NCWM LPG Exam Reference Tables

Excerpts from
NIST OWM LPG Training Materials -Appendix B

(Revised Jan 2017, Ross Andersen and Val Miller),
and
Tables prepared specifically for the NCWM Exam [1]

Note: NCWM exam questions will specify one of two different provers.
Candidates must select and use the tables corresponding to the prover referenced in the question.

Table 1.a - Pressure Corrections to Indicated Volume of 100 gal Prover

NCWM Exam Prover 100 gal Low Carbon Steel S/N NCWM-100LCS

Pressure psig	Correction gal	Pressure psig	Correction gal
0	-0.03	100	0.00
5	-0.03	105	0.00
10	-0.03	110	0.01
15	-0.03	115	0.01
20	-0.03	120	0.01
25	-0.03	125	0.02
30	-0.03	130	0.02
35	-0.03	135	0.03
40	-0.03	140	0.03
45	-0.02	145	0.03
50	-0.02	150	0.04
55	-0.02	155	0.04
60	-0.02	160	0.05
65	-0.02	165	0.05
70	-0.02	170	0.06
75	-0.01	175	0.06
80	-0.01	180	0.07
85	-0.01	185	0.07
90	-0.01	190	0.08
95	0.00	195	0.08
100	0.00	200	0.09

Add correction to the indicated volume.

Table 1.b - Pressure Corrections to Indicated Volume of 100 gal Prover

NCWM Exam Prover 100 gal Stainless Steel S/N NCWM-100SS

Pressure psig	Correction gal	Pressure psig	Correction gal
0	-0.04	100	0.00
5	-0.04	105	0.00
10	-0.04	110	0.01
15	-0.04	115	0.01
20	-0.04	120	0.02
25	-0.04	125	0.02
30	-0.04	130	0.03
35	-0.04	135	0.04
40	-0.04	140	0.04
45	-0.03	145	0.05
50	-0.03	150	0.05
55	-0.03	155	0.06
60	-0.03	160	0.07
65	-0.02	165	0.07
70	-0.02	170	0.08
75	-0.02	175	0.09
80	-0.02	180	0.10
85	-0.01	185	0.10
90	-0.01	190	0.11
95	0.00	195	0.12
100	0.00	200	0.13

Add correction to the indicated volume.

Table 2.a - Volume Corrections for Thermal Expansion or Contraction of a 100-gallon Low Carbon Steel Prover

Coefficient of Expansion = 0.0000186 /°F

Temp °F	Correction gal	Correction in³
-9	-0.128	-29.6
-8	-0.126	-29.2
-7	-0.125	-28.8
-6	-0.123	-28.4
-5	-0.121	-27.9
-4	-0.119	-27.5
-3	-0.117	-27.1
-2	-0.115	-26.6
-1	-0.113	-26.2
0	-0.112	-25.8
1	-0.110	-25.3
2	-0.108	-24.9
3	-0.106	-24.5
4	-0.104	-24.1
5	-0.102	-23.6
6	-0.100	-23.2
7	-0.099	-22.8
8	-0.097	-22.3
9	-0.095	-21.9
10	-0.093	-21.5
11	-0.091	-21.1
12	-0.089	-20.6
13	-0.087	-20.2
14	-0.086	-19.8
15	-0.084	-19.3
16	-0.082	-18.9
17	-0.080	-18.5
18	-0.078	-18.0
19	-0.076	-17.6
20	-0.074	-17.2
21	-0.073	-16.8
22	-0.071	-16.3
23	-0.069	-15.9
24	-0.067	-15.5
25	-0.065	-15.0
26	-0.063	-14.6
27	-0.061	-14.2
28	-0.060	-13.7
29	-0.058	-13.3
30	-0.056	-12.9
31	-0.054	-12.5
32	-0.052	-12.0
33	-0.050	-11.6
34	-0.048	-11.2
35	-0.047	-10.7
36	-0.045	-10.3
37	-0.043	-9.9
38	-0.041	-9.5
39	-0.039	-9.0
40	-0.037	-8.6
41	-0.035	-8.2
42	-0.033	-7.7
43	-0.032	-7.3
44	-0.030	-6.9
45	-0.028	-6.4
46	-0.026	-6.0
47	-0.024	-5.6
48	-0.022	-5.2
49	-0.020	-4.7
50	-0.019	-4.3
51	-0.017	-3.9
52	-0.015	-3.4
53	-0.013	-3.0
54	-0.011	-2.6
55	-0.009	-2.1
56	-0.007	-1.7
57	-0.006	-1.3
58	-0.004	-0.9
59	-0.002	-0.4
60	0.000	0.0
61	0.002	0.4
62	0.004	0.9
63	0.006	1.3
64	0.007	1.7
65	0.009	2.1
66	0.011	2.6
67	0.013	3.0
68	0.015	3.4
69	0.017	3.9
70	0.019	4.3
71	0.020	4.7
72	0.022	5.2
73	0.024	5.6
74	0.026	6.0
75	0.028	6.4
76	0.030	6.9
77	0.032	7.3
78	0.033	7.7
79	0.035	8.2
80	0.037	8.6
81	0.039	9.0
82	0.041	9.5
83	0.043	9.9
84	0.045	10.3
85	0.046	10.7
86	0.048	11.2
87	0.050	11.6
88	0.052	12.0
89	0.054	12.5
90	0.056	12.9
91	0.058	13.3
92	0.060	13.7
93	0.061	14.2
94	0.063	14.6
95	0.065	15.0
96	0.067	15.5
97	0.069	15.9
98	0.071	16.3
99	0.073	16.8
100	0.074	17.2
101	0.076	17.6
102	0.078	18.0
103	0.080	18.5
104	0.082	18.9
105	0.084	19.3
106	0.086	19.8
107	0.087	20.2
108	0.089	20.6
109	0.091	21.1
110	0.093	21.5

Table 2.b - Volume Corrections for Thermal Expansion or Contraction of a 100-gallon Stainless Steel Prover

Coefficient of Expansion = 0.0000265 /°F

Temp °F	Correction gal	Correction in³
-9	-0.183	-42.2
-8	-0.180	-41.6
-7	-0.178	-41.0
-6	-0.175	-40.4
-5	-0.172	-39.8
-4	-0.170	-39.2
-3	-0.167	-38.6
-2	-0.164	-38.0
-1	-0.162	-37.3
0	-0.159	-36.7
1	-0.156	-36.1
2	-0.154	-35.5
3	-0.151	-34.9
4	-0.148	-34.3
5	-0.146	-33.7
6	-0.143	-33.1
7	-0.140	-32.4
8	-0.138	-31.8
9	-0.135	-31.2
10	-0.133	-30.6
11	-0.130	-30.0
12	-0.127	-29.4
13	-0.125	-28.8
14	-0.122	-28.2
15	-0.119	-27.5
16	-0.117	-26.9
17	-0.114	-26.3
18	-0.111	-25.7
19	-0.109	-25.1
20	-0.106	-24.5
21	-0.103	-23.9
22	-0.101	-23.3
23	-0.098	-22.6
24	-0.095	-22.0
25	-0.093	-21.4
26	-0.090	-20.8
27	-0.087	-20.2
28	-0.085	-19.6
29	-0.082	-19.0
30	-0.079	-18.4
31	-0.077	-17.8
32	-0.074	-17.1
33	-0.072	-16.5
34	-0.069	-15.9
35	-0.066	-15.3
36	-0.064	-14.7
37	-0.061	-14.1
38	-0.058	-13.5
39	-0.056	-12.9
40	-0.053	-12.2
41	-0.050	-11.6
42	-0.048	-11.0
43	-0.045	-10.4
44	-0.042	-9.8
45	-0.040	-9.2
46	-0.037	-8.6
47	-0.034	-8.0
48	-0.032	-7.3
49	-0.029	-6.7
50	-0.026	-6.1
51	-0.024	-5.5
52	-0.021	-4.9
53	-0.019	-4.3
54	-0.016	-3.7
55	-0.013	-3.1
56	-0.011	-2.4
57	-0.008	-1.8
58	-0.005	-1.2
59	-0.003	-0.6
60	0.000	0.0
61	0.003	0.6
62	0.005	1.2
63	0.008	1.8
64	0.011	2.4
65	0.013	3.1
66	0.016	3.7
67	0.019	4.3
68	0.021	4.9
69	0.024	5.5
70	0.026	6.1
71	0.029	6.7
72	0.032	7.3
73	0.034	8.0
74	0.037	8.6
75	0.040	9.2
76	0.042	9.8
77	0.045	10.4
78	0.048	11.0
79	0.050	11.6
80	0.053	12.2
81	0.056	12.9
82	0.058	13.5
83	0.061	14.1
84	0.064	14.7
85	0.066	15.3
86	0.069	15.9
87	0.072	16.5
88	0.074	17.1
89	0.077	17.8
90	0.080	18.4
91	0.082	19.0
92	0.085	19.6
93	0.087	20.2
94	0.090	20.8
95	0.093	21.4
96	0.095	22.0
97	0.098	22.6
98	0.101	23.3
99	0.103	23.9
100	0.106	24.5
101	0.109	25.1
102	0.111	25.7
103	0.114	26.3
104	0.117	26.9
105	0.119	27.5
106	0.122	28.2
107	0.125	28.8
108	0.127	29.4
109	0.130	30.0
110	0.133	30.6

Table 3. Volume Reduction to 60 ºF for Liquefied Petroleum Gas
From ASTM Table 24E
Propane - Specific Gravity 60/60 F= 0.505

Temp °F	Factor
-10	1.10383
-9	1.10247
-8	1.10111
-7	1.09974
-6	1.09837
-5	1.09699
-4	1.09562
-3	1.09424
-2	1.09285
-1	1.09147
0	1.09008
1	1.08869
2	1.08729
3	1.08590
4	1.08449
5	1.08309
6	1.08168
7	1.08027
8	1.07886
9	1.07744
10	1.07602
11	1.07460
12	1.07317
13	1.07174
14	1.07031
15	1.06887
16	1.06743
17	1.06599
18	1.06454
19	1.06309
20	1.06163
21	1.06017
22	1.05871
23	1.05725
24	1.05578
25	1.05430
26	1.05283
27	1.05134
28	1.04986
29	1.04837
30	1.04688

Temp °F	Factor
30	1.04688
31	1.04538
32	1.04388
33	1.04237
34	1.04086
35	1.03935
36	1.03783
37	1.03631
38	1.03478
39	1.03325
40	1.03172
41	1.03018
42	1.02863
43	1.02708
44	1.02553
45	1.02397
46	1.02241
47	1.02084
48	1.01927
49	1.01769
50	1.01611
51	1.01452
52	1.01293
53	1.01133
54	1.00973
55	1.00812
56	1.00651
57	1.00489
58	1.00326
59	1.00163
60	1.00000
61	0.99836
62	0.99671
63	0.99506
64	0.99340
65	0.99174
66	0.99007
67	0.98840
68	0.98671
69	0.98503
70	0.98333

Temp °F	Factor
70	0.98333
71	0.98163
72	0.97993
73	0.97821
74	0.97649
75	0.97477
76	0.97304
77	0.97130
78	0.96955
79	0.96780
80	0.96604
81	0.96427
82	0.96249
83	0.96071
84	0.95892
85	0.95712
86	0.95532
87	0.95351
88	0.95168
89	0.94986
90	0.94802
91	0.94617
92	0.94432
93	0.94246
94	0.94059
95	0.93871
96	0.93682
97	0.93493
98	0.93302
99	0.93110
100	0.92918
101	0.92724
102	0.92530
103	0.92335
104	0.92138
105	0.91941
106	0.91742
107	0.91543
108	0.91342
109	0.91141
110	0.90938

Table 4 - Temperature Corrections to Indicated Volume of a 100-Gallon Prover

Correction for 100-Gallon Per ºF Difference between Meter Temperature and Prover Temperature

Product Temperature in Prover °F	Propane 0.500*	Propane 0.505*	Propane 0.510*	Butane ** 0.585*	Anhydrous Ammonia #
Over -10 to 0	0.128	0.126	0.123	0.091	0.107
Over 0 to 10	0.133	0.130	0.127	0.093	0.109
Over 10 to 20	0.138	0.135	0.132	0.095	0.112
Over 20 to 30	0.144	0.140	0.137	0.097	0.116
Over 30 to 40	0.150	0.146	0.143	0.100	0.119
Over 40 to 50	0.157	0.153	0.149	0.102	0.123
Over 50 to 60	0.165	0.160	0.156	0.105	0.128
Over 60 to 70	0.174	0.169	0.164	0.108	0.133
Over 70 to 80	0.184	0.178	0.172	0.111	0.138
Over 80 to 90	0.195	0.189	0.183	0.115	0.144
Over 90 to 100	0.209	0.202	0.194	0.119	0.150
Over 100 to 110	0.225	0.217	0.208	0.123	0.157

***Approximate specific gravities for some commercial LPG & Butane products. Values in the table derived from ASTM Table 24E.**

**** Butane boils at 31.1 ºF. Prover pressure will be less than one atmosphere below boiling point.**

 # Values in the table derived from Table 4A. Volume Reduction to 60 ºF for Saturated Anhydrous Ammonia, Based on 5th order fit of product density over range of -16 °F to 111 °F.
Reference: Haar and Gallagher, J. Phys. Chem. Ref. Data, Vol. 7, No. 3, 1978.

Note: The appropriate correction factor should be multiplied by the number of degrees difference between the meter and prover temperatures. If the temperature at the meter is *higher* than the temperature of the prover, the correction should be *added* to the prover gauge reading to compensate for the contraction of the liquid that has taken place after it was measured by the meter. If the temperature at the meter is *lower* than the temperature of the prover, the correction should be *subtracted* from the prover gauge reading to compensate for the expansion of the liquid that has taken place after it was measured by the meter.