CABLE PRESSURE SYSTEMS

UPKEEP

CONTENTS PAGE

1. GENERAL

1.01 This section covers the overall upkeep of pipes and cables associated with cable pressure systems. This section is intended for pressure systems using manual monitoring techniques. See Section 637-600-050 or -051 for upkeep of pressure systems using automated monitoring.

1.02 This section is reissued to:

- Make reference to the F pressure transducer system (replaces the E pressure transducer system), which is recommended for monitoring the pressure in all underground subscriber cable.
- Include reference to C meter-panel, which replaces the General Cable Corporation, Puregas Division 8541-A pipe alarm meter-panel.
- Include information pertaining to the G pressure transducer.
- Correct Form E-5406 Airflow and Pressure Readings—Manifold and Hi-Valve Manholes (Fig. 5).
- Correct instructions for making airflow test for individual cables fed at a manifold.
- Illustrate the valve reading points in manifold manhole using the C automatic shutoff valve and the C manifold assembly.

Since this is a general revision, arrows ordinarily used to indicate changes have been omitted.

2. BASIC MONITORING AND ALARM PROVISIONS

2.01 Pressure systems can be monitored by observing the operation of the following:

(1) Air usage

(2) Pressure transducers

(3) Pressure contactors.

NOTICE

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Air Usage (Manual Recording)

2.02 Dry air furnished to each pipe is fed through the C meter-panel or the superseded pipe alarm meter-panel (Sections 637-225-201 or -210, respectively) in the central office (CO). The meter-panels permit:

(a) Thorough daily readings of its air meter, comparing daily air requirements to the system. These readings can serve as a guide to determine the need for routine maintenance of the pipe route (Part 5). They also can be used in analyzing alarm conditions.

(b) Thorough operation of the meter-panel alarm, constant monitoring against airflow exceeding a predetermined level due to pipe or tubing failure, or zero leak condition in typical large size underground cable or nearby large laterals.

Pressure Transducers

2.03 The ***F pressure tranducer system*** (Section 637-222-101) supersedes the E pressure transducer system (Section 637-222-100) and is designed to monitor pressures, using working pairs, in many individual cables at one location in the underground subscriber, trunk, and toll plant. It is recommended for manhole installation.

2.04 The ***G pressure transducer*** (Section 637-222-103) consists of an F pressure transducer attached to a mounting plate which permits single installations in buried or underground cable routes.

2.05 The ***C pressure transducer*** (Section 637-220-100) normally is located on principal lateral or feeder cables at or near riser poles. ***This transducer is for aerial use only.***

2.06 The above-mentioned pressure transducer systems and pressure transducers permit the following:

(a) Reading from the test center the specific cable pressure existing at the transducer location. These readings should be made daily and checked against the ***alert*** pressure established for the transducer, as posted on Form E-5405 (Part 4). When the reading is lower than the ***alert*** pressure, it should be referred to the outside maintenance forces.

(b) Determining at the test center the pressure in specific cables which is associated with the operation of a pipe alarm.

Pressure Contactors

2.07 The ***L or M pressure contactors*** (Section 637-214-100) in new systems usually are located well out along the pressurized aerial cable, such as at the ends of 200-pair cable branches. In older systems the contactors were frequently placed at or near riser poles. These pressure contactors use working pairs to monitor pressure.

2.08 The ***P pressure contactor*** (Section 637-211-100) is intended for use on buried, underground, or aerial cable routes using a dedicated pair. This device may be installed in a manhole when required for underground installation and in the appropriate cable closure when required for buried installation.

2.09 The ***N pressure contactor*** (Section 637-213-100) is intended for use on buried, underground, or aerial cable routes using a dedicated pair. This device is for installation within a protective environment, such as inside an apparatus, maintenance, or splice case.

2.10 The above-mentioned pressure contactors permit the following:

(a) Determining from the test center if the cable pressure at the contactor location is above or below the ***alarm*** level. Operated contactors should be referred to the outside maintenance forces.

(b) Determining from the test center, subsequent to transducer indications, which cable branch or branches are affected by a low-pressure condition.

3. OTHER MONITORING DATA

3.01 In addition to having data for the normal and alarm or alert pressures at transducers and contactors, it is also a necessity for maintenance purposes to have the following monitoring data for key locations:

(a) Airflow into pipe manifolds

(b) Airflow into individual cables at manifolds

(c) Pressure in pipe and individual cables at hi-valve manholes when transducers are not used

(d) Pressure at flow analysis valves at the start of aerial cable leads.

4. MAINTAINING DATA

4.01 Maintaining up-to-date data on air usage, flow rates, and pipe and cable pressures at key points is essential for effective economical operation of the pipe system.

4.02 Because various operational groups are responsible for posting and maintaining specific data, it is desirable for each group to have an appreciation of:

(a) The data available

(b) The group responsible for posting the data in each instance

(c) The data to be referred from one group to another.

Data Forms

4.03 Six E-forms are available for recording pressure system data. The form numbers and the group normally using each are listed in Table A. The forms are illustrated in Fig. 1 through 6.

4.04 Responsibility for maintaining the various forms should be determined on a company basis.

4.05 To better understand the terms used on the Air Usage Log (Fig. 1), the following definitions have been prepared:

(a) ***Stabilized daily air usage*** is the normal ***quantity*** of air ***in cubic feet as read on the air meter*** (Section 637-225-105) that is required in a 24-hour period for the specific pipe or cable route. No correction is made to convert this quantity of air at pipe delivery pressure to ***standard*** cubic feet at atmospheric pressure. This usage figure becomes the reference for comparing subsequent daily meter readings. For this reason, effort should be made to read the meter at the same hour daily in order to provide a realistic comparison.

(b) ***Stabilized airflow rate*** is the normal ***rate*** of air usage ***in standard cubic feet per day (scfd) as read on the flow rate indicator or flowrater.*** The indicator or flowrater show the instantaneous rate of air usage, whereas the air meter shows the ***cumulative quantity*** of pressurized air that has been delivered to a specific pipe route. The stabilized airflow rate therefore always will be considerably higher than the stabilized daily air usage.

TABLE A

FORMS FOR RECORDING PRESSURE DATA

FORM NO.	TITLE	FORM NORMALLY USED BY	FIG.
E-5403	Air Usage Log — Meter-Panel	CO Mtce	1
E-5404	Pipe Alarm Log	CO Mtce	2
E-5405	Contactor and Transducer Data	Test Center	3
E-6369	Daily Transducer Data	Test Center	4
E-5406	Airflow and Pressure Readings— Manifold and Hi-Valve Manholes	OP Mtce	5
E-5407	Pressure Readings — Lateral Distribution Cables	OP Mtce	6

1

FORM E-5403

AIR USAGE LOG
METER PANEL

PIPE ROUTE _____

C.O. _____

Daily Reading Time _____

Pipe Pressure _____ psi

			Date of Stabilization
Stabilized Daily Air Usage (Meter Reading)	_____	CFD*	_____
Stabilized Air Flow Rate (Flow Rate indicator)	_____	SCFD**	_____
Alarm Flow Setting	_____	SCFD	_____

Date	Meter Reading (cfd)	Difference Between Readings * (cfd)	Flow Rate** (scfd)	Date	Meter Reading (cfd)	Difference Between Readings * (cfd)	Flow Rate** (scfd)

NOTES: 1. Refer any daily "Difference Between Readings" that exceeds "Stabilized Daily Air Usage" by 50 cfd.

2. Refer an Operated Alarm immediately, giving the "Stabilized Air Flow Rate," the present flow rate, and the previous day's flow rate.

3. Send completed Air Usage Log to test center monthly.

Fig. 1—Air Usage Log—Meter-Panel

FORM E-5404

PIPE ALARM LOG

C.O. _____

Pipe Route	Alarm Date	Alarm Time	Flow Rate	Referred		Trouble Cause	Date		New Alarm Flow Setting*
				By	To		Trouble Cleared	Alarm Cleared	

* New Alarm Flow Setting may be necessary after air flow has stabilized (difference in air meter readings on two successive days not exceeding 5%).

2

Fig. 2—Pipe Alarm Log

CONTACTOR AND TRANSDUCER DATA

3

FORM E-5405

SHEET NO. ____ OF ___

C.O. _____

PIPE ROUTE _____

Transducer or Contactor*	Location	Line Number	Cable No.		Cable Pressure	
			UG	Aerial	Normal	Alarm Setting or Alert Pressure **

* Indicate by "TD" for Transducer and "C" for Contactor.

** No alarm setting for Transducer; an "alert" point should be assigned.

NOTES: 1. List Transducers sequentially outward from C.O. along pipe route.
2. List Contactors sequentially outward along lateral cable.

Fig. 3—Contactor and Transducer Data

MONTH _____

DAILY TRANSDUCER DATA

FORM E-6369

TRANSDUCER NUMBER	LINE NUMBER	DAYS OF THE MONTH																													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

NOMINAL PRESSURE AT TRANSDUCER (PSI)	0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0
VOLTMETER READING (120 VOLT SCALE)	50.0	47.5	45.0	42.5	40.0	37.5	35.0	32.5	30.0	27.5	25.0	22.5	20.0	17.5	15.0	12.5	10.0

Fig. 4—Daily Transducer Data

E-5406

AIRFLOW AND PRESSURE READINGS – MANIFOLD AND HI-VALVE MANHOLES

PIPE ROUTE _____

WIRE CENTER _____

DATE	Manhole Location	Airflow Into Manifold	Airflow or Pressure Readings at Individual Cables (See Note)																			
			Ca#		Ca#		Ca#		Ca#		Ca#		Ca#		Ca#		Ca#		Ca#		Ca#	
			SCFH	PSIG	SCFH	PSIG	SCFH	PSIG	SCFH	PSIG	SCFH	PSIG	SCFH	PSIG	SCFH	PSIG	SCFH	PSIG	SCFH	PSIG	SCFH	PSIG

NOTE: Ca# = Individual Cable Airflow or Pressure at Manifold or Hi-Valve Manholes. Space is Available for Identifying The Cables in Front of or Behind The Work Location.
SCFH = Standard Cubic Feet per Hour (Airflow at Manifold Manhole).
PSIG = Pounds per Square Inch Gauge (Pressure at Hi-Valve Manhole).

Fig. 5—Airflow and Pressure Readings—Manifold and Hi-Valve Manholes

5

FORM E-5407

PRESSURE READINGS
LATERAL DISTRIBUTION CABLES
(At Analysis Valves, Transducers and Contactors)

PIPE ROUTE_____

UG CABLE_____

* AERIAL CABLE ROUTE OR NO._____

Date	Location or Pole No.	Pressure Reading at				For Analysis Valves Only	
		V_1	V_2	Transducer	Contactor	Distance (Ft.) Between V_1 and V_2	Cable Size and Gauge

* Covers all pressurized cable outward from V_1 location.

Fig. 6—Pressure Readings—Lateral Distribution Cables

(c) ***Alarm flow setting*** is the rate of air usage, in scfd as read on the flow rate indicator or flowrater, at which the alarm has been set to operate. The C meter-panel is preset to indicate an alarm condition when the flow rate exceeds 1200 scfd. For the superseded pipe alarm meter-panel, the alarm flow setting is generally 50 to 75 scfd above the stablized airflow rate.

4.06 Form E-6369, Daily Transducer Data, is used for entering daily readings of all transducers for a month and a voltmeter equivalent reading for quick analysis.

5. MAINTENANCE CONSIDERATIONS

5.01 All cable systems can be expected to develop leaks. Therefore, such terms as ***stabilized daily air usage*** or ***stabilized airflow rate*** refer to air requirements as of some specific time when end pressure requirements were being met satisfactorily. Beyond that time, air requirements would increase as leaks occurred. Utilization of the monitoring equipment described in Part 2 will direct attention to when, where, and how soon leak locating and repairing should be undertaken.

5.02 ***The keys to effective maintenance of a pressure system are:***

(a) ***The recognition that there are several different monitoring devices or methods which should be used almost simultaneously to provide realistic initial analysis.***

(b) ***Mutual understanding, by all forces involved, of the data available and its significance as applicable to the pipe system.***

5.03 ***An increase in air usage, as observed from the Air Usage Log,*** may have resulted from various causes.

(1) Air loss due to splicing activity

(2) The result of various small leaks

(3) The result of leaks in cables which have not yet resulted in significant pressure drops at transducer and contactor locations

(4) A leak or break in the pipe or tubing (a potential major failure).

If a significant increase in air usage is observed, information should be obtained as to the pressure situation on all transducers related to the specific pipe route.

5.04 ***The operation of the alarm on the meter-panel can have major or minor significance.*** Related data is necessary for proper interpretation. A break in the pipe itself is indicated by a great increase in flow rate (flow rate indicator or flowrater showing maximum flow). A break in the tubing at a manifold location would show a flow increase of several hundred standard cubic feet. A large leak in an underground cable, a tubing break at a hi-valve location, or a large leak in an aerial feeder close to the underground may indicate a flow increase of 50 or more scfd. On the other hand, an ***alarm*** condition can be indicated as a result of flow increasing gradually over a period of weeks to the alarm point as a result of cumulative small leaks—a condition which should have been noted from the Air Usage Log readings and corrected on a routine basis in absence of alarm operation. Therefore, with any ***alarm*** on the meter-panel, determine the immediate possible major significance by obtaining information as to the amount of flow increase. Based on the flow increase and the previous day-to-day usage, estimate the probable cause of the alarm. In addition, a check on transducers associated with the particular pipe route may help further in evaluating the alarm significance.

Inspection of Lead Sleeves

5.05 Each thin-walled lead (no ridge) or lead-antimony (three ridges) 4-1/2 inches and larger in diameter and sleeves which show evidence of swelling under continuous pressure should be reinforced with lashed cable supports (see Section 637-020-200). When entering manifold manholes, the following procedure is recommended:

(a) Verify that lashed cable supports have been installed on each pressurized sleeve in accordance with the foregoing requirements. Install supports at any of the these sleeves not so equipped.

(b) Where sleeve swelling is observed, reinforce the sleeve in the standard manner. Refer the condition to the supervisor so arrangements can be made to inspect sleeves in adjacent manholes.

6. MAINTENANCE PROCEDURES

6.01 Maintenance procedures will vary, as between specific alarm and general routine situations.

(a) Typically, ***under alarm conditions,*** attention will be directed to a particular pipe route, transducer, or contactor. Related data may point to a definite type of fault, such as a pipe or tubing failure, series cable leak, etc. A complete pipe analysis may be necessary or, where transducer or contactor data indicate, the analysis may be limited to a particular aerial cable section.

(b) Under ***routine conditions*** it may be desirable, where increased air usage is detected, to make a complete analysis of the pipe route, the underground cables, and the aerial feeders. In this connection, a routine investigation is warranted where the daily air usage has increased more than 30 scfd, as determined from Form E-5403, Air Usage Log, and the increase has remained constant for three days.

General Analysis

6.02 An analysis of current airflows, and a comparison with data posted on Form E-5406, Airflow and Pressure Readings—Manifold and Hi-Valve Manholes (Fig. 5), generally will give a good indication of which section or sections of the pipe route require attention. Starting at the CO, take airflow readings at each manifold manhole and enter them on Form E-5406.

6.03 The Puregas PEC 546 portable flowrater (Fig. 7) is recommended for measuring the flow of air entering the manifold and the individual cables connected to the manifold in the vault or manifold manholes. This flowrater provides accurate instantaneous flow rates, which eliminates the need for mathematical airflow computations based on pressure drop information. Operation instructions are furnished with the flowrater.

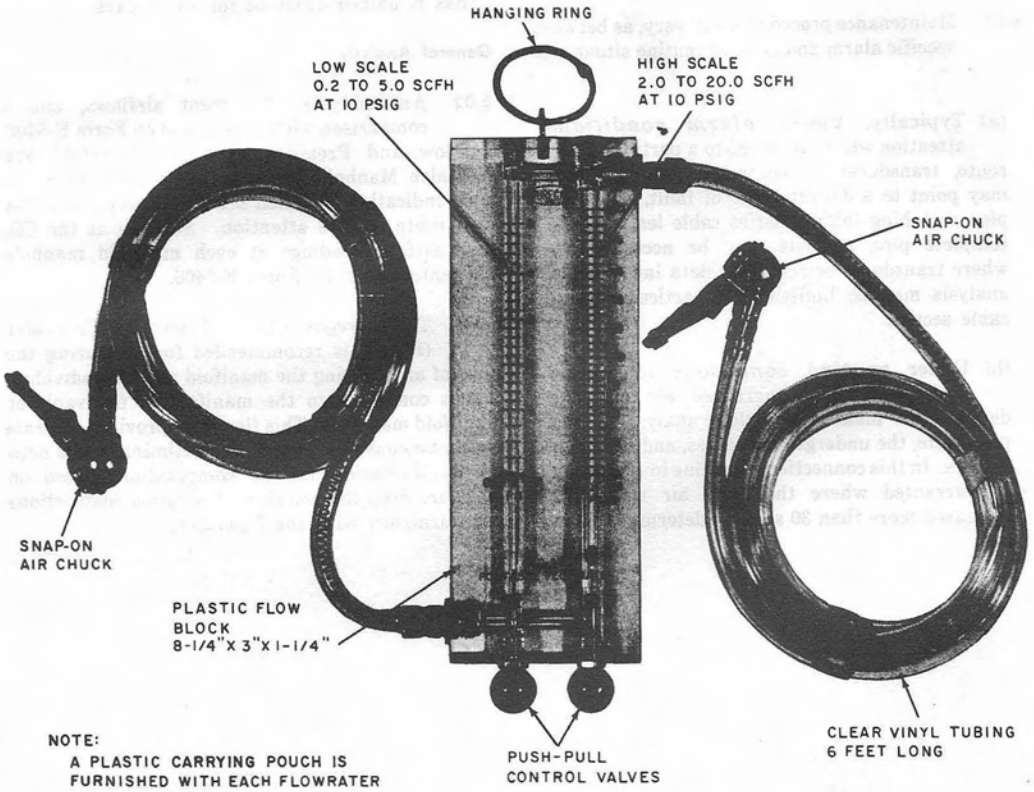

Fig. 7—Portable Flowrater (Puregas PEC 546)

6.04 ***Vault or Manifold Manholes:***

(a) Take airflow reading into manifold at points V_p and V_m (Fig. 8 or 9). This flow reading is a relative reading and will not equal the total airflow into the individual cables connected to this manifold.

(b) Compare the ***current*** airflow with the ***previous*** airflow into the manifold. The fact that currently there may be a large flow is not itself significant; it is significant only if it is higher than previously.

(c) At any manifold where an increase in flow into the manifold is observed, make the following additional test (refer to Fig. 8 or 9):

(1) Connect the flowrater to V_m and to the V_c valve of the cable to be tested.

(2) Close shutoff valves for the cable to be tested.

(3) After airflow has stabilized, record reading indicated on flowrater.

(4) Open shutoff valve to that cable and remove flowrater connection from V_c valve.

(5) Connect flowrater to V_c valve of adjacent cable and close shutoff valve for that cable.

(6) Repeat this procedure until readings for all five cables associated with a particular manifold have been recorded.

(d) A flow increase when a shutoff valve is closed (during above test of individual cables) may indicate that the cable needs further investigation.

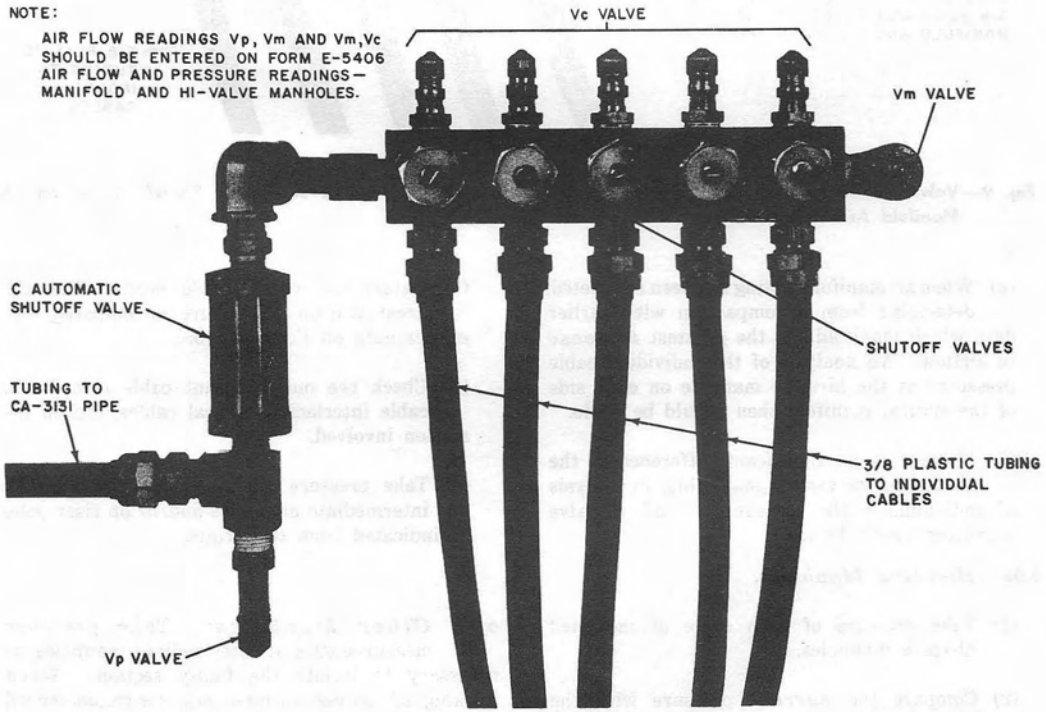

Fig. 8—Valve Reading Points in Vault or Manifold Manhole Using C Automatic Shutoff Valve and C Manifold Assembly

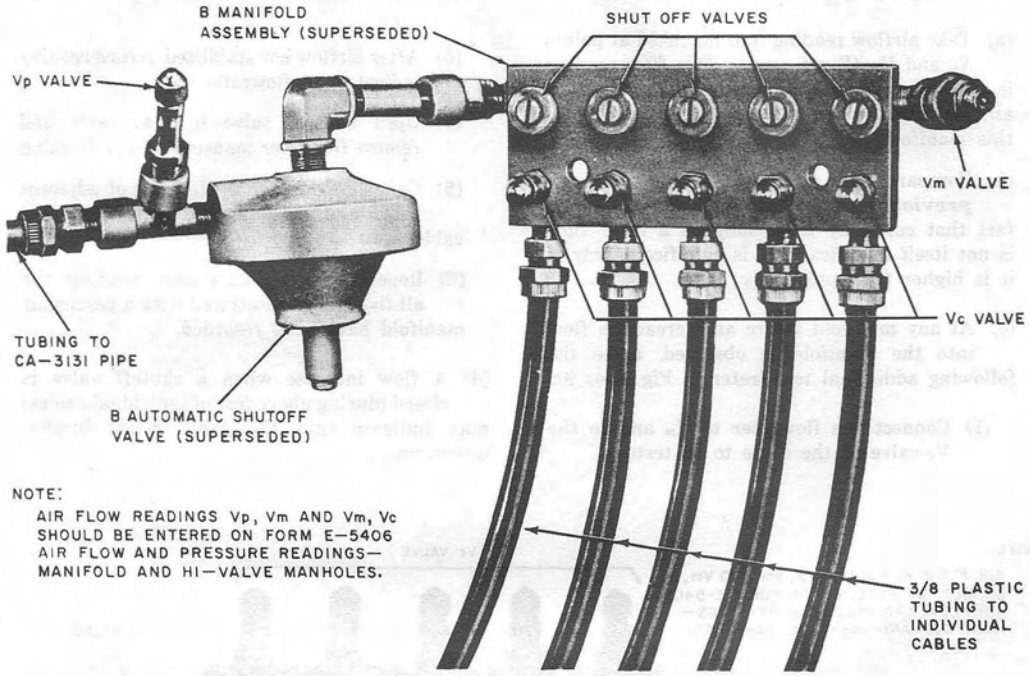

Fig. 9—Valve Reading Points in Manifold Manhole Having Superseded B Automatic Shutoff Valve and B Manifold Assembly Installed

(e) When all manifold testing has been completed, determine from a comparison with earlier data which manifold has the greatest ***increase*** in airflow. An analysis of the individual cable pressures at the hi-valve manhole on each side of the critical manifold then should be made.

(f) If there is no significant difference in the airflow at the various manifolds, an analysis of individual cable pressures at all hi-valve manholes should be made.

6.05 ***Hi-Valve Manholes:***

(1) Take pressure of each cable at indicated hi-valve manholes.

(2) Compare the ***current*** pressure with the ***previous*** pressure. It is the change in pressure rather than the pressure itself that is significant.

(3) Determine which cable section has the greatest drop in pressure as compared with earlier data on Form E-5406.

(4) Check the outside plant cable records for cable interlacing, lateral cables, etc, in the section involved.

(5) Take pressure measurements on cables in intermediate manholes and/or on riser poles as indicated from the prints.

6.06 ***Other Manholes:*** Take pressure measurements at intermediate manholes as necessary to isolate the faulty section. When working in intermediate manholes, it is recommended that ***all*** cables in the manhole be tested for leaks with ultrasonic leak-locating equipment, if it is available.

Analyzing Lateral Cables

6.07 Where the analysis of pipe and underground cable pressures points to a fault in one or more laterals, make analysis valve readings on the suspected laterals. Compare these readings with those previously posted on Form E-5407, Pressure Readings—Lateral Distribution Cables.

6.08 Use the Cable Pressurization Computer, flow analysis methods, and available leak locating equipment (ultrasonic or spray) in working on each lateral suspected of having a significant leak.

Analyzing From Transducer Indications

6.09 Where the lowering of cable pressure to an ***alert*** level at a transducer location directs attention to a particular lateral, determine first whether the fault appears to be back toward the underground or in the aerial. Compare current pressure readings at the transducer and analysis valves with those posted on Form E-5407. A cable pressure reading at a nearby hi-valve or intermediate manhole may be necessary for determining the general direction of the fault.

6.10 Continue with underground or lateral cable analysis as necessary to locate the leak. Where the fault is indicated to be in the aerial section, it may be helpful to have the test center make a check for operated contactors on the lateral cable involved.

Analyzing From Contactor Operation

6.11 Where a drop in pressure has resulted in contactor operation, a check should be made from the test center as to the operation of any other contactors on the lateral and the pressure at any transducer on the lateral. Such data will be helpful to the employee dispatched on the trouble. Based on this data, take pressure readings at the indicated contactor(s) and/or transducer. Compare such readings with those posted on Form E-5407.

6.12 Use conventional flow analysis methods (see the 637 Division of the Bell System Practices) and leak-locating equipment for determining the leak location.

Recheck on Pipe Alarms, Transducers, and Contactors

6.13 After leak repairs have been completed and the cable pressure has been stabilized (generally two or three days later), the following is recommended:

(1) Check the pressure at contactors and/or transducers on any affected lateral cable. Reset the contactors where necessary, and update any pertinent data on Forms E-5405 and E-5407 relating to cable pressure and the alarm setting or ***alert*** pressure.

(2) Check the air usage and flow rate at the meter-panel in any case where the pipe alarm had been operated or a routine pipe analysis had been required. Update any pertinent data on Form E-5403 relating to stabilized air usage and flow rate.