

# Fundamentals of Pipe & Cable Locating

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# Pipe and Cable Locator

- A device that is usually made up of two components, a transmitter and a receiver, that is used to transmit an electro magnetic signal onto an intended target (conductor).

# LOCATING INSTRUMENTS



# How does a Pipe or Cable Locator work?

- The transmitter generates a signal on a specific frequency to energize the target.
- The receiver is tuned to the same frequency as the transmitter.
- The target (conductor) is “energized” by the signal from the transmitter.

# TYPES OF CONDUCTORS

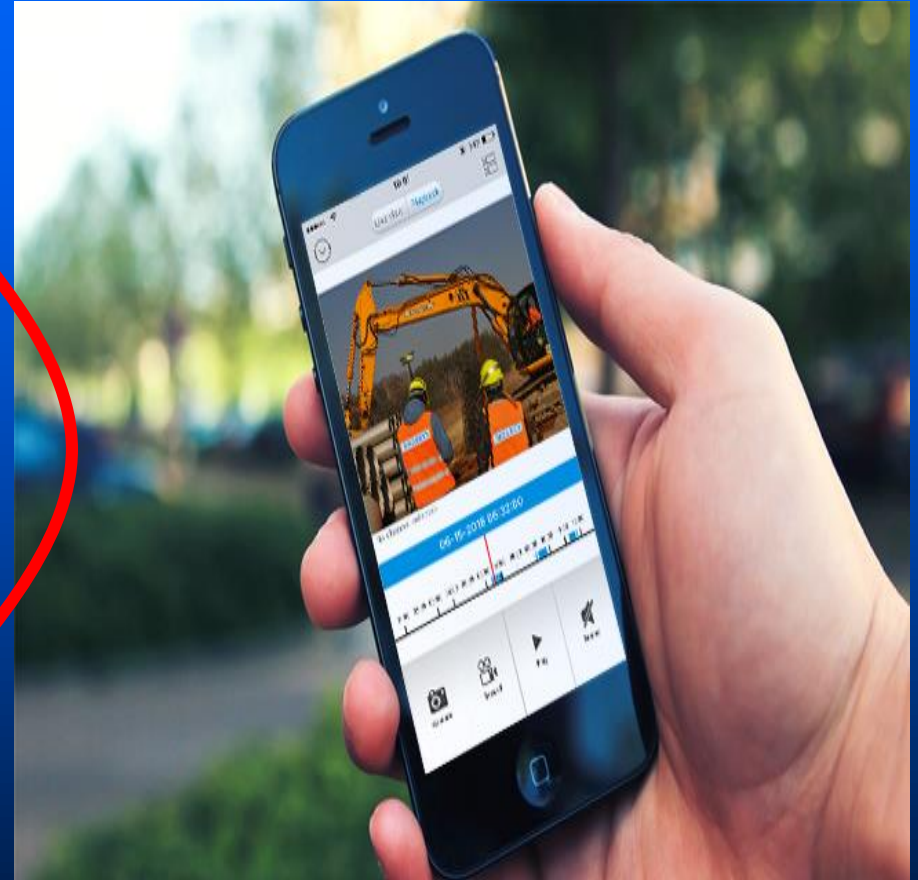
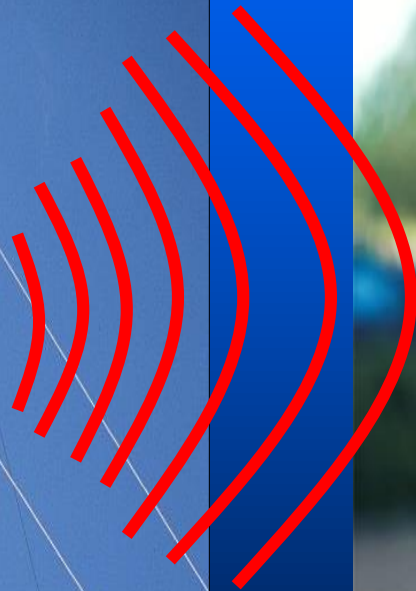
- **Cable TV** –This in most cases will be the easiest because of the shallow depth at which it is buried and the fact that it is a natural conductor of signal.
- **Telephone** – Good conductor; is bonded. But in most cases it is buried deeper, thus giving a weaker signal.
- **Electric Cable** –A good conductor because it is coated and all grounds are bonded.
- **Tracer Wire/Tracer Tape**  
-Another good conductor, but not as good as electric cable because it carries a smaller signal on its 12 gauge wire, however, usually buried about the same depth.



# TYPES OF CONDUCTORS (cont'd)

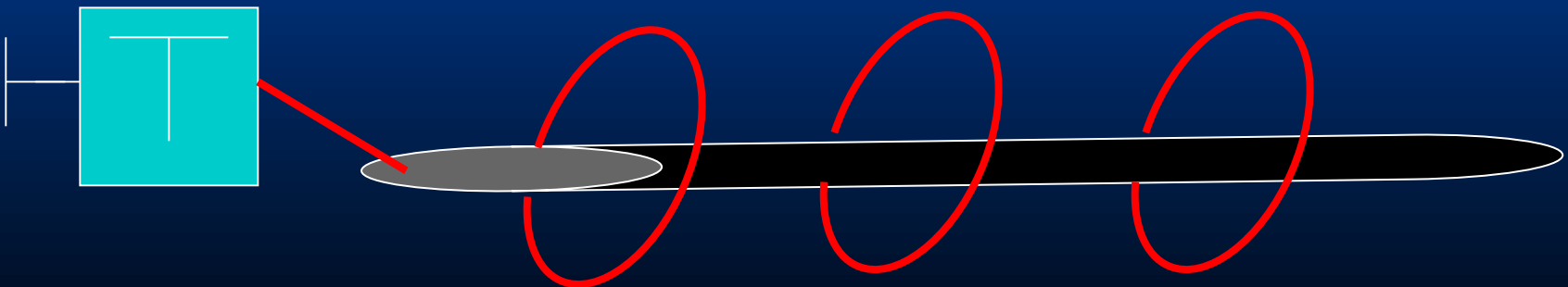
- **Copper Pipe** –Not as good as coated cable or wire line, but copper, being a good conductor in itself, makes it easier to locate than other types of pipe.
- **Wrapped steel** –Not the best conductor, but far from the worst. Because it is welded and wrapped, it will carry a fair signal.
- **Bare steel** –It is getting near the bottom of the barrel when it comes to conductors.
- **Cast / Ductile iron** –It is locatable, but not easy, due to the fact that cast iron is not a good conductor. It also has bell joints which act as insulators.

# THEORY



# THEORY

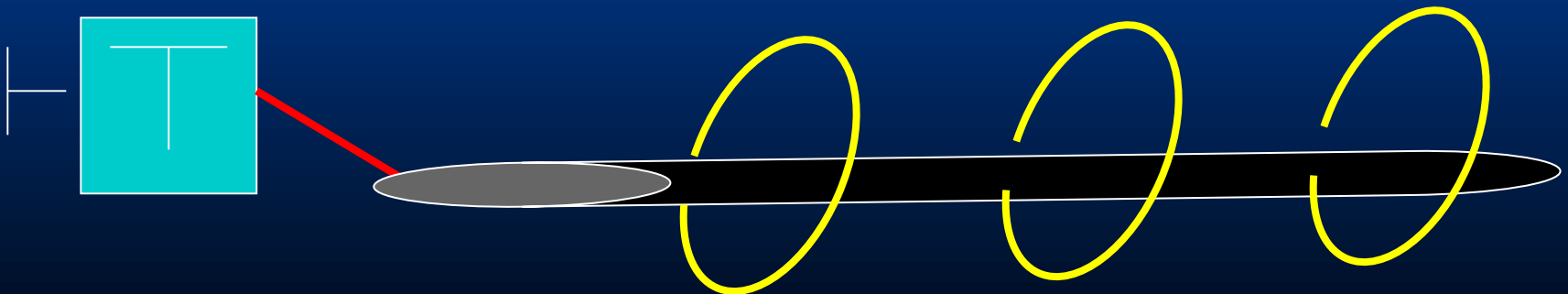
- Pipe locator consist of two parts:
  - Receiver and Transmitter
- Transmitter:
  - Functions as a stationary device
  - Broadcast an electromagnetic signal onto a conductor





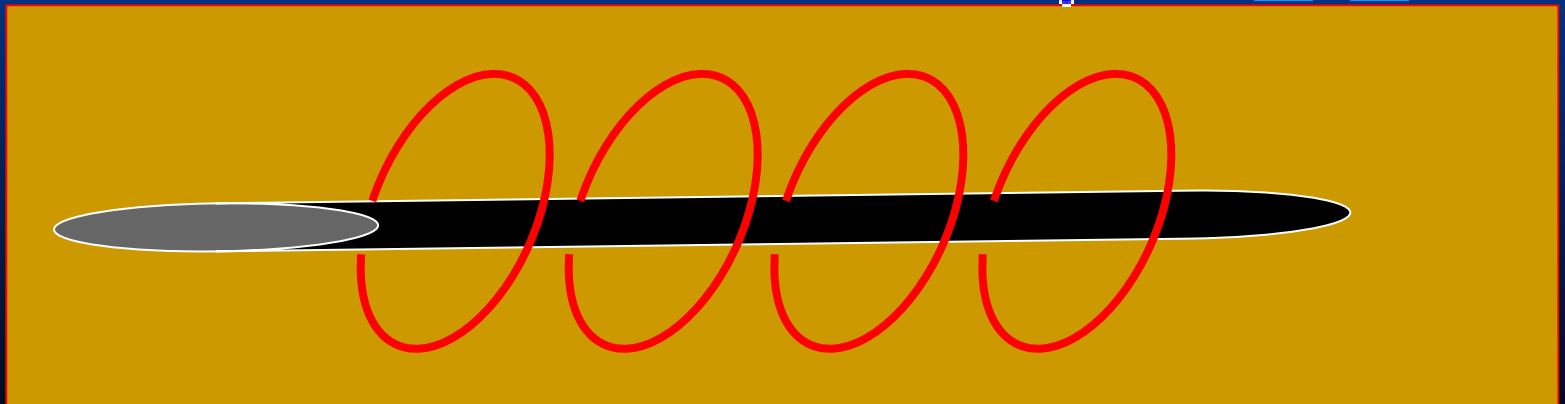
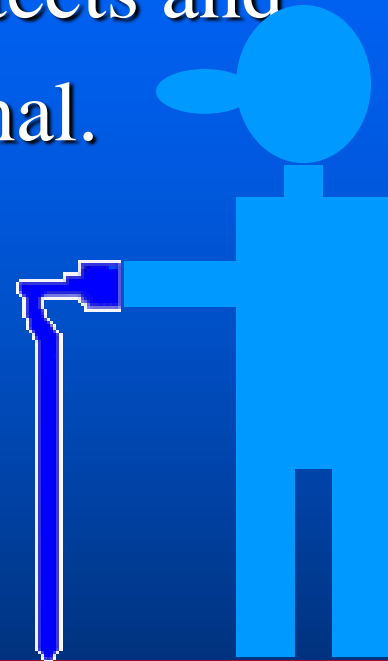
# TRANSMITTER

- A pipe is an electrical conductor (metal). When it is energized with current from a transmitter a magnetic field is produced in the shape of concentric circles which spreads along the pipe.



# RECEIVER

- Portable component that detects and Interprets the transmitters signal.
- Receiver is tuned into the Frequency of the signal

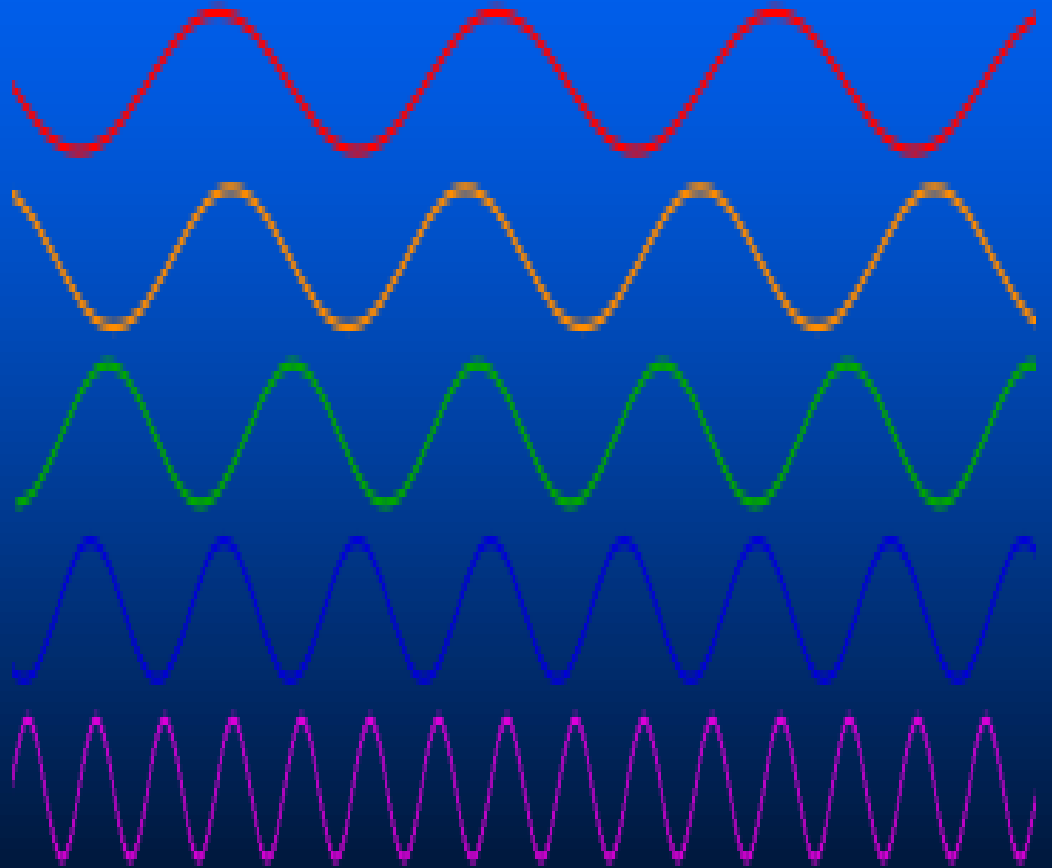


# Transmitter Frequencies

- Low Frequency 800Hz to 20Khz
  - Advantages: Distance & Adherence
  - Disadvantage: Poor Penetration
- High Frequency 250Khz to 480Khz
  - Advantages: Good Penetration
  - Disadvantages: Distance & Adherence
- Medium Frequency: 20Khz to 250Khz
  - Best frequency for general locating

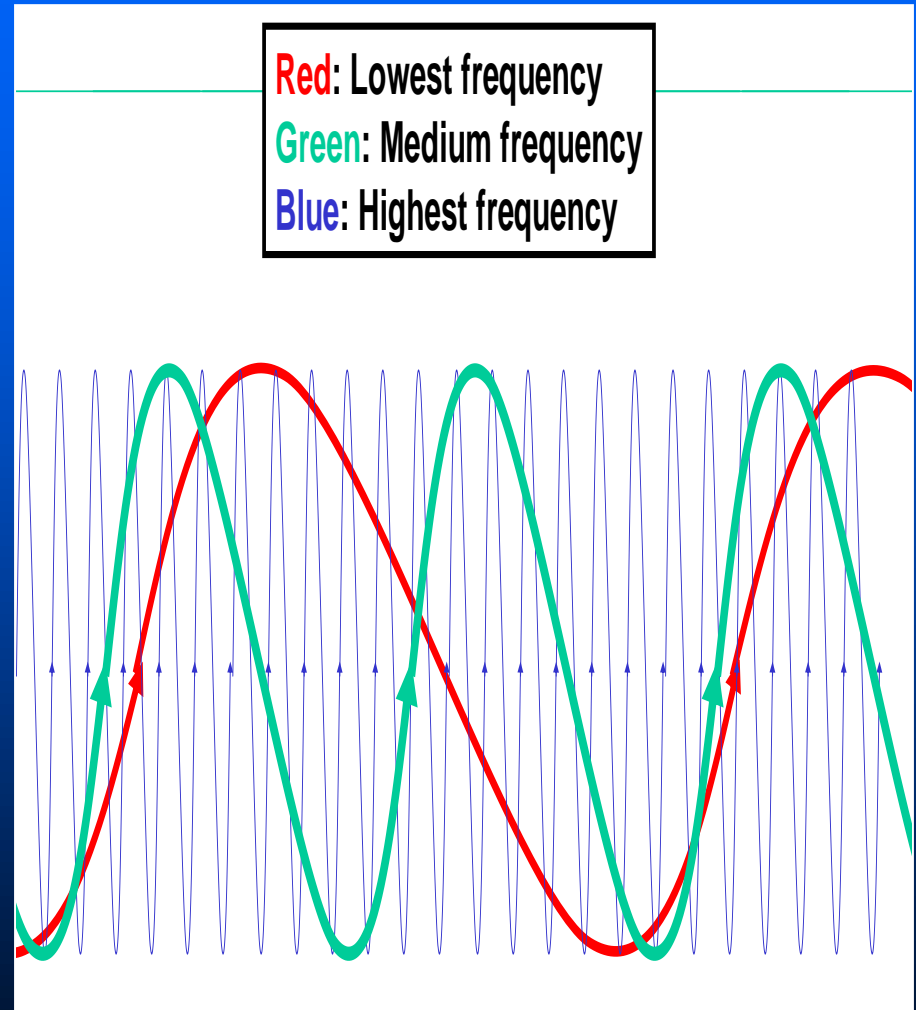
# THEORY - FREQUENCY

- A frequency results from the summation of several oscillations produced by electronic components called crystals.



# FREQUENCIES

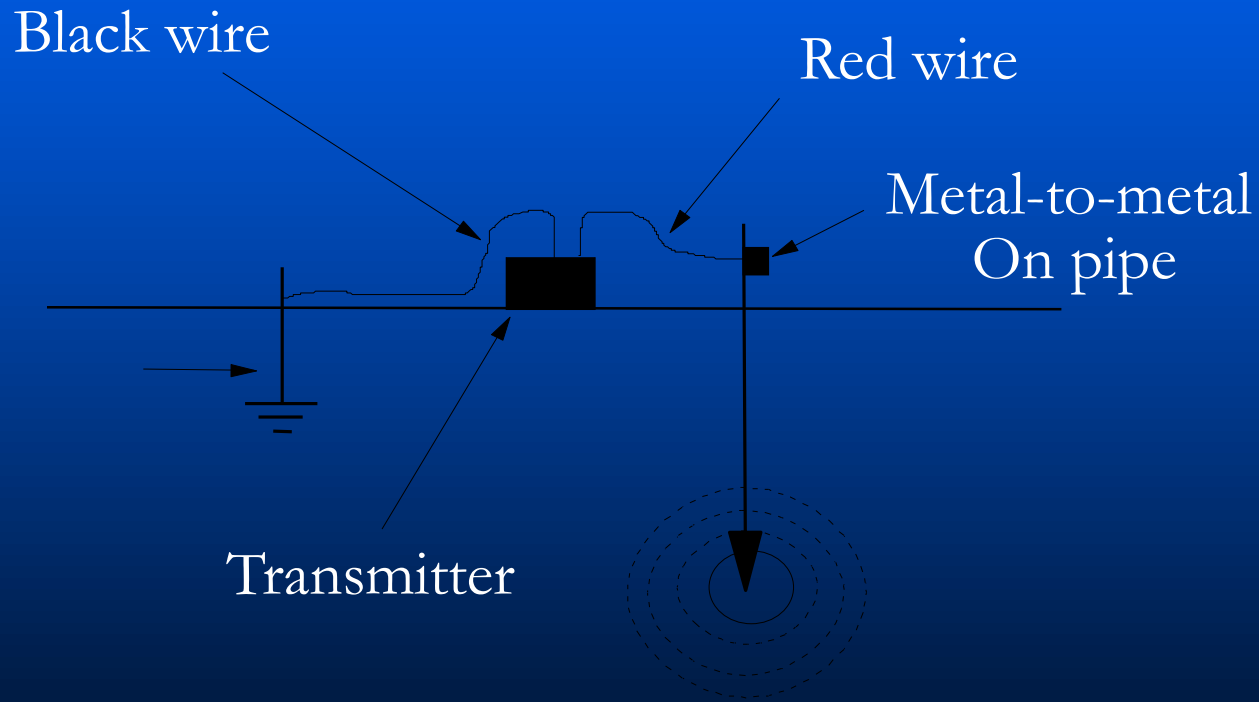
- Broken down into three groups:
  - High radio frequency (250-480Khz)
  - Medium radio frequency (60-200Khz)
  - Low Audio frequency (500hz–33Khz)



# Modes of Operation

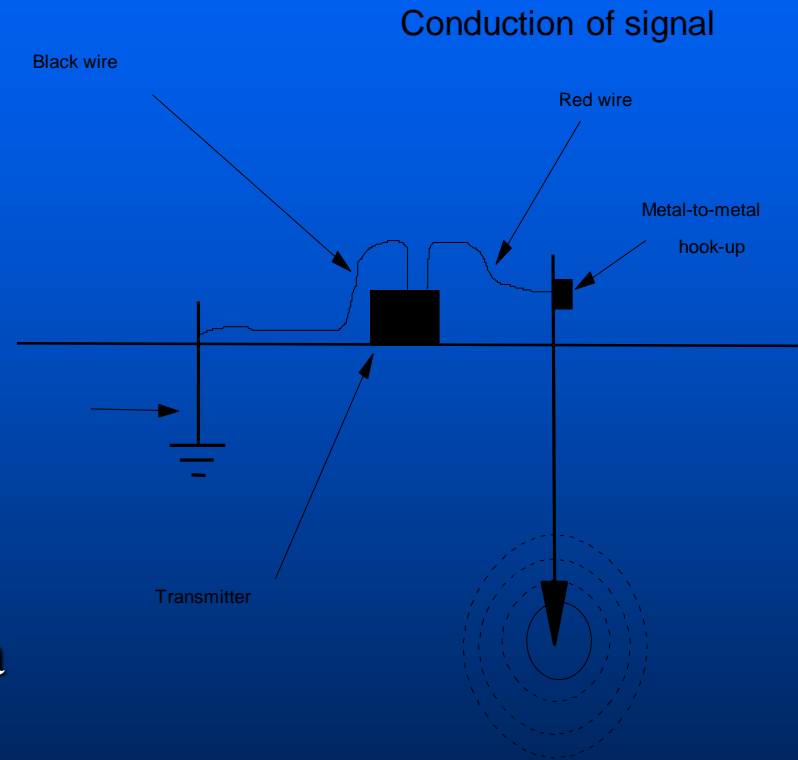
- Conductive (direct hook up)
  - Often hard to find contact point, better accuracy
- Inductive (indirect)
  - Easy to setup, least accurate way to locate
- Inductive Clamp
  - Better accuracy than inductive
- Passive
  - Detects 60Hz AC “ripple” on conductor

# CONDUCTIVE MODE: or Direct Connection to the pipe/cable



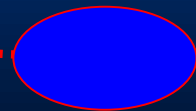
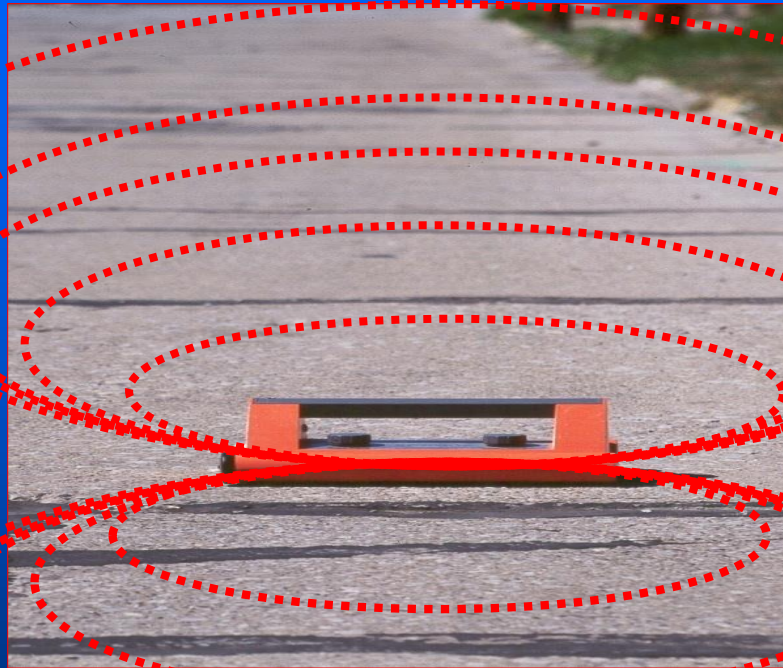
# Conductive

- Preferred Method that will send the strongest signal to your receiver.
- Results in better accuracy
- Less likely to “bleed” over to other conductors.
- This method allows for the use of a greater range of frequency and power outputs.





# INDUCTIVE LOCATING



**INDUCTIVE MODE: or not connecting to any pipe/cable**

**Is least preferred**

**Poor isolation of signal**

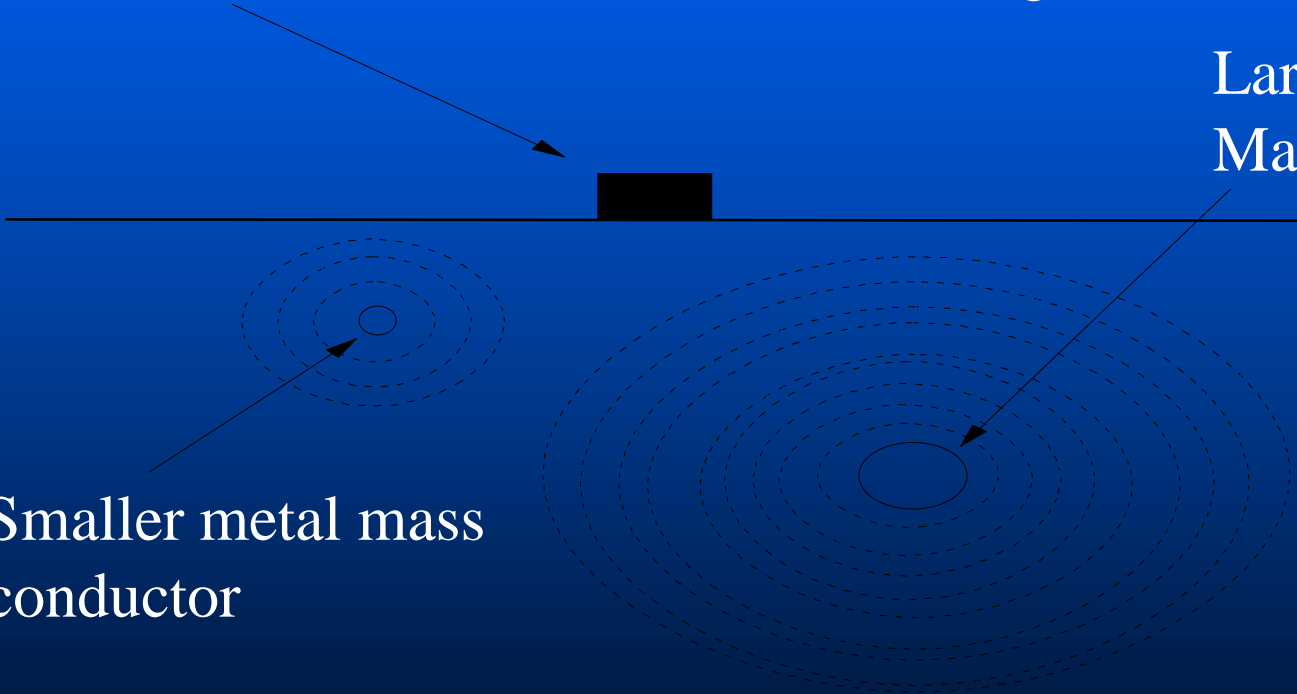
**Least accurate**

Transmitter

Induction of signal

Larger metal  
Mass conductor

Smaller metal mass  
conductor



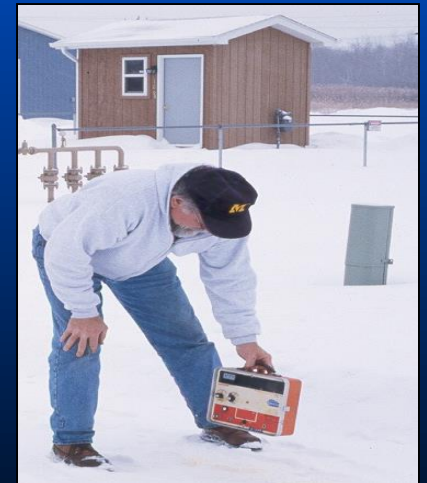
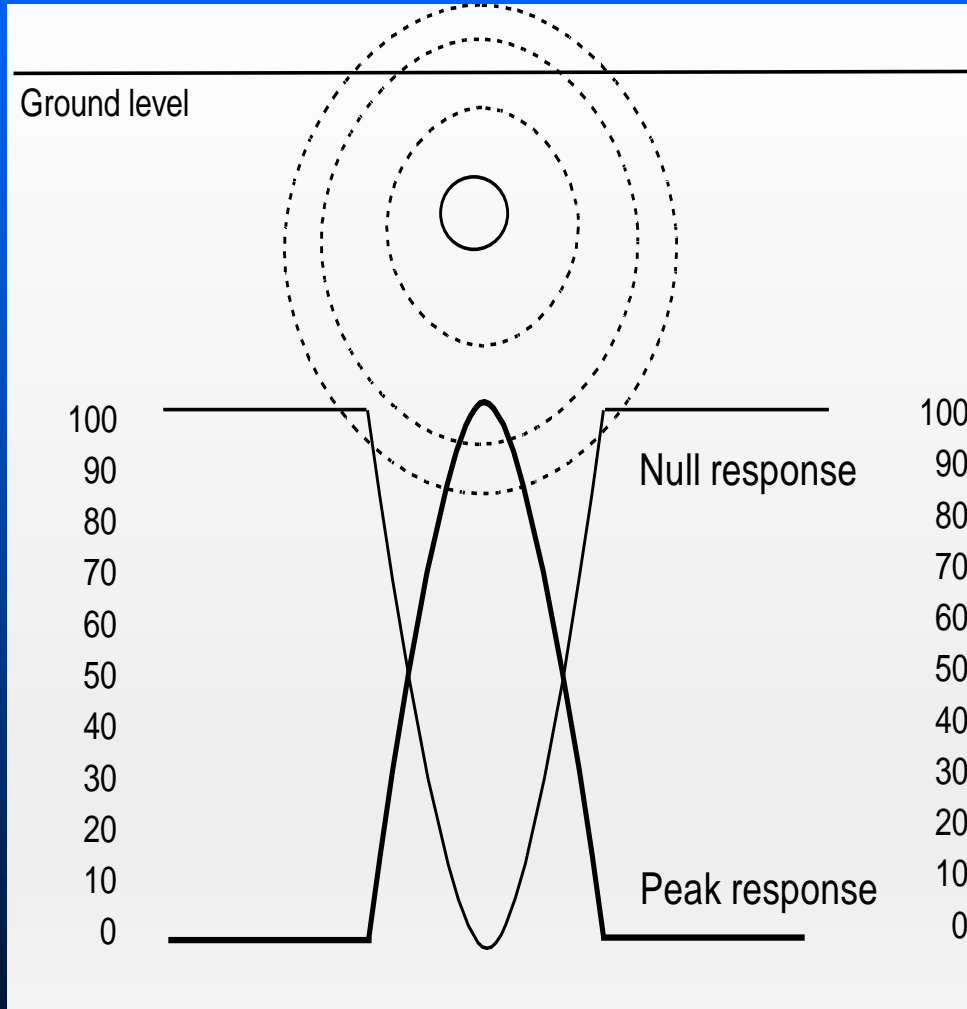
# INDUCTIVE BASIC FACTS

- **Easiest and Quickest**
- **Disadvantage – most inaccurate**
- **Internal antenna of the transmitter energizes the conductor through the process of induction. Signal returns more easily through the ground.**
- **Transmitter should be placed over a known point to work effectively.**
- **Bleed off to other conductors is more likely, then the conductive mode. Best to use in areas with no other conductors, if possible.**

# Choosing the Right Tool

- Simple Split Box vs. Electronic Locator
  - Split Box Locator should be used for short incidental locates, C&M crew, leak repair, etc.
  - Single Frequency Computerized Locator is recommended for more accurate locates where depth measurements are needed.
  - Multi-Frequency Computerized Locators are recommended for Damage Prevention and trouble shooting Cathodic Protection Systems.

# FEATURES - PEAK VS NULL



# Other Types of Locators

- Valve Box Locator
  - Treasure finder type instrument
- Ferromagnetic Locator
  - Locates iron based objects only
- Ground Penetrating Radar
  - Must interpret readings

# Keys to Accurate Locating

- Always read instruction manual provided with instrument.
- Request on-site training by qualified person.
- Become familiar with operation of instrument on “known” locates.
- Research conductor to be located:
  - Maps, Service Records, Inspection Reports

# Keys to Accurate Locating

- Read the Street before locating:
  - Look for visual indicators, valves, hydrants, pedestals, test stations, etc.
- For best accuracy, always use the **Conductive Mode**
- When grounding the transmitter, try to run ground cable at a 90° angle to the conductor.



Always Ground at a 90° Angle



# Keys to Accurate Locating

- Always connect cable assembly from transmitter to “clean shiny metal”.
- Never run ground wire over or near other conductors.
- When locating in the inductive mode, make sure transmitter is aligned properly with the intended conductor.
- Always check for “air lock”.

# Keys to Accurate Locating

- Depth measurements using a “split box” type locator are most inaccurate.
- Depth measurements using an Electronic Locator are only accurate when used in Conductive Mode.
- Depth measurements are for your information only.
- Depth measurements are to the CENTER of the pipe

# Keys to Accurate Locating

- If in doubt, hand dig to confirm location of conductor.
- If still in doubt, don't mark it out.
- A guess is the shortest distance between an accurate locate and a reportable incident.

# Review

- **Mode of use:**

**Inductive** – Least Preferred. Weak signal and will energize other conductors

**Conductive** – Preferred method. Gives the highest signal strength, longest distance, and better accuracy. Use low frequency.

- **Remember:**

The majority of locating problems stem from the improper use or positioning of the transmitter/ground. The transmitter is the “dumb” end – use it intelligently.

# UTILITY COLOR CODES



**ELECTRIC**



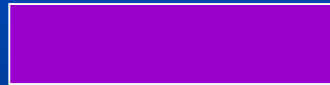
**GAS-OIL-STEAM**



**COMMUNICATION  
CATV**



**POTABLE WATER**



**IRRIGATION, RECLAIMED WATER,  
SLURRY LINES**



**SEWER**



**TEMPORARY SURVEY MARKINGS**



**PROPOSED EXCAVATION**



The End