# GUIDE MATERIAL APPENDIX G-11A

(See guide material under 192.11 and 192.723)

## GAS LEAKAGE CONTROL GUIDELINES FOR PETROLEUM GAS SYSTEMS (SEE GUIDE MATERIAL APPENDIX G-11 FOR NATURAL GAS SYSTEMS)

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## GAS LEAKAGE CONTROL GUIDELINES FOR PETROLEUM GAS SYSTEMS (SEE GUIDE MATERIAL APPENDIX G-11 FOR NATURAL GAS SYSTEMS)

## 1 SCOPE

These guidelines provide criteria for the detection, grading and control of gas leakage and for related records for systems handling Petroleum Gases or Petroleum Gas/Air mixtures which are heavier than air.

## 2 GENERAL DISCUSSION

A separate set of guidelines for Petroleum Gas System Leakage Surveys has been developed because of the differing physical properties of Natural Gas and Petroleum Gases.

When considering gas leakage detection and control, the two most significant differences between natural gas and petroleum gas vapor are their specific gravity and flammable limits. The specific gravity of natural gas is approximately 0.6 which is, therefore, lighter than air. This property facilitates the venting and dissipation of natural gas leakage into the atmosphere.

Petroleum gas vapor has a specific gravity range of 1.6 to 2.0 which is heavier than air. Therefore, when petroleum gas vapor escapes, it tends to settle in low places, and to move along the bottom of ditch lines and substructures unless dissipated by substantial air movement. It does not readily vent to the surface under normal conditions. When conducting tests for leakage on buried petroleum gas systems, it is essential that samples be taken at or near the pipe, in the bottom of ditch lines and at the low point of substructures.

Hazardous concentrations of petroleum gas can develop rapidly because of the relatively low LEL. The flammable range of natural gas is approximately 5 to 15 percent gas in air compared to 2 to 10 percent gas in air for petroleum gases. Therefore, when conducting a petroleum gas system leakage survey, it is essential to remember that the lower explosive limit can be as low as 1.9 percent gas in air. It is essential that Combustible Gas Indicator (CGI) instruments used to conduct petroleum gas leakage surveys be properly calibrated. This is especially important when a CGI calibrated for natural gas or methane is used in conjunction with conversion curves for detecting concentrations of other gases. CGI instruments are discussed in more detail in 4.5 below.

## 3 DEFINITIONS (Applicable to Guide Material Appendix G-11A Only)

*Bar Hole* is a hole that is made in the soil or paving for the specific purpose of testing the subsurface atmosphere with a CGI.

*Building* is any structure which is normally or occasionally entered by humans for business, residental or other purposes, and in which gas could accumulate.

*Combustible Gas Indicator (CGI)* is a device capable of detecting and measuring gas concentrations (of the gas being transported) in the atmosphere.

*Confined Space* is any subsurface structure (such as vaults, catch basin, or manholes) of sufficient size to accommodate a person, and in which gas could accumulate.

*Follow-up Inspection* is an inspection performed, after a repair has been completed, to determine the effectiveness of the repair.

**TABLE 1 – SIGNIFICANT PHYSICAL PROPERTIES OF FOUR TYPICAL HYDROCARBON GASES NORMALLY FOUND IN DISTRIBUTION AND PIPELINE SYSTEMS[1]**

| | Natural Gas | Propane | Propane/Air 40/60% | Butane |
|---|---|---|---|---|
| Formula | Blend | $C_3H_8$ | $C_3H_8$/Air | $C_4H_{10}$ |
| Normal State @ atmospheric pressure @ 60°F | Gas | Gas | Gas | Gas |
| Specific Gravity (Air = 1) | 0.6 | 1.6 | 1.2 | 2.0 |
| Flammability Limits | | | | |
| Lower Limit % Gas in Air | 5 | 2 | [2] | 2 |
| Upper Limit % Gas in Air | 15 | 10 | [2] | 9 |

[1] Other mixtures may have significantly different physical properties. Each operator should evaluate the gas in his distribution system and react accordingly.
[2] The explosive limits refer to percent gas in air and are the same as shown for propane.

*Gas Associated Substructure* is a device or facility utilized by a gas company (such as a valve box, vault, test box or vented casing pipe) which is not intended for storing, transmitting or distributing gas.

*L.E.L.* is the *lower* explosive limit of the gas being transported.

*Natural Gas* is a blend of gases that is primarily methane and is lighter than air.

*Petroleum Gas* is propane, butane, or mixtures of these gases (other than a gas air mixture that is used to supplement supplies in a natural gas distribution system) that is heavier than air.

*Permanent Test Point* is a selected sample point which has been installed to maintain an opening for the testing of the subsurface atmosphere over or adjacent to the gas facility. Curb boxes, vents, or test inserts are normally used for this purpose.

*Prompt-Action* shall consist of dispatching qualified personnel without delay for the purpose of evaluating and, where necessary, abating the existing or probable hazard.

*Reading* is a repeatable deviation on a CGI or equivalent instrument, expressed in LEL. Where the reading is in an unvented confined space, consideration should be given to the rate of dissipation when the space is ventilated, and the rate of accumulation when the space is resealed.

*Small Substructures (other than gas associated substructures)* are any subsurface structures that are of insufficient size to accommodate a person (such as telephone and electrical ducts and conduit or non-gas-associated valve and meter boxes), and in which gas could accumulate or migrate.

*Tunnel* is a subsurface passageway large enough for a man to enter and in which gas could accumulate.

## 4 LEAKAGE DETECTION

### 4.1 *Qualification of personnel.*

Gas leakage surveys should be performed by personnel who are qualified by training and experience in the type of survey being performed. They should be thoroughly familiar with the characteristics of the petroleum gas in the system and trained in the use of leakage detection instruments.

### 4.2 *Reports from outside sources.*

Any notification from an outside source (such as police or fire department, other utility, contractor, customer or general public) reporting a leak, explosion or fire, which may involve gas pipelines or other gas facilities, should be investigated promptly. If the investigation reveals a leak, the leak should be graded and action should be taken in accordance with these guidelines.

*4.3 Odors or indications from foreign sources.*

When leak indications (such as gasoline vapors, natural, petroleum, sewer or marsh gas) are found to originate from a foreign source or facility, or customer owned piping, prompt actions should be taken where necessary to protect life and property. Potentially hazardous leaks should be reported promptly to the operator of the facility and, where appropriate, to the police department, fire department, or other governmental agency. When the company's pipeline is connected to a foreign facility (such as the customer's piping), necessary action (such as disconnecting or shutting off the flow of gas to the facility) should be taken to eliminate the potential hazard.

*4.4 Leakage surveys and test methods.*

The following gas leakage surveys and test methods may be employed, as applicable, singly or in combination, in accordance with written procedures.

- Subsurface Gas Detector Survey (including bar hole surveys)
- Bubble Leakage Test
- Pressure Drop Test
- Ultrasonic Leakage Test

Other survey and test methods may be employed if they are deemed appropraite and are conducted in accordance with procedures which have been tested and proven to be at least equal to the methods listed in this section.

The Surface Gas Detection Survey and Vegetation Survey methods used for natural gas systems are not recommended for use on petroleum gas systems. Petroleum gases are heavier than air and will frequently not come to the ground surface or cause surface indications in the vegetation. However, the Surface Gas Detection Survey, when properly conducted taking into account that the gas is heavier than air, may be used adjacent to above ground facilities.

(a) Subsurface Gas Detection Survey

(1) *Definition.* The sampling of the subsurface atmosphere with a combustible gas indicator or other device capable of detecting 10 percent of the LEL at the sample point.

(2) *Procedure.* The survey should be conducted by performing tests with a CGI in a series of bar holes immediately adjacent to the gas facility and in available openings (confined spaces and small substructures) adjacent to the gas facility. The location of the gas facility and its proximity to buildings and other structures should be considered when determining the spacing of sample points. Spacing of sample points along the main or pipeline will depend on soil and surface conditions but should never be more than 20 feet apart. Where the facility passes under paving for a distance of 20 feet or less, tests should be made at the entrance and exit points of the paved area. Where the paved area over the facility is 20 feet or greater in length, sample points should be located at intervals of 20 feet or less. In the case of extensive paving, permanent test points should be considered, particularly in low places. The sampling pattern should include tests at potential leak locations such as threaded or mechanical joints, and at building walls at the service riser or service line entrance. All available openings adjacent to the facility should be tested.

When testing available openings for petroleum gas, readings should be taken at both the top and bottom of the structure. When testing larger confined spaces or basements, the floor areas, including floor drains, should be thoroughly tested because petroleum gases can lie temporarily in pockets containing explosive mixtures. Since migrating gas may not enter at the pipeline entrance, a perimeter survey of the floors and walls is recommended. When conducting the survey, all bar holes should

penetrate to the pipe depth where necessary in order to obtain consistent and worthwhile readings. The required depth of the test hole will depend upon the soil conditions, the depth of and pressure in the pipeline, and the type of instrument being used. The reading should be taken at the bottom of the test hole. The probe used should be equipped with a device to preclude the drawing in of fluids. When conducting the survey, the inspector should use the most sensitive scale on the instrument, watching for small indications of combustible gas. Any indication should be further investigated to determine the source of the gas. Care should be taken to avoid damaging the pipe and/or coating with the probe bar.

(3) *Utilization.* This survey method should be utilized for buried facilities. Good judgment must be used to determine when the recommended spacing of sample points is inadequate. Additional sample points should be provided under these conditions. Available openings (such as manholes, vaults and valve boxes) should be tested. However, they should not be relied upon as the only points used to test for petroleum gas leakage.

(b) Bubble Leakage Test

(1) *Definition.* The application of a soap-water or other bubble forming solutions on exposed piping to determine the existence of a leak.

(2) *Procedure.* The exposed piping systems should be reasonably cleaned and completely coated with the solution. Leaks are indicated by the presence of bubbles. The bubble forming solution should not be used on piping unless it has been determined by investigation or test that the piping is adequately resistant to direct contact with the solution.

(3) *Utilization.* This test method may be used for the following.

(i) Testing exposed above ground portions of a system (such as meter set assemblies or exposed piping on bridge crossings).

(ii) Testing a tie-in joint or leak repair which is not included in a pressure test.

(c) Pressure Drop Test

(1) *Definition.* A test to determine if an isolated segment of pipe line loses pressure due to leakage.

(2) *Procedure.* Facilities selected for pressure drop tests should first be isolated and then tested. The following criteria should be considered in determining test parameters.

(i) Test Pressure. A test conducted on existing facilities solely for the purpose of detecting leakage should be performed at a pressure at least equal to the operating pressure. A pressure test conducted for the purpose of line qualification or uprating must be performed in accordance with the requirements of Subparts J or K of the Minimum Federal Safety Standards.

(ii) Test Medium. The test medium used must comply with the requirements of 192.503(b) of the Minimum Federal Safety Standards.

(iii) Test Duration. The duration of the test should be of sufficient length to detect leakage. The following should be considered in the determination of the duration.

– The volume under test.

– The time required for the test medium to become temperature stabilized.

– The sensitivity of the test instrument.

(3) *Utilization.* Pressure drop tests should be used only to establish the pressure or absence of a leak on a specifically isolated segment of a pipe line. Normally, this type of test will not provide a leak location. There-

fore, facilities on which leakage is indicated may require further evaluation by another detection method in order that the leak may be located, evaluated and graded.

(d) Ultrasonic Leakage Test

(1) *Definition.* The testing of exposed piping facilities with an instrument capable of detecting the ultrasonic energy generated by escaping gas. The instrument used should be suitable for the pressure involved.

(2) *Procedure.* In the testing of a gas facility by this method, the following should be considered.

(i) *Line Pressure.* As the line pressure increases, the magnitude of the ultrasonic energy generated by a leak increases.

(ii) *Location of Facility.* Objects near or surrounding a facility being tested may reflect or attenuate the ultrasonic energy generated, making it difficult to detect or pinpoint the leak.

(iii) *Leak Frequency.* A number of leaks in a given area can create a high ultrasonic background level which may reduce the detection capabilities of this type of test.

(iv) *Type of Facility.* Pneumatic and gas operated equipment generate ultrasonic energy. The location and amount of this type of equipment should be known to determine if the ultrasonic background is too high.

Personnel conducting this type of test should scan the entire area to eliminate the tracking of reflected indications.

Ultrasonic indications of leakage should be verified and/or pinpointed by one of the other acceptable survey or test methods.

(3) *Utilization.* The ultrasonic test may be used for the testing of exposed piping facilities. However, if the ultrasonic background level produces a full scale meter reading when the gain is set at mid-range, the facility should be tested by some other survey method.

*4.5 Typically available instruments for the detection of gas.*

(a) Type and General Usage

See Table 2

(b) Maintenance of Instruments

Each instrument utilized for leak detection and evaluation should be operated in accordance with the manufacturer's recommended operating instructions and:

(1) Should be periodically "checked" while in use to insure that the recommended voltage requirements are available.

(2) Should be tested daily or prior to use to insure proper operation, to insure that the sampling system is free of leakage, and to insure that the filters are not obstructing the sample flow.

(3) Hydrogen Flame Ionization (HFI) systems should be tested at each start-up and periodically tested during a survey.

(c) Calibration of Instruments (Also See 4.5(d) below.)

Each instrument utilized for leak detection and evaluation should be calibrated in accordance with the manufacturer's recommended calibration instructions.

(1) After any repair or replacement of parts.

(2) On a regular schedule giving consideration to the type and usage of the instrument involved. HFI and CGI instruments should be checked for calibration at least once each month while in use.

(3) At any time it is suspected that the instrument's calibration has changed.

TABLE 2 – TYPE AND GENERAL USAGE[1]

| Instrument Type Subsurface Survey | Lower Sensitivity Level PPM[2] | % LEL | % GAS | Upper Sensitivity Level PPM | % LEL | % GAS | Sampling Method |
|---|---|---|---|---|---|---|---|
| Catalytic Type (Hotwire % LEL) | 2,000 | 10 | 0.2 | 20,000 | 100 | 2[3] | Hand Aspirated |
| Thermal Conductivity (% Gas) | 50,000 | | 5.0 | | | 100 | Hand Aspirated |
| Amplified Thermal Conductivity | 50 | 1 | | | | 25[3] | Pump |
| Infrared Detector | 5 | | | 1,000 | 2 | 0.1 | Pump |
| Hydrogen Flame[4] Ionization Detector | 1 | | | 10,000 to 50,000 | 20 to 100 | 1 to 5 | Pump |

[1] The PPM, percent LEL, and percent gas values shown are for propane concentrations on instruments calibrated for propane. Where other liquified petroleum gases or manufactured gas are involved, appropriate adjustment should be made to be commensurate with the criteria of these procedures. See 4.5(d) below.

[2] PPM-Parts per Million

[3] When the maximum concentration detectable is exceeded, the needle of this instrument meter will drop to zero or below.

[4] Upper sensitivity level varies with different models.

(d) Conversion Curves

It is not absolutely essential that instruments used to conduct petroleum gas system leakage surveys be calibrated specifically for the gas being distributed. However, it is essential that the instrument be properly calibrated for the gas specified by the manufacturer and that conversion curves for the appropriate petroleum gas be obtained from the manufacturer or be developed by the operator. Without proper calibration and the appropriate conversion curves the inspector cannot interpret meter readings or determine concentrations. For example, hotwire CGI instruments calibrated for methane or natural gas will read true for propane on the LEL scale (2.0 percent propane in air will read 100 percent LEL on the meter). On dual scale instruments calibrated for natural gas, a 100 percent propane concentration will not read 100 percent gas.

## 5 LEAKAGE CLASSIFICATION AND ACTION CRITERIA

*5.1 General.*

The following establishes a procedure by which leakage indications of flammable petroleum gas can be graded and controlled. When evaluating any petroleum gas leak indication, the initial step is to determine the perimeter of the leak area. When this perimeter extends to a building wall, the investigation should continue into the building. Where petroleum gas is involved, special attention should be given to the basement or other low areas.

*5.2 Leak grades.*

Based on an evaluation of the location and/or magnitude of a leak, one of the following leak grades should be assigned, thereby establishing the leak repair priority.

*Grade 1,* a leak that represents an existing or probable hazard to persons or property and requires immediate repair or continuous action until the conditions are no longer hazardous.

*Grade 2,* a leak that is recognized as being non-hazardous at the time of detection, but, requires scheduled repair based on probable future hazard.

*Grade 3,* a leak that is non-hazardous at the time of detection and can be reasonably expected to remain non-hazardous. Because petroleum gas is heavier than air and will collect in low areas instead of dissipating, few leaks can safely be classified as Grade 3.

*5.3 Leak classification and action criteria.*

Guidelines for leak classification and leakage control are provided in Tables 3a, 3b, and 3c. The examples of leak conditions provided in the tables are presented as guidelines and are not exclusive. The judgment of the company personnel at the scene is of primary importance in determining the grade assigned to a leak.

*5.4 Follow-up inspection.*

The adequacy of leak repairs should be checked before backfilling. The perimeter of the leak area should be checked with the CGI. Where there is residual gas in the ground after the repair of a Grade 1 leak, follow-up inspections should be made as soon as practical after allowing the soil atmosphere to vent and stabilize, but in no case later than one month following the repair. Since petroleum gases are heavier than air, it is usually necessary to purge or mechanically vent an area one or more times to insure that a hazardous condition no longer exists. In the case of other repairs, the need for a follow-up inspection should be determined by qualified personnel and when a follow-up inspection is needed, it should be made as soon as practical but in no case later than three months.

*5.5 Reevaluation of a leak.*

When a leak is to be reevaluated (see Tables 3b and 3c), it should be classified using the same criteria as when the leak was first discovered.

## 6 RECORDS AND SELF AUDIT GUIDELINES

*6.1 Leak records.*

Historical gas leak records should be maintained. Sufficient data should be available to provide the information needed to complete the Department of Transportation Leak Report Forms DOT F-7100.1, DOT F-7100.1-1, DOT F-7100.2 and DOT F-7100.2.1 and to demonstrate the adequacy of company maintenance programs.

The following data should be recorded and maintained, but need not be in any specific format or retained at one location. Time of day and environmental description records are required only for those leaks which are reported by an outside source or require reporting to a regulatory agency.

(a) Date discovered, time reported, time dispatched, time investigated and by whom.
(b) Date(s) reevaluated before repair and by whom.
(c) Date repaired, time repaired and by whom.
(d) Date(s) rechecked after repair and by whom.
(e) If a reportable leak, date and time of telephone report to regulatory authority and by whom.
(f) Location of leak.
(g) Leak grade.
(h) Line use (distribution, transmission, etc.).
(i) Method of leak detection (if reported by outside party, list name and address).
(j) Part of system where leak occurred (main, service, etc.).

*Text continued on p. 279.*

TABLE 3a – LEAK CLASSIFICATION AND ACTION CRITERIA – GRADE 1

| GRADE | DEFINITION | ACTION CRITERIA | EXAMPLES |
|---|---|---|---|
| 1 | A leak that represents an existing or probable hazard to persons or property, and requires immediate repair or continuous action until the conditions are no longer hazardous. | Requires *prompt action** to protect life and property, and continuous action until the conditions are no longer hazardous.<br><br>*The prompt action in some instances may require one or more of the following.<br><br>a. Implementation of company emergency plan (192.615).<br><br>b. Evacuating premises.<br><br>c. Blocking off an area.<br><br>d. Rerouting traffic.<br><br>e. Eliminating sources of ignition.<br><br>f. Venting the area.<br><br>g. Stopping the flow of gas by closing valves or other means.<br><br>h. Notifying police and fire departments. | 1. Any leak which, in the judgment of operating personnel at the scene, is regarded as an immediate hazard.<br><br>2. Escaping gas that has ignited.<br><br>3. Any indication of gas which has migrated into or under a building, or into a tunnel.<br><br>4. Any reading at the outside wall of a building, or where gas would likely migrate to an outside wall of a building.<br><br>5. Any reading of 60% LEL, or greater, in a confined space.<br><br>6. Any reading of 60% LEL, or greater in small substructures (other than gas associated substructures) from which gas would likely migrate to the outside wall of a building.<br><br>7. Any leak that can be seen, heard, or felt, and which is in a location that may endanger the general public or property. |

TABLE 3b – LEAK CLASSIFICATION AND ACTION CRITERIA – GRADE 2

| GRADE | DEFINITION | ACTION CRITERIA | EXAMPLES |
|---|---|---|---|
| 2 | A leak that is recognized as being non-hazardous at the time of detection, but justifies scheduled repair based on probable future hazard. | Leaks should be repaired or cleared within one calendar year, but no later than 15 months from the date the leak was reported. In determining the repair priority, criteria such as the following should be considered.<br><br>a. Amount and migration of gas.<br><br>b. Proximity of gas to buildings and subsurface structures.<br><br>c. Extent of pavement.<br><br>d. Soil type, and soil conditions (such as frost cap, moisture and natural venting).<br><br>Grade 2 leaks may vary greatly in degree of potential hazard. Some Grade 2 leaks, when evaluated by the above criteria, may justify scheduled repair within the next 5 working days. During the working day on which the leak is discovered, these situations should be brought to the attention of the individual responsible for scheduling leak repair.<br><br>On the other hand, many Grade 2 leaks, because of their location and magnitude, can be scheduled for repair on a normal routine basis with periodic reinspection as necessary.<br><br>Grade 2 leaks should be reevaluated at least once every 3 months until cleared. The frequency or reevaluation should be determined by the location and magnitude of the leakage condition. | A. *Leaks Requiring Action Ahead of Ground Freezing or Other Adverse Changes in Venting Conditions.*<br><br>Any leak which, under frozen or other adverse soil conditions, would likely migrate to the outside wall of a building.<br><br>B. *Leaks Requiring Action Within Six Months*<br><br>1. Any reading of 40% LEL, or greater, under a sidewalk in a wall-to-wall paved area that does not qualify as a Grade 1 leak.<br><br>2. Any reading of 100% LEL, or greater, under a street in a wall-to-wall paved area that has significant gas migration and does not qualify as a Grade 1 leak.<br><br>3. Any reading less than 60% LEL in small substructures (other than gas associated substructures) from which gas would likely migrate creating a probable future hazard.<br><br>4. Any reading of less than 60% LEL in a a confined space.<br><br>5. Any reading on a pipeline operating at 30 percent SMYS, or greater, in a class 3 or 4 location, which does not qualify as a Grade 1 leak.<br><br>6. Any reading of 80% LEL, or greater, in gas associated substructures.<br><br>7. Any leak which, in the judgment of operating personnel at the scene, is of sufficient magnitude to justify scheduled repair. |

TABLE 3c – LEAK CLASSIFICATION AND ACTION CRITERIA – GRADE 3

| GRADE | DEFINITION | ACTION CRITERIA | EXAMPLES |
|---|---|---|---|
| 3 | A leak that is non-hazardous at the time of detection and can be reasonably expected to remain non-hazardous. Because petroleum gas is heavier than air and will collect in low areas instead of dissipating, few leaks can safely be classified as Grade 3. | These leaks should be rechecked within 3 months of date reported to substantiate the grading.<br><br>Thereafter, these leaks should be reevaluated during the next scheduled survey, or within 15 months of the date reported, whichever occurs first, until the leak is regraded or no longer results in a reading. | *Leaks Requiring Reevaluation at Periodic Intervals*<br><br>1. Any reading of less than 80% LEL in small gas associated substructures.<br><br>2. Any reading under a street in areas without wall-to-wall paving where it is unlikely the gas could migrate to the outside wall of a building. |

(k) Part of system which leaked (pipe, valve, fitting, compressor or regulator station, etc.).
(l) Material which leaked (steel, plastic, cast iron, etc.).
(m) Origin of leak.
(n) Pipe description.
(o) Type repair.
(p) Leak cause.
(q) Date pipe installed (if known).
(r) Under cathodic protection? (Yes – No).
(s) Magnitude of CGI indication.

*6.2 Leak survey records.*

For the current and immediately previous survey of an area, the following information should be available.

(a) Description of system and area surveyed. (This could include maps and/or leak survey logs.)
(b) Survey results.
(c) Survey method.
(d) Names of those making survey.
(e) Survey dates.
(f) In addition to the above, the following records should be kept for a pressure drop test.
  (1) The name of the operator, the name of the operator's employee responsible for making the test, and the name of any test company used.
  (2) Test medium used.
  (3) Test pressure.
  (4) Test duration.
  (5) Pressure recording charts, or other record of pressure readings.
  (6) Test results.

*6.3 Self audits.*

In order that the effectiveness of the leak detection and repair program may be evaluated, self audits should be performed on the following.

(a) Schedule of leakage survey. The operator should insure that the schedule is commensurate with Subpart M of the Minimum Federal Safety Standards and the general condition of the pipeline system.
(b) Survey effectiveness. The operator should evaluate leakage survey results to assure that, throughout the system a consistent evaluation is being made.
(c) Repair scheduling. The operator should insure that repairs are made within the time specified.
(d) Repair effectiveness. The operator should insure that leak repairs are effective.
(e) Leak records. The operator should insure that adequate records are being maintained.

## 7 PINPOINTING

*7.1 Scope.*

Pinpointing is the process of tracing a detected gas leak to its source. It should follow an orderly systematic process which uses one or more of the following procedures to minimize excavation. The objective is to prevent unnecessary excavation which is more time consuming and costly than time spent pinpointing a leak.

*7.2 Procedure.*

(a) The migration of gas should be determined by establishing the outer boundaries of the indications. This will define the area in which the leak will normally be located. These tests should be made with a CGI without expending excessive effort providing sample points.

(b) All gas lines should be located to narrow the area of search. Particular attention should be paid to the location of valves, fittings, tees, stubs and connections, the latter having a relatively high probability of leakage. Caution should be exercised to prevent damage to other underground structures during barring or excavating.

(c) Foreign facilities in the area of search should be identified. The operator should look for evidence of recent construction activities which could have contributed to the leakage. Gas may also migrate and vent along a trench provided for other facilities.

(d) Evenly spaced bar or test holes should be used over the gas line suspected to be leaking. All barholes should be of equal depth and diameter (and down to the pipe depth where necessary) and all CGI readings should be taken at an equal depth in order to obtain consistent and worthwhile readings. Using only the highest sustained readings, the gas can be traced to its source by identifying the test holes with the highest readings.

(e) Frequently, high readings are found in more than one barhole and additional techniques are necessary to determine which reading is closest to the probable source. Many of the barhole readings will normally decline over a period of time but it may be desirable to dissipate excess gas from the underground locations to hasten this process. Evaluation methods should be used with caution to avoid distorting the venting patterns.

(f) Once underground leakage has been identified, additional holes and deeper holes should be probed to more closely bracket the area. (For example, test holes may be spaced six feet apart initially and then the six foot spacing between the two highest holes might be probed with additional test holes, with spacing as close as twelve inches.)

(g) Additional tests include taking CGI readings at the top of a barhole or using manometer or bubble forming solutions to determine which barhole has the greatest positive flow. Other indications are dust particles blowing from the barholes, the sound of gas coming from the barhole or the feel of gas flow on a sensitive skin surface. On occasion, sunlight diffraction can be observed as the gas vents to the atmosphere.

(h) When gas is found in an underground conduit, testing at available openings may be used to isolate the source in addition to the techniques previously mentioned. Many times the leak is found at the intersection of the foreign conduit and the gas line. Particular attention should be given to these locations.

(i) When the pattern of the CGI readings has stabilized, the bar hole with the highest reading will usually pinpoint the gas leak.

(j) The operator should test with bubble forming solution where piping has been exposed, particularly to locate smaller leaks.

*7.3 Precautions.*

(a) Unusual situations may complicate these techniques on some occasions. They are unlikely, but possible. For example, multiple leakage can be occurring which gives confusing data. The area should be rechecked after repairs are completed to eliminate this potential. Gas may occasionally pocket and give a strong indication until the cavity has been vented. Foreign gases, such as gas from decomposed material, can occasionally be encountered. This is characterized by fairly constant CGI readings between 15 percent and 30 percent gas throughout the area. Indications of gas detected in sewer systems should be considered migrating gas leakage until proven otherwise by test and/or analysis.

(b) When pinpointing leakage where the gas is heavier than air (LP gas), the gas will normally stay low near the pipe level but may flow downhill. LP gases usually do not diffuse or migrate widely so the leak is generally close to the indication. If the gas is venting into a duct or sewer system, it can travel considerable distance.