

BELL SYSTEM PRACTICES
Outside Plant Construction
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PRESSURE TESTING

PRECISION LEAK LOCATING PROCEDURE

Contents	Page
1. General	1
2. Cable Pressure	2
3. Size of Leak	2
4. Preparatory Work	2
5. Making Precision Measurements	3
6. Plotting Time-Pressure Curves	4
7. Plotting Leak Location Gradient	4
8. Computing Leak Location	5

1. GENERAL

1.01 This section covers the procedures to be followed in obtaining data with the FA-176021 Wallace and Tiernan Manometer for accurate leak location in underground and buried cable. The section also outlines the conditions under which precision leak locating methods are applicable and describes the preparations necessary for making such tests.

1.02 In order to obtain good results with precision leak location apparatus the tester must be thoroughly familiar with the operation of the apparatus used and he must follow the prescribed methods of leak location covered in this and other related sections. The operation of the FA-176021 W. & T. Manometer is described in the G80 division of this series.

1.03 These methods are applicable to the location of small and medium leaks in underground and buried cables in which a constant cable temperature can be depended upon while the pressure measurements are being made.

1.04 If the measurements are made accurately and the corrections and plotting work are done carefully, the fault locations should be good enough to permit repairs by excavating at the indicated location.

2. CABLE PRESSURE

2.01 In order to be within the range of the precision manometer scale, which is 19 to 24 pounds per square inch absolute pressure, the maximum and minimum gauge pressures of the section of cable under test must be within the values indicated below.

<u>Cable Elevation</u>	<u>Gauge Pressure</u>	
	<u>Maximum</u>	<u>Minimum</u>
Sea Level	9.3	4.3
1000 feet	9.8	4.8
2000 "	10.3	5.3
3000 "	10.8	5.8
4000 "	11.3	6.3
5000 "	11.8	6.8
6000 "	12.3	7.3

2.02 The term "gauge pressure" refers to pressure measurements made with a 3-1/2-inch gauge or mercury manometer which measure the difference between absolute cable pressure and atmospheric pressure.

3. SIZE OF LEAK

3.01 The precision manometer can be read with an accuracy of $\pm .001$ psi. Considerable error in leak location may occur if the pressure gradient caused by the leak is too flat.

3.02 Accurate location of leaks is possible if the leak gradient has a slope of about .015 psi or more in 500 feet. Gradients having a slope of .010 psi or less in 500 feet can not be depended upon.

3.03 When locating a small leak which has a relatively flat gradient, it is desirable to charge the cable to a pressure value near the maximum range of the instrument before making the final pressure readings. The use of the higher cable pressure will steepen the slope of the gradient and permit a more accurate leak location.

4. PREPARATORY WORK

4.01 **Preliminary Leak Location:** The precision manometer should not be employed without first making a preliminary leak location as described in the section on leak location procedures. A mercury manometer or instrument of comparable accuracy should be used for these tests.

4.02 In underground cable, flow measurements should then be made in the manhole at each side of the preliminary leak location with a B flow indicator in order to verify the conduit section containing the leak.

4.03 **Temporary Valves:** Temporary short-spaced valves should be installed on each side of the preliminary leak location as described in the section on making pressure readings. In buried cable, flow measurements can be made at this time at the temporary valve on each side of the preliminary location to verify the section containing the leak.

4.04 Sufficient time should be allowed after installing the valves to assure that normal temperature conditions surrounding the cable have been reestablished and that the cable pressure has stabilized before proceeding with the test. If the preliminary measurements indicate that the cable pressure is low the cable should be charged to a higher value near the maximum range of the instrument at the time the temporary valves are installed. Place the charging cylinders at the next regular valve point on each side of the temporary valve locations.

4.05 After the temporary valves have been installed take another set of readings with the mercury manometer or its equivalent, following the two-direction method, and plot the pressure gradient. This gradient should be examined carefully to make sure that the effects of charging have leveled off. Also check the gradient for irregularities which would indicate other leaks or obstructions at splices near the leak to be located.

4.06 **Valve Spacing:** If accurate measurements of the valve spacing are not available the measurements should be made using a surveyor's steel tape or a standard fabric measuring tape in good condition.

4.07 **Elevation at Valve Points:** The differences in elevation between the temporary valve points must be determined to the nearest foot.

5. MAKING PRECISION MEASUREMENTS

5.01 The preparation of the precision manometer for the test and the method of making the individual pressure readings is covered in the section in the G80 division describing the FA-176021 Wallace and Tiernan Manometer.

5.02 The time-pressure curves method of leak location which is described in another section should be followed in making the precision measurements.

5.03 The four sets of measurements required for the time-pressure curves should be made on the same day, preferably allowing about the same length of time for each set. The pressure drop between adjacent valves on successive sets of readings should be fairly uniform, that is, within about .001—.002 psi. If not uniform, an additional run is advisable if time allows, to permit discarding the run that is inconsistent.

6. PLOTTING TIME-PRESSURE CURVES

6.01 Prepare time-pressure curves of the pressure measurements as described in the section on the time-pressure curves method of leak location.

6.02 An 11-inch by 17-inch sheet of K and E Graph Paper No. 334-3G, or equivalent, should be used for preparing the time-pressure curves. This graph paper has 20 divisions per inch and a total of 200 vertical and 300 horizontal divisions.

6.03 Allow either one or two small blocks for each minute along the horizontal time scale. The larger scale is preferable if the measurements are completed within 2-1/2-hours time (150 minutes).

6.04 Use as large a scale as practicable for the vertical pressure scale. Select a scale so that the interval between the highest and the lowest pressure reading during the four sets of measurements will cover not less than 1/2 the total vertical scale. However, on very small leaks where the drop in pressure is small, do not use a scale larger than two small blocks for each .001 pound. A larger pressure scale will exaggerate small differences in pressure and make it harder to analyze the over-all appearance of the time-pressure curves.

7. PLOTTING LEAK LOCATION GRADIENT

7.01 If the time-pressure curves appear consistent, plot leak location gradients for two or three selected times as outlined in the section on the time-pressure curves method. Plot the gradients on a sheet of K and E Graph Paper No. 334-3G, or equivalent, using as large a scale as practical for pressure and distance on the graph. The indicated leak location will be the average of the leak intersections obtained from these gradients.

7.02 If differences in elevation of one foot or more exist between the lowest and highest valves at which measurements were taken, it is necessary to correct the pressure values selected from the time-pressure curves for these differences in altitude before plotting the leak location gradients.

The method of making altitude corrections is described in the section covering altitude correction for precise measurements.

8. COMPUTING LEAK LOCATION

8.01 Generally, it is desirable to compute the location of small and medium leaks before excavating and exposing the cable sheath. This is done in order to eliminate errors which may be introduced by inaccuracies in plotting the pressure gradient. The method of computing is described in another section.

8.02 Computation of a leak location should not be made without first plotting and analyzing the pressure gradient to determine the reliability of the pressure readings and the possible existence of disturbances or irregularities which may have distorted the pressure gradient.