BELL SYSTEM PRACTICES
Outside Plant Construction and Maintenance

SECTION G73.005.1
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AT&T Co Standard

PRESSURE TESTING
GENERAL
DESCRIPTION OF TESTS AND SYSTEMS

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1. GENERAL

1.01 This is a new section which describes in general terms for informational purposes the various pressure tests and pressure testing systems that are available for placing and maintaining cables under gas pressure.

1.02 A detailed description of the materials, equipment and methods used in pressure testing is contained in other sections of the G73 Division. The tools employed in pressure testing work are described in the G80 Division.

1.03 The engineering considerations and procedures to be followed in the actual design and layout of pressure testing systems are covered in another series of Bell System Practices. Questions regarding the engineering and layout of pressure systems should be referred to the engineer.

2. PURPOSE OF PRESSURE TESTING

2.01 Major sheath damage, which usually results from such causes as bullets, foreign workmen, fires, electrical burns, etc., is generally accompanied by conductor trouble. In such cases the sheath damage can be located by means of electrical tests on the damaged conductors. Gas pressure will not prevent this type of trouble but it will minimize service interruptions on undamaged conductors by reducing or eliminating associated moisture trouble.

2.02 Sheath openings in the cable which result from causes such as sheath crystallization, ring cuts, porous solder work, electrolysis or other corrosion, etc., are not generally accompanied by mechanical damage to the conductors. These types of sheath openings, which constitute a large majority of the total sheath openings that occur in cable plant, can usually be detected and located by gas pressure testing methods before moisture enters and causes conductor troubles.

2.03 The purpose of pressure testing can be summarized as follows:

(a) To provide means of detecting and locating sheath openings so that repairs can be made before service is affected.

(b) To provide protection against the entrance of moisture when sheath openings occur and thus prevent or minimize service interruptions.

(c) To provide warning by means of an alarm system that a sheath opening has occurred so that repairs can be made before service is affected.

3. TYPES OF PRESSURE TESTS

3.01 Pressure tests can be divided into (1) tests to detect the presence of sheath openings and (2) tests to locate such openings for repair.

Tests to Detect Leaks

3.02 There are two tests of this type. The first is by flash testing a particular item or section of plant, such as a wiped joint or soldered seam, a limited area of cable sheath, or a load coil case and stub. It is done by admitting gas to build up an internal pressure, brushing a testing solution on the surface to be tested, and then visually inspecting the film formed by the solution for the formation of bubbles produced by the escape of gas.

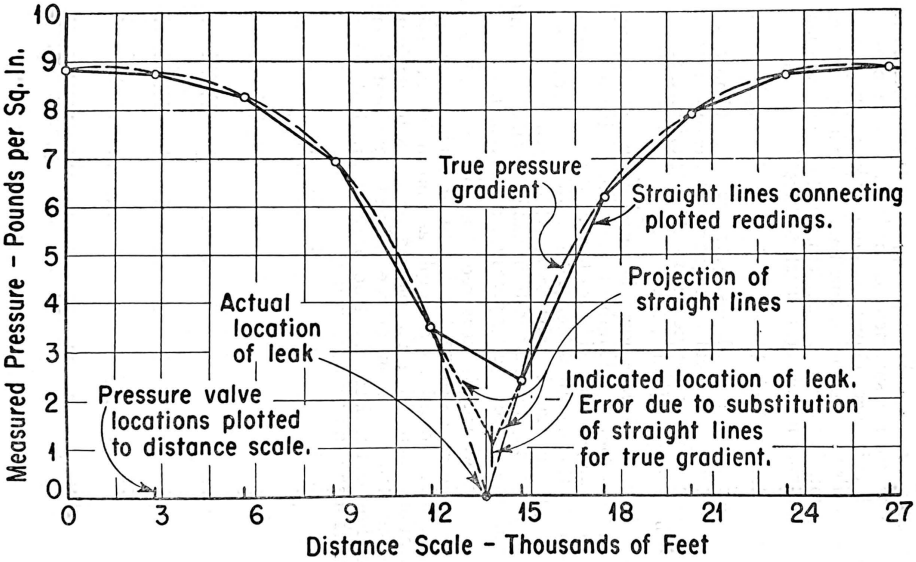
3.03 The second type of test to detect leaks is used where large or inaccessible surface areas are involved, such as individual reel lengths or spliced lengths of cable. This test is made by sealing all known openings in the cable and then admitting gas to build up an internal pressure which is measured accurately. After an appropriate interval of time a second pressure measurement is made. A loss in pressure indicates the existence of one or more leaks in the cable. This method is also applicable to small units of plant, such as load coil cases and is the more reliable method of detecting leaks, as small leaks may be missed in flash testing.

Tests to Locate Leaks

3.04 Detection by flash testing provides a definite location of the leak. Leaks detected by pressure loss usually require approximate location before applying testing solution as the final step in finding them.

3.05 In general, leak locating tests are based on the principle that if a length of cable containing a leak is allowed to stand, the gas will flow toward the leak through which it escapes into the atmosphere. This results in decreasing cable pressure as the leak is approached, the pressure being lowest at the leak. Leak locating tests in cable depend on finding the point of lowest pressure by pressure measurements.

3.06 The pressure is measured at a number of valves spaced at intervals along the length of cable under test and the readings plotted on a graph as shown in the following illustration. Connecting the plotted points with straight lines gives an approximation of the pressure gradient along the cable. For comparison, the true pressure gradient, which is a curve, is also shown on the graph.


Measured Pressure - Pounds per Sq. In.
10
9
8
7
6
5
4
3
2
1
0
0
3
6
9
12
15
18
21
24
27
Distance Scale - Thousands of Feet
True pressure gradient
Straight lines connecting plotted readings.
Projection of straight lines
Actual location of leak
Indicated location of leak. Error due to substitution of straight lines for true gradient.
Pressure valve locations plotted to distance scale.

4. PRESSURE TESTS DURING CONSTRUCTION

4.01 Certain pressure tests are desirable during the construction of cables to be maintained under pressure. The loss in pressure resulting from a small leak in a container of small volume is much more pronounced than the loss in pressure produced by the same size leak in a container of large volume. Small leaks that would be difficult to detect and locate in completed plant can be easily detected if the units containing them are tested before splicing.

4.02 Check tests before and after placing and before splicing of cable and load coil cases, which have been put under pressure at the factory, will indicate any pressure loss due to leakage and the leaks can be located before moisture can enter. Solder work can be flash tested as it is completed, with little additional effort since no additional travel or setup time is involved.

5. PRESSURE TESTING SYSTEMS

5.01 There are three basic types of pressure testing systems for cable maintenance purposes which differ in amount of preparatory work and equipment required and in degree of protection provided to the cable plant. Variations of these systems are frequently engineered to meet specific plant and operating conditions.

Periodic Flash Testing

5.02 This system of testing consists of a periodic application of gas pressure followed by a solution test, to make a quick check of the gas tightness of the accessible portions of cable plant that are most likely to leak.

5.03 Since flash testing merely requires a temporary pressure build up in a short length of cable, a minimum of preparatory work is necessary. Pressure plugs are not usually provided in this system. Flash testing is generally employed where conditions do not warrant doing the work necessary to seal the cable as would be required in setting up a continuous pressure system. Its major field of use is in exchange cable plant.

5.04 Flash testing does not provide a test of areas not actually solution tested. Since the gas is allowed to escape from the cable following the test it provides no sustained protection against the entrance of moisture.

Continuous Pressure without Alarm

5.05 The first requirement in establishing a continuous pressure system is to install gas plugs at the end of the main cable and in all branches and to install valves at intervals for testing purposes. Gas is then admitted to the section to establish a continuous pressure.

5.06 A reservoir consisting of one or more cylinders of gas or a compressor-dehydrator unit is connected to the cable, preferably in the cable vault of an attended office where it is available for inspection. The reservoir supplies gas as required to compensate for the loss through leakage, and maintains a constant pressure at the admission point. From there to the distant end of the cable, the pressure decreases at each point of leakage, the total drop depending upon the size and number of leaks.

5.07 Since the maximum pressure at the reservoir end is limited by cable sheath strength, it is necessary to eliminate a sufficient number of leaks so that adequate cable pressure for protection purposes is maintained at the distant end of the cable.

5.08 The main feature of this system is that it provides continuous protection for all portions of the cable. Leak location and repair is necessary only to the extent required to obtain adequate pressure at the distant end of the cable. The latter feature is important since the location of leaks becomes increasingly difficult as their size decreases. The cost of the gas lost through a small leak, even over a long period of time, may be much less than the cost of locating and eliminating the leak, particularly for underground cable as replacement of a section is frequently the only practical means of repair.

5.09 After a system of this type is in operation any change in conditions, such as a new leak or enlargement of an old leak, will be indicated by an increase in the rate of gas usage or decrease in pressure at the distant end. Frequent observations by maintenance forces are necessary to ensure that the development of a serious leak does not deplete the supply of gas in the cable and reservoir before the leak is located and cleared.

Continuous Pressure with Alarm

5.10 Continuous pressure systems are more effective if means are provided to give automatic indication of dangerous decrease in cable pressure. This is done by equipping the cable with one or more pressure contactors connected to an alarm in an attended office by means of a cable pair. When the pressure

at a contactor falls below the operating value to which it is adjusted, the contactor short-circuits the pair and operates the alarm in the office. If more than one contactor is connected to the alarm pair, measurement of loop resistance on the pair indicates which contactor has operated.

5.11 In addition to the alarm pair, a cableman's talking pair is provided in the first cable to be placed under pressure on a route. Access to this pair is provided by terminal facilities at each contactor point. A high pressure type contactor is also available for connection to reservoir cylinders to signal depletion of reservoir supply.

5.12 Successful alarm circuit operation requires that the cable be sufficiently free of leaks to permit fairly uniform pressure equalization throughout its length. Alarm circuits are, therefore, most practicable in cables whose sheath is either relatively free from leaks or can be made so.

5.13 After a continuous pressure system with alarm is placed in operation the development of a serious leak will be signaled by operation of a contactor and the associated office alarm. Except for investigating contactor alarms, observations by the maintenance forces are not necessary. The cable is recharged with gas at regularly scheduled intervals to replace gas lost through normal seepage (minute leaks distributed along the cable) and maintain adequate operating pressure.