GAS-OIL RATIO CALCULATION

RAILROAD COMMISSION OF TEXAS

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GENERAL

This pamphlet has been prepared by the Railroad Commission to assist the oil operator in complying with the rules and regulations which have been adopted to carry out a gas-oil ratio program. Operators should refer to Statewide Rule 49 concerning Gas-Oil Ratio.

In selecting the equipment to be used in making measurements, the operator should consider the maximum and minimum volumes which he plans to measure, and he should select a measuring device which covers his range of volumes most accurately.

All ratio tests submitted to the Commission shall be made by persons qualified by training or experience to make such tests, and the methods of gas measurement used shall be those described in this pamphlet, or methods of at least equal accuracy.

Definitions

Schedule daily allowable is the allowable which appears on the Commission proration schedule.

Calendar day allowable is the figure that is determined by multiplying the schedule daily allowable by the percentage factor determined by the Commission to supply demand for oil during the month in which the test is made.

Prorated well is a well subject to the market demand factor.

Exempt well is a well exempt from the market demand factor.

Limited well is a prorated well with an allowable less than a top well allowable.

Top well allowable is the maximum assigned well allowable in a field.

Penalized well is a prorated or exempt well restricted in allowable because of high gas-oil ratio.

Volumes Reported

Report the total volume of gas and oil produced from the well during the 24 hour test period. Include all gas withdrawn from the casing as well as that produced through the tubing of well which is singly completed.

Maximum and Minimum Test Rate

Amount of oil produced during the test shall not be less than the well's then current calendar day allowable if the well is capable of producing that amount and shall not exceed the schedule allowable by more than ten percent.

Prorated Wells

The oil flow shall be stabilized during the 24 hour period immediately preceding the test period at any rate the operator desires between the calendar day allowable (penalized, if such is the case) and 10% above the schedule allowable (unpenalized). Operators are cautioned that:

1. A test below the calendar day allowable WILL result in an allowable reduction.
2. A test at or near the calendar day allowable rate MAY result in having to retest the well if a future market demand factor causes the calendar day allowable to become greater than the test rate.
3. A test of a penalized well at or above the penalized calendar day rate MAY result in a limited allowable, as a result of reduced gas-oil ratio.

Therefore, operators are encouraged to conduct tests at as near the schedule allowable rate as is practical consistent with equipment and condition of the well in order to avoid the necessity for additional tests.

Exempt Wells

The oil flow shall be stabilized during the 24 hour period immediately preceding the test period at a rate fixed as nearly as possible to the well's schedule allowable. Adjustments in the rate of flow should be made during the first 12 hours of the stabilization period and no adjustments shall be made during the last 12 hours of the stabilization period or during the time in which the well is being tested.

Pumping Wells

Total gas and oil produced during the 24 hour test period must be used regardless of the pumping time during the test period.

Gas Lift or Jetting Wells

The total input and total output gas volumes shall be reported separately. These volumes shall be properly identified and determined by continuous measurement during the test. The volume of gas used in determining the operating gas-oil ratios hereunder shall be the volume remaining after the total input gas has been deducted from the total output volume.

Stop-Cocked Wells

Both the closed-in casing pressure at the beginning of the test period and the closed-in casing pressure at the conclusion of the test must be shown and properly identified on the report. If the closed-in casing pressure at the end of the 24 hour test period exceeds the closed-in casing pressure at the beginning of the test by more than six-tenths (0.6) pounds per square inch per barrel of oil produced during the test, the well must be retested.

Form W-10 Instructions

List all gas production figures in Mcf (thousands of cubic feet) measured at a base pressure of 14.65 pounds per square inch absolute, and a standard base temperature of 60° Fahrenheit; correction to be made for pressure according to Boyle's Law, and for specific gravity according to test made by the Balance Method, as outlined in this pamphlet.

Show all data requested for each well separately.

Under Producing Method, show whether the well is flowing, pumping, or on gas-lift, by 'flow', 'pump', or 'lift'. The Gas Production listed shall be the total volume of gas produced during the test in thousands of cubic feet (Mcf). The Gas-Oil Ratio required is the number of cubic feet of gas produced per barrel of oil during the test.

GAS MEASUREMENT

1. **Orifice Meters**

The orifice type meter is suitable for the measurement of all volumes and, when available, should be used in preference to any other gas measurement method, except that positive displacement meters are equally acceptable in the volume ranges for which they are applicable. Orifice type meters include not only the conventional pen type recorders, but also electronic pneumatic, mechanical, or other data recorders and/or gas flow computers used in conjunction with orifices.

There are two basic equations used with orifice meters.

$$Q_h = C'\sqrt{h_w P_f} \qquad (1)$$

$$C' = F_b\, F_{pb}\, F_{tb}\, F_g\, F_{tf}\, F_r\, Y\, F_{pv}\, F_m \qquad (2)$$

Where: Q_h = gas flow rate, SCF per **hour**
C' = orifice constant
h_w = differential across orifice, inches of water
P_f = flowing pressure, psia

Table 1 and 2:
- F_b = basic orifice factor
- F_{pb} = pressure base factor
- F_{tb} = temperature base factor

Table 3:
- F_g = specific gravity factor

Table 4:
- F_{tf} = flowing temperature factor

Optional:
- F_r = Reynolds number factor
- Y = expansion factor
- F_{pv} = supercompressibility factor
- F_m = manometer factor

The last four factors are relatively small and, although they are used to obtain accurate results for the purchase or sale of gas, their use is optional in gas-oil ratio reports to the Commission.

The points at which h_w, the differential across the orifice, is taken influences the values of the factors F_b, F_r, and Y. Either flange taps (1" from respective orifice plate surfaces) or pipe taps (2 1/2" pipe diameters upstream and 8" pipe diameters downstream) are used with the orifice meter. Care should be taken in selecting the proper table, either flange tap or pipe tap table, when determining the three factors affected.

The standard temperature and pressure base in Texas is set out in the *Texas Natural Resources Code*, at TEX. NAT. RES. CODE 186.002(12) (Vernon 1978), in the following definition:

> "Cubic foot of gas" or "standard cubic foot of gas" means the volume of gas, including natural and casinghead gas, contained in one cubic foot of space at a standard pressure base of 14.65 pounds per square inch absolute and at a standard temperature base of 60° Fahrenheit, and if the conditions of pressure and temperature differ from this standard, conversion of the volume from the differing conditions to the standard conditions shall be made in accordance with the ideal gas laws, corrected for deviation.

The average specific gravity of gas in certain fields in the State of Texas enumerated in Commission Special Order No. 20-21,272 indicates that most of the gravities are reasonably close to the value 0.60.

Tables 1 and 2 in this pamphlet were computed at a base pressure of 14.65 pounds per square inch absolute, base temperature of 60° Fahrenheit, specific gravity of 0.60, and a flow rate in cubic feet per day. These tables incorporate the first three factors given in formula number 2 into a composite correction factor for use in reports to the Commission. This composite factor is designated as the Texas Basic Orifice Factor, F_{TX}.

Gravity of the gas is to be found by a specific gravity balance. Section 6.3p, Bureau of Mines Monograph 10 provides supplementary information in operating this equipment. After the gas gravity is determined, the proper Specific Gravity Factor, F_g, is to be applied, as given in Table 3.

Flowing temperature is to be measured and the proper Flowing Temperature Factor, F_{tf}, is to be applied, according to Table 4.

For Commission reports only, the orifice meter equations may be simplified to:

$$Q_d = C_{TX} \sqrt{h_w P_f} \qquad (3)$$

$$C_{TX} = F_{TX} F_g F_{tf} \qquad (4)$$

Where: Q_d = gas flow rate, SCF per day

C_{TX} = Texas orifice constant

h_w = differential across orifice, inches of water

P_f = flowing pressure, psia (gauge + atmospheric)

F_{TX} = Texas basic orifice factor
F_g = specific gravity factor
F_{tf} = flowing temperature factor

An example problem will illustrate the calculation of a gas volume.

Given: 2" pipe (2.067" Inside Diameter)
orifice diameter: 1/2"
flange taps
gas gravity: 0.70
flowing temperature: 84° F
differential: 40 inches of water
flowing pressure: 143 psig.
barometric pressure: 29.81 inches of mercury

Required: Find the volume of gas

Procedure: F_{TX} = 1.574 from Table 1
F_g = 0.9258 from Table 3
F_{tf} = 0.9777 from Table 4

C_{TX}, the product of the above numbers = 1424.71

$$Q_d = C_{TX} \sqrt{h_w P_f}$$
$$= 1424.71 \sqrt{40\,(143 + 14.64)}$$
$$= 1424.71 \sqrt{40 \text{ X } 157.64}$$
$$= 1424.71 \text{ X } 79.41$$
$$= 113{,}136 \text{ scf/day}$$

2. Alternate Methods of Measuring Gas

Where an orifice type meter or a positive displacement meter is not available, an orifice well tester, an orifice assembly, a critical flow prover, an open type pitot tube, or a choke nipple is an acceptable, although less desirable alternate.

A. Small Gas Volumes

Orifice Well Tester

The two-inch orifice well tester is suitable for the measurement of volumes of gas up to 1,000 Mcf per day but is most accurate at rates below 300 Mcf per day; however, the tables include volumes for the two-inch orifice well tester above 1,000 Mcf per day for use only when a more accurate measuring device is not available.

This method is only recommended for measuring small volumes of gas and for use where the vent line from the separator is two-inch. The tester is manufactured by several gas equipment companies and consists of a special cast nipple fitted with a pressure connection, an orifice disc, a gasket, and a cap for holding the orifice on the end of the nipple, as Figure 1 illustrates.

In making the test, attach the nipple of the tester to the vent line, allowing the gas to flow through the nipple to the atmosphere. Connect a recording pressure gauge or a U-Tube manometer. Next hold the largest of the orifice discs near the end of the test nipple and observe the recorded pressure. It is preferable to try different size orifices until that point is reached which will give readings between 50% and 75% of the maximum reading of the gauge or manometer; then secure the disc and gasket to the nipple by tightening the cap. A test with readings less than 5% of the maximum reading of the gauge or manometer will be rejected.

If a U-Tube manometer is used it should be set in a vertical position and the pressure read in inches by adding the readings above and below the zero mark in the fluid columns of the U-Tube. As this instrument does not record the pressure at any time it must be frequently observed during the test and the pressure recorded manually.

Tables 5 and 6 have been prepared for use with the 2" orifice well tester. It is necessary to make corrections for the specific gravity and the flowing temperature.

Example Problem:

Given: 2" orifice well tester
1/2" orifice disc
Pressure: 72" of water
Specific gravity: 1.08
Flowing temperature: 70° F

Required: Find the volume of gas

Procedure: Rate = 53,200 cubic feet per day
(Table 5)

Fg = 0.7453 (Table 3)
Ftf = 0.9905 (Table 4)

53,200 X 0.7453 X 0.9905 = **39,273 cubic feet per day**

B. **Large Gas Volumes**

The following methods are designed for the measurement of large volumes of gas:

(1) **Orifice Assembly with Single Tap**

The three-and four-inch orifice methods are accurate up to rates of 3,000 Mcf per day and should be used in preference to the two-inch orifice well tester for all volumes over 300 Mcf per day.

Although practically any diameter pipe may be used, depending upon the volume of gas to be measured, only the three- and four-inch devices are discussed here. Engineers have found this type of equipment very satisfactory in field work due to the ruggedness of its construction, and the accuracy of the results obtained through its use.

A study of Figure 2 will show the simplicity of the orifice assembly. A pair of orifice flanges is installed at the outlet of a three- or four-inch pipe nipple, and the proper orifice placed between the flanges with the square edge of the orifice facing the flow of gas. Figure 2 shows the pressure connection as made in the upstream flange.

After the measuring device has been installed on the vent line, and the proper size orifice placed between the flanges (ratio of the orifice to pipe size should not exceed 0.75), the pressure is taken at the point shown in Figure 2. The pressure may either be recorded or observed on a U-Tube manometer. If a recording pressure gauge is employed in making gas-oil ratio surveys, a permanent record of the test upon each individual well may be retained.

Tables 7 and 8 have been prepared to be used with the apparatus described above. These tables given in thousands of cubic feet (Mcf) for a 24 hour period the volume of gas vented corresponding to the pressure recorded in inches of mercury, and the size orifice used.

As an example: Assuming that the recording pressure gauge read in inches of mercury and the reading averaged 18 inches of mercury over a five-hour period and assuming that the orifice size was 2-inch in a 4-inch tester, from Table 8 opposite 18.0 inches of mercury and 2-inch orifice we read the volume of 1,730 Mcf per day. This volume is measured at a base pressure of 14.65 pounds absolute, base and flowing temperature of 60 degrees Fahrenheit, and 0.60 specific gravity.

Assuming a specific gravity of 0.90 and a flowing temperature of 75 degrees Fahrenheit, use Tables 3 and 4 to correct the volume as follows:

1,730 X 0.8165 X 0.9859 = **1393 Mcf per day**
Where .8165 is the specific gravity factor, Fg
Where .9859 is the flowing temperature factor, F_{tf}

(2) **Critical Flow Prover**

The minimum volume which can accurately be measured with the critical flow prover is approximately 50 Mcf per day.

This equipment is designated for the accurate measurement of large volumes of gas, and its use is limited to conditions where gas can be measured at pressures greater than 15 pounds per square inch. The apparatus employed is shown in Figure 3.

The pressure which will be obtained on the guage will depend upon the volume of gas flowing and the orifice size. An orifice size should be chosen which will give a guage pressure between 15 and 500 pounds per square inch. Table 9 gives the coefficients corresponding to the different size orifices for the two- and four-inch critical flow provers. These coefficients should be multiplied by the absolute pressures to obtain the volume of gas flowing per 24 hours.

Corrections for specific gravity and flowing temperature of the gas are made in the same manner as usual. The absolute pressure are obtained by adding the guage pressures to the barometric pressures at the time of the test. For most work a barometric pressure of 14.4 pounds per square inch may be assumed along the Gulf Coast and 13.2 pounds per square inch in West Texas and the Panhandle. (Tables 14 and 20.)

As an example: Assume that a 1-3/8" orifice is used in a four-inch critical flow prover and that the flowing temperature and pressure are 80 degrees Fahrenheit and 22.5 pounds per square inch gauge, respectively. Assume also that the specific gravity of the gas is 0.61. From Table 9 we find that the critical flow coefficient is 41.295. The absolute pressure will be 14.4 plus 22.5 or 36.9 pounds per square inch.

The specific gravity and flowing temperature factors are obtained from Tables 3 and 4 and are 0.9918 and 0.9813, respectively. The daily volume of gas is equal to:

$$41.295 \times 36.9 \times 0.9918 \times 0.9813 = \textbf{1483 Mcf per day}$$

(3) **Open Flow Pitot Tube**

The minimum volumes for the open type pitot tube vary with the size of the pipe, but will approximate 150 Mcf per day for pitot tubes in 2-inch lines, and 600 Mcf per day for pitot tubes in 4-inch lines.

The assembly illustrated in Figure 4 is only one of the many types of open-flow pitot tube assemblies which have been used in the field in past years. This type is shown since it is very easy to use in case no other method of measurement is available or applicable. This assembly may be made into a permanent installation on a separator vent line and may be used very conveniently for taking spot readings.

The tube should be constructed of 1/3 inch internal diameter pipe, the end exposed to the flow of gas being finished to a thin edge. The tube is bent in a curve, and the plane of the end should be as nearly perpendicular to the center of the pipe as possible.

The tube is fastened to the test nipple by means of clamps to assure that the tube is in the plane of the open end of the nipple, and coincides with the center line of the nipple.

At the pressure connection a rubber or flexible metal hose is connected and is also connected to a recording pressure guage or U-Tube manometer; thus, the impact pressure is either recorded or observed.

Table 10 contains volumes which are rates of flow in thousands of cubic feet of gas discharged per day from a test nipple having an internal diameter of exactly one (1.000) inch.

From this Table 10 it can be seen that when the guage pressure is 16 pounds per square inch, a volume of 726 thousand cubic feet per day is discharged from a 1-inch tube. Since a 4-inch pipe is actually used in the illustration, this volume must be multiplied by the factor 16.209 obtained from Table 11. Hence the volume is 726 X 16.209 = 11,768 Mcf per day.

The above volume must then be corrected for specific gravity and flowing temperature in accordance with Tables 3 and 4.

Assuming a specific gravity of 0.72 and a flowing temperature of 69 degrees Fahrenheit, use Tables 3 and 4 to correct the volume as follows:

11,768 X 0.9129 X 0.9915 = **10,652 Mcf per day**
Where 0.9129 is the specific gravity factor, F_g
Where 0.9915 is the flowing temperature factor, F_{tf}

(4) **Choke Nipple**

Choke nipples may be used to measure gas volumes. Table 12 gives the coefficients for 6" choke nipples. Coefficients are used directly with upstream pressure in pounds per square inch absolute, with corrections made for gas gravity and flowing temperature.

Example Problem:

Given: 1/2" choke nipple
upstream pressure: 375 psig.
gas gravity: 0.66
flowing temperature: 75° F

Required: Find the volume of gas

Procedure: Coefficient = 1.3650 from Table 12
F_g = 0.9535 from Table 3
F_{tf} = 0.9859 from Table 4

(375 + 14.65) (1.3650) (0.9535) (0.9859) = **500 Mcf per day**

OIL MEASUREMENT

1. Gross Volume

A test tank or a recently proved positive displacement meter are acceptable methods of measuring the volume of oil produced. When a test tank is used, the tank tables for that specific tank should be used to compute the volume of oil produced. A less desirable method is shown by Table 13 where the tank strap tables are unavailable. Gauging procedures should follow the current American Petroleum Institute Standards as closely as practical.

In determining the amount of oil in the total fluid production, any method using sound and recognized engineering principles is acceptable.

2. Corrections

Volume of oil should be corrected to 60 degrees Fahrenheit. Oil gravity at the observed temperature is used to convert to net volume by the Reduction Tables found in the ASTM-IP Petroleum Measurement Tables. In the absence of these tables, Figure 5 may be used to calculate the approximate change in volume.

TABLE 1

TEXAS BASIC ORIFICE FACTORS FOR FLANGE TAPS

F_{TX} for flange taps

Orifice Diameter, Inches	NOMINAL PIPE SIZE, INCHES (Inside Diameter, Inches)					
	2 (1.939)	2 (2.067)	3 (2.900)	3 (3.068)	4 (4.026)	6 (6.065)
0.250	396	396	396	396	395	
0.375	886	886	884	884	883	
0.500	1,576	1,574	1,567	1,567	1,565	1,563
0.625	2,477	2,471	2,451	2,449	2,443	2,439
0.750	3,602	3,587	3,542	3,538	3,523	3,512
0.875	4,971	4,937	4,842	4,833	4,806	4,784
1.000	6,619	6,549	6,357	6,341	6,293	6,257
1.125	8,605	8,464	8,098	8,070	7,986	7,931
1.250	11,015	10,752	10,082	10,033	9,890	9,805
1.375	13,975	13,505	12,331	12,246	12,010	11,881
1.500		16,894	14,872	14,735	14,356	14,162
1.625			17,747	17,527	16,936	16,648
1.750			21,012	20,668	19,764	19,343
1.875			24,744	24,212	22,857	22,250
2.000			28,994	28,226	26,236	25,372
2.125			33,996	32,790	29,923	28,715
2.250				38,108	33,955	32,285
2.375					38,373	36,086
2.500					43,217	40,133
2.625					48,544	44,426
2.750					54,417	48,984
2.875					60,922	53,819
3.000					68,381	58,941
3.125						64,368
3.250						70,122

Pressure Base:	14.65 psia
Temperature Base:	60° F
Gas Flow Rate:	cubic feet per day
Specific Gravity:	0.60

This table is a composite of the Basic Orifice Factors, F_b, in Gas Measurement Committee Report No. 3 of the American Gas Association, Pressure Base Factor, F_{pb}, for 14.65 psia, and Temperature Base Factor, F_{tb}, for 60° Fahrenheit, with the data converted to a gas flow rate in cubic feet per day and a specific gravity of 0.60. The formula for this table is:

$$F_{TX} = F_b \times F_{pb} \times F_{tb} \times \sqrt{\frac{24}{0.60}}$$

Where: $F_{pb} = 1.0055$ for 14.65 psia

$F_{tb} = 1.0000$ for 60° F

$F_{TX} = 31.154277\ F_b$

TABLE 2

TEXAS BASIC ORIFICE FACTORS FOR PIPE TAPS

F_{TX} for pipe taps

Orifice Diameter, Inches	NOMINAL PIPE SIZE, INCHES					
	2 (1.939)	2 (2.067)	3 (2.900)	3 (3.068)	4 (4.026)	6 (6.065)
0.250	399	399	397	397	396	
0.375	906	904	894	894	891	
0.500	1,645	1,635	1,600	1,596	1,585	1,577
0.625	2,646	2,620	2,528	2,518	2,487	2,466
0.750	3,952	3,894	3,697	3,676	3,605	3,558
0.875	5,640	5,517	5,127	5,088	4,952	4,857
1.000	7,823	7,579	6,846	6,777	6,540	6,368
1.125	10,685	10,218	8,894	8,775	8,384	8,099
1.250	14,518	13,645	11,322	11,126	10,501	10,058
1.375	18,193	14,201	13,887	12,914	12,254	
1.500			17,627	17,133	15,651	14,695
1.625			21,728	20,965	18,749	17,391
1.750			26,679	25,517	22,249	20,354
1.875			32,724	30,967	26,207	23,596
2.000			40,211	37,559	30,688	27,133
2.125				45,644	35,777	30,983
2.250					41,572	35,167
2.375					48,205	39,709
2.500					55,838	44,635
2.625					64,673	49,981
2.750					74,988	55,775
2.875						62,065
3.000						68,901
3.125						76,331
3.250						84,425

Pressure Base:	14.65 psia
Temperature Base:	60° F
Gas Flow Rate:	cubic feet per day
Specific Gravity:	0.60

This table is a composite of the Basic Orifice Factors, F_b, in Gas Measurement Committee Report No. 3 of the American Gas Association, Pressure Base Factor, F_{pb}, for 14.65 psia, and Temperature Base Factor, F_{tb}, for 60° Fahrenheit, with the data converted to a gas flow rate in cubic feet per day and a specific gravity of 0.60. The formula for this table is:

$$F_{tx} = F_b \times F_{pb} \times F_{tb} \times \sqrt{\frac{24}{0.60}}$$

Where: $F_{pb} = 1.0055$ for 14.65 psia

$F_{tb} = 1.0000$ for 60° F

Thus: $F_{TX} = 31.154277\ F_b$

TABLE 3

SPECIFIC GRAVITY FACTORS

$$F_g = \sqrt{\frac{0.60}{\text{Sp. Gr.}}}$$

SP.GR.	FACTOR	SP.GR.	FACTOR
0.500	1.0954	0.725	0.9097
0.505	1.0900	0.730	0.9066
0.510	1.0847	0.735	0.9035
0.515	1.0794	0.740	0.9005
0.520	1.0742	0.745	0.8974
0.525	1.0690	0.750	0.8944
0.530	1.0640	0.755	0.8914
0.535	1.0590	0.760	0.8885
0.540	1.0541	0.765	0.8856
0.545	1.0492	0.770	0.8827
0.550	1.0445	0.775	0.8793
0.555	1.0398	0.780	0.8771
0.560	1.0351	0.785	0.8743
0.565	1.0304	0.790	0.8715
0.570	1.0260	0.795	0.8687
0.575	1.0215	0.800	0.8660
0.580	1.0171	0.805	0.8635
0.585	1.0127	0.810	0.8607
0.590	1.0084	0.815	0.8580
0.595	1.0041	0.820	0.8554
0.600	1.0000	0.825	0.8528
0.605	0.9958	0.830	0.8502
0.610	0.9918	0.835	0.8476
0.615	0.9877	0.840	0.8452
0.620	0.9837	0.860	0.8353
0.625	0.9798	0.880	0.8257
0.630	0.9759	0.900	0.8165
0.635	0.9721	0.920	0.8076
0.640	0.9682	0.940	0.7989
0.645	0.9645	0.960	0.7906
0.650	0.9608	0.980	0.7825
0.655	0.9571	1.000	0.7746
0.660	0.9535	1.020	0.7669
0.665	0.9498	1.040	0.7595
0.670	0.9463	1.060	0.7523
0.675	0.9427	1.080	0.7453
0.680	0.9393	1.100	0.7385
0.685	0.9359	1.120	0.7319
0.690	0.9325	1.140	0.7255
0.695	0.9292	1.160	0.7192
0.700	0.9258	1.180	0.7131
0.705	0.9225	1.200	0.7071
0.710	0.9193	1.220	0.7013
0.715	0.9161	1.240	0.6956
0.720	0.9129	1.260	0.6901

TABLE 4

FLOWING TEMPERATURE FACTORS

$$F_{tf}\sqrt{\frac{520}{460^{o}+T}}$$

Temp. °F	Factor	Temp. °F	Factor	Temp. °F	Factor	Temp. °F	Factor
20	1.0408	65	0.9952	110	0.9551	155	0.9195
21	1.0398	66	0.9943	111	0.9543	156	0.9187
22	1.0387	67	0.9933	112	0.9534	157	0.9180
23	1.0376	68	0.9924	113	0.9526	158	0.9173
24	1.0365	69	0.9915	114	0.9518	159	0.9165
25	1.0355	70	0.9905	115	0.9510	160	0.9158
26	1.0344	71	0.9896	116	0.9501	161	0.9150
27	1.0333	72	0.9887	117	0.9493	162	0.9143
28	1.0323	73	0.9877	118	0.9485	163	0.9135
29	1.0312	74	0.9868	119	0.9477	164	0.9128
30	1.0302	75	0.9859	120	0.9469	165	0.9121
31	1.0291	76	0.9850	121	0.9460	166	0.9112
32	1.0281	77	0.9840	122	0.9452	167	0.9106
33	1.0270	78	0.9831	123	0.9444	168	0.9099
34	1.0260	79	0.9822	124	0.9436	169	0.9092
35	1.0249	80	0.9813	125	0.9428	170	0.9085
36	1.0329	81	0.9804	126	0.9420	171	0.9077
37	1.0229	82	0.9795	127	0.9412	172	0.9069
38	1.0219	83	0.9786	128	0.9404	173	0.9063
39	1.0208	84	0.9777	129	0.9396	174	0.9055
40	1.0198	85	0.9768	130	0.9388	175	0.9048
41	1.0188	86	0.9759	131	0.9380	176	0.9042
42	1.0178	87	0.9750	132	0.9372	177	0.9035
43	1.0168	88	0.9741	133	0.9364	178	0.9028
44	1.0157	89	0.9732	134	0.9356	179	0.9020
45	1.0147	90	0.9723	135	0.9348	180	0.9014
46	1.0137	91	0.9715	136	0.9341	181	0.9007
47	1.0127	92	0.9706	137	0.9333	182	0.9000
48	1.0117	93	0.9697	138	0.9325	183	0.8992
49	1.0107	94	0.9688	139	0.9317	184	0.8985
50	1.0098	95	0.9680	140	0.9309	185	0.8979
51	1.0088	96	0.9671	141	0.9301	186	0.8972
52	1.0078	97	0.9662	142	0.9293	187	0.8965
53	1.0068	98	0.9653	143	0.9284	188	0.8958
54	1.0058	99	0.9645	144	0.9279	189	0.8951
55	1.0048	100	0.9636	145	0.9271	190	0.8944
56	1.0039	101	0.9627	146	0.9263	191	0.8937
57	1.0029	102	0.9618	147	0.9255	192	0.8931
58	1.0019	103	0.9610	148	0.9247	193	0.8923
59	1.0010	104	0.9602	149	0.9240	194	0.8916
60	1.0000	105	0.9592	150	0.9233	195	0.8910
61	0.9990	106	0.9585	151	0.9225	196	0.8900
62	0.9981	107	0.9576	152	0.9217	197	0.8996
63	0.9971	108	0.9568	153	0.9210	198	0.8889
64	0.9962	109	0.9559	154	0.9202	199	0.8882
						200	0.8876

TABLE 5

RATES FOR 2" ORIFICE WELL TESTER*
CUBIC FEET PER DAY; PRESSURE BASE, 14.65 P.S.I.A.
SP. GR. 0.60; BASE AND FLOWING TEMPERATURE, 60° F

Pressure Inches of WATER	ORIFICE SIZE, INCHES							
	1/8	1/4	3/8	1/2	3/4	1	1-1/4	1-1/2
1.0	528	1680	3560	6270	14200	25800	43900	69600
1.2	578	1850	3910	6870	15500	28300	48000	76200
1.4	625	1990	4220	7420	16800	30600	51900	82300
1.6	669	2130	4520	7940	17900	32700	55500	88000
1.8	709	2260	4790	8430	19000	34600	58900	93300
2.0	747	2370	5050	8870	20000	36500	62000	98500
2.2	784	2490	5290	9310	21000	38300	65100	103000
2.4	818	2610	5520	9720	21900	40000	67900	108000
2.6	852	2710	5760	10100	22900	41600	70700	112000
2.8	884	2810	5980	10500	23800	43200	73300	116000
3.0	915	2920	6180	10900	24500	44700	76000	121000
3.2	945	3010	6390	11200	25300	46200	78500	124000
3.4	975	3110	6580	11600	26100	47600	80900	128000
3.6	1000	3190	6780	11900	26900	48900	83300	132000
3.8	1030	3280	6960	12200	27600	50300	85500	136000
4.0	1060	3370	7140	12500	28300	51600	87800	139000
4.5	1120	3580	7580	13300	30100	54700	93100	148000
5.0	1180	3710	7980	14100	31600	57700	98100	156000
5.5	1240	3950	8370	14700	33200	60500	103000	163000
6.0	1290	4120	8740	15400	34700	63300	107000	170000
6.5	1340	4300	9100	16000	36100	65800	112000	177000
7.0	1390	4450	9450	16700	37400	68300	116000	184000
8.0	1500	4760	10100	17200	40000	73100	124000	197000
9.0	1590	5050	10700	18800	42500	77500	132000	209000
10.0	1670	5320	11300	19900	44800	81600	138000	220000
11.0	1750	5600	11900	20900	47200	85900	145000	231000
12.0	1830	5860	12400	21900	49300	89800	152000	241000
13.0	1910	6100	12900	22800	51400	93600	158000	251000
14.0	1980	6330	13400	23700	53300	97300	164000	260000
15.0	2050	6550	13900	24500	55200	101000	170000	270000
16.0	2110	6720	14200	25100	56800	103000	176000	278000
17.0	2180	6930	14700	25800	58500	106000	181000	287000
18.0	2240	7120	15100	26600	60200	110000	186000	295000
19.0	2300	7320	15500	27300	61900	113000	191000	303000
20.0	2360	7510	15900	28000	63500	115000	196000	311000

*Based on tables appearing in American Meter Company's Bulletin E-7.

NOTE: The 1-1/2 plate to be used only when smaller plates will not handle the volume satisfactorily.

TABLE 5 - Cont.

RATES FOR 2" ORIFICE WELL TESTER*
CUBIC FEET PER DAY: PRESSURE BASE, 14.65 P.S.I.A.
SP. GR. 0.60; BASE AND FLOWING TEMPERATURE, 60° F

Pressure Inches of WATER	ORIFICE SIZE, INCHES							
	1/8	1/4	3/8	1/2	3/4	1	1-1/4	1-1/2
22	2480	7880	16700	29400	66600	121000	206000	326000
24	2590	8220	17400	30700	69500	126000	215000	341000
26	2690	8560	18100	31900	72400	132000	224000	355000
28	2790	8890	18800	33200	75100	137000	233000	368000
30	2890	9200	19500	34300	77800	141000	241000	381000
32	2990	9500	20100	35500	80300	146000	248000	394000
34	3080	9790	20800	36500	82800	151000	256000	406000
36	3170	10100	21300	37600	85200	155000	264000	418000
38	3250	10400	21900	38600	87500	159000	271000	429000
40	3340	10600	22500	39600	89800	163000	278000	440000
42	3420	10900	23100	40700	92000	167000	285000	451000
44	3500	11100	23600	41600	94100	171000	291000	462000
46	3580	11400	24100	42500	96300	175000	298000	473000
48	3660	11600	24700	43400	98400	179000	304000	482000
50	3730	11900	25200	44300	100000	183000	311000	493000
52	3810	12100	25700	45200	102000	186000	317000	502000
54	3880	12300	26200	46100	104000	190000	323000	511000
56	3950	12600	26600	46900	106000	193000	329000	521000
58	4020	12800	27100	47800	108000	197000	335000	530000
60	4090	13000	27600	48600	110000	200000	340000	539000
62	4160	13200	28000	49400	112000	203000	346000	549000
64	4230	13400	28500	50200	114000	207000	352000	557000
66	4280	13600	28900	50900	115000	210000	357000	565000
68	4350	13900	29400	51700	117000	213000	362000	575000
70	4420	14100	29800	52400	119000	216000	368000	583000
72	4480	14300	30200	53200	120500	219000	373000	
74	4540	14450	30650	53900	122200	222000	378000	
76	4600	14640	31050	54700	123800	225000	383000	
78	4660	14830	31400	55300	125400	228000	388000	
80	4720	15020	31850	56100	127000	231000	393000	
82	4780	15200	32250	56800	128600	233500	398000	
84	4840	15400	32650	57400	130200	236500	403000	
86	4900	15580	33000	58100	131700	239000	407000	
88	4960	15760	33400	58800	133200	242000	412000	
90	5010	15930	33800	59500	134700	244500	417000	
92	5060	16110	34150	60100	136200	247500	422000	
94	5120	16300	34500	60800	137600	250500	426000	
96	5170	16460	34900	61500	139100	253000	431000	
98	5230	16630	35250	62100	140600	255500	435000	
100	5280	16800	35600	62700	142000	258000	439000	

*Based on tables appearing in American Meter Company's Bulletin E-7.

NOTE: The 1-1/2 plate to be used only when smaller plates will not handle the volume satisfactorily.

TABLE 6

RATES FOR 2" ORIFICE WELL TESTER*
Mcf PER DAY; PRESSURE BASE, 14.65 P.S.I.A.
SP. GR. 0.60; BASE AND FLOWING TEMPERATURE, 60° F

Pressure Inches of MERCURY	ORIFICE SIZE, INCHES							
	1/8	1/4	3/8	1/2	3/4	1	1-1/4	1-1/2
1.0	1.91	6.23	13.2	23.1	52	96	162	258
1.1	2.01	6.53	13.8	24.2	55	100	170	271
1.2	2.11	6.83	14.5	25.2	58	105	178	283
1.3	2.19	7.14	15.1	26.3	60	109	185	295
1.4	2.26	7.37	15.6	27.4	62	113	192	306
1.5	2.36	7.67	16.3	28.4	64	117	199	317
1.6	2.42	7.89	16.7	29.5	67	121	206	328
1.7	2.50	8.11	17.2	30.5	69	125	212	338
1.8	2.59	8.41	17.9	31.6	71	129	219	348
1.9	2.65	8.63	18.3	32.6	73	132	225	358
2.0	2.73	8.86	18.8	33.7	75	136	231	367
2.2	2.86	9.31	19.8	34.7	78	143	242	386
2.4	2.98	9.69	20.5	35.8	82	149	253	403
2.6	3.12	10.1	21.5	37.9	85	155	264	420
2.8	3.23	10.5	22.3	38.9	89	161	274	446
3.0	3.35	10.9	23.1	40.0	92	167	284	451
3.2	3.47	11.3	23.9	43.1	95	173	293	467
3.4	3.58	11.6	24.7	44.2	98	179	303	482
3.6	3.68	11.9	25.3	45.2	101	184	312	497
3.8	3.79	12.3	26.2	46.3	104	189	321	510
4.0	3.89	12.6	26.8	47.4	107	194	330	524
4.5	4.14	13.4	28.5	50.5	113	206	350	558
5.0	4.37	14.2	30.1	52.6	120	218	370	589
5.5	4.60	14.9	31.7	56.8	126	229	389	619
6.0	4.80	15.6	33.2	59.0	132	240	407	648
6.5	5.01	16.3	34.6	61.0	137	251	425	676
7.0	5.22	17.0	36.0	63.5	143	261	442	704
8	5.59	18.3	38.6	68.1	154	280	475	756
9	5.95	19.3	41.2	72.8	164	298	506	806
10	6.33	20.5	43.8	77.4	173	316	536	854
11	6.65	21.6	45.9	80.9	183	333	565	899
12	7.00	22.7	48.3	85.5	192	349	593	944
13	7.29	23.6	50.4	89.0	200	365	620	986
14	7.62	24.8	52.7	93.6	209	381	646	1025
15	7.93	25.8	54.7	97.0	217	396	672	1068
16	8.22	26.8	56.8	100.0	225	411	691	1110
17	8.49	27.6	58.6	104	233	425	721	1148
18	8.80	28.7	60.8	107	241	439	746	1185
19	9.08	29.5	62.7	110	249	453	769	1223
20	9.36	30.5	64.6	115	256	467	793	1262

*Based on tables appearing in American Meter Company's Bulletin E-7.

NOTE: The 1-1/2 plate to be used only when smaller plates will not handle the volume satisfactorily.

TABLE 6 - Cont.

RATES FOR 2" ORIFICE WELL TESTER*
Mcf PER DAY; PRESSURE BASE, 14.65 P.S.I.A.
SP. GR. 0.60; BASE AND FLOWING TEMPERATURE, 60° F

Pressure Inches of	ORIFICE SIZE, INCHES							
MERCURY	1/8	1/4	3/8	1/2	3/4	1	1-1/4	1-1/2
21	9.60	31.2	66.4	118	264	481	816	1296
22	9.89	32.1	68.4	120	271	494	838	1333
23	10.1	32.9	70.0	123	278	507	861	1370
24	10.4	33.9	71.9	127	285	520	883	1404
25	10.6	34.6	73.6	131	292	533	905	1440
26	10.9	35.5	75.4	133	300	546	927	1474
27	11.2	36.4	77.2	136	306	559	948	1508
28	11.5	37.2	78.9	140	313	571	969	1540
29	11.7	37.9	80.5	142	320	583	990	1576
30	11.9	38.7	82.2	145	327	596	1011	1608
31	12.2	39.6	84.0	150	334	608	1032	1640
32	12.4	40.5	86.0	152	340	620	1052	1673
33	12.6	41.2	87.4	155	347	632	1073	1709
34	12.9	42.0	89.0	157	353	644	1093	1740
35	13.2	42.7	90.6	160	360	656	1113	1771
36	13.4	43.5	92.2	164	366	668	1133	1802
37	13.6	44.2	93.9	167	373	679	1153	1835
38	13.8	45.0	95.5	169	379	691	1173	1865
39	14.1	45.7	97.0	172	386	703	1193	1896
40	14.3	46.4	98.7	175	392	714	1212	1928
41	14.7	47.5	101	178	400	729	1240	1957
42	14.9	48.2	102	180	406	740	1250	1990
43	15.1	48.9	104	184	413	752	1270	2019
44	15.3	49.6	105	187	418	763	1300	2052
45	15.5	50.3	107	189	426	775	1320	2080
46	15.7	51.2	108	191	431	787	1337	2112
47	15.9	51.9	109	193	437	798	1348	2145
48	16.3	52.6	112	198	442	809	1369	2172
49	16.5	53.3	113	200	450	819	1390	2203
50	16.7	54.1	115	202	455	830	1411	2230
51	16.9	54.7	116	205	461	841	1422	2260
52	17.1	55.4	118	207	466	853	1441	2293
53	17.3	56.3	119	211	473	865	1463	2320
54	17.6	57.0	121	213	480	877	1485	2350
55	17.8	57.7	122	216	487	887	1506	2380
56	18.0	58.3	124	219	492	897	1527	2410
57	18.2	59.0	125	222	497	907	1538	2440
58	18.4	59.7	126	224	504	918	1559	2470
59	18.6	60.4	129	226	509	929	1578	2500
60	18.8	61.1	130	229	515	940	1590	2530

*Based on tables appearing in American Meter Company's Bulletin E-7.

NOTE: The 1-1/2 plate to be used only when smaller plates will not handle the volume satisfactorily.

TABLE 6 - Cont.

RATES FOR 2" ORIFICE WELL TESTER*
Mcf PER DAY; PRESSURE BASE, 14.65 P.S.I.A.
SP. GR. 0.60; BASE AND FLOWING TEMPERATURE, 60° F

Pressure Inches of MERCURY	ORIFICE SIZE, INCHES							
	1/8	1/4	3/8	1/2	3/4	1	1-1/4	1-1/2
61	19.0	61.8	132	231	521	950	1610	2555
62	19.2	62.5	133	235	526	962	1632	2585
63	19.4	63.1	134	237	533	971	1653	2615
64	19.6	63.9	136	240	538	985	1664	2640
65	19.9	64.5	137	242	545	993	1686	2670
66	20.1	65.3	139	245	552	1000	1706	2700
67	20.3	66.0	140	247	557	1010	1727	2730
68	20.5	66.7	141	250	563	1020	1738	2760
69	20.7	67.4	143	253	568	1040	1759	2785
70	20.9	68.0	144	255	573	1050	1780	2810
71	21.1	68.8	146	259	579	1055	1790	2845
72	21.3	69.4	148	261	585	1062	1812	2870
73	21.6	70.1	149	263	591	1072	1832	2900
74	21.8	70.7	151	266	595	1083	1843	2930
75	22.0	71.6	152	269	603	1094	1864	2955
76	22.2	72.2	154	272	609	1104	1885	
77	22.4	72.8	155	274	615	1115	1907	
78	22.6	73.4	156	276	619	1126	1917	
79	22.8	74.1	158	278	624	1136	1939	
80	23.0	75.0	159	280	632	1147	1959	
81	23.3	75.5	160	284	636	1157	1970	
82	23.4	76.0	162	286	642	1168	1991	
83	23.7	77.0	163	289	650	1179	2011	
84	23.9	77.5	165	291	654	1188	2025	
85	24.0	78.1	167	294	658	1198	2045	
86	24.3	79.0	168	297	665	1210	2065	
87	24.4	79.6	169	299	670	1220	2073	
88	24.6	80.2	171	302	676	1230	2093	
89	24.9	81.0	172	305	683	1241	2116	
90	25.1	81.4	173	307	687	1251	2127	
91	25.3	82.3	175	309	693	1262	2148	
92	25.5	82.9	176	312	700	1273	2170	
93	25.7	83.5	177	313	704	1284	2180	
94	25.9	84.3	179	316	710	1294	2200	
95	26.1	84.9	180	318	715	1305	2222	
96	26.3	85.7	183	321	722	1314	2232	
97	26.5	86.3	184	324	727	1325	2255	
98	26.8	87.0	186	326	734	1335	2275	
99	27.0	87.5	187	329	739	1346	2286	
100	27.2	88.3	188	331	744	1357	2306	

*Based on tables appearing in American Meter Company's Bulletin E-7.

NOTE: The 1-1/2 plate to be used only when smaller plates will not handle the volume satisfactorily.

TABLE 7

ORIFICE ASSEMBLY WITH SINGLE TAP
RATES FOR ORIFICE (3")* METHOD
Mcf PER DAY, PRESSURE BASE, 14.65 P.S.I.A.
SP. GR. 0.60; BASE AND FLOWING TEMPERATURE, 60° F

Pressure, Inches of Mercury	ORIFICE DIAMETER, INCHES				
	3/4	1	1-1/4	1-1/2	2
1.0	50	90	143	211	419
1.1	53	94	150	222	440
1.2	55	99	157	232	460
1.3	57	103	163	241	479
1.4	59	106	169	251	497
1.5	62	110	175	259	515
1.6	64	114	181	268	533
1.7	66	118	187	277	549
1.8	68	121	192	285	565
1.9	70	124	198	293	581
2.0	71	128	203	301	597
2.2	75	134	213	315	626
2.4	78	140	223	330	655
2.6	82	146	232	344	682
2.8	85	152	241	357	709
3.0	88	157	250	370	734
3.2	91	162	258	382	759
3.4	94	168	266	395	783
3.6	96	173	274	406	807
3.8	99	178	282	418	830
4.0	102	182	290	429	852
4.5	108	194	308	456	906
5.0	114	205	325	482	957
5.5	120	215	342	507	1010
6.0	126	226	358	531	1050
6.5	131	235	374	554	1100
7.0	137	245	389	576	1140
8	147	263	418	619	1230
9	157	280	445	660	1310
10	166	297	471	698	1390
11	175	313	497	736	1460
12	183	328	521	772	1530
13	192	343	545	807	1600
14	200	358	568	841	1670
15	208	372	590	875	1740
16	215	386	613	908	1800
17	223	399	634	940	1870
18	230	413	656	971	1930
19	238	426	676	1010	1990
20	245	439	697	1030	2050

*Actual pipe diameter, 3.068 inches.

Table taken from American Meter Company's Bulletin E-7.

TABLE 8

ORIFICE ASSEMBLY WITH SINGLE TAP
RATES FOR ORIFICE (4")* METHOD
Mcf PER DAY, PRESSURE BASE, 14.65 P.S.I.A.
SP. GR. 0.60; BASE AND FLOWING TEMPERATURE, 60° F

Pressure, Inches of Mercury	ORIFICE DIAMETER, INCHES				
	1	1-1/4	1-1/2	2	2-1/2
1.0	89	140	204	377	638
1.1	94	147	214	396	669
1.2	98	154	224	414	700
1.3	102	160	233	430	728
1.4	106	166	242	447	756
1.5	109	172	250	463	783
1.6	113	178	259	479	810
1.7	117	183	267	493	835
1.8	120	189	275	508	859
1.9	124	194	282	523	884
2.0	127	199	290	536	907
2.2	133	209	304	563	952
2.4	139	219	318	588	995
2.6	145	228	331	613	1040
2.8	151	237	344	637	1080
3.0	156	245	357	660	1120
3.2	161	253	369	682	1150
3.4	167	262	380	704	1190
3.6	171	269	392	725	1230
3.8	176	277	403	746	1260
4.0	181	285	414	766	1300
4.5	193	303	440	814	1380
5.0	203	320	465	860	1450
5.5	214	336	489	904	1530
6.0	224	352	512	947	1600
6.5	234	367	534	988	1670
7.0	243	382	555	1030	1740
8	261	410	597	1100	1870
9	278	437	636	1180	1990
10	295	463	673	1250	2110
11	310	488	709	1310	2220
12	326	512	745	1380	2330
13	341	535	778	1440	2440
14	355	558	811	1500	2540
15	369	580	843	1560	2640
16	383	602	875	1620	2740
17	396	623	906	1680	2840
18	410	644	936	1730	2930
19	423	664	966	1790	3020
20	436	684	995	1840	3120

*Actual pipe diameter, 4.026 inches.
Table taken from American Meter Company's Bulletin E-7.

TABLE 9

CRITICAL FLOW PROVERS
COEFFICIENTS FOR TWO- AND FOUR-INCH CRITICAL FLOW PROVERS*
Mcf PER DAY, PRESSURE BASE, 14.65 P.S.I.A.
SP. GR. 0.60; BASE AND FLOWING TEMPERATURE, 60° F

TWO-INCH CRITICAL FLOW PROVER

Orifice size, Inches	Coefficient
1/16	0.0848
3/32	0.1867
1/8	0.3506
3/16	0.8052
7/32	1.1112
1/4	1.4390
5/16	2.2130
3/8	3.1484
7/16	4.5123
1/2	5.6647
5/8	8.5694
3/4	12.5147
7/8	17.2112
1	22.6311
1-1/8	28.9803
1-1/4	36.5871
1-3/8	44.9506
1-1/2	55.7570

FOUR-INCH CRITICAL FLOW PROVER

Orifice Size Inches	Coefficient
1/4	1.387
3/8	3.117
1/2	5.576
5/8	8.686
3/4	12.448
7/8	16.927
1	22.052
1-1/8	27.778
1-1/4	34.300
1-3/8	41.295
1-1/2	49.208
1-3/4	67.220
2	88.811
2-1/4	113.851
2-1/2	142.787
2-3/4	176.787
3	217.241

*Calculated from data in U.S. Bureau of Mines Monograph 7.

TABLE 10

OPEN FLOW PITOT TUBE
RATES FOR OPEN-FLOW PITOT TUBE*
Mcf PER DAY; PRESSURE BASE, 14.65 P.S.I.A.
SP. GR. 0.60; BASE AND FLOWING TEMPERATURE, 60° F
(Volumes are for 1.000 inch I.D. pipe; Refer to Table 11 for Multiple)

Press.,Ins. of Water	Volume, Mcf Per Day	Press.,Ins. of Mercury	Volume, Mcf Per Day	Pressure P.S.I.G.	Volume, Mcf Per Day
.10	11.01	.10	40.5	15	702
.20	15.57	.20	57.4	16	726
.30	19.06	.30	70.2	17	750
.40	22.02	.40	81.1	18	774
.50	24.61	.50	90.7	19	798
.60	26.98	.60	99.5	20	822
.70	29.13	.71	07.4	21	846
.80	31.13	.81	14.9	22	870
.90	33.03	.91	21.8	23	893
1.00	34.81	1.01	29.6	24	917
1.50	42.64	1.51	57.2	25	941
2.00	49.17	2.01	81.5	26	965
2.50	55.03	2.50	203.1	27	989
3.00	60.22	3.00	222.4	28	1013
3.50	65.13	3.50	240.3	29	1037
4.00	69.62	4.00	256.8	30	1061
4.50	73.85	4.50	272.4	32	1108
5.00	77.83	5.00	287.1	34	1156
5.50	81.63	5.50	301.2	36	1204
6.00	85.20	6.00	314.5	38	1252
7.00	92.11	7.00	339.9	40	1300
8	98.44	8	363.2	45	1419
9	104.4	9	385.3	50	1539
10	110.1	10	406.1	55	1658
11	115.5	11	426.0	60	1777
12	120.5	12	444.9	65	1897
13	125.5	13	463.2	70	2016
14	130.3	14	480.6	75	2136
15	134.7	15	497.4	80	2255
16	139.2	16	513.8	85	2375
18	147.7	17	529.6	90	2494
20	155.7	18	545.0	95	2614
25	174.1	19	559.9	100	2733
30	190.7	20	574.4	---	----

*Based on Reid's Formulae.

TABLE 11

OPEN FLOW PITOT TUBE MULTIPLIERS FOR PIPE AND CASING

For use with the Open Flow Pitot Tube for determining gas volumes through various diameter openings.

A.P.I. LINE PIPE

Nominal Size, In.	Inside Diameter, D. In.	Multiple, D^2
1	1.049	1.100
1-1/4	1.380	1.904
1-1/2	1.610	2.592
2	2.067	4.272
2-1/2	2.469	6.096
3	3.068	9.413
3-1/2	3.548	12.588
4	4.026	16.209
5	5.047	25.472
6	6.065	36.784
8 (25 lb.)	8.071	65.141
8 (29 lb.)	7.981	63.696
10 (33 lb.)	10.192	103.877
10 (36 lb.)	10.136	102.738
10 (42 lb.)	10.020	100.400

A.P.I. CASING

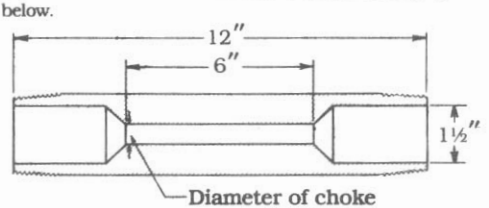
Nominal Size, In.	Weight Lb./ft.	Inside Diameter, D, In.	Multiple D^2
4-1/2	9.50	4.090	16.728
	11.60	4.000	16.000
5	13.00	4.494	20.196
	15.00	4.408	19.430
	18.00	4.276	18.284
5-1/2	14.00	5.012	25.120
	15.50	4.950	24.503
	17.00	4.892	23.932
	20.00	4.778	22.829
6	18.00	5.424	29.420
	20.00	5.352	28.644
	23.00	5.240	27.458
6-5/8	20.00	6.049	36.590
	24.00	5.921	35.058
	28.00	5.791	33.536
7	23.00	6.366	40.526
	26.00	6.276	39.388
	29.00	6.184	38.242
	32.00	6.094	37.137
	35.00	6.004	36.048
7-5/8	24.00	7.025	49.351
	26.40	6.969	48.567
	29.70	6.875	47.266
	33.70	6.765	45.765
8-5/8	28.00	8.017	84.272
	32.00	7.921	62.742
	36.00	7.825	61.231
	40.00	7.725	59.676

TABLE 12

CHOKE NIPPLES
SIX-INCH CHOKE NIPPLE COEFFICIENTS
Mcf PER DAY PER P.S.I.A.; PRESSURE BASE, 14.65 P.S.I.A.
SP. GR. 0.60; TEMPERATURE BASE, 60° F

Nominal Choke Size, Inches	Inside Diameter Inches	COEFFICIENT †	COEFFICIENT *
3/32	.0938	.1866	0.198
7/64	.1094	.2551	0.272
1/8	.1250	.3345	0.348
9/64	.1406	.4246	0.444
10/64	.1563	.5264	0.553
11/64	.1719	.6383	0.674
3/16	.1875	.7615	0.804
13/64	.2031	.8955	0.956
14/64	.2188	1.0415	1.116
15/64	.2344	1.1977	1.288
1/4	.2500	1.3650	1.475
17/64	.2656	1.5434	1.667
18/64	.2813	1.7340	1.885
19/64	.2969	1.9348	2.110
5/16	.3125	2.1466	2.428
21/64	.3281	2.3696	2.601
22/64	.3438	2.6054	2.866
23/64	.3594	2.8508	3.144
3/8	.3750	3.1076	3.406
25/64	.3906	3.3753	3.740
26/64	.4063	3.6563	4.063
27/64	.4219	3.9466	4.394
7/16	.4375	4.2483	4.737
29/64	.4531	4.5615	5.101
30/64	.4688	4.8879	5.474
31/64	.4844	5.2235	5.862
1/2	.5000	5.5705	6.272
9/16	.5625	7.0745	8.010
5/8	.6250	8.7604	10.002
11/16	.6875	10.6293	12.176
3/4	.7500	12.6815	14.523

* Calculated from data appearing in Bureau of Mines Monograph 7. For Choke Nipples as illustrated below.



† For standard six-inch long Thornhill-Craver positive flow beans. Calculated from Texas College of Arts and Industries Test Data.

TABLE 13

OIL MEASUREMENT SPECIFICATIONS FOR A.P.I. BOLTED TANKS

Capacity		Dimensions			*Average Volume
Nominal (42 gal. Bbls.)	Actual (42 gal. Bbls.	Inside Diam. (Nominal)	Bottom Bolt Circle Diam.	Height Inside	Bbls./In.
100	95.80	9'-2 3/4"	9'-4 3/4"	8'-0 1/2"	0.993
200	191.64	9'-2 3/4"	9'-4 3/4"	16'-1"	0.993
250	266.28	15'-4 5/8"	15'-6 5/8"	8'-0 1/2	2.759
500 (high)	532.56	15'-4 5/8"	15'-6 5/8"	16'-1	2.759
500 (low)	522.01	21'-6 1/2"	21'-8 1/2"	8'-0 1/2	5.409
750	798.84	15'-4 5/8"	15'-6 5/8"	24'-1 1/2"	2.759
800	804.57	26'-8 15/16"	26'-10 15/16"	8'-0 1/2"	8.337
1000 (high)	1044.02	21'-6 1/2"	21'-8 1/2"	16'-1	5.409
1000 (low)	993.53	29'-8 5/8"	29'-10 5/8"	8'-0 1/2"	10.296

* This value to be used in oil production calculations only when actual tank strappings are unavailable.

TABLE 14

AVERAGE ATMOSPHERIC PRESSURES

LOCATION	PRESSURE, psi	LOCATION	PRESSURE, psi
Abilene	13.84	Houston	14.69
Amarillo	12.94	Lubbock	13.10
Austin	14.41	Midland	13.26
Brownsville	14.73	Port Arthur	14.74
Corpus Christi	14.74	San Angelo	13.75
Dallas	14.49	San Antonio	14.33
Del Rio	14.27	Victoria	14.67
El Paso	12.79	Waco	14.48
Fort Worth	14.45	Wichita Falls	14.22
Galveston	14.73	Shreveport, La.	14.61

NOTE: Mean annual station pressures from the Weather Bureau, U. S. Department of Commerce, compiled November, 1969.

TABLE 15

MISCELLANEOUS CONVERSION FACTORS

Acre	43,560 square feet
Acre foot	7,758 barrels
Atmosphere	33.94 feet of water
Atmosphere	29.92 inches of mercury
Atmosphere	760 millimeters of mercury
Atmosphere	14.70 pounds per square inch
Barrel	5.6146 cubic feet
Barrel	42.0 gallons
Barrel per hour	0.0936 cubic feet per minute
Barrel per hour	0.700 gallons per minute
Barrel per day	0.02917 gallon per minute
Cubic foot	0.1781 barrel
Cubic foot	7.4805 gallons
Cubic foot per minute	10.686 barrels per hour
Cubic foot per minute	7.481 gallons per minute
Cubic inch	16.387 cubic centimeters
Cubic yard	4.8089 barrels
Foot	30.48 centimeters
Foot pound	0.001286 B.T.U.
Gallon	0.02381 barrel
Gallon	0.1337 cubic feet
Gallon	231.0 cubic inches
Gallon	3.785 liters
Gallon per minute	34.286 barrels per day
Horse-power	42.44 B.T.U. per minute
Horse-power	33,000 foot-pounds per minute
Horse-power	550 foot-pounds per second
Horse-power	0.7457 kilowatt
Horse-power hour	2547 B.T.U.
Inch	2.54 centimeters
Inch of Mercury	13.608 inches of water
Inch of Mercury	1.134 feet of water
Inch of Mercury	0.4912 pound per square inch
Inch of Water @ 60° F	0.0361 pound per square inch
Kilogram	2.2046 pounds

TABLE 15 - Cont.

MISCELLANEOUS CONVERSION FACTORS

Kilometer	3,281 feet
Kilometer	0.6214 mile
Kilowatt	1.341 horse-power
Liter	0.2642 gallon
Liter	1.0567 quarts
Meter	3.281 feet
Meter	39.37 inches
Mile	5,280 feet
Mile per hour	1.4667 feet per second
Ounce (Avoirdupois)	437.5 grains
Ounce (Avoirdupois)	28.3495 grams
Part per million	0.058 grain per gallon
Pound	453.6 grams
Pound per square inch	2.0353 inches of mercury
Pound per square inch	27.708 inches of water @ 60° F
Quart (liquid)	0.946 liter
Rod	16.5 feet
Square Centimeter	0.1550 square inch
Square meter	10.76 square feet
Watt-hour	3.415 B.T.U.

TABLE 16

PRESSURE BASE CONVERSION FACTORS

$$\text{Multiple} = \frac{14.65}{\text{desired pressure base}}$$

Pressure Base		Factor
14.40 (14.40	0 oz.)	1.017
14.65 (14.40	4 oz.)	1.000
14.90 (14.40	8 oz.)	0.983
15.40 (14.40	1 lb.)	0.951
15.90 (14.40	1½ lb.)	0.921
16.40 (14.40	2 lb.)	0.893
17.40 (14.40	3 lb.)	0.842

TABLE 17

CONVERSION OF ° A.P.I. TO SPECIFIC GRAVITY

Degrees API at 60° F	Specific Gravity	Degrees API at 60° F	Specific Gravity	Degrees API at 60° F	Specific Gravity
0	1.076	34	.8550	66	.7093
1	1.068	35	.8498	69	.7057
2	1.060	36	.8448	70	.7022
3	1.052	37	.8398	71	.6988
4	1.044	38	.8348	72	.6953
5	1.037	39	.8299	73	.6919
6	1.029	40	.8251	74	.6886
7	1.022	41	.8203	75	.6852
8	1.014	42	.8155	76	.6819
9	1.007	43	.8109	77	.6787
10	1.000	44	.8063	78	.6754
11	.9930	45	.8017	79	.6722
12	.9861	46	.7972	80	.6690
13	.9792	47	.7927	81	.6659
14	.9725	48	.7883	82	.6628
15	.9659	49	.7839	83	.6597
16	.9593	50	.7796	84	.6566
17	.9529	51	.7753	85	.6536
18	.9465	52	.7711	86	.6506
19	.9402	53	.7669	87	.6476
20	.9340	54	.7628	88	.6446
21	.9279	55	.7587	89	.6417
22	.9218	56	.7547	90	.6388
23	.9159	57	.7507	91	.6360
24	.9100	58	.7467	92	.6331
25	.9042	59	.7428	93	.6303
26	.8984	60	.7389	94	.6275
27	.8927	61	.7351	95	.6247
28	.8871	62	.7313	96	.6220
29	.8816	63	.7275	97	.6193
30	.8762	64	.7238	98	.6166
31	.8708	65	.7201	99	.6139
32	.8654	66	.7165	100	.6112
33	.8602	67	.7128		

$$\text{SP. GR.} = \frac{141.5}{131.5 + {}^{\circ}\ \text{A.P.I.}}$$

TABLE 18

PRESSURE PEN SETTING FOR ATMOSPHERIC PRESSURE ON L-10 CHARTS

Pressure range, psi	Atmospheric pressure, psia						
	14.7	14.4	14.0	13.5	13.0	12.5	12.0
24.7	7.71	7.64	7.53	7.39	7.25	7.11	6.97
50	5.42	5.37	5.29	5.20	5.10	5.00	4.90
100	3.83	3.79	3.74	3.67	3.61	3.54	3.46
250	2.42	2.40	2.37	2.32	2.26	2.24	2.19
500	1.71	1.70	1.67	1.64	1.61	1.58	1.55
1000	1.21	1.20	1.18	1.16	1.14	1.12	1.10
2000	0.86	0.85	0.84	0.82	0.81	0.79	0.77
5000	0.54	0.54	0.53	0.52	0.51	0.50	0.49

TABLE 19

M, METER FACTORS FOR L-10 CHARTS

$$M = 0.01 (R_h \times R_s)^{1/2}$$

R_h Maximum Differential Range of Meter, Ins. of Water	R_s Maximum Static Pressure Range of Meter, Pounds per Square Inch Absolute						
	24.7	50	100	250	500	1000	1500
2½	0.0766						
10	0.1572	0.2236					
20	0.2223	0.3162	0.4472	0.7071	1.0000		
50	0.3514	0.5000	0.7071	1.1180	1.5810	2.2360	2.7390
100		0.7071	1.0000	1.5810	2.2360	3.1620	3.8730

NOTE: When an L-10 (Square root) chart is used, Mh_uP_u may be substituted for the term $\sqrt{H_wP_f}$ of Equation (3) on Page 4

Where: M = Meter Factor for L-10 Chart

h_u = differential reading on L-10 Chart

P_u = pressure reading on L-10 Chart

TABLE 20

Multipliers for an Atmospheric Pressure of 13.2 psia for Orifice Well Tester, Orifice Assembly with Single Tap, or Open Flow Pitot Tube.

Tester Pressure, Inches of Water	Multiplier	Tester Pressure, Inches of Mercury	Multiplier
1	.9576	1	.9579
2	.9576	2	.9584
3	.9576	3	.9588
4	.9576	4	.9592
5	.9577	5	.9596
6	.9577	6	.9600
7	.9577	7	.9604
8	.9577	8	.9608
9	.9578	9	.9611
10	.9578	10	.9615
11	.9578	11	.9619
12	.9579	12	.9622
13	.9579	13	.9626
14	.9579	14	.9630
15	.9580	15	.9633
16	.9580	16	.9636
17	.9580	17	.9639
18	.9581	18	.9642
19	.9581	19	.9645
20	.9581	20	.9648
24	.9583	24	.9659
28	.9584	28	.9670
32	.9585	32	.9681
36	.9586	36	.9691
40	.9587	40	.9700
44	.9589	44	.9709
48	.9590	48	.9717
52	.9591	52	.9725
56	.9592	56	.9732
60	.9593	60	.9739
64	.9594	64	.9745
68	.9595	68	.9751
72	.9596	72	.9757
76	.9598	76	.9763
80	.9599	80	.9768
84	.9600	84	.9774
88	.9601	88	.9779
92	.9603	92	.9784
96	.9604	96	.9788
100	.9606	100	.9792

NOTE: When the atmospheric pressure at the point of measurement differs appreciably from 14.4 psia a correction should be applied as follows:

$$\text{Multiplier} = \sqrt{\frac{.3 \text{ Tester Pressure} + \text{Atmospheric Pressure}}{.3 \text{ Tester Pressure} + 14.4}}$$

In the past most operators have used 13.2 psia as the average atmospheric pressure in Commission Districts No. 8, No. 8A, and No. 10 (West Texas and the Panhandle).

TABLE 21

COMBINATION SPECIFIC GRAVITY-TEMPERATURE MULTIPLIERS

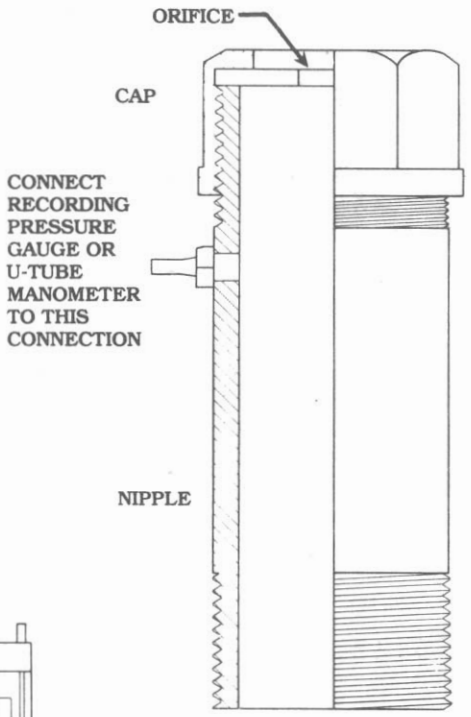
These values are used as multipliers when the coefficient is based on specific gravity, 0.60; and flowing temperature, 60 degrees F.

Sp. Gravity	0° F	10° F	20° F	30° F	40° F	50° F	60° F	70° F	80° F	90° F	100° F	110° F	SP. Gravity
.50	1.1640	1.1522	1.1402	1.1285	1.1171	1.1061	1.0954	1.0851	1.0750	1.0652	1.0556	1.0463	.50
.51	1.1526	1.1409	1.1289	1.1174	1.1061	1.0952	1.0847	1.0744	1.0644	1.0574	1.0452	1.0360	.51
.52	1.1414	1.1299	1.1180	1.1066	1.0954	1.0847	1.0742	1.0640	1.0541	1.0445	1.0351	1.0260	.52
.53	1.1306	1.1192	1.1074	1.0961	1.0851	1.0744	1.0640	1.0539	1.0441	1.0346	1.0253	1.0163	.53
.54	1.1201	1.1087	1.0971	1.0859	1.0750	1.0644	1.0541	1.0441	1.0344	1.0249	1.0157	1.0068	.54
.55	1.1099	1.0986	1.0871	1.0760	1.0652	1.0547	1.0445	1.0346	1.0249	1.0156	1.0065	0.9976	.55
.56	1.0999	1.0888	1.0774	1.0663	1.0556	1.0452	1.0351	1.0253	1.0157	1.0065	0.9974	0.9887	.56
.57	1.0902	1.0792	1.0679	1.0569	1.0463	1.0360	1.0260	1.0163	1.0068	0.9976	0.9887	0.9799	.57
.58	1.0808	1.0698	1.0586	1.0478	1.0372	1.0270	1.0717	1.0075	0.9981	0.9890	0.9801	0.9715	.58
.59	1.0716	1.0607	1.0496	1.0389	1.0284	1.0183	1.0084	0.9989	0.9896	0.9806	0.9718	0.9632	.59
.60	1.0626	1.0518	1.0408	1.0302	1.0198	1.0098	1.0000	0.9905	0.9813	0.9723	0.9636	0.9551	.60
.61	1.0539	1.0432	1.0323	1.0217	1.0114	1.0014	0.9918	0.9824	0.9732	0.9643	0.9557	0.9473	.61
.62	1.0453	1.0347	1.0239	1.0134	1.0032	0.9933	0.9837	0.9744	0.9653	0.9565	0.9480	0.9396	.62
.63	1.0370	1.0265	1.0157	1.0053	0.9952	0.9854	0.9759	0.9667	0.9577	0.9489	0.9404	0.9321	.63
.64	1.0289	1.0184	1.0078	0.9974	0.9874	0.9777	0.9682	0.9591	0.9501	0.9415	0.9330	0.9248	.64
.65	1.0209	1.0106	1.0106	0.9897	0.9798	0.9701	0.9608	0.9517	0.9428	0.9342	0.9258	0.9177	.65
.66	1.0132	1.0029	0.9924	0.9822	0.9723	0.9628	0.9535	0.9444	0.9356	0.9271	0.9188	0.9107	.66
.67	1.0056	0.9954	0.9850	0.9749	0.9651	0.9556	0.9463	0.9374	0.9286	0.9202	0.9119	0.9039	.67
.68	0.9982	0.9880	0.9777	0.9677	0.9579	0.9485	0.9393	0.9304	0.9218	0.9134	0.9052	0.8972	.68
.69	0.9909	0.9809	0.9706	0.9606	0.9510	0.9416	0.9325	0.9237	0.9151	0.9067	0.8986	0.8907	.69
.70	0.9838	0.9738	0.9636	0.9537	0.9442	0.9349	0.9258	0.9170	0.9085	0.9002	0.8921	0.8843	.70
.71	0.9768	0.9669	0.9568	0.9470	0.9375	0.9282	0.9193	0.9106	0.9021	0.8939	0.8858	0.8780	.71
.72	0.9700	0.9602	0.9501	0.9404	0.9309	0.9218	0.9129	0.9042	0.8958	0.8876	0.8797	0.8719	.72
.73	0.9634	0.9536	0.9436	0.9339	0.9246	0.9154	0.9066	0.8980	0.8897	0.8815	0.8736	0.8659	.73
.74	0.9568	0.9471	0.9372	0.9276	0.9183	0.9092	0.9005	0.8919	0.8836	0.8755	0.8677	0.8601	.74

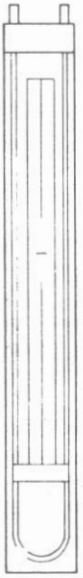
.75	0.9504	0.9408	0.9309	0.9214	0.9121	0.9032	0.8944	0.8859	0.8770	0.8697	0.8619	0.8543	.75
.76	0.9442	0.9346	0.9248	0.9153	0.9061	0.8972	0.8885	0.8801	0.8718	0.8640	0.8562	0.8487	.76
.77	0.9380	0.9285	0.9188	0.9094	0.9002	0.8913	0.8827	0.8744	0.8662	0.8583	0.8606	0.8431	.77
.78	0.9320	0.9225	0.9129	0.9035	0.8944	0.8856	0.8771	0.8687	0.8607	0.8528	0.8452	0.8377	.78
.79	0.9261	0.9167	0.9071	0.8978	0.8887	0.8800	0.8715	0.8632	0.8552	0.8474	0.8398	0.8324	.79
.80	0.9203	0.9109	0.9014	0.8921	0.8832	0.8745	0.8660	0.8578	0.8498	0.8421	0.8345	0.8272	.80
.81	0.9146	0.9053	0.8958	0.8866	0.8777	0.8691	0.8607	0.8525	0.8446	0.8369	0.8294	0.8220	.81
.82	0.9090	0.8997	0.8903	0.8812	0.8723	0.8637	0.8554	0.8473	0.8394	0.8317	0.8243	0.8170	.82
.83	0.9035	0.8943	0.8849	0.8759	0.8671	0.8585	0.8502	0.8422	0.8343	0.8267	0.8193	0.8121	.83
.84	0.8981	0.8890	0.8797	0.8706	0.8620	0.8534	0.8452	0.8371	0.8294	0.8218	0.8144	0.8072	.84
.85	0.8928	0.8837	0.8745	0.8655	0.8569	0.8484	0.8402	0.8322	0.8245	0.8169	0.8096	0.8025	.85
.86	0.8876	0.8786	0.8694	0.8605	0.8518	0.8434	0.8353	0.8274	0.8197	0.8122	0.8049	0.7978	.86
.87	0.8825	0.8735	0.8644	0.8555	0.8469	0.8386	0.8305	0.8226	0.8149	0.8075	0.8002	0.7932	.87
.88	0.8774	0.8685	0.8594	0.8506	0.8421	0.8338	0.8257	0.8179	0.8103	0.8029	0.7957	0.7887	.88
.89	0.8725	0.8636	0.8546	0.8458	0.8373	0.8291	0.8211	0.8133	0.8057	0.7984	0.7912	0.7842	.89
.90	0.8676	0.8588	0.8498	0.8411	0.8327	0.8245	0.8165	0.8088	0.8012	0.7939	0.7868	0.7799	.90
.91	0.8629	0.8541	0.8452	0.8365	0.8281	0.8199	0.8120	0.8043	0.7968	0.7895	0.7825	0.7756	.91
.92	0.8581	0.8494	0.8405	0.8319	0.8236	0.8155	0.8076	0.7999	0.7925	0.7852	0.7782	0.7713	.92
.93	0.8535	0.8449	0.8360	0.8274	0.8191	0.8111	0.8032	0.7956	0.7882	0.7810	0.7740	0.7672	.93
.94	0.8490	0.8404	0.8316	0.8230	0.8148	0.8067	0.7989	0.7914	0.7840	0.7768	0.7699	0.7631	.94
.95	0.8445	0.8359	0.8272	0.8187	0.8105	0.8025	0.7947	0.7872	0.7799	0.7727	0.7658	0.7591	.95
.96	0.8401	0.8316	0.8229	0.8144	0.8062	0.7983	0.7906	0.7831	0.7758	0.7687	0.7618	0.7551	.96
.97	0.8357	0.8273	0.8186	0.8102	0.8021	0.7942	0.7865	0.7790	0.7718	0.7647	0.7579	0.7512	.97
.98	0.8315	0.8230	0.8144	0.8061	0.7901	0.7901	0.7825	0.7750	0.7678	0.7608	0.7540	0.7474	.98
.99	0.8273	0.8189	0.8103	0.8020	0.7939	0.7861	0.7785	0.7711	0.7639	0.7570	0.7502	0.7436	.99
1.00	0.8231	0.8148	0.8062	0.7980	0.7899	0.7822	0.7746	0.7673	0.7601	0.7532	0.7464	0.7398	1.00
1.01	0.8190	0.8107	0.8022	0.7940	0.7860	0.7783	0.7708	0.7634	0.7563	0.7494	0.7427	0.7362	1.01
1.02	0.8150	0.8067	0.7983	0.7901	0.7822	0.7744	0.7670	0.7597	0.7526	0.7458	0.7391	0.7326	1.02
1.03	0.8110	0.8028	0.7944	0.7862	0.7783	0.7707	0.7632	0.7560	0.7490	0.7421	0.7355	0.7290	1.03
1.04	0.8071	0.7989	0.7906	0.7825	0.7746	0.7670	0.7596	0.7524	0.7454	0.7386	0.7319	0.7255	1.04

NOTE: Reproduced by permission from Southwestern Gas Measurement Short Course, Report of Practical Methods Sub-Committee, "Useful Tables for the Gas Measurement Man", Part Two.

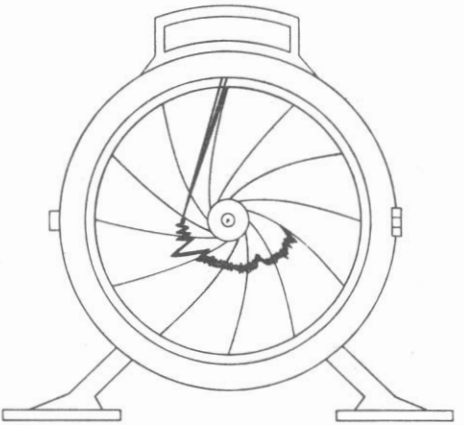
FIGURE 1



ORIFICE WELL TESTER

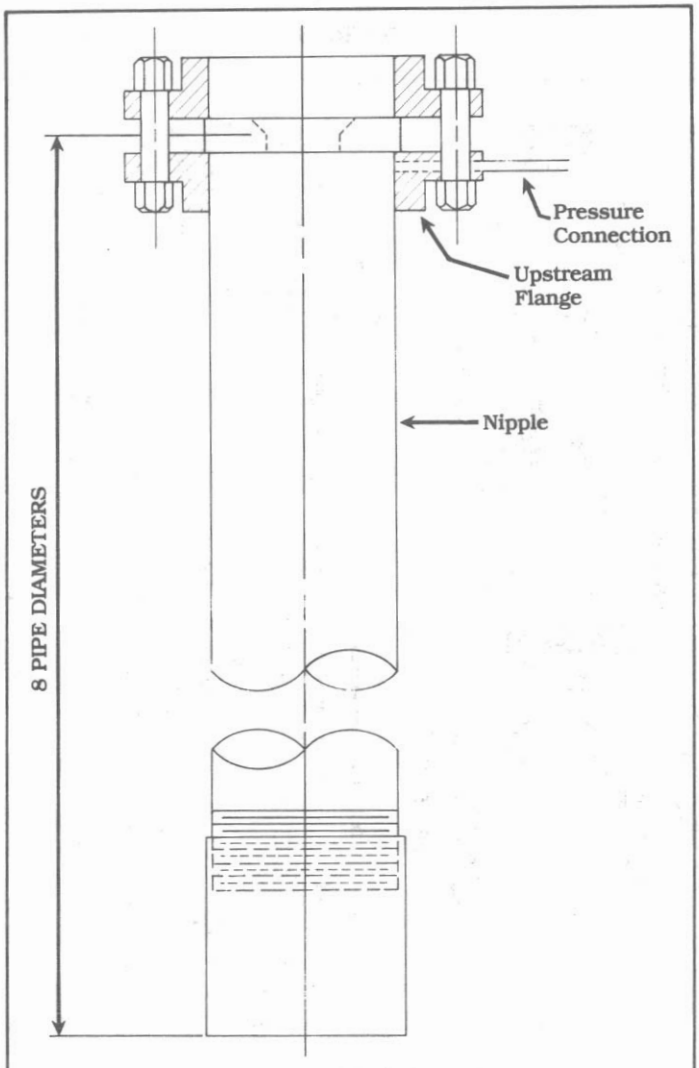


U-TUBE MANOMETER



RECORDING PRESSURE GAUGE

FIGURE 2

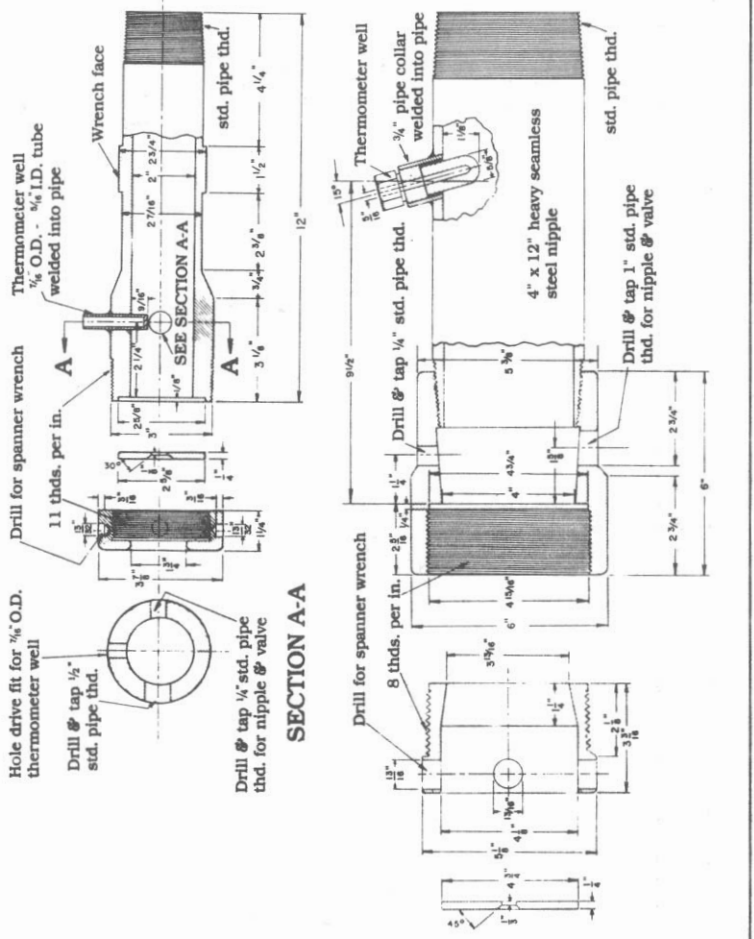


ORIFICE ASSEMBLY

WITH SINGLE TAP

(3″ and 4″ Method)

FIGURE 3



DESIGNS OF 2- AND 4-INCH CRITICAL FLOW PROVERS FROM UNITED STATES BUREAU OF MINES MONOGRAPH 7, PAGE 118.

FIGURE 4

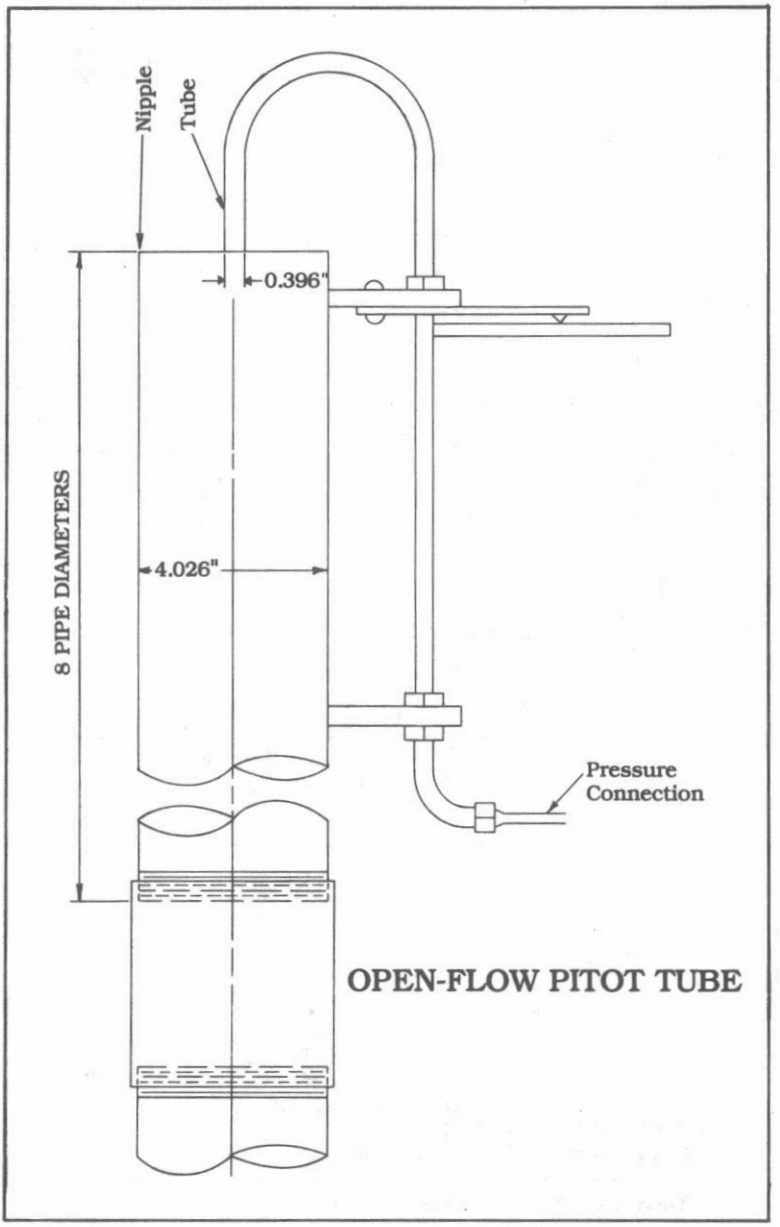
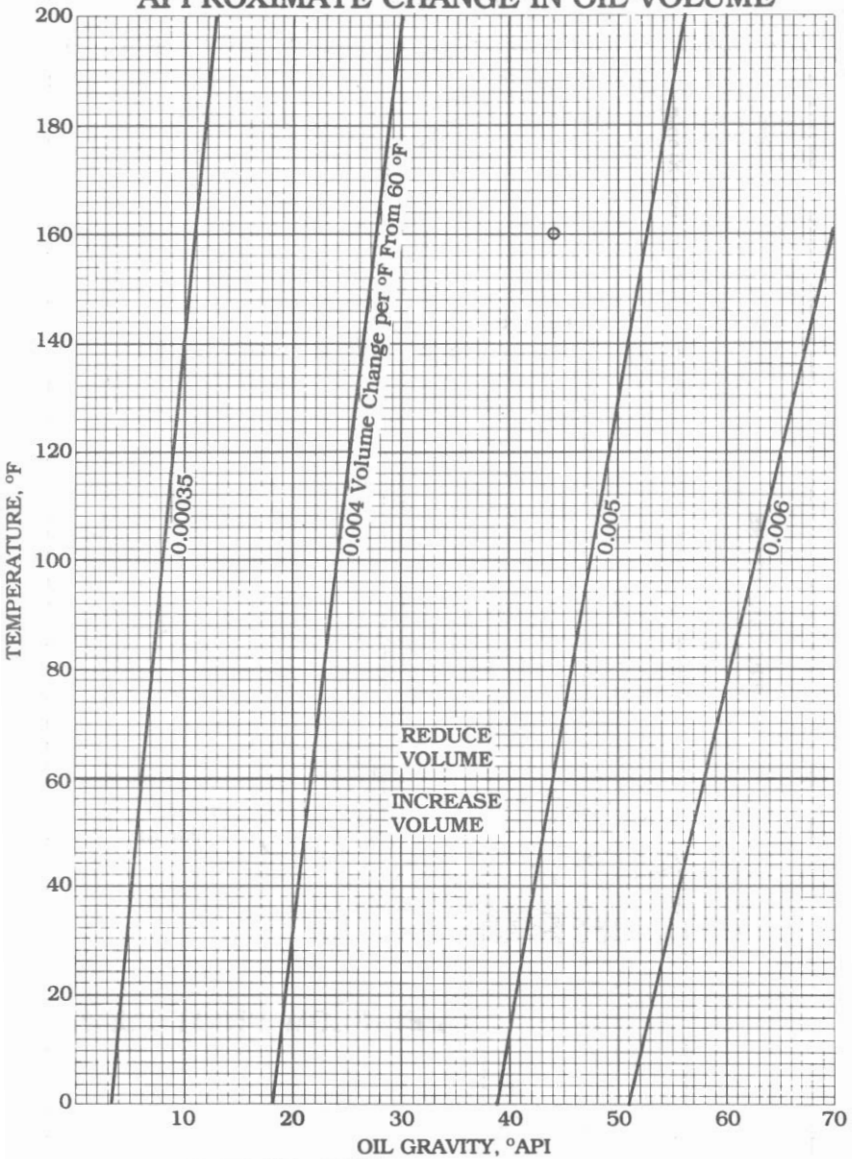

Nipple
Tube
0.396"
8 PIPE DIAMETERS
4.026"
Pressure
Connection
OPEN-FLOW PITOT TUBE

FIGURE 5
APPROXIMATE CHANGE IN OIL VOLUME



EXAMPLE: 44° API @ 160°F
Nearest diagonal line = 0.0005 volume change
160° = 100° above 60° F 0.0005 x 100 = 0.05 reduction
Therefore, 95% of measured volume

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