484	2440	2398	2357	2318	2280
15800	2940	2870	2806	2745	2688	2635	2585	2537	2491	2447	2405	2364	2325	2287
15900	2946	2877	2812	2752	2695	2642	2591	2544	2498	2454	2412	2371	2332	2294
16000	2952	2883	2818	2758	2702	2648	2598	2550	2505	2461	2419	2378	2339	2301

*Reference conditions for the SCF of gas are 60°F and 14.7 psi

SCF* OF NITROGEN PER BARREL OF SPACE

Pressure	Temperature Degrees Fahrenheit													
PSIG	40	60	80	100	120	140	160	180	200	220	240	260	280	300
16100	2958	2889	2825	2765	2708	2655	2605	2557	2512	2468	2426	2385	2346	2308
16200	2964	2895	2831	2771	2715	2662	2612	2564	2518	2475	2433	2392	2353	2315
16300	2970	2901	2837	2777	2721	2668	2618	2571	2525	2482	2440	2399	2360	2322
16400	2976	2907	2843	2784	2727	2675	2625	2577	2532	2488	2446	2406	2367	2329
16500	2982	2913	2849	2790	2734	2681	2631	2584	2538	2495	2453	2413	2374	2335
16600	2988	2919	2855	2796	2740	2687	2638	2590	2545	2502	2460	2420	2380	2342
16700	2994	2925	2861	2802	2746	2694	2644	2597	2552	2508	2467	2426	2387	2349
16800	2999	2931	2867	2808	2752	2700	2650	2603	2558	2515	2473	2433	2394	2356
16900	3005	2937	2873	2814	2759	2706	2657	2610	2565	2521	2480	2440	2400	2362
17000	3011	2943	2879	2820	2765	2712	2663	2616	2571	2528	2486	2446	2407	2369
17100	3016	2948	2885	2826	2771	2719	2669	2622	2577	2534	2493	2453	2414	2375
17200	3022	2954	2891	2832	2777	2725	2675	2629	2584	2541	2499	2459	2420	2382
17300	3027	2960	2897	2838	2783	2731	2682	2635	2590	2547	2506	2466	2427	2389
17400	3033	2965	2902	2844	2789	2737	2688	2641	2596	2553	2512	2472	2433	2395
17500	3038	2971	2908	2849	2795	2743	2694	2647	2602	2560	2518	2478	2439	2401
17600	3044	2976	2914	2855	2800	2749	2700	2653	2609	2566	2525	2485	2446	2408
17700	3049	2982	2919	2861	2806	2755	2706	2659	2615	2572	2531	2491	2452	2414
17800	3054	2987	2925	2867	2812	2760	2712	2665	2621	2578	2537	2497	2458	2420
17900	3059	2992	2930	2872	2818	2766	2718	2671	2627	2584	2543	2503	2465	2427
18000	3065	2998	2936	2878	2823	2772	2723	2677	2633	2590	2549	2510	2471	2433

*Reference conditions for the SCF of gas are 60°F and 14.7 psi

SCF* OF NITROGEN PER BARREL OF SPACE

Pressure	Temperature Degrees Fahrenheit													
PSIG	40	60	80	100	120	140	160	180	200	220	240	260	280	300
18100	3070	3003	2941	2883	2829	2778	2729	2683	2639	2596	2555	2516	2477	2439
18200	3075	3008	2946	2889	2834	2783	2735	2689	2645	2602	2562	2522	2483	2445
18300	3080	3014	2952	2894	2840	2789	2741	2695	2651	2608	2568	2528	2489	2451
18400	3085	3019	2957	2900	2846	2795	2746	2700	2657	2614	2573	2534	2495	2457
18500	3090	3024	2962	2905	2851	2800	2752	2706	2662	2620	2579	2540	2501	2463
18600	3095	3029	2968	2910	2856	2806	2758	2712	2668	2626	2585	2546	2507	2469
18700	3100	3034	2973	2916	2862	2811	2763	2718	2674	2632	2591	2552	2513	2475
18800	3105	3039	2978	2921	2867	2817	2769	2723	2680	2638	2597	2558	2519	2481
18900	3110	3044	2983	2926	2873	2822	2774	2729	2685	2643	2603	2563	2525	2487
19000	3115	3049	2988	2931	2878	2827	2780	2734	2691	2649	2609	2569	2531	2493
19100	3120	3054	2993	2936	2883	2833	2785	2740	2697	2655	2614	2575	2537	2499
19200	3124	3059	2998	2941	2888	2838	2791	2745	2702	2660	2620	2581	2542	2505
19300	3129	3064	3003	2947	2893	2843	2796	2751	2708	2666	2626	2586	2548	2510
19400	3134	3069	3008	2952	2899	2849	2801	2756	2713	2671	2631	2592	2554	2516
19500	3138	3073	3013	2957	2904	2854	2807	2762	2719	2677	2637	2598	2559	2522
19600	3143	3078	3018	2962	2909	2859	2812	2767	2724	2683	2642	2603	2565	2528
19700	3148	3083	3023	2966	2914	2864	2817	2772	2729	2688	2648	2609	2571	2533
19800	3152	3087	3027	2971	2919	2869	2822	2778	2735	2693	2653	2614	2576	2539
19900	3157	3092	3032	2976	2924	2874	2827	2783	2740	2699	2659	2620	2582	2544
20000	3161	3097	3037	2981	2929	2879	2833	2788	2745	2704	2664	2625	2587	2550

*Reference conditions for the SCF of gas are 60°F and 14.7 psi

N_2 REQUIREMENTS FOR FOAMED FLUIDS

NITROGEN REQUIREMENTS — PRESSURE VS FOAM QUALITY

The tables in this section are for determining the volume of nitrogen required to obtain a specific foam quality at a given pressure. Foam quality is the ratio of N_2 gas to the total volume of gas and liquid.

The nitrogen volume is reported in SCF of N_2 per BBL of liquid (i.e., water, acid, oil, etc.).

Using the Tables

To use these tables, find the table calculated at a temperature close to the given well temperature. Read down the left-hand column to the desired pressure. Then read over to the column representing the desired foam quality. (Note: Some interpolation may be necessary to improve the accuracy of volume requirements.)

Example

How much N_2 is needed to make a 75 quality foam at 6,500 psi and 150°F? From Section 310 — 4,897 SCF N_2/BBL Liquid.

NITROGEN REQUIREMENTS

SCF N_2/BBL LIQUID† REQUIRED AT 100°F

Pressure	Foam Quality																
(PSI)	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	9
500	20	32	46	61	78	98	122	149	183	223	274	339	426	548	730	1034	1
1000	40	63	90	119	154	193	239	293	358	438	537	665	836	1075	1433	2030	3
1500	59	94	133	177	227	285	353	434	530	648	795	984	1237	1590	2120	3004	4
2000	77	123	174	232	298	375	464	569	696	850	1044	1292	1623	2087	2783	3942	6
2500	95	151	213	284	366	459	569	698	853	1043	1280	1585	1991	2560	3413	4835	7
3000	111	177	250	334	429	539	667	819	1001	1224	1502	1859	2336	3003	4004	5673	9
3500	126	201	284	379	488	613	759	931	1138	1391	1707	2113	2655	3414	4552	6449	10
4000	141	223	316	422	542	681	843	1035	1265	1546	1897	2349	2952	3795	5060	7168	11
4500	153	243	345	459	591	742	919	1128	1378	1684	2067	2559	3216	4134	5512	7809	12
5000	165	262	371	495	536	799	990	1214	1484	1814	2227	2757	3464	4453	5938	8412	13
5500	176	280	395	528	679	853	1056	1296	1584	1937	2377	2942	3697	4753	6338	8978	14
6000	187	296	420	560	719	904	1119	1374	1679	2052	2518	3118	3917	5036	6715	9513	15
6500	196	312	442	589	758	952	1179	1446	1768	2161	2652	3283	4125	5303	7071	10018	15
7000	206	327	463	617	794	997	1235	1515	1852	2264	2778	3440	4322	5556	7408	10495	16
7500	215	341	483	644	828	1040	1288	1581	1932	2361	2898	3588	4508	5796	7728	10948	17
8000	223	353	502	670	861	1082	1340	1644	2009	2456	3014	3732	4689	6028	8038	11387	18
8500	231	366	519	692	890	1118	1384	1698	2076	2537	3113	3855	4843	6227	8303	11762	18
9000	238	377	535	713	916	1151	1426	1750	2138	2614	3208	3971	4990	6415	8553	12117	19
9500	244	388	549	733	942	1183	1465	1798	2198	2686	3297	4082	5128	6593	8791	12454	19
10000	250	398	564	751	966	1214	1503	1844	2254	2755	3381	4186	5260	6763	9017	12774	20

†water, acid or oil

NITROGEN REQUIREMENTS

SCF N_2/BBL LIQUID† REQUIRED AT 100°F (Cont'd)

Pressure	Foam Quality															
(PSI)	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85
10500	256	407	577	769	989	1243	1538	1888	2308	2821	3462	4286	5385	6923	9231	13077
11000	262	416	590	786	1011	1270	1572	1930	2359	2883	3538	4380	5504	7076	9435	13366
11500	267	425	602	802	1032	1296	1605	1970	2407	2942	3611	4471	5617	7222	9629	13641
12000	273	433	613	818	1052	1321	1636	2007	2454	2999	3680	4557	5725	7361	9814	13904
12500	278	441	624	833	1070	1345	1665	2044	2498	3053	3747	4639	5828	7493	9991	14154
13000	282	448	635	847	1089	1368	1693	2078	2540	3104	3810	4717	5927	7620	10160	14393
13500	287	455	645	860	1106	1389	1720	2111	2580	3154	3871	4792	6021	7741	10322	14622
14000	291	462	655	873	1122	1410	1746	2143	2619	3201	3929	4864	6111	7857	10476	14842
14500	295	469	664	885	1138	1430	1771	2173	2656	3246	3984	4933	6198	7969	10625	15052
15000	299	475	673	897	1154	1449	1795	2202	2692	3290	4038	4999	6281	8075	10767	15253
15500	303	481	681	909	1168	1468	1817	2230	2726	3332	4089	5062	6361	8178	10904	15447
16000	307	487	690	920	1182	1485	1839	2257	2759	3372	4138	5123	6437	8276	11035	15633
16500	310	492	698	930	1196	1502	1860	2283	2790	3410	4185	5182	6511	8371	11161	15812
17000	313	498	705	940	1209	1519	1880	2308	2821	3448	4231	5238	6582	8462	11283	15984
17500	317	503	712	950	1221	1535	1900	2332	2850	3483	4275	5293	6650	8550	11400	16150
18000	320	508	720	959	1233	1550	1919	2355	2878	3518	4317	5345	6716	8634	11513	16309
18500	323	513	726	968	1245	1564	1937	2377	2905	3551	4358	5396	6779	8716	11621	16463
19000	326	517	733	977	1256	1579	1954	2399	2932	3583	4397	5444	6840	8795	11726	16612
19500	329	522	739	986	1267	1592	1971	2419	2957	3614	4435	5491	6899	8871	11828	16756
20000	331	526	745	994	1278	1605	1988	2439	2981	3644	4472	5537	6957	8944	11925	16894

†water, acid or oil

NITROGEN REQUIREMENTS

SCF N_2/BBL LIQUID† REQUIRED AT 125°F

Pressure	Foam Quality															
(PSI)	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85
500	19	31	44	58	75	94	116	143	174	213	261	324	407	523	697	987
1000	38	60	85	114	146	184	228	279	341	417	512	634	797	1024	1366	1935
1500	56	89	126	168	216	272	336	413	504	617	757	937	1177	1513	2018	2859
2000	74	117	165	221	284	356	441	541	662	809	993	1229	1544	1985	2647	3750
2500	90	143	203	271	348	437	541	664	812	992	1217	1507	1894	2435	3247	4599
3000	106	168	238	318	408	513	635	780	953	1165	1429	1770	2223	2859	3812	5400
3500	121	191	271	362	465	584	723	887	1085	1326	1627	2014	2531	3254	4338	6146
4000	134	213	301	402	517	649	804	986	1205	1473	1808	2239	2813	3616	4821	6830
4500	146	232	329	438	564	708	877	1076	1315	1608	1973	2443	3069	3916	5261	7454
5000	158	250	355	473	608	764	946	1161	1419	1734	2129	2635	3311	4257	5676	8041
5500	169	268	379	506	650	817	1011	1241	1517	1854	2275	2817	3540	4551	6068	8596
6000	179	284	402	536	690	867	1073	1317	1609	1967	2414	2989	3755	4828	6438	9120
6500	189	299	424	566	727	914	1181	1389	1697	2074	2546	3152	3960	5091	6789	9617
7000	198	314	445	593	763	959	1187	1457	1780	2176	2670	3305	4154	5341	7121	10088
7500	207	328	465	620	797	1001	1240	1521	1859	2272	2789	3453	4338	5578	7437	10536
8000	215	341	484	645	829	1042	1290	1583	1934	2364	2902	3592	4513	5803	7737	10961
8500	222	353	500	667	857	1077	1334	1637	2000	2445	3000	3715	4667	6001	8001	11335
9000	229	364	516	688	884	1111	1375	1688	2063	2521	3094	3831	4813	6189	8251	11690
9500	236	375	531	707	910	1143	1415	1736	2122	2594	3183	3941	4952	6367	8489	12026
10000	242	384	545	726	934	1173	1452	1783	2179	2663	3268	4046	5084	6536	8715	12346

†water, acid or oil

NITROGEN REQUIREMENTS

SCF N_2/BBL LIQUID† REQUIRED AT 125°F (Cont'd)

Pressure	Foam Quality															
(PSI)	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85
10500	248	394	558	744	957	1202	1488	1827	2232	2729	3349	4146	5209	6697	8930	12651
11000	254	403	571	761	979	1230	1522	1868	2284	2791	3426	4241	5329	6851	9135	12941
11500	259	412	583	778	1000	1256	1555	1908	2333	2851	3499	4332	5443	6998	9330	13218
12000	264	420	595	793	1020	1281	1586	1947	2379	2908	3569	4419	5552	7138	9517	13482
12500	269	428	606	808	1039	1305	1616	1983	2424	2963	3636	4501	5656	7272	9696	13735
13000	274	435	617	822	1057	1328	1644	2018	2467	3015	3700	4581	5755	7400	9866	13977
13500	279	443	627	836	1075	1350	1672	2052	2508	3085	3761	4657	5851	7523	10030	14209
14000	283	449	637	849	1091	1371	1698	2084	2547	3113	3820	4730	5942	7640	10187	14432
14500	287	456	646	861	1108	1392	1723	2114	2584	3159	3877	4800	6030	7753	10338	14645
15000	291	462	655	874	1123	1411	1747	2144	2621	3203	3931	4867	6115	7862	10482	14850
15500	295	469	664	885	1138	1430	1770	2173	2655	3245	3983	4931	6196	7966	10621	15047
16000	299	474	672	896	1152	1448	1792	2200	2689	3286	4033	4993	6274	8066	10755	15236
16500	302	480	680	907	1166	1465	1814	2226	2721	3326	4081	5053	6349	8163	10884	15419
17000	306	486	688	917	1179	1482	1835	2252	2752	3363	4128	5111	6421	8256	11008	15594
17500	309	491	695	927	1192	1498	1855	2276	2782	3400	4173	5166	6491	8345	11127	15764
18000	312	496	703	937	1205	1513	1874	2300	2811	3435	4216	5220	6558	8432	11243	15927
18500	315	501	710	946	1216	1528	1892	2322	2838	3469	4258	5271	6623	8515	11354	16085
19000	318	506	716	955	1228	1543	1910	2344	2865	3502	4298	5321	6686	8596	11461	16237
19500	321	510	723	964	1239	1557	1928	2366	2891	3534	4337	5370	6746	8674	11565	16384
20000	324	515	729	972	1250	1570	1944	2386	2916	3565	4375	5416	6805	8749	11666	16527

†water, acid or oil

NITROGEN REQUIREMENTS

SCF N_2/BBL LIQUID† REQUIRED AT 150°F

Pressure	Foam Quality																
(PSI)	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	
500	19	29	42	56	71	90	111	136	167	204	250	310	389	500	667	945	
1000	36	58	82	109	140	176	217	267	326	399	489	606	761	978	1304	1848	
1500	53	85	120	160	206	259	321	394	481	588	722	894	1123	1444	1925	2727	
2000	70	111	158	210	270	340	421	516	631	771	946	1172	1472	1892	2523	3575	
2500	86	137	193	258	332	417	516	633	774	946	1160	1437	1805	2321	3095	4384	
3000	101	160	227	303	389	489	606	743	909	1111	1363	1688	2120	2726	3635	5149	
3500	115	183	259	345	444	557	690	847	1035	1265	1553	1922	2415	3105	4140	5866	
4000	128	203	288	384	493	620	768	942	1151	1407	1727	2138	2687	3454	4606	6525	1
4500	140	222	315	419	539	678	839	1030	1258	1538	1888	2337	2936	3775	5034	7131	1
5000	151	240	340	453	583	732	906	1112	1360	1662	2039	2525	3172	4079	5438	7704	1
5500	162	257	364	485	624	784	970	1191	1455	1779	2183	2703	3396	4366	5821	8247	1
6000	172	273	387	515	663	833	1031	1265	1546	1890	2319	2871	3608	4638	6184	8761	1
6500	181	288	408	544	700	879	1088	1336	1632	1995	2448	3031	3809	4897	6529	9250	1
7000	190	303	429	571	735	923	1143	1403	1714	2095	2571	3184	4000	5143	6857	9714	1
7500	199	316	448	597	768	965	1195	1466	1792	2191	2688	3329	4182	5377	7169	10156	1
8000	207	329	466	622	799	1004	1244	1526	1865	2280	2798	3464	4353	5596	7462	10571	1
8500	215	341	483	644	828	1040	1287	1580	1931	2360	2897	3586	4506	5793	7724	10943	1
9000	221	352	498	664	854	1073	1329	1631	1993	2436	2990	3702	4651	5980	7974	11296	1
9500	228	362	513	684	880	1105	1368	1679	2053	2509	3079	3812	4790	6158	8211	11632	1
10000	234	372	527	703	904	1136	1406	1726	2109	2578	3164	3917	4921	6327	8437	11952	1

†water, acid or oil

NITROGEN REQUIREMENTS

SCF N_2/BBL LIQUID† REQUIRED AT 150°F (Cont'd)

Pressure	Foam Quality															
(PSI)	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85
10500	240	382	541	721	927	1165	1442	1770	2163	2644	3244	4017	5047	6489	8652	12257
11000	246	391	554	738	949	1192	1476	1812	2214	2706	3322	4112	5167	6643	8857	12548
11500	251	399	566	754	970	1219	1509	1852	2263	2766	3395	4204	5281	6790	9054	12826
12000	257	408	578	770	990	1244	1540	1890	2310	2824	3466	4291	5391	6931	9242	13093
12500	262	416	589	785	1009	1268	1570	1927	2355	2879	3533	4374	5496	7066	9422	13347
13000	267	423	600	800	1028	1292	1599	1962	2399	2932	3598	4454	5597	7196	9594	13592
13500	271	431	610	813	1046	1314	1627	1996	2440	2982	3660	4531	5693	7320	9760	13826
14000	276	438	620	827	1063	1335	1653	2029	2480	3031	3719	4605	5786	7439	9918	14051
14500	280	444	629	839	1079	1356	1678	2060	2518	3077	3777	4676	5875	7553	10071	14267
15000	284	451	639	851	1095	1375	1703	2090	2554	3122	3832	4744	5960	7663	10218	14475
15500	288	457	647	863	1110	1394	1726	2119	2590	3165	3885	4809	6043	7769	10359	14675
16000	292	463	656	875	1124	1413	1749	2147	2624	3207	3936	4873	6122	7871	10495	14867
16500	295	469	664	885	1138	1430	1771	2173	2656	3247	3985	4933	6198	7969	10626	15053
17000	299	474	672	896	1152	1447	1792	2199	2688	3285	4032	4992	6272	8064	10752	15232
17500	302	480	680	906	1165	1464	1812	2224	2718	3323	4078	5049	6343	8155	10874	15405
18000	305	485	687	916	1178	1480	1832	2248	2748	3359	4122	5103	6412	8244	10992	15571
18500	308	490	694	925	1190	1495	1851	2272	2776	3393	4164	5156	6478	8329	11105	15732
19000	312	495	701	935	1202	1510	1869	2294	2804	3427	4206	5207	6542	8411	11215	15888
19500	314	499	708	943	1213	1524	1887	2316	2830	3459	4246	5256	6604	8491	11321	16039
20000	317	504	714	952	1224	1538	1904	2337	2850	3491	4284	5304	6664	8568	11424	16185

†water, acid or oil

NITROGEN REQUIREMENTS

SCF N_2/BBL LIQUID† REQUIRED AT 175°F

Pressure	Foam Quality															
(PSI)	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85
500	18	28	40	53	68	86	107	131	160	195	240	297	373	479	639	906
1000	35	55	78	104	134	168	208	255	312	381	468	580	728	936	1248	1768
1500	51	81	115	153	197	248	307	376	460	562	690	854	1074	1380	1840	2607
2000	67	106	151	201	258	325	402	493	603	737	904	1119	1406	1808	2411	3415
2500	82	130	185	246	317	398	493	605	739	903	1109	1372	1724	2217	2956	4188
3000	96	153	217	289	372	467	579	710	868	1061	1302	1612	2026	2605	3473	4920
3500	110	175	247	330	424	533	660	810	990	1209	1484	1838	2309	2969	3958	5608
4000	122	195	276	367	472	594	735	902	1102	1347	1654	2047	2572	3307	4410	6247
4500	134	213	302	402	517	650	804	987	1207	1475	1810	2241	2815	3620	4826	6837
5000	145	230	326	435	559	703	870	1068	1305	1595	1958	2424	3046	3916	5221	7396
5500	155	247	350	466	600	753	933	1145	1399	1710	2098	2598	3264	4197	5596	7927
6000	165	263	372	496	638	801	992	1217	1488	1819	2232	2763	3472	4464	5952	8432
6500	175	278	393	524	674	847	1048	1287	1573	1922	2359	2921	3669	4718	6291	8912
7000	184	292	413	551	709	890	1102	1353	1653	2021	2480	3070	3858	4960	6613	9369
7500	192	305	433	577	742	932	1154	1416	1730	2115	2595	3213	4037	5191	6921	9805
8000	200	318	451	601	772	970	1201	1474	1802	2203	2703	3347	4205	5406	7208	10212
8500	207	330	467	622	800	1005	1245	1528	1867	2282	2801	3468	4357	5602	7469	10581
9000	214	340	482	643	827	1039	1286	1578	1929	2358	2894	3583	4502	5788	7717	10932
9500	221	351	497	663	852	1071	1326	1627	1988	2430	2982	3693	4639	5965	7953	11267
10000	227	361	511	682	876	1101	1363	1673	2045	2499	3067	3797	4771	6134	8179	11587

†water, acid or oil

NITROGEN REQUIREMENTS

SCF N_2/BBL LIQUID† REQUIRED AT 175°F (Cont'd)

Pressure	Foam Quality															
(PSI)	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85
10500	233	370	525	700	899	1130	1399	1717	2099	2565	3148	3897	4897	6296	8394	11892
11000	239	379	538	717	921	1158	1433	1759	2150	2628	3225	3993	5017	6450	8600	12183
11500	244	388	550	733	943	1184	1466	1799	2199	2688	3299	4084	5132	6598	8797	12463
12000	250	396	562	749	963	1210	1498	1838	2246	2746	3370	4172	5242	6739	8986	12730
12500	255	404	573	764	982	1234	1528	1875	2292	2801	3438	4256	5347	6875	9167	12986
13000	259	412	584	778	1001	1257	1557	1911	2335	2854	3503	4337	5449	7005	9341	13232
13500	264	419	594	792	1019	1280	1585	1945	2377	2905	3565	4414	5546	7131	9507	13469
14000	269	427	604	806	1036	1301	1611	1977	2417	2954	3625	4489	5639	7251	9668	13696
14500	273	433	614	818	1052	1322	1637	2009	2455	3001	3683	4560	5729	7366	9822	13914
15000	277	440	623	831	1068	1342	1662	2039	2493	3046	3739	4629	5816	7478	9970	14125
15500	281	446	632	843	1084	1361	1686	2069	2528	3090	3793	4695	5899	7585	10113	14327
16000	285	452	641	854	1098	1380	1709	2097	2563	3132	3844	4759	5980	7688	10251	14523
16500	288	458	649	865	1113	1398	1731	2124	2596	3173	3894	4821	6057	7788	10384	14711
17000	292	464	657	876	1126	1415	1752	2150	2628	3212	3942	4881	6132	7884	10512	14893
17500	295	469	665	886	1140	1432	1773	2176	2659	3250	3989	4938	6205	7977	10636	15068
18000	299	475	672	896	1152	1448	1793	2200	2689	3287	4034	4994	6274	8067	10756	15238
18500	302	480	680	906	1165	1464	1812	2224	2718	3322	4077	5048	6342	8154	10872	15402
19000	305	485	687	915	1177	1479	1831	2247	2746	3356	4119	5100	6407	8238	10984	15561
19500	308	489	693	924	1188	1493	1849	2269	2773	3389	4160	5150	6471	8319	11093	15715
20000	311	494	700	933	1200	1507	1866	2290	2799	3422	4199	5199	6532	8398	11198	15863

†water, acid or oil

NITROGEN REQUIREMENTS

SCF N_2/BBL LIQUID† REQUIRED AT 200°F

Pressure	Foam Quality																
(PSI)	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	
500	17	27	38	51	66	83	102	126	154	188	230	285	358	461	614	870	
1000	33	53	75	100	128	161	200	245	299	366	449	556	698	898	1197	1696	2
1500	49	78	110	147	189	237	294	361	441	539	661	819	1029	1323	1763	2498	3
2000	64	102	144	192	247	311	385	472	577	705	866	1072	1347	1732	2309	3271	5
2500	79	125	177	236	303	381	472	579	708	865	1061	1314	1651	2123	2830	4009	6
3000	92	147	208	277	356	448	554	680	831	1016	1247	1544	1940	2494	3325	4710	7
3500	105	167	237	316	406	510	632	776	948	1158	1422	1760	2212	2844	3791	5371	8
4000	118	187	264	353	453	570	705	866	1058	1293	1587	1965	2468	3174	4232	5995	9
4500	129	205	290	386	497	624	773	948	1159	1417	1739	2153	2705	3478	4637	6569	10
5000	139	222	314	418	538	676	837	1027	1255	1534	1883	2332	2929	3766	5022	7114	11
5500	150	238	337	449	577	725	898	1102	1347	1646	2021	2502	3143	4041	5388	7633	12
6000	159	253	359	478	615	772	956	1174	1434	1753	2151	2664	3347	4303	5737	8128	12
6500	169	268	379	506	650	817	1012	1242	1517	1855	2276	2818	3541	4552	6070	8599	13
7000	177	282	399	532	684	860	1065	1307	1597	1952	2395	2966	3726	4791	6388	9049	14
7500	186	295	418	558	717	901	1115	1369	1673	2045	2509	3107	3903	5018	6691	9479	15
8000	194	308	436	581	747	939	1162	1426	1743	2131	2615	3238	4068	5230	6974	9880	15
8500	201	319	452	603	775	974	1205	1479	1808	2210	2712	3358	4219	5424	7232	10246	16
9000	208	330	467	623	801	1007	1246	1530	1870	2285	2805	3472	4363	5609	7479	10595	16
9500	214	340	482	643	827	1038	1286	1578	1929	2357	2893	3582	4500	5786	7714	10929	17
10000	221	350	496	662	851	1069	1323	1624	1985	2426	2977	3686	4631	5954	7939	11247	17

†water, acid or oil

NITROGEN REQUIREMENTS

SCF N_2/BBL LIQUID† REQUIRED AT 200°F (Cont'd)

Pressure	Foam Quality															
(PSI)	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85
10500	227	360	510	680	874	1098	1359	1668	2039	2492	3058	3786	4757	6116	8154	11552
11000	232	369	523	697	896	1125	1393	1710	2090	2554	3135	3882	4877	6270	8360	11844
11500	238	378	535	713	917	1152	1426	1750	2139	2615	3209	3973	4992	6418	8558	12123
12000	243	386	547	729	937	1177	1458	1789	2187	2673	3280	4061	5102	6560	8747	12391
12500	248	394	558	744	957	1202	1488	1826	2232	2728	3348	4145	5208	6696	8929	12649
13000	253	402	569	759	975	1225	1517	1862	2276	2782	3414	4226	5310	6827	9103	12896
13500	258	409	579	773	993	1248	1545	1896	2318	2833	3477	4304	5408	6953	9271	13134
14000	262	416	590	786	1011	1270	1572	1929	2358	2882	3537	4379	5502	7074	9432	13363
14500	266	423	599	799	1027	1291	1598	1961	2397	2930	3596	4452	5593	7191	9588	13583
15000	270	430	609	811	1043	1311	1623	1992	2434	2975	3652	4521	5680	7303	9738	13795
15500	275	436	618	824	1059	1330	1647	2021	2471	3020	3706	4588	5765	7412	9882	14000
16000	278	442	626	835	1074	1349	1670	2050	2505	3062	3758	4653	5846	7516	10022	14198
16500	282	448	635	846	1088	1367	1693	2077	2539	3103	3809	4716	5925	7617	10157	14388
17000	286	454	643	857	1102	1385	1714	2104	2572	3143	3857	4776	6001	7715	10287	14573
17500	289	459	651	868	1116	1402	1735	2130	2603	3182	3905	4834	6074	7809	10412	14751
18000	293	465	658	878	1129	1418	1756	2155	2633	3219	3950	4891	6145	7900	10534	14923
18500	296	470	666	888	1141	1434	1775	2179	2663	3255	3994	4945	6213	7989	10652	15090
19000	299	475	673	897	1153	1449	1794	2202	2691	3289	4037	4998	6280	8074	10766	15251
19500	302	480	680	906	1165	1464	1813	2225	2719	3323	4079	5050	6344	8157	10876	15408
20000	305	485	686	915	1177	1478	1831	2247	2746	3356	4119	5099	6407	8237	10983	15559

†water, acid or oil

GASEOUS NITROGEN COLUMN BOTTOM-HOLE PRESSURES

GASEOUS NITROGEN COLUMN — BOTTOM-HOLE PRESSURES

The graphs in this section are for determining the wellhead pressure produced by a gaseous column of N_2 given bottom-hole pressure and depth. In the same manner, they can be used to find bottom-hole pressure given nitrogen wellhead pressure and depth. They can also be used to calculate hydrostatic pressure —Hydrostatic Pressure = (Bottom-Hole Pressure) - (Nitrogen Wellhead Pressure). The sensitivity of nitrogen to pressure and temperature makes it necessary to report a family of curves based on wellhead pressure and various temperature gradients.

Using the Graphs

To determine the wellhead pressure of a gaseous column of N_2, enter the graph on the y-axis with the bottom-hole pressure and x-axis with the corresponding well depth. Where these two coordinates meet indicates the wellhead pressure on the cross-plots. (Note: Some interpolation may be needed.)

Example

Find the wellhead pressure of a gaseous column of nitrogen in a 4,000-ft well with a BHP of 3,150 psi and a 1.1°F/100-ft temperature gradient.

From the graph (see p. 315.07) — Wellhead Pressure = 2,750 psi.

To determine the bottom-hole pressure of a gaseous column of nitrogen, enter the graph on the cross-plot corresponding to the wellhead pressure and the x-axis with the well depth. Read over to the y-axis from the intercept of the two coordinates to determine the bottom-hole pressure.

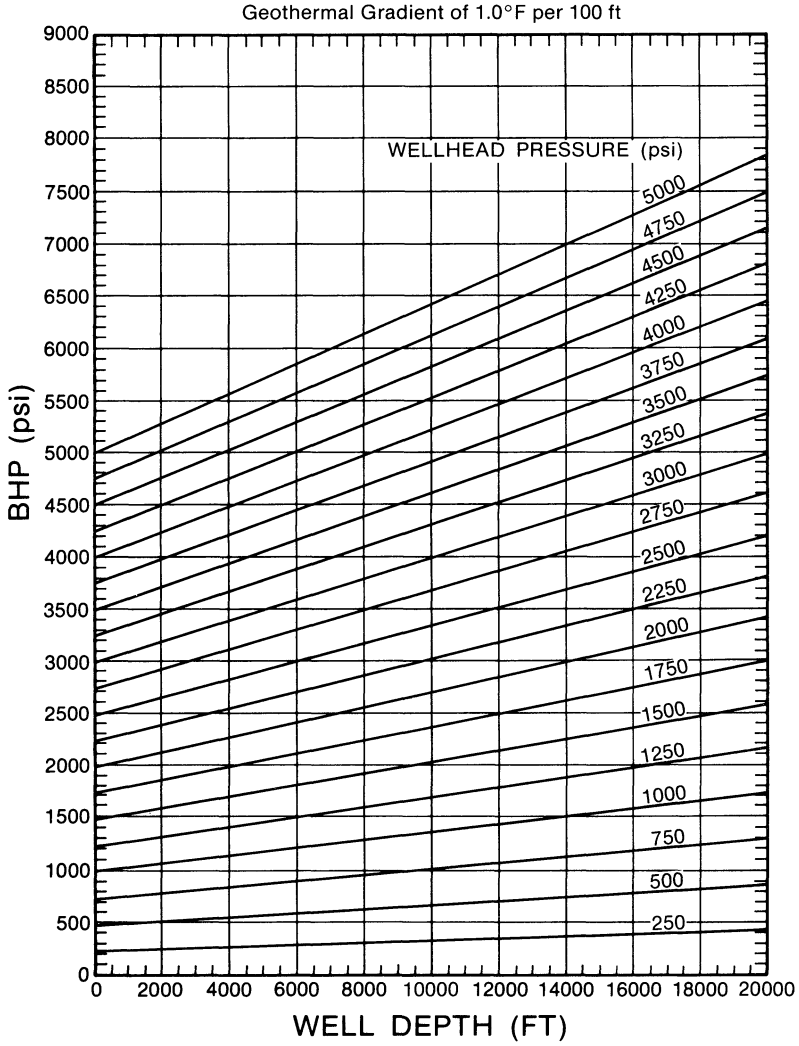
Example

Find bottom-hole pressure of a gaseous column of nitrogen in a 10,000-ft well with a wellhead pressure of 4,500 psi and a 1.6°F/100-ft temperature gradient.

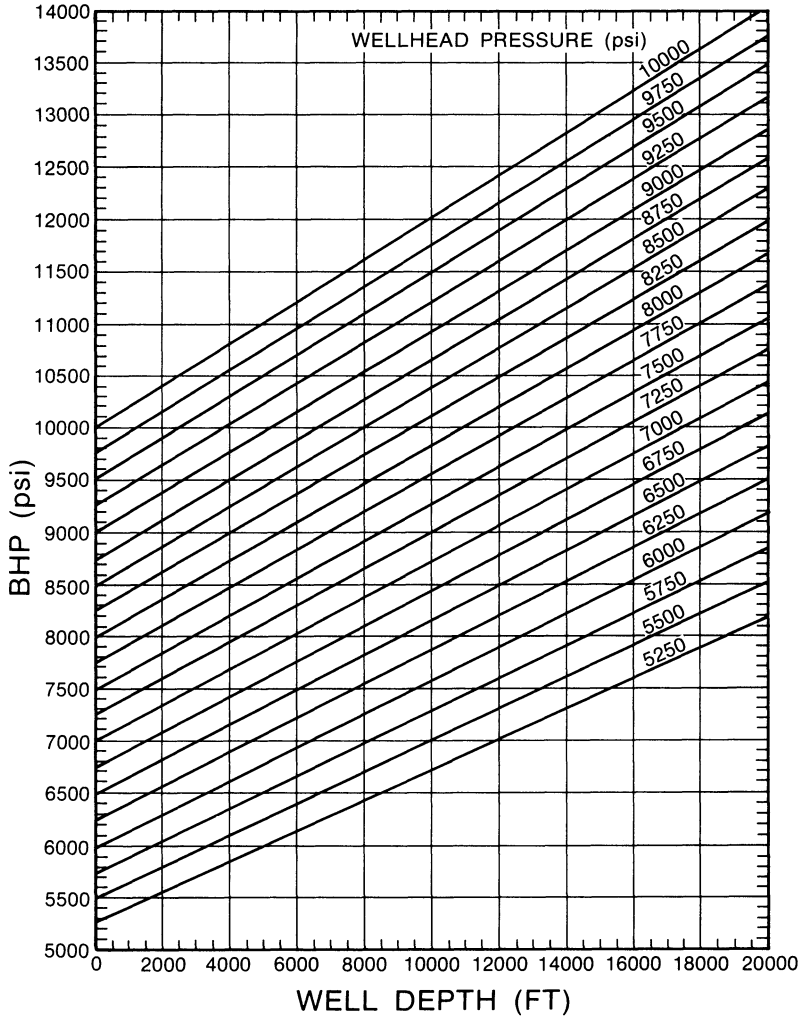
From p. 315.09 — Bottom-Hole Pressure = 5,750 psi.

GASEOUS NITROGEN COLUMN — BOTTOM-HOLE PRESSURES

Geothermal Gradient of 1.0°F per 100 ft

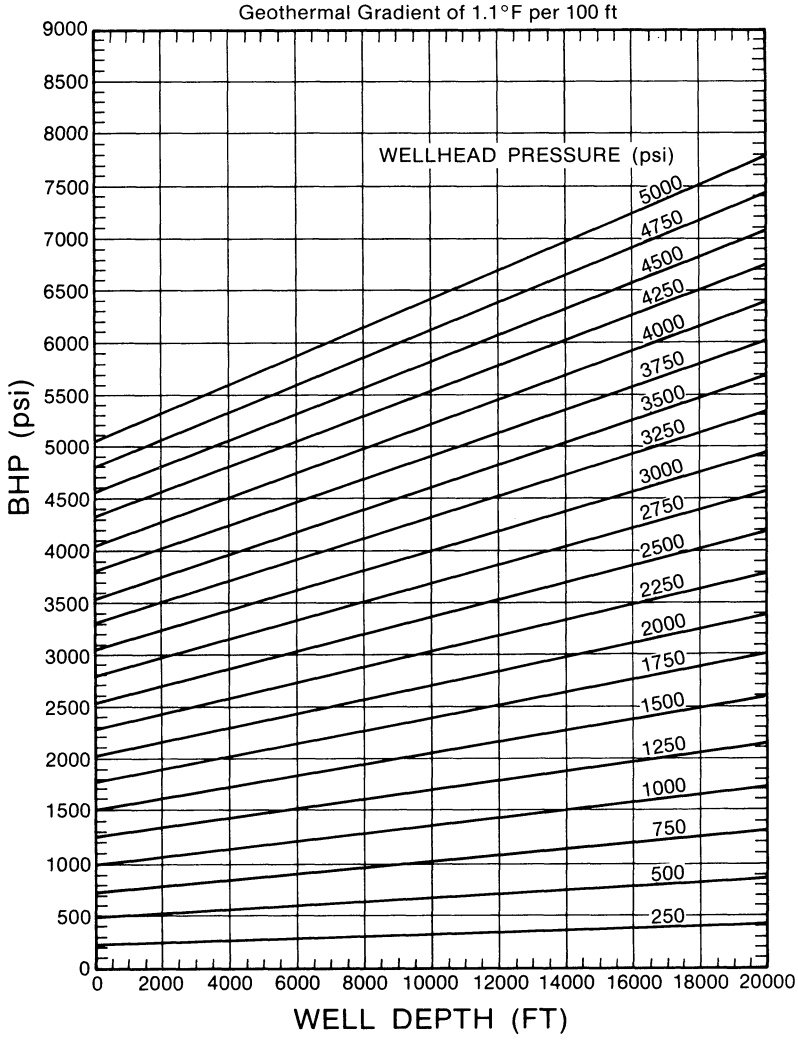


GASEOUS NITROGEN COLUMN — BOTTOM-HOLE PRESSURES
Geothermal Gradient of 1.0°F per 100 ft



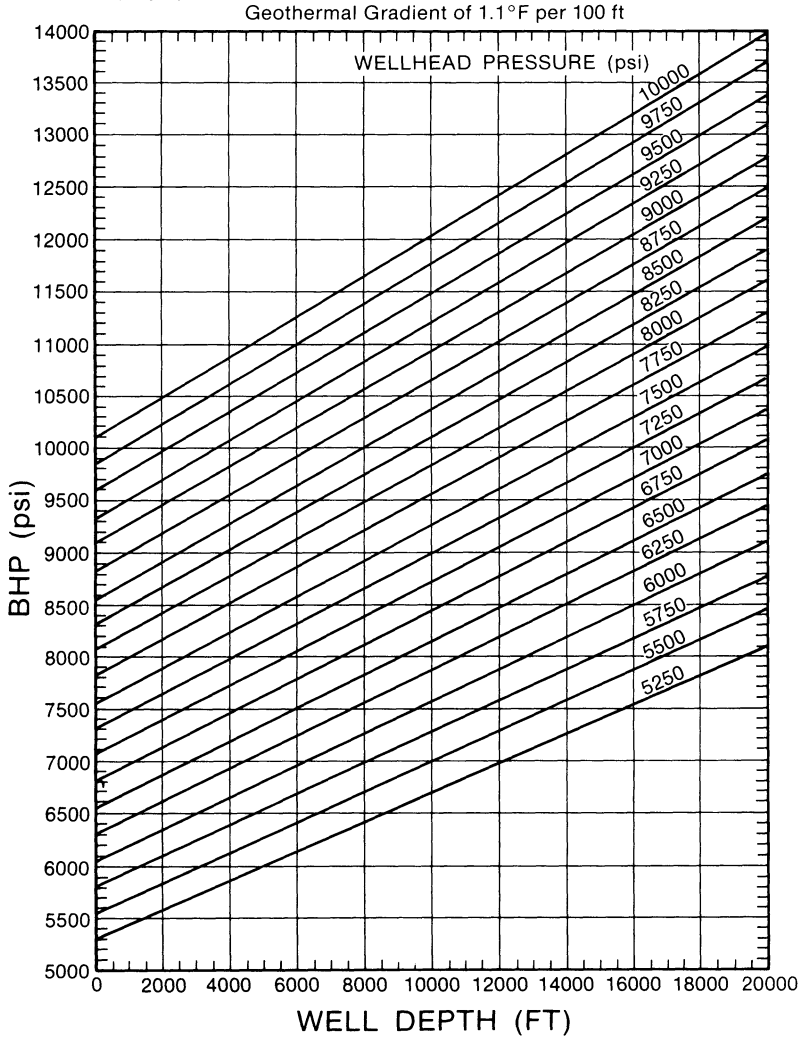
GASEOUS NITROGEN COLUMN — BOTTOM-HOLE PRESSURES

Geothermal Gradient of 1.1°F per 100 ft



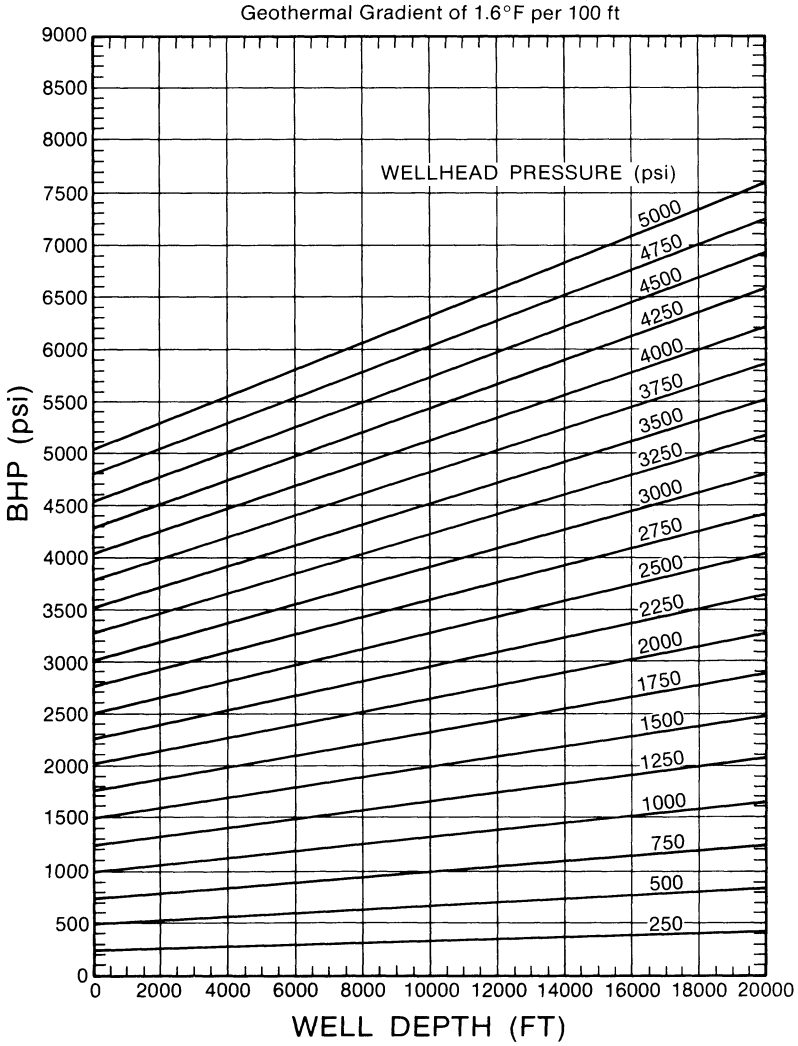
GASEOUS NITROGEN COLUMN — BOTTOM-HOLE PRESSURES

Geothermal Gradient of 1.1°F per 100 ft

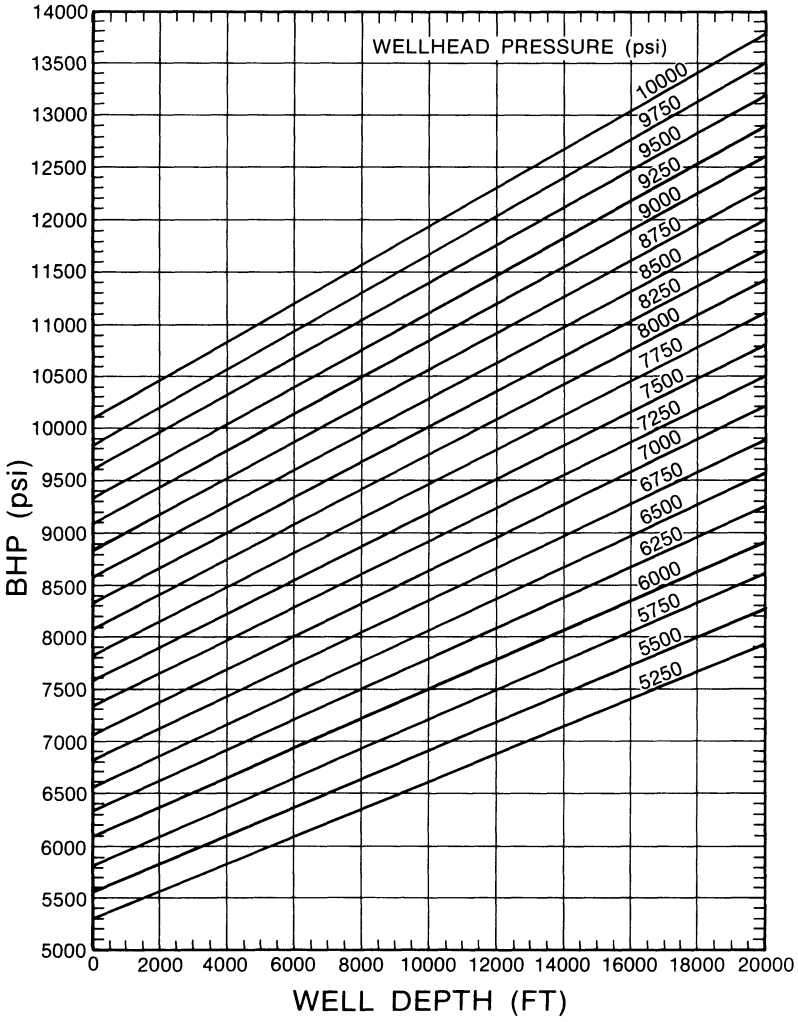


GASEOUS NITROGEN COLUMN — BOTTOM-HOLE PRESSURES

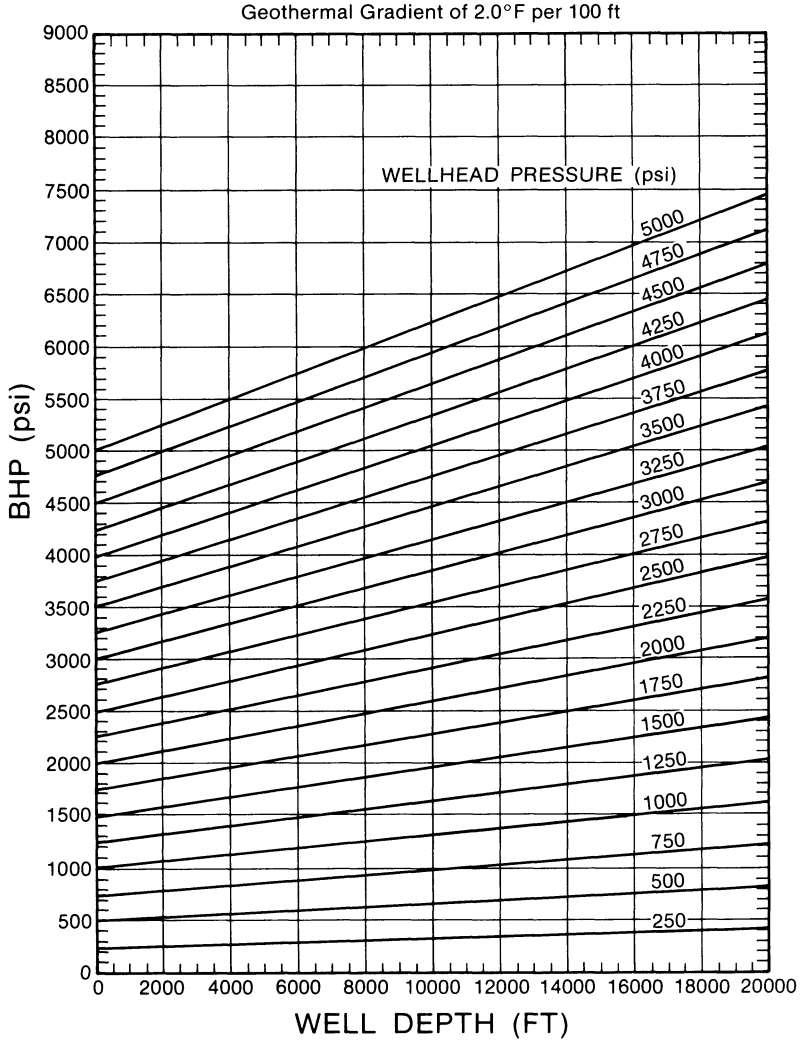
Geothermal Gradient of 1.6°F per 100 ft



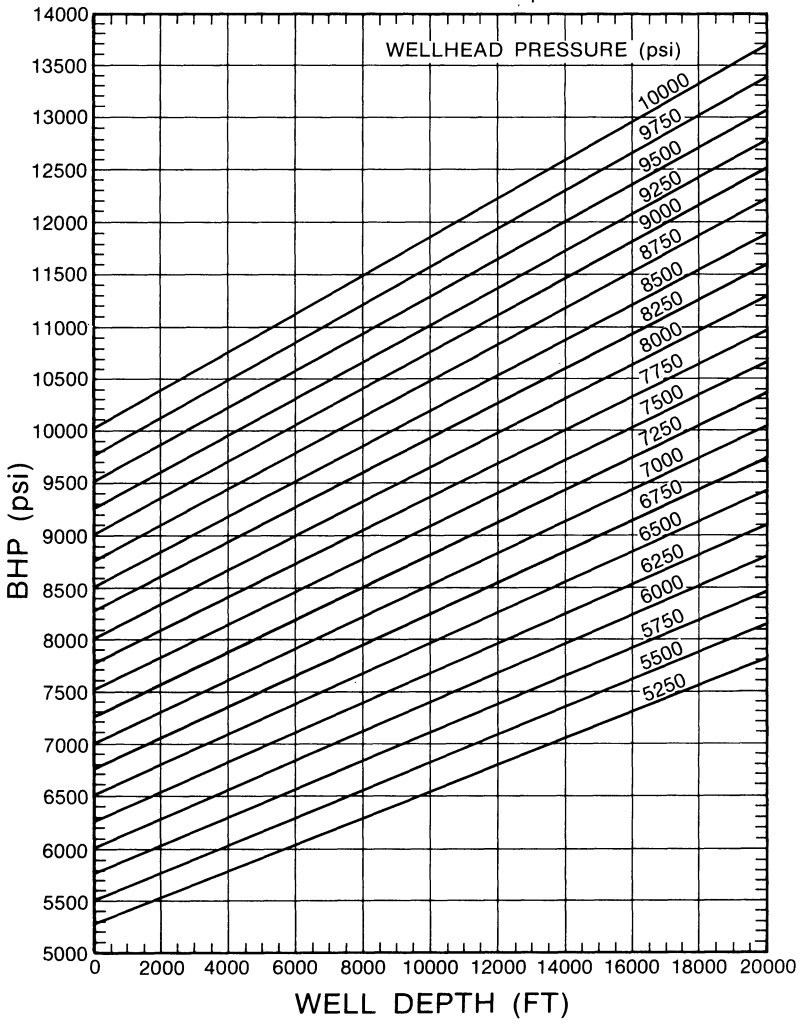
GASEOUS NITROGEN COLUMN — BOTTOM-HOLE PRESSURES
Geothermal Gradient of 1.6°F per 100 ft



GASEOUS NITROGEN COLUMN — BOTTOM-HOLE PRESSURES
Geothermal Gradient of 2.0°F per 100 ft



GASEOUS NITROGEN COLUMN — BOTTOM-HOLE PRESSURES
Geothermal Gradient of 2.0°F per 100 ft



HYDROSTATIC PRESSURE OF A NITRIFIED FLUID

HYDROSTATIC PRESSURE OF A NITRIFIED FLUID

The calculation of the hydrostatic pressure of a nitrified fluid must begin with either bottom-hole or wellhead pressure and the nitrogen concentration expressed as the foam quality or SCF/BBL of liquid. The hydrostatic pressure graphs in this publication are calculated with a wellhead pressure of zero. The worksheets can be used in situations when the wellhead pressure is greater than zero.

Worksheet Example

Calculate the hydrostatic pressure under the following conditions.

Depth = 14,000 ft
Liquid S.G. = 1.0
Wellhead Pressure = 5,000 psi
N_2 Concentration = 1,000 SCF/BBL
Surface Temperature = 70°F
Temperature Gradient = 1.0°F/100 ft

In this case, the wellhead pressure is greater than zero, so the Worksheet is used as follows.

A NITRIFIED FLUID (Example)

1. Liquid Hydrostatic =

   .433 (14,000) (1.00) = 6,062 psi.
   Depth, ft Fluid S.G.

2. Nitrogen Hydrostatic: enter the graph for Gaseous Nitrogen Column (Section 315) with the depth and bottom-hole pressure to determine wellhead pressure. Or, with the wellhead pressure and depth given, determine the bottom-hole pressure. Use WHP and BHP in the following equation.

   Nitrogen Hydrostatic =
   (7,000) - (5,000) = 2,000 psi.
   Bottom-Hole Pressure, psi Wellhead Pressure

3. Calculate foam quality if unknown.

   a. Average Pressure = [(5,000) + (7,000)]/2 = 6,000 psi.
      WHP BHP

   b. Average Temperature =
      [(70) + (210)]/2 = 140 °F.
      Surface Temperature Bottom-Hole Temperature

   c. Determine nitrogen volume factor from tables in Section 305.

      SCF/BBL = 1,568 (from p. 305.07)

   d. Gas Ratio =

      (1,000) / (1,568) = .638.
      SCF/BBL Liquid N_2 Volume Factor SCF/BBL

   e. Foam Quality =

      [(.638) / (1 + .638)] = .389.
      Gas Ratio Gas Ratio

4. Foam Hydrostatic =

   [(1 - .389) (6,062)] + [(.389) (2,000)] = 4,482 psi.
   FQ Liquid Hydrostatic, psi FQ Nitrogen Hydrostatic psi

A NITRIFIED FLUID (WORKSHEET)

1. Liquid Hydrostatic =

   .433 (_____) (_____) = ____ psi.
   Depth, ft Fluid S.G.

2. Nitrogen Hydrostatic: enter the graph for Gaseous Nitrogen Column (Section 315) with the depth and bottom-hole pressure to determine wellhead pressure. Or, with the wellhead pressure and depth given, determine the bottom-hole pressure. Use WHP and BHP in the following equation.

   Nitrogen Hydrostatic =
   (_____) - (_____) = ____ psi.
   Bottom-Hole Pressure, psi Wellhead Pressure

3. Calculate foam quality if unknown.

   a. Average Pressure = [(____) + (____)]/2 = ____ psi.
      WHP BHP

   b. Average Temperature =
      [(_____) + (_____)]/2 = ____.
      Surface Temperature Bottom-Hole Temperature

   c. Determine nitrogen volume factor from tables in Section 305.

      SCF/BBL = ____ .

   d. Gas Ratio =

      (_____) / (_____) = ____ .
      SCF/BBL Liquid N_2 Volume Factor SCF/BBL

   e. Foam Quality =

      [(_____) / (1 + _____)] = ____ .
      Gas Ratio Gas Ratio

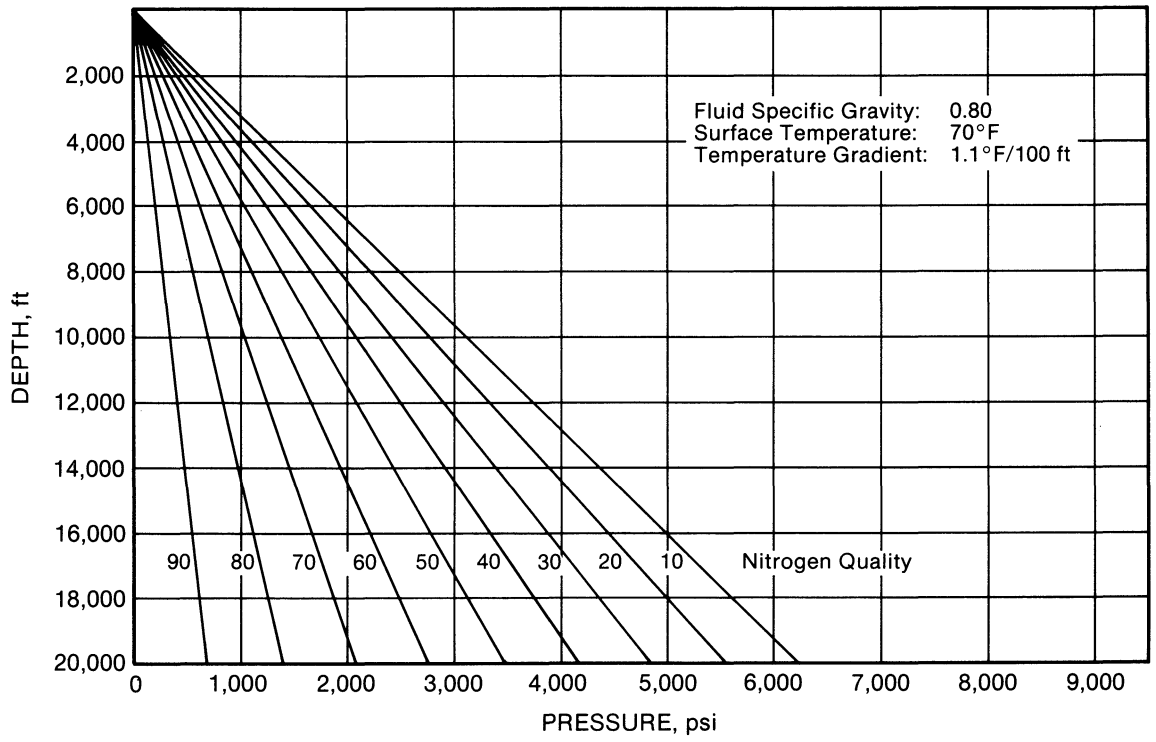
4. Foam Hydrostatic =

   [(1 - _____) (_____)] + [(_____) (_____)] = ____psi.
   FQ Liquid Hydrostatic, psi FQ Nitrogen Hydrostatic, psi

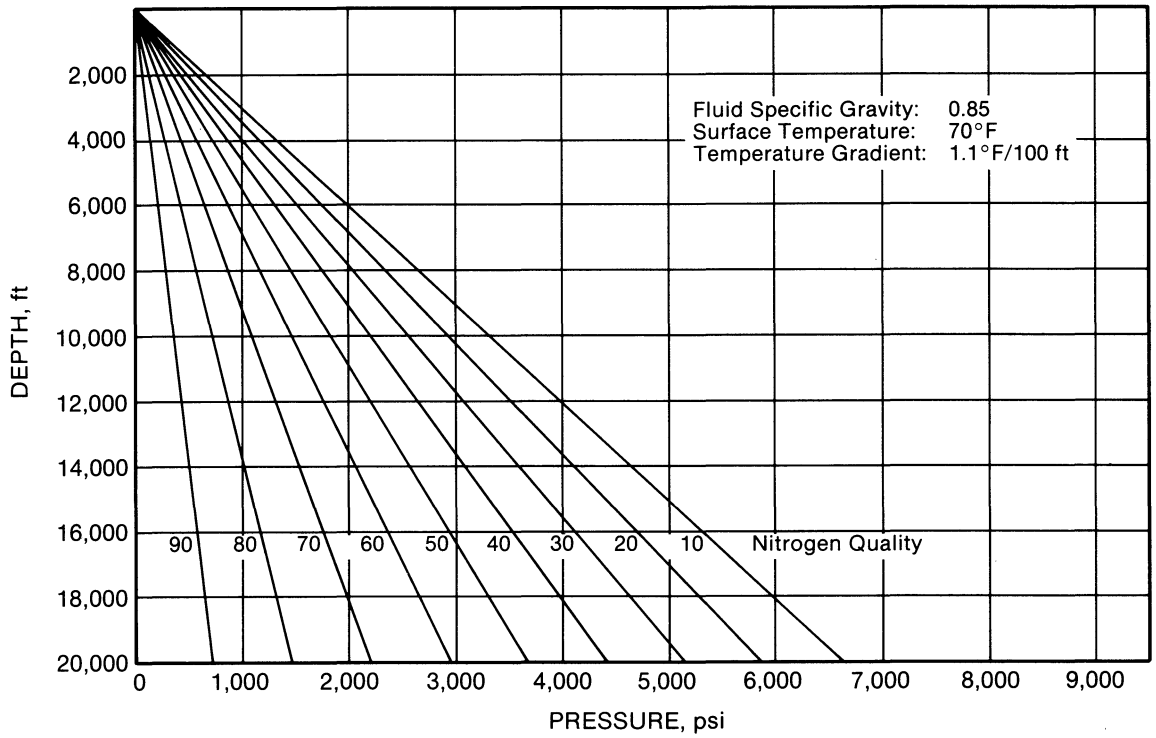
Using the Graphs

If the wellhead pressure equals zero, the hydrostatic pressure of the nitrified fluid can be read directly from one of the following graphs. Select the appropriate graph based on base fluid specific gravity.

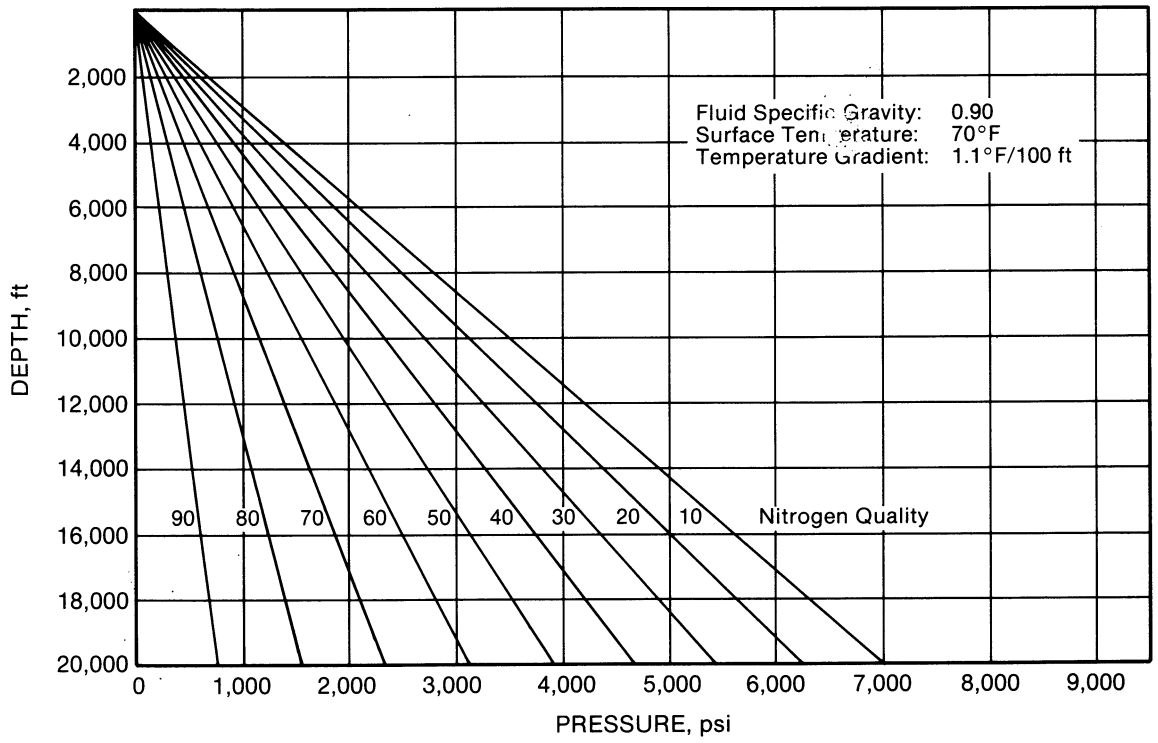
HYDROSTATIC PRESSURE OF A COLUMN OF NITRIFIED FLUID



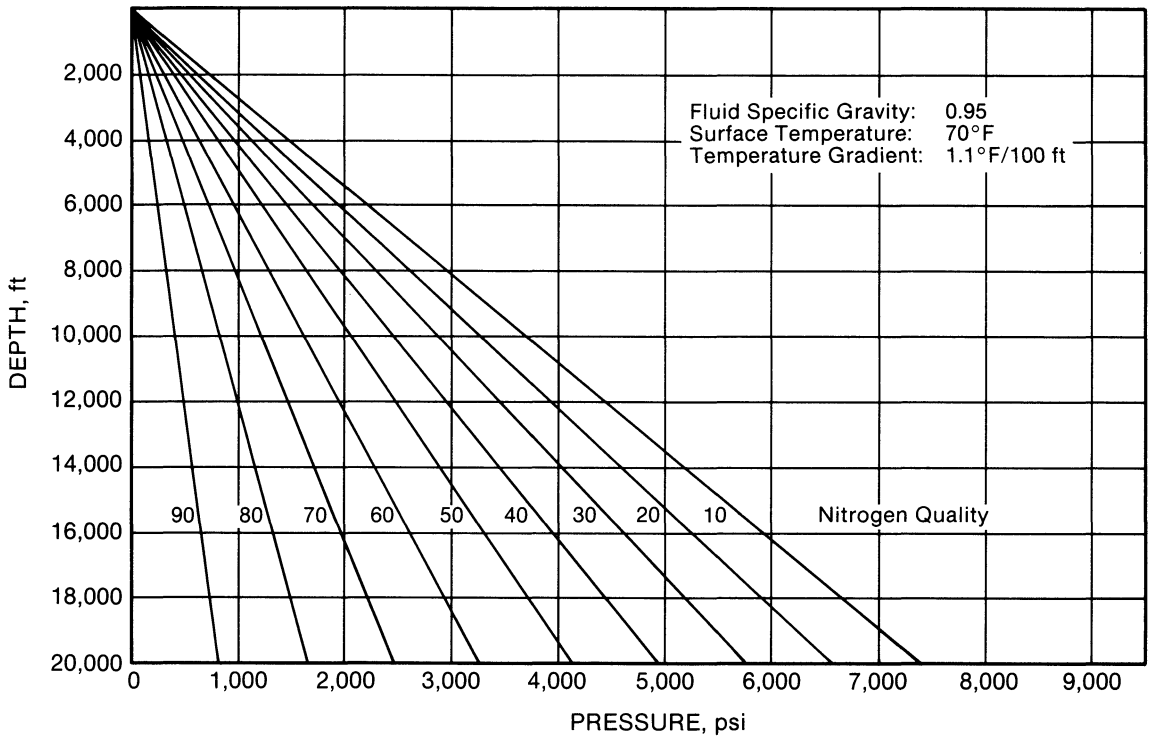
HYDROSTATIC PRESSURE OF A COLUMN OF NITRIFIED FLUID



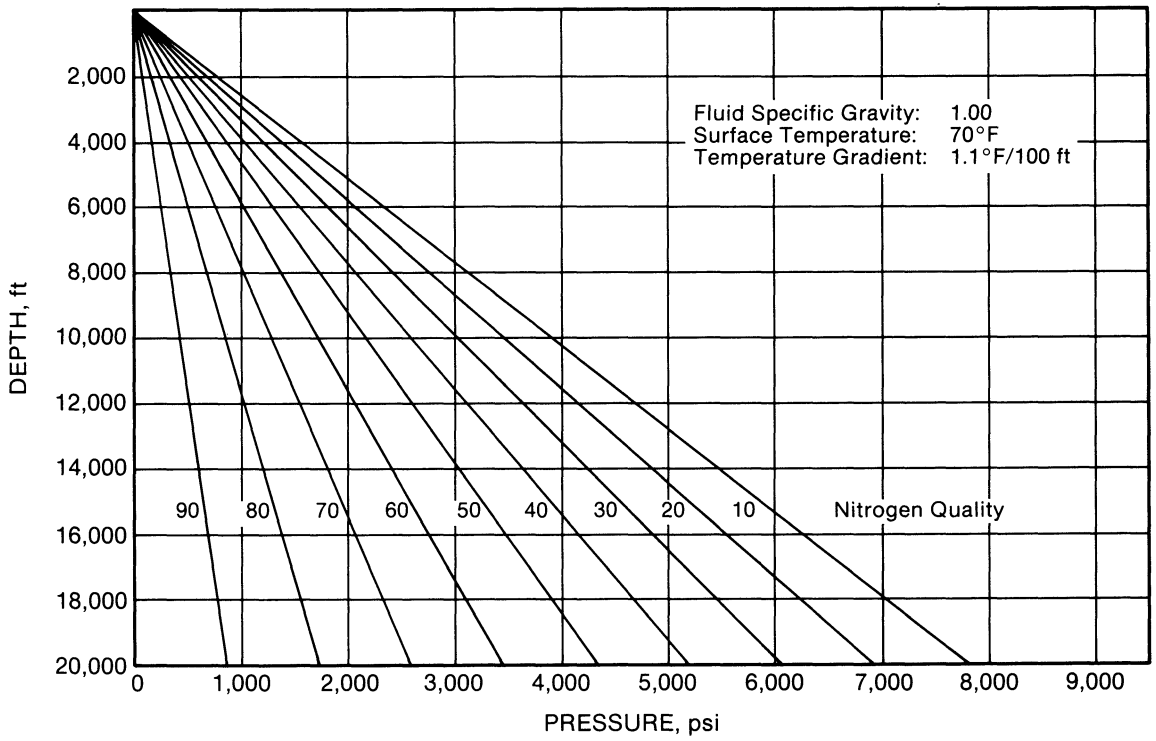
HYDROSTATIC PRESSURE OF A COLUMN OF NITRIFIED FLUID



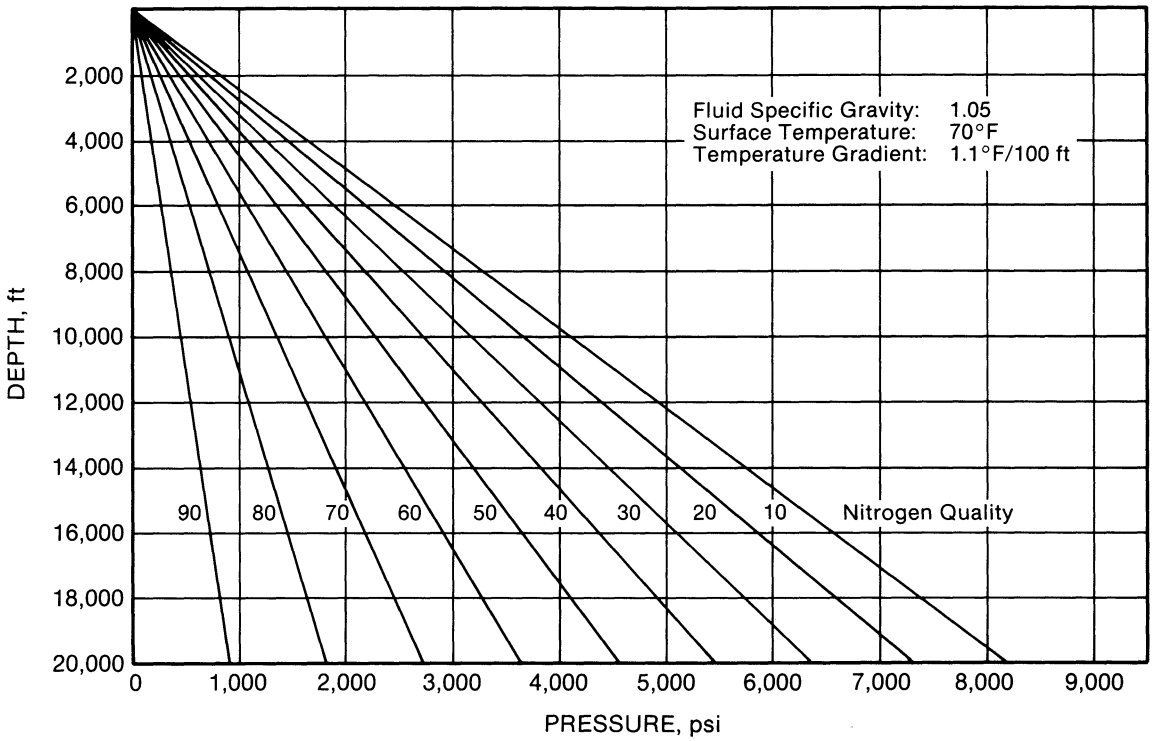
HYDROSTATIC PRESSURE OF A COLUMN OF NITRIFIED FLUID



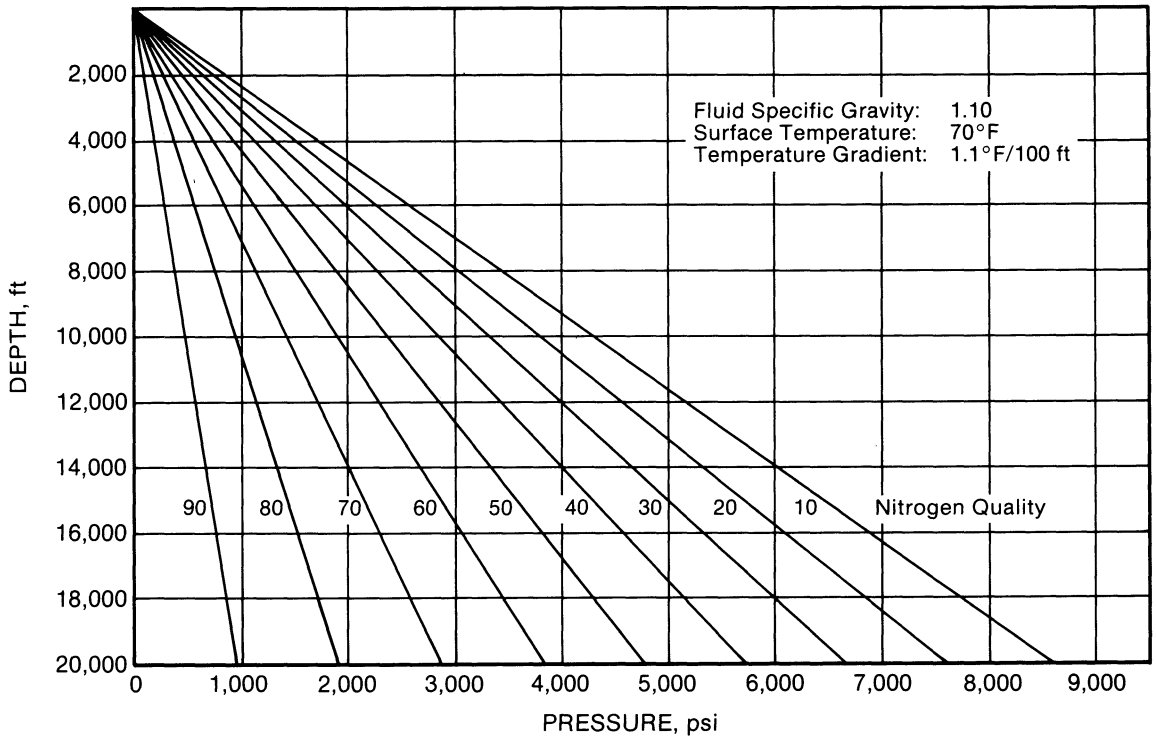
HYDROSTATIC PRESSURE OF A COLUMN OF NITRIFIED FLUID



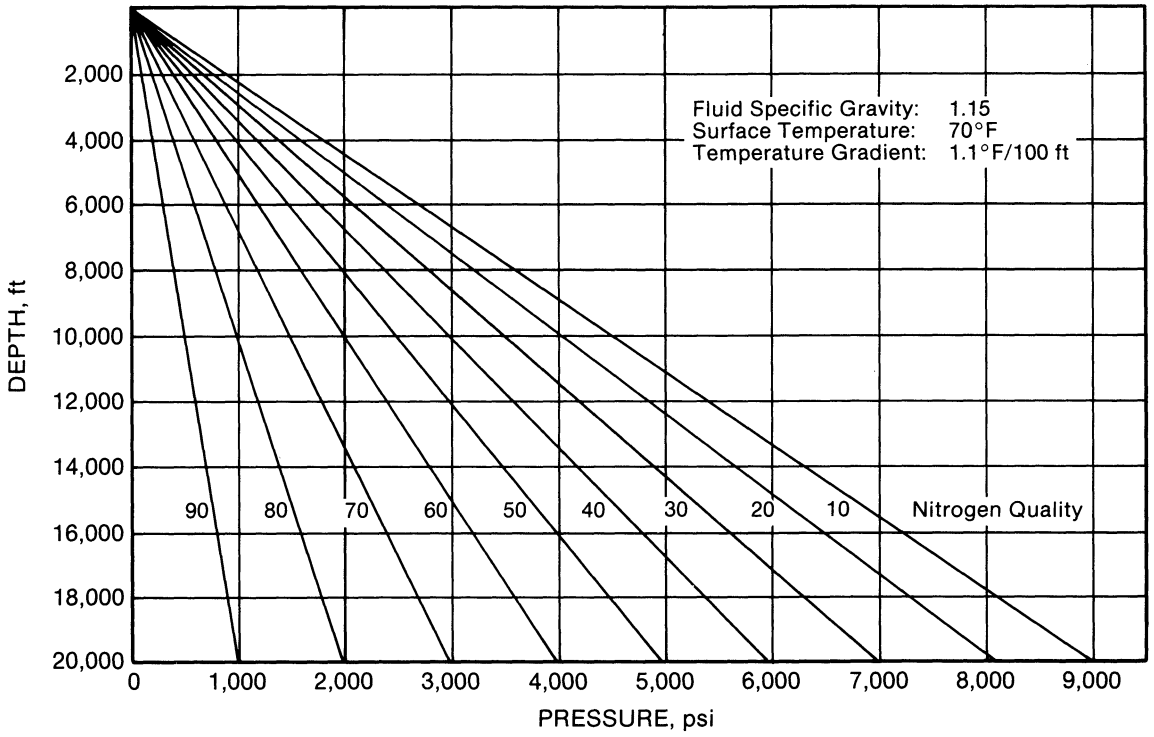
HYDROSTATIC PRESSURE OF A COLUMN OF NITRIFIED FLUID



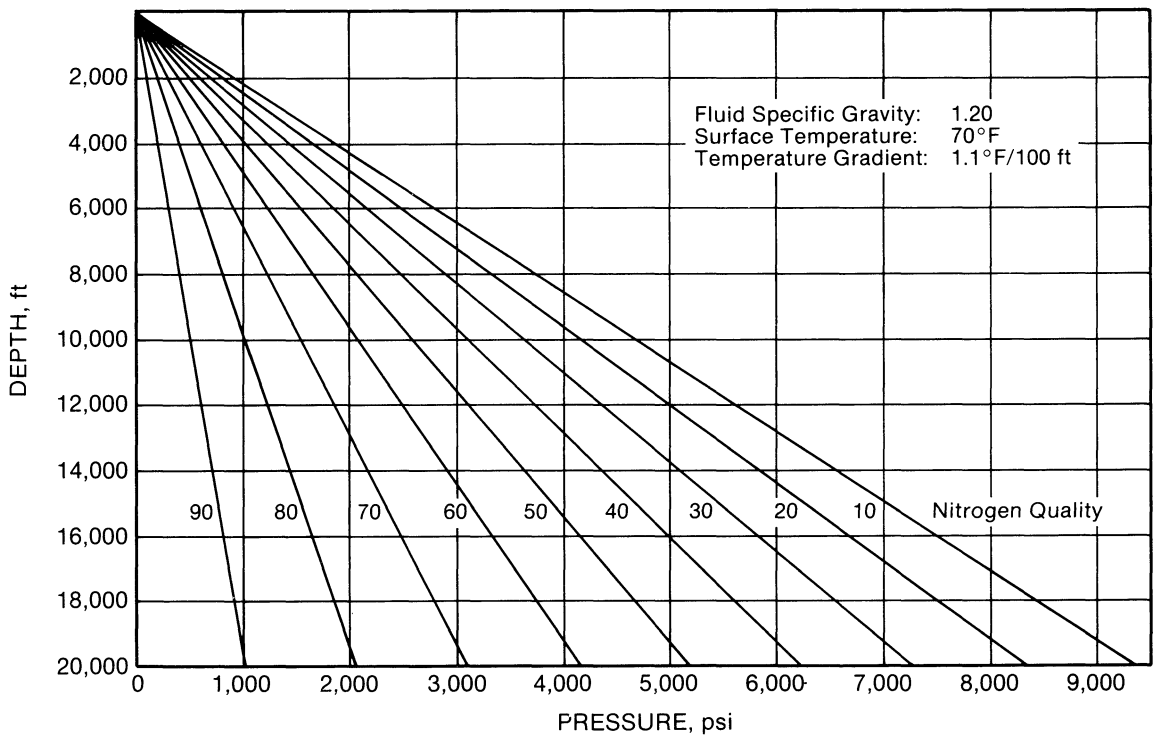
HYDROSTATIC PRESSURE OF A COLUMN OF NITRIFIED FLUID



HYDROSTATIC PRESSURE OF A COLUMN OF NITRIFIED FLUID



HYDROSTATIC PRESSURE OF A COLUMN OF NITRIFIED FLUID



BOTTOM-HOLE OR WELLHEAD PRESSURE OF AN ENERGIZED FLUID

BOTTOM-HOLE OR WELLHEAD PRESSURE OF AN ENERGIZED FLUID

The graphs in this section are for determining the pressure exerted by a fluid energized with gaseous nitrogen. Given wellhead pressure, well depth and nitrogen concentration, these graphs can be used to determine the bottom-hole pressure. Likewise, if the bottom-hole pressure, well depth and nitrogen concentration are known, these graphs can be used to determine wellhead pressure. All the graphs in this section are based on the base fluid specific gravity of 1.00 and a geothermal gradient of 1.1°F/100 ft. The nitrogen concentrations range from 100 to 1,000 SCF N_2/BBL of liquid.

Using the Graphs

To determine the bottom-hole pressure of a column of energized fluid, enter the graph on the y-axis with the wellhead pressure and corresponding depth on the x-axis. Where the two coordinates intersect is the bottom-hole pressure on the cross-plot. (Note: Some interpolation may be needed.)

Example

Find bottom-hole pressure of a fluid with 300 SCF N_2/BBL liquid in a well 5,000 ft deep and 4,500-psi wellhead pressure.

From p. 325.07 — Bottom-Hole Pressure 6,400 psi.

To determine the wellhead pressure of a column of energized fluid, enter the graph on the cross-plot corresponding to the bottom-hole pressure and the x-axis with the well depth. Read over to the y-axis from the intersect of the two coordinates to determine the wellhead pressure.

Example

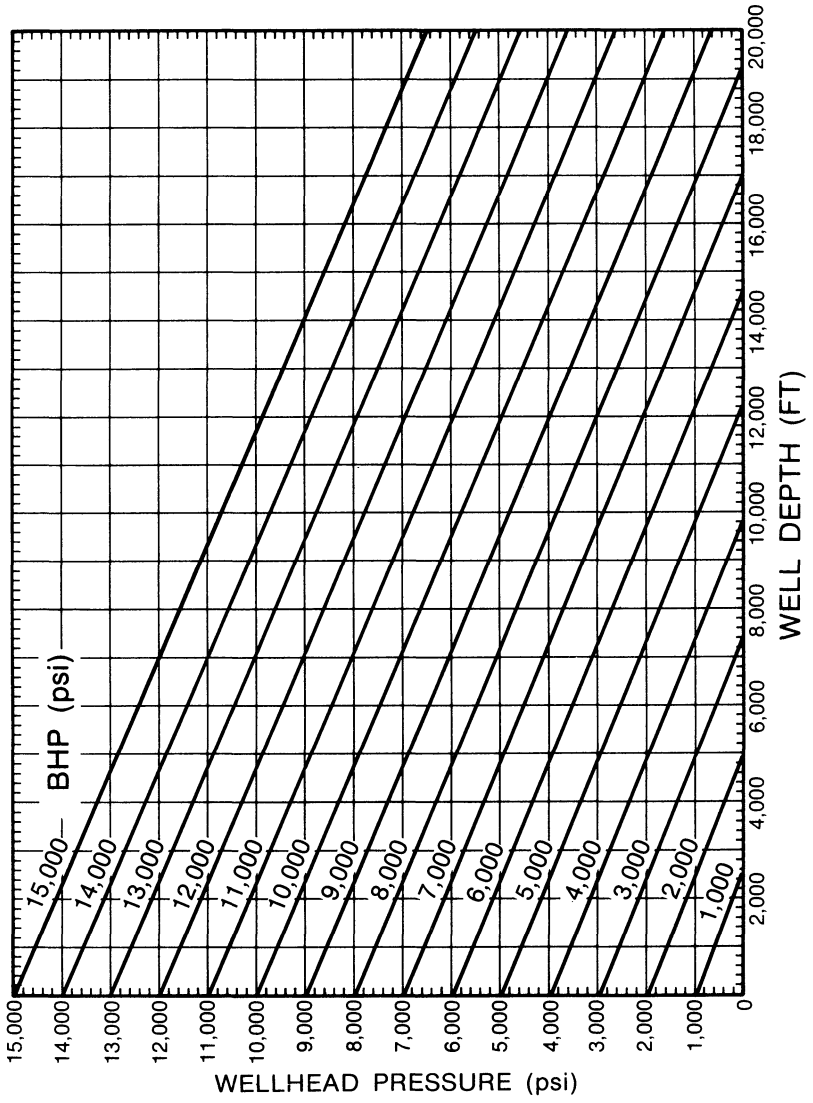
Find the wellhead pressure of a fluid with 500 SCF N_2/BBL liquid in a 10,000-ft well with a BHP of 7,000 psi.

From p. 325.09 — Wellhead Pressure = 3,230 psi.

ENERGIZED FLUID — 100 SCF N_2/BBL

Geothermal Gradient of 1.1°F per 100 ft

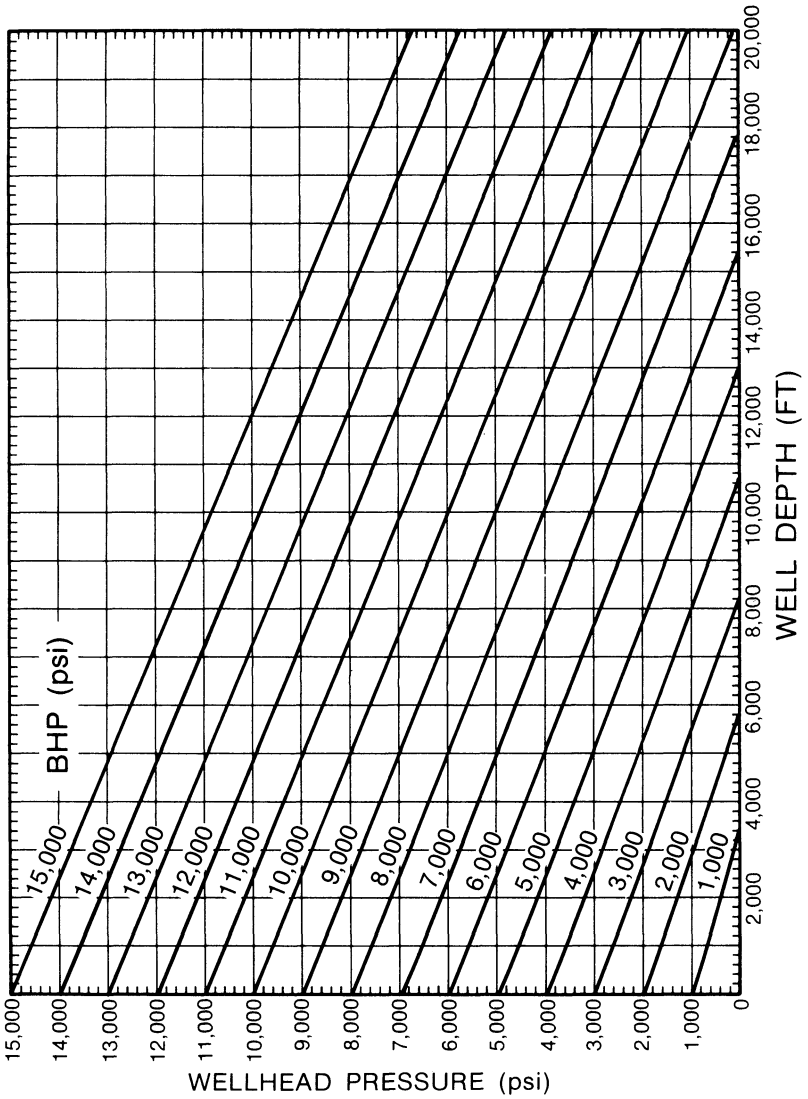
FLUID S.G. = 1.0



ENERGIZED FLUID — 200 SCF N_2/BBL

Geothermal Gradient of 1.1°F per 100 ft

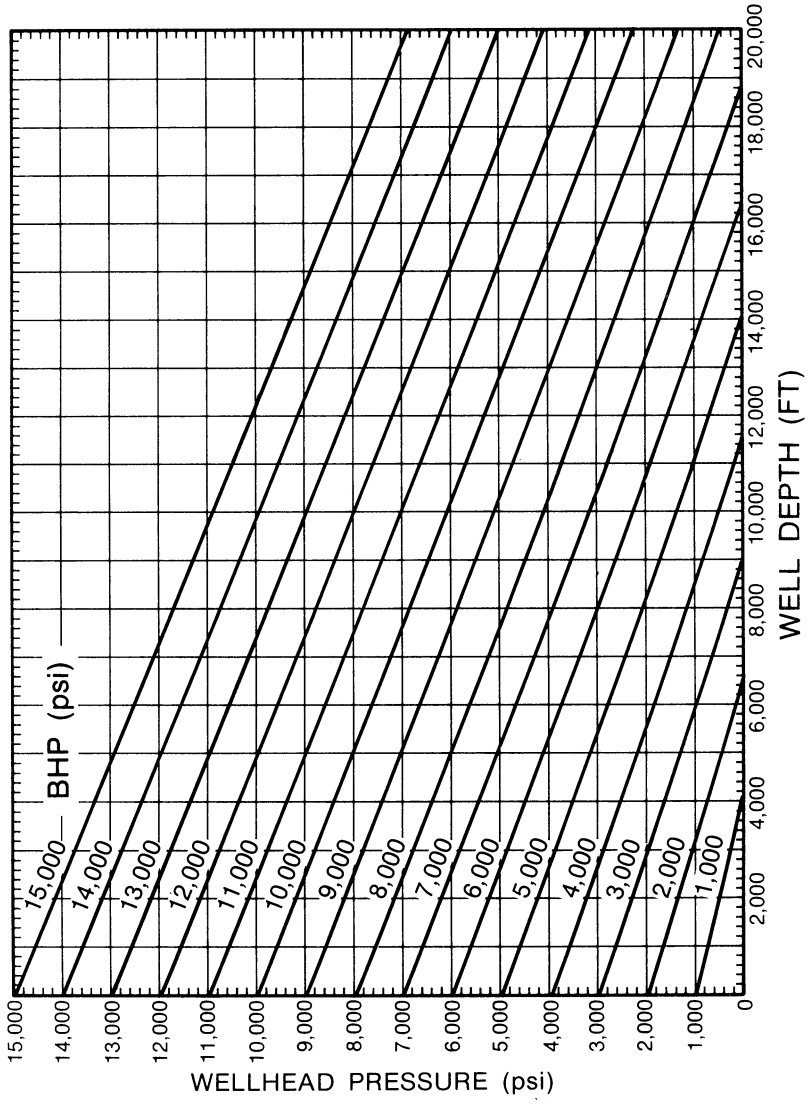
FLUID S.G. = 1.0



ENERGIZED FLUID — 300 SCF N_2/BBL

Geothermal Gradient of 1.1°F per 100 ft

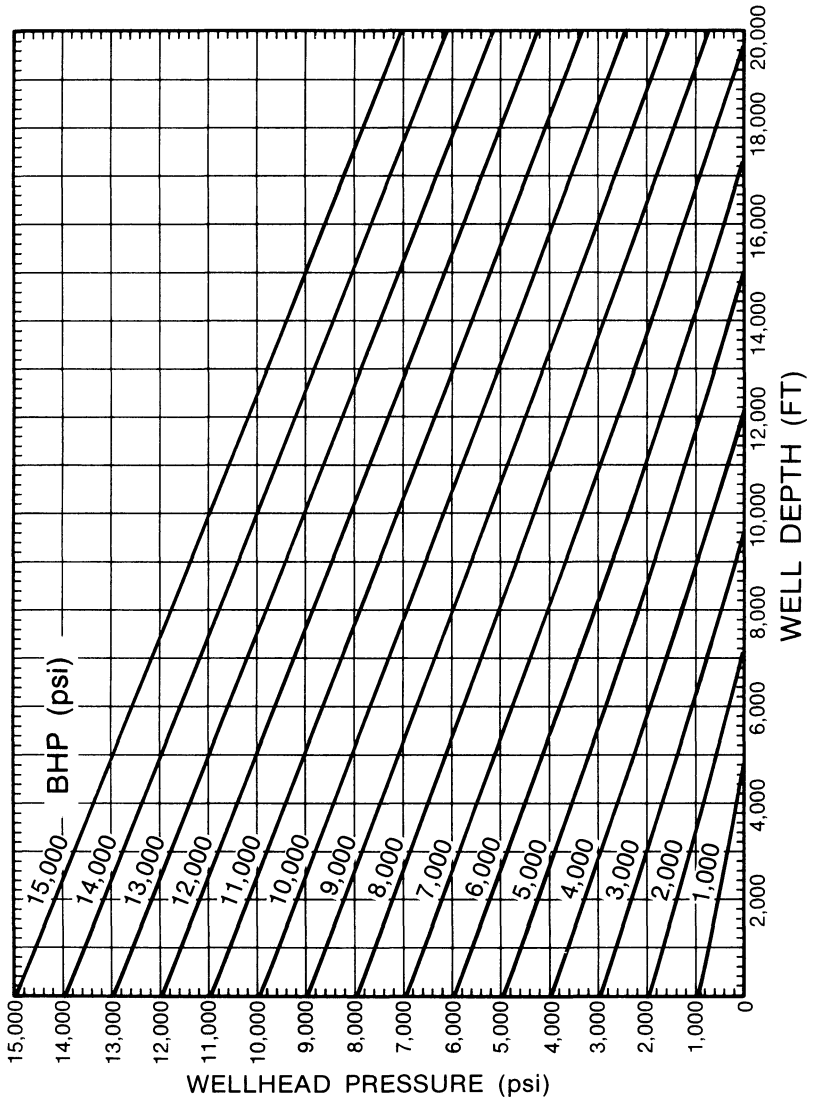
FLUID S.G. = 1.0



ENERGIZED FLUID — 400 SCF N_2/BBL

Geothermal Gradient of 1.1°F per 100 ft

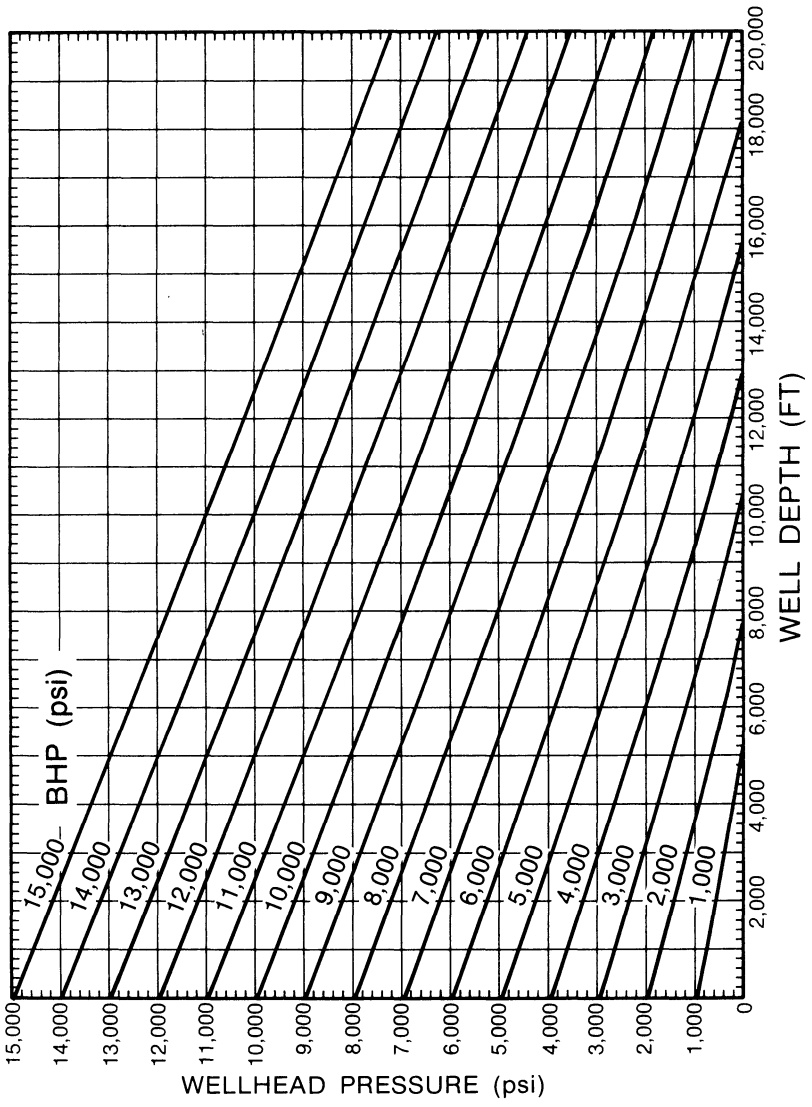
FLUID S.G. = 1.0



ENERGIZED FLUID — 500 SCF N_2/BBL

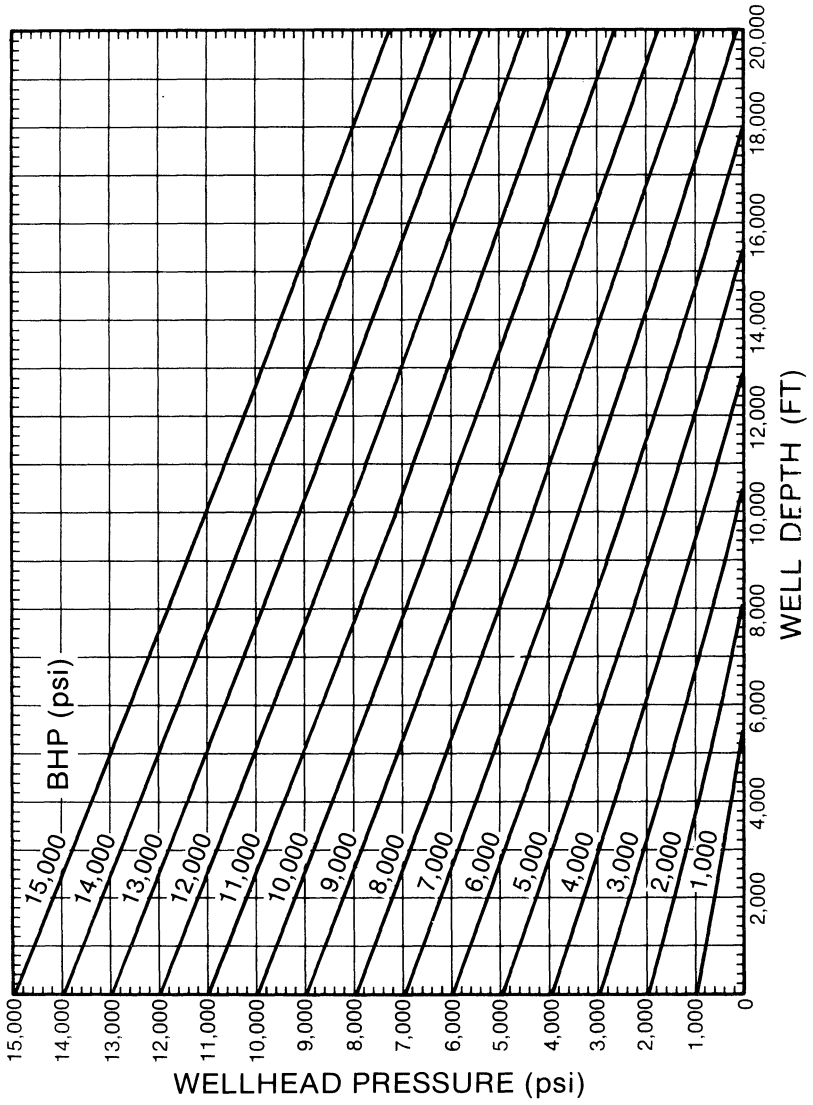
Geothermal Gradient of 1.1°F per 100 ft

FLUID S.G. = 1.0



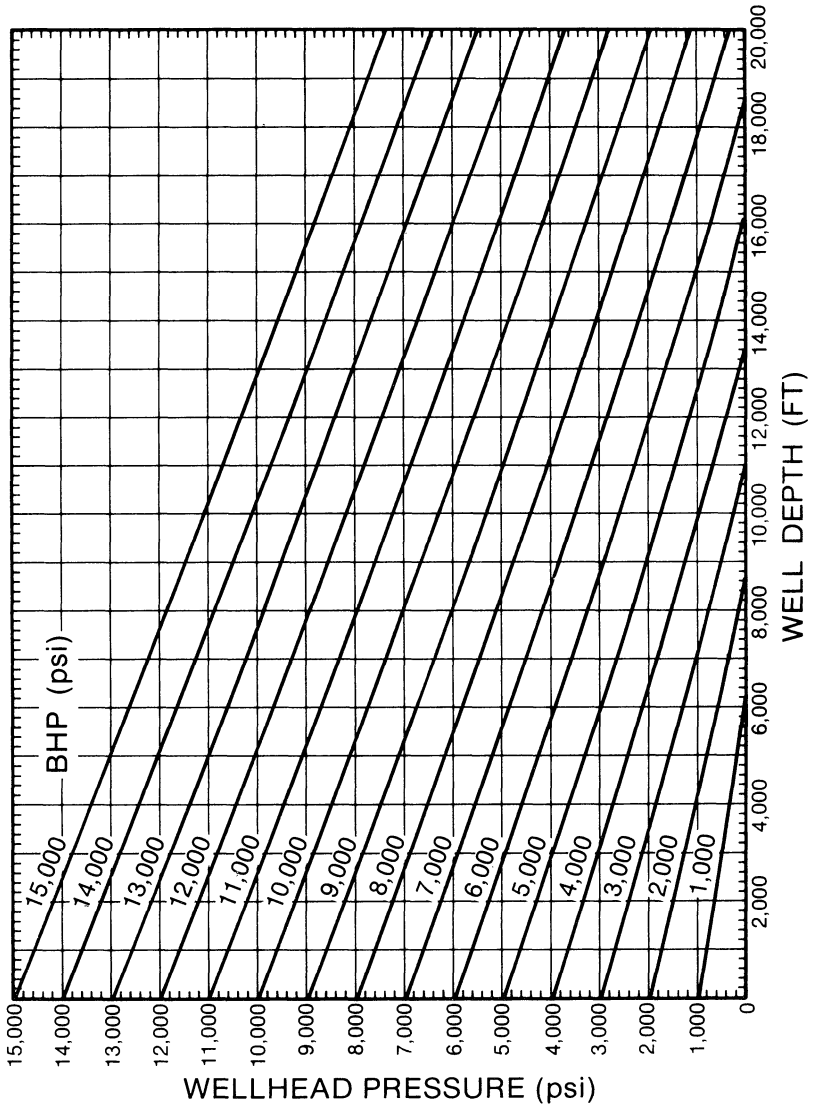
ENERGIZED FLUID — 600 SCF N_2/BBL

Geothermal Gradient of 1.1°F per 100 ft



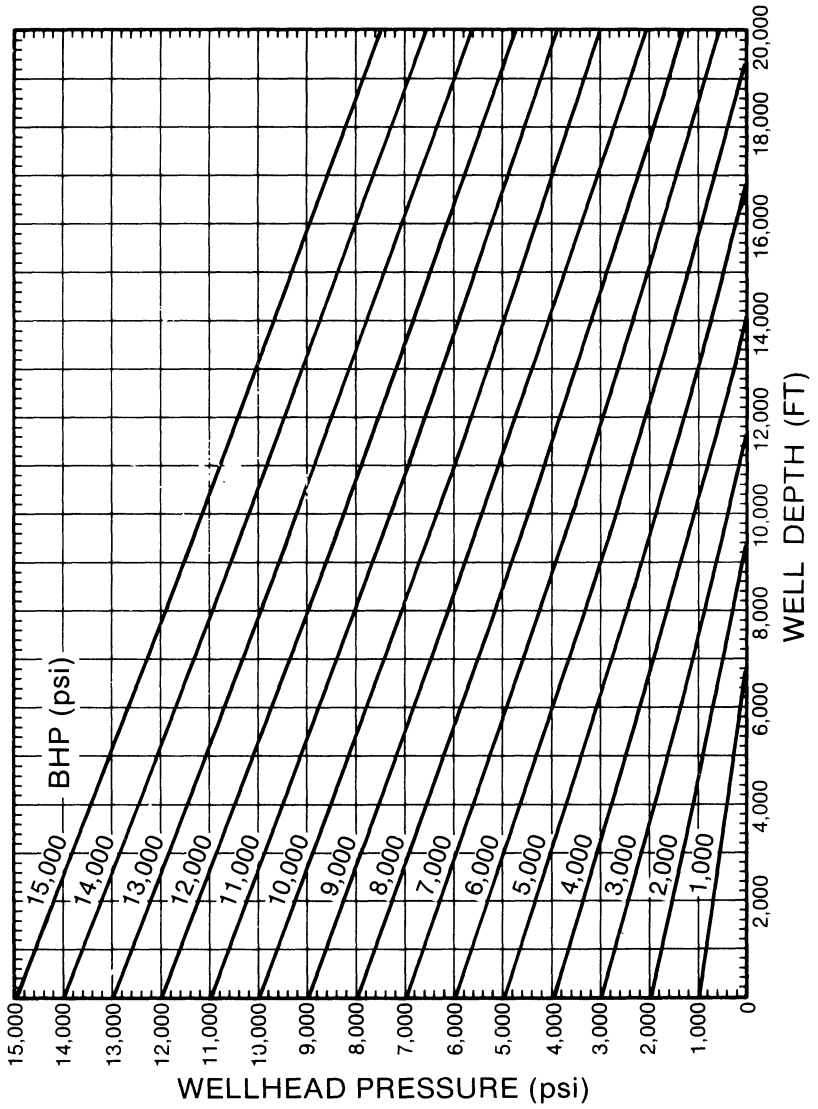
ENERGIZED FLUID — 700 SCF N_2/BBL

Geothermal Gradient of 1.1°F per 100 ft



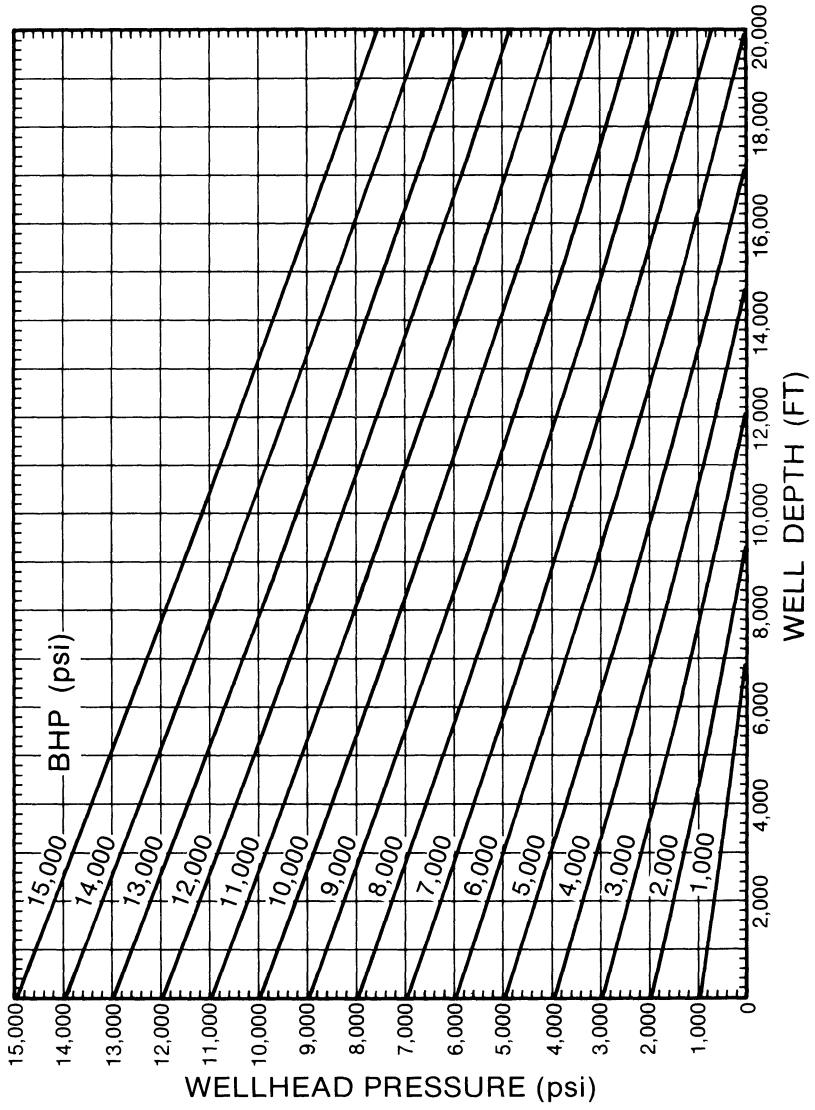
ENERGIZED FLUID — 800 SCF N_2/BBL

Geothermal Gradient of 1.1°F per 100 ft



ENERGIZED FLUID — 900 SCF N_2/BBL

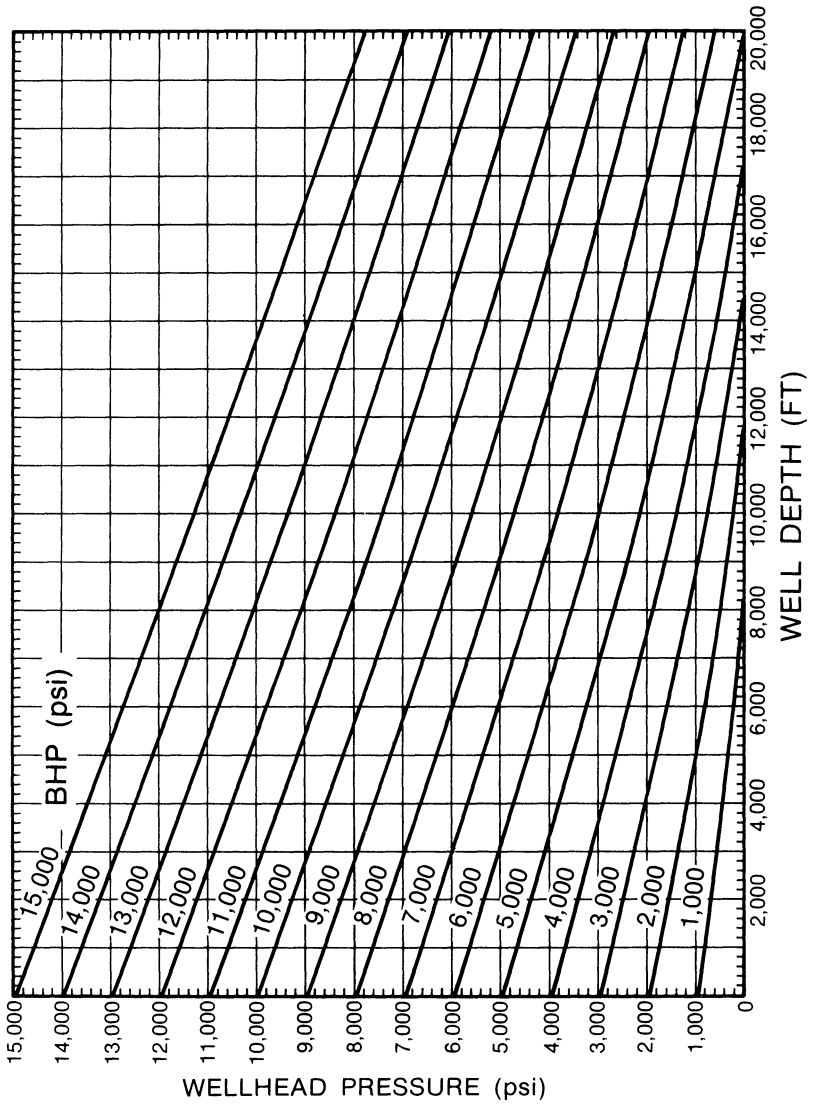
Geothermal Gradient of 1.1°F per 100 ft



ENERGIZED FLUID — 1,000 SCF N_2/BBL

Geothermal Gradient of 1.1°F per 100 ft

FLUID S.G. = 1.0



AVERAGE DENSITY OF A NITRIFIED MUD

AVERAGE DENSITY OF A NITRIFIED MUD

The graphs in this section are for determining the average density of a Nitrified Mud System. Given the wellhead pressure or annulus back pressure and the standard cubic feet of nitrogen per barrel of mud, the average mud density in pounds per gallon (lb/gal) can be determined. The pressure at any depth in the mud column can be calculated by adding the wellhead pressure or annulus back pressure and the hydrostatic pressure of the nitrified mud. The nitrified mud hydrostatic pressure can be calculated as follows.

$$\text{Hydrostatic Pressure (psi)} = .052 \times \text{Average Mud Density (lb/gal)} \times \text{Depth (ft)}$$

Using the Graph

To determine the average density of a nitrified mud, select the appropriate graph based on the density of the mud before the addition of nitrogen. Enter the graph on the x-axis with the wellhead pressure or annulus back pressure. Move up to the crossplot curve corresponding to the concentration of nitrogen in standard cubic feet per barrel (SCF/BBL) of mud. Move horizontally to the y-axis and read the average mud density.

EXAMPLE

Calculate the pressure at the top of a lost-circulation zone in the following well.

Zone Interval = 7,200 to 7,249 ft
Base Fluid Density = 10.00 lb/gal
Back Pressure = 300 psi
N_2 Concentration = 100 SCF/BBL

From p. 330.09 — Average Mud Density = 5.17 lb/gal.

Pressure at 7,200 ft

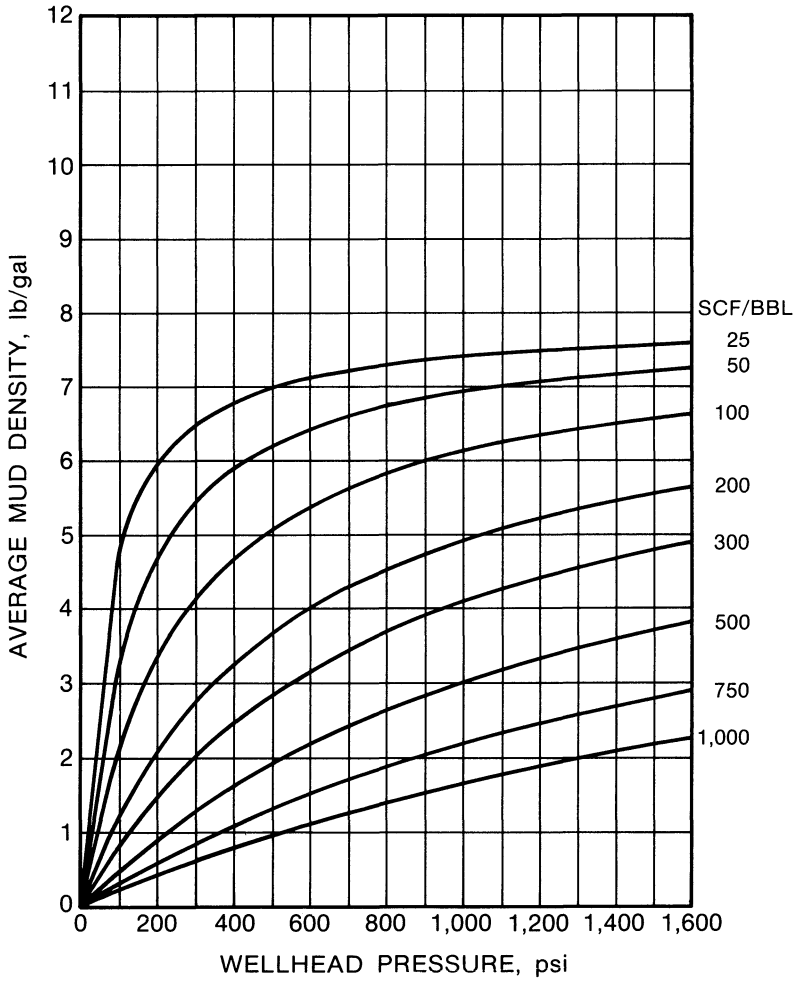
= Nitrified Mud Hydrostatic (psi) and Back Pressure (psi)

= (.052) (5.17 lb/gal) (7,200 ft) + 300 psi

= 2,235.6 psi

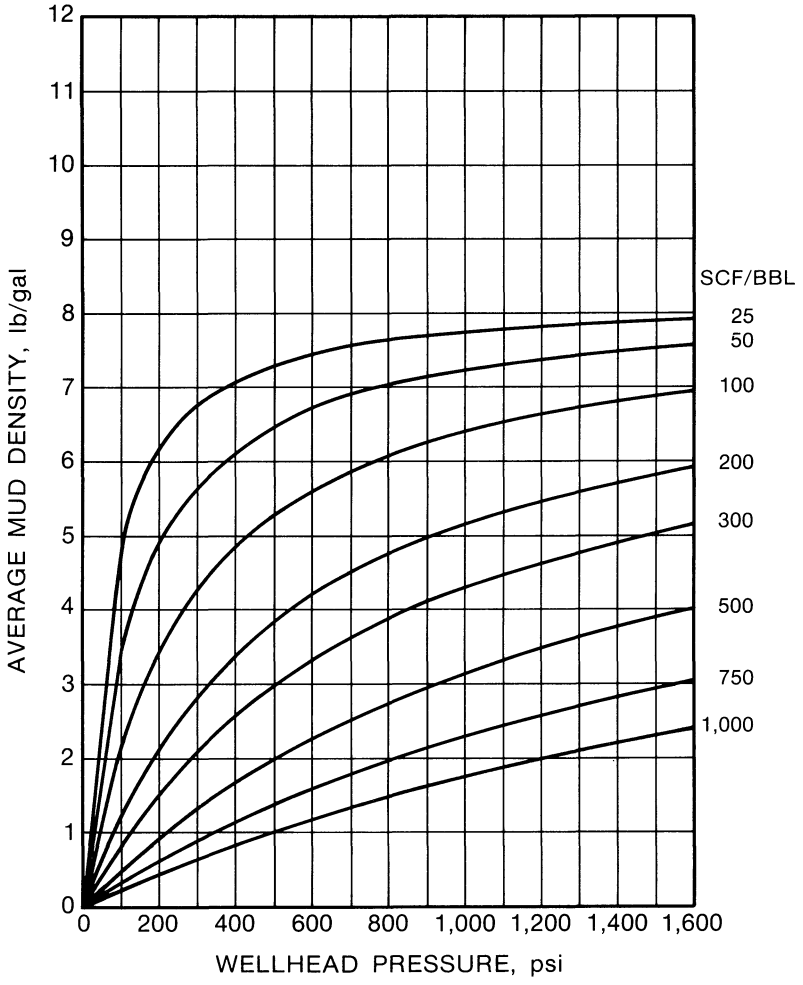
AVERAGE DENSITY OF A NITRIFIED MUD vs WELLHEAD PRESSURE

BASE FLUID DENSITY — 8.00 lb/gal



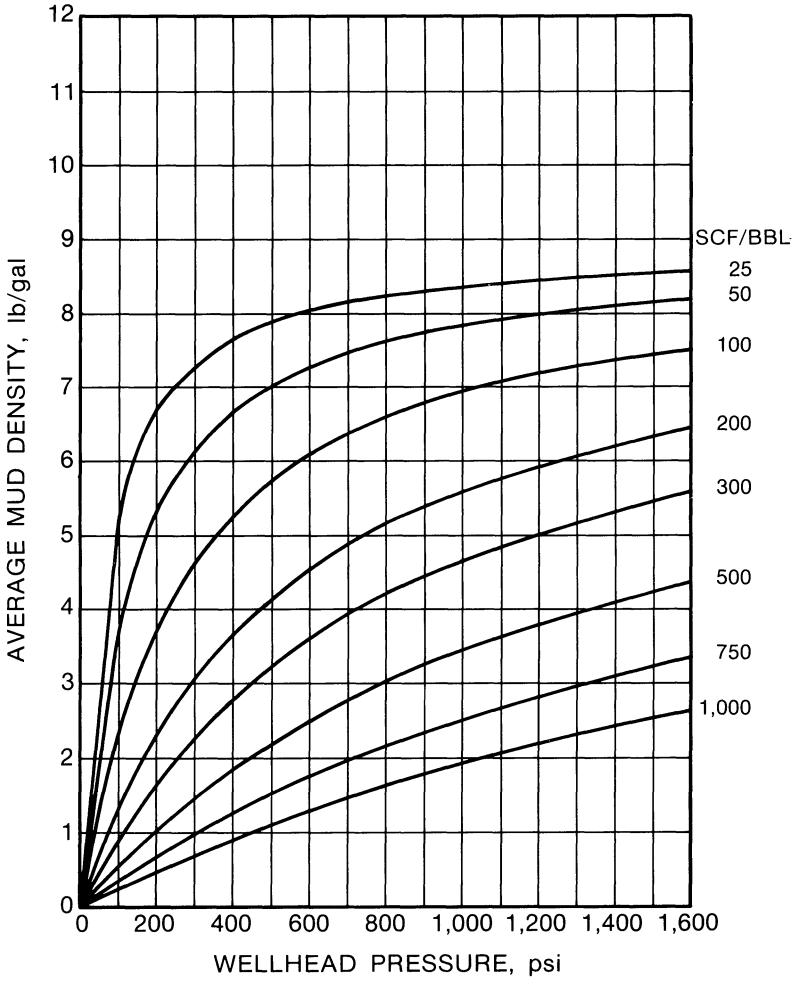
AVERAGE DENSITY OF A NITRIFIED MUD vs WELLHEAD PRESSURE

BASE FLUID DENSITY — 8.34 lb/gal



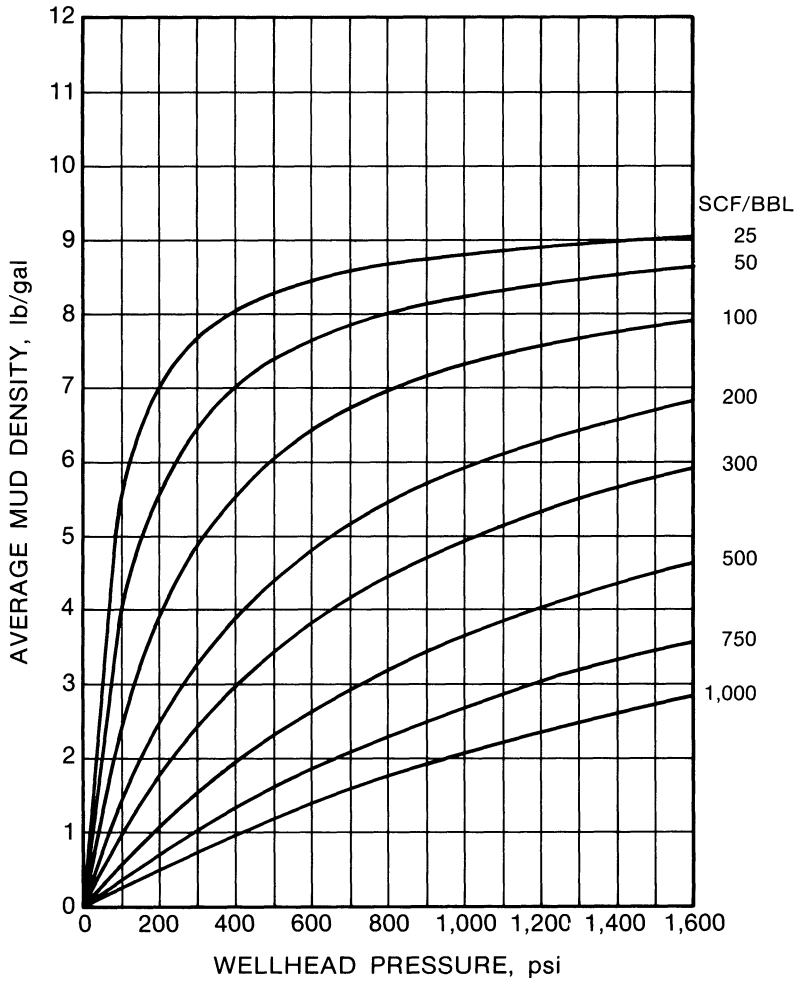
AVERAGE DENSITY OF A NITRIFIED MUD vs WELLHEAD PRESSURE

BASE FLUID DENSITY — 9.00 lb/gal



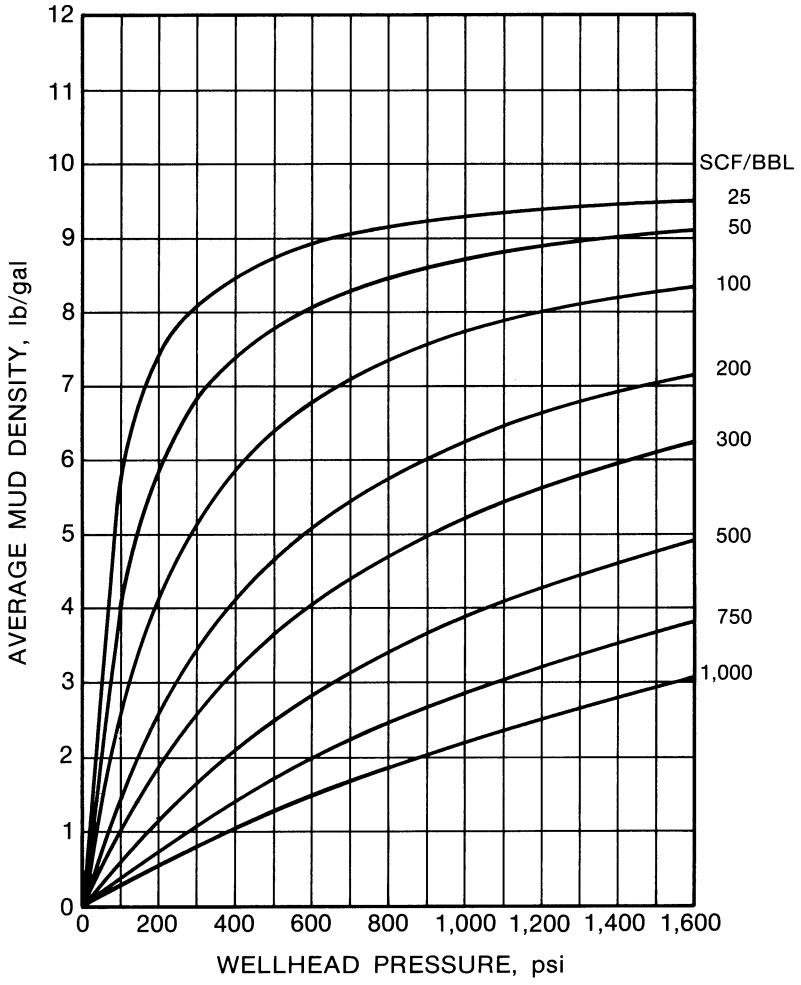
AVERAGE DENSITY OF A NITRIFIED MUD vs WELLHEAD PRESSURE

BASE FLUID DENSITY — 9.50 lb/gal



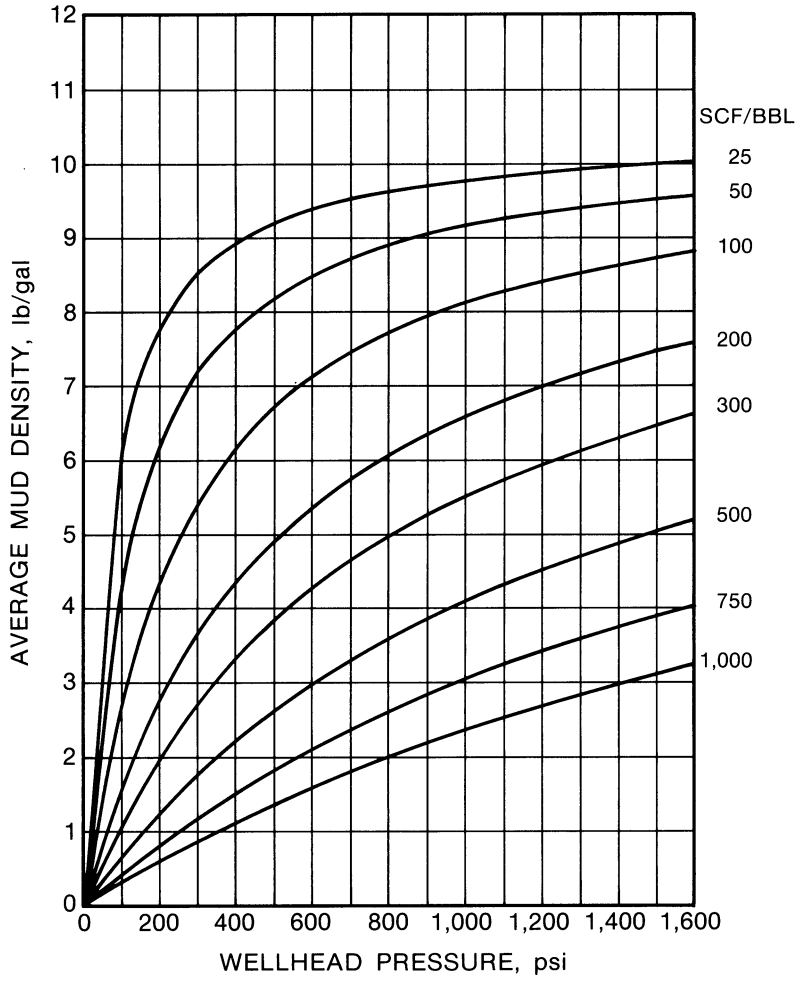
AVERAGE DENSITY OF A NITRIFIED MUD vs WELLHEAD PRESSURE

BASE FLUID DENSITY — 10.00 lb/gal



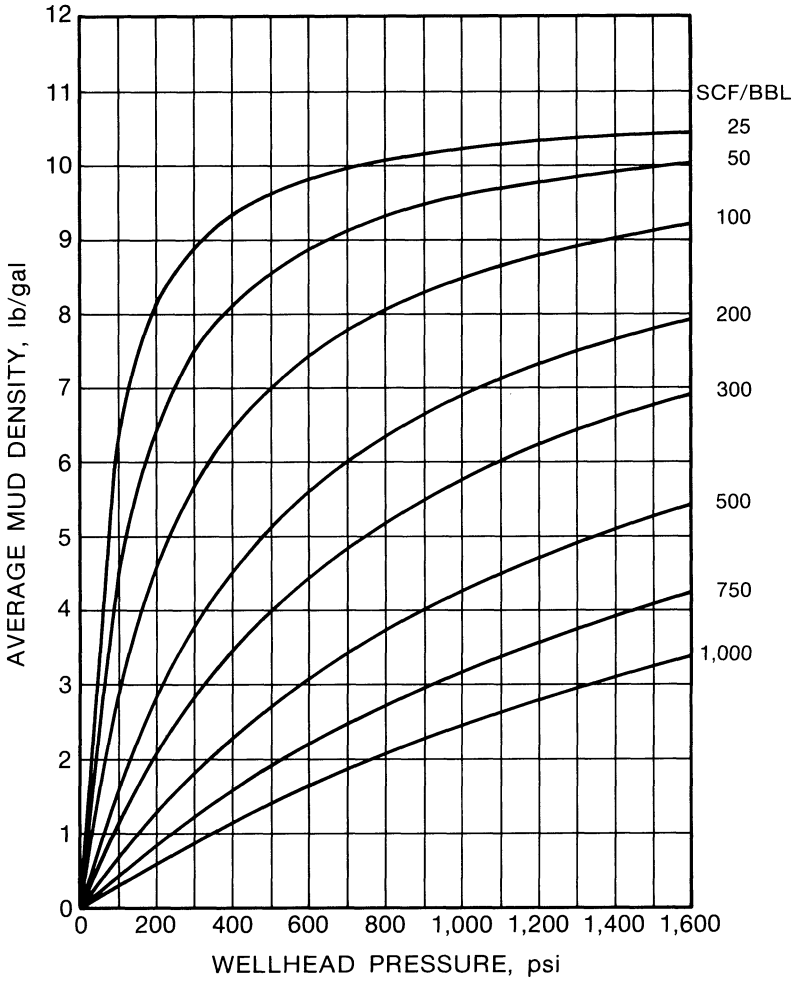
AVERAGE DENSITY OF A NITRIFIED MUD vs WELLHEAD PRESSURE

BASE FLUID DENSITY — 10.50 lb/gal



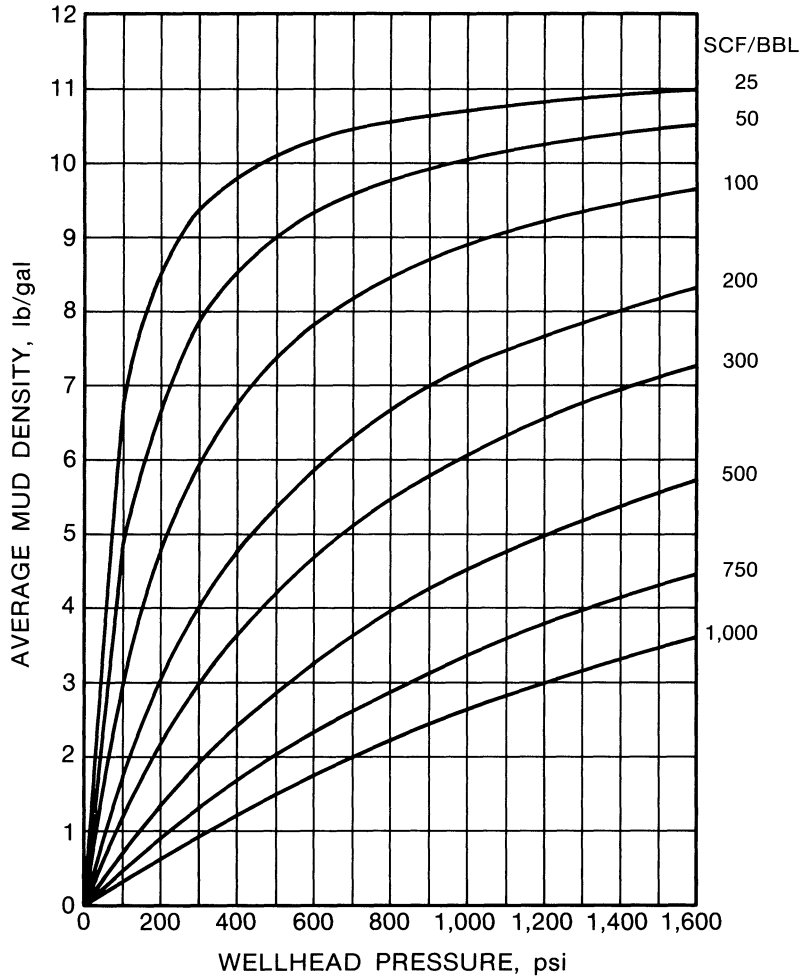
AVERAGE DENSITY OF A NITRIFIED MUD vs WELLHEAD PRESSURE

BASE FLUID DENSITY — 11.00 lb/gal



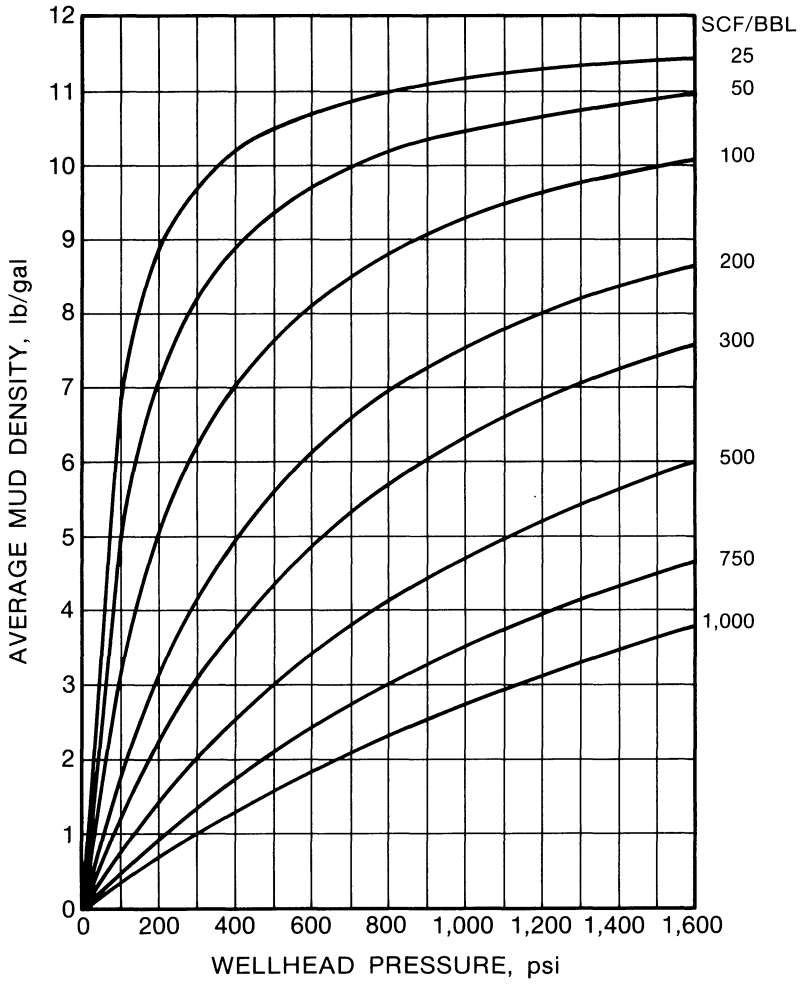
AVERAGE DENSITY OF A NITRIFIED MUD vs WELLHEAD PRESSURE

BASE FLUID DENSITY — 11.50 lb/gal



AVERAGE DENSITY OF A NITRIFIED MUD vs WELLHEAD PRESSURE

BASE FLUID DENSITY — 12.00 lb/gal



NITROGEN-LIQUID
FLOWBACK TABLES

NITROGEN-LIQUID FLOWBACK CURVES

The following section deals with the volumes of N_2 to use in flowback situations based upon bottom-hole flowing pressures. These volumes are idealistic, being based upon gas law calculations for unloading various weight fluids under ideal conditions. Field experience has shown that for the most effective cleanup, you probably will want to increase (perhaps even double) the volume shown on the graphs. Also shown are the recommended flowback rates for each size of pipe. This also needs to be handled with an added experience factor. The best flowback approach would be to start flowback at the recommended rates and alter these rates as flowback proceeds, based upon the following criteria.

- If the pressure increases, slowly increase the flowing rate until there is some pressure stabilization.

- If the pressure decreases, the flowing rate should be decreased until there is some pressure stabilization.

Using these guides, plus good field and reservoir experience, better recovery of treating fluids can be obtained.

NOTE: If there is no pressure at the surface, the bottom-hole static pressure (BHSP) can be calculated by determining the fluid level in the well and calculating the hydrostatic pressure of the fluid. If the bottom-hole producing pressure is not known, use 80% of BHSP for gas wells and 50% BHSP for oil wells.

Flowback Calculation

Well Depth:	7,000 ft	BHSP:	2,000 psi
Type Well:	Oil	Fluid Gravity:	1.15

QUESTIONS:
1. What is the estimated bottom-hole (effective) pressure?
2. How many standard cubic feet per barrel will be necessary to flow the well back?

1. Bottom-Hole Producing Pressure (effective)

   = BHSP x 50% (for oil wells only)

   = 2,000 psi x .5 = 1,000 psi.

2. Using the N_2 Flowback Ratios tables, find the intersection of the column under 1,000 psi and the line corresponding to 7,000 ft. This yields a number equal to 1,100 SCF/BBL (from p. 335.07).

   Therefore, to unload spent acid injected into the well described above, it will require at least 1,100 SCF/BBL to aid the estimated bottom-hole producing pressure.

FLUID FLOWBACK TABLE

SCF of N_2 per BBL of fluid
SG = 0.85

DEPTH FEET	BOTTOM-HOLE PRODUCING PRESSURE, PSI							
	500	1000	1500	2000	2500	3000	4000	5000
1000	100	0	0	0	0	0	0	0
2000	300	0	0	0	0	0	0	0
3000	500	150	0	0	0	0	0	0
4000	700	300	150	0	0	0	0	0
5000	1000	450	250	100	0	0	0	0
6000	0	600	350	200	0	0	0	0
7000	0	800	500	300	150	0	0	0
8000	0	1000	700	400	250	100	0	0
9000	0	1300	900	550	350	150	0	0
10000	0	1700	1100	700	450	250	0	0
11000	0	0	1300	850	600	350	150	0
12000	0	0	1550	1000	750	500	250	0
13000	0	0	1850	1150	850	600	350	100
14000	0	0	0	1300	1000	750	450	200
15000	0	0	0	1500	1150	950	550	300

The ratio of N_2 required to flow back a well with a back pressure of 100 psi, a friction pressure loss of maximum 30 psi/1,000 ft, a wellhead temperature of 70°F and a geothermal gradient of 1.1°F/100 ft can be read from the flowback ratio tables. Effective bottom-hole pressure is approximately 80% of static BHP for gas wells and 50% of static BHP for oil wells.

FLUID FLOWBACK TABLE

SCF of N_2 per BBL of fluid
SG = 1.00

DEPTH FEET	BOTTOM-HOLE PRODUCING PRESSURE, PSI							
	500	1000	1500	2000	2500	3000	4000	5000
1000	100	0	0	0	0	0	0	0
2000	350	50	0	0	0	0	0	0
3000	600	200	0	0	0	0	0	0
4000	850	350	150	0	0	0	0	0
5000	1150	500	300	150	0	0	0	0
6000	0	750	450	300	150	0	0	0
7000	0	950	600	400	250	100	0	0
8000	0	1200	750	550	400	200	0	0
9000	0	1450	950	700	550	350	100	0
10000	0	1750	1150	850	700	500	200	0
11000	0	0	1400	1100	850	650	350	100
12000	0	0	1650	1300	1050	800	450	200
13000	0	0	1850	1500	1250	1000	550	300
14000	0	0	0	1750	1450	1150	700	400
15000	0	0	0	0	1600	1300	800	500

The ratio of N_2 required to flow back a well with a back pressure of 100 psi, a friction pressure loss of maximum 30 psi/1,000 ft, a wellhead temperature of 70°F and a geothermal gradient of 1.1°F/100 ft can be read from the flowback ratio tables. Effective bottom-hole pressure is approximately 80% of static BHP for gas wells and 50% of static BHP for oil wells.

FLUID FLOWBACK TABLE

SCF of N_2 per BBL of fluid

SG = 1.15

DEPTH FEET	BOTTOM-HOLE PRODUCING PRESSURE, PSI							
	500	1000	1500	2000	2500	3000	4000	5000
1000	100	0	0	0	0	0	0	0
2000	350	100	0	0	0	0	0	0
3000	650	250	100	0	0	0	0	0
4000	950	400	250	100	0	0	0	0
5000	1300	600	400	200	100	0	0	0
6000	0	800	550	350	200	100	0	0
7000	0	1100	750	500	350	200	0	0
8000	0	1400	950	650	500	350	100	0
9000	0	1800	1150	800	650	500	200	0
10000	0	0	1350	1050	850	650	350	100
11000	0	0	1600	1300	1000	800	500	250
12000	0	0	1800	1550	1200	950	600	350
13000	0	0	0	1800	1400	1100	750	500
14000	0	0	0	0	1600	1250	900	600
15000	0	0	0	0	1800	1400	1000	700

The ratio of N_2 required to flow back a well with a back pressure of 100 psi, a friction pressure loss of maximum 30 psi/1,000 ft, a wellhead temperature of 70°F and a geothermal gradient of 1.1°F/100 ft can be read from the flowback ratio tables. Effective bottom-hole pressure is approximately 80% of static BHP for gas wells and 50% of static BHP for oil wells.

FLUID FLOWBACK TABLE

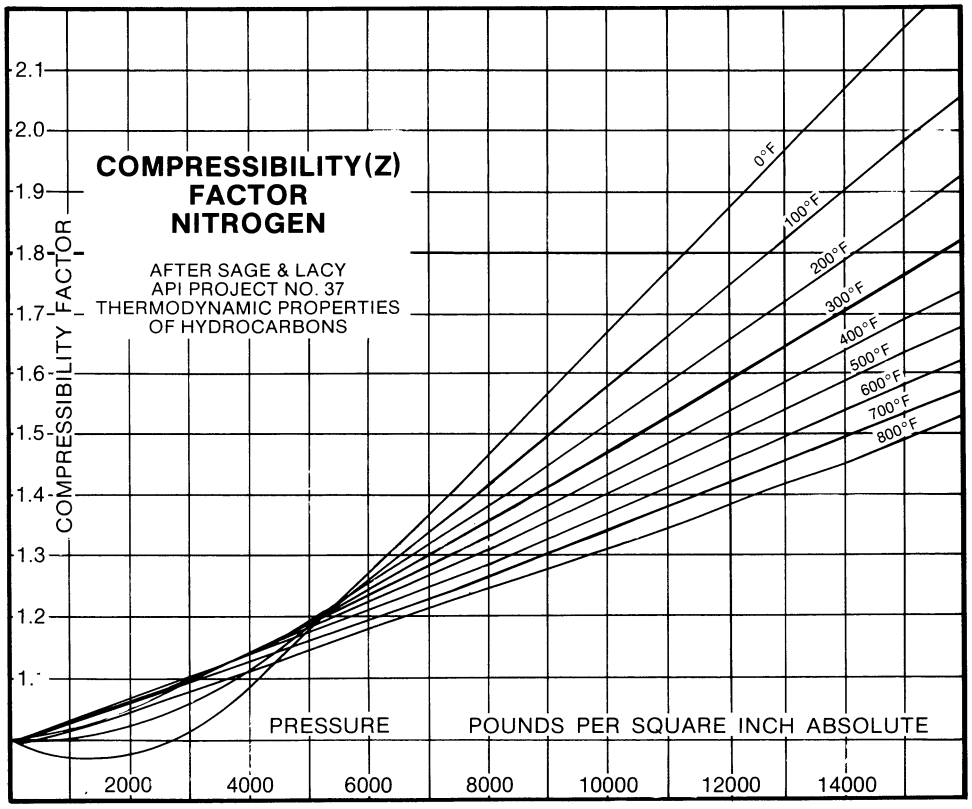
SCF of N_2 per BBL of fluid

SG = 1.30

DEPTH FEET	BOTTOM-HOLE PRODUCING PRESSURE, PSI							
	500	1000	1500	2000	2500	3000	4000	5000
1000	100	0	0	0	0	0	0	0
2000	350	100	0	0	0	0	0	0
3000	650	300	100	0	0	0	0	0
4000	1000	500	250	150	0	0	0	0
5000	0	750	400	300	150	0	0	0
6000	0	1000	600	450	250	150	0	0
7000	0	1300	800	600	400	250	100	0
8000	0	1600	1000	800	600	400	200	0
9000	0	1900	1250	1000	750	600	350	150
10000	0	0	1550	1200	950	750	500	250
11000	0	0	1800	1500	1150	950	600	400
12000	0	0	2000	1750	1350	1150	750	500
13000	0	0	0	2000	1600	1350	900	650
14000	0	0	0	0	1800	1550	1050	800
15000	0	0	0	0	2000	1750	1200	950

The ratio of N_2 required to flow back a well with a back pressure of 100 psi, a friction pressure loss of maximum 30 psi/1,000 ft, a wellhead temperature of 70°F and a geothermal gradient of 1.1°F/100 ft can be read from the flowback ratio tables. Effective bottom-hole pressure is approximately 80% of static BHP for gas wells and 50% of static BHP for oil wells.

MISCELLANEOUS TECHNICAL INFORMATION


COMPRESSIBILITY(Z) FACTOR NITROGEN
AFTER SAGE & LACY
API PROJECT NO. 37
THERMODYNAMIC PROPERTIES
OF HYDROCARBONS
COMPRESSIBILITY FACTOR
2.1
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
0°F
100°F
200°F
300°F
400°F
500°F
600°F
700°F
800°F
PRESSURE
POUNDS PER SQUARE INCH ABSOLUTE
2000
4000
6000
8000
10000
12000
14000

PIPELINE CAPACITIES

VOLUME OF NITROGEN PER 1000 FT OF PIPE AT 100°F

CAPACITY, CU FT/FT	NOMINAL PIPE SIZE IN.	VOLUME OF N_2 SCF/1000 FT PRESSURE, PSIG 0	20	40	60
0.006	1	5	13	20	28
0.023	2	21	51	80	110
0.051	3	47	112	178	243
0.088	4	82	194	306	419
0.139	5	129	305	482	658
0.201	6	187	441	696	951
0.223	7	208	491	775	1059
0.347	8	323	764	1205	1646
0.377	9	351	830	1309	1788
0.548	10	510	1206	1902	2598
0.573	11	534	1261	1989	2717
0.777	12	724	1710	2697	3684
0.802	13	747	1765	2783	3802
0.940	14	875	2068	3261	4455
1.079	15	1005	2374	3744	5114
1.227	16	1143	2701	4259	5818
1.434	17	1336	3157	4978	6799
1.553	18	1448	3420	5393	7366
1.792	19	1670	3945	6221	8497
1.930	20	1799	4250	6702	9154
2.128	21	1983	4684	7386	10088
2.348	22	2189	5170	8153	11136
2.792	24	2602	6146	9691	13237
3.409	26	3177	7505	11834	16164
4.276	28	3986	9414	14845	20276
4.507	30	4201	9923	15646	21371
5.585	32	5206	12297	19389	26484
6.305	34	5877	13882	21889	29897
7.068	36	6589	15563	24540	33519

VOLUME OF NITROGEN PER 1000 FT OF PIPE AT 100°F (Cont'd)

CAPACITY, CU FT/FT	NOMINAL PIPE SIZE IN.	VOLUME OF N_2 SCF/1000 FT PRESSURE, PSIG 80	100	200	300
0.006	1	36	43	81	120
0.023	2	140	169	317	466
0.051	3	308	373	699	1026
0.088	4	531	643	1205	1768
0.139	5	853	1011	1894	2778
0.201	6	1206	1461	2736	4012
0.223	7	1343	1627	3047	4468
0.347	8	2087	2528	4736	6944
0.377	9	2267	2747	5145	7544
0.548	10	3294	3990	7473	10958
0.573	11	3445	4173	7816	11460
0.777	12	4671	5659	10598	15540
0.802	13	4820	5839	10937	16036
0.940	14	5648	6842	12815	18790
1.079	15	6485	7855	14712	21572
1.227	16	7377	8936	16737	24540
1.434	17	8621	10443	19559	28678
1.553	18	9340	11314	21189	31068
1.792	19	10774	13052	24444	35840
1.930	20	11606	14060	26331	38608
2.128	21	12791	15495	29020	42550
2.348	22	14120	17104	32033	46968
2.792	24	16784	20331	38077	55830
3.409	26	20495	24827	46498	68176
4.276	28	25709	31143	58326	85518
4.507	30	27097	32824	61474	90134
5.585	32	33580	40677	76181	111698
6.305	34	37908	45921	86001	126097
7.068	36	42499	51482	96417	141369

VOLUME OF NITROGEN PER 1000 FT OF PIPE AT 100°F (Cont'd)

CAPACITY, CU FT/FT	NOMINAL PIPE SIZE IN.	VOLUME OF N_2 SCF/1000 FT PRESSURE, PSIG 400	500	600	700
0.006	1	158	196	234	272
0.023	2	614	762	909	1057
0.051	3	1352	1678	2003	2328
0.088	4	2330	2891	3452	4011
0.139	5	3661	4543	5424	6303
0.201	6	5287	6561	7834	9103
0.223	7	5888	7307	8724	10138
0.347	8	9151	11357	13559	15756
0.377	9	9942	12338	14730	17118
0.548	10	14441	17922	21397	24865
0.573	11	15103	18743	22377	26004
0.777	12	20480	25416	30344	35262
0.802	13	21133	26227	31313	36387
0.940	14	24763	30731	36690	42637
1.079	15	28429	35281	42123	48949
1.227	16	32341	40135	47918	55684
1.434	17	37794	46903	55998	65074
1.553	18	40944	50812	60665	70497
1.792	19	47233	58617	69983	81326
1.930	20	50881	63144	75388	87607
2.128	21	56076	69591	83086	96551
2.348	22	61899	76817	91713	106577
2.792	24	73578	91311	109017	126686
3.409	26	89849	111503	133125	154700
4.276	28	112704	139867	166989	194052
4.507	30	118788	147416	176002	204526
5.585	32	147207	182685	218110	253458
6.305	34	166182	206233	246224	286129
7.068	36	186309	231211	276046	320784

VOLUME OF NITROGEN PER 1000 FT OF PIPE AT 100°F (Cont'd)

CAPACITY, CU FT/FT	NOMINAL PIPE SIZE IN.	VOLUME OF N_2 SCF/1000 FT PRESSURE, PSIG 800	900	1000	1200
0.006	1	310	347	385	460
0.023	2	1204	1351	1496	1786
0.051	3	2651	2974	3295	3933
0.088	4	4569	5125	5679	6778
0.139	5	7180	8053	8923	10650
0.201	6	10369	11631	12888	15382
0.223	7	11548	12953	14352	17130
0.347	8	17948	20132	22306	26623
0.377	9	19499	21871	24234	28923
0.5482	10	28323	31769	35201	42012
0.573	11	29620	33224	36813	43937
0.777	12	40166	45053	49920	59580
0.802	13	41448	46491	51513	61482
0.940	14	48566	54475	60360	72040
1.079	15	55757	62541	69297	82707
1.227	16	63428	71146	78831	94086
1.434	17	74124	83143	92124	109951
1.553	18	80301	90072	99802	119114
1.792	19	92636	103907	115131	137410
1.930	20	99790	111932	124023	148023
2.128	21	109979	123360	136686	163136
2.348	22	121398	136169	150878	180075
2.792	24	144304	161862	179346	214052
3.409	26	176215	197655	219006	261386
4.276	28	221039	247933	274715	327876
4 507	30	232970	261316	289544	345573
5.585	32	288707	323834	358815	428250
6.305	34	325922	365577	405067	483451
7 068	36	365396	409853	454127	542004

VOLUME OF NITROGEN PER 1000 FT OF PIPE AT 100°F

CAPACITY, CU FT/FT	NOMINAL PIPE SIZE IN.	VOLUME OF N_2 SCF/1000 FT PRESSURE, PSIG 1400	1600	1800	2000
0.006	1	533	606	677	747
0.023	2	2072	2354	2631	2903
0.051	3	4563	5183	5794	6392
0.088	4	7864	8933	9985	11016
0.139	5	12356	14037	15689	17309
0.201	6	17845	20272	22658	24998
0.223	7	19873	22576	25233	27839
0.347	8	30887	35088	39217	43266
0.377	9	33556	38120	42606	57005
0.548	10	48741	55371	61887	68277
0.573	11	50974	57907	64722	71405
0.777	12	69122	78524	87764	96826
0.802	13	71328	81030	90566	99917
0.940	14	83578	94946	106119	117076
1.079	15	95953	109004	121831	134411
1.227	16	109154	124001	138593	152903
1.434	17	127560	144910	161963	178687
1.553	18	138191	156987	175461	193578
1.792	19	159417	181100	202412	223312
1.930	20	171729	195087	218045	240559
2.128	21	189264	215006	240308	265120
2.348	22	208915	237330	265259	292648
2.792	24	248334	282110	315309	347865
3.409	26	303249	344495	385035	424791
4.276	28	380387	432125	482977	532846
4.507	30	400919	455450	509047	561607
5.585	32	496837	564413	630833	695968
6.305	34	560880	637167	712148	785680
7.068	36	628810	714337	798400	880836

VOLUME OF NITROGEN PER 1000 FT OF PIPE AT 100°F (Cont'd)

CAPACITY, CU FT/FT	NOMINAL PIPE SIZE IN.	VOL. OF N_2 SCF/1000 FT PRESSURE, PSIG 2500	3000
0.006	1	915	1073
0.023	2	3556	4169
0.051	3	7830	9179
0.088	4	13494	15818
0.139	5	21203	24854
0.201	6	30621	35895
0.223	7	34102	39975
0.347	8	53000	62127
0.377	9	57579	67495
0.548	10	83637	98040
0.573	11	87468	102532
0.777	12	118609	139035
0.802	13	122395	143473
0.940	14	143415	168113
1.079	15	164649	193003
1.227	16	187302	219558
1.434	17	218886	256580
1.553	18	237127	277964
1.792	19	273550	320659
1.930	20	294677	345424
2.128	21	324764	380693
2.348	22	358485	420220
2.792	24	426124	499508
3.409	26	520356	609967
4.276	28	652719	765126
4.507	30	687951	806425
5.585	32	852539	999357
6.305	34	962433	1128176
7.068	36	1078997	1264814