CABLE LEAK LOCATING
HELIUM METHOD

CONTENTS PAGE

1. GENERAL

1.01 This practice describes the procedures and equipment needed to use the helium tracer gas leak location method for buried or underground pressurized plant.

1.02 This section is revised to include underground leak locating procedures using helium tracer gas. Revision arrows are used to emphasize the more significant changes.

1.03 The helium method consists of three steps:

(a) Initial gradient work ➧and transducer alarm indication➧ to establish the approximate location of the leak

(b) Charging the cable with helium

(c) Locating the leak, using the helium detector (standard B, E, F, or G gas indicator).

2. PRECAUTIONS

2.01 Helium has a lower breakdown strength than nitrogen or air and this necessitates the following precautions:

(a) Do ***not*** introduce helium into coaxial cables that have high voltages such as that used for repeater powering.

(b) Fill only as much cable with helium as needed to determine the leak location.

(c) Flush single sheath cable with nitrogen after using the helium method if the cable is in a lightning area.

(d) Do not use breakdown test sets on cables filled with helium.

(e) Follow procedures described in Section 637-300-100 for handling gas cylinders.

(f) ➧For ***underground plant,*** follow the procedures outlined in Section 620-140-501 covering testing and ventilating the manhole.➧

3. TOOLS AND MATERIAL

3.01 The following tools, in addition to those normally carried, are required to locate leaks using the helium gas method:

➧Sampling Probe (paragraph 3.02)—Buried Cable➧

Adapter, for connecting B or C Pressure

Regulator to helium cylinder (paragraph 3.04)

NOTICE

Not for use or disclosure outside the
Bell System except under written agreement

▶Portable Drill E/W carbide tip bit—Buried Cable◀

▶Hose (5 ft or longer) for connecting probe to Gas◀ Indicator.

3.02 ▶Sampling Probe (Buried Cable):◀ The sampling probe (Fig. 1) can be obtained through Western Electric from the manufacturers of either the B or E gas indicator, or can be made locally of 1/4-inch diameter metal tubing. The probe should have sampling holes drilled into the tube wall 2 inches from the tube end. The end of the probe should be solid to prevent plugging with dirt. A rubber ball 2 to 3 inches in diameter should be pierced by the probe and placed about 4 inches from the end. The rubber ball seals the top of the sample hole made in the earth.

3.03 ▶The 5-foot hose is used to interconnect the probe and the gas indicator as shown in Fig. 5. For underground application, the length requirement for the hose may vary with manhole depth. The sampling probe is not required for underground testing.◀

3.04 The adapter for connecting the female threaded B or C pressure regulator to the female threaded helium cylinder is generally available at local gas distributors.

3.05 ***Helium*** gas cylinders can be obtained locally, usually from a supplier that furnishes welding gasses. The helium should be commercial welding grade.

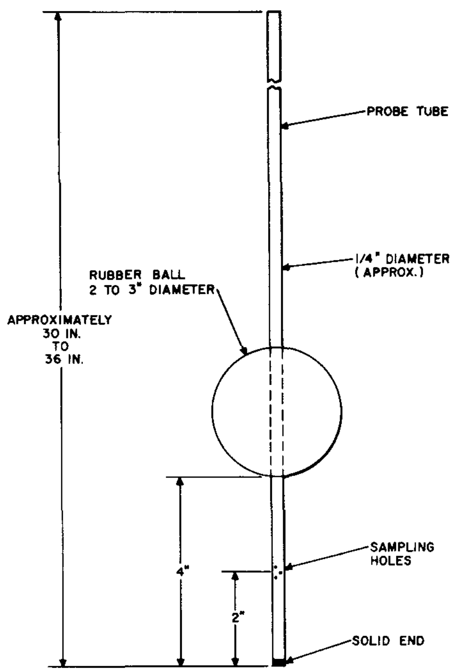

Fig. 1—Sampling Probe

4. PRELIMINARY GRADIENTS

4.01 ➧It is essential that accurate gradients of the cable pressure and transducer alarm data be obtained and analyzed prior to any helium location work. Preliminary gradients or transducer data will indicate the section of cable in which the leak is located. Accurate gradients can be obtained with the following guidelines:⬅

(a) Place nitrogen tanks on each side of the leak to obtain sharper gradients.

(b) Include at least two valve points between the nitrogen tank source and section with the indicated leak if this is possible.

(c) Make pressure measurements on aerial cable included in the gradient section early in the morning before the temperature changes disturb the gradient.

(d) Repeat gradient pressure readings until two successive series of readings point to approximately the same leak location.

(e) If any leaks are repaired, allow cable pressure to stabilize and regraph the gradients.

5. CHARGING CABLE WITH HELIUM

5.01 Helium is a nontoxic, inert gas very similar in flow characteristics to nitrogen and is introduced into a cable in the same manner. Helium is fed into the cable to replace the air or nitrogen.

5.02 For ***buried*** application, the helium will escape from the cable at leaks and diffuse through the soil. It can then be detected just below the earth surface with a helium detector (gas indicator and probe assembly).

5.03 ➧For ***underground*** application, the helium escapes from a splice closure or cable leaks inside the manhole and is detected, with the helium detector, at the manhole location.⬅

5.04 The B or C pressure testing regulator with a hose and chuck is connected to the helium tank by means of an adapter (paragraph 3.04). Set the low pressure side of the standard B or C pressure testing regulator at 12 psi. Check this pressure with a C pressure gauge. Feed helium into the cable at the valve point nearest the indicated position of the leak. (See Fig. 2.) At the other end of the cable section, bleed the cable by removing the core from the F valve (Fig. 2). If the gradients indicate that the leak is near a valve point and there is some uncertainty as to which side of the valve the leak is located, fill sections on each side of the valve with helium.

6. HELIUM CHARGING TIME—VALVE SPACING 1000 FEET OR LESS

6.01 For short sections (less than 1000 feet) of cable with nonzero leaks, fill the entire section of cable with helium. The cable section will be full when helium with a high concentration is detected (paragraph 8.02) at the bleed point. When this occurs replace the valve core to allow the pressure to build up.

6.02 The time required to push the air out of the cable should be about one hour for pulp core cables 1000 feet long and correspondingly less for cables of shorter length and for PIC core cables. A cable with a large leak may require more time to fill completely.

6.03 As soon as helium is detected at the bleed point, the leak location procedure can be started. Always begin leak locating near the helium source and work away from it to allow more time for helium to diffuse through the soil.

7. HELIUM CHARGING TIME—VALVE SPACING EXCEEDING 1000 FEET

7.01 Valve spacings on buried pressurized cable frequently exceed 1000 feet and spacings as long as 6000 feet have been noted. (When very long valve spacings are found, consider adding more permanent valves if this is feasible.) The time required to displace the air in the cable with helium is dependent on the square of the length. Hence, if it takes 1 hour to completely fill a pulp cable 1000 feet long, it will take about 36 hours to completely fill a cable 6000 feet long. The following methods determine when leak locating can begin without waiting for the entire cable section to fill with helium:

(a) Cable Volume Method

(b) Pneumatic Resistance Method.

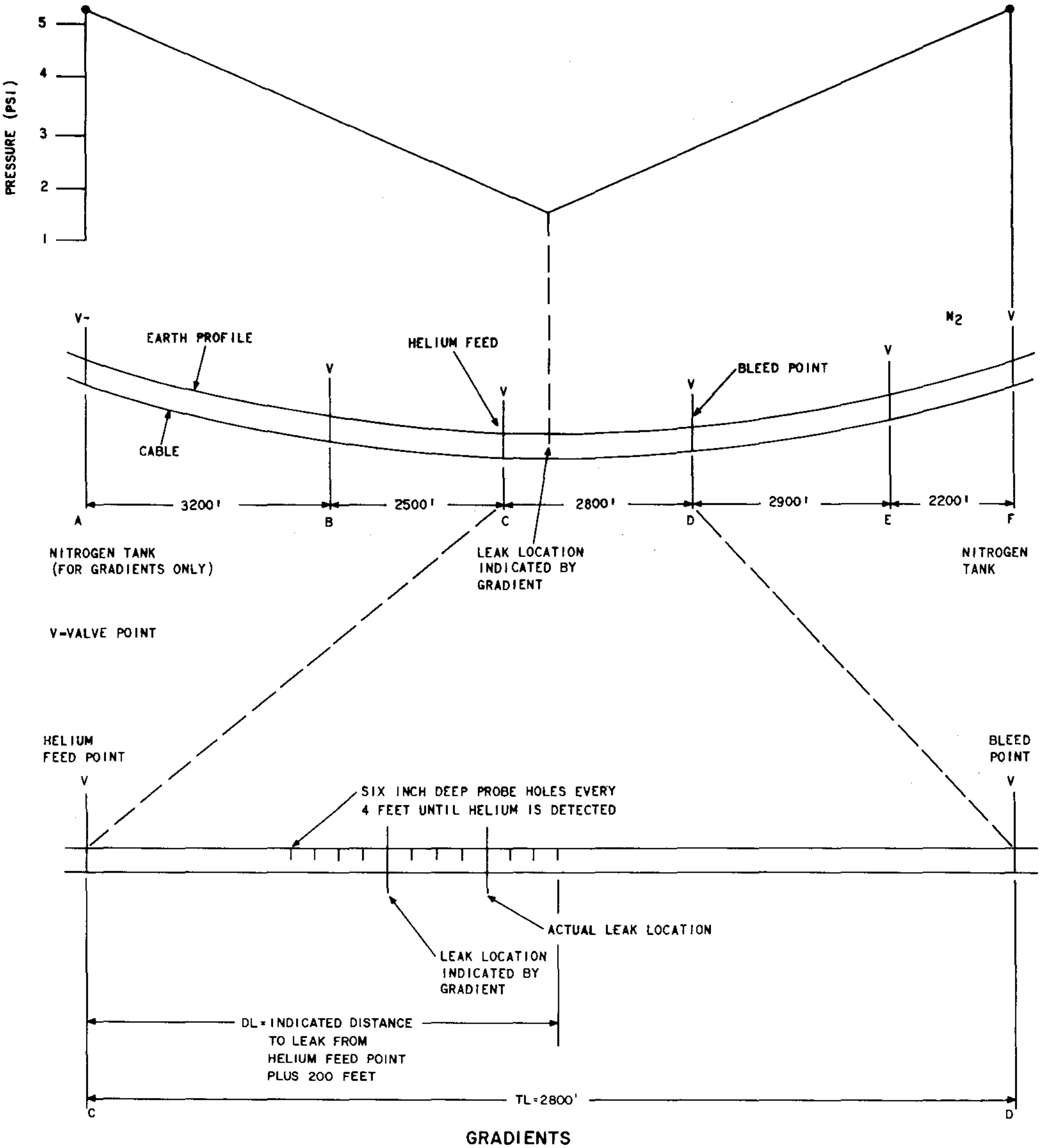

Fig. 2—Leak Locating—Helium Method

7.02 The following parameters are needed to determine when cable is charged with helium.

(a) Each method for determining when a long cable section is charged requires an approximate location of the leak with respect to the helium feed point. For the gradient graph (Fig. 2), determine the approximate distance from the expected placement of the helium feed point to the indicated leak location. Add 200 feet to this distance to allow for gradient error. This distance is called DL.

(b) The other parameters needed is the total length (TL) of the cable section from the helium feed point to the bleed point and the cable gauge and pair size.

Cable Volume Method

7.03 The cable volume method involves comparing the air volume in the cable core to be filled with the amount of helium fed into the cable. The procedure is as follows:

(1) Record the volume of helium in the tank from the high pressure gauge on the B or C pressure testing regulator before charging the cable.

(2) Determine the volume of helium that must be fed into the cable from the nomagraph in Fig. 3.

Note: This volume takes into account feeding in both directions and pressure of the gas.

(3) Begin leak locating when the volume of helium fed into the cable, as determined from the high pressure gauge, is equal to or greater than the volume read from the nomagraph in Fig. 3.

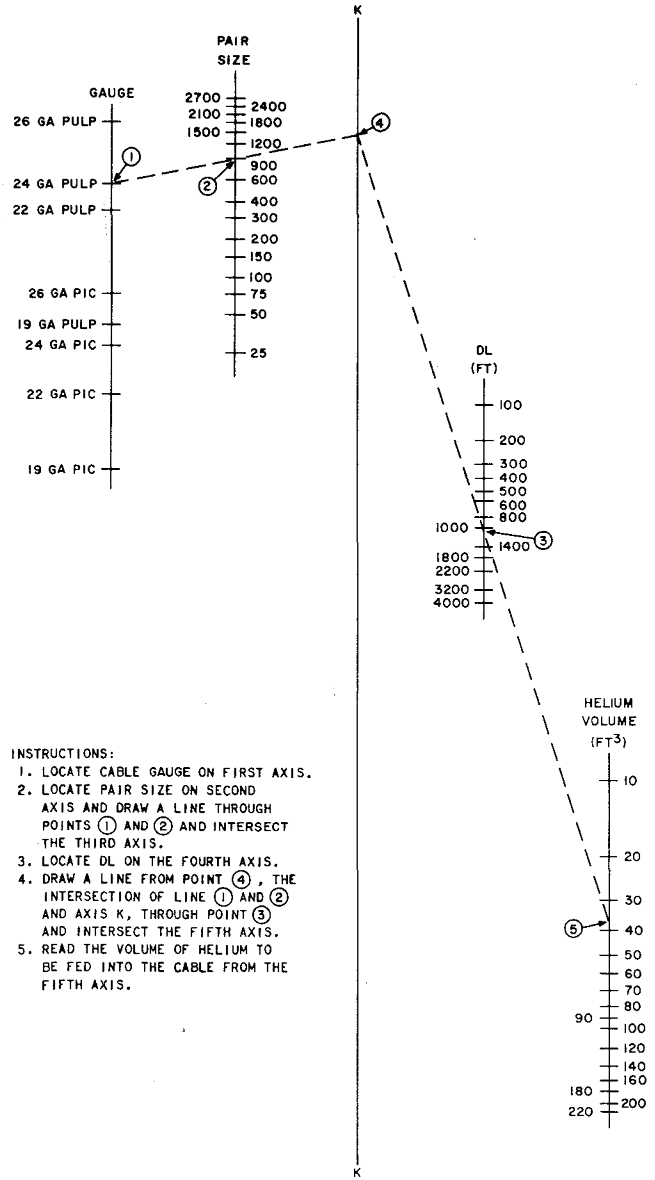

Fig. 3—Waiting Time—Cable Volume Method

Pneumatic Resistance Method

7.04 In this method the waiting time before leak location can begin is calculated. The advantage of using this method is that no one is required to wait on the job site while the cable is being charged with helium. To determine the waiting time, use the nomagraph in Fig. 4.

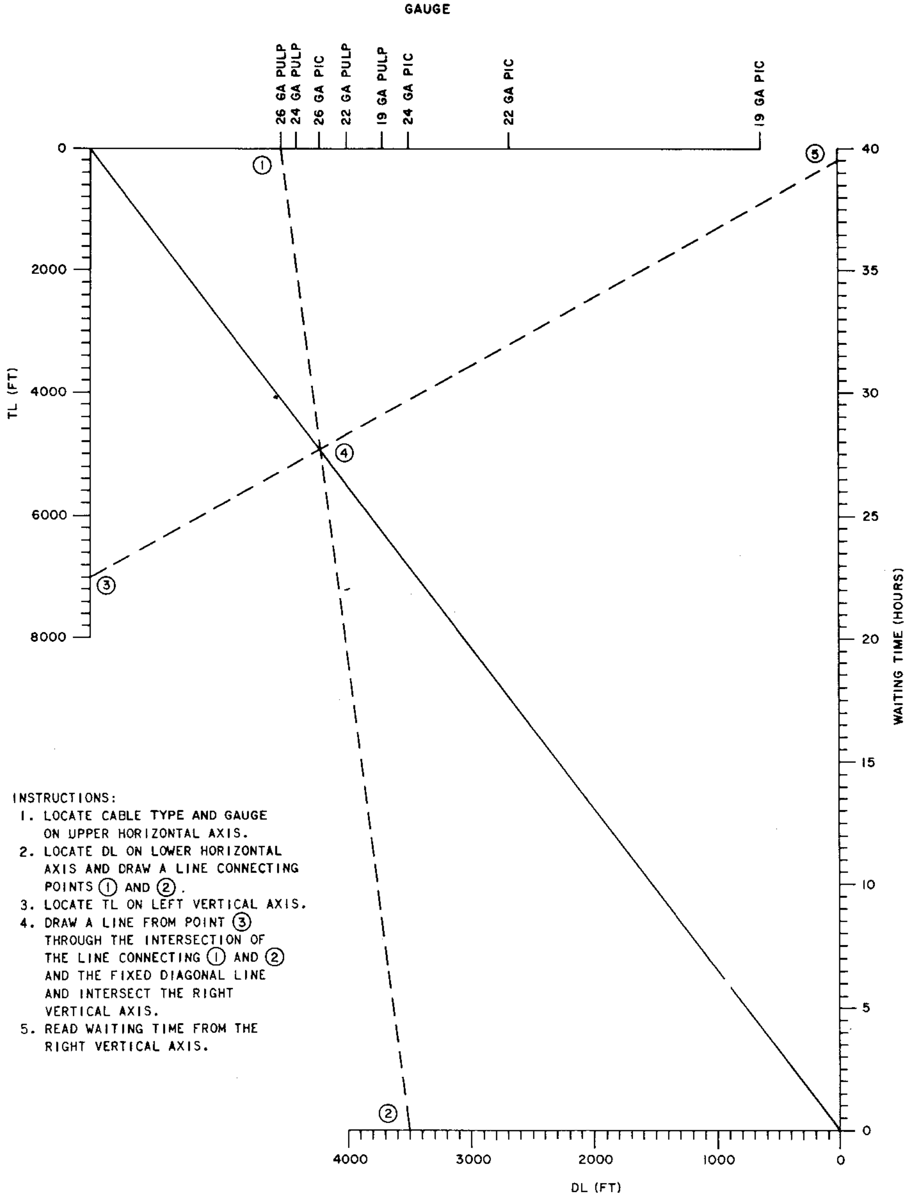

Fig. 4—Waiting Time—Pneumatic Resistance Method

8. HELIUM DETECTOR

8.01 The detector used in the helium method is any of the standard B, E, F, or G gas indicators connected to the probe assembly by a hose (Fig. 5). ♦For underground application, the probe portion of the detector is not required. However, a longer length of hose may be required.♦ The complete description and operation of these gas indicators are covered in the following sections:

SECTION	GAS INDICATOR
081-700-100	B
081-700-105	E
081-700-106	F
081-700-107	G

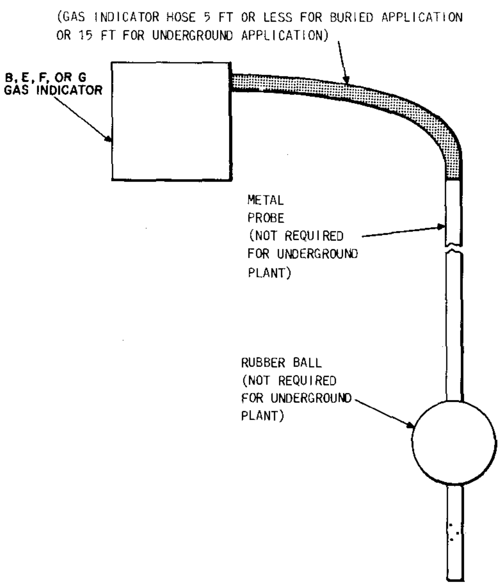

Fig. 5—Gas Indicator and Sampling Probe Assembly

Detector Operation

8.02 A simplified explanation of the normal operation of the detector is as follows. The meter contains a bridge circuit with a hot wire on one leg of the bridge. When a combustible gas is drawn across the hot wire, it burns, causing the wire temperature to increase. This unbalances the bridge and gives a meter indication. When helium is drawn across the hot wire of the bridge circuit, it cools the wire, thereby causing the bridge to unbalance. Since cooling of the wire has the opposite effect, the meter indication will be a downscale deflection. ***Hence, to use the instrument as helium detector, simply zero the meter needle at the midpoint of the scale.*** A high concentration of helium will cause a full downscale deflection of the needle. Observe the operation of the meter by sampling helium directly from the helium tank.

Use of Gas Indicators as Helium Detectors

8.03 Adjust voltage on gas indicators according to the appropriate section (paragraph 8.01). Use the zero adjust knob on all instruments to adjust the needle to midscale. New batteries may be needed to make this adjustment. Test the operation of the gas indicator with the B or C Gas Test Kit as covered in Sections 081-700-120 and 081-700-122, respectively.

9. ♦LEAK LOCATING

A. General

9.01 Before starting leak locating operations, identify the section in which the leak is suspected, as covered in Section 634-220-501. Locate and determine the depth of cable and mark the cable location (buried cable) with stakes placed at appropriate intervals along the route. This may be done while waiting for the helium charge to build up.

9.02 After the cable is charged, zero the gas indicator at the midpoint of the scale as covered in paragraph 8.03.

9.03 The best place to start searching for the leak is at the leak location indicated on the gradient graph. Work systematically in both directions from the assumed leak location.

B. Buried Plant

9.04 In the vicinity of the leak area, establish "probe" holes approximately 6 inches deep (1/2 inch in diameter) in the ground at intervals of 3 to 5 feet along the cable route. ***The probe holes should be established 12 inches on either side of the located cable. This will eliminate any chance that the cable may be punctured while probe holes are being made.***

> *Note:* Probe holes may be made by driving a ground rod with a linemans hammer or other suitable means. For concrete, blacktop, or hardpack earth, a portable drill with a carbide tipped bit is satisfactory.

9.05 Insert the probe from the helium detector into the established probe holes, making sure the rubber ball on the probe seals off the probe hole.

9.06 Sample the air from the hole with at least three squeezes of the aspirator bulb. Watch for a downscale deflection of the needle on the detector.

> *Note:* When sampling the air in the probe holes above the cable, the first indication of helium will generally cause a meter needle downscale deflection of about 5 to 10 percent (0.05 to 0.1) or, eg, from 50 to 45 or 40. When the probe hole is closest to the leak, a downscale deflection of about 30 to 40 percent should be observed or from 50 to 20 or 10.

9.07 Repeat this procedure every 4 feet along the cable until the positive indication is observed on the helium detector.

9.08 When a positive indication is observed on the meter, reduce the spacing of the probe holes to find the highest helium concentration.

9.09 If the leak is in a pipe section, under a concrete apron or other protective device, the helium will not diffuse directly to the surface but will flow along the device until it reaches an unobstructed path to the surface.

C. Underground Plant

9.10 Since the majority of all leaks in the underground plant occur in the manhole, leak detection using helium is recommended, not only on an alarm basis, but also as a regular part of the overall pressure maintenance program.

9.11 The procedures for locating leaks in the underground are basically the same as those employed for buried, except for the following:

- The leak detection probe is not required
- Only manholes are tested for helium concentration.

9.12 Manholes are tested for helium concentration by extending the hose of the detector through the holes in the manhole cover. Where the manhole frame is equipped with an inner cover (Type A or SA), the inner cover must be removed to allow the detector hose to be extended into the manhole. Also, if a Type G manhole cover is employed (no holes in cover), the cover must be removed. Refer to Part 8 for helium detector operation.

9.13 When helium is detected, follow the procedures outlined in Section 620-140-501 for testing and ventilating the manhole before entering the manhole.