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Bi-DIRECTIONAL METER PROVING CALCULATIONS

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Introduction

The most reliable means of determining and verifying the accuracy of an Automatic Custody Transfer (**ACT**) liquid sales meter is to compare a measured volume of liquid through the meter against the known volume of a bi-directional meter prover system. The actual comparison of these volumes is referred to as a "meter proving". To ensure proving accuracy, it is necessary to collect fluid data, which will be used in making calculations to determine "true volume".

The basic principle of operation of the bi-directional meter prover is to provide an accurate and repetitive displacement of liquid through a pre-calibrated volume between two detector switches. Accurate displacement of the liquid is accomplished by forcing an inflatable spheroid through the calibrated section of pipe using fluid energy from the stream being metered and recording the metered volume. A ratio is determined between the known volume displaced and the volume indicated by the meter. This ratio is the "**Meter Factor**". Meter Factor is what we multiply the counter register by to obtain true volume.

Prover Volume

The volume of the prover is expressed as a round trip, meaning that the spheroid has been diverted from one launch chamber through the calibrated section and back. The prover volume is determined from a calibration test or "Water Draw" using water as a test fluid with the prover volume corrected to a pressure of 0 PSIG and a temperature of 60 degrees F. When the prover is operated, it is necessary to correct prover volume for the following conditions:

1. Liquid Temperature Correction **(Ctl)** - This correction is applied to the prover only when the meter being calibrated is equipped with an automatic temperature compensating device to allow a true volume comparison. This correction is obtained from the appropriate API Tables found under Chapter 11 of the API Manual of Petroleum Measurement Standards Standard 2540 or from the calculations obtained from the API Manual of Petroleum Measurement Standards, Chapter 11, Section 1 and is used to correct the volume of the prover to 60 degrees F. When proving a meter with an automatic temperature compensating device it is referred to as a "net" proving. The liquid temperature at the prover is obtained from accurate thermometers installed on the prover inlet and outlet connections. When proving a meter without an automatic temperature compensating device it is necessary to apply the liquid temperature correction **(Ctl)** to both the prover volume and the meter volume. The temperature of the meter is read on an accurate thermometer installed as close as possible to the meter. When the temperature of the prover is the same as the temperature of the meter, the liquid temperature correction factors will cancel. When proving a meter without an automatic temperature compensating device it is referred to as a "gross" proving.

2. Prover Expansion Due to Pressure **(Cps)** - This correction is applied only to the prover and is

obtained from the API Manual of Petroleum Measurement Standards, Chapter 12, Section 2 for standard wall provers, or, from the equation shown for special wall provers. This correction is used to correct for prover volume change due to the effect pressure has on steel.

3. Prover Expansion Due to Temperature **(Cts)** - This correction is applied only to the prover and is obtained from the API Manual of Petroleum Measurement Standards, Chapter 12, Section 2. This correction is used to correct for prover volume change due to the effect temperature has on steel.

4. Liquid Compression **(Cpl)** - The liquid pressure correction is a factor used to correct prover volume due to the effect pressure has on the liquid being proved. This correction is used to correct for compressibility of the liquid to a base pressure of 0 PSIG and is obtained from the API Manual of Petroleum Measurement Standards, Chapter 11, Section 2.1 or from calculations obtained from the API Manual of Petroleum Measurement Standards, Chapter 11, Section 2.2.

Meter Volume (Temperature Corrected)

The volume metered by a positive displacement custody transfer meter is displayed on a mechanical counter driven by a mechanical gear train. The gear train is also used to drive an automatic mechanical temperature compensating device used to correct volume to a base of 60 degrees F at a designated specific gravity or API gravity. The same meter gear train is connected to a high resolution electronic photo-pulser that is used to provide a transmitted output of 1000 electrical pulses per revolution of the gear train to an Electronic Prover Counter. In the case of a 4" Smith Series F4 meter, this electrical output is equivalent to 200 pulses per metered gallon or 8400 pulses per barrel. When the meter is proved it is necessary to convert the pulses per metered gallon into equivalent units for comparison to "Prover Volume" in order to develop a "Meter Factor". During a "net" proving, it is necessary to correct metered volume for the following conditions:

1. Pulse Factor of Meter - is the factor based on the number of pulses per gallon or barrel generated by the photo-pulser transmitter installed on the meter. The units must be the same (i.e., gallons or barrels) as used for the prover.

2. Liquid Temperature Correction **(Ctl)** - This correction is applied to the prover only when the meter being calibrated is equipped with an automatic temperature compensating system to allow a true volume comparison. This correction is used to correct the volume of the product to 60 degrees F.

3. Liquid Compression **(Cpl)** - The liquid pressure correction is a factor used to correct meter volume due to the effect pressure has on the liquid being metered. This correction is used to correct for compressibility of the liquid to a base of 0 PSIG.

Proving Procedures

Meters should be calibrated under actual operating conditions of pressure, temperature and flow. Before proving a meter, product should be circulated long enough to insure that the meter, the meter case, the meter internal operating parts, the automatic temperature compensation device and the meter prover temperatures are equalized. The spheroid should be reversed several times by manipulation of the four-way prover valve to stabilize the temperature. During movement of the spheroid, the vent valves located on each launch chamber should be operated to remove all air or vapor from the prover system.

The Electronic Prover Counter should be checked before each proving. The counter is equipped with a test switch which will allow testing of the photo-pulser (attached to the meter to be calibrated) to ensure that a total of 1000 pulses per revolution in being received from the meter being calibrated. A satisfactory proving will not be possible if the photo-pulser is off more than plus or minus one count in 1000.

Round Trip - Consists of moving the spheroid from one end of the prover and then moving it back to the starting position. A round trip proving run should start from the same end of the prover each time. The Electronic Prover Counter should be zeroed before starting the spheroid movement and then wait to zero the register until a full round trip has been recorded. (Example: Initial 5776 - Total 11568). The total pulses registered for a round trip are considered a basic proving run. Usually a complete proving consists of five (5) consecutive round trips of the spheroid. In some cases seven (7) round trips are made and the highest and lowest run are discarded with the five remaining to be averaged. A series of five consecutive round trips that agree within 0.05% are generally considered as an acceptable test of a meters performance.

The temperature of the liquid should always be taken at the inlet and at the outlet of the prover. These temperatures should be recorded during each complete trip of the spheroid and the average of these temperatures will be the temperature of the liquid in the prover.

Calculation of Meter Factor - Using Temperature Compensated Meter

The "Meter Factor" is the correction to all the changes that can affect the meter. The relation between the quantity of a liquid indicated on the register of the meter and the true quantity of the liquid that has passed through the meter during the same time interval is called "Meter Output". This relation can express itself in various ways, but for operation, it is expressed more commonly as "Meter Factor". This "Meter Factor" is a mathematical expression obtained as a product between the division of the quantity that passes through the meter in a given time and the quantity of volume indicated by the counter at the same time. The true measurement of volume that passes through the meter is then, the product of multiplying the digits indicated on the counter register by the "Meter Factor".

The "Meter Factor" based on 0 PSIG and 60 degrees F. for an automatic temperature corrected meter is obtained from the following mathematical expression;

Meter Factor = Gross round trip prover volume x prover liquid temperature correction **(Ctl)** x prover expansion of metal due to pressure **(Cps)** x prover expansion of metal due to temperature **(Cts)** x prover liquid compressibility factor **(Cpl)** divided by round trip temperature corrected meter pulses per unit volume (pulses per gallon or pulses per barrel) x meter liquid compressibility factor **(Cpl)**

The "Composite Meter Factor" based on normal operating pressure and average temperature conditions for an automatic temperature corrected meter is obtained from the following mathematical expression;

Composite Meter Factor = Meter Factor (at 0 PSIG and 60 degrees F) x meter liquid compressibility factor **(Cpl** - at average operating meter pressure)

Calculation of Meter Factor - Non-Temperature Compensated Meter

The "Meter Factor" based on 0 PSIG and 60 degrees F. for a non- temperature corrected meter is obtained from the following mathematical expression;

Meter Factor = Gross round trip prover volume x average prover liquid temperature correction **(Ctl)** x prover expansion of metal due to pressure **(Cps)** x prover expansion of metal due to temperature **(Cts)** x prover liquid compressibility factor **(Cpl)** divided by round trip meter pulses per unit volume (pulses per gallon or pulses per barrel) x average meter liquid temperature correction **(Ctl)** x meter liquid compressibility factor **(Cpl)**

The "Composite Meter Factor" based on operating pressure and average temperature for a non-temperature corrected meter is obtained from the following mathematical expression;

Composite Meter Factor = Meter Factor (at 0 PSIG and 60 degrees F) x meter liquid compressibility factor (**Cpl** - at average operating meter pressure)

Meter Factor Deviation

Meter factor deviation is the drift between meter provings. The allowable drift is based on the individual company requirements as agreed upon between buyer and seller. If the meter factor on a mechanically temperature corrected meter consistently drifts over several provings it may be necessary to prove the meter on both "gross" and "net" to determine the exact cause of the drift.

Inspection and Maintenance

The characteristics of the metered liquid generally determine the frequency of meter inspections and repairs. Meters susceptible to damage by wear or excessive tolerance will require more frequent inspections in order to prevent malfunctions. A good preventative maintenance program will always insure reliable performance. Inspections, maintenance and provings should be documented on each meter in order to develop statistical data.

When putting a new or repaired meter in service, the inlet and outlet block valves should be opened gradually to permit the displacement of air or gases that might exist inside the meter. Failure to slowly eliminate vapors may result in structural damage to the meter.

Calculations

Attached are examples of proving reports and tabulated correction factors. These proving reports are included for information only and not intended as a required method of operation.

Bi-Directional Meter Proving Calculations
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TEMPERATURE CORRECTED (Net) METER PROVING REPORT
USING BI-DIRECTIONAL METER PROVER

Client: XYZ OIL COMPANY
Lease: NONE
Location: NONE

Date: 11/20/02
Time: 3:20:40PM
Report Number: 1

PREVIOUS REPORT

Date:	11/20/02
Meter Factor:	1.0051
Gravity:	49.5
Temperature:	78.5
Rate:	475.0
Current Total:	12,345
Previous Total:	12,345
Thru Put:	0

METER DATA

Meter ID:	17
Model:	F4-S1
Manufacturer:	Smith
Serial:	FS3157
Size:	4.0
K Factor:	8400.0000
Compensated:	A.T.G.

PROVER DATA

Manufacturer:	XYZ
Prover Type:	Bi-directional
Serial Number:	12345
Prover Volume:	7.126430
Calibration Date:	10/25/01
Inside Diameter:	8.0000
Wall Thickness:	0.375
Thermal Exp:	0.0000124

PRODUCT DATA

Type: CRUDE
API Table: 5A/6A
Grav @ 60°F: 49.5

Vapor Press: .0
Obs Gravity: 0.00
Obs Temp: 0.00

Run No.	Forward Pulses	Reverse Pulses	Round Pulses	Flow Rate	Meter Temp	Prover Temp	Meter Press	Prover Press
1	0.000	59,057.000	59,057.000	510.0	77.5	77.5	112.0	115.0
2	0.000	59,066.000	59,066.000	510.0	78.0	78.0	114.0	117.0
3	0.000	59,069.000	59,069.000	510.0	78.5	78.5	112.0	115.0
4	0.000	59,058.000	59,058.000	510.0	79.0	79.0	112.0	115.0
5	0.000	59,065.000	59,065.000	510.0	79.5	79.5	112.0	115.0
Average:	0.000	59,063.000	59,063.000	510.0	78.5	78.5	112.4	115.4

PROVER

Prover Volume		CTSP		CPSP		CTLP		CPLP		NET PROVER VOLUME
7.126430	X	1.00034	X	1.00008	X	.98962	X	1.00078	=	7.06100

METER

Average Pulses		Pulses per Unit		Gross Meter Volume		CTLM		CPLM		NET METER VOLUME
59,063.000	/	8,400.0000	=	7.03131	X	1.00000	X	1.00076	=	7.03665

METER FACTOR

Net Prover Volume		Net Meter Volume		METER FACTOR		112.4 PSI CPL @ Meter Conditions		COMPOSITE METER FACTOR
7.06100	/	7.03665	=	1.00350	X	1.00076	=	**1.0043**

Repeatability: 0.020 %

Comment:

SIGNED BY: ______________________ DATE: __________ FOR: ______________________
WITNESSED BY: ______________________ DATE: __________ FOR: ______________________
WITNESSED BY: ______________________ DATE: __________ FOR: ______________________

Bi-Directional Meter Proving Calculations
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NON-TEMPERATURE CORRECTED (Gross) METER PROVING REPORT USING BI-DIRECTIONAL METER PROVER

Client: XYZ OIL COMPANY
Lease: NONE
Location: NONE

Date: 11/20/02
Time: 3:13:03PM
Report Number: 0

PREVIOUS REPORT

Date: No Data
Meter Factor:
Gravity:
Temperature:
Rate:
Current Total:
Previous Total: 12,345
Thru Put:

METER DATA

Meter ID: 17
Model: F4-S1
Manufacturer: Smith
Serial: FS3157
Size: 4.0
K Factor: 8400.0000
Compensated: T.A.

PROVER DATA

Manufacturer: XYZ
Prover Type: Bi-directional
Serial Number: 12345
Prover Volume: 7.126430
Calibration Date: 10/25/01
Inside Diameter: 8.0000
Wall Thickness: 0.375
Thermal Exp: 0.0000124

PRODUCT DATA

Type: CRUDE
API Table: 5A/6A
Grav @ 60°F: 49.5

Vapor Press: .0
Obs Gravity: 0.00
Obs Temp: 0.00

Run No.	Forward Pulses	Reverse Pulses	Round Pulses	Flow Rate	Meter Temp	Prover Temp	Meter Press	Prover Press
1	0.000	59,635.000	59,635.000	475.0	78.0	77.5	112.0	115.0
2	0.000	59,644.000	59,644.000	475.0	78.5	78.0	114.0	117.0
3	0.000	59,650.000	59,650.000	475.0	79.0	78.5	112.0	115.0
4	0.000	59,658.000	59,658.000	475.0	79.5	79.0	112.0	115.0
5	0.000	59,663.000	59,663.000	475.0	80.0	79.5	112.0	115.0
Average:	0.000	59,650.000	59,650.000	475.0	79.0	78.5	112.4	115.4

	Prover Volume		CTSP		CPSP		CTLP		CPLP		NET PROVER VOLUME
PROVER	7.126430	X	1.00034	X	1.00008	X	.98962	X	1.00078	=	7.06100

	Average Pulses		Pulses per Unit		Gross Meter Volume		CTLM		CPLM		NET METER VOLUME
METER	59,650.000	/	8,400.0000	=	7.10119	X	.98934	X	1.00077	=	7.03089

	Net Prover Volume		Net Meter Volume		METER FACTOR		CPL @ Meter Conditions (112.4 PSI)		COMPOSITE METER FACTOR
METER FACTOR	7.06100	/	7.03089	=	1.00430	X	1.00077	=	**1.0051**

Repeatability: 0.047 %

Comment:

SIGNED BY: ____________________ DATE: __________ FOR: ____________________
WITNESSED BY: ____________________ DATE: __________ FOR: ____________________
WITNESSED BY: ____________________ DATE: __________ FOR: ____________________

TABLE 6A, GENERALIZED CRUDE OILS
VOLUME CORRECTION TO 60° F (Ctl)

API GRAVITY AT 60 F — FACTOR FOR CORRECTING VOLUME TO 60 F

TEMP. F	45.0	45.5	46.0	46.5	47.0	47.5	48.0	48.5	49.0	49.5	50.0	TEMP. F
75.0	0.9920	0.9920	0.9919	0.9919	0.9918	0.9918	0.9917	0.9917	0.9916	0.9916	0.9915	75.0
75.5	0.9917	0.9917	0.9916	0.9916	0.9915	0.9915	0.9915	0.9914	0.9914	0.9913	0.9913	75.5
76.0	0.9915	0.9914	0.9914	0.9913	0.9913	0.9912	0.9912	0.9911	0.9911	0.9910	0.9910	76.0
76.5	0.9912	0.9912	0.9911	0.9911	0.9910	0.9910	0.9909	0.9908	0.9908	0.9907	0.9907	76.5
77.0	0.9909	0.9909	0.9908	0.9908	0.9907	0.9907	0.9906	0.9906	0.9905	0.9905	0.9904	77.0
77.5	0.9907	0.9906	0.9906	0.9905	0.9905	0.9904	0.9903	0.9903	0.9902	0.9902	0.9901	77.5
78.0	0.9904	0.9903	0.9903	0.9902	0.9902	0.9901	0.9901	0.9900	0.9900	0.9899	0.9898	78.0
78.5	0.9901	0.9901	0.9900	0.9900	0.9899	0.9899	0.9898	0.9897	0.9897	0.9896	0.9896	78.5
79.0	0.9899	0.9898	0.9898	0.9897	0.9896	0.9896	0.9895	0.9895	0.9894	0.9893	0.9893	79.0
79.5	0.9896	0.9895	0.9895	0.9894	0.9894	0.9893	0.9892	0.9892	0.9891	0.9891	0.9890	79.5
80.0	0.9893	0.9893	0.9892	0.9891	0.9891	0.9890	0.9890	0.9889	0.9888	0.9888	0.9887	80.0
80.5	0.9891	0.9890	0.9889	0.9889	0.9888	0.9888	0.9887	0.9886	0.9886	0.9885	0.9884	80.5
81.0	0.9888	0.9887	0.9887	0.9886	0.9885	0.9885	0.9884	0.9883	0.9883	0.9882	0.9882	81.0
81.5	0.9885	0.9885	0.9884	0.9883	0.9883	0.9882	0.9881	0.9881	0.9880	0.9879	0.9879	81.5
82.0	0.9883	0.9882	0.9881	0.9881	0.9880	0.9879	0.9879	0.9878	0.9877	0.9877	0.9876	82.0
82.5	0.9880	0.9879	0.9879	0.9878	0.9877	0.9877	0.9876	0.9875	0.9874	0.9874	0.9873	82.5
83.0	0.9877	0.9877	0.9876	0.9875	0.9874	0.9874	0.9873	0.9872	0.9872	0.9871	0.9870	83.0
83.5	0.9875	0.9874	0.9873	0.9872	0.9872	0.9871	0.9870	0.9870	0.9869	0.9868	0.9867	83.5
84.0	0.9872	0.9871	0.9870	0.9870	0.9869	0.9868	0.9867	0.9867	0.9866	0.9865	0.9865	84.0
84.5	0.9869	0.9868	0.9868	0.9867	0.9866	0.9865	0.9865	0.9864	0.9863	0.9862	0.9862	84.5
85.0	0.9867	0.9866	0.9865	0.9864	0.9863	0.9863	0.9862	0.9861	0.9860	0.9860	0.9859	85.0
85.5	0.9864	0.9863	0.9862	0.9862	0.9861	0.9860	0.9859	0.9858	0.9858	0.9857	0.9856	85.5
86.0	0.9861	0.9860	0.9860	0.9859	0.9858	0.9857	0.9856	0.9856	0.9855	0.9854	0.9853	86.0
86.5	0.9858	0.9858	0.9857	0.9856	0.9855	0.9854	0.9854	0.9853	0.9852	0.9851	0.9850	86.5
87.0	0.9856	0.9855	0.9854	0.9853	0.9853	0.9852	0.9851	0.9850	0.9849	0.9848	0.9848	87.0
87.5	0.9853	0.9852	0.9851	0.9851	0.9850	0.9849	0.9848	0.9847	0.9846	0.9846	0.9845	87.5
88.0	0.9850	0.9850	0.9849	0.9848	0.9847	0.9846	0.9845	0.9844	0.9844	0.9843	0.9842	88.0
88.5	0.9848	0.9847	0.9846	0.9845	0.9844	0.9843	0.9843	0.9842	0.9841	0.9840	0.9839	88.5
89.0	0.9845	0.9844	0.9843	0.9842	0.9842	0.9841	0.9840	0.9839	0.9838	0.9837	0.9836	89.0
89.5	0.9842	0.9842	0.9841	0.9840	0.9839	0.9838	0.9837	0.9836	0.9835	0.9834	0.9833	89.5
90.0	0.9840	0.9839	0.9838	0.9837	0.9836	0.9835	0.9834	0.9833	0.9832	0.9831	0.9830	90.0

* DENOTES EXTRAPOLATED VALUE

API GRAVITY = 45.0 TO 50.0

NOTE: This Volume Correction Table obtained from API Manual of Petroleum Measurement Standards, Chapter 11.1, Page 183

TABLE A-1, TEMPERATURE CORRECTION FACTORS FOR MILD STEEL (Cts)

C_{ts} for mild steel having a cubical coefficient of expansion of 1.86×10^{-5} per °F

Observed Temperature, °F	C_{ts} Value	Observed Temperature, °F	C_{ts} Value
−7.2– −1.9	0.9988	73.5– 78.8	1.0003
−1.8– 3.5	0.9989	78.9– 84.1	1.0004
3.6– 8.9	0.9990	84.2– 89.5	1.0005
9.0– 14.3	0.9991	89.6– 94.9	1.0006
14.4– 19.6	0.9992	95.0–100.3	1.0007
19.7– 25.0	0.9993	100.4–105.6	1.0008
25.1– 30.4	0.9994	105.7–111.0	1.0009
30.5– 35.8	0.9995	111.1–116.4	1.0010
35.9– 41.1	0.9996	116.5–121.8	1.0011
41.2– 46.5	0.9997	121.9–127.2	1.0012
46.6– 51.9	0.9998	127.3–132.5	1.0013
52.0– 57.3	0.9999	132.6–137.9	1.0014
57.4– 62.6	1.0000	138.0–143.3	1.0015
62.7– 68.0	1.0001	143.4–148.7	1.0016
68.1– 73.4	1.0002	148.8–154.0	1.0017

NOTE: This table is suitable for application in meter proving; in prover calibration use the formulas. For the formula used to derive the tabulated values and to calculate values, see 12.2.5.1.

Table A-2—Temperature Correction Factors for Stainless Steel

C_{ts} for stainless steel having a cubical coefficient of expansion of 2.65×10^{-5} per °F

Observed Temperature, °F	C_{ts} Value	Observed Temperature, °F	C_{ts} Value
−9.8– −6.1	0.9982	73.3– 76.9	1.0004
−6.0– −2.3	0.9983	77.0– 80.7	1.0005
−2.2– 1.5	0.9984	80.8– 84.5	1.0006
1.6– 5.2	0.9985	84.6– 88.3	1.0007
5.3– 9.0	0.9986	88.4– 92.0	1.0008
9.1– 12.8	0.9987	92.1– 95.8	1.0009
12.9– 16.6	0.9988	95.9– 99.6	1.0010
16.7– 20.3	0.9989	99.7–103.3	1.0011
20.4– 24.1	0.9990	103.4–107.1	1.0012
24.2– 27.9	0.9991	107.2–110.9	1.0013
28.0– 31.6	0.9992	111.0–114.7	1.0014
31.7– 35.4	0.9993	114.8–118.4	1.0015
35.5– 39.2	0.9994	118.5–122.2	1.0016
39.3– 43.0	0.9995	122.3–126.0	1.0017
43.1– 46.7	0.9996	126.1–129.8	1.0018
46.8– 50.5	0.9997	129.9–133.5	1.0019
50.6– 54.3	0.9998	133.6–137.3	1.0020
54.4– 58.1	0.9999	137.4–141.1	1.0021
58.2– 61.8	1.0000	141.2–144.9	1.0022
61.9– 65.6	1.0001	145.0–148.6	1.0023
65.7– 69.4	1.0002	148.7–152.4	1.0024
69.5– 73.2	1.0003	152.5–156.2	1.0025

NOTE: This table is suitable for application in meter proving; in prover calibration use the formulas. For the formula used to derive the tabulated values and to calculate the values, see 12.2.5.1.

NOTE: These Correction Tables obtained from API Manual of Petroleum Measurement Standards, Chapter 12.2, Page 21

TABLE A-3, PRESSURE CORRECTION FACTORS FOR STEEL (Cps)

(All measurements are in pounds per square inch gage.)

Factor C_{ps}	Prover Dimensions: 6-in. Pipe 0.25-in. Wall	6-in. Pipe 0.280-in. Wall	8-in. Pipe 0.322-in. Wall	8-in. Pipe 0.375-in. Wall	10-in. Pipe 0.365-in. Wall	10-in. Pipe 0.375-in. Wall	12-in. Pipe 0.375-in. Wall	14-in. Pipe 0.312-in. Wall	14-in. Pipe 0.375-in Wall
1.0000	0–61	0–69	0–60	0–71	0–54	0–56	0–46	0–34	0–42
1.0001	62–183	70–207	61–181	72–214	55–163	57–168	47–140	35–104	43–127
1.0002	184–306	208–346	182–302	215–357	164–273	169–281	141–234	105–174	128–212
1.0003	307–428	347–484	303–423	358–499	274–382	282–393	235–328	175–244	213–297
1.0004	429–551	485–623	424–544	500–642	383–491	394–506	329–421	245–314	298–382
1.0005	552–673	624–761	545–665	643–785	492–601	507–618	422–515	315–384	383–466
1.0006	674–795	762–900	666–786	786–928	602–701	619–731	516–609	385–454	467–551
1.0007	796–918	901–1038	787–907	929–1071	711–819	732–843	610–703	455–524	552–636
1.0008	919–1040		908–1028		820–928	844–956	704–796	525–594	637–721
1.0009					929–1038	957–1068	797–890	595–664	722–806
1.0010							891–984	665–734	807–891
1.0011							985–1078	735–804	892–976
1.0012								805–874	977–1061
1.0013								875–944	
1.0014								945–1014	
1.0015									
1.0016									
1.0017									
1.0018									
1.0019									
1.0020									
1.0021									
1.0022									
1.0023									
1.0024									

NOTE: This Pressure Correction Table obtained from API Manual of Petroleum Measurement Standards, Chapter 12.2, Page 22

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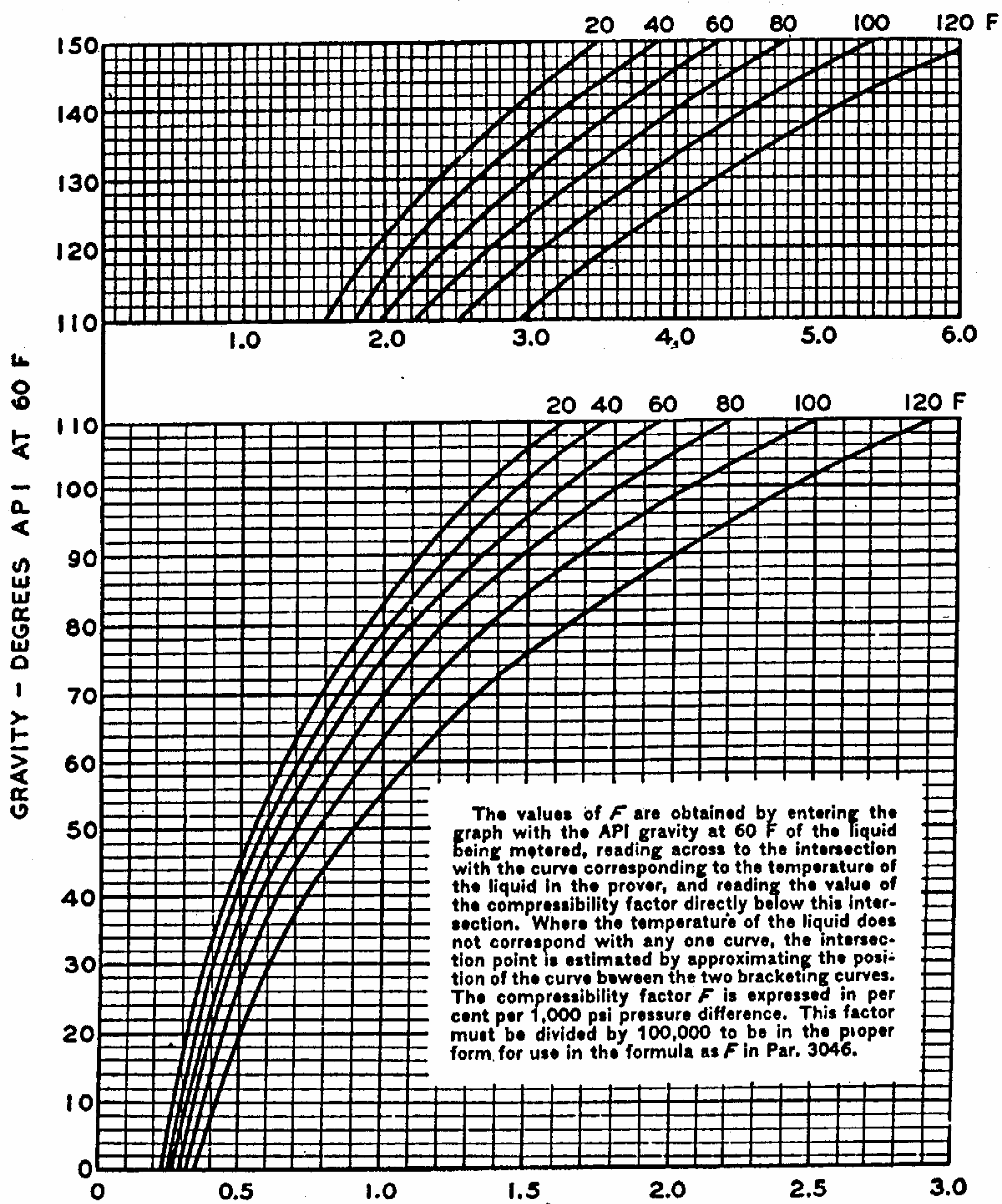
CORRECTION FOR PRESSURE ON LIQUID (Cpl)



NOTE: This Correction Table obtained from API Standard 1101, Measurement of Petroleum Liquid Hydrocarbons by Positive Displacement Meter, Figure 33, Page 52