

BELL SYSTEM PRACTICES
Outside Plant Construction
and Maintenance

SECTION G73.205.3
Issue 1, November, 1952
AT&T Co Standard

PRESSURE TESTING

CORRECTION OF PRESSURE MEASUREMENTS

TEMPERATURE

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1. GENERAL

1.01 This section replaces the related information contained in Section G73.205, Issue 1. This section describes the methods of measuring the temperature of cable, nitrogen cylinders, load cases, terminals, etc., and the methods used to convert pressure measurements made under different temperature conditions to their equivalent pressures at a common temperature value so that the pressures may be compared directly.

1.02 Pressure measurements are usually converted to their equivalent values at 60° F. This is the reference temperature at which normal cable maintenance and contactor operating pressures are specified.

2. MEASUREMENT OF TEMPERATURE

2.01 For pressure testing purposes, temperature is determined by measuring the surrounding atmospheric or ground temperature using an approved thermometer. When measuring temperature, the thermometer should not be held

in the hand. About 5 minutes should be allowed for the thermometer to record the correct temperature.

2.02 Cable on Reel, Loading Coil Case, etc.: When measuring temperatures in connection with pressure tests of cable on a reel, loading coil cases, or other item, the thermometer is located on the reel, case, etc. If the reel or other item is in the sun, the thermometer should be on the sunny side, with its tube facing the sun. If the reel or other item is in the rain, the thermometer is placed so that the rain strikes it directly. If the reel or other item has recently been moved, time is allowed to permit the material to come to air temperature, before the temperature measurements are made.

2.03 Aerial Cable: Measurements of temperature, when required in an aerial cable, are made at each point where a pressure reading is made. To measure the temperature of aerial cable, proceed as follows: If the sun is shining, suspend the thermometer from the cable or a pole so that it is in the sun with the tube facing the sun (whether the pressure measuring point is sunny or shaded); if the sun is not shining, face the tube in the direction of the sun; if it is raining, place the thermometer where the rain strikes it directly.

2.04 Underground and Buried Cable: For underground cable in conduit or buried cable, temperature measurements, when required, generally need be made at only a few of the points where pressure readings are taken. For tests on individual reel lengths after placing, and loading sections during construction of a cable, a measurement of temperature at one point along the section is sufficient. For tests on a completed gas section, temperature measurements can be made at intervals of 12,000 to 18,000 feet, for instance, at the location of the routine reading valves of the gas section.

2.05 To measure the temperature of underground cable, fasten the thermometer to duct rods or tree pruner handles and insert 6 to 9 feet inside a duct near that containing the cable to be measured. In the event that the cable in the conduit is submerged in water, suspend the thermometer under water in the manhole at approximately the same level as the cable.

2.06 Temperature measurements on buried cable can be made by burying the thermometer in the ground near the cable, with the bulb at least 12 inches below the ground line but preferably at the approximate depth of the cable, or insert the thermometer in a hole one to two feet in depth formed by driving a rod or bar into the ground about 10 feet to the side of the cable line. If a buried thermometer well is provided,

suspend the thermometer in the well, wait about 5 minutes, then withdraw the thermometer and immediately observe its reading.

2.07 Nitrogen Cylinders: When measuring the temperature of a nitrogen cylinder, the thermometer should be placed in a vertical position alongside the cylinder. If the cylinder is in the sun, the thermometer should be on the sunny side with its tube facing the sun. If the cylinder is in the rain, the thermometer should be placed so that the rain strikes it directly. If the cylinder has been moved recently, time should be allowed to permit it to come to air temperature before the temperature measurement is made.

2.08 When measuring cylinder volume in connection with gas flow resistance tests, more accurate results will be obtained if the cylinder is kept in the shade, the thermometer being suspended in the shade adjacent to the cylinder.

3. CORRECTION FOR CABLE TEMPERATURE

3.01 Measured cable pressures can be converted to their equivalent values at the reference temperature of 60° F., or to any other temperature by use of Table 1, or by use of the pressure testing rule. Instructions for the use of the rule are printed on its face.

3.02 The table and the rule graduations are based on the variation of absolute pressure with temperature, but are expressed in terms of average gauge pressure at sea level. An error results when the table or rule is used to convert pressure readings taken at higher elevations. However, the error introduced is small (less than .1 pound) and may be neglected in the usual gas pressure maintenance operations requiring temperature correction.

TABLE NO. 1

Cable Temp. Degrees F.	Equivalent Gauge Pressures at Various Temperatures (Assuming normal sea level atmospheric pressure of 30 inches mercury or 15 pounds pressure.)											
	Pressure in Cable - Pounds per Square Inch (Equivalent Pressures at Various Temperatures Shown in Vertical Columns)											
	4.7	5.8	6.9	8.0	9.1	10.2	11.3	12.4	13.5	14.6	15.7	16.8
110	4.7	5.8	6.9	8.0	9.1	10.2	11.3	12.4	13.5	14.6	15.7	16.8
105	4.5	5.6	6.7	7.8	8.9	10.0	11.1	12.1	13.2	14.3	15.4	16.5
100	4.4	5.4	6.5	7.6	8.7	9.7	10.8	11.9	13.0	14.1	15.1	16.2
95	4.2	5.3	6.3	7.4	8.5	9.5	10.6	11.7	12.7	13.8	14.9	15.9
90	4.0	5.1	6.1	7.2	8.3	9.3	10.4	11.4	12.5	13.5	14.6	15.7
85	3.9	4.9	5.9	7.0	8.0	9.1	10.1	11.2	12.2	13.3	14.3	15.4
80	3.7	4.7	5.8	6.8	7.8	8.9	9.9	11.0	12.0	13.0	14.1	15.1
75	3.5	4.5	5.6	6.6	7.6	8.7	9.7	10.7	11.7	12.8	13.8	14.8
70	3.3	4.4	5.4	6.4	7.4	8.4	9.5	10.5	11.5	12.5	13.5	14.6
65	3.2	4.2	5.2	6.2	7.2	8.2	9.2	10.2	11.2	12.3	13.3	14.3
60	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0
55	2.8	3.8	4.8	5.8	6.8	7.8	8.8	9.8	10.8	11.7	12.7	13.7
50	2.7	3.6	4.6	5.6	6.6	7.6	8.5	9.5	10.5	11.5	12.5	13.4
45	2.5	3.5	4.4	5.4	6.4	7.3	8.3	9.3	10.3	11.2	12.2	13.2
40	2.3	3.3	4.2	5.2	6.2	7.1	8.1	9.0	10.0	11.0	11.9	12.9
35	2.1	3.1	4.1	5.0	6.0	6.9	7.9	8.8	9.8	10.7	11.7	12.6
30	2.0	2.9	3.9	4.8	5.7	6.7	7.6	8.6	9.5	10.5	11.4	12.3
25	1.8	2.7	3.7	4.6	5.5	6.5	7.4	8.3	9.3	10.2	11.1	12.1
20	1.6	2.6	3.5	4.4	5.3	6.3	7.2	8.1	9.0	9.9	10.9	11.8
15	1.5	2.4	3.3	4.2	5.1	6.0	7.0	7.9	8.8	9.7	10.6	11.5
10	1.3	2.2	3.1	4.0	4.9	5.8	6.7	7.6	8.5	9.4	10.3	11.2
5	1.1	2.0	2.9	3.8	4.7	5.6	6.5	7.4	8.3	9.2	10.1	11.0
0	1.0	1.8	2.7	3.6	4.5	5.4	6.3	7.1	8.0	8.9	9.8	10.7
-5	0.8	1.7	2.5	3.4	4.3	5.2	6.0	6.9	7.8	8.7	9.5	10.4
-10	0.6	1.5	2.3	3.2	4.1	4.9	5.8	6.7	7.5	8.4	9.3	10.1

4. CORRECTION FOR CYLINDER TEMPERATURE

4.01 The pressure of the gas in a cylinder varies with temperature. Cylinder pressure is indicated by the high pressure gauge of the regulator. This gauge is also calibrated to indicate the volume of nitrogen contained in the cylinder in equivalent cubic feet of gas reduced to average sea level pressure and 60° F. Readings taken at other cylinder temperatures are in error. When the cylinder temperature is higher than 60° F., the reading is high; when the cylinder temperature is lower than 60° F., the reading is low.

4.02 At temperatures other than 60° F., indicated volumes on the high pressure gauge of the regulator can be converted to equivalent volumes at 60° F. by the use of Table 2.

TABLE 2

Temp. Deg. F.	Equivalent Volume of Gas in 220 Cubic Foot Cylinder Cubic Feet at Normal Sea Level Atmospheric Pressure and 60°F.																			Temp. Deg. F.			
	34	46	57	68	80	91	103	115	126	138	149	161	173	185	196	208	220	230	240		250	2590	
125	34	46	57	68	80	91	103	115	126	138	149	161	173	185	196	208	220	230	240	250	2590	125	
120	34	45	56	67	79	90	102	113	125	137	148	159	171	183	194	206	217	2200	2310	2440	2500	2560	120
115	34	45	56	67	78	90	101	112	124	136	147	158	170	181	192	204	215	2180	2290	2410	2470	2530	115
110	33	44	55	66	78	89	100	111	122	134	145	156	168	179	190	201	213	224	2270	2380	2440	2510	110
105	33	44	55	66	77	88	99	110	121	133	144	155	166	177	188	199	211	222	2240	2360	2420	2480	105
100	33	44	54	65	76	87	98	109	120	131	142	153	164	176	186	197	208	220	2220	2330	2390	2450	100
95	32	43	53	64	76	86	97	108	119	130	141	151	163	174	184	195	206	217	2190	2300	2360	2420	95
90	32	43	53	64	75	85	96	107	118	129	139	149	161	172	182	193	204	215	225	2270	2330	2390	90
85	32	42	52	63	74	85	95	106	116	127	138	148	159	170	180	191	201	212	222	2250	2300	2360	85
80	31	42	52	63	73	84	94	105	115	126	136	146	157	168	178	189	199	210	220	2220	2270	2330	80
75	31	41	51	62	72	83	93	103	114	124	135	145	155	166	176	187	197	207	217	2200	2250	2300	75
70	31	41	51	61	71	82	92	102	112	123	133	143	154	164	174	185	195	205	215	225	2220	2280	70
65	30	40	50	61	71	81	91	101	111	121	131	141	152	162	172	182	192	203	213	223	2200	2250	65
60	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	225	2220*	60
55	30	40	49	59	69	79	89	99	109	119	129	138	148	158	168	178	188	198	207	217	222	2190	55
50	29	39	49	59	69	78	88	98	107	117	127	137	146	156	166	176	185	195	205	215	220	225	50
45	29	39	48	58	68	77	87	97	106	116	126	135	145	154	164	174	183	193	202	212	217	222	45
40	29	38	48	57	67	77	86	95	105	115	124	133	143	152	162	171	181	190	199	209	214	219	40
35	28	38	47	57	66	76	85	94	104	113	122	132	141	150	159	169	179	188	197	207	211	216	35
30	28	37	47	56	65	75	84	93	102	112	121	130	139	148	157	167	176	185	194	204	209	213	30
25	28	37	46	55	65	74	83	92	101	110	119	129	138	147	155	165	174	183	192	201	206	210	25
20	27	36	46	55	64	73	82	91	100	109	118	127	136	145	153	162	171	180	189	198	203	207	20
15	27	36	45	54	63	72	81	89	99	108	116	125	134	143	151	160	169	178	187	195	200	204	15
10	27	36	45	53	62	71	80	88	97	106	115	123	132	141	149	158	167	175	184	193	197	201	10
5	26	35	44	53	62	70	79	87	96	105	113	121	130	139	147	156	164	173	181	190	194	198	5
0	26	35	43	52	61	69	78	86	95	103	111	120	129	137	145	153	162	170	179	187	191	195	0
-5	26	34	43	51	60	68	77	85	93	102	110	118	127	135	143	151	159	168	176	184	189	192	-5
-10	25	34	42	51	59	67	76	84	92	100	109	117	125	133	141	149	157	165	173	181	186	189	-10

*2220 pounds, 60°F. = 230 cu. ft.

Instructions -

- (1) Read across line representing measured cylinder temperature and determine column in which observed volume reading appears on that line. Then read vertically in column to line representing 60°F. cylinder temperature. True volume of atmospheric gas in cylinder appears in column opposite 60°F. temperature.
- (2) The volume scale of the high pressure gauge does not extend above 225 cubic feet. To obtain volume readings above end of scale, observe cylinder pressure and read across line representing measured cylinder temperature to column in which observed pressure reading appears on that line. Then proceed as in (1).