

# Direct Burial Cable

## Installation Guide



# Notice

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3. VR will file the claim with the carrier and replace the damaged/missing product at no charge to the customer. Customer Service will work with production facility to have the replacement product shipped as soon as possible.

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## **RETURN SHIPPING**

For the parts return procedure, please follow the appropriate instructions in the "General Returned Goods Policy" and "Parts Return" pages in the "Policies and Literature" section of the Veeder-Root **North American Environmental Products** price list.

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# Introduction

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## General

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Do not attempt to wire sensors and probes into a new installation based solely on the information contained in this manual. This manual contains installation and wiring procedures for the installation of Direct Burial Cable only.

If this is a new installation and site preparation is necessary, refer to the appropriate Site Preparation and Installation Instructions or contact your Veeder-Root representative for assistance.

## Related Manuals

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Depending on your installed console, you must reference the appropriate manual below, to connect the probe/sensor to the console:

576013-879      TLS-3XX0 Series Site Prep and Installation Manual

577013-879      TLS-4XX Console Site Prep and Installation Manual

## Contractor Certification Requirements

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Veeder-Root requires the following minimum training certifications for contractors who will install and setup the equipment discussed in this manual:

**Level 1** Contractors holding valid Level 1 Certification are approved to perform wiring and conduit routing, equipment mounting, probe and sensor installation, tank and line preparation, and line leak detector installation.

**Level 2/3** Contractors holding valid Level 2 or 3 Certifications are approved to perform installation checkout, startup, programming and operations training, troubleshooting and servicing for all Veeder-Root Tank Monitoring Systems, including Line Leak Detection and associated accessories.


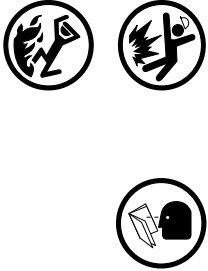
**Warranty Registrations** may only be submitted by selected Distributors.

## Safety Symbols

The following safety symbols may be used throughout this manual to alert you to important safety hazards and precautions

 <p><b>EXPLOSIVE</b> Fuels and their vapors are extremely explosive if ignited.</p>	 <p><b>FLAMMABLE</b> Fuels and their vapors are extremely flammable.</p>
 <p><b>ELECTRICITY</b> High voltage exists in, and is supplied to, the device. A potential shock hazard exists.</p>	 <p><b>TURN POWER OFF</b> Live power to a device creates a potential shock hazard. Turn Off power to the device and associated accessories when servicing the unit.</p>
 <p><b>NO SMOKING</b> Sparks and embers from burning cigarettes or pipes can ignite fuels and their vapors.</p>	 <p><b>NO OPEN FLAMES</b> Open flames from matches, lighters, welding torches, etc. can ignite fuels and their vapors.</p>
 <p><b>NO POWER TOOLS</b> Sparks from power tools (such as drills) can ignite fuels and their vapors.</p>	 <p><b>NO VEHICLES</b> Moving vehicles in the area during service can create a potential for personal injury to you or others. Sparks from starting vehicles can ignite fuels and their vapors.</p>
 <p><b>NO PEOPLE IN THE AREA</b> Unauthorized people in the area during service can create a potential for personal injury to you and them.</p>	 <p><b>USE SAFETY BARRICADES</b> Unauthorized people or vehicles in the work area are dangerous. Always use safety cones or barricades, safety tape, and your vehicle to block the work area.</p>
 <p><b>WEAR EYE PROTECTION</b> Fuel spray from residual pressure in the lines can cause serious eye injuries. Always wear eye protection.</p>	 <p><b>INJURY</b> Careless or improper handling of materials can result in bodily injury.</p>
 <p><b>GLOVES</b> Wear gloves to protect hands from irritation or injury.</p>	 <p><b>READ ALL RELATED MANUALS</b> Knowledge of all related procedures before you begin work is important. Read and understand all manuals thoroughly. If you do not understand a procedure, ask someone who does.</p>
 <p><b>MASK</b> Wear a mask when cutting or grinding or when using epoxy sealant.</p>	 <p><b>EAR PROTECTION</b> Wear ear protection when cutting or grinding.</p>

## Warnings and Important Notes

 <b>WARNING</b>	
	<p>This product is to be installed in systems operating near locations where highly combustible fuels or vapors may be present.</p> <p>Fire or explosion resulting in serious injury or death could result if the equipment is improperly installed or modified. Serious contamination of the environment may also occur.</p> <ol style="list-style-type: none"><li>1. Read and follow all instructions in this manual, including all safety warnings.</li><li>2. Comply with all applicable codes including: the National Electrical Code; federal, state, and local codes; and other applicable safety codes.</li><li>3. Do not modify or use service parts other than those provided by Veeder-Root.</li></ol>

## **Before You Begin**

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### **Installation Sequence**

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1. Read all Installation Instructions.
2. Determine if Direct Burial is possible.
3. Plan lay out for saw cutting.
4. Calculate sealant and filler rod length.
5. Calculate cable length.
6. Plan installation with respect to weather conditions.
7. Make saw cut.
8. Clean trench with compressed air.
9. Lay and test cable for shorts and opens.
10. Install probes and sensors.
11. Make Direct Burial connections with splice kits.
12. Verify probe and sensor operation.
13. Install filler rod to proper depth.
14. Install sealant.
15. Verify probe and sensor operation.

### **Parts Needed For Direct Burial Installations**

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#### **Site Preparation Document**

One set of Installation Instructions needed for each site. Order Kit No. 848100-500.

#### **Splice Kits**

A splice kit is needed for every probe or sensor installed with a Direct Burial Cable. Order Kit No. 848100-501.

#### **Filler Rod**

Available in lengths of 100 to 2,000 feet, in increments of 100 feet. Refer to *Sealant and Rod Filler Calculations* to calculate length needed. Order Part No. 848100-1XX.

## **Direct Burial Cable**

Available in lengths of 100 to 2,000 feet, in increments of 100 feet. Refer to *Cable Length Calculations* to calculate length needed. Order Part No. 848100-2XX for 2-conductor cable and 848100-3XX for 3-conductor cable.

## **Sealant**

Refer to *Sealant and Rod Filler Calculations* to calculate amount of sealant required. Sealant is available in quart cartridges, Part No. 848100-800, or 4.5 gallon cans, Part No. 848100-805. A cartridge will cover about 60 feet of filler rod and one can will cover about 1200 linear feet. See *Filler Rod and Sealant Installation* for recommendations on dispensing sealant.

## **Conduit**

Installation of this Direct Burial System can only be done in those locations where local codes permit the use of buried cable instead of conduit and epoxy splices instead of junction boxes.

If needed, order Conduit entry boots from sump manufacturer.


Rigid conduit may be used when entering a sump. A coupling will be needed for installing our cord grip on rigid conduit. Rigid conduit must be used in areas below grade not covered by either asphalt or concrete.

## **Recommended Tools**


- ☐ Filler Rod Installation Tool, Part No. 848100-904
- ☐ Manually Driven Cartridge Gun, Part No. 848100-901
- ☐ Compressed Air Driven Cartridge Gun, Part No. 848100-902
- ☐ Compressed Air Driven Bulk Gun, Part No. 848100-903



# Installation

**Important**  Before considering Direct Burial, check to be sure that Direct Burial practices are acceptable at this location. Determine acceptability prior to ordering materials.

## Site Layout

**Important**  The Direct Burial cable is for intrinsically safe wiring only. Using Direct Burial Cable for any other wiring is not permitted.

The wiring and cables for the intrinsically safe probes and sensors cannot be combined with wiring from any other system. a physical separation of at least two inches must be maintained. probe and sensor wiring cables must have a two inch separation from all other wiring.

Failure to maintain proper separation of probe and sensor wiring, can result in equipment damage, inaccurate inventory control, or undetected environmental and health hazards.

The words “saw cut”, “joint” and “trench” refer to the location of the Direct Burial Cable when installed below grade.

1. Determine the following: building junction box location; location of each probe and sensor; which probe and sensor cables can be run together.
2. Use a layout diagram to determine the number and length of the saw cuts. Figure 1 shows a typical layout including trench lengths

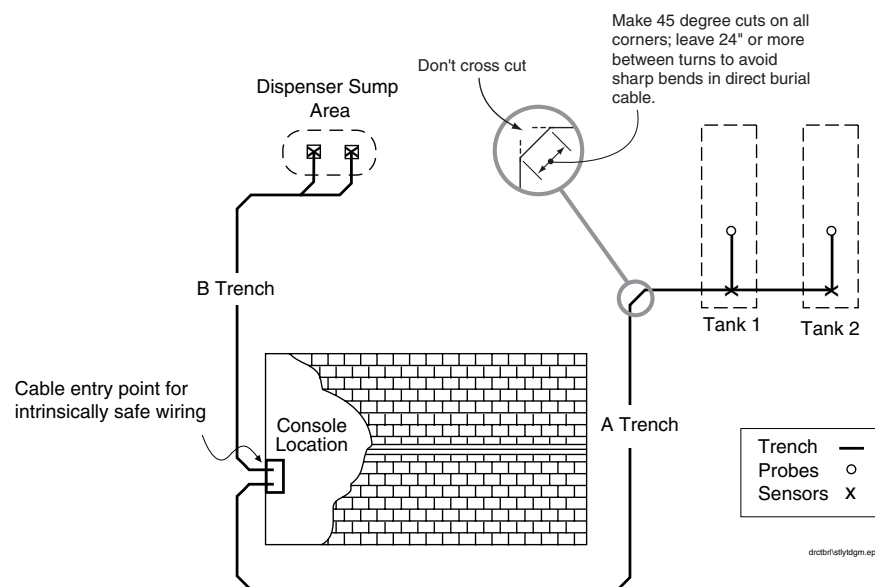



Figure 1. Site Layout Diagram, Top View

## ! WARNING



**Careful consideration must be given to existing fuel and wiring systems. The trench layout must not cut through existing systems as fire and explosion may result.**

**Important**  Each probe and sensor will have its own Direct Burial Cable. These cables must run from each probe and sensor to a junction box located prior to the seal-off.

*When crossing over existing piping or wiring, determine their depth before cutting a new trench.*

3. Measure the trench lengths with a tape measure. Record these lengths on a layout sketch.
4. The Direct Burial Layout should not be located in areas of poor drainage or improperly designed subsurface drainage systems.

## Sealant And Filler Rod Calculations

Use the dimensions recorded on your layout sketch for determining the required amount of sealer and filler rod.

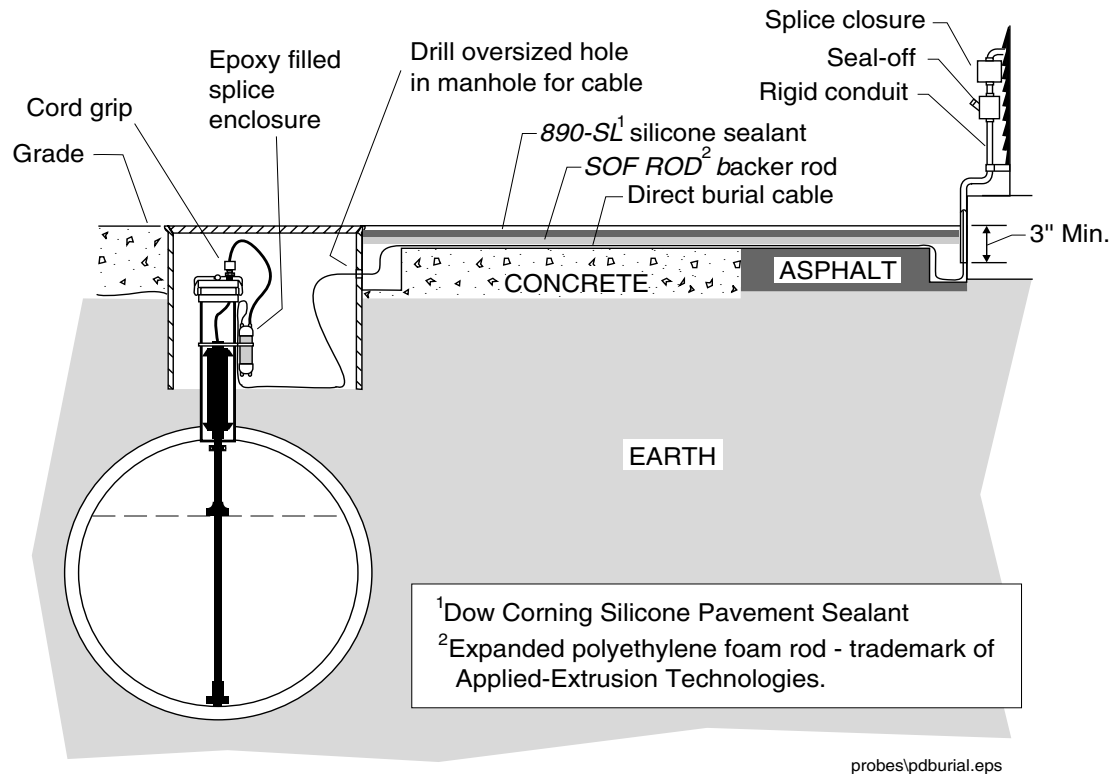
The calculation for the “A” trench length uses the longest linear length for the furthest probe or sensor. Separate wires for each probe and sensor are placed in a common trench “A”. The length of the trench is obtained by determining the total trench length including all its branches from the console to the probe and sensor locations. Add 15 percent to the determined length to allow for measurement errors.

The same method is used for calculating the “B” trench length. Add the length needed for another sensor, plus 15 percent.

## Cable Length Calculation

1. Use your layout diagram to determine the distance from the cable entry point to each probe or sensor.
2. Add all of the probe and sensor cable lengths together. Add an additional 40 feet to the total required cable length for cabling connections.

See Figure 2 for a cross sectional view of a single Direct Burial Cable run. Figure 2 is a typical cable run from a probe to the cable entry point.



**Figure 2. Direct Burial Installation**

Direct Burial Cable can be ordered as one continuous length up to 2,000 feet. Always “round up” any length calculation to the next 100 feet length.

Where possible, the Direct Burial Cable should be run in asphalt or concrete. If an unpaved surface cannot be avoided in the cable layout, the cable must be run through rigid conduit. Refer to local applicable codes when using Direct Burial Cable in an unpaved surface.

### Example: Sealant and Filler Rod

From the cable entry point to the probe riser in Tank 2, the “A” length is 295 feet. From the cable entry point to the furthest sump sensor, the “B” length is 205 feet. For the “A” trench, add an additional 40 feet for the tank 1 probe. For the “B” trench, add an additional 40 feet for the other sump sensor. Add the lengths for both trenches together. An equal length of sealant and filler rod is needed.

“A”:  $295 + 40 = 335$  feet

“B”:  $205 + 40 = 245$  feet

Total length = 335 feet + 245 feet or 580 feet.

In this example, the total amount of sealant and filler rod needed is 580 feet. Order Part No. 848100-106 for 600 feet of filler rod. Order 600 linear feet of sealant; either ten 1 quart cartridges, Part No. 848100-800, or one 4.5 gallon can, Part No. 848100-805. The 10 cartridges will cover  $10 \times 60 = 600$  linear feet. One 4.5 gallon can covers 1,200 linear feet.

### Example: Direct Burial Cable

Calculate six cable lengths plus 40 feet per cable for making connections at both the riser and the cable entry point.

2 Probes:  $295 + 275 + 80 = 650$  feet.


2 Interstitial Sensors:  $275 + 255 + 80 = 610$  feet

Total length is 650 feet + 610 feet or 1260 feet

2 Sump Sensors:  $205 + 195 + 80 = 480$  feet

In this example, a 1300 feet cable spool would be used for probes and interstitial sensors. Order 1300 feet of 2 conductor Direct Burial Cable, Part No. 848100-213. Order 500 feet of 3 conductor cable, Part No. 848100-305, for the sump sensors.

## Installation Strategy

**Important**  *Maintain a 6-foot separation between direct burial conductors and lighting conductors.*

*It is recommended that all materials be on site before starting the Direct Burial Installation.*

*Although saw cutting can be done under various conditions, sealant installation cannot be. The sealant cure time depends on humidity and temperature. The cure time will increase with lower humidity or lower temperatures. Sealant cannot be installed at temperatures below 20°F or when surfaces are wet. Below 40°F the sealant will probably require more effort to “shoot” out of the gun, but this can be helped by keeping it indoors until it is ready to use. At 20°F the sealant will be tack-free in about 3 hours. At 75°F the tack-free time is about an hour, at which time the area can be reopened to traffic provided the sealant is properly recessed.*

*Joint faces must be clean, dry and frost-free when the sealant is installed. Joints must be free of standing water; and under no circumstances shall sealing take place during rain, snow, or temperatures below 20°F.*

*Do not install sealant when the temperature is below the dew point (the point at which dew begins to form).*

*If rain or other inclement weather occurs during joint preparation or sealing, all operations should cease. Sufficient time must be allowed for the trench to dry prior to continuing.*

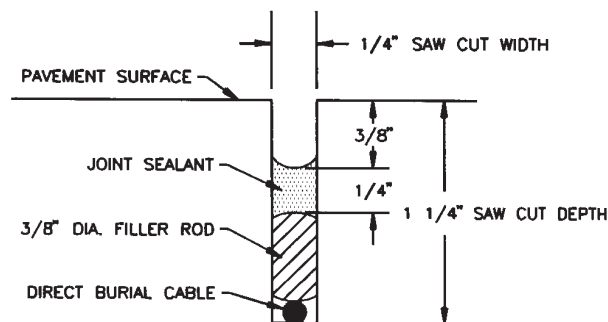
## Trench Preparation



When Cutting Or Grinding, Be Sure To Wear Adequate Safety Protection: Ear Protection, Gloves, Goggles, And A Dust Mask.

Sawing through concrete is actually a grinding operation. Please follow the rules listed in the ANSI B7.1 Safety Requirements for Use, Care and Protection of Abrasive Wheels. For more information, you may contact ANSI by writing to American National Standards Institute, 11 W. 42nd Street, New York, New York, 10036.

1. The saw cut depth is determined by the number of cables to be run in the trench [Figure 3]. The depth for one Direct Burial Cable is 1 1/4 inches. For each additional cable, 1/4 inch should be added to the saw cut depth.



dntrb/asecvdbac.apa


**Figure 3. Sectional View of Direct Burial Saw Cut**

**Important** If the Direct Burial Cable exits the ground in a hazardous location, a sealoff must be used prior to any J-Box, raceway, or cable entry.

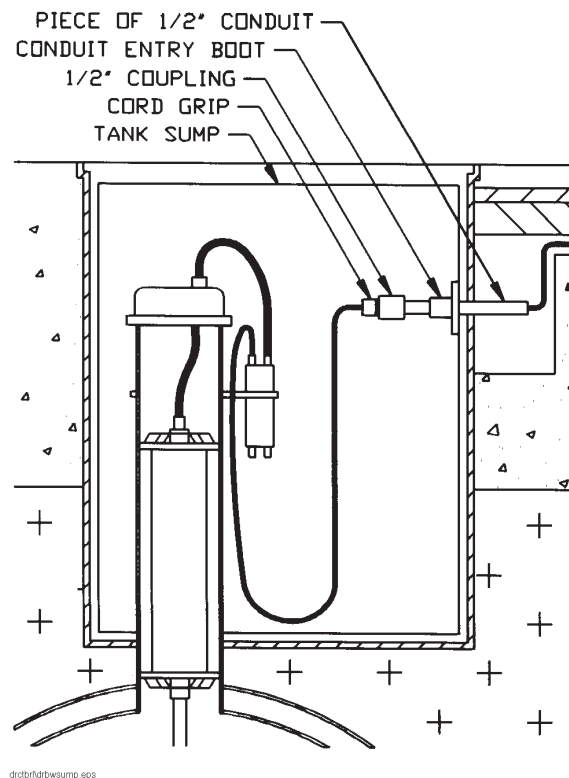
2. The width of the trench should not be less than 1/4-inch or more than 3/8-inch.

In the example from , the "A" trench with four cables would need a depth of 2 1/4 inches and the "B" trench with two cables would need 1 1/2 inch depth.

3. Dig out areas around the entry and exit points for the Direct Burial Cable (see Figure 2 on page 8). In the sump area these holes need to be about eight inches deep for cord grip installation. For the building entry area, about six inches is needed for the conduit which can be secured to the outside walls or come up through the floor. These areas should be back filled once the cable has been tested.
4. In sumps using conduit entry boots, run the Direct Burial Cable in a short piece (6 to 12 inches) of 1/2-inch conduit [Figure 4 on page 11]. Use a 1/2-inch NPT coupling with female threads for connecting the cord grip to the conduit. In other types of sumps drill and tap a 1/2-inch NPT hole in the sump wall for the cord grip. Make sure all pipe threads are sealed with a suitable compound and use corrosion resistant materials.

**Important**  *The conduit, coupling and entry boot are not provided by Veeder-Root. You may substitute with 3/4-inch or 1-inch parts with a suitable adapter to mate with the cord grip.*

*When turning corners with saw cuts, always use 45 degree cuts (see Figure 1 on page 6). 90 degree saw cuts may cause damage to the Direct Burial Cable.*



**Figure 4. Direct Burial with Sump**

5. Follow the sump manufacturer's guidelines when drilling and tapping holes in the sumps. If required, seal the conduit according to local applicable codes.

6. After cutting, clean the trench using compressed air. A clean trench will have no visible signs of residual sealant or debris on the joint wall, and will leave no residual cement powder or dust on your fingers after rubbing the joint face. If residuals are found, wash the entire trench and air blast dry.

**Important** ⓘ *The trench must be clean and dry before proceeding.*

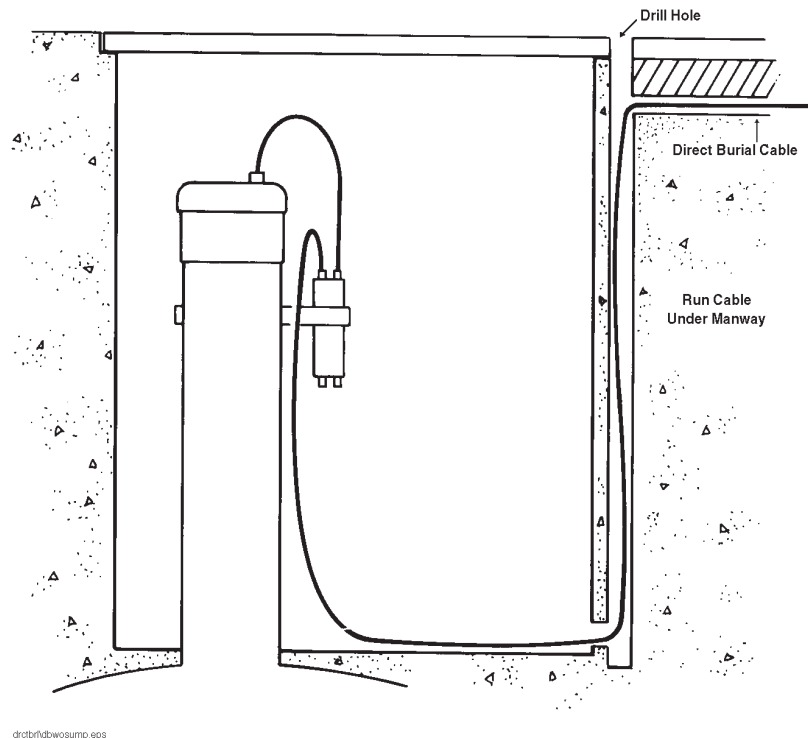
7. Install Direct Burial Cables leaving enough slack to make probe and sensor connections.

**Important** ⓘ *The cables should lie in the bottom of the trench so that at least 1 inch of clearance remains between the top of the cables and the pavement surface.*

*When removing the outer jacket of a cable, care should be taken not to damage the insulation on the inner conductors.*

8. In the sump area, install a cord grip over each Direct Burial Cable. Mount each cord grip into the sump wall. Run the Direct Burial Cables along the bottom of the sump, as shown in Figure 2 on page 8, then tighten the cord grips.
9. If a sump is not used, see Figure 5.

**Important** ⓘ *This application does not provide the containment required for a riser pipe used for filling the tank.*



**Figure 5. Direct Burial without a Sump**

10. At the entry point into the Hazardous Location, install a weatherproof junction box for making the wiring connections (refer to appropriate console Site Prep manual for all sensor/probe wiring connections).
11. Test each cable conductor, one at a time, for continuity. Then check for shorts between both the black and white conductors and the drain wire. After each successful test, label each cable inside the junction box.
12. Install probes and sensors according to the instructions shipped with them. In place of the junction box, located in the sump, use the Direct Burial Splice Kit. Read the Splice Kit Instructions Installation Manual for more information on Direct Burial Installation.

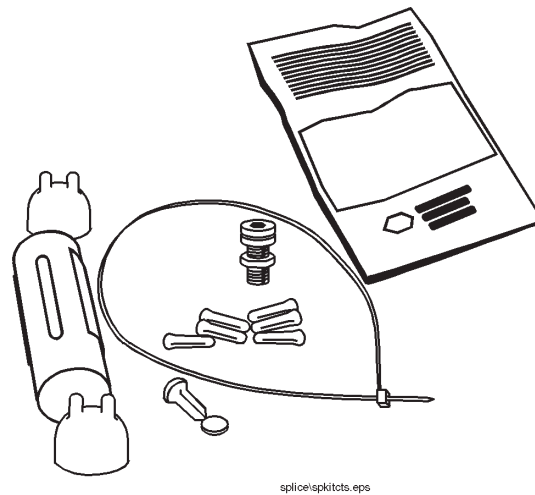


# Splicing

## Splicing Instructions

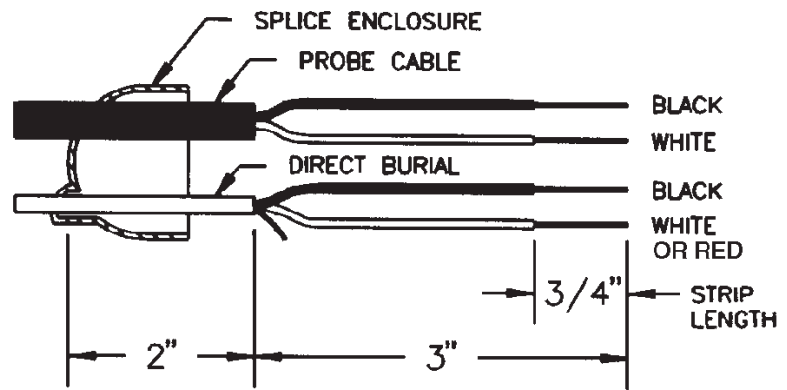
*When making direct burial cable connections to a sensor/probe cable, mark the direct burial cable wires to ensure that probe/sensor polarity is maintained (if required). Defer to sensor/probe wiring diagrams in the applicable console Site Prep manual when making these connections.*

1. Use a Splice Kit [Figure 6] for making splices.



**Figure 6. Splice Kit Contents**

2. Insert the probe cable or sensor cable through the top of each riser cap and through the cable bushing.
3. If the Direct Burial Cable is entering from a sump wall, insert the Direct Burial Cable through the cable bushing supplied in the Splice Kit (see the Direct Burial Cable Installation Instructions manual for more information).
4. Cut the soft vinyl end cap entrance hole to accommodate each cable diameter. Keep the hole size to a minimum. Insert about 5 inches of cable through the opening [Figure 7].

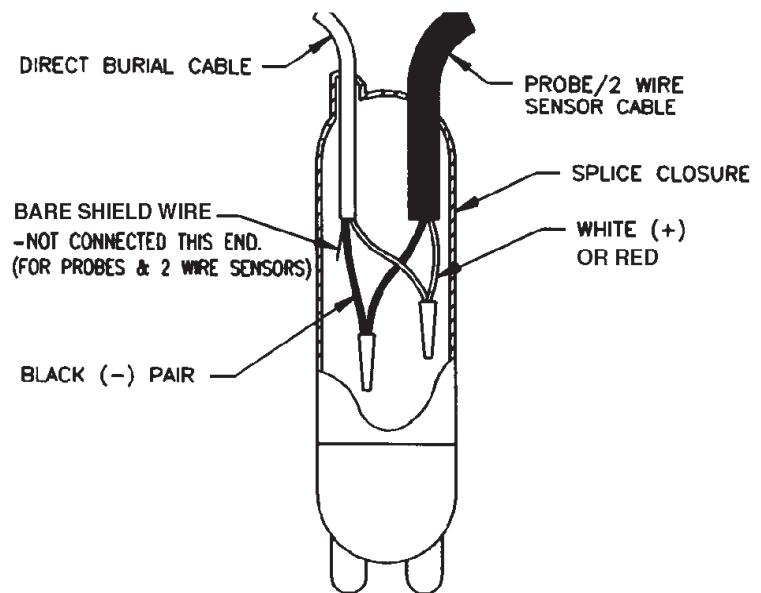


splice\lengthdim.eps

Figure 7. Splice Length Dimensions


5. Remove 3 inches of the outer jacket from each cable. Trim the insulation from the conductors [Figure 7 on page 15].
6. Make the connections using wire nuts [Figure 8 on page 15] for a 2-wire sensor or probe. Cut off the bare shield wire.

**Important** Normally the drain wire is not connected to probes and sensors in the sump area. At the other end (conduit entry point), the drain wire must be spliced to a wire connected to a bonding screw inside the console. This connection effectively ties the Direct Burial Cable shield to console ground.

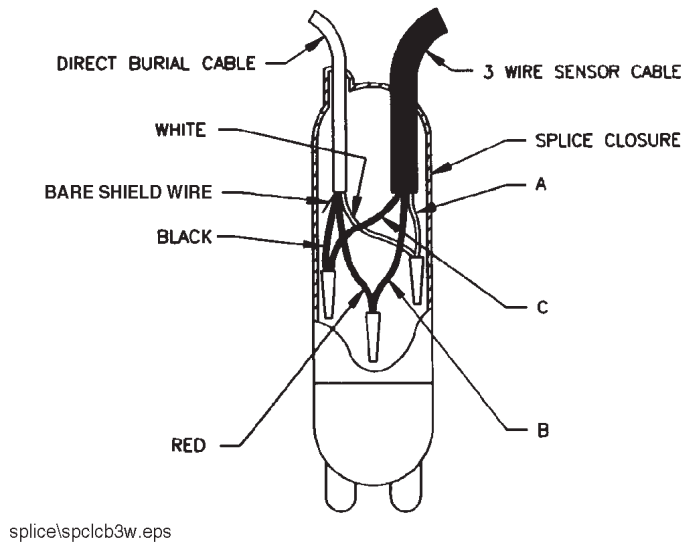


splice\spclcb2w.eps

Figure 8. Splice Closure/Cable Diagram—Probe and 2-Wire Sensor

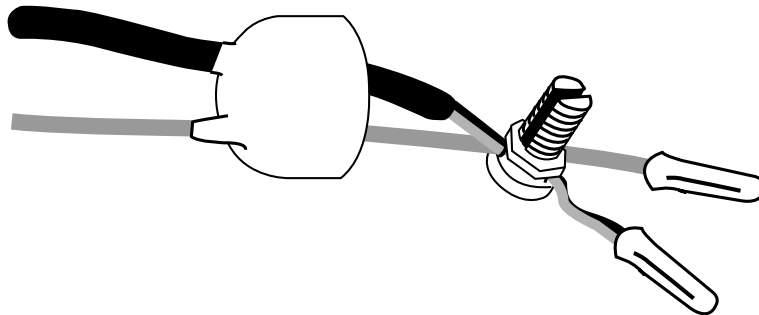
**Important**  For the 3-wire sensors, see Figure 9.

For direct burial of 3-wire sensors, use 3-wire shielded cable.



**Figure 9. Splice Closure/Cable Diagram—3-Wire Sensor**

7. Use the aluminum bonding clamp to hold the Direct Burial and probe/sensor cables together [Figure 10 on page 16]. Finger tighten, being careful not to damage the conductor insulation. This clamp is not intended to make any electrical connections.



**Figure 10. Probe Cable Splice**

8. Center the splice in the clear plastic sleeve. Assemble the splice closure, making sure the sleeve is fully inserted into each of the vinyl end caps. Rotate the sleeve cover until both openings line up. Place the splice on a level surface.

**! CAUTION**

**Q-compound and epoxy sealant may be irritating to skin and eyes, absorbed through the skin, or cause skin sensitization in susceptible individuals.**



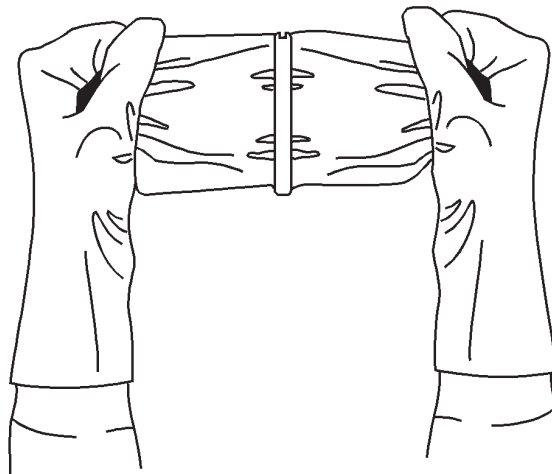
**Minor injury may result. Also materials contained in epoxy have caused skin cancer in animal tests.**

**You must wear gloves that are chemically resistant.**



**Avoid skin and eye contact. Wear appropriate safety equipment. Use only in well ventilated areas. If exposed, wash affected skin areas with soap and water. For eye contamination, flush with water for 15 minutes and get immediate medical attention. For ingestion, if conscious give plenty of water and induce vomiting.**

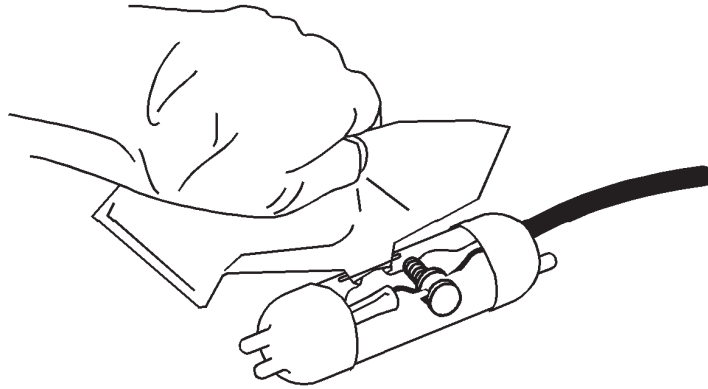
9. Remove bag of “Q-compound” from foil package. Grasp the ends, one in each hand, then pull sharply to remove plastic clip [Figure 11].



**Figure 11. Q Compound, Clip Removal**

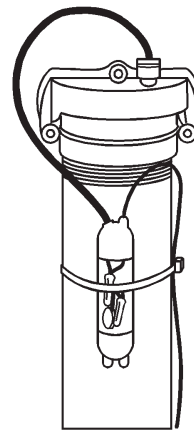
10. Thoroughly mix compound together. Invert bag several times while squeezing compound from one end to the other for a minimum of one minute.

11. Once the mixture feels warm, immediately cut one corner and slowly fill the plastic sleeve. Stop just short of filling the entire sleeve. **Do not overfill.** [Figure 12]



**Figure 12. Pouring Q Compound**

12. With a twisting motion, rotate the outer clear plastic barrel to close the pouring slot.
13. Wait at least five minutes, then use the large cable tie to mount the splice to the riser pipe [Figure 13].



splicekitimgwps.jpg

**Figure 13. Direct Burial Splice with Cable**

14. Make the console connections at the entry point into the hazardous location. Refer to the appropriate console Site Prep manual for making field wiring connections. Use wire nuts provided with Splice Kit to make these connections.
15. Splice the Direct Burial Cables using the Splice Kit for all probes and sensors. Use the console to verify wiring, connections, probe and sensor operation. Do NOT proceed until the entire system is communicating with every probe and sensor.

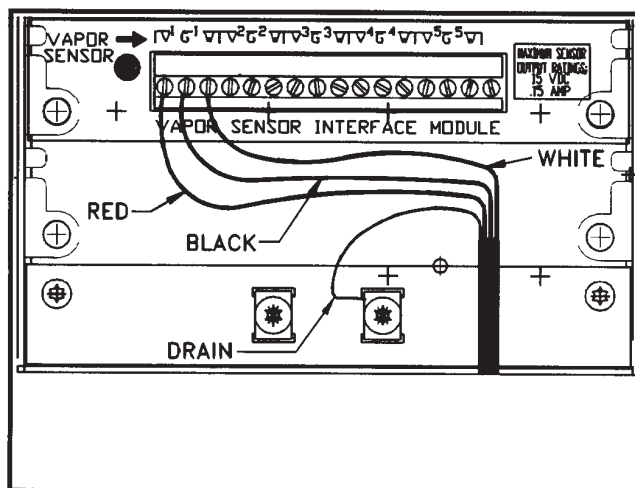
- 16. There must be no paths for gases to pass from the Hazardous Location to the Non-Hazardous Location.** To ensure water-tight seals, tighten all probe and sensor cable bushing nuts. Pour and check all seals in accordance with the National Electrical Code (NFPA 70) and the Automotive and Marine Service Station Code (NFPA 30A) since they pass from a Class I, Division I or Division II area into a non-hazardous area.

**Important**

*Using cables or sealants other than those described in this manual will void the product warranty. For sealing the trench, the only acceptable sealant is the 890-SL (self-leveling) from Dow Corning.*

*Sealant and epoxy are not interchangeable. Do not use sealant for potting wires and do not use the epoxy for covering the buried cable. The sealant, 890-SL, is dark gray, and packaged in cartridges and cans. The epoxy, Q Compound, is clear and packaged in a foil package.*

*Normally the drain wire cable shield is not connected to probes and sensors in the sump area. At the other end (conduit entry point), the drain wire must be spliced to a wire connected to a bonding screw inside the console [Figure 14]. This connection effectively ties the Direct Burial Cable shield to console ground.*



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Figure 14. Bonding the Drain Wire

## Filler Rod And Sealant Installation




**Avoid skin contact with Q-compound and sealant. If exposed, wash affected skin areas with soap and water. For eye contamination, flush with water for 15 minutes and get immediate medical attention. For ingestion, if conscious give plenty of water and induce vomiting.**

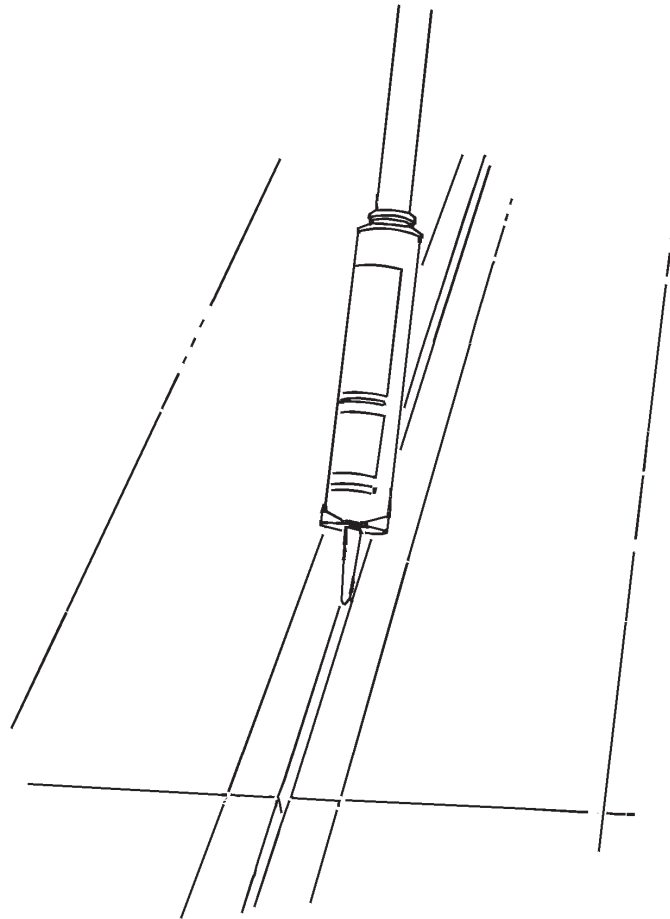
1. Uncoil the filler rod over the trenches. Install the rod to proper depth [Figure 3 on page 10]. The depth, 5/8 inch, is measured from the paved surface to the top of the filler rod. Placing the rod too deep will result in the need for excessive sealant.

**Important**  *Filler rod can be installed by hand, but a roller tool to aid in placement is a better choice. Order Veeder-Root Filler Rod Installer Part No. 848100-904. Sealant should only be installed if the temperature is above 20°F and joint surfaces are dry (see “Installation Strategy” on page 9 for more on application temperatures).*

2. The self-leveling sealant should be installed as soon as the container is opened. An air powered dispenser works best, but a manual pump gun can be used.
3. The following types of sealant dispenser guns are available. Order using these part numbers:
  - ☐ 848100-901, Manually Driven Cartridge Gun.
  - ☐ 848100-902, Compressed Air Driven Cartridge Gun.
  - ☐ 848100-903, Compressed Air Driven Bulk Gun, for use with 4.5 gallon cans.
4. When using compressed air to dispense the sealant, an air line pressure regulator is recommended. Adjust air line pressure to achieve the desired flow rate. The air line pressure needed will usually be below 60 psi.
5. To load the bulk gun, first remove the bottom cap. Immerse the bottom of the gun into the sealant to a depth of about one inch. While holding the barrel, pull the piston rod back slowly. Pause at every inch allowing the barrel to fill with a minimum of air pockets. Remove gun and clean any excess sealant with a putty knife. Replace the bottom cap and attach a nozzle.
6. When using sealant cartridges, cut the nozzle at an angle and be sure to break the seal between the nozzle and the cartridge.
7. Pump the sealant along the top of the filler rod [Figure 15 on page 21]. Move the nozzle along the joint pushing the sealant ahead to form a uniform bead. Fill the joint from the top of the filler rod to 3/8 inches below the pavement surface.

**Important**  *Filler rod must be installed to the proper depth or sealant failure may occur. When installed, the top of the filler rod should be 5/8 inch deep.*

*Failure to install sealant to a minimum depth of 1/4 inch below grade will result in sealant failure [Figure 3 on page 10].*



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**Figure 15. Sealing the Filler Rod**

8. Excess sealant on the pavement surface should be scraped up and removed to prevent possible tracking.
9. Use the console to again verify that all probes and sensors are working correctly.
10. Once a skin has formed on the sealant surface, about one to three hours depending on cure time, the area can be reopened to traffic. Typically the sealant surface will feel tacky.



