

Calibration Certificate for Volume Transfer of LPG

Calibration Date: February 6, 2018

Certificate Number: 2018-015-1

Submitted by: FSCP Area 70
1730 SW 14 th St
Martell, NE 68404

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Date Received: 02/05/2018

PO Number: N/A
Job Order #: N/A

Artifact(s) Description

Test Item(s): 20 gal LPG Prover
Serial No: 88220
Manufacture: Midwest Meter
Condition: good

Material: Steel, Pressure Vessel, Low Carbon
Specification: NIST HB 150-4
Cubical Coefficient of Expansion: 0.000016 / °F

Calibration Information

Reference Standards Used:
NE-1586-5gal

Procedure: NIST SOP 21

Metrologist: JPL

Temperature: 21.3 °C

Humidity: 43.2 % RH

Water Temperature: 9.7 °C

Calibration Results

Nominal Volume (at zero mark on gauge)	Prover Volume As Found @ 60 °F and 100 psig (gal)	Prover Volume As Left @ 60 °F and 100 psig (gal)	Spec. Tol. ± (gal)	Uncertainty ± (gal)	k factor	Degrees of Freedom
20 gal	19.966	20.000	0.04	0.019	2.001	3865

Conversion Factors

1 gallon (U.S.) (gal) = 231 in³
1 gallon (U.S.) (gal) = 3.785 412 E-03 m³

Pertinent Information

- The artifact is considered in-tolerance when the error is equal to or less than the specified tolerance minus the measurement uncertainty. **RED** print indicates an out-of-tolerance reading.
- Enter the Pressure Correction from Table 1 that corresponds with the pressure being tested on your LPG Meter Test form.
- The calibration item was calibrated in a 'wet down' condition using water. The calibration data above applies when the prover bottom zero is obtained during a 30 (± 5) second period after cessation of the main flow.
- The drain time (using gravity) to the bottom zero was approximately 6 minute(s) 0 seconds.
- The Top Security Seal Number is Ne lab and the Bottom Security Seal Number is Ne Lab.

Traceability Statement

The artifact(s) described in this report have been compared to the Standards of the State of Nebraska. The Standards of the State of Nebraska are traceable to the SI through the National Institute of Standards and Technology (NIST) and are part of a comprehensive measurement assurance program for ensuring continued accuracy and measurement traceability within the level of uncertainty reported by this laboratory. The International System of Units (SI) for volume is the cubic meter (m³) (see Conversion Factors below). The report number for this report is the only unique report number to be used in referencing measurement traceability for the artifact(s) described in this report.

Uncertainty Statement

The combined standard uncertainty includes uncertainties for the standard(s), for the measurement process, for the material cubical coefficient of expansion, for reading meniscus, for the pressure gauge, for graduated neck errors and for the thermometer(s) used for measuring the water temperature. The combined standard uncertainty is multiplied by a coverage factor, *k*, to give the expanded uncertainty, which defines an interval with a 95.45 % level of confidence. The expanded uncertainty presented in this report is consistent with JCGM 100:2008, *Evaluation of measurement data — Guide to the expression of uncertainty in measurement (GUM 1995 with minor corrections)*. A component for the effects of viscosity was not included in the uncertainty budget.

Signature: 

Date: 2/7/2018

Joel P. Lavicky, State Metrologist

The results in this certificate only applies to those items specifically listed in this certificate. The certificate cannot be considered complete unless it contains all pages. The document may not be reproduced except in full, without the written consent of the Nebraska Standards Laboratory

- Attachments: Table 1 and Chart 1 - LPG Prover Pressure Corrections
Table 2 - LPG Prover Temperature Corrections
Table 3 - Volume Corrections for Thermal Expansion or Contraction of Prover
Table 4 - Volume Correction Factors to 60 °F

LPG Prover Pressure Corrections

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88220

Table 1 - 20 gal LPG Prover Pressure Corrections @ 60 °F

psig	Prover Scale Reading (gal)	Pressure Correction (Pcorr) (gal)
20	0.010	-0.020
30	0.007	-0.017
40	0.003	-0.014
50	0.000	-0.012
60	-0.003	-0.009
70	-0.006	-0.007
80	-0.009	-0.005
90	-0.012	-0.002
100	-0.015	0.000
110	-0.017	0.001
120	-0.019	0.003
130	-0.021	0.004
140	-0.023	0.005
150	-0.025	0.007
160	-0.027	0.008
170	-0.029	0.009
180	-0.031	0.011
190	-0.033	0.012
200	-0.035	0.014

LPG Prover Pressure Corrections

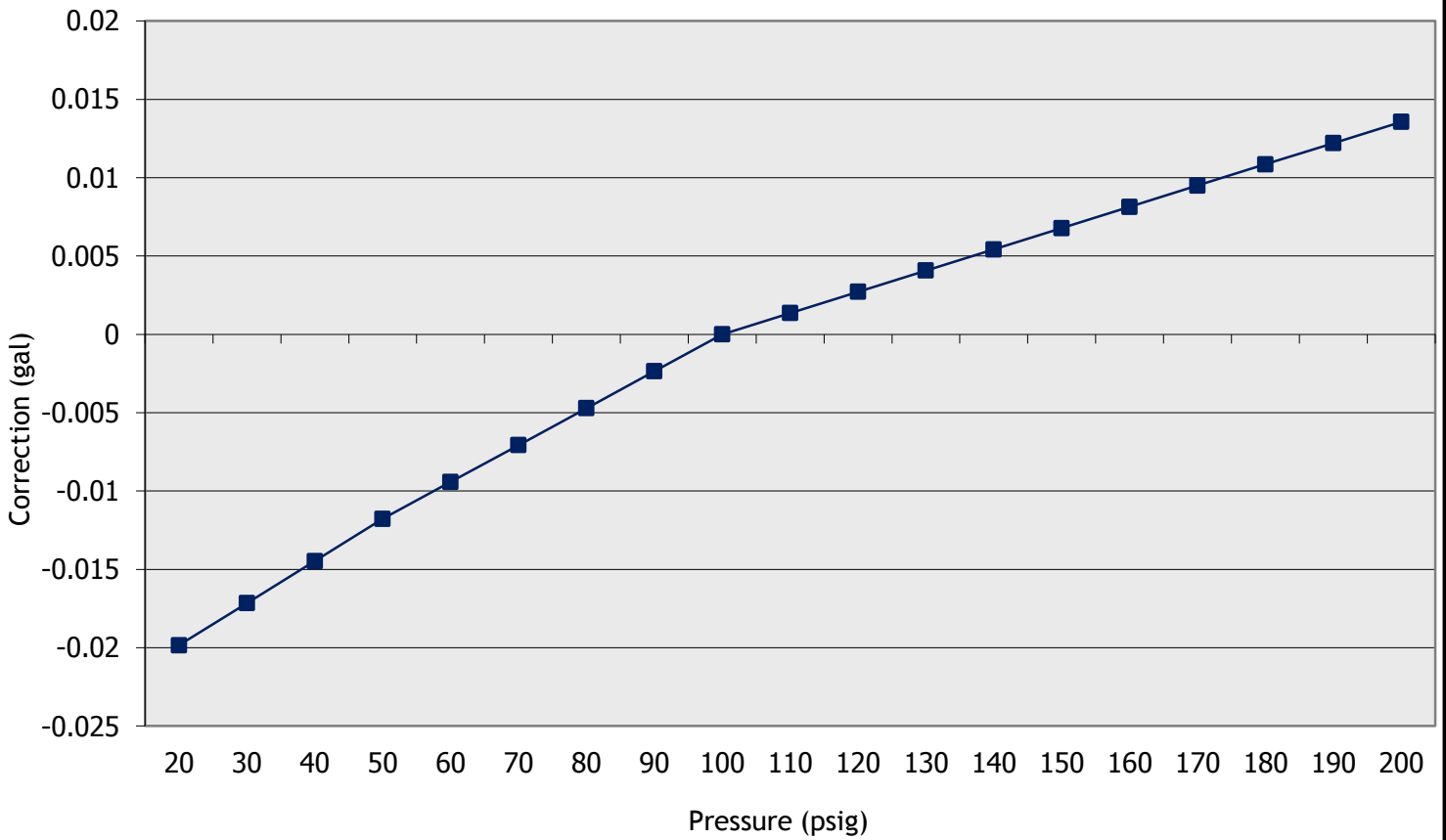
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Chart 1 - LPG Pressure Corrections (gal) @ 60 °F



LPG Prover Temperature Corrections

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Table 2 - LPG Temperature Corrections

Correction Per °F Difference between Meter Temperature and Prover Temperature

Propane Specific Gravity 60/60 °F 0.505*

Liquid in Prover Temp. °F	in ³ / °F	gal / °F	Liquid in Prover Temp. °F	in ³ / °F	gal / °F	Liquid in Prover Temp. °F	in ³ / °F	gal / °F
0	6.908	0.0299	34	7.235	0.0313	68	7.632	0.0330
1	6.917	0.0299	35	7.245	0.0314	69	7.645	0.0331
2	6.926	0.0300	36	7.256	0.0314	70	7.658	0.0332
3	6.935	0.0300	37	7.267	0.0315	71	7.672	0.0332
4	6.944	0.0301	38	7.277	0.0315	72	7.685	0.0333
5	6.953	0.0301	39	7.288	0.0315	73	7.698	0.0333
6	6.962	0.0301	40	7.299	0.0316	74	7.712	0.0334
7	6.971	0.0302	41	7.310	0.0316	75	7.726	0.0334
8	6.980	0.0302	42	7.321	0.0317	76	7.739	0.0335
9	6.989	0.0303	43	7.332	0.0317	77	7.753	0.0336
10	6.999	0.0303	44	7.343	0.0318	78	7.767	0.0336
11	7.008	0.0303	45	7.354	0.0318	79	7.781	0.0337
12	7.017	0.0304	46	7.366	0.0319	80	7.795	0.0337
13	7.027	0.0304	47	7.377	0.0319	81	7.810	0.0338
14	7.036	0.0305	48	7.388	0.0320	82	7.824	0.0339
15	7.045	0.0305	49	7.400	0.0320	83	7.839	0.0339
16	7.055	0.0305	50	7.411	0.0321	84	7.853	0.0340
17	7.064	0.0306	51	7.423	0.0321	85	7.868	0.0341
18	7.074	0.0306	52	7.434	0.0322	86	7.883	0.0341
19	7.084	0.0307	53	7.446	0.0322	87	7.898	0.0342
20	7.093	0.0307	54	7.458	0.0323	88	7.913	0.0343
21	7.103	0.0307	55	7.470	0.0323	89	7.928	0.0343
22	7.113	0.0308	56	7.482	0.0324	90	7.944	0.0344
23	7.123	0.0308	57	7.494	0.0324	91	7.959	0.0345
24	7.133	0.0309	58	7.506	0.0325	92	7.975	0.0345
25	7.143	0.0309	59	7.518	0.0325	93	7.990	0.0346
26	7.153	0.0310	60	7.531	0.0326	94	8.006	0.0347
27	7.163	0.0310	61	7.543	0.0327	95	8.022	0.0347
28	7.173	0.0311	62	7.555	0.0327	96	8.038	0.0348
29	7.183	0.0311	63	7.568	0.0328	97	8.055	0.0349
30	7.193	0.0311	64	7.581	0.0328	98	8.071	0.0349
31	7.204	0.0312	65	7.593	0.0329	99	8.088	0.0350
32	7.214	0.0312	66	7.606	0.0329	100	8.105	0.0351
33	7.224	0.0313	67	7.619	0.0330			

* Approximate specific gravity for a commercial LPG product.

Volume Corrections for Thermal Expansion or Contraction of Prover

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Table 3 - Volume Corrections for Thermal Expansion or Contraction of Prover

Coefficient of Cubical Expansion = 0.000016 / °F

Temp. °F	Correction (in ³)	Correction (gal)	Temp. °F	Correction (in ³)	Correction (gal)	Temp. °F	Correction (in ³)	Correction (gal)
0	-4.4	-0.019	34	-1.9	-0.008	68	0.6	0.003
1	-4.4	-0.019	35	-1.8	-0.008	69	0.7	0.003
2	-4.3	-0.019	36	-1.8	-0.008	70	0.7	0.003
3	-4.2	-0.018	37	-1.7	-0.007	71	0.8	0.004
4	-4.1	-0.018	38	-1.6	-0.007	72	0.9	0.004
5	-4.1	-0.018	39	-1.6	-0.007	73	1.0	0.004
6	-4.0	-0.017	40	-1.5	-0.006	74	1.0	0.004
7	-3.9	-0.017	41	-1.4	-0.006	75	1.1	0.005
8	-3.8	-0.017	42	-1.3	-0.006	76	1.2	0.005
9	-3.8	-0.016	43	-1.3	-0.005	77	1.3	0.005
10	-3.7	-0.016	44	-1.2	-0.005	78	1.3	0.006
11	-3.6	-0.016	45	-1.1	-0.005	79	1.4	0.006
12	-3.5	-0.015	46	-1.0	-0.004	80	1.5	0.006
13	-3.5	-0.015	47	-1.0	-0.004	81	1.6	0.007
14	-3.4	-0.015	48	-0.9	-0.004	82	1.6	0.007
15	-3.3	-0.014	49	-0.8	-0.004	83	1.7	0.007
16	-3.3	-0.014	50	-0.7	-0.003	84	1.8	0.008
17	-3.2	-0.014	51	-0.7	-0.003	85	1.8	0.008
18	-3.1	-0.013	52	-0.6	-0.003	86	1.9	0.008
19	-3.0	-0.013	53	-0.5	-0.002	87	2.0	0.009
20	-3.0	-0.013	54	-0.4	-0.002	88	2.1	0.009
21	-2.9	-0.012	55	-0.4	-0.002	89	2.1	0.009
22	-2.8	-0.012	56	-0.3	-0.001	90	2.2	0.010
23	-2.7	-0.012	57	-0.2	-0.001	91	2.3	0.010
24	-2.7	-0.012	58	-0.1	-0.001	92	2.4	0.010
25	-2.6	-0.011	59	-0.1	0.000	93	2.4	0.011
26	-2.5	-0.011	60	0.0	0.000	94	2.5	0.011
27	-2.4	-0.011	61	0.1	0.000	95	2.6	0.011
28	-2.4	-0.010	62	0.1	0.001	96	2.7	0.012
29	-2.3	-0.010	63	0.2	0.001	97	2.7	0.012
30	-2.2	-0.010	64	0.3	0.001	98	2.8	0.012
31	-2.1	-0.009	65	0.4	0.002	99	2.9	0.012
32	-2.1	-0.009	66	0.4	0.002	100	3.0	0.013
33	-2.0	-0.009	67	0.5	0.002			

Volume Correction Factors to 60 °F

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Table 4 - Volume Correction Factors to 60 °F

Propane Specific Gravity 60/60 °F 0.505*

Temp. °F	Correction Factor	Temp. °F	Correction Factor	Temp. °F	Correction Factor	Temp. °F	Correction Factor
0	1.09008	26	1.05283	52	1.01293	78	0.96955
1	1.08869	27	1.05134	53	1.01133	79	0.96780
2	1.08729	28	1.04986	54	1.00973	80	0.96604
3	1.08590	29	1.04837	55	1.00812	81	0.96427
4	1.08449	30	1.04688	56	1.00651	82	0.96249
5	1.08309	31	1.04538	57	1.00489	83	0.96071
6	1.08168	32	1.04388	58	1.00326	84	0.95892
7	1.08027	33	1.04237	59	1.00163	85	0.95712
8	1.07889	34	1.04086	60	1.00000	86	0.95532
9	1.07744	35	1.03935	61	0.99836	87	0.95351
10	1.07602	36	1.03783	62	0.99671	88	0.95168
11	1.07460	37	1.03631	63	0.99506	89	0.94986
12	1.07317	38	1.03478	64	0.99340	90	0.94802
13	1.07174	39	1.03325	65	0.99174	91	0.94617
14	1.07031	40	1.03172	66	0.99007	92	0.94432
15	1.06887	41	1.03018	67	0.98840	93	0.94246
16	1.06743	42	1.02863	68	0.98671	94	0.94059
17	1.06599	43	1.02708	69	0.98503	95	0.93871
18	1.06454	44	1.02553	70	0.98333	96	0.93682
19	1.06309	45	1.02397	71	0.98163	97	0.93493
20	1.06163	46	1.02241	72	0.97993	98	0.93302
21	1.06017	47	1.02084	73	0.97821	99	0.93110
22	1.05871	48	1.01927	74	0.97649	100	0.92918
23	1.05725	49	1.01769	75	0.97477		
24	1.05578	50	1.01611	76	0.97307		
25	1.05430	51	1.01452	77	0.97130		

* Approximate specific gravity for a commercial LPG product.