BELL SYSTEM PRACTICES
Outside Plant Construction and Maintenance

SECTION G73.305.1
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AT&T Co Standard

PRESSURE TESTING
CHARGING CABLES WITH GAS

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1. GENERAL

1.01 This section covers the procedures to be followed in charging cables with gas either initially or to replace gas lost through sheath or splice openings or normal loss in a gas section. This information was formerly contained in Section G73.240, Issue 1, which is cancelled.

2. GAS CAPACITY OF CABLES

2.01 The number of cubic feet of gas that a length of cable will hold depends on the desired pressure and the diameter of the cable. The gas capacity will vary slightly with differences in make-up, layup and insulating materials of the cable. In general, from 50 to 70 per cent of the volume inside a cable is air space.

2.02 The following table has been prepared to indicate the number of cubic feet of gas required to raise the pressure of 1000 feet of cable by one pound for cables of various diameters. The values are for cables with average gas capacities. The capacities will be somewhat higher for cables containing coaxials or large gauge conductors and lower for small gauge exchange type cables. The values shown, however, are sufficiently accurate for practical purposes.

Diameter of Cable Over Sheath (Inches)	Gas Required to Raise Pressure by One Pound in 1000 Feet of Cable (Cubic Feet)
3/4	.1
1	.2
1-1/4	.4
1-1/2	.5
1-3/4	.6
2	.8
2-1/4	1.0
2-1/2	1.3
2-3/4	1.6
3	1.9
3-1/4	2.2

2.03 The gas capacity values given in the above table represent cubic feet of nitrogen gas measured at 60° F. and normal sea level atmospheric pressure.

2.04 Following is an example in the use of the table. It is desired to raise the average pressure in a subsection 15,000 feet long from 3.8 pounds to 7.0 pounds or an increase of 3.2 pounds. The cable has a diameter of 2 inches and consequently a capacity of .8 cu. ft. per 1000 ft. per lb. pressure. Therefore, $.8 \times 15 \times 3.2 = 38.4$ cu. ft. required.

3. MEASUREMENT OF CUBIC FEET OF GAS

3.01 The high pressure gauge of the standard regulator furnishes a satisfactory means of measuring the cubic feet of gas used during pressure testing work. This gauge has a scale showing the cubic foot content of the cylinder at 60° F. and normal sea level pressure.

3.02 The number of cubic feet of gas used during a charging operation can be determined by a comparison of the readings in cubic feet at the start and end of the charging period. For cylinder temperatures other than 60°F. the readings should be corrected to 60° F. as described in the sections on correction of pressure measurements.

4. PRESSURE TO WHICH CABLE IS CHARGED

4.01 The average pressure desired in a cable after charging has been completed varies with cable temperature. The following table gives the desired, the maximum, and the min-

imum average pressure to which cables should be charged for various temperatures under normal atmospheric pressure. The table covers cable maintenance pressures of both 6.0 and 9.0 pounds.

CHARGING TABLE

Cable Temp. Degrees Fahrenheit	For Cables Maintained at 6 Lbs.			For Cables Maintained at 9 Lbs.			Cable Temp. Degrees Fahrenheit
	Not Less Than	Desired	Not More Than	Not Less Than	Desired	Not More Than	
110	6.9	8.0	9.1	10.2	11.3	12.4	110
105	6.7	7.8	8.9	10.0	11.1	12.1	105
100	6.5	7.6	8.7	9.7	10.8	11.9	100
95	6.3	7.4	8.5	9.5	10.6	11.7	95
90	6.1	7.2	8.3	9.3	10.4	11.4	90
85	5.9	7.0	8.0	9.1	10.1	11.2	85
80	5.8	6.8	7.8	8.9	9.9	11.0	80
75	5.6	6.6	7.6	8.7	9.7	10.7	75
70	5.4	6.4	7.4	8.4	9.5	10.5	70
65	5.2	6.2	7.2	8.2	9.2	10.2	65
60	5.0	6.0	7.0	8.0	9.0	10.0	60
55	4.8	5.8	6.8	7.8	8.8	9.8	55
50	4.6	5.6	6.6	7.6	8.5	9.5	50
45	4.4	5.4	6.4	7.3	8.3	9.3	45
40	4.2	5.2	6.2	7.1	8.1	9.0	40
35	4.1	5.0	6.0	6.9	7.9	8.8	35
30	3.9	4.8	5.7	6.7	7.6	8.6	30
25	3.7	4.6	5.5	6.5	7.4	8.3	25
20	3.5	4.4	5.3	6.3	7.2	8.1	20
15	3.3	4.2	5.1	6.0	7.0	7.9	15
10	3.1	4.0	4.9	5.8	6.7	7.6	10
5	2.9	3.8	4.7	5.6	6.5	7.4	5
0	2.7	3.6	4.5	5.4	6.3	7.1	0
-5	2.5	3.4	4.3	5.2	6.0	6.9	-5
-10	2.3	3.2	4.1	4.9	5.8	6.7	-10

4.02 It is important not to admit an excessive amount of gas to a cable which would raise the average cable pressure above the maximum values given in the table. Excessive pressure may cause bulging of the sheath or lead sleeves, and splitting of soldered seams.

5. SELECTION OF CHARGING POINTS

5.01 In a gas section, the valves selected as charging points should be approximately equally spaced and should be 12,000 to 18,000 feet apart.

5.02 To select the location of charging points, first determine the total length of the gas section and decide upon the proper number of charging points. Then, divide the total length of the gas section by the number of charging points to find the length of subsection which is to be charged from each point. Select an accessible valve near the middle of each subsection as the charging point for that subsection. Generally, the same valves in a gas section will be used for both routine readings and periodic charging of the section.

5.03 On twin cable and multi-cable routes it is advisable to use the same charging points for all the cables.

6. NORMAL CHARGING METHOD

6.01 The normal method of charging is to connect a cylinder of gas to the cable at each charging point, with regulator adjusted to the desired cable pressure. The cylinders are left connected until the cable has equalized, as nearly as practicable, at that pressure. It is not necessary to return to the charging points at a specified time to disconnect the cylinders.

6.02 The procedure for normal charging is as follows:

(1) Determine the cable temperature and existing barometer reading.

(2) Refer to the Charging Table in Part 4 and determine the **maximum** average pressure to which the cable should be charged for the measured temperature. On aerial cable the charging pressure should be based on the average cable temperature expected during the period of charging.

(3) Correct this charging pressure for existing atmospheric pressure as described in the sections on correction of pressure measurements.

(4) At each charging point, adjust the regulator pressure under a no flow condition to the corrected charging pressure determined in (3) above.

(5) Continue the charging for several days or longer until the pressure in the cable measured at valves approximately midway between the charging points and adjacent to the ends of the section has reached a value about equal to the charging pressure. The cylinders may be disconnected whenever the measured pressure is within one-half pound of the charging pressure.

6.03 Where two cables forming a circular section are involved, the gas may be admitted to both cables at the same time using a T connection with two admission hoses at the regulator.

6.04 For gas sections located in terrain appreciably above sea level the pressures given in the Charging Table in Part 4 are applicable at the elevation of the lowest valve point. This elevation is established as the "base elevation" of the section. When the cable is charged from valves at elevations more than 150 feet above this base elevation the charging pressure should be corrected for the difference in elevation as described in the sections on correction of pressure measurements.

7. ACCELERATED CHARGING METHOD

7.01 Accelerated charging is used where it is desired to admit the volume of gas required to charge the cable as quickly as practicable, such as during the course of one work day. Generally, normal charging is the preferred method, however, the accelerated method is advantageous when there are not sufficient cylinders and regulators available to permit leaving them connected to a gas section for the time required for normal charging, and also at remote locations where considerable travel time is required and it is desired to complete the charging operation during one trip.

7.02 The accelerated method should not be used to charge short lengths of cable or small diameter cables which have small gas capacity. Serious charging errors might occur due to the inaccuracy of the method of measuring the volume of gas when only a few cubic feet are involved.

7.03 When the accelerated method is used, charging points should not be located less than about 3000 feet from a contactor or plug because of damage which might result from the higher pressure employed in this method.

7.04 In the case of accelerated charging the amount of gas to be admitted at each charging point is calculated and regulator pressures up to 20 pounds are used. The cylinders are

disconnected when the calculated volume of gas has been admitted to the cable.

7.05 The procedure for accelerated charging is as follows:

(1) Measure the cable pressure and temperature at the charging point. Obtain the barometer reading from a nearby source.

(2) Refer to the Charging Table in Part 4 and determine the **desired** average pressure to which the cable should be charged for the measured temperature. Correct this desired pressure for existing atmospheric pressure as described in the sections on correction of pressure measurements.

(3) Subtract the measured pressure from the desired pressure to determine the amount the pressure is to be raised. Calculate the number of cubic feet of gas required to raise the cable pressure this amount for the length of subsection covered by the charging point as described in Part 2.

(4) Note the cubic contents of the cylinder as indicated on the regulator and start charging the cable at a regulator pressure not to exceed 20 pounds. Disconnect the cylinder when the calculated amount of gas has been admitted.

7.06 The time required to complete charging at each point depends upon the cable pressure and number of cubic feet of gas to be admitted. Generally, the charging will be completed in 2 to 4 hours time. Failure to disconnect the cylinders when the required volume of gas has been admitted will result in overcharging and excessive average cable pressure which may damage sheath or lead sleeves. The charging is considered satisfactory if the average pressure in the section, measured several days after charging, is within the allowable limits given in the Charging Table in Part 4.