PRECISION LEAK LOCATION USING THE MARK 1820A HELIUM DETECTOR

1. GENERAL

1.01 This section is a cover sheet for the Mark Products Model 1820A Helium Detector. This section is reproduced with permission of Mark Products, Inc.

1.02 Whenever this section is reissued the reason(s) for reissue will be listed in this paragraph.

1.03 The Model 1820A Helium Detector is a microprocessor driven portable test set that is used to detect helium.

1.04 If corrections are required in the attached document, use Form-3973 as described in Section 000-010-015.

1.05 If equipment design and/or manufacturing problems should occur, refer to Section SW 010-522-906.

2. ORDERING PROCEDURE

2.01 The Model 1820A Helium Detector may be ordered via the Southwestern Inventory Management System (SWIMS).

2.02 To order additional copies of this practice, use MKTP 081-603-800SW as the section number.

3. REPAIR/RETURN

3.01 Paragraph 10 describes the Trouble Shooting Guides.

Attachment: Mark Products, Inc.
Precision Leak Location
Using The Mark 1820A
Helium Detector

Operations Practice
Publication No. 002-88
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Mark Products, Inc.

Precision Leak Location Using The Mark 1820A Helium Detector

CONTENTS PAGE

1. GENERAL

1.1 This practice describes the Mark Products Model 1820A Helium Detector, along with procedures and equipment needed for locating leaks using helium in buried or underground pressurized cable plant. The process is described in this practice as "heliumization" of pressurized cable plant (Fig. 1).

1.2 The heliumization method of leak locating consists of three separate steps:

(a) Initial gradient work and/or analysis of computerized pressure and flow monitoring data to establish the approximate location of the leak(s).
(b) Application of helium to the cable.
(c) Precise location of leaks using the Model 1820A Helium Detector.

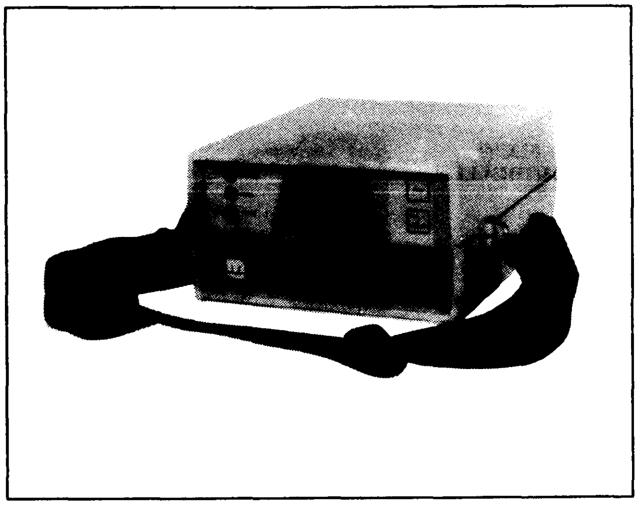

Fig.1 - Model 1820A

2. PRECAUTIONS

2.1 The following precautions should be followed:

(a) Do not introduce helium in coaxial cables since helium has a lower breakdown strength then nitrogen or air.
(b) Fill only as much cable with helium as needed to determine the location of the leak(s).
(c) Follow established safety procedures for handling gas cylinders.
(d) Follow established safety procedures for testing, entering and working in man hole and vault structures.

3. TOOLS AND MATERIALS

3.1 The following tools and materials are required to locate leaks using the heliumization method:

(a) Model 1820A Helium Detector (Fig.1)
(b) Helium gas (commercial welding grade)
(c) Mark Products Model 526 Portable Flow Rater (Fig. 2)
(d) Pressure Regulator and adaptor (if required) for a standard helium tank
(e) Mark Products Model 530 Helium Flow Controller (Fig. 2).

3.2 The following accessories are available from Mark Products to make the use of the Mark Model

1820A Helium Detector more convenient and effective(Fig. 3):

(a) Model 224 Battery Charger, 12V car.
(b) Model 1820-00356 Carrying Harness, Belt.
(c) Model 5.5 Extension Hose w/ model 415 Distribution Block.
(d) Model 525 Helium Application Kit, Distribution Panel.

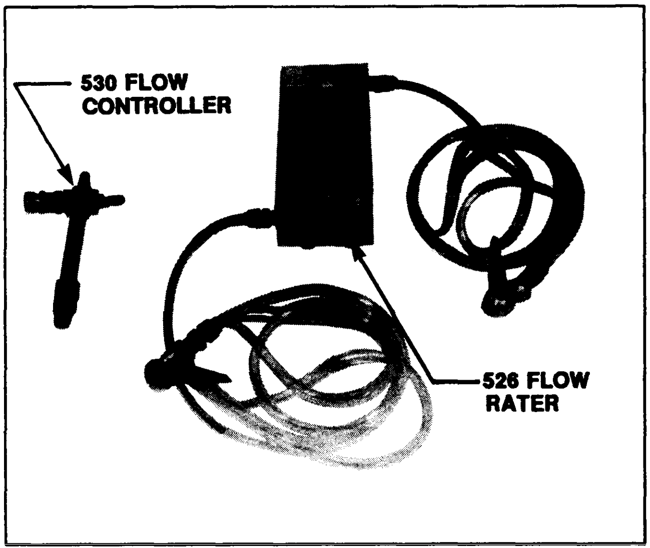

Fig. 2 - Model 526 Flow Rater & Model 530 Flow Controller

4. PRELIMINARY GRADIENTS

4.1 Direct Buried Pressurized Cables:

4.11 *It is essential that accurate gradients of the cable pressure be obtained and analyzed prior to any helium location work.* Preliminary gradients will indicate the section of cable in which the leak is located. Use the following guidelines for obtaining accurate pressure gradients (see BSP 637-410-504 or GSP 637-800-501 for details):

(a) Check at least three valve points on each side of the leak.
(b) Repeat pressure readings until at least two successive series of readings point to approximately the same leak location.
(c) If any leaks are repaired, allow the cable pressure to stabilize and regraph the gradients.
(d) When the gradient is stable after two successive readings and the leak location appears to be the same, the cable may be charged with helium.

4.12 *Note: Be sure you have isolated the inner and outer sheath of a double sheath cable before doing gradient work. If you do not do this your calculations will not lead you to the actual leak location.*

4.2 Underground Cables:

4.21 Underground systems without air pipes:

(a) Establish approximate leak location using data from the computerized monitoring system or data gathered manually through field visits, if no computerized or remote system exists. Use this data to calculate the pressure gradient.
(b) Heliumize all cables on the distribution panel which feed the cable with the leak as described in sections 5 and 6. This will help you find multiple leaks, especially if your system is "interlaced".

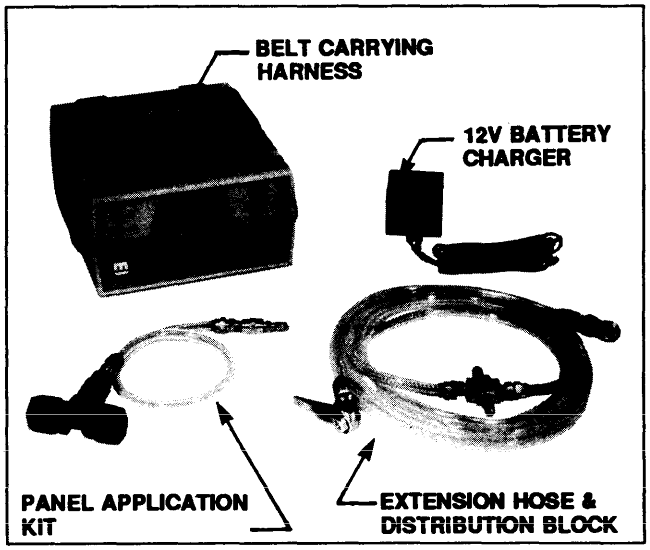

Fig. 3 - Other Accessories

4.22 Underground pipe systems without Flow Transducers:

(a) Analyze pressure and contactor readings to determine the approximate location of air loss using the printouts from your computerized cable pressure monitoring system.
(b) Heliumize the associated pipe system as described in Sections 5 and 6.

4.23 Underground pipe systems with Flow Transducers in the field:

(a) Analyze flow readings to determine the approximate location of air loss using the printouts from your computerized cable pressure monitor ing system.
(b) Analysis will allow you to isolate the search area to a location between flow transducers, usually spaced from 3000 to 6000 feet.
(c) Heliumize the associated pipe system, as described in Sections 5 and 6.

5. CHARGING THE CABLE WITH HELIUM

5.1 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 in small percentages relative to the air or nitrogen flow.

5.2 Charging Direct Buried Cable With Helium:

5.21 Buried cables are charged with helium at the valve points closest to the leak location on the air source side of the leak (central office dryers, pole mounted dryers or nitrogen tanks) (Fig. 4)

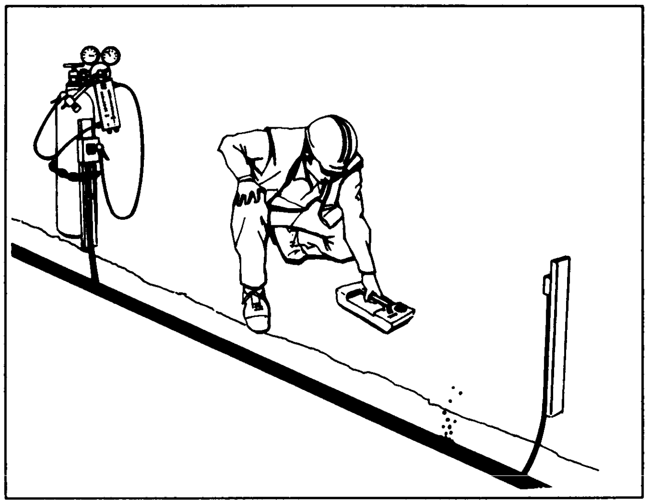

Fig. 4 - Charging Cables

5.22 The first valve beyond the graphed leak location may be used as a bleed valve (remove valve core) during the heliumization process. *NOTE: Be sure to replace the valve core and allow sufficient time for the helium to exit the leak point(s) and rise to the surface before beginning leak location with the Model 1820A (Fig. 5).* A period of one hour or more will be needed to wait from the time the "bleed valve" is capped. Refer to **5.24** for precautions.

5.23 Helium will appear directly over the path of the cable at the point the cable is leaking. It is important to carefully mark the path of the cable before using the Model 1820A Helium Detector. Precise cable path location can be accomplished while the cable is being heliumized (Fig. 4).

5.24 Helium will escape from the cable at leak locations and diffuse through the soil. It can then be detected with the Model 1820A at ground level without boring test holes (see Section **9** and (Fig. 5)).

5.25 *Helium will diffuse to the surface through loose soil faster than through compacted soil. Frozen ground will also slow down the diffusion of the helium to the surface. ALLOW MORE TIME FOR HELIUM DETECTION AT THE SURFACE WHEN THE SOIL IS COMPACTED AND/OR FROZEN.*

5.3 Charging Underground Cable Systems With Helium:

5.31 To heliumize underground systems feed helium from the central office pipe panel or distribution panel (Fig. 6). ***When applying helium to a distribution panel, use the Mark Products Model 525, Helium Application Kit, Distribution Panel (Fig. 3). If you do not use this Kit or a locally assembled equivalent, some of the cables may not be charged with helium.***

5.32 Helium will escape from faults in manhole or duct structures once the system is properly charged. Helium will rise to the top of the manhole structure and gather under the lid where it may be detected with the Model 1820A through the lid without removing it (see Section **8**, (Fig. 7)).

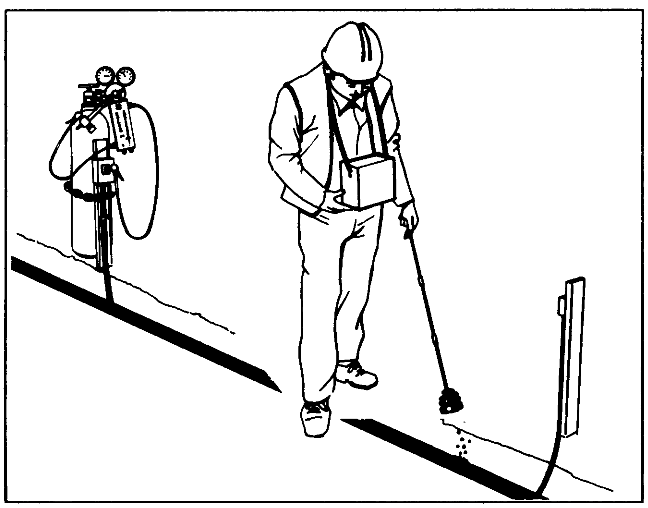

Fig. 5 - Search For Helium

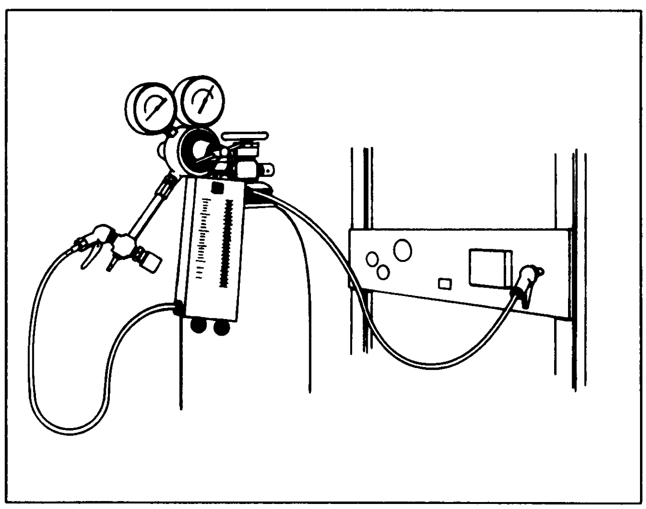

Fig. 6 - Charging a Pipe System

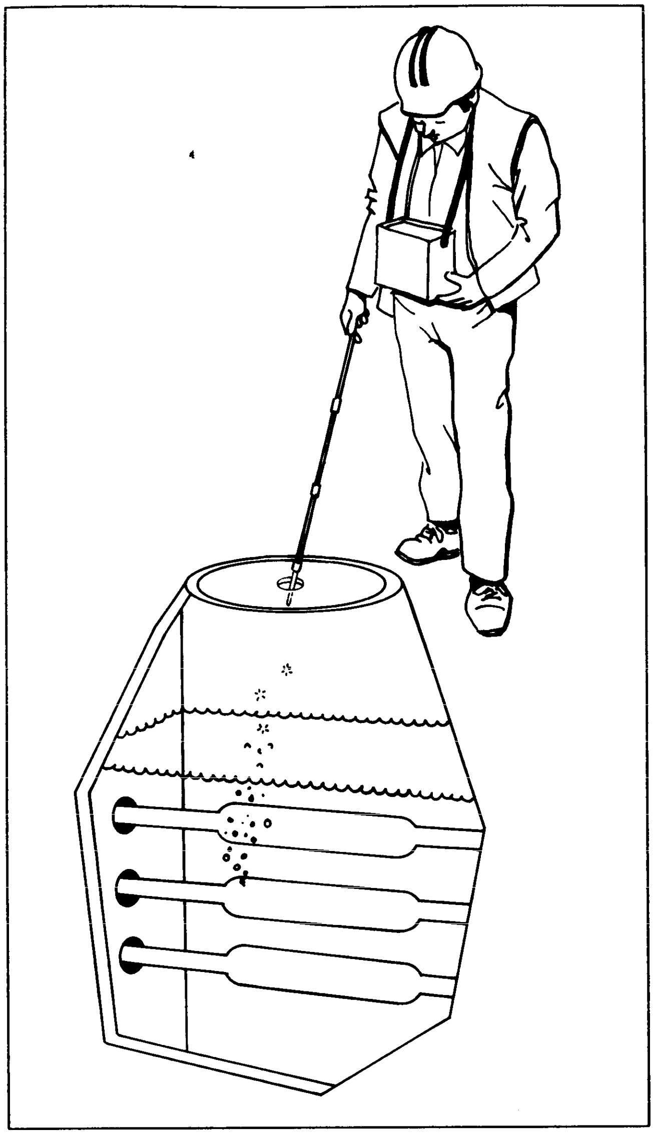

Fig. 7 - Sampling For Helium at Manhole

6. HELIUM CHARGING TIMES

6.1 Helium Charging Times-Directly Charging the Cable:

6.11 When applying helium directly to a cable refer to Appendix A. This chart, called a nomograph, will tell you the amount of time needed to flow helium to the suspected leak location. ***The nomograph is used whenever helium is introduced directly into the cable. This applies to both direct buried and underground cable types.*** The nomograph requires the following data:

(a) Cable type and gauge.
(b) Estimated distance to the leak (DL) established from analysis (see Section 4).
(c) Total length of the cable section (TL) from the helium feed point to the "Bleed Valve". *NOTE:* If analysis cannot be accomplished easily due to the lack of a computerized cable pressure monitoring system or recent field pressure readings, consider "DL" AND "TL" to be the same, usually the end of the cable.

6.12 A second method for determining cable filling times uses the table found in **Appendix B**, at the end of this practice. This table called **"Cable Filling Times Based Upon Head End Flow Rates"** is used when the flow in a cable can be established and the diameter of the cable is known. To use the table, perform the following steps:

(a) Determine the amount of flow in the cable you wish to charge by one of the following methods:
(i) Observe the panel-mounted Flow Rater in the central office, or
(ii) Manually read the flow into a cable with a portable Flow Rater (0-21 SCFH is best) at the central office distribution panel, or
(iii) Take a manual flow reading using a portable Flow Rater (0-21 SCFH) at the manifold or bypass location in the field.
(b) Determine the outside diameter of the cable from cable charts or by manually measuring the cable diameter.
(c) Find the cable diameter on the left hand column of the table. If you don't see the exact diameter, go to the next larger one.
(d) Find the flow time for your cable under the appropriate flow rate found in # i above for the diameter you have established. If the flow into the cable is greater than 10 SCFH, divide the number found in the column for 1 SCFH by the flow rate. The result is the number of hours per thousand feet for that flow rate and cable diameter.
(e) Multiply the time found by the length of cable you want to charge this is done in number of thousands of feet. The result is the total amount of time required to flow helium from the entry point to the desired end point.

EXAMPLE :

1) The cable flow rate at the bypass is 7 SCFH. You wish to push helium 4200 feet from this reading point.
2) Cable diameter is 2.35 inches.
3) Go to the line for 2.4 inches in the far left column of the table.
4) Go across to the column titled "7". Your flow time per 1000 feet is 2.24 hours.
5) Multiply 2.24 hours by 4.2 (number of thousands of feet) to find your total flow time of 9.41 hours. This is the time it will take helium to flow from the reading point to a point 4200 feet distant in this cable.

6.13 Direct Buried Cables:

(a) Introduce helium at the valve point closest to the suspected leak.

(i) Attach a Mark Products Model 530 Helium Flow Controller to the helium Tank Regulator. (For more details concerning the purpose and operation of the Model 530 Helium Flow Controller see "Operations Manual Model 530 Helium Controller" supplied with the instrument).

(ii) Attach the "INLET" hose of a Mark Telephone Products Model 526 Portable Flow Rater to one of the valves at the end of the Model 530.

(iii) Attach the "OUTLET" hose of a Model 526 Portable Flow Rater to the pressure valve of the system to be charged. If the hose of the Model 526 is not long enough to reach from the regulator to the valve on the cable, you may add additional lengths of pressure hose.

(iv) Set the pressure gauge on the tank regulator to 50 PSI. The resulting flow into the system will be approximately 5 SCFH of helium. This will register on the Mark Model 526 Portable Flow Rater as approximately 2 SCFH (2 SCFH of air is equal to 5 SCFH of helium). *THE HELIUM CHARGING PROCESS IS CORRECT WHEN YOU SEE THESE RESULTS.*

(b) Refer to the nomograph, **Appendix A**, or the Cable Filling Times Chart, **Appendix B**, to determine the amount of time needed to flow the helium to the point of the suspected leak. See Section **6.11** and **6.12.**

(c) Remember to allow extra time for the helium/air mixture to escape from the cables and rise up through the ground in direct buried applications (see Section **5.24**).

(d) A typical helium tank contains 240 SCF of helium when full. At a constant rate of 5SCFH, a full tank will keep adding helium to the system for approximately 48 hours. This should allow for the successful charging of almost any pressure system.

6.14 Underground Cables:

(a) Introduce helium at the Meter Panel in the central office that feeds the leaking cable. (See **4.21** (b) for details).

(b) Helium will be flowed into the cable in the underground from manhole locations or riser pole valves instead of from the central office. This may save charging time for helium.

(c) Introducing helium directly into an under ground cable from a central office or field location is accomplished as outlined in Sections **6.12** and **6.13.**

6.2 Charging Pipe Systems:

6.21 Introduce helium to the pipe system at the pipe panel in the central office. Find the "outlet side" of the Pipe Panel and flow helium into the air pipe at 5 SCFH as outlined in Section **6.21:**

(a) Place the helium tank close to the pipe panel to be charged. Be sure to secure the tank.

(b) Follow the procedures outlined in Section **6.1** for the use of Model 530 Helium Flow Controller and the Model 526 Portable Flow Rater.

(c) To determine the number of hours of helium available from your tank, divide the number of SCF remaining in the tank (as shown on the regu lator of the helium tank) by 5 SCFH.

EXAMPLE :

The gauge shows 150 SCF remaining in the tank. You are using 5 SCFH. 150 divided by 5 = 30 hours of helium flow at this rate.

6.22 Helium will travel to the end of a normal pipe run (approximately 30,000 feet) in five or six hours. Additional time should then be allowed for the helium/air mixture to permeate the cable system beyond the manifold points.

6.23 It is recommended that helium be applied to the air pipe at least 18 hours before sampling begins to allow sufficient time for the helium to permeate the cable system.

NOTE: If more precise filling times for pipe systems are desired, contact **Mark Products** *at 800/621-4215 (outside CA) OR 408/732-4600 and ask for Customer Service.*

6.24 If you want to survey a complete pipe system, place the helium on both the pipe panel and the associated distribution panels in the central office. This allows helium to completely permeate the cables between the central office and the first manifold location. If you are charging both pipe and distribution panels simultaneously, use sets of tanks, gauges, Helium Flow Controllers, etc., for each additional panel to be charged.

7. DESCRIPTION & OPERATION

7.1 The Model 1820A Helium Detector is a microprocessor driven portable test set that is used to detect helium. Pushing the "ON/OFF" switch once turns the unit on and begins the automatic startup sequence. Pushing the "RUN" switch starts the automatic helium detection sequence when a sample is desired. The unit is designed to withstand the daily abuse of the outside plant environment. It has a 12V rechargeable battery and comes with a battery charger. A protective carrying case is also provided with the unit.

7.2 To assemble the unit, follow the instructions provided with the unit or refer to **Mark Products** Operations Practicẽs #001-88, "Model 1820A Helium Detector, Operation and Maintenance."

7.3 To turn the unit on press the **"ON/OFF"** button once.

7.4 When the unit is turned on it will start counting down from 100 to 0. This is the initial warmup period for the Model 1820A. It will take approximately 20 seconds. The pump in the Model 1820A will work continuously while the machine is **"ON"**.

7.5 Once the warm up period is complete **"00"** will appear on the display. The unit is ready for use. The Model 1820A may be left **"ON"** for extended periods of time without depleting the battery. Turn the unit off only when transporting from location to location. ***The 1820A will automatically turn itself off after 15 minutes if no samples have been taken.***

7.6 To check for helium, position the Probe Assembly in the area that you wish to check.

7.7 Momentarily press the **"RUN"** button. The **"SAMPLE"** light will come on and 00 will appear on the display. The unit is now taking a sample of air/gas. A **"SAMPLE"** will take 6 seconds.

7.8 After the sample has been taken the **"SAMPLE"** light will go off and the **"READ"** light will come on. If there is any helium present a reading, in percent of helium, will appear and remain on the display until the next sample is taken. If no helium is present the display will continue to show **"00"**. The **"READ"** cycle takes 4 seconds. ***If there is no helium present in the sample, another sample may be taken immediately by pressing the "RUN" button. A complete "SAMPLE" and "READ" cycle with no helium present is 10 seconds.***

7.9 ***CAUTION! Movement of the Model 1820A or the Probe Assembly during the "SAMPLE" or "READ" cycles may result in false readings. The Model 1820A and Probe Assembly may be moved after the "READ" light has gone out.***

7.10 The Model 1820A Helium Detector gives readings in percent of helium. For example, the reading of .05 on the display indicates the presence of five hundredths of one percent helium. Once Helium is detected in concentrations over .99 percent, the readings are shown in tenths. For example, a reading of 2.3 on the display indicates at least two point three percent but less than two point four percent helium. If the helium is in concentrations higher than 10 percent, the amount will be displayed in whole numbers. A reading of 11 on the unit indicates at least eleven percent but less than twelve percent helium. The Model 1820A will detect helium in concentrations as small as .01% or *One Hundredth of One Percent.* Stated otherwise, this is *One Hundred Parts Per Million.* It will detect helium in concentrations as high as 100%, or *One Million Parts Per Million.*

7.11 ***NOTE: The advanced electronics of the Model 1820A will begin sensing helium during the "SAMPLE" cycle. As a result, when the "READ" cycle begins, the LCD display may start registering at a number above 0.01%. This is a normal condition in the presence of helium and does not indicate a malfunction. However, always verify the presence of helium by taking a second reading in the same location.***

7.12 After the unit has read the sample, and helium has been detected, the **"READ"** light will go off and the **"PURGE"** light will come on. The **"PURGE"** light will stay on until the unit has completed the purge cycle. This will take an additional 15 to 20 seconds, depending on the concentration of helium detected.

7.13 When the purge cycle is over and all the lights are off, the unit is ready to take another sample. Note that the Model 1820A should not be turned off after every sample cycle. See Section **7.5.**

7.14 The Model 1820A Helium Detector has a recharge able battery. If the battery is low a **"LOW BAT"** will appear in the upper left corner of the display. The unit will not function properly once the **"LOW BAT"** appears. Recharge the unit as soon as possible. The battery charger will automatically discontinue charging when the battery is fully charged. Under normal operating conditions, the unit will cycle throughout a normal work day before a recharge is necessary.
NOTE: It is recommended that the unit be recharged as soon as possible after every day's use. The Model 1820A will operate in a LOW BAT state by plugging in the battery charger and turning it on. The set will run on direct battery power or from the charger, if necessary, and may be left plugged into a power source indefinitely without damage to the unit.

8. LEAK LOCATION

8.1 Buried Plant:

8.11 ***Carefully follow the procedures in Sections 4, 5, and 6 before using the Model 1820A Helium Detector. Thoughtful preparation is essential for success.***

8.12 Locate and mark the cable path in the projected search area.

8.13 Under normal circumstances, no probe holes are needed for successful helium detection with the Model 1820A. The rubber collection cup is placed on the ground directly over the path of the cable during the "SAMPLE".

8.14 Samples should be taken every 3 feet or less over normal soil.

8.15 Samples should be taken at intervals closer than three feet in compacted or frozen soil.

8.16 For extremely hard or frozen ground punch holes approximately 6 inches deep to make it easier for the helium to be detected.

8.17 Holes may also be needed at curblines or at road expansion joints to help helium rise to the surface.

8.18 When helium is detected, continue to sample the adjacent area until you determine the highest concentration of helium. This location will be directly above the cable fault. **DO NOT DIG UNLESS YOU OBTAIN SEVERAL POSITIVE READINGS!**

8.19 Start Digging!

8.2 Underground System:

8.21 *Carefully follow the procedures in Sections 4, 5, and 6 before using the Model 1820A Helium Detector. Thoughtful preparation is essential for success.*

8.22 If you are surveying a complete pipe system, begin your sampling at the central office vault. It is advisable to check the central office vault plugs and other plant before proceeding with the outside survey.

8.23 At the manhole location set up work area protection according to local practice.

8.24 DO NOT REMOVE MANHOLE COVER!

(a) Turn on the Model 1820A and insert the extension tip of the probe through one of the holes in the manhole lid.
(b) Take a sample as outlined in Section 7 and record your findings.
(c) Take a second reading on the opposite side of the lid and record your findings.
(d) Proceed to the next manhole.

8.25 Survey all of the manholes in your projected search area in the same fashion as **8.24** and record your findings.

8.26 Return to the manholes with the highest percent ages of helium readings.

(a) Enter these locations following local safety practices and search for leaks using the Mark Products Model 1805 Multisonic Translator/Detector. (Fig. 8).
(b) If no faults are found in the manhole, check the ducts using the 1820A.
(c) To do this, remove the collection cup from the end of the 1820A Probe. Replace it with the Extension Tip. Insert the probe into the duct a few inches. Temporarily seal the duct and around the probe using rags. Take a sample and record your findings. ***Be careful that the open probe tip does not become clogged from dirt, mud, or water from the duct. Examine and clean the probe tip, if necessary, after each sample.***

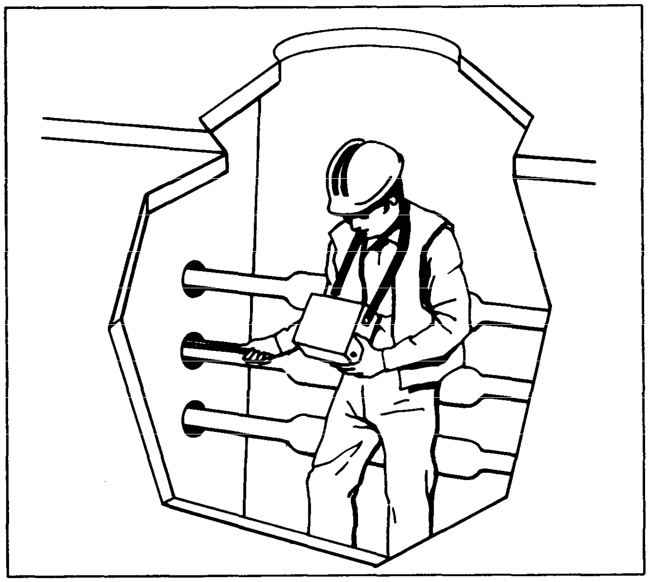

Fig. 8 - Verifying Leak Location

8.27 When helium is detected in a duct the Mark Products Model 1801 Underground Duct Probe may be used to establish the exact location of leaks between manholes. (Fig.9)

8.28 If pressure leaks are **NOT** found in the manholes or adjacent ducts, the pressure leaks may be in riser cables or plugs of riser cables. Be sure to check this plant if you do not find helium indications in the manholes or ducts.

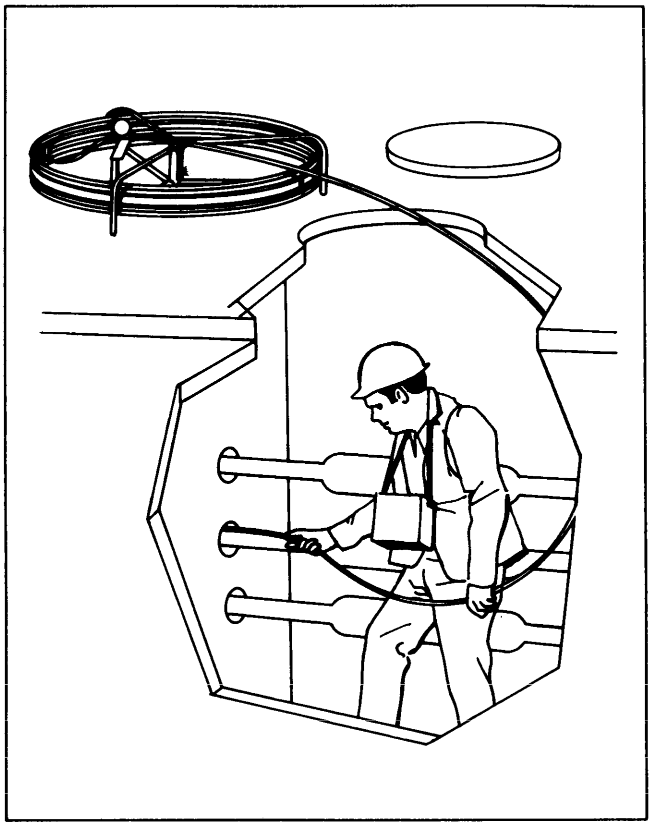

Fig. 9 - Using Model 1801 Multisonic Duct Probe to Find Leaks in Conduit

9. REFERENCES

9.1 The following are reference to **Mark Products** Publications describing the operation and maintenance of various tools mentioned in this practice:

Operations Practices:
MARK PRODUCTS, INC.
Model 1820A Helium Detector
Operations Manual
Publication #001-88
November, 1988

MARK PRODUCTS, INC.
Model 530 Helium
Flow Controller
Operations and Maintenance
Publication #003-87
September 1987

MARK PRODUCTS, INC.
Model 1801 Underground Duct Probe
Description and Operation
Publication #044-85
May 1985

MARK PRODUCTS, INC.
Model 1805 Multisonic Translator Detector
Operations and Maintenance
Publication #040-85
April 1985

TROUBLE SHOOTING GUIDE

CONDITION	PROBABLE CAUSE	REPAIR PROCEDURE
"LOW BAT" "E 10" indication on LCD Display	1. Battery discharged	1. Recharge Battery see section 3
"E 15" indication on LCD Display	1. Clogged system 2. Processor malfunction	1. Inspect and clean Probe 2. Restart unit 3 times. If condition does not clear, call qualified service agent or Mark Products
Pump Failure	1. Clogged system 2. Battery discharged	1. Inspect and clean Probe 2. Recharge Battery
Unit will not turn on	1. Battery discharged 2. Processor malfunction	1. Recharge Battery 2. Call qualified service agent or Mark Products
Pump running slowly	1. Battery discharged 2. Clogged system	1. Recharge Battery 2. Inspect and clean Probe
LCD Display stops during start up countdown	1. Processor malfunction	1. Restart 2. Call qualified service agent or Mark Products
Unit will not respond to Switches. Will not turn off or respond to Switch commands	1. Processor malfunction	1. Restart unit by using a small pointed instrument to push the reset button located in the small hole on the left side of the unit below the strap

Model 1820A Helium Detector
U.S. Patent No. 4,787,239

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800/621-4215 Outside CA
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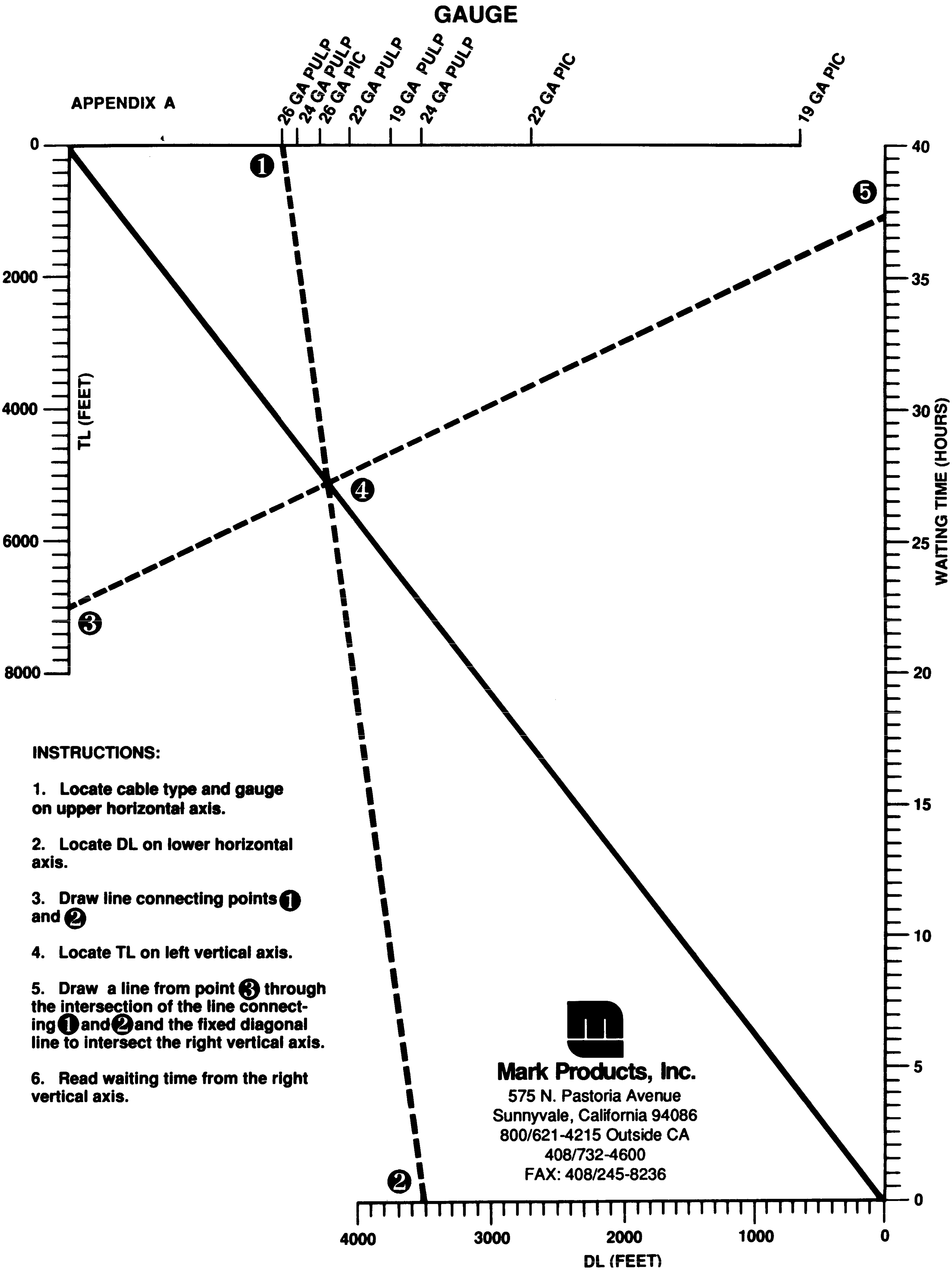
APPENDIX A



INSTRUCTIONS:

1. Locate cable type and gauge on upper horizontal axis.

2. Locate DL on lower horizontal axis.

3. Draw line connecting points 1 and 2

4. Locate TL on left vertical axis.

5. Draw a line from point 3 through the intersection of the line connecting 1 and 2 and the fixed diagonal line to intersect the right vertical axis.

6. Read waiting time from the right vertical axis.

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APPENDIX B

CABLE FILLING TIMES BASED UPON HEAD END FLOW RATES
STATED IN HOURS PER 1000 FEET

CABLE DIAMETER IN INCHES	MEASURED FLOW RATE IN SCFH									
	1	2	3	4	5	6	7	8	9	10
1.0	2.73	1.36	.91	.68	.55	.45	.39	.34	.30	.27
1.2	3.92	1.96	1.31	.98	.78	.65	.56	.49	.44	.39
1.4	5.34	2.67	1.78	1.34	1.07	.89	.76	.67	.59	.53
1.6	6.98	3.49	2.33	1.74	1.40	1.16	1.00	.87	.78	.70
1.8	8.83	4.42	2.94	2.21	1.77	1.47	1.26	1.10	.98	.88
2.0	10.90	5.45	3.63	2.73	2.18	1.82	1.56	1.36	1.21	1.09
2.2	13.19	6.60	4.40	3.30	2.64	2.20	1.88	1.65	1.47	1.32
2.4	15.70	7.85	5.23	3.92	3.14	2.62	2.24	1.96	1.74	1.57
2.6	18.43	9.21	6.14	4.61	3.69	3.07	2.63	2.30	2.05	1.84
2.8	21.37	10.68	7.12	5.34	4.27	3.56	3.05	2.67	2.37	2.14
3.0	24.53	12.27	8.18	6.13	4.91	4.09	3.50	3.07	2.73	2.45
3.2	27.91	13.96	9.30	6.98	5.58	4.65	3.99	3.49	3.10	2.79
3.4	31.51	15.75	10.50	7.88	6.30	5.25	4.50	3.94	3.50	3.15