

Induction – an important locating tool

You may have heard that you should only use induction as a last resort. In most cases that's a good rule to live by but when you do need to use it, knowing how is extremely important. There are times when only induction will help you reduce interference and other times when using induction is your only option.

In this article we will look at inducing a signal onto an underground line without a direct metal to metal connection. We want to explain what it is, when you might want to use it, and how to use it to help you get the results you want.

Introduction to induction

Induction is the transfer of energy from one circuit (in this case the transmitter's antenna) to another (utility) *without metal-to-metal contact*. It is another way to make current flow in a circuit when you cannot make a metal to metal direct connection to the utility.

There are two ways to induce a current onto a target utility. The first method is with a clamp, or coupler. A clamp's jaws are placed around the conductor you want to energize, and the other end of the clamp is plugged into the transmitter. The jaws put out a signal field which induces a current onto the target conductor. If you cannot connect directly to the line this is the next preferred method as you can place it directly around the target conductor which helps isolate the line.



Placing the clamp around the telephone cable helps to isolate it from other lines.

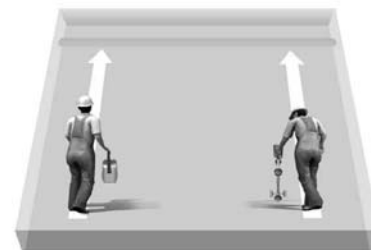
The second type of induction uses a coil built into the transmitter. When positioned over the target utility, some of the energy emitted from these coils transfers some of its energy to the utility, causing it to be energized with the transmitter's signal.

Using Induction

Induction gives you a way of getting a signal onto a line when a direct connection isn't possible or doesn't give you the result you want.

Benefits of Induction:

1. Energize a conductor without physically touching it.
2. With proper transmitter management (placement, orientation, aiming, frequency selection, power output) you can determine which conductor gets the most signal and creates the best locating circuit. Induction may, in some cases, help isolate difficult (congested) circuits.
3. Induction can be used to sweep an area to see if any conductors are present. If the likely direction of the pipe or cable is known, two people can sweep, with one carrying the transmitter and one carrying the receiver, as they walk in tandem. If the receiver and the transmitter cross an underground conductor at the same time it may be energized and show up on the receiver.





Click on image to play video.

Drawbacks of induction:

1. It is less efficient because there is no metal to metal contact to transfer the current onto the line. A smaller portion of the transmitter’s signal makes it onto the target conductor, and that limits the distance you can trace the line.
2. Induction using just the transmitters coils does not discriminate between utilities above ground and utilities below ground. The higher the frequency, the easier it is to induce a current onto all of the surrounding utilities.
3. When using the transmitter coils Air Coupling needs to be tested for and avoided.
4. Induction is less effective on deeper conductors.

Requirements

To create a circuit inductively, the signal must be able to travel in a both directions on a conductor. In other words, the conductor needs to be grounded at both ends. Some conductors do this better than others. As a rule of thumb, lines that require electrical continuity in order to move their product (electric, cable, phone) are better at this than those that do not (gas, water).

Remember that you need a good circuit for current to flow. **Higher frequencies used while inducing may help but Induction in practice will not make current flow in a bad (high resistant) circuit.**

Induction also requires a higher frequency than direct connect. Nearly all transmitters work better at a frequency of 33kHz or higher for induction. (The SeekTech ST-33Q “Q-ring” is an exception. In many cases it can produce a locatable signal at 8kHz on highly conductive utilities.)

Air Coupling

Air-coupling occurs when the transmitter’s signal travels through open air and is received directly by the receiver. This causes the receiver to sense the signal from the transmitter when what you want is the receiver to sense the signal from the utility line so you can trace it. When you’re close to the transmitter, this direct signal is much stronger than the signal coming from the utility you’re trying to locate and it may add confusion.

Air coupling distance can vary over a wide range and you must always carefully confirm that a real utility is detected and that an accurate depth measurement is being made. The air coupling distance can be large, greater than 70 feet (20m) if the induced utility is deep and poorly grounded at both ends. It can be short, perhaps 15 ft (5m) if the induced utility is very shallow and well grounded. Always confirm that air coupling does not distort your readings. Air coupling varies continuously and is not simply an off and on distortion. As you move away from the transmitter the distortion caused by air coupling continues to reduce until the signal from the induced utility dominates and air coupling effects become small.

To test for air-coupling using Multi Directional Antennas, tilt the locator about 45° toward the transmitter, with the lower antenna of the locator touching the ground. Then tilt it about 45° away from the transmitter. Observe the depth reading. If it changes significantly, air-coupling is occurring.



Another method to test for air-coupling is to stand in the area you want to locate and notice the indicated depth measurement on the locator with the lower antenna on the ground. Then, raise the locator vertically, about 18 inches (45 cm) and observe the change in depth indication. If the locator is reading on the conductor only, the depth will increase accordingly; if it is reading on the transmitter's field (air-coupling) it will not change by 18 inches, but may change disproportionately.

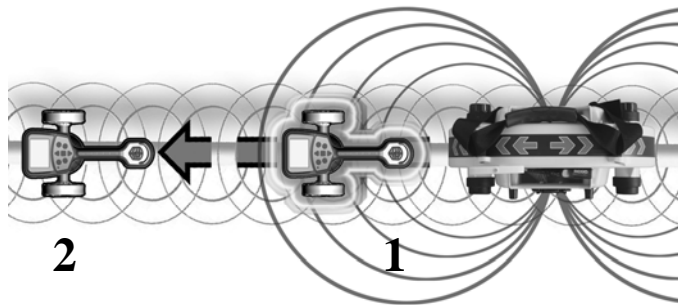


Figure 1: Air Coupling

Locator 1 is too close to the conductor and is receiving signal directly from the transmitter through the air, while locator 2 is receiving more or all of the signal from the target utility.

Tips

There are several techniques you can use to maximize your chances of success with inductive locating.

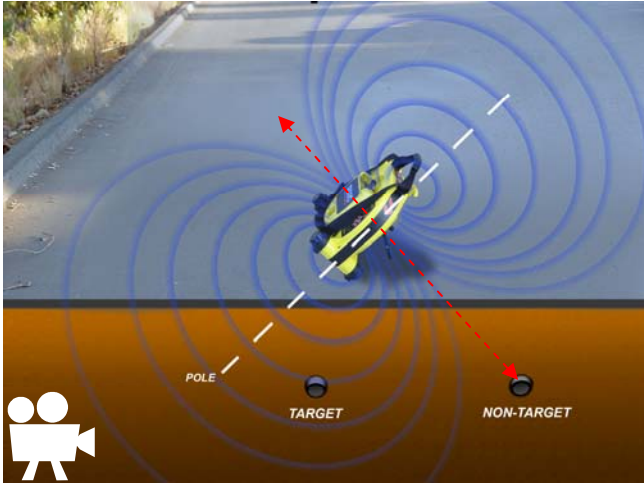
1. The signal induced onto a line will be strongest when the transmitter's antenna is in-line with the conductor (utility). Transmitter cases have arrows to help you align the unit properly.



2. Aim the signal away from adjacent non-target utilities and overhead lines (see illustrations).



Click on image to play video.



Click on image to play video.

3. When you have a non-target conductor that's located next to your target conductor, you can lay the transmitter on its side so that the signal is directed at the target conductor and avoids other utilities. (Click on image to play video.)
4. Sometimes transmitters can illuminate a vertical power line which is closely fastened to a pole when a clamp cannot be placed around it.



Things to Remember

- Try a direct connection first to see what the results are. Next best is using an inductive clamp to help isolate the line and finally try inducing onto a line using the transmitter's coils. Getting a strong isolated signal from the target conductor is the objective.

- Be aware and test for Air Coupling. You need to detect the signal from the line underground and not from the transmitter through the air.
- Watch out for overhead lines if inducing with the transmitter.
- Experiment and try different positions and frequencies to help isolate the target conductor.
- A good "Best Practice" when locating is to trace out to a known termination point and mark the line on the way back to the transmitter. This practice is especially important when using induction to energize the underground line as it is more difficult to tell what you are tracing. Following to a known termination point helps verify you are tracing the target conductor.