

## Line Locating and Temporary Marking

<b>Purpose</b>	This purpose of this document is to share components of line locating programs with operators to ensure that underground facilities are properly identified and marked, ultimately safeguarding company facilities, employees/contractors, the public and the environment.
<b>Reference</b>	<p>49 CFR 195.442 “Damage prevention program”</p> <p>Common Ground Alliance Best Practices</p> <p>National Utility Locating Contractors Association (NULCA) Standards for Locating Technicians</p> <p>American Public Works Association (APWA)</p> <p>Encouraging Innovation in Locating and Characterizing Underground Utilities by the Transportation Research Board Report (S2-R01-RW)</p> <p>Utility Locating Technologies: Summary of Responses to a Statement of Need Distributed by the Federal Laboratory Consortium (FLC)</p> <p>Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data, 38-02 by the American Society of Civil Engineers (ASCE)</p>
<b>Appendices</b>	<ul style="list-style-type: none"> <li>• Appendix B: Other Documents</li> </ul>
<b>Related Toolbox Topics</b>	<ul style="list-style-type: none"> <li>• Line Locating Quality Assurance</li> <li>• One-Call Notification Screening</li> <li>• Excavation Monitoring and Observation</li> <li>• One-Call Notifications Response and Communications</li> <li>• Operator One-Call Ticket Management Systems</li> </ul>

**Introduction:**

This topic/document applies to pipeline locating and for the placement of temporary excavation marking. This topic/document references the guidelines of the Common Ground Alliance (CGA) Best Practices and National Utility Locating Contractors Association (NULCA) standards.

**Available Records:**

Facility locators use available records at all times. Facility records indicate approximate location, number of facilities, and access points for buried facilities within a requested area. The use of facility owner/operator-supplied records is an effective method of identifying facilities as part of the locating process. In addition, consult with field employees familiar with the site to identify any other below grade facilities that may not be recorded.









During the course of a locating activity, a locator may become aware of errors or omissions within records. "Redlining" is a process used when the maps of facility do not match the physical locations of these facilities. The locator should mark the correct position and GPS coordinates of the located facilities on the map/drawing. The locator should give this map to the appropriate parties so that the drawings can be updated. Failure to note errors or omissions when found could result in damages to the facility at a later date.

**CONSIDERATIONS: Information Sources**

- As-built drawings
- Mainline route/alignment sheets
- Station drawings
- Electrical/mechanical drawings
- Site photographs
- Survey plans
- Administrative plot plans
- Depth of cover plans
- Engineer plot plans
- Instrumentation and cathodic protection drawings
- Aerial photographs and GIS maps
- Landowners
- Provincial/state regulatory boards, agencies or commissions
- Locator drawings
- Land titles or instruments
- Government records (county/parish records)
- Third party databases
- Other owners/operators of buried facilities

**Color Code:**

Color-coded surface marks (paint or a similar coating) should be used to indicate the locations and route of buried lines. Markings should follow the APWA (American Public Works Association) Uniform Color Code:

	Red: Electric Power Lines, Cables, Conduit & Lighting Cables
	Yellow: Gas Oil, Steam, Petroleum or Gaseous Materials
	Orange: Communication, Cable TV, Alarm or Signal Lines, Cables or Conduit
	Blue: Potable Water
	Green: Sewers and Drain Lines
	Purple: Reclaimed Water, Irrigation and Slurry Lines
	Pink: Temporary Survey Markings
	White: Proposed Excavation

**Locator Training:**

Training may be necessary to ensure that designated personnel can identify and perform locates in a variety of environments, for example locating within a station may be more complex and require additional training. Some states may require specific training requirements.

**CONSIDERATIONS: Training Guidelines and Practices**

- Understanding system design/prints/technology
- Understanding construction standards and practices for all types of facilities
- Equipment training and techniques
- Terminal/station recognition training
- Theory of locating
- Daily operations
- Facility owner/excavator relationships and image
- Safety procedures per Occupational Safety and Health Administration (OSHA) regulations/federal, state/provincial and local laws
- Written and field testing
- Field training
- Annual retesting
- Abnormal Operating Conditions (AOC) training

Documentation of all training is maintained to ensure that facility locators have been properly trained.

**Visual Inspection:**

Be aware of, and avoid, electric fencing, rodents, stinging insects, venomous reptiles, livestock, predatory animals, excavations, soil conditions and poisonous vegetation in the vicinity.

Operators may want to check with municipal or county authorities to see if a permit is required to temporarily mark the system. Be aware of road conditions and traffic when working near roads/streets/highways and appropriate personal protective equipment (PPE), such as wearing bright visible colors (i.e. fluorescent orange or yellow). “Workers Ahead” highway signs may be required in some areas when working adjacent to roadways. Before performing a locate, a visual inspection should be completed at the site to determine potential hazards or obstacles. A visual inspection should identify the following, hazards if present:

**CONSIDERATIONS:**

- Obstructions such as buildings, poles, fences, and trees
- Traffic including highways, roads, or railways
- Physical site conditions such as extreme weather, uneven terrain, holes (hydrovac or animal), traffic, barbed wire, electric fences, livestock, etc.
- Signs of new construction such as fresh dirt, safety fencing, new signs, etc.
- Signs of foreign underground facilities including markers, signs of trenching, etc.

**Factors Affecting Locate:**

Locators must understand, identify and solve various locating obstacles including:

**CONSIDERATIONS:**

- Technology limitations
- Inaccurate records
- Differences in size
- Facility depth
- Surface structures
- Common bounded facilities
- Short facilities
- Congestion
- Unwanted coupling
- Air coupling (transmitter interference)
- Sharp drop in signal
- Complete loss of signal
- Signal distortion
- Ghost signals

**Facility Marking:**

Surface markings may include one or any combination of the following: paint, flags, stakes, brushes, or offsets. All marks extend a reasonable distance beyond the bounds of the requested area. Proper training for all facility locators includes properly identifying the varying surface and environmental conditions that exist in the field and what marking methods should be used. Conditions that may affect markings are rain, snow, vegetation, high traffic, construction, etc. Paint markings must be 1-inch in width and 12 – 18-inches in length.

In the ROW: Markings should be appropriately spaced on centerline of facility. The line of sight between markings must be taken in to consideration.

In a station\terminal\congested area: Underground facilities should be marked at sufficient intervals to clearly identify the alignment of the buried facility. The markings should be clear enough so that anyone can clearly see the location(s) and directions of underground facilities.

**CONSIDERATIONS:**

- Parallel lines can be marked as sets, perpendicular to each other, to help eliminate confusion.
- Temporary markings should be labeled with Company Name, Centerline, and the size and type of facility.

**Marking Multiple Facilities in the Same Trench:**

In general, the number of lines marked on the surface equals the number of lines buried below. In circumstances where the total number of lines buried in the same trench by a single facility owner/operator may not be readily known, a corridor marker is used. The corridor marker indicates the width of the corridor.

**Abandoned Facilities:**

When the presence of an operator's abandoned facility within an excavation site is known, an attempt can be made to locate and mark the abandoned facility. Information regarding the presence or location of an abandoned facility may not be available because of updating or deletion of records. Abandoned facilities may be difficult to locate due to limited or non-existing access points or if sections of the facility have been removed. When located or exposed, all abandoned facilities may be treated as live facilities.

**Locating Methods:**

To identify all below grade facilities within the work area, consider the following methods:

**CONSIDERATIONS:**

- Electromagnetic line locating equipment (direct hook up, inductive mode, inductive clamp)
- Probing
- Hand digging
- Hydrovac

For electromagnetic line locating equipment:

**CONSIDERATIONS:**

- Variable frequencies, frequency indicator
- Output  $\geq 3$  watts
- Depth indicator
- Current measurement indicator
- Headphone jack (recommended when working in noisy areas)
- Peak and null
- Depth accuracy
- Battery condition
- Radio or A/C mode
- Transmitter makes appropriate contact with the ground
- Passive mode can be used to perform the initial locate of a target line. However, an active mode must be used to confirm the location. Always perform locate in PEAK mode.

Check with equipment manufacturer for appropriate calibration and accuracy schedule and recorded. Equipment should be checked for accuracy (in relation to location and depth against a known underground facility) on a regular basis and recorded.

**CONSIDERATIONS: During Operation in Extreme Conditions**

- Snow must be removed prior to placing transmitter on the ground
- Units should be periodically warmed to ensure the receiver and transmitter function properly
- Caution should be used when storing cables used for direct hookup and inductive clamp methods to prevent freezing

**Locating Electromagnetically:*****Induction***

When using “induction” technique the locator should ensure that the locator is placing the box in a spot conducive to finding the target facility. The locator should be aware of air coupling and unwanted coupling. The locator should also ensure that the equipment is in the proper mode and frequency. The locator should trace lines to point where they can be “proven”.



***Direct Hook-Up***

When using the “Direct Hook-Up” technique, the locator should ensure that the hook-up is properly grounded. The positive lead should be hooked directly to the targeted facility. The negative lead should be grounded, at as close to 90 degrees as possible, to the anticipated direction of the targeted facility. The locator should also ensure that the equipment is in the proper mode and frequency. The locator should trace lines to point where they can be “proven”.

***Inductive Clamp***

When using the “inductive clamp” method, the locator should ensure that the clamp is properly attached. The locator should also beware of air coupling. The locator should also ensure that the equipment is in the proper mode and frequency. The locator should trace lines to point where they can be “proven.”

**Facility Owner/Operator Identification:**

The owner/operator of a facility is identified on markings at the time the facility is located and marked.

**Communication Between Parties:**

One-call centers, facility owners/operators, and excavators all have clearly defined processes to facilitate communication between all parties. If the complexity of a project or its duration is such that a clear and precise understanding of the excavation site is not easily conveyed in writing on a locate request, then a pre-location meeting should be scheduled on-site to establish the scope of the excavation.

Any changes to the areas that are to be located are in writing and include all parties responsible for the excavation and marking of the excavation sites. Locators also schedule meetings if the complexity of the markings requires further explanation.

**Documentation of Work Performed:**

The locator should fill out a locate form which captures the critical methodology that must be followed when completing a line locate, and includes the three primary steps of a successful locate: pre-locate, locate and post-locate.

**CONSIDERATIONS: The Benefits of this Form Include**

- Ensuring that employees are following the appropriate steps of a line locate
- Fully completed forms protect locators in the case of an incident, documenting that they followed correct procedures
- Ensures improved communication amongst all parties regarding the line locate
- Improved pipeline protection and damage avoidance

The locate form captures information such as the locator name, locate date, excavator name, ticket number, and the locate details. GPS coordinates, a sketch of the search area, and photograph locations are also included on the locate form.

**Forecasting/Planning for Predictable Workload Fluctuations:**

Facility owners/operators and/or their representatives develop methods to sufficiently forecast and plan for future workloads so that ticket requests may be completed in a timely manner. Managers and supervisors should plan accordingly for workload fluctuations, vacations, etc. to ensure that one-call notices received are completed in the time frame stipulated by the local one-call laws.

## 1 Appendix B: Other Documents

*This appendix contains industry examples of forms and reports related to the topic.*

### 1.1 Example Line Locating Procedure

#### Procedure Steps

1. Line Locating Equipment and other Equipment used in Locating Pipelines
  - a. Conductive locating (direct connection to the pipeline) is the preferred method for locating Company pipelines.
  - b. Line locating equipment will be field checked (factory diagnostics testing) for proper operation, prior to use. This includes testing the lead wires for continuity. Any locator not operating properly shall not be used for any locate and will be sent in for repair or replaced.
  - c. A known buried pipe shall be used to verify the proper operation of the line locator.
  - d. Electrical Multi-Meters should be checked for correct function before use.
  - e. Reference Half-Cells should be checked before use for copper sulfate crystals and distilled water.
2. Receiving and Processing Tickets from State One-Call Systems
  - a. When the field receives a one-call notice into the system, a response to the ticket is required within 48 hours per the procedures below and state one-call laws (exceptions are 72 hrs. in Michigan and South Carolina).
  - b. The locator will first, within the system, assign to themselves the one-call tickets that they will work for that day.
  - c. If Company assets will not be impacted, the locator will then add "Respond to Complete the Job" and then add "No Conflict" from the drop down menu and give a brief explanation why the ticket is no conflict in the notes section.
  - d. If the work is within 25 feet of Company assets, or if there is a potential for the work to encroach to within 25 feet of Company assets, a Company representative will first assign that ticket to themselves in the system and physically mark the asset. If, after marking the area specified on the ticket, it is determined that there will be no further impact to Company assets, the locator will add "Respond to Complete the Job" and select the appropriate choice from the drop down menu.
  - e. If the work referenced on the one-call ticket will continue past the 48 hour compliance time frame, the locator will add "Respond to Ongoing Job" and select "On-Going" from the drop down menu and give a brief description of why it will be on-going. This will keep the ticket active until such time the job concludes. At that time the locator will then add "Respond to Complete the Job" and select Complete Job from the drop down menu. This will then close the ticket and archive it in the system completing the location process for that ticket.

3. Marking Underground Structures
4. Company personnel will locate and mark pipelines in areas where excavation activities are observed or will occur as indicated by one-call notification. Exception: Line marking may not be possible due to no notification (tickets) transmitted in states which allow exemptions to the one-call law for activities such as plowing and tilling of farm land, road grading, emergency excavation, etc.
5. Locate and mark the pipeline within 25 feet of the excavation work and as specified below:
  - a. Pipelines will be marked within 48 hours of receipt of notification (excluding weekends and holidays) or in accordance with local one-call laws, whichever timeframe is more stringent, and before any excavation activities begins. Emergency notifications will be responded to promptly.
  - b. Locates and markings shall be performed safely. Consideration should be given to items such as, but not limited to: traffic, site conditions, and personal protective equipment (refer to Personal Protective Equipment).
  - c. Alignment sheets shall be utilized for a locate of the approximate physical location of the pipe. Should an alignment sheet for a pipeline not be available, a GIS map of the pipeline from the GIS Department shall be used along with any other pertinent location information, such as a property plat. Any errors or omissions discovered shall be communicated to the Engineering/GIS Department immediately for correction.
  - d. Available Company records/strip maps/alignment sheets are to be reviewed prior to marking the pipeline(s). The minimum length of pipeline to be marked shall be as required by conditions of the site and job.
  - e. Perform a visual inspection of the locate area to determine if there is evidence of a Company pipeline which is not on any record, map or alignment sheet. Also be aware of other pipelines that might be in the area that are not on Company drawings.
  - f. Conductive locating (direct connection to the pipeline) is the preferred method for locating Company pipelines. Whenever possible a locator will first try and find a CP test point or non-insulated appurtenance connected to the pipe to enable a direct connection with the locating equipment.
  - g. If using a CP test point, a locator will first perform a pipe to soil potential test to ensure that the test leads are attached to the pipe (The local area Cathodic Technician will be able to give the target voltage to look for).
  - h. If there are no connection points for a direct connect but there are indications of where the pipe location is, the locator will select the most appropriate frequency for the hand unit and base station to perform an "induction" locate.
  - i. If there are no clear indications of where the Company pipeline is located in the target area the locator will have to perform a "blind locate sweep" with the base and hand held set to induction mode in order to find all underground substructure.
  - j. When marking the line, the marks must be able to identify where the pipeline is located within 24" of either side of the center point of the pipeline or whatever the marking tolerance is stipulated in that state's one-call law. If this criteria is not possible, a positive identification (e.g. pothole/probe) will be necessary before marking.

- k. Bend areas and other changes of direction shall be marked so that the pipe's location is clearly delineated.
- l. Marks on straight pipeline sections shall be set at intervals required by conditions of the site. The spacing of the locate shall be a maximum of 10 feet apart to locate any unknown bends, Points of Intersection (PIs) and other deviations.
- m. Any PI in the area must be marked.
- n. Any PI, not shown on the alignment sheet, must be reported immediately to the Engineering Department.
- o. Any potholing done for a positive finding must be documented, using Pipeline Inspection/Repair Report Form completed and filed, and photographed.
- p. Temporarily mark the physical location of a pipeline using yellow flags, laths and/or yellow paint. The Company asset name should be easily identifiable Use the appropriate marking for the existing and expected surface conditions.
- q. The type of temporary marking used and how to identify the marking will be communicated to the excavator.
- r. Buoys, poles or PVC markers may be used for submerged underwater facilities in areas such as wide commercially navigable waterways and bays. Markers should be placed as close as practical over the facilities that are submerged in such a manner without impeding or creating additional hazards.
- s. Multiple Company pipelines in the same ROW will be marked individually.