GROUNDING METHODS

Proper grounding is an essential precondition for safe and reliable holiday detection testing using high voltage.

The combination of:

1. The connection of the SPY® holiday detector electrode on the test object
2. The connection of the test object with a suitable ground closes the circuit and ensures the proper return path to the holiday detector. This completes the circuit and allows the holiday detector alarm to "jeep" when a holiday is detected.

There are 4 different types of grounding methods:

1. Direct grounding

2. Direct grounding using a secondary grounding rod

3. Indirect grounding using a trailing ground wire

4. Capacitive grounding using a grounding collar

SPY® 780 & 115 DC holiday detectors allow 3 different grounding methods:

1. Direct grounding

2. Direct grounding using a secondary grounding rod

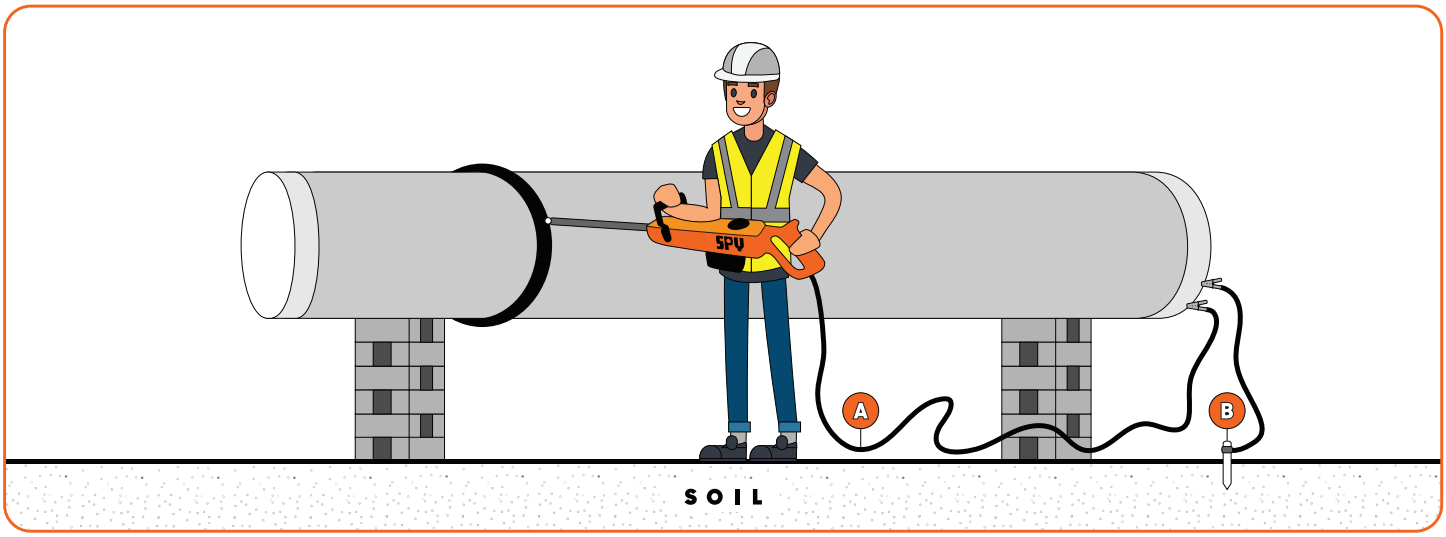
3. Indirect grounding using a trailing ground wire

SPY® 785/790 & 125/135 Pulse holiday detectors allow 4 different grounding methods (1-3 above) and:

4. Capacitive grounding using a grounding collar

GROUNDING METHODS DEFINED

1. DIRECT GROUNDING



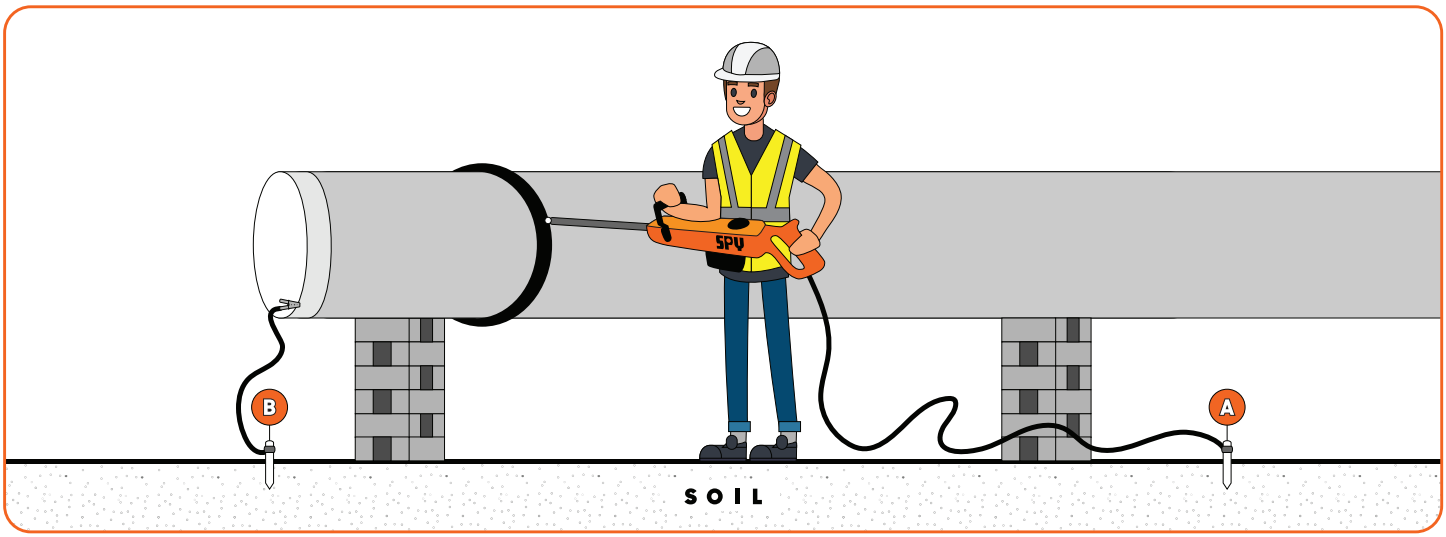
Direct grounding using the standard 25 ft ground cable is the most reliable form of grounding which offers a direct connection between the holiday detector and the non-insulated pipe end (cut back) to be tested.

A. Part #12884 additional 25 ft ground cable

Optional Parts needed to ground using this method:

B. Part #14196 Grounding Rod

2. DIRECT GROUNDING USING A SECOND GROUNDING ROD



An additional grounding rod allows the direct grounding of the holiday detector, if the bare pipe end (cut back) cannot be connected using the standard 25 ft ground cable. **If desired SPY® also makes custom length ground cables of any length, contact sales for details.** Refer to the Appendix on page 4 for more details.

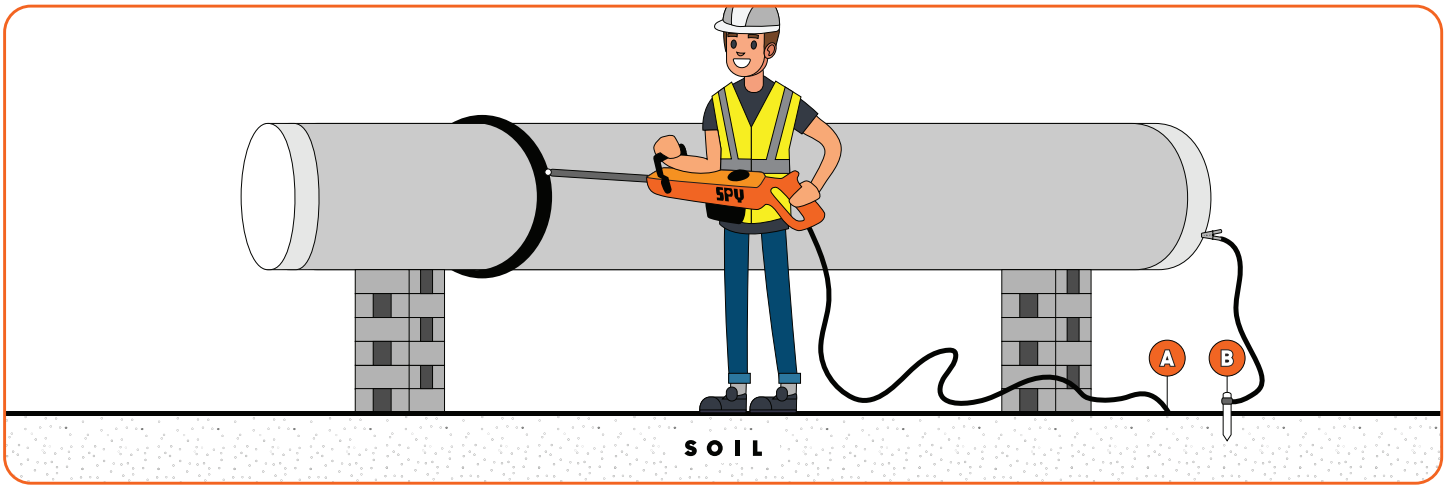
A. Part #12884 additional 25 ft ground cable (custom lengths available)

Optional Parts needed to ground using this method:

B. Part #14196 Grounding Rod

GROUNDING METHODS DEFINED

3. INDIRECT GROUNDING USING A TRAILING GROUND WIRE



Indirect grounding using a trailing ground. This grounding alternative allows holiday testing without an obstructing cable, if direct grounding is not possible. **IMPORTANT:** Soil Moisture is very important to establishing a good ground using the trailing grounding method, if the trailing ground wire is on soil that is too dry, there is ice or it is on cement this method will not work properly and the trailing ground will need to be connected to a grounding rod. Refer to the Appendix on page 4 for more details.

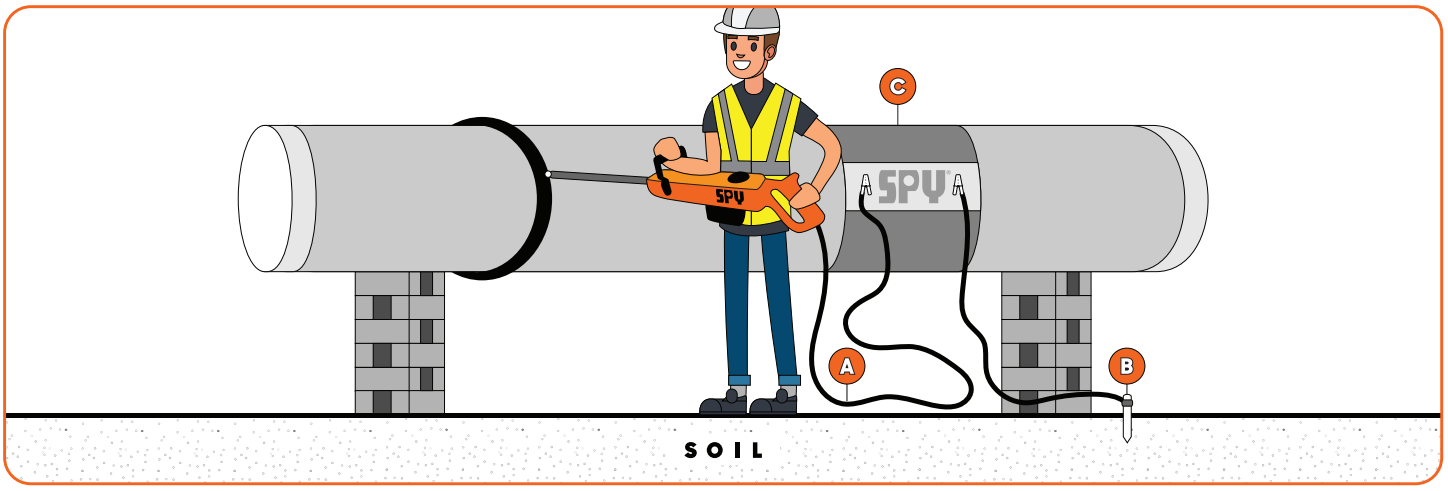
A. Part #12884 additional 25 ft ground cable (custom lengths available)

Optional Parts needed to ground using this method:

B. Part #14196 Grounding Rod

4. CAPACITIVE GROUNDING USING A GROUNDING COLLAR

FOR USE ONLY WITH 785 / 790 AND 125 / 135 PULSE UNITS



The grounding collar is used if no direct or indirect grounding is possible. The grounding collar is also recommended in case of bad conducting or extremely dry soil. Refer to the Appendix on page 4 for more details.

A. Part #12884 additional 25 ft ground cable (custom lengths available)

Optional Parts needed to ground using this method:

B. Part #14196 Grounding Rod

C. Part #14188 Grounding collar 4" - 8"
Part #14189 Grounding collar 10" - 18"
Part #14190 Grounding collar 20" - 30"
Part #14191 Grounding collar 32" - 42"
Part #14192 Grounding collar 48" - 60"

SPY® APPENDIX

EARTH (SOIL) GROUND AS AN ELECTRICAL CURRENT RETURN PATH

For a Holiday Detector to inspect a coated pipe properly an electrical ground return path is needed. When a holiday in the coating is detected a spark occurs forcing a low current to flow from the metal pipe back through the ground wire of the detector. An alarm circuit inside the detector senses the low current and a "JEEP" is heard.

The most optimum electrical ground return path is with the ground wire of the Holiday Detector directly connected to the bear pipe end, "cutback". This method is called "Direct Grounding". Using this method, the low current flows through a wire of very low resistance back to the detector. In this case the Earth is not part of the ground return path.

In many instances Direct Grounding is not possible. Two alternate methods can be used, "Direct grounding using a secondary ground rod" or "Indirect grounding using a trailing ground wire". In both methods the Earth (soil) now becomes part of the electrical ground return path allowing the low current to flow back to the detector.

In all cases, for the safety of all personnel during the coating inspection, the pipe should be grounded to Earth. Make an electrical connection to the bear end of the pipe, "cutback". Attach a wire from this connection to a ground rod driven into the Earth. Depending on the moisture content of the soil the ground rod should be driven down about 2 feet. Drive the rod deeper in dryer soils.

GOOD GROUNDING PRACTICES

Soil conditions must be evaluated prior to beginning the job

1. **SOIL MOISTURE CONTENT**

   Since the Earth is being used as an electrical conductor the moisture content of the soil must be taken into consideration. Soils with a high moisture content offer a lower resistance to current flow and have a much lower voltage loss. While soils of a low moisture content offer a higher resistance to current flow, there is a greater voltage loss.

   The voltage loss that is referred to here, exists between the ground rod where the pipe is grounded to Earth and the ground rod or trailing wire where the Holiday Detector is grounded to Earth. This distance could be 35 – 50 feet or even several 1000 feet depending on the job conditions.

   As an example, if the job was located in an area of low soil moisture content, called for an inspection voltage of 2.5KV and there happened to be a voltage loss of 1.5KV between ground rods, the Holiday Detector would have to be adjusted to 4KV to compensate for the 1.5KV loss in the Earth and yet maintain the 2.5KV between the pipe and the coating. The 4KV voltage setting would have been identified by performing a "Field Calibration".

   In this example, refer to illustration #3, avoid using the "Indirect grounding using a trailing ground wire" method. This method allows the ground wire to only come in contact with the surface of the soil. No ground rod is used to locate an area of higher soil moisture content.

2. **"INSULATING" SURFACES**

   When the moisture content in a soil is so low it can't provide the low resistance return path for the low current and it basically becomes an "insulator" with very high resistance and higher voltage loss.

   For example, if the soil is very dry with low moisture content such as sand, dry clay or a rocky surface, when the soil is frozen or there is ice on the surface, these surfaces have become "insulators" and can't provide a low resistance return path. Other "insulating" surfaces would be concrete, cement and asphalt. In each instance there would be a significant voltage loss in the soil.

GROUND ROD DEPTH BECOMES AN ISSUE WHEN PROVIDING A GOOD EARTH GROUND

1. **SHALLOW GROUND ROD**

   When the moisture content of the soil is high a ground rod can be driven into the earth about 1 - 2 feet to provide a low resistance return path to the holiday detector.

2. **DEEP GROUND ROD**

   When the moisture content is low the ground rod needs to be driven down deeper into an area where a higher soil moisture content exists. Driving the rod deeper helps to reduce the voltage loss in the Earth. Both ground rods, at the cutback end of pipe and where the Holiday Detector is connected, typically are driven to the same depth and could be up to 5 feet deep or greater, in some areas. Soils of this type would be sand, dry clay or very rocky soils.

SPY® APPENDIX

PERFORM FIELD CALIBRATIONS TO MAINTAIN A GOOD GROUND THROUGHOUT THE JOB

Spy highly suggests performing a Field Calibration at the beginning of the job, at certain intervals during the job, if the soil moisture content becomes questionable and when changing locations on the same job.

FIELD CALIBRATION:

- How to perform a Field Calibration can be found in NACE SP0490-2007, Section 3.
- Per section 3.3.1, create a holiday that is approximately 0.031" in diameter. Ensure that the hole extends completely through the coating to the metal substrate.
- Per section 3.3.2, start with the lowest test voltage setting of the holiday detector and slowly increase the test voltage until the manufactured holiday can be positively detected at normal operating speeds.
- Per section 3.3.3, this method of test voltage adjustment shall be performed while the exploring electrode and grounding are in the expected operating position.

For example, when inspecting a good distance of welded pipeline, it would be advisable to perform Field Calibrations at certain intervals along the pipeline to verify a known holiday can still be easily detected at the specified inspection voltage. This will assure the operator that he is inspecting the pipe under optimum conditions and is not missing any holidays. A Field Calibration would also allow the operator to make any voltage adjustments to the Holiday Detector to compensate for any voltage loss in the soil between ground rods, if conditions do change.

CONSIDERATIONS – "INDIRECT GROUNDING USING THE TRAILING GROUND WIRE" METHOD

This grounding alternative, Illustration #3, allows holiday testing without an obstructing cable, if direct grounding is not possible.

IMPORTANT: When using this method "Soil Moisture Content" is very important to establish a good ground. The moisture in the soil acts as a return path for a low current that flows back to the holiday detector allowing the unit to "Jeep" when a holiday is located. Without this low resistance return path, the unit would not Jeep and the operator would miss valid holidays.

CAUTION: This method should not be used when a surface becomes an "insulator" and can't provide a low current return path.

For example, if the soil is very dry with low moisture content such as sand, dry clay or a rocky surface, when the soil is frozen or there is ice on the surface. these surfaces have become "insulators". DO NOT use this method when the trailing ground must be dragged across concrete, cement or asphalt surfaces. These too are considered "insulating" surfaces.

CONSIDERATIONS – "CAPACITIVE GROUNDING USING A GROUNDING COLLAR" METHOD

This grounding method, Illustration #4, can be used only with Pulsed DC holiday detectors such as the SPY 785 or 790. It cannot be used with the SPY 780 detector since it has a continuous DC voltage output. The DC low current that would normally be produced when a holiday is located is blocked by the capacitance of the grounding collar. Therefore, no holidays can be detected.