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Inductive Locating – What do you do when you can't hook up?

The Problem

Many times, locating with a direct connection using a low frequency yields satisfactory results. The problem is that often there is no access to direct connect or there is not sufficient signal at low frequency to trace the line. These situations don't have to be classified as "un-locatable". Locating *inductively*, or without hooking up, using higher frequencies can often solve an otherwise difficult locate. This paper seeks to convey an understanding of inductive locating with higher frequencies as a technique for advanced users of locating equipment.

Examples of Inductive/Higher Frequency Locates

Inductive locate situations can be lines with no access or starting point, and high impedance/resistance locates. The following are usually inductive locates:

- Tracer wire/tape that is broken, has deteriorated, or is not accessible
- Street/parking lot lighting or two-wire photocell systems with no access
- Cast /ductile iron pipes with electrically resistive joints
- Searching for unknown conductors
- Verifying existing marks
- Energized power lines and stubbed-out power secondaries
- Short lengths like water and gas short-side services and stub-outs
- Fiber Optic lines with no access or minimal metallic content.

The Solution – Inductive/Higher Frequency Locating

For Advanced Users Only

Locating without hooking up is sometimes viewed as dangerous, unprofessional, or likely to result in poor locates. In fact, it is a powerful technique for advanced users who really know locating. Unsuccessful inductive locates most often result from a poor understanding of the three "T's":

- Theory – lack of inductive knowledge/locate principles
- Technology – frequency is too low resulting in poor signal
- Technique – poor inductive locating practices

This paper introduces important inductive locating concepts to achieve the best results.

Theory – Inductive Locating

Inductive locators consist of two parts, a transmitter and a receiver. The transmitter sends a signal through the earth (no connection) to generate current on the line and the receiver detects the strength of that current.

Applying a Signal Inductively

Higher frequency transmitters, ranging up to 480 kHz, are better at inducing a signal. *Precise placement* of the transmitter is essential to a good inductive locate. Place the transmitter to maximize signal on the target and minimize it on adjacent lines. The signal pattern is *highly directional*, but can spread as it is transmitted into the earth. The signal must have a complete path. Choose the *best locate "circuit"* when applying signal inductively. Consider the target conductors, adjacent conductors, and site conditions.

Detecting the Signal

Receivers are directional and indicate the strength of the signal detected. *Orient the receiver* to detect the maximum signal and scan left and right. Pinpoint the *strongest signal*. It is

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theoretically directly over the target. Inductive locating requires a *check for air-coupling* to eliminate transmitter interference. Determine that the *signal is symmetric*, or balanced. Asymmetric (unbalanced) signals may indicate a poor locate or the presence of another conductor.

Technology – Using Higher Frequencies

Often the best way to inductively locate is to use higher frequency locators. Higher frequency transmitters apply a stronger signal through the *frequency multiplier*. For example, a 480 kHz transmitter applies a signal 60 times stronger than an 8 kHz transmitter of the same strength. This is a key factor in *overcoming a high impedance/resistance* locate and placing a traceable signal on poor conductors.

Technique – Inductive Locating Do's and Don'ts

Locating inductively is very flexible. It offers *and requires* more technique than conductive locating. Some of the more important field practices are outlined below.

Starting from a known point
Place the transmitter at a known point (marker, manhole, meter, valve, or locate mark) whose conductor is not accessible. *Spot* the line, *check* for air-coupling, move the transmitter out to the spot and trace back to *verify* the locate. This is a good technique even when you direct connect. Be certain of what you're tracing by verifying the mark.

Searching for unknown lines
Induction is an excellent way to search an area for *unknown conductors* and *verify marks* already in place. It is an excellent form of damage prevention. Two people can search an area for unknown conductors running in all directions in just a few minutes. A one-person search is also highly effective in clearing an area, particularly in tight quarters.

Avoiding Bleed Over
Bleed over (or more accurately, signal on unwanted conductors) can occur when operating inductively or conductively. In addition to return path and common bonding bleed over, induction can apply signal to adjacent conductors. The techniques outlined below can help overcome bleed over problems.

- *Work short distances* by relocating the transmitter to the last good mark.
- *Offset* the transmitter to increase the signal differential between target and adjacent conductors.
- *Null out* adjacent conductors with the transmitter to maximize the signal on the target and minimize it on unwanted conductors.

Summary

Know the capabilities and limitations of inductive locating. Often it is the only tool/technique that will get the job done. The most important thing when locating inductively is *proper use of the transmitter*. How the signal is applied determines whether the locate is successful. *Listen to the receiver* for the strongest signal and a reliable locate. When operated properly, it will never "lie".

In summary, inductive locating is a powerful tool/technique that can be a best friend when used properly or a worst enemy when best practices are ignored. It is partly about *good equipment* and partly about good equipment *used well*.

