



Introduction to Locating Technologies


There is not a single source technological solution available on the market for locating any and all types of underground facilities in any circumstance without limitations. There are however, several different types of technologies available today for locating buried facilities. Many of these were designed for other tasks in other industries but are often applied for finding underground facilities. I've listed for you a few of these technologies, how they are applied for locating and a brief description of their advantages and limitations.

Technology Type and Locating Application:


- EM Pipe and Cable Locator
- EM Sonde “Beacon”
- EM Passive Signal Detectors
- EM Marker and Detector
- Ground Penetrating Radar
- Ferromagnetic Detectors
- GIS Data
- Locating Accessories

Electromagnetic (EM) Pipe and Cable Locator

This is the most common of locating equipment and consists of a portable signal transmitter which applies a signal along the buried line and a hand-held signal receiver used for detecting and tracing the signal being applied. The transmitter creates a detectable electromagnetic field also called a signal. An EM signal receiving unit detects the signal and provides information about the signal field including horizontal centerline of the field, intensity of the field and estimated distance to the center of the signal.



The *EM Signal transmitter* applies alternating current to underground cables and pipes which creates a detectable signal field. The transmitter is applied by means of direct connection or signal inductive broadcasting. The signal current constantly reverses in direction as it travels back and forth along the underground line. The back and forth movement of the current produces a back and forth movement of the signal field around the conductor.



The *EM signal receiver*, tuned to the transmitters signal frequency, can detect the signal broadcasting from the targeted line. Once the signal is detected, the receiver can provide information about the signal including signal strength, direction, estimated horizontal centerline of the signal and vertical distance to the center of the signal.

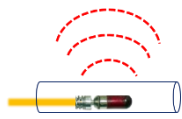
Advantage and Limitation of EM Equipment

- Most common piece of equipment used to estimate the location of pipe of cables.
- A signal receiving unit can provide the operator with a variety of information about the signal being detected. This information includes horizontal centerline of the signal, the intensity of the signal and the estimated distance to the center of the signal source
- Most signal receivers are programed to also detect Passive Signals which are created from outside sources other than the signal transmitter. These signals are already present on many conductive lines in the ground and only require a signal receiver for detection.

Advantage and Limitation of EM Equipment -continued

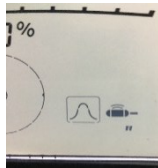
- Many advancements of this technology in the lighter in weight, or to provide more information about an EM signal including line direction and GPS ordinance.
- To be located, the buried pipe or cable **must be metallic** and have electrical continuity.
- The overall accuracy provided by the signal receiver is dependent on the shape of the round electromagnetic signal field. The information provided by the receiver is formulated under the assumption that the magnetic signal field is perfectly round.

Related EM Technologies



EM Sonde (beacon) A typical Sonde, also known as a beacon, is a miniature signal transmitter which can be inserted in a non-conductive pipe and pushed through the pipe while being tracked along the surface above ground. A sonde provides the strongest signal response when the signal receiver is directly over it. Many types of signal receivers are equipped to locate a sonde signal broadcasting at an assortment of set signal frequencies.

A Sonde is placed behind a horizontal directional drill bit which allows the locator to track the path of the drill head. Sondes are also placed with the head of a pipe inspection camera to allow users to pinpoint issues within the pipe.



Advantages and Limitation of Sonde Locating

- In ideal conditions, a signal broadcasting from a sonde can be located at greater depths than a signal broadcasting from a pipe or cable.
- Low frequency sondes have trouble broadcasting through metallic pipes.
- In many situations, a sonde signal is more difficult to pinpoint and trace compared to a signal broadcast from a pipe or cable.

EM Markers are small electronic markers that can be buried over the top of a non-conductive utility or at specific points within a network including underground splices or connections. EM markers can be detected by a receiver specially equipped to find the specific frequency of the EM markers.



Ground Penetrating Radar (GPR)



Ground penetrating radar, commonly called a GPR, is a noninvasive near surface geological investigation tool. In the locating industry, we use it to find buried pipes, cables, vaults, tanks, barrels and other buried objects.

The GPR antenna is both a radar signal broadcast source and a radar signal receiver unit. Radar waves which are broadcast into the soil are reflected back by underground objects. The GPR antenna can be mounted to a portable cart along with a laptop computer. The cart is pushed along by a technician who reads real time data. The signals that reflect back from the underground objects are displayed on the screen as the cart moves across the surface of the earth. This technology is very similar to a common fish finder. The GPR broadcast high range radar wave and simultaneously receives radar waves that are reflected back from underground objects.

Advantage and Limitation of GPR Technology:

- In ideal conditions, the GPR can locate non-conductive pipes, tunnels, tanks and barrels at depths up to 30 ft. or greater
- GPR technology is quickly deployed and provides operator with real time display of radar signal reflections are received back from objects as the cart is rolled across the buried object
- Very effective for concrete investigations for rebar and post tension cables, cracks and voids.
- The “detectability” of underground pipes, cables and other objects and structures in the ground depends upon their size, shape, depth and the difference in electrical properties of the soil and the object below as well as operator skills and ability to interpret readings.
- GPR struggles in areas where the soil is of high conductivity levels. There are unfavorable geological conditions that work against a GPR scan.



Ferromagnetic Locators



Unlike ordinary metal detectors, which detect all metals, the ferromagnetic detectors only respond to items with ferromagnetic content specifically iron, cobalt or nickel. A ferromagnetic detector is mostly used to find below surface manhole lids, valve covers which may have been covered by asphalt or by dirt. This detector is also used to locate property pins, iron or steel plates, tanks, barrels, property pins and survey rods.

- Advantage and Limitation of Ferromagnetic Detectors: Ferromagnetic detectors are capable of locating ferrous metals at greater depths than a conventional metal detector can.
- Will not detect aluminum or copper lines unless current is present on the line.

- Advanced Ferromagnetic technology provides magnetic polarity information which allows the operator to locate pipe joints in cast and ductile iron pipes. Each joint of the pipe and each center of pipe segment represents a reversal in magnetic polarity. This helps in the location of joints and welds.



GIS Data Collection

Several high grade GPS units can be Bluetooth paired with most conventional locating equipment to gather facility location information while performing the locate. Many locate receivers have a GPR built in to the unit but can have a degree of accuracy of plus or minus 3 meters.

There are several other technologies used to investigate the underground, these are but a few. To date we still do not have a single source machine that can locate all underground facilities without limitation.

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