

Variable Speed Flow Controller

Installation Guide



IMPORTANT NOTICE!

The VSFC does not support DPLLD sensors, and is not to be used with TLS-450 consoles.

A V-R PLLD Pressure Transducer must be installed in the STP and connected to the Variable Speed Flow Controller (VSFC) for the VSFC to control the STP.

For VSFC standalone installations (i.e., sites without a TLS-350 Console, or sites having a TLS-350 without PLLD line leak detection), a PLLD Pressure Transducer is required in the STP (V-R kit P/N 330020-45X). To install this transducer refer to relevant sections of the PLLD Site Prep guide (V-R P/N 576013-902).

For VSFC installations in sites that include a TLS-350 Console with PLLD line leak detection, a separate PLLD Pressure Transducer is not required because the VSFC unit and the PLLD system will share the same transducer.

For all VSFC installations, you must connect the PLLD Pressure Transducer's cable to the VSFC unit following the instructions in this VSFC installation Guide.

Unit is shipped from factory preconfigured in Single-Unit mode. There is no need to change any settings except Line Pressure if unit will be installed as a single unit.

Notice

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Introduction

This manual contains procedures for the installation or replacement of the Red Jacket Variable Speed Flow Controller (VSFC). This manual assumes all preliminary site preparation is completed, and that field wiring from the pumps to the VSFC is in place.



The VSFC does not support DPLLD sensors/TLS-450 consoles. The VSFC is designed for use with PLLD sensors/TLS-350 consoles only!

Reference Manuals - As Required

- The Red Jacket STP Installation, Service, Parts Manual - P/N 577013-830
- Quantum 4" STP Installation, Operation, & Service Manual - P/N 042-129-1
- 4" STP and AG Pump Installation, Operation, & Service Manual - P/N 042-153-1
- PLLD (Pressurized Line Leak Detection) Site Prep and Installation Guide - P/N 576013-902
- FXV Leak Detectors Installation Instructions - P/N D042-106-1

Contractor Certification Requirements

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

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

TLS-350 Technician Certification: Contractors holding valid TLS-350 Technician Certifications are approved to perform installation checkout, startup, programming and operations training, troubleshooting and servicing for all Veeder-Root TLS-300 or TLS-350 Series Tank Monitoring Systems, including Line Leak Detection and associated accessories.

Warranty Registrations may only be submitted by selected distributors.

Required Installation kits

Table 1 illustrates the required kits and STP check valves for VSFC operation, by Red Jacket pump type.

Table 1.- PLLD Required Kits

Pump Type	PLLD Kit P/N	Additional Parts for Manifolded Pumps		
		Check Relief Valve	Single Tank w/ 2 STPs	2 or More Tanks w/ STP in each
Red Jacket Standard	848480-003	SwiftCheck (in PLLD kit)	Non-vented SwiftCheck valve for slave pump. Kit P/N 330020-416 and interlock relay	Non-vented SwiftCheck valve for each slave pump. Kit P/N 330020-416
Red Jacket Quantum	848480-001	Red Jacket Spike Check (factory installed)		
The Red Jacket Pump	848480-001	Factory installed check/relief valve	High pressure relief check valve, P/N 410153-002 and interlock relay	High pressure relief check valve, P/N 410153-002



WARNING! When installing VSFC at sites having TLS-350 Console with PLLD line leak, the Pressure Line Leak Interface Module must be V-R Form No. 847490-110.

The correct module can be verified as follows.

1. Remove the PLLD Interface Module from the TLS 350 Console.
2. Turn the PLLD Interface Module over and look for the part number on the board (see Figure 1).
3. The older module (part number 330312-001) must be replaced with the newer module (part number 330885-001).

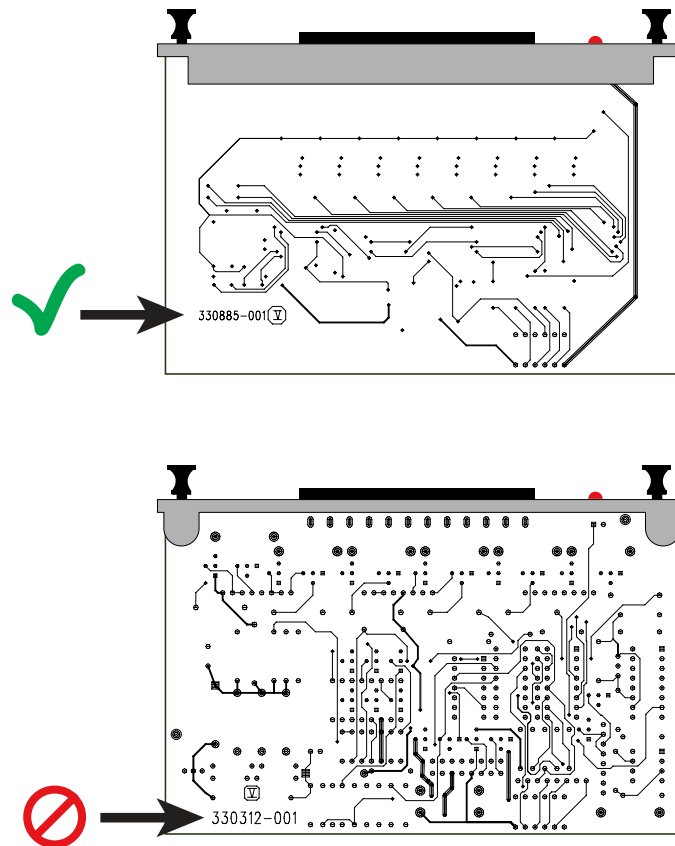











Figure 1. Verifying correct PLLD module (P/N 330885-001)





WARNING! Only Veeder-Root Pressure Transducers, form number 848480-001, can be used with this system.

Safety Precautions

The following safety symbols are used in this manual to alert you to important safety hazards and precautions.

 EXPLOSIVE Fuels and their vapors are extremely explosive if ignited.	 FLAMMABLE Fuels and their vapors are extremely flammable.
 ELECTRICITY High voltage exists in, and is supplied to, the device. A potential shock hazard exists.	 TURN POWER OFF Live power to a device creates a potential shock hazard. Turn Off power to the device and associated accessories when servicing the unit.
 WARNING Heed the adjacent instructions to avoid equipment damage or personal injury.	 WEAR EYE PROTECTION Wear eye protection when working with pressurized fuel lines or epoxy sealant to avoid possible eye injury.
 GLOVES Wear gloves to protect hands from irritation or injury.	 INJURY Careless or improper handling of materials can result in bodily injury.
 READ ALL RELATED MANUALS 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.	



⚠ WARNING

The VSFC unit is to be installed in systems operating near locations where highly combustible fuels or vapors may be present.

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.

Read and follow all instructions in this manual, including all safety warnings.

To be installed in accordance with the National Electrical Code, NFPA70, the Automotive and Marine Service Station Code, NFPA30A.

Substitution of components may impair intrinsic safety.

Do not use this component with Automatic Tank Gauges other than the TLS-350 Console. Install only as described in this manual or you will void all warranties connected with this product.

⚠ WARNING

The installer must ensure that all grounds are properly connected. Failure to connect any ground wire may result in severe personal injury, death, substantial property damage or sub-par performance of the system.

⚠ WARNING

The VSFC unit contains high voltages which can be lethal. It is also connected to low power devices that must be kept intrinsically safe.

Do not connect the VSFC AC power supply wires at the breaker until all devices are installed.

Attach conduit from the power panel to the unit's power side knockouts only.

Power and communication wiring/conduit must not enter the intrinsically-safe side of the VSFC unit.

Connecting power wires to a live circuit can cause electrical shock that may result in serious injury or death.

Routing conduit for power wires into the intrinsically-safe compartment can result in fire or explosion resulting in serious injury or death.

⚠ WARNING

Explosive vapors or flammable liquids could be present near locations where fuels are stored or being dispensed.

The VSFC unit is not explosion proof. Do not install this device in a volatile, combustible, or explosive atmosphere.

An explosion or fire resulting in serious injury or death, property loss and equipment damage could occur if the VSFC unit is installed in a volatile, combustible or explosive atmosphere (Class I, Division 1 or 2).

VSFC Description and Component Locations

The Red Jacket Variable Speed Flow Controller (VSFC) is only to be used with CPT or VSFC pumps P200U20-2, AGP200T20-2 or P200T20-2 (Standard, Quantum or RED JACKET models).

The VSFC monitors pump output line pressure to ensure a constant flow to each nozzle in the fuel line, regardless of the number of nozzles in use at any time. Depending on observed line pressure, the VSFC varies the pump's fundamental frequency and power to increase or decrease the pump's rotational speed and hence its output pressure.

When multiple tanks are connected to a common product line, one tank is designated the master tank and additional tanks are designated as slaves. A VSFC unit is required for each tank in a multiple tank system, but only the master tank requires a pressure transducer.

For installations that have a power conduit in the ground to the STP, and the customer does not want to bury a new wiring conduit for the VSFC-to-pressure transducer cable, a Veeder-Root Intrinsically-Safe (I.S.) barrier can be installed in the STP (NOTE: a one inch or larger conduit is required). The contractor can just pull a separate cable through the existing power conduit to the I.S. barrier in the STP (this can be done provided conduit and seal-off conductor fill requirements are met and the contractor adheres to all other aspects of the NEC or local codes).

The Red Jacket VSFC can be installed stand-alone or in conjunction with a TLS-350 console. If the TLS-350 console also performs pressurized line leak detection, the VSFC independently controls the pump to maintain desired nozzle flow rate, and operates the pump for line leak testing as directed by the console using a single Pressure Transducer.

VSFC Unit Dimensions

Figure 2 shows dimensions and mounting hole pattern of the VSFC unit. Note the clearance around the unit that is required for air circulation.

INSTALLATION TIP! Cut out mounting hole template from Appendix C. Tape template in position on wall and drill all six holes for fasteners. Remove template and screw in the bottom two fasteners, leaving about 3/8" of thread showing. Position unit so bottom mounting slots rest on the first two screws. Screw in remaining four screws and then tighten bottom two screws.

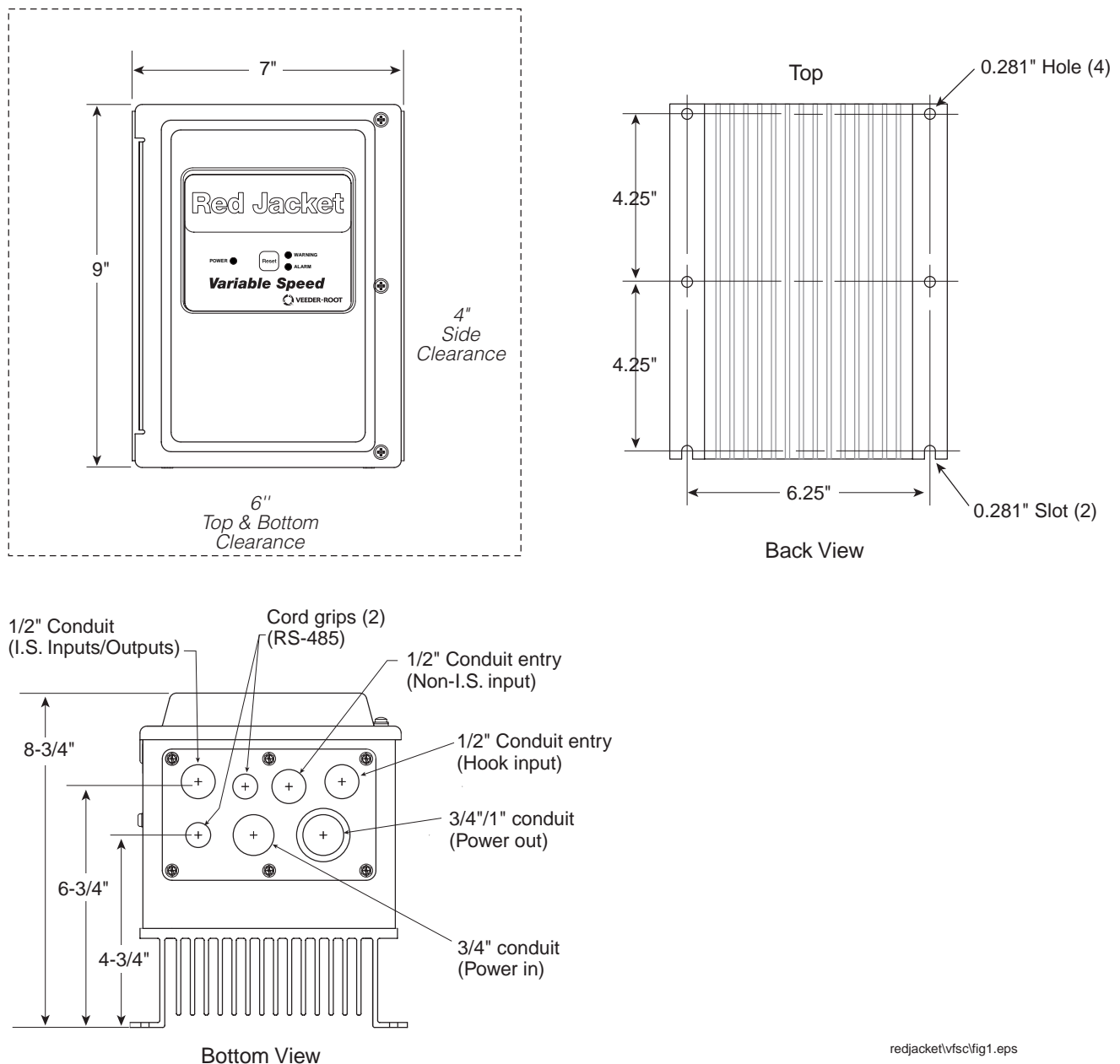


Figure 2. VSFC mounting holes and unit dimensions

VSFC Unit PC Boards

Figure 3 shows the front door of the VSFC unit open. The VSFC board is on top, the Logic board is in the middle, and the Power board is on the bottom.

Note that the intrinsically-safe wiring compartment has the cover removed in this diagram. Only intrinsically-safe (I.S.) wiring/conduit can enter this side of the unit.

Non-I.S. wiring (VSFC power, pump power, barrier/pressure input, and com) wiring/conduit must enter the power side of the unit only.

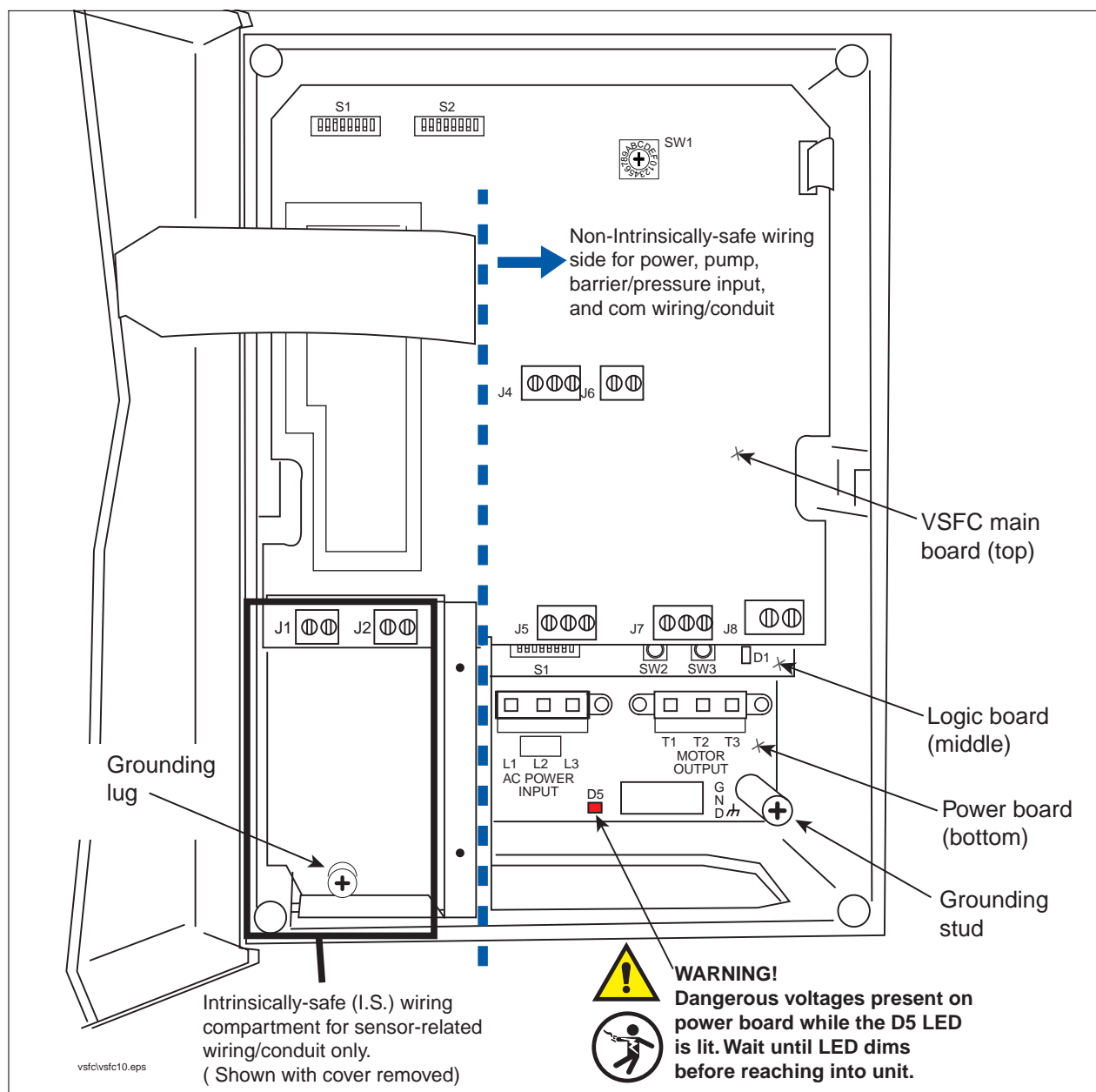




Figure 3. VSFC Board Locations

 The numbers in the hex symbols, e.g., , identify important components displayed in various diagrams throughout this manual. Any text relevant to these numbered items, such as conductor type, wiring connections, or switch settings, can be identified by that item's unique hex number identifier.

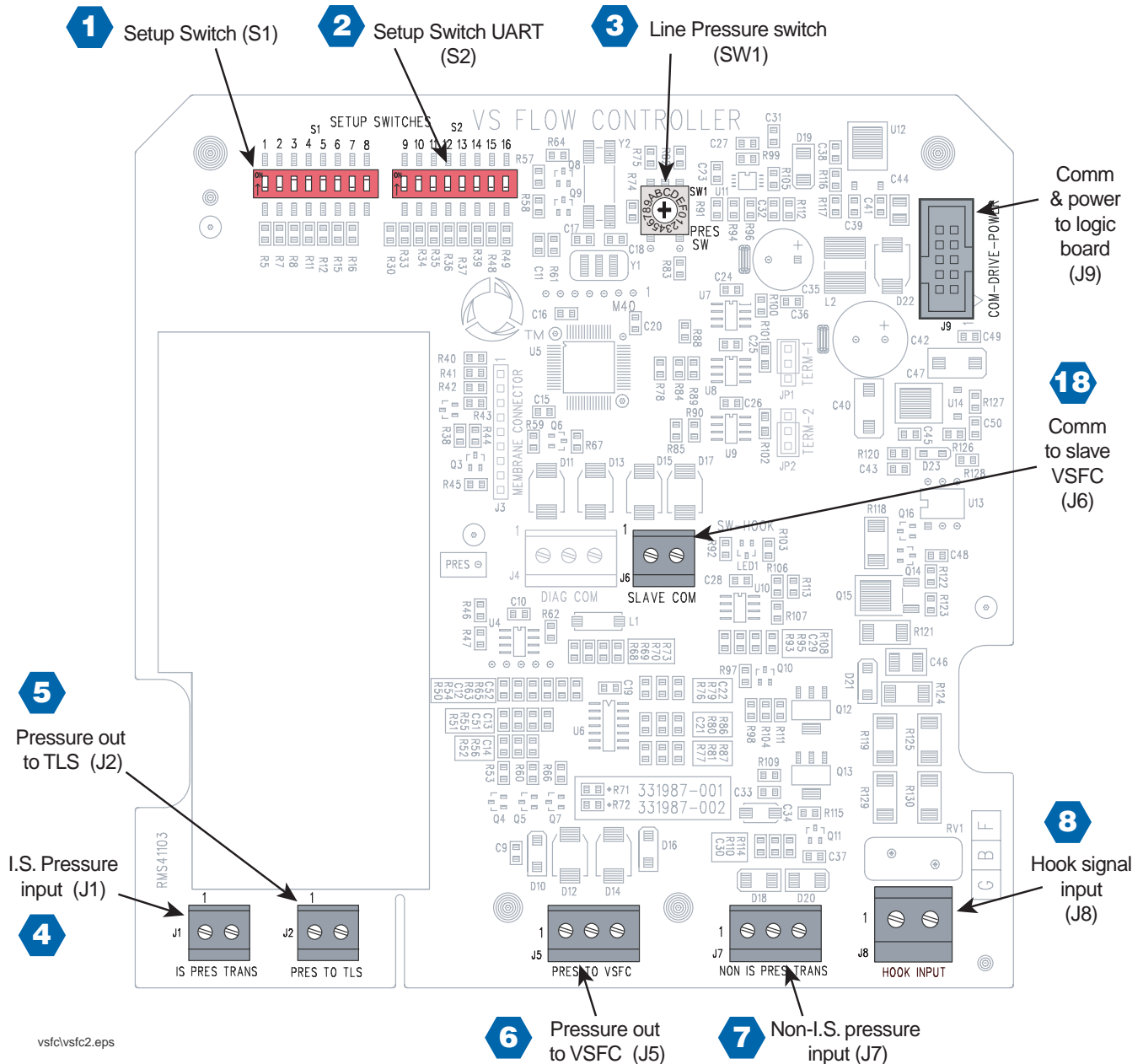


Figure 4. VSFC main board switch settings and wiring connectors

1 S1 DIP SWITCH SETTINGS

The S1 DIP switch settings are shown in Table 2 below.

Table 2.- Setup Switch S1

DIP Switch	Position - 'ON' is up, 'OFF' is down
1	Off (default - DO NOT CHANGE!)
2	Off (default - DO NOT CHANGE!)
3/4	On/On = Single Unit (default), On/Off = alternate, Off/On = master/slave, Off/Off = Tank Based - Refer to "Selecting an Operating Mode for Multiple VSFCs" on page 37 for more information on these selections.
5	Off = slave, On = master (default)
6	On = PLLD mode enabled (default), Off = disabled (mechanical LLD)
7	On = Dry run retry disabled, Off = enabled (default)
8	Off = Long handle warning enabled (2 hours), On = disabled (default)

2 S2 DIP SWITCH SETTINGS

The S2 DIP switch settings are shown in Table 3 below.

Table 3.- Setup Switch S2

DIP Switch	Position - 'ON' is up, 'OFF' is down
9	On = 19200 Uart0 Baud, Off = 9600 Uart0 Baud (default - DO NOT CHANGE)
10	Off = 9600 Uart1 Baud, On = 19200 Uart1 Baud (default - DO NOT CHANGE)
11	Off (default - DO NOT CHANGE!)
12	Off (default - DO NOT CHANGE!)
13	Off (default - DO NOT CHANGE!)
14	Off (default - DO NOT CHANGE!)
15	Off (default - DO NOT CHANGE!)
16	Off (default - DO NOT CHANGE!)

3 LINE PRESSURE SETTINGS - SW1 ROTARY SWITCH

Select a rotary switch setting for the desired line pressure from Table 4 below.

Table 4.- Rotary Switch SW1

Position	Line Pressure (psi)
0	14
1	16
2	18



NOTE: Pressure should not be set below 22 psi on The Red Jacket pump or on other Red Jacket pumps that have the SwiftCheck or Spike Check valve installed.

Table 4.- Rotary Switch SW1

Position	Line Pressure (psi)
3	20
4	22
5	24
6	26
7	28
8	30 (Default)
9	32
A	34
B	36
C	38
D	40
E	42
F	44

VSFC POWER BOARD

Figure 5 shows the position of key components on the VSFC power board.

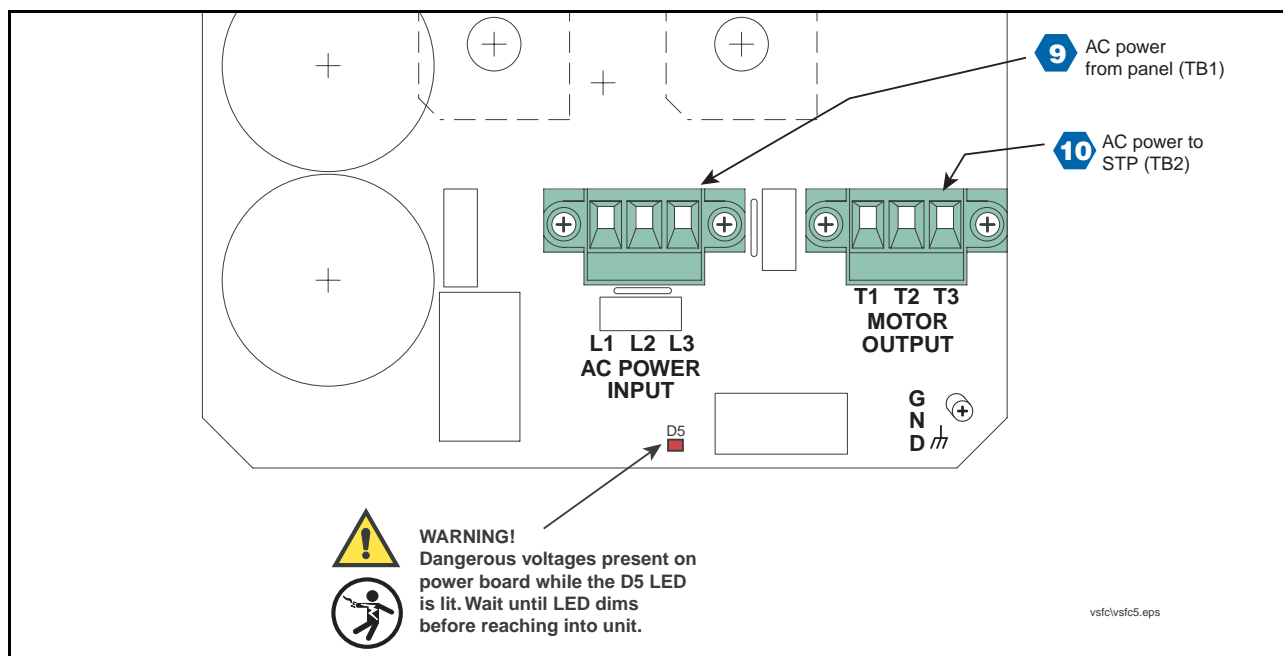


Figure 5. VSFC Power Board Wiring Connectors

Mounting the VSFC Unit

⚠ WARNING	
	<p>Explosive vapors or flammable liquids could be present near locations where fuels are stored or being dispensed.</p> <p>The VSFC unit is not explosion proof. Do not install this device in a volatile, combustible, or explosive atmosphere.</p> <p>An explosion or fire resulting in serious injury or death, property loss and equipment damage could occur if the VSFC unit is installed in a volatile, combustible or explosive atmosphere (Class I, Division 1 or 2).</p>

Select a mounting location on the inside of any building. The VSFC unit must be protected from severe vibration, extremes in temperature and humidity, rain, and other conditions that could harm computerized electronic equipment. The unit's operating temperature range is 32 to 113°F (0 to 45°C), and its storage temperature range is -40 to +167°F (-40 to +75°C).

The mounting surface should be strong enough to support the unit's weight of 9 pounds. You should also consider wall space for routing the power wiring conduits and comm wiring conduits that must be connected to the unit.

VSFC Site Installation Examples

Verify RJ Pump Type and VSFC Operation Mode

Standalone VSFC (No TLS Console)

- Figure 6 illustrates RJ pump connections for stand-alone VSFC installations with shared conduit for pressure and pump control wiring.
- Figure 7 illustrates RJ pump connections for stand-alone VSFC installations with separate conduit for pressure and pump control wirings.

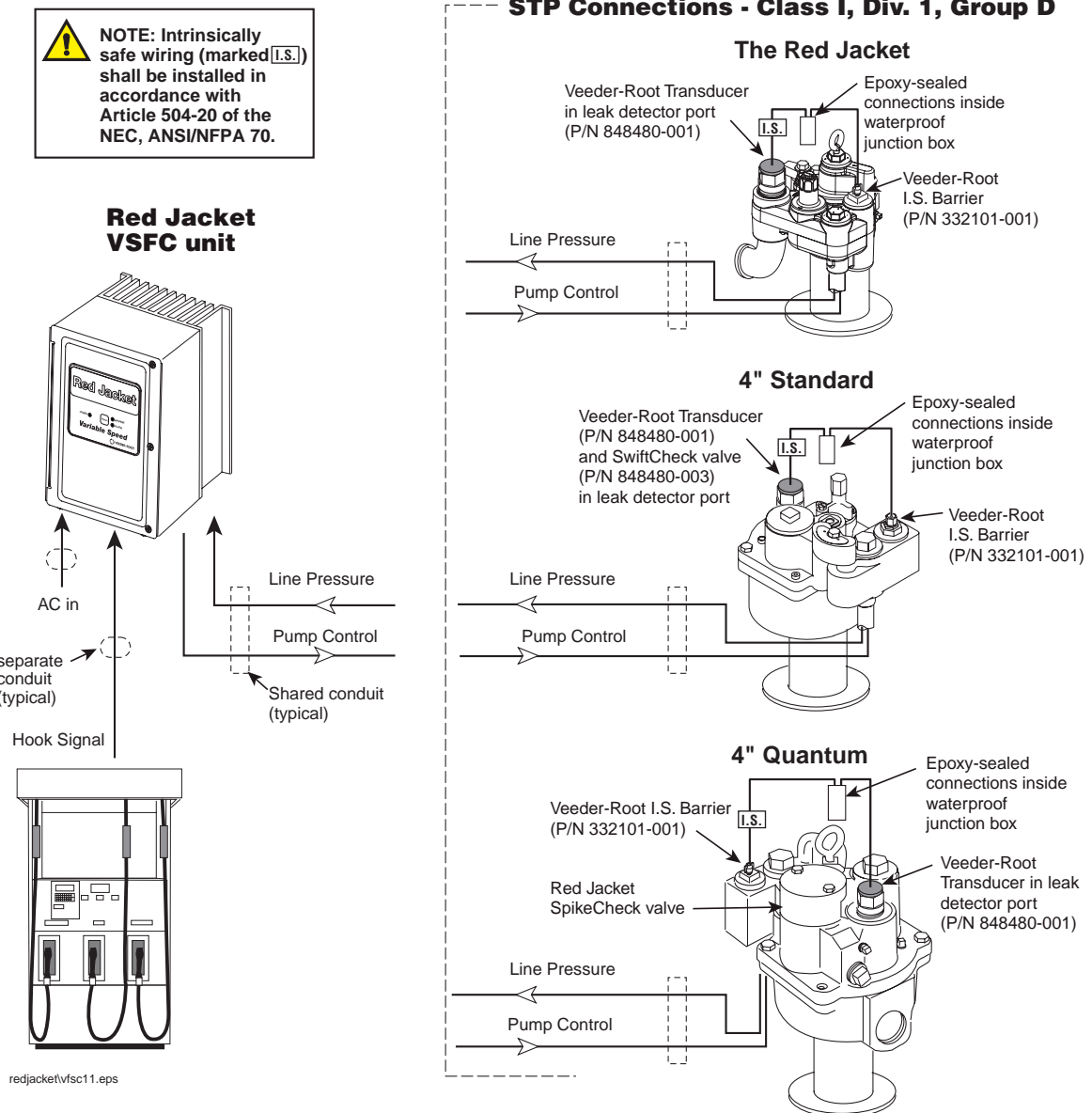
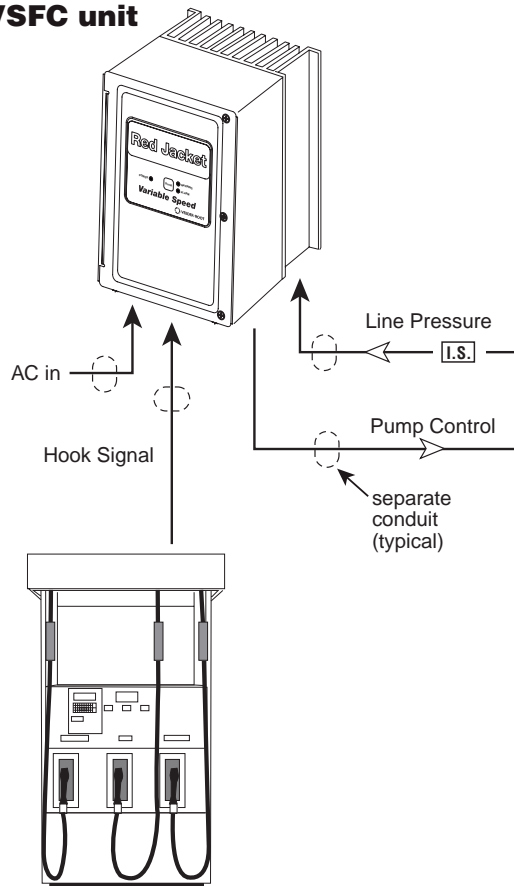


Figure 6. VSFC standalone installation examples with shared conduit for pump control and pressure signals



NOTE: Intrinsically safe wiring (marked **I.S.**) shall be installed in accordance with Article 504-20 of the NEC, ANSI/NFPA 70.

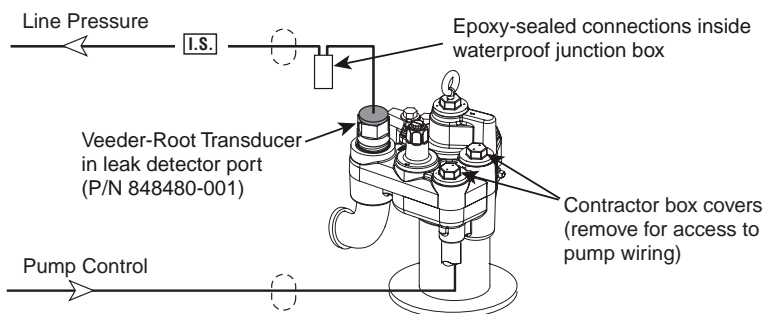
Red Jacket VSFC unit



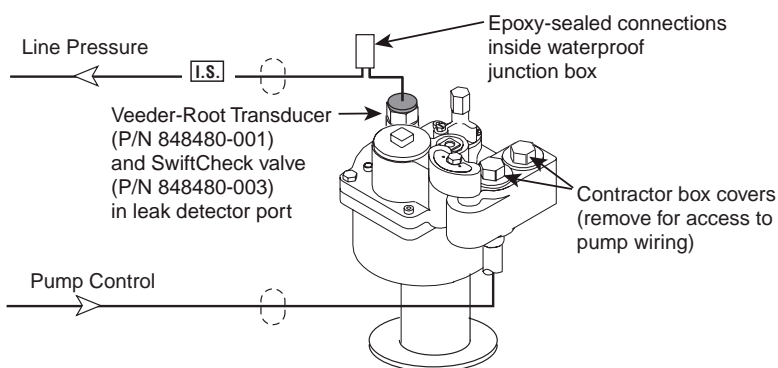
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STP Connections - Class I, Div. 1, Group D

The Red Jacket



4" Standard



4" Quantum

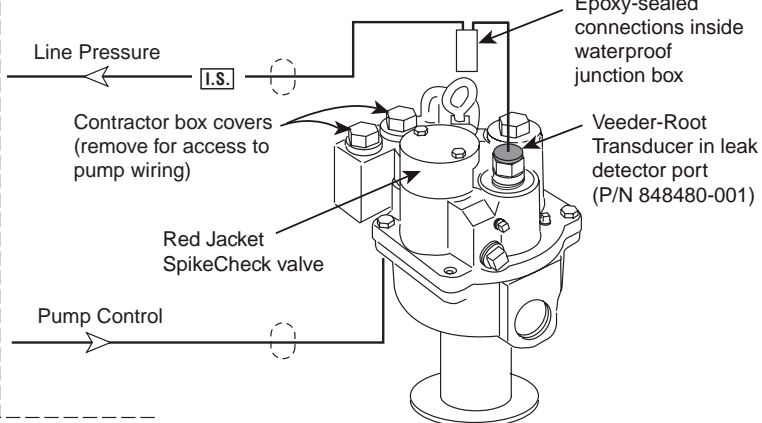


Figure 7. VSFC standalone installation examples with separate conduits for pressure and pump control signals

VSFC with TLS Console

- Figure 8 illustrates RJ pump connections needed for VSFC/TLS-350 installations with shared conduit for pressure and pump control wiring.
- Figure 9 illustrates RJ pump connections needed for VSFC/TLS-350 installations with separate conduit for pressure and pump control wiring.

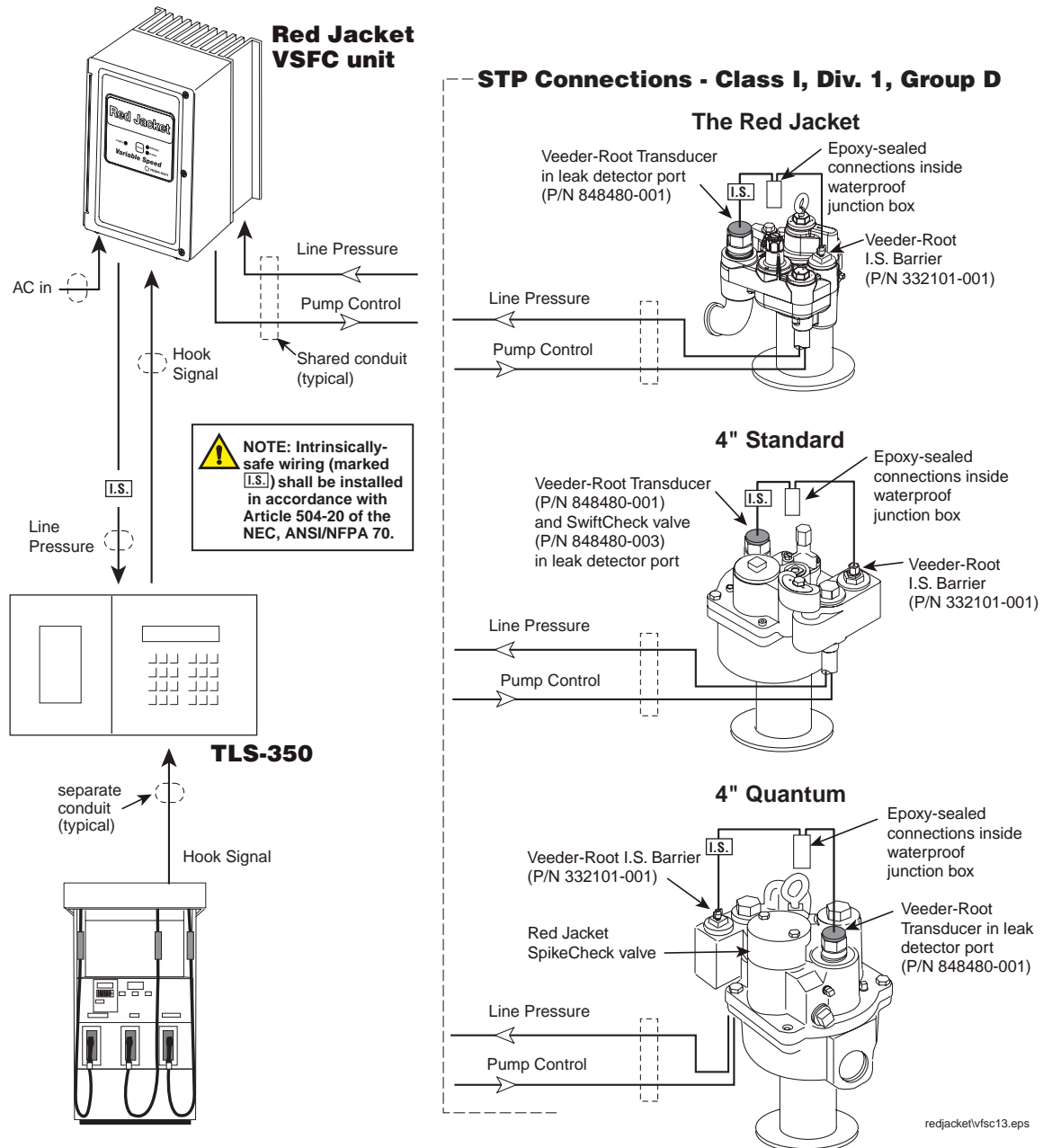


Figure 8. VSFC/TLS-350 installation examples with shared conduit for pump control and pressure signals

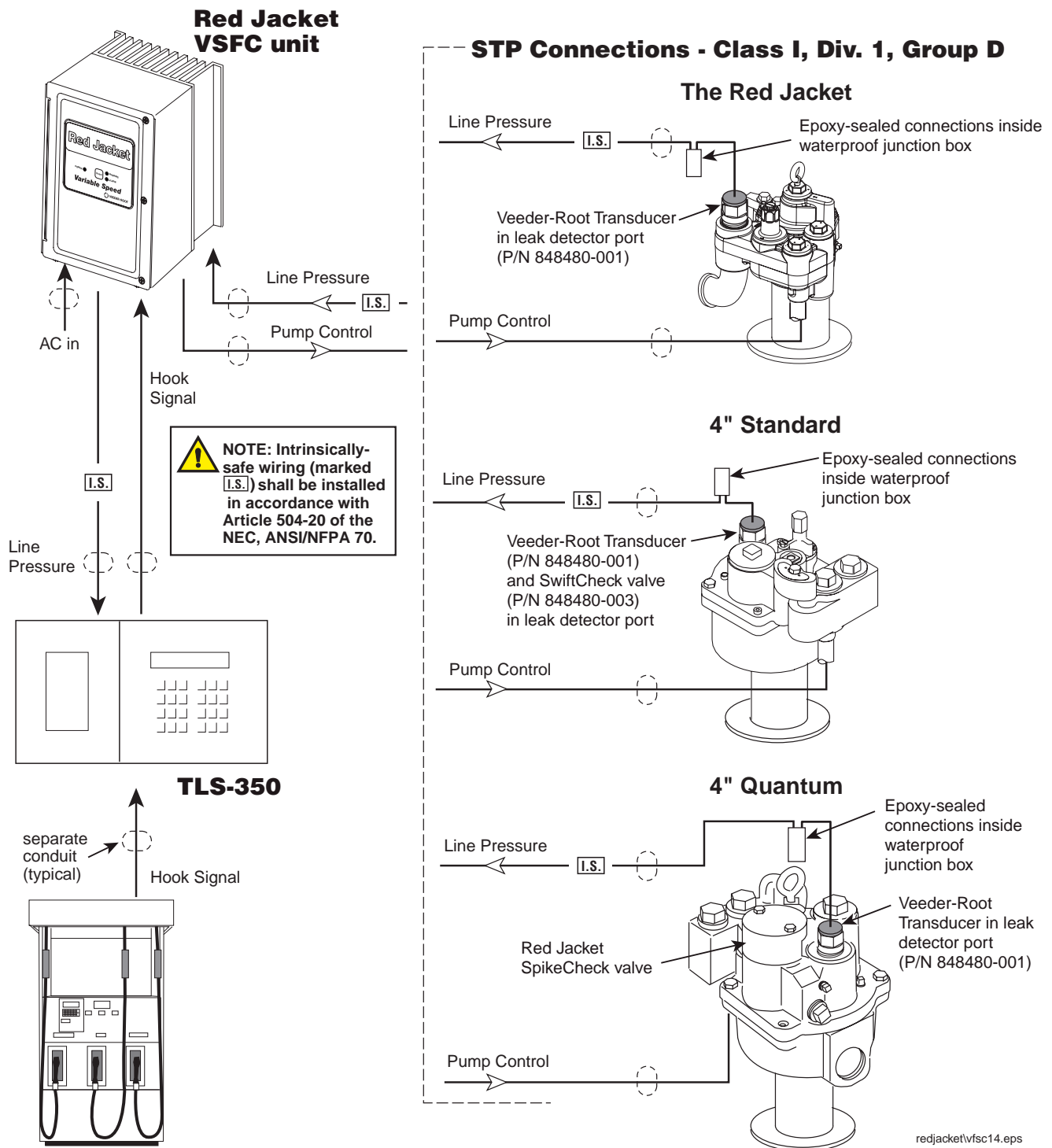
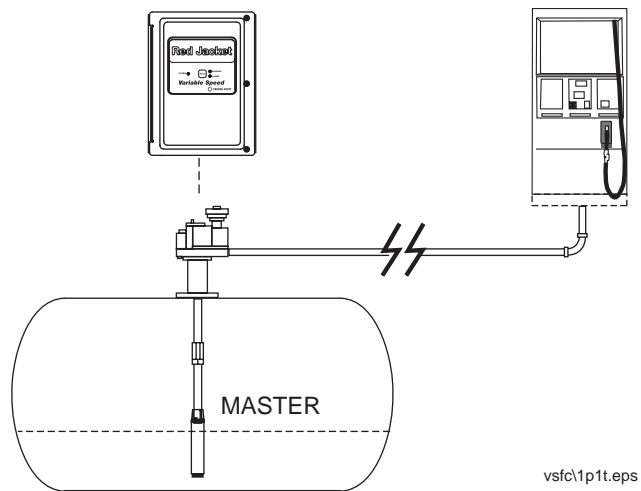


Figure 9. VSFC/TLS-350 installation examples with separate conduits for pressure and pump control signals

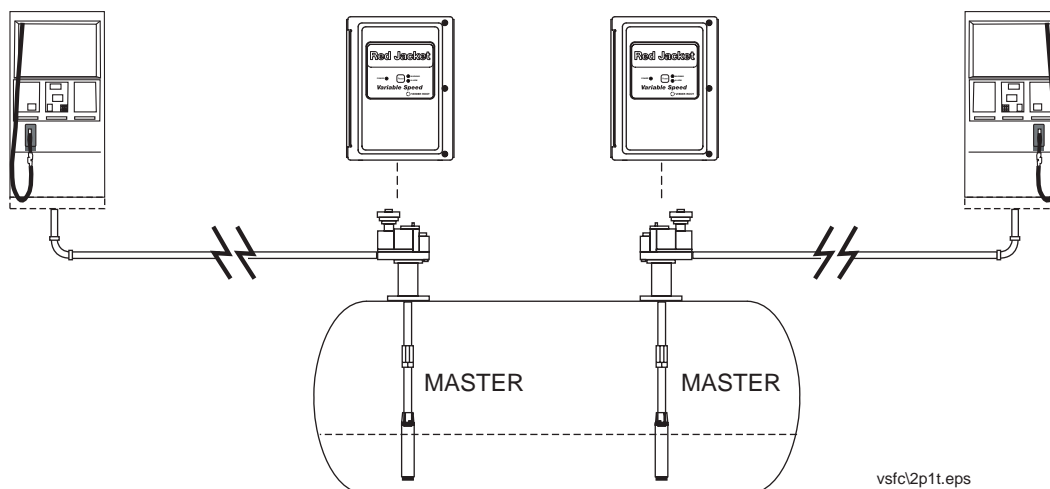
Determine Site's pump/tank configuration

Examine the examples below to determine if your site will require Slave VSFCs.

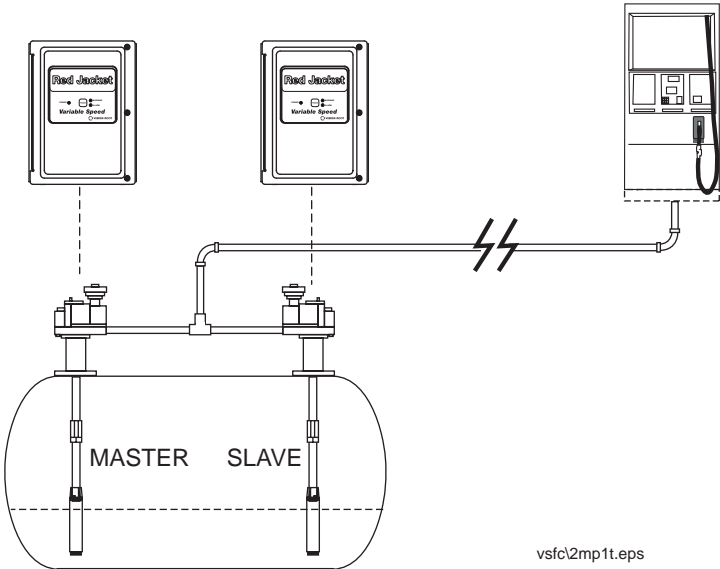
Single Pump/Single Line/Single Tank



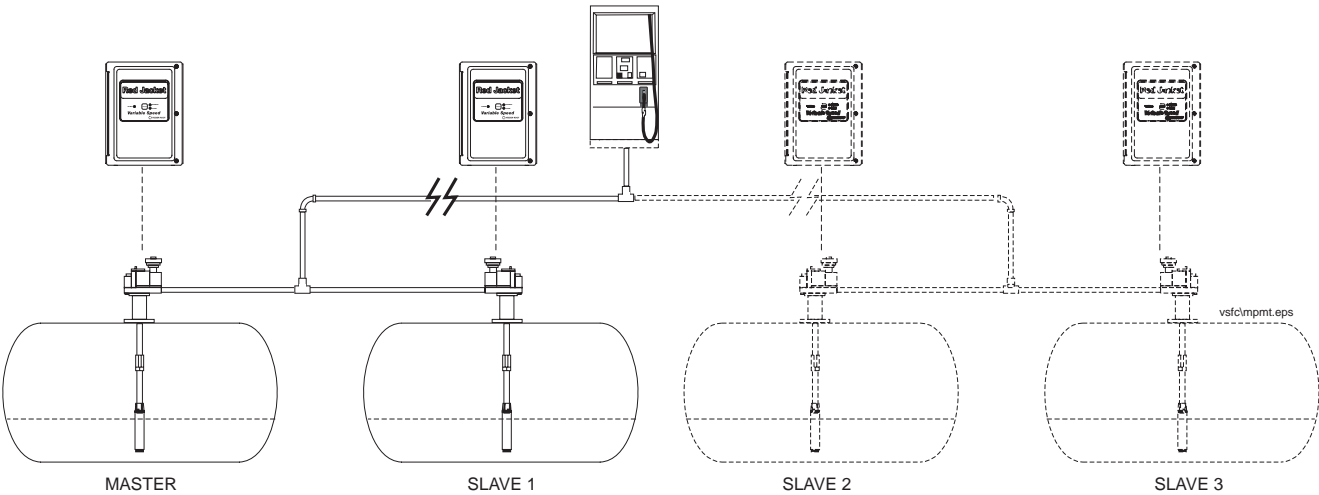
Multiple pumps/Separate Lines / Single Tank



Multiple Pumps / Manifolded Line / Single Tank



Multiple Pumps / Manifolded Line / 2 or More Tanks



Select a VSFC Site Wiring Diagram

Table 5.- Selecting VSFC Wiring Examples

VSFC Configuration	Wiring Example To Use		
	W/O I. S. Barrier	W/ I.S. Barrier	Comm connections (between Master/ Slave VSFCs)
Standalone VSFC, Single Pump	Figure 10	Figure 11	N/A
VSFC/TLS Console, Single Pump	Figure 12	Figure 13	
Standalone VSFC, Multiple Pumps	Figure 14	Figure 15	Figure 18
VSFC/TLS Console, Multiple Pumps	Figure 16	Figure 17	

Single Pump, Standalone VSFC - no TLS-350
(separate conduits for 3 phase STP power & pressure transducer wiring)

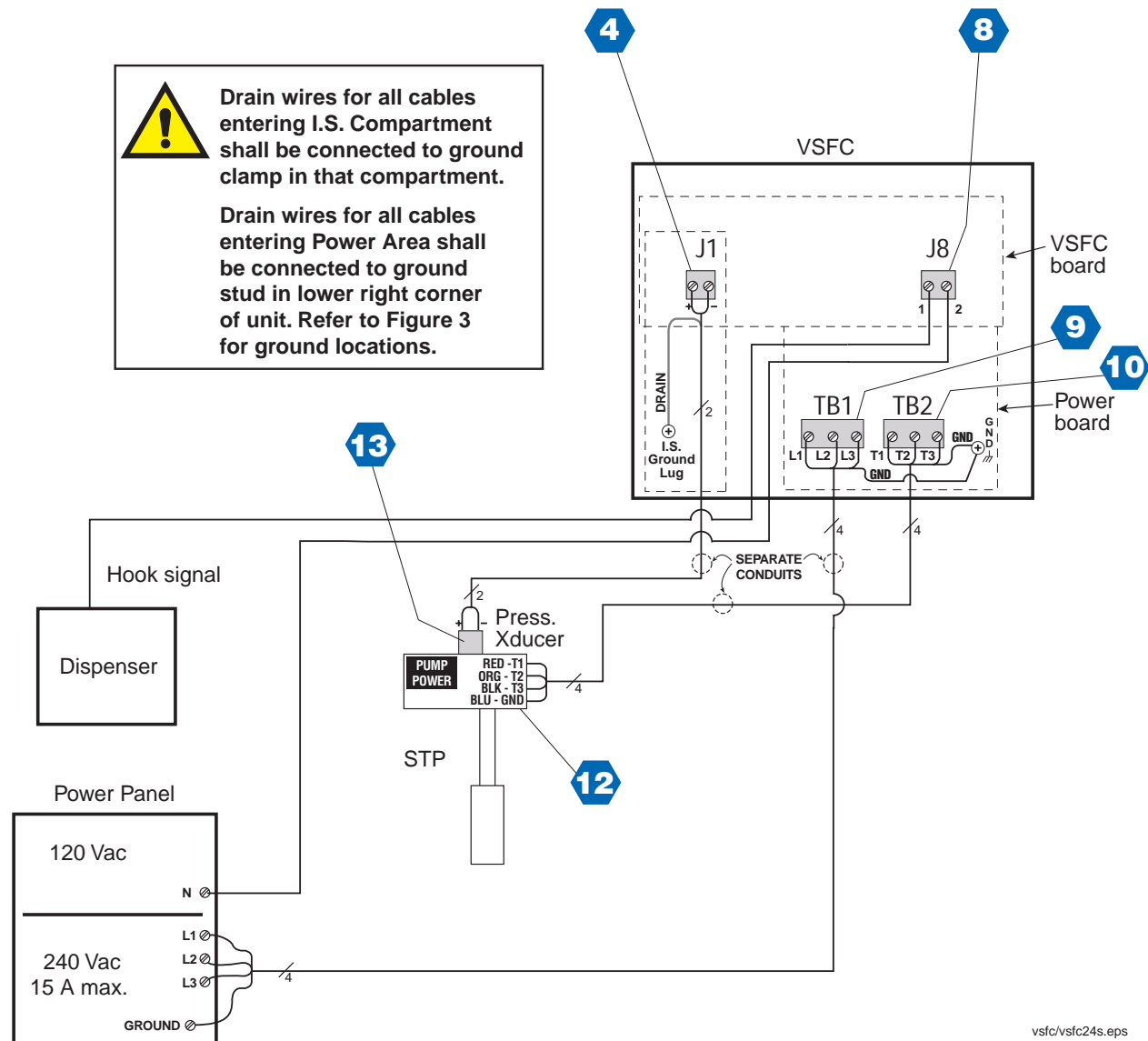


Figure 10. Example Wiring Diagram 1 - Single Pump, Standalone VSFC, No I.S. Barrier

Single Pump with Standalone VSFC - no TLS-350 (shared conduit for 3 phase STP power & I.S. Barrier wiring)

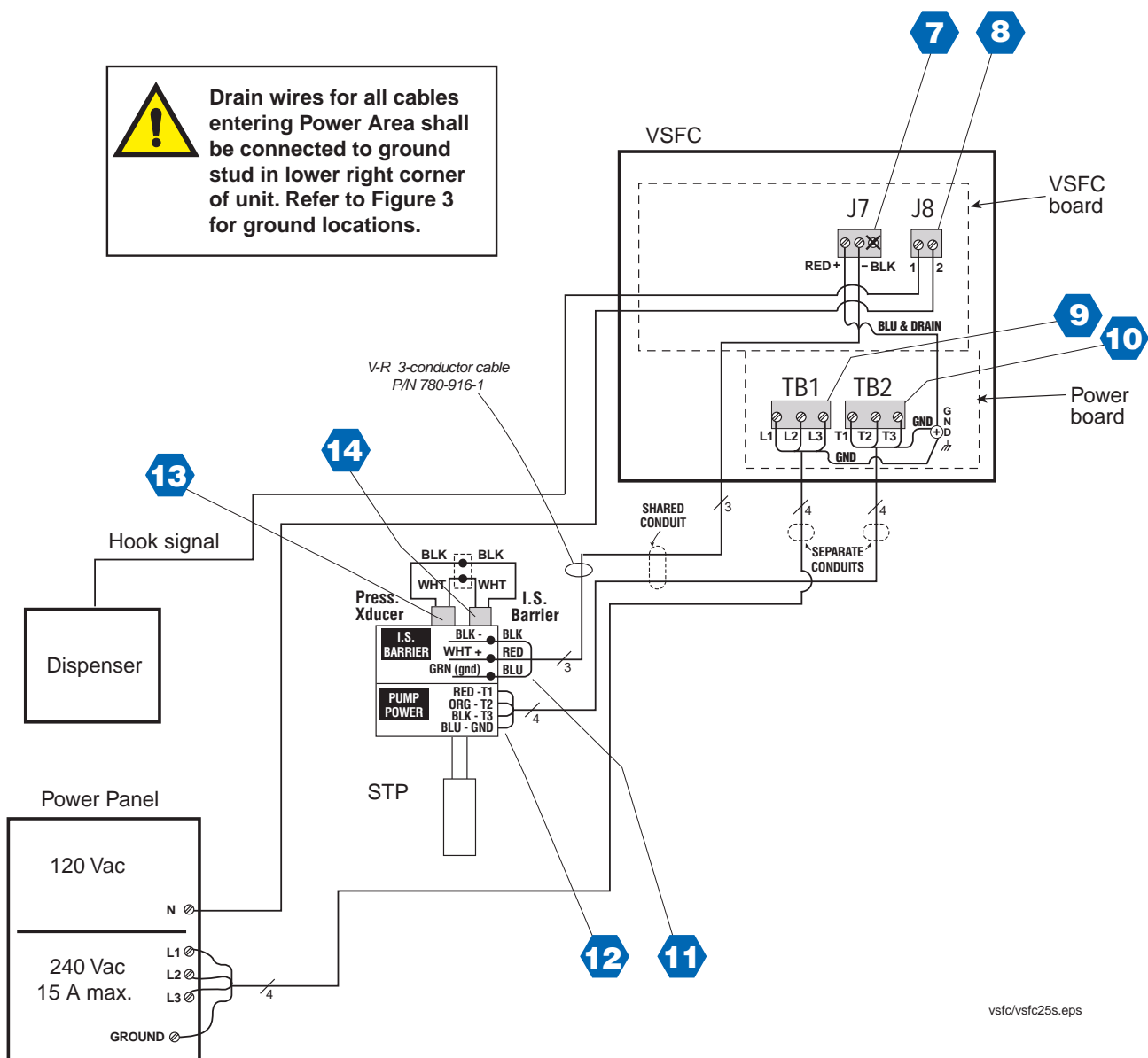


Figure 11. Example Wiring Diagram 2 - Single Pump, Standalone VSFC , With I.S. Barrier

Single Pump with TLS-350 console and PLLD (separate conduits for 3 phase STP power & pressure transducer wiring)

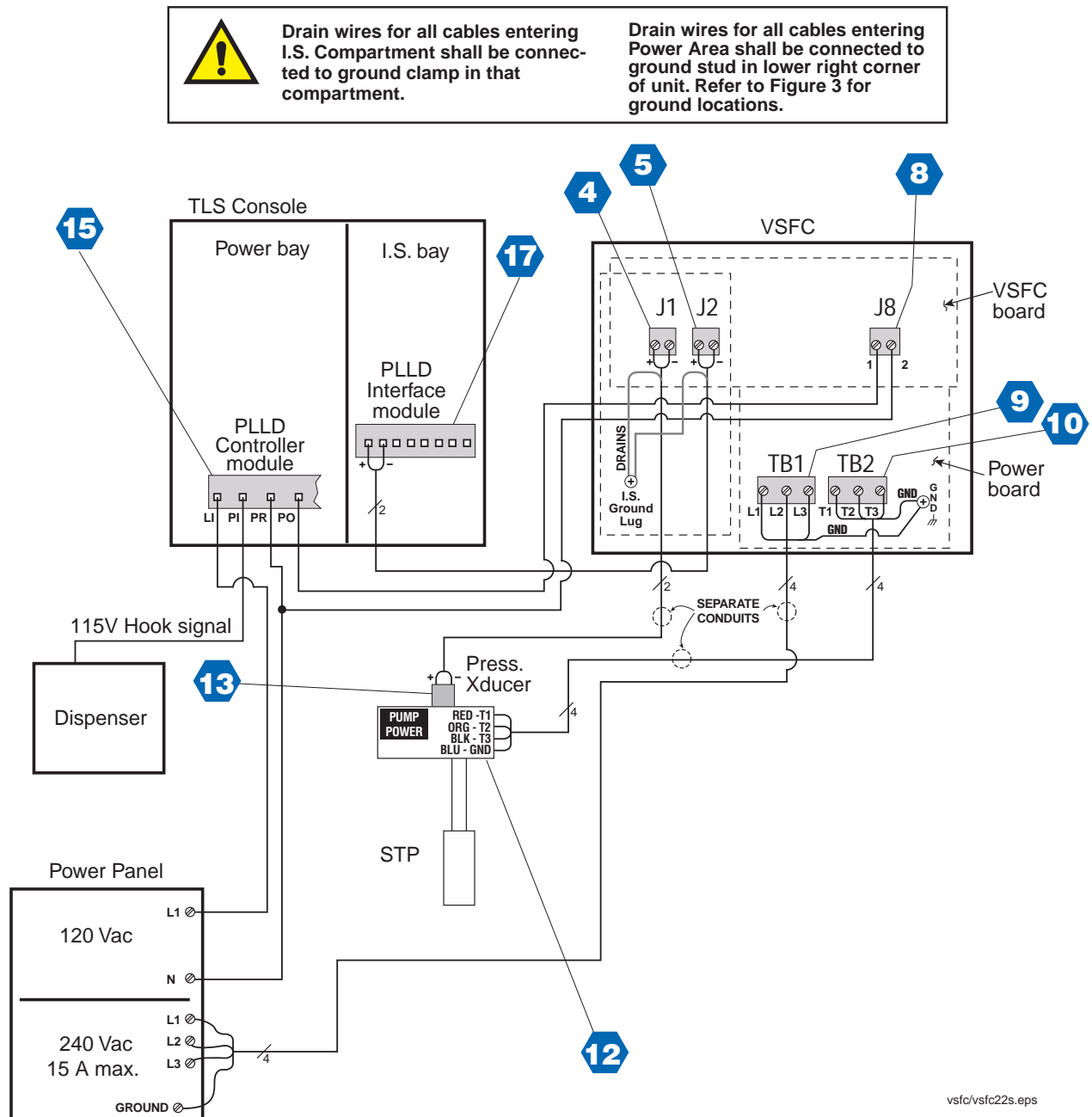


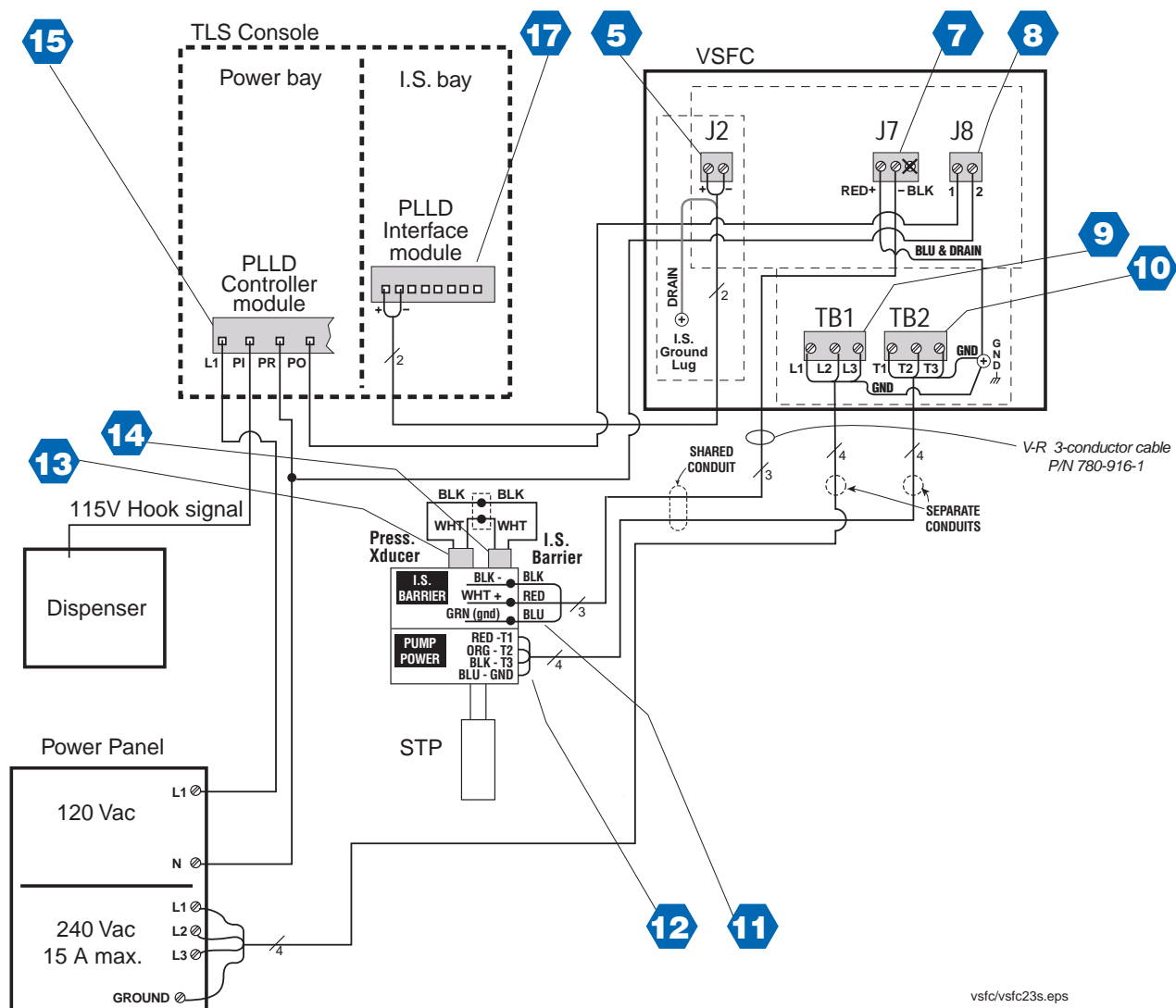
Figure 12. Example Wiring Diagram 3 - Single Pump, VSFC, TLS Console, No I.S. Barrier

Single Pump with TLS-350 console and PLLD (shared conduit for 3 phase STP power & I.S. Barrier wiring)



Drain wires for all cables entering I.S. Compartment shall be connected to ground clamp in that compartment.

Drain wires for all cables entering Power Area shall be connected to ground stud in lower right corner of unit. Refer to Figure 3 for ground locations.



vsfc/vsfc23s.eps

Figure 13. Example Wiring Diagram 4 - Single Pump, Single VSFC, TLS Console, With I.S. Barrier

**Multipump with stand-alone VSFCs - no TLS-350
(separate conduits for 3 phase STP power & pressure transducer wiring)**

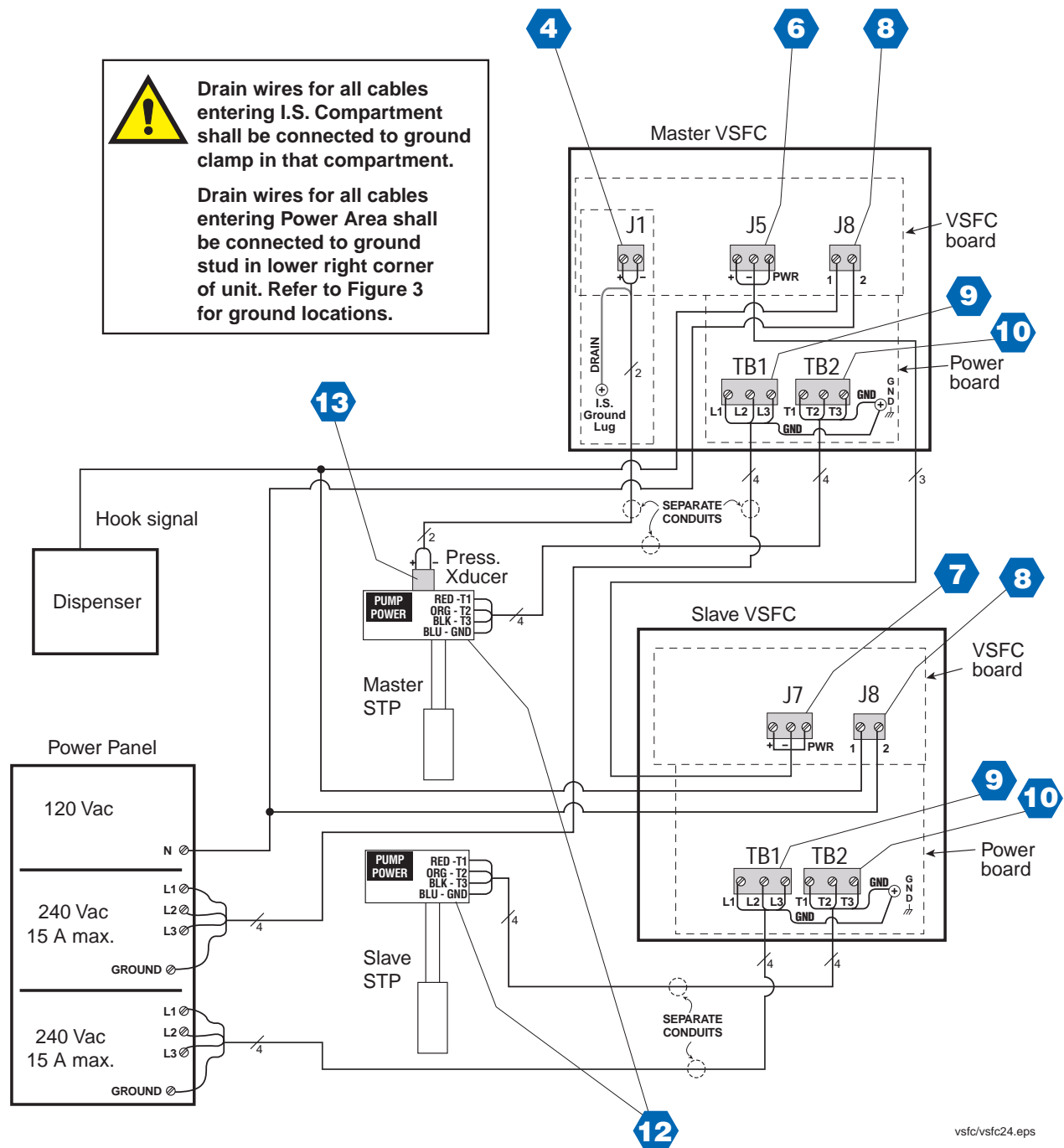


Figure 14. Example Wiring Diagram 5 - Multiple Pumps, Master/Slave Standalone VSFCs, No I.S. Barrier

**Multipump with stand-alone VSFCs - no TLS-350
(shared conduit for 3 phase STP power & I.S. Barrier wiring)**

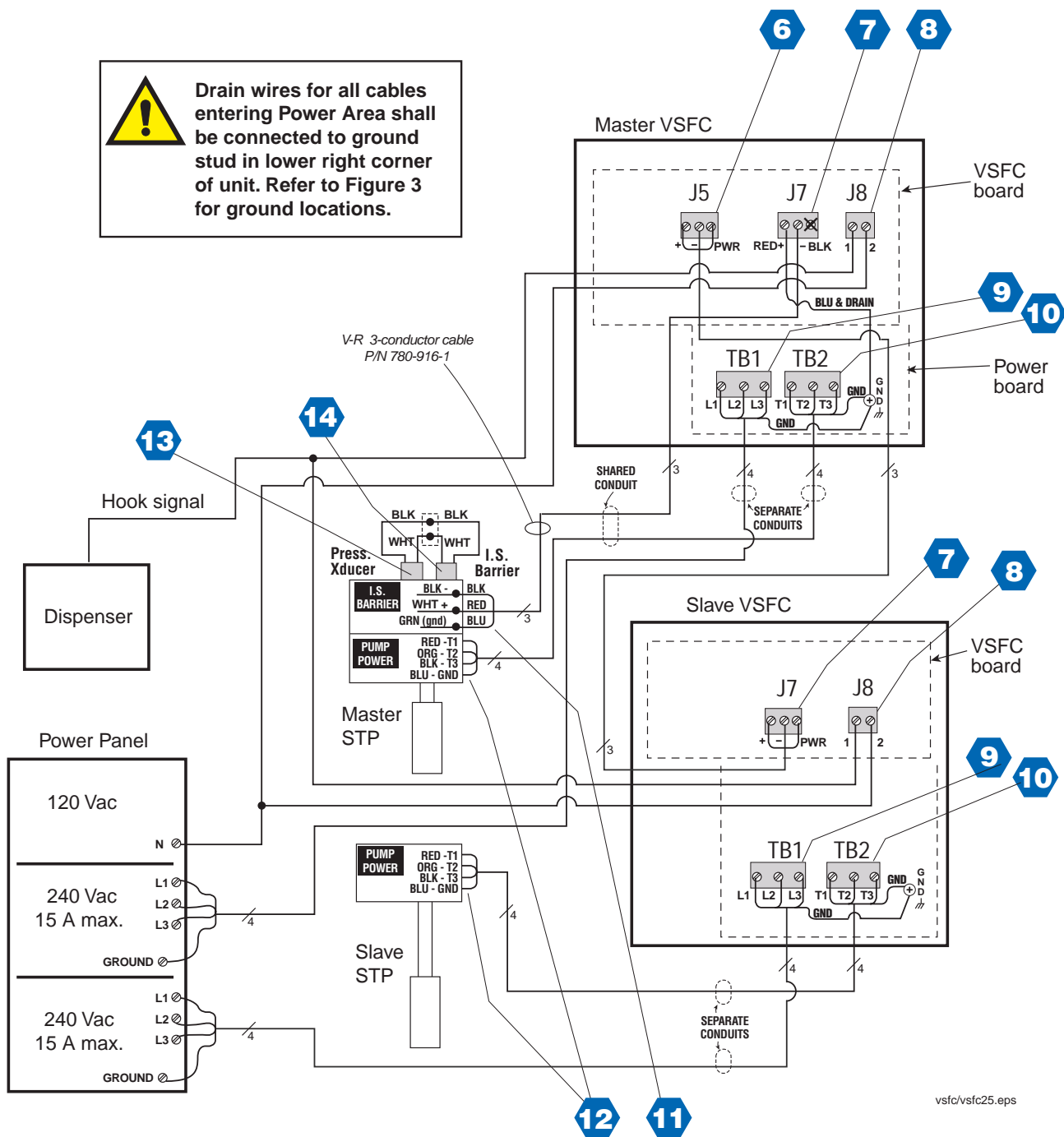


Figure 15. Example Wiring Diagram 6 - Multiple Pumps, Master/Slave Standalone VSFCs, With I.S. Barrier

Multipump with TLS-350 console and PLLD (separate conduits for 3 phase STP power & pressure transducer wiring)



Drain wires for all cables entering I.S. Compartment shall be connected to ground clamp in that compartment.

Drain wires for all cables entering Power Area shall be connected to ground stud in lower right corner of unit. Refer to Figure 3 for ground locations.

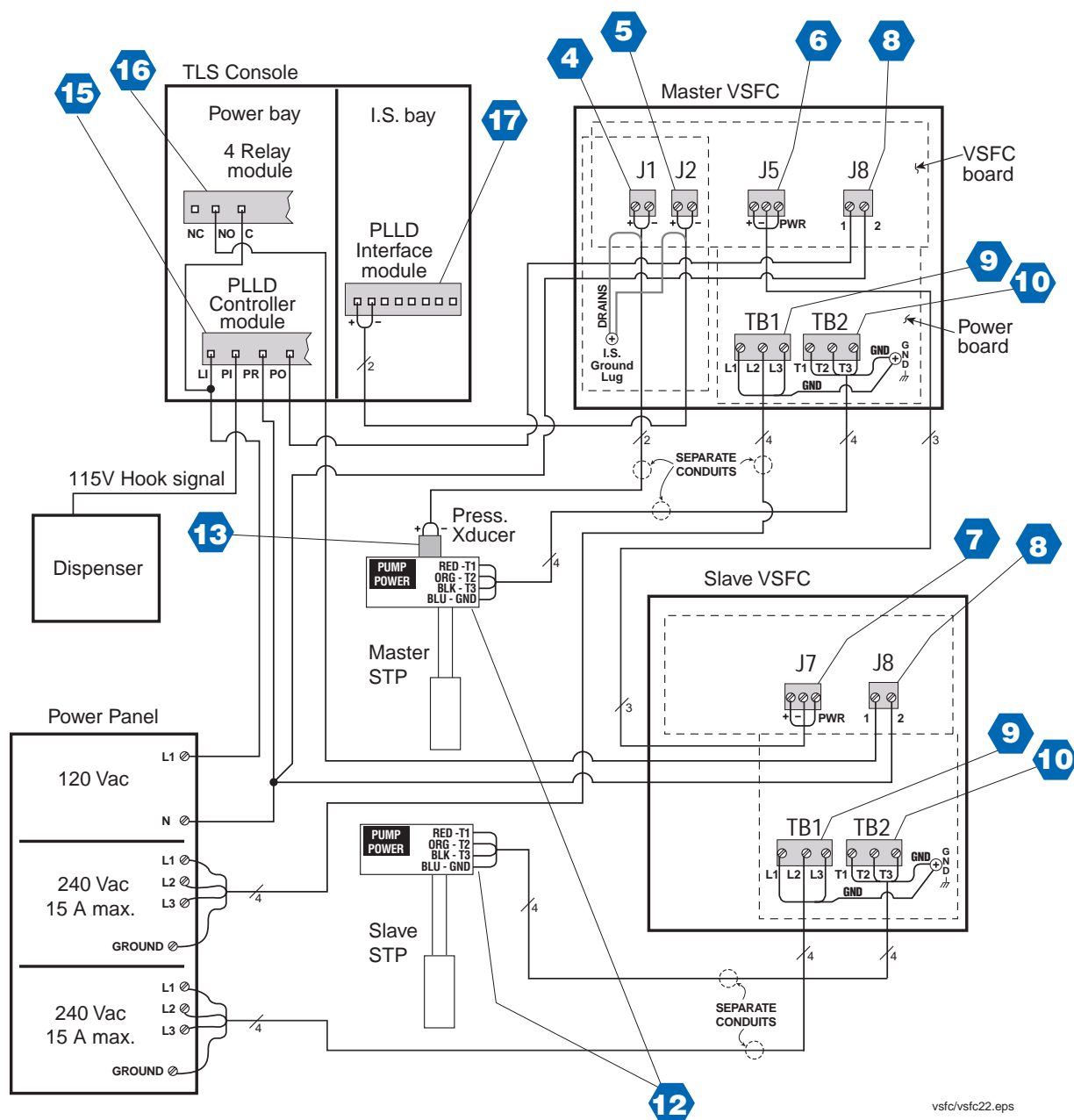


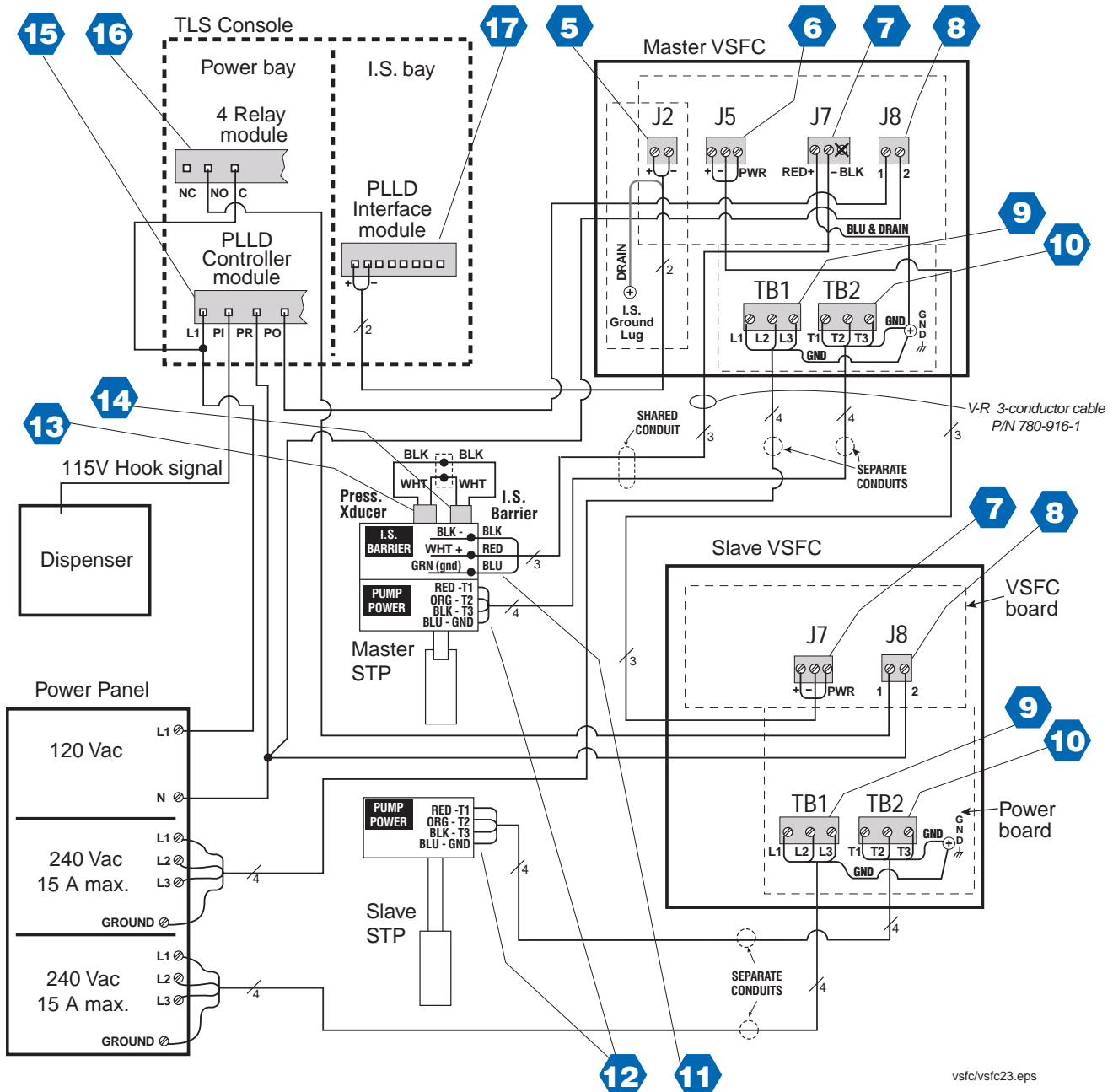
Figure 16. Example Wiring Diagram 7 - Multiple Pumps, Master/Slave VSFCs, TLS Console, No I.S. Barrier

Multipump with TLS-350 console and PLLD (shared conduit for 3 phase STP power & I.S. Barrier wiring)



Drain wires for all cables entering I.S. Compartment shall be connected to ground clamp in that compartment.

Drain wires for all cables entering Power Area shall be connected to ground stud in lower right corner of unit. Refer to Figure 3 for ground locations.



vsfc/vsfc23.eps

Figure 17. Example Wiring Diagram 8 - Multiple Pumps, Master/Slave VSFCs, TLS Console With I.S. Barrier

Comm Connections Between Multiple VSFCs

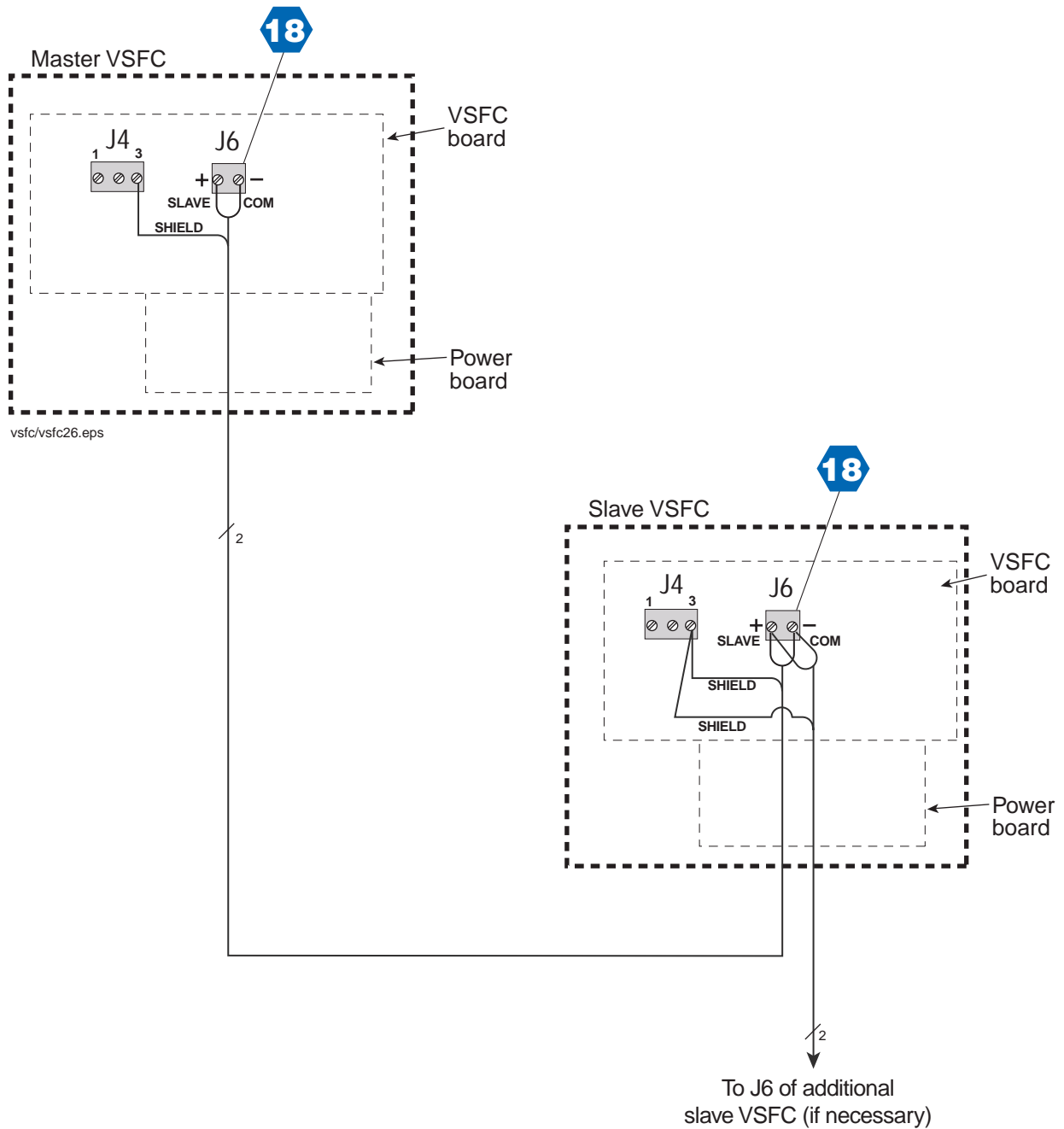


Figure 18. Example Wiring Diagram 9 - Multiple VSFC Comm Connections

Wiring Notes for Example Site Wiring Diagrams

4 J1 ON VSFC MAIN BOARD (PRESSURE TRANSDUCER W/O I.S. BARRIER)

Intrinsically safe direct input from pressure transducer: positive (+) = white wire, common (-) = black wire. Polarity required. Attach cable's drain/shield to grounding lug in I.S. compartment of VSFC unit.



NOTE: Cable for transducer signal must be shielded cable rated less than 100 picofarad per foot and be manufactured of a type designated for use in the presence of gasoline and oil, such as Carol C2534 or Belden 88760, 8760. Wire size can be #18 AWG, max. total length 1000 feet, or #22 AWG, max. total length 750 feet for each transducer.

5 J2 ON VSFC MAIN BOARD

Output to PLLD Interface module in TLS-350 console: positive (+) = white wire, common (-) = black wire. Polarity required. Attach cable's drain/shield to grounding lug in I.S. compartment of VSFC unit.



NOTE: Cable for transducer signal must be shielded cable rated less than 100 picofarad per foot and be manufactured of a type designated for use in the presence of gasoline and oil, such as Carol C2534 or Belden 88760, 8760. Wire size can be #18 AWG, max. total length 1000 feet, or #22 AWG, max. total length 750 feet for each transducer.

7 J7 ON MASTER VSFC MAIN BOARD (PRESSURE TRANSDUCER/I.S. BARRIER COMBINATION)

Input from I.S. barrier in STP. Requires 3-wire cable between VSFC and STP mounted I.S. Barrier. Connects to terminal strip J7 in the master VSFC unit. Polarity required.



NOTE: Cable for I.S. Barrier must be a 600 volt, shielded 3-conductor with drain, V-R P/N 780-916-1 (Belden 1121A). Drain connects to green grounding wire in STP's contractor box.

6 7 J5 MASTER VSFC TO J7 ON SLAVE VSFC

Supplies pressure signal from Master VSFC unit to slave VSFC unit. Up to three slave VSFC units can be daisy chained to the master VSFC unit (the slave connect kit, P/N 330020-494, is required for each slave unit). Connect terminal strip J5 on the master VSFC unit to terminal strip J7 on the first slave unit, connect J5 on the first slave unit to J7 on the second slave unit, and connect J5 on the second slave unit to J7 on the third slave unit.



NOTE: Cable for transducer signal must be a shielded cable. Cable for transducer signal from Master to Slave unit can be the same cable used for transducer wiring.

18 J6 MULTIPLE VSFC COMMCONNECTIONS

When multiple VSFC units are installed, connect wiring between the J6 terminal strips of the master unit and the J6 terminal strip of each slave unit as shown in Figure 18. Slave Comm pinouts are; 1 = Plus, 2 = minus, and If shielded cable is used, attach shield of Slave Comm cable to J4 position 3 - shares position 3 with Diag Comm cable shield.

NOTE: Cable for Slave Comm wiring can be #20 AWG or #22 AWG. Conduit not necessary for interdrive coms. For installations requiring slave VSFC units, please use kit P/N 330020-494.

8

J8 - 115V DISPENSER HOOK WIRING INPUTS

Standalone VSFC or VSFC/TLS-350 connections to 115 Vac dispenser hook signal inputs (#12 AWG max. wire) are shown in Table 6 and Table 7 below. These wiring connections apply for the following VSFC kit part numbers: 330020-450 (VSFC with VR transducer), 330020-451 (VSFC with VR transducer and I.S. barrier), and for a VSFC controller only part number: 856194-001.

Table 6.- 115V Dispenser Hook Connections for Standalone VSFC Installations

VSFC J8 (P/N 856194-001) Terminal	Input
1	115 Vac hook signal from dispenser
2	Neutral from power panel

Table 7.- Three Types of 115 V Dispenser Hook Connections for VSFC / TLS-350 Installations

	TLS-350 Wiring Connections - Select One Type		
	Type 1	Type 2	Type 3
VSFC (P/N 856194-001) J8 Terminal	120V 4 Relay Module (P/N 329378-001)	120V I/O Module (P/N 329379-001) Relay Side	120V PLLD Controller Module (PLLD Leak Detection) (P/N 330374-001)
1 (from a type at right)	NO (to J8, Ter. 1 in VSFC)	NO (to J8, Ter. 1 in VSFC)	PO (to J8, Ter. 1 in VSFC)
2 (connects to Neutral from the power panel)	C (L1 from Power Panel)	C (L1 from Power Panel)	L1 (L1 from Power Panel)
	120V Pump Sense Module (P/N 329999-001)	Input Side	PI (Dispenser hook signal - 115 V)
	PI (Dispenser hook signal - 115 V)	+ (external relay - Normally Open)*	PR (Neutral from power panel)
	PR (Neutral from power panel)	- (external relay - Common)*	

*Requires a customer supplied relay to convert 115 V hook signal to +/- contact closure for I/O Module Inputs.

8 J8 - 230V DISPENSER HOOK WIRING INPUTS

Standalone VSFC or VSFC/TLS-350 connections to 230 Vac dispenser hook signal inputs (#12 AWG max. wire) are shown in Table 9 and Table 9 below. These wiring connections apply for the following VSFC kit part numbers: 330020-540 (VSFC with VR transducer), 330020-541 (VSFC with VR transducer and I.S. barrier), and for a VSFC controller only part number: 856164-101.

Table 8.- 230 V Dispenser Hook Connections for Standalone VSFC Installations

VSFC (P/N 856164-101) J8 Terminal	Input
1	230 Vac hook signal from dispenser
2	Neutral from power panel

Table 9.- Two Types of 230 V Dispenser Hook Connections for VSFC / TLS-350 Installations

VSFC (P/N 856164-101) J8 Terminal	TLS-350 Wiring Connections - Select One Type	
	Type 1	Type 2
	240V I/O Module (P/N 329379-002) Relay Side	240V PLLD Controller Module (P/N 330374-002) (PLLD Leak Detection)
1 (from a type at right)	NO (to J8, Ter. 1 in VSFC)	PO (to J8, Ter. 1 in VSFC)
2 (connects to Neutral from the power panel)	C (L1 from Power Panel)	L1 (L1 from Power Panel)
	I/O Module - Input Side	PI (Dispenser hook signal - 230 V)
	+ (external relay - Normally Open)*	PR (Neutral from power panel)
	- (external relay - Common)*	

*Requires a customer supplied relay to convert 230 V hook signal to +/- contact closure for I/O Module Inputs.

9 TB1 POWER INPUTS

Drive voltage should not exceed 230 Vac, $\pm 15\%$.

Table 10.- Power Inputs - TB1

TB1 Terminal	Input	Circuit Breaker	Wire Sizes/Length Limits
Single-Phase 208, 220, 230, 240 Vac Power			
L1	Hot (L1)	20 Amp	#10 AWG 370 feet #12 AWG 236 feet
L2	Not Used		
L3	Hot (L2)		
Ground stud	Ground from power panel		
Three-Phase 208, 220, 230, 240 Vac Power			
L1	Phase 1	15 Amp	#10 AWG 683 feet #12 AWG 437 feet #14 AWG 275 feet
L2	Phase 2		
L3	Phase 3		
Ground stud	Ground from power panel		



Turn off, lock out, and tag power at the panel before making these connections.

NOTE: VSFC Power Wire must be appropriate gauge shielded 4-conductor Anixter wire 14 AWG (2A-1404S or W2A-1404S), 12 AWG (2A - 1204S or W2A-1204S), 10 AWG (2A - 1004S or W2A-1004S), or CSA equivalent.



Power input cable and power output cable cannot be installed in the same conduit.

10 12 TB2 POWER OUTPUTS

Table 11.- Motor Outputs - TB2

TB2 Terminal	Motor Wire Color	Acceptable Wire Sizes/Length Limits
T1	Red wire	#10 AWG 785 feet #12 AWG 502 feet #14 AWG 316 feet
T2	Orange wire	
T3	Black wire	
Ground stud	Blue wire	



Turn off, lock out, and tag power at the panel before making these connections.

NOTE: VSFC Pump Wire must be appropriate gauge shielded 4-conductor Anixter wire 14 AWG (2A-1404S or W2A-1404S), 12 AWG (2A - 1204S or W2A-1204S), 10 AWG (2A - 1004S or W2A-1004S), or CSA equivalent.

NOTE: Both I.S. Barrier and STP power shielded cables must be sealed in accordance with NEC Article 501-5(d) which states that the outer jacket of multi-conductor cable must be removed within the seal off of the Division 1 location, (submersible sump) so the sealing compound will surround each individual conductor. Do not break the drain wire or remove any more of the jacket than is required (see Figure 19).

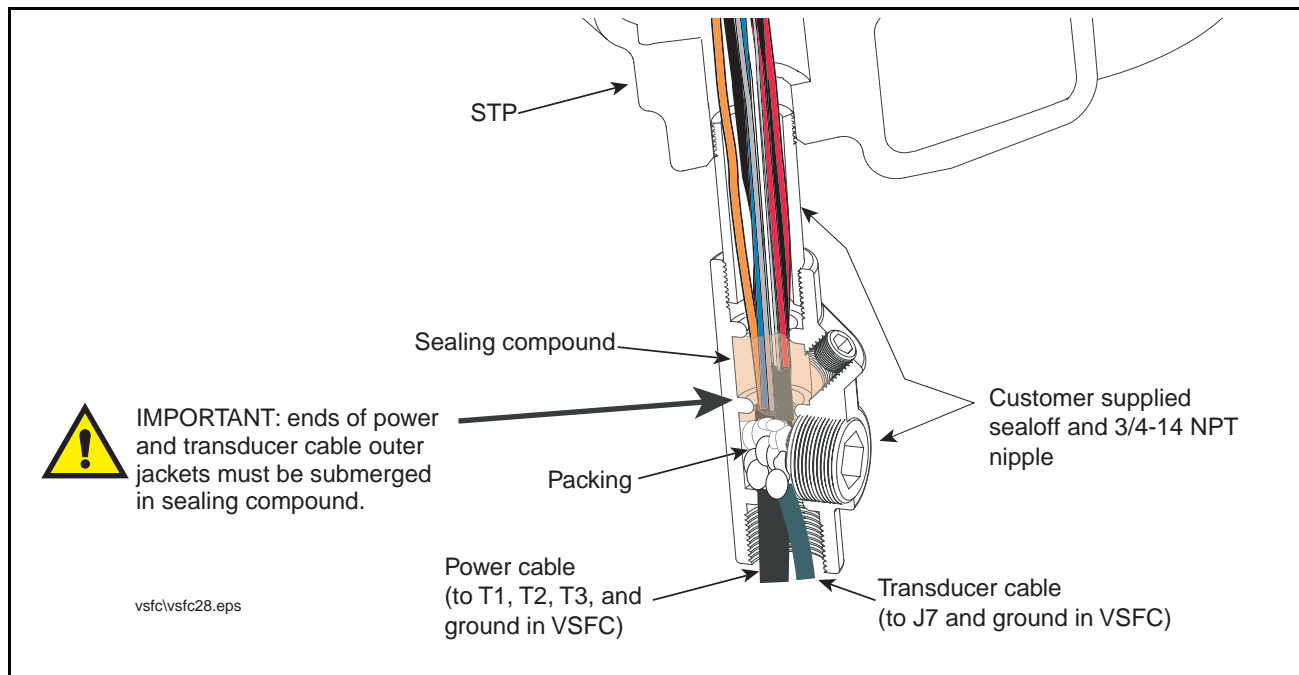


Figure 19. Sealing I.S. Barrier and Power Cable jacket ends at STP



Before applying power to the VSFC unit, you must check the resistance between the terminals on TB2. Resistances between terminals must be within the ranges shown in Table 12.

Table 12.- Motor Wiring Resistance limits

TB2 Terminals	Resistance
T1 - T2	2 - 5 ohms
T2 - T3	2 - 5 ohms
T1 - T3	2 - 5 ohms
T1, T2, T3 to ground	Infinite (at least 1 Megohm)

NOTE: It is possible to wire the pump so that it runs in reverse. To verify correct rotation:

1. Install a pressure gauge in the STP's line test port.
2. Ensure that the pump inlet is submerged in product.
3. Close the ball valve to the product line.
4. Disconnect the transducer input from the VSFC.
5. Turn on the pump. With the pump running at shutoff (no flow), the pressure should be 28 to 32 psi.
6. If pressure is much lower, reverse any two of the motor wires at the TB2 terminal and retest the pressure.
7. If reversing the two motor wires doesn't work, check for blockage at the pump inlet.

15 PLLD CONTROLLER MODULE (TLS-350 POWER BAY) - P/N 330374-001 (120V)

LI = Line In, PI = Pump In (hook signal), PR = Pump Return, PO = Pump Output

The wire for these connections should be #14 AWG copper wire.

16 4 RELAY MODULE (TLS-350 POWER BAY) - P/N 329378-001 (120V)

NO = Normally Open, C = Common

The wire for these connections should be #14 AWG copper wire.

17 PLLD INTERFACE MODULE (TLS-350 I.S. SAFE BAY)

Input from J2 on VSFC main board: + = positive, - = negative. Polarity required.



NOTE: Cable for transducer signal must be shielded cable rated less than 100 picofarad per foot and be manufactured of a type designated for use in the presence of gasoline and oil, such as Carol C2534 or Belden 88760, 8760. Wire size can be #18 AWG, max. total length 1000 feet, or #22 AWG, max. total length 750 feet for each transducer.

7 11 INSTALLING A PRESSURE TRANSDUCER WITH I.S. BARRIER IN THE STP**13 14**

For installations in which the Pressure Transducer and pump control wiring share the same conduit to the VSFC unit, a Veeder-Root Intrinsically Safe Barrier must be installed in the STP and be connected to the Pressure Transducer. These connections are discussed in the procedure below:

1. Reference Figure 6 and Figure 8 for installation examples.
2. Install Pressure Transducer (P/N 848480-001) as instructed in PLLD Transducer Installation Manual (P/N 576013-902) for the appropriate STP.
3. Remove the two contractor box covers (see Figure 6 or Figure 8) for cover locations on each style pump).
4. Inspect port's threads and hand clean with a wire brush if necessary.
5. Lubricate the o-ring of the I.S. barrier with petroleum jelly.

⚠ WARNING	
	<p>DO NOT APPLY ANY THREAD SEALANT OR PIPE DOPE TO THE THREADS OF THE I.S. BARRIER OR TO THE THREADS OF THE STP'S CONTRACTOR BOX INTO WHICH IT IS INSTALLED.</p> <p>The metal-to-metal joint created by threads of the I.S. Barrier in the STP's contractor's box ensures a restricted flame path to prevent propagation of a spark or flame to a hazardous area. If any thread sealant or pipe dope is applied to the threads of the I.S. Barrier or to the threads of the contractor's box, the flame path may not be restricted, potentially resulting in serious injury or death from explosion.</p>

6. Install the I.S. Barrier (P/N 332101-001). Do not use thread sealant. Torque the I.S. Barrier to 35 ft-lbs (50 N•m).
7. Pull the three wire cable (P/N 780-916-1) from the VSFC Master Unit into the STP's contractor box. In The Red Jacket VSFC pumps, the compression bushing (P/N 410301-001) and tubing kit (P/N 410370-001) is required with this cable.

8. Connect the black, white, and green wires in the bottom of the I.S. Barrier to the black (-) red (+), and blue (ground) wires in the VSFC cable using wire nuts as shown in Figure 20. Use a wire nut to connect the cable's drain wire to the grounding wire attached to contractor's box.

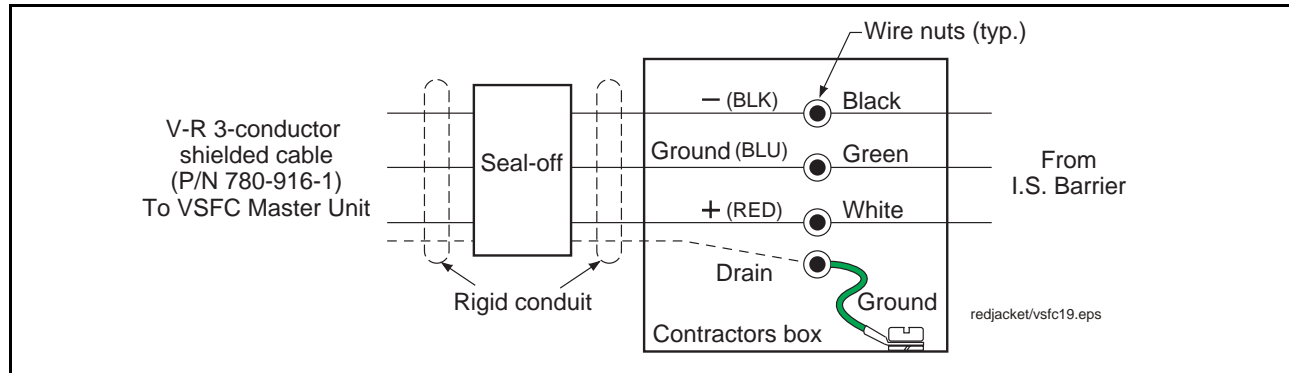


Figure 20. I.S. Barrier field wiring connections

9. Install and torque the contractor's box cover to 35 ft-lbs (50 N•m).
10. In the weatherproof junction box, connect the Pressure Transducer cable to the cable out of the top of the I.S. Barrier with wire nuts as shown in Figure 21.

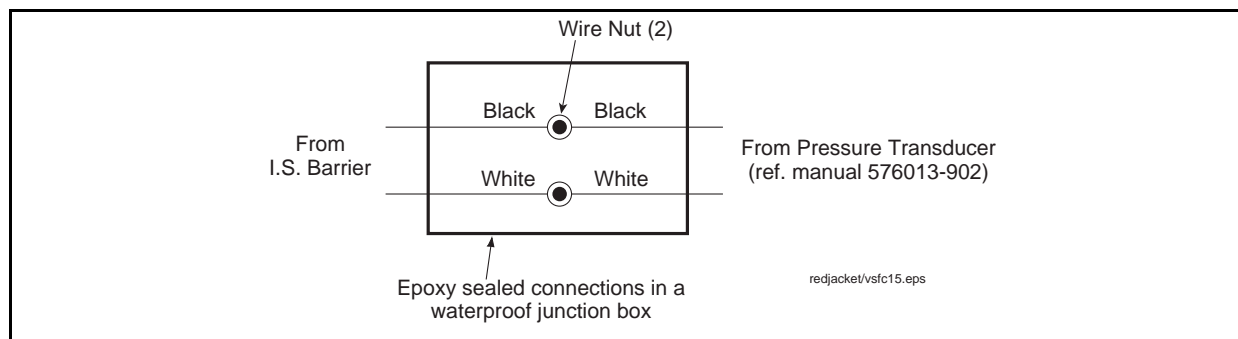


Figure 21. Connecting I.S. Barrier to Pressure Transducer

11. Seal I.S. Barrier to Pressure Transducer wire nuts with epoxy sealant following the instructions in Figure 22.

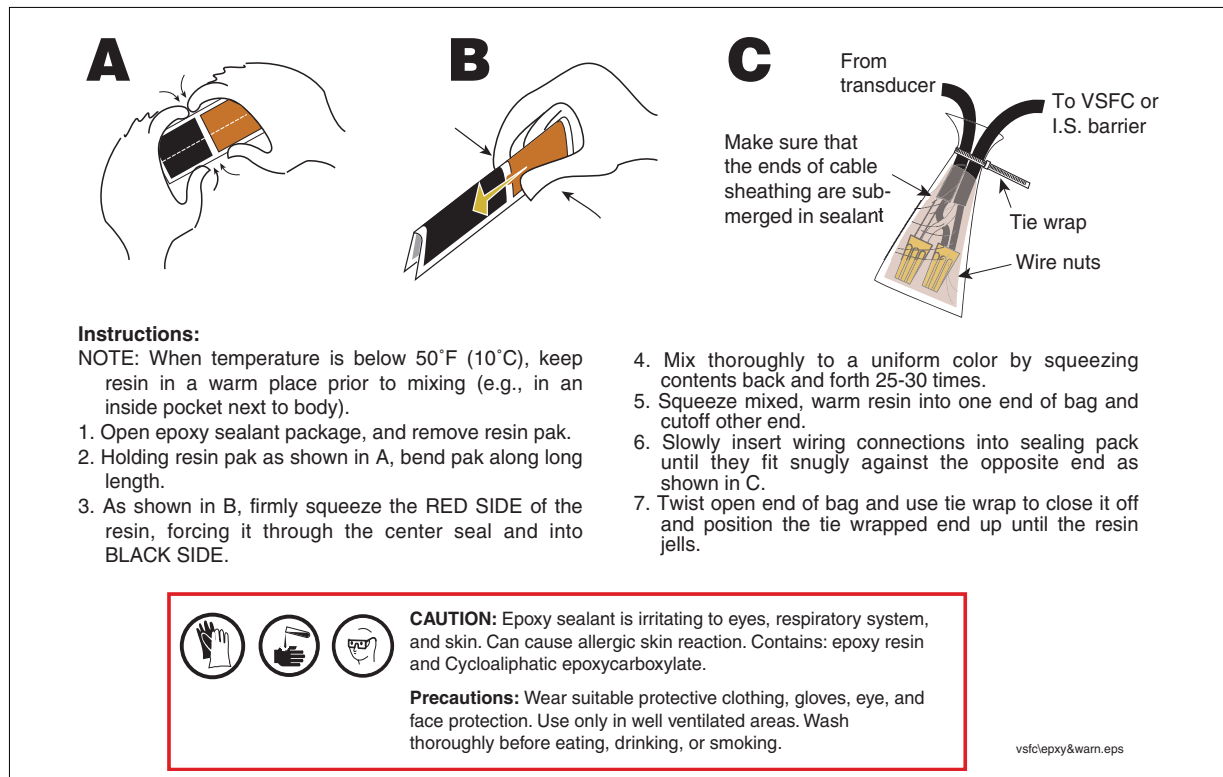


Figure 22. Epoxy sealing field wiring

12. Place the epoxy pack with the encapsulated wiring connections in the sump's weatherproof junction box. Replace and tighten the junction box cover.
13. Connect the 3 wires from the I.S. Barrier to J7 in the VSFC Master Unit.
14. Return to the PLLD Site Prep and Installation manual (P/N 576013-902) and complete the PLLD System Checkout procedure (PLLD System Checkout section). After completing the PLLD System Checkout procedure run the "FLOW CALIBRATION TEST" on page 36.

13 4 INSTALLING A PRESSURE TRANSDUCER ONLY IN A STP

For installations in which the Pressure Transducer and pump control wiring have separate conduits to the VSFC unit, follow the procedure below to install the Pressure Transducer in the STP:

1. Reference Figure 7 and Figure 9 for installation examples.
2. Install Pressure Transducer (P/N 848480-001) as instructed in PLLD Transducer Installation Manual (P/N 576013-902) for the appropriate STP.
3. In the weatherproof junction box, connect the Pressure Transducer cable to the cable from the VSFC Master Unit using wire nuts as shown in Figure 23 and epoxy seal connections as shown in Figure 22.

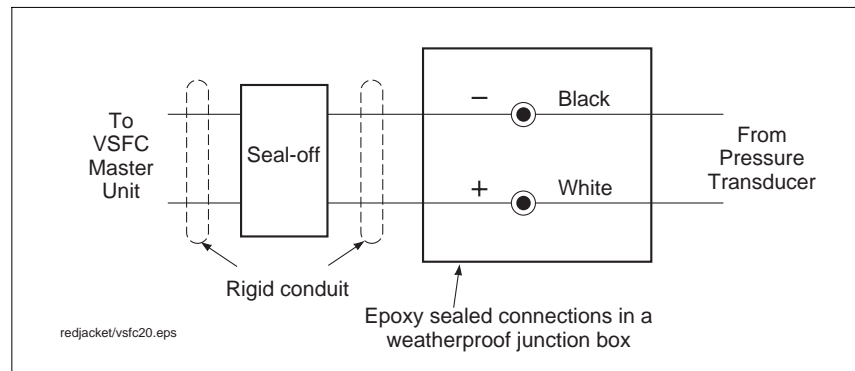


Figure 23. Field wiring Pressure Transducer

4. Place the epoxy pack with the encapsulated wiring connections in the sump's weatherproof junction box. Replace and tighten the junction box cover.
5. Connect the two wires from the Pressure Transducer to the VSFC Master Unit as shown in Figure 10 or Figure 12 as applicable.
6. Return to the PLLD Site Prep and Installation manual (P/N 576013-902) and complete the PLLD System Checkout procedure (PLLD System Checkout section). After completing the PLLD System Checkout procedure run the "FLOW CALIBRATION TEST" below.


FLOW CALIBRATION TEST

After performing the PLLD System Checkout procedure, calibrate the VSFC flow rate as follows:

1. With the nozzle closest to the pump fully open and dispensing into an approved 5 gallon container or gas tank of a vehicle, record the gallons pumped for a timed interval of 15 seconds. For best accuracy, wait 15 seconds after lifting the dispenser handle before beginning the timed interval.
2. Calculate the flow rate (gpm) by multiplying the gallons pumped in 15 seconds by 4. The result is in gallons per minute.
3. Increase or decrease the pressure if necessary to change flow as needed. This is accomplished with rotary switch SW1 (ref. Table 4 on page 9).
4. Repeat the Flow Calibration Test after every adjustment of pressure and until flow rate does not exceed 10 gpm.

Selecting an Operating Mode for Multiple VSFCs

Operating Modes selections are made with DIP switches 3 and 4 of SW1 (ref. Item 1 in Figure 4 on page 8) as shown below:

 SW1 DIP Switches	Position - 'ON' is up, 'OFF' is down
3/4	On/On = Single Unit (default), On/Off = Alternate, Off/On = Master/Slave, Off/Off = Tank Based

VSFC OPERATING MODES – STANDALONE VSFCs

Desired Operation	VSFC Mode Settings	Help?
Master VSFC alternates pumps and determines when help is needed.	Alternate	Yes
Master VSFC controls which pump turns on and determines when help is needed.	Master/Slave	Yes

TLS TANK-BASED LINE MANIFOLDING WITH VSFC PUMP MANIFOLDING

Desired Operation	TLS* Mode Setting	VSFC Mode Settings	Help?	Notes
TLS maintains similar tank volumes by turning on the pump in the tank with the highest volume.	Alternate	Tank Based	No	VSFC follows TLS hook signals
TLS pumps from one tank until minimum level reached and then switches to the other tank.	Sequential	Tank Based	No	VSFC follows TLS hook signals
TLS turns on all pumps	All pumps	Tank Based	Not applicable	All pumps are on. VSFC maintains flow rate.
Pumps alternate pumping. Help available when needed. Wear on pumps is spread out equally.	All pumps	Alternate	Yes	VSFC controls which pump turns on. VSFC alternates pumps and determines when help is needed.
Master pump always runs, slave pump runs when help is needed.	All pumps	Master/Slave	Yes	VSFC controls which pump turns on and determines when help is needed.

*With or without PLLD.

VSFC Troubleshooting

Front Panel Warning/Alarm LED Messages

The Warning and Alarm LEDs on the front of the VSFC unit will blink when a fault is detected. The time between blinks in an alarm or warning message is 0.5 second. If there is more than one warnings/alarm message, each message is separated by a 2 second space. A single message or a multiple message sequence will continue to repeat until the fault(s) is corrected and the Reset button on the front of the unit is pressed. The messages are:

ALARM MESSAGES (RED LED)

- 1 blink = High current
- 2 blinks = Over voltage
- 3 blinks = Low voltage
- 4 blinks = Over temperature
- 5 blinks = Pressure sensor fault
- 6 blinks = Self-test fault
- 7 blinks = Motor drive fault
- 8 blinks = Communication fault

WARNING MESSAGES (YELLOW LED)

- 1 blink = Low current
- 2 blinks = Dry run
- 3 blinks = Long run
- 4 blinks = Communications warning
- 5 blinks = EEPROM warning
- 6 blinks = Setup warning

Logic Board



THIS SECTION IS ONLY FOR TECHNICIANS AND INSTALLERS!

The Logic board is installed between the top VSFC controller board and the lower Power board. Figure 24 shows switches and LEDs on the Logic board with the front door of the VSFC open.

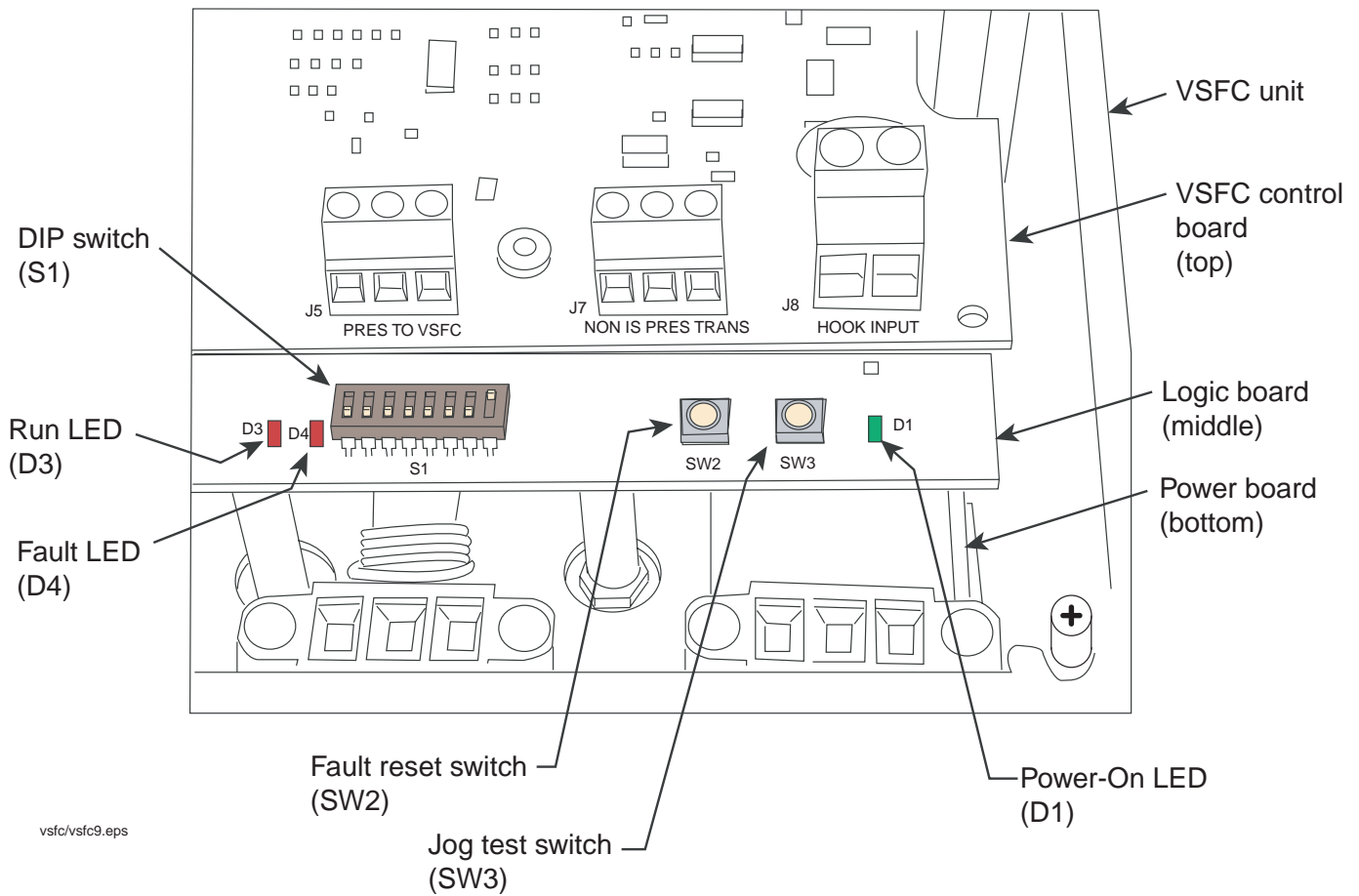


Figure 24. Logic board component location

LOGIC BOARD - DIP SWITCH S1 SETTINGS**Table 13.- Logic Board - DIP Switch S1**

Switch	Position	
1	Serial address A0	Switch 1,2 positions: Off, Off = 1 (default), On, Off = 2, Off, On = 3, On, On = 4 NOTE: For single unit operation, settings must be OFF, OFF. Also, for multiple pumps, master must be highest address. See Appendix A. (CHANGE ONLY WHEN INSTALLING MULTIPLE VSFCs ON A SINGLE LINE)
2	Serial address A1	
3	Serial baud rate: Off = 9600, On = 19200 (default) (DO NOT CHANGE!)	
4,5,6	Reserved (DO NOT CHANGE!)	
7	D3, D4 LEDs: Off = normal (default) (DO NOT CHANGE!), On = disabled	
8	Serial time-out: Off = enabled (default) (DO NOT CHANGE!), On = disabled	

**THIS SECTION IS ONLY FOR TECHNICIANS AND INSTALLERS!****Fault Reset Switch (S2)**

Pressing the Fault Reset switch will reset the Logic board only.

Jog Test Switch (S3)

Pressing the Jog Test switch will test power to the pump only.

Power LED (D1)

The green Power LED is on while power is applied to the unit.

Run LED (D3)

When the red Run LED is flashing slowly the motor has stopped. When the LED is flashing fast the motor is running.

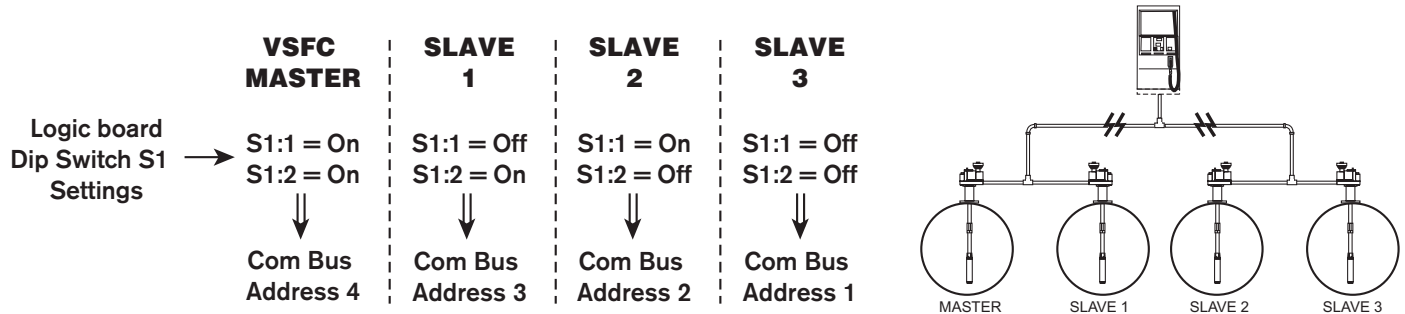
Fault LED (D4)

The number of red Fault LED flashes indicate what type of problem has occurred on the Logic board. This LED is to assist technicians in Logic board diagnostics.

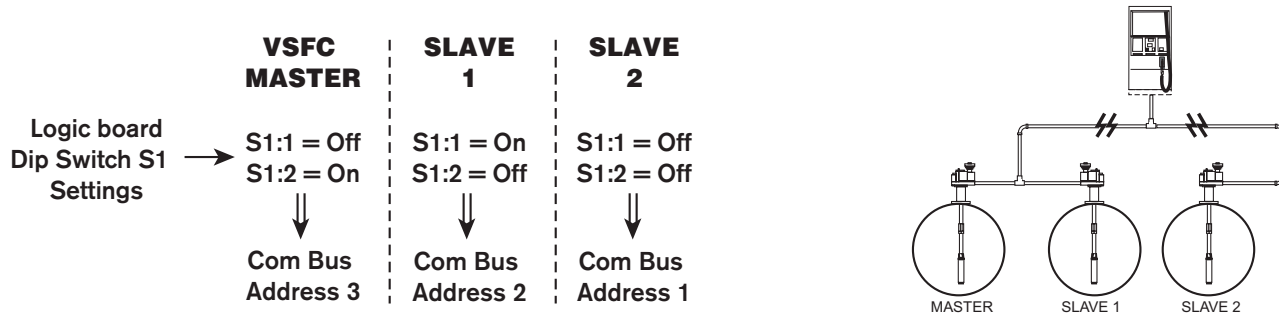
Appendix A: Logic Board Dip Switch (S1) Settings

Note: refer to Figure 24 on page 39 and Table 13 on page 40.

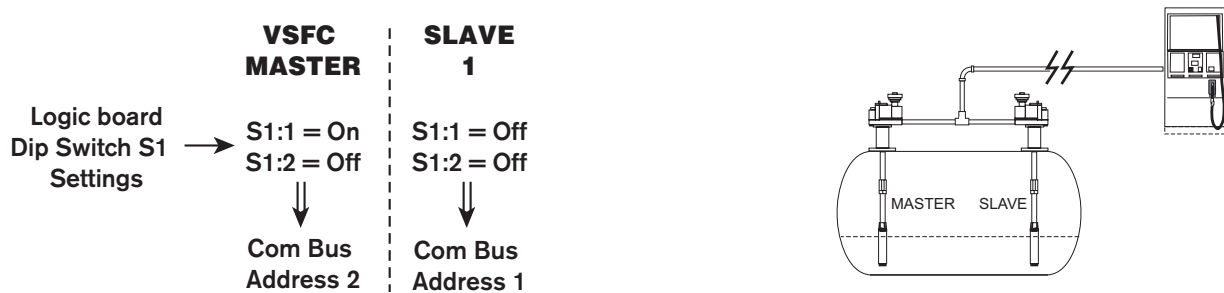
4 UNIT SETUP



3 UNIT SETUP



2 UNIT SETUP IN THE SAME TANK



redjacke/vsfo/dip.eps

Appendix B: VSFC Faults and Alarms

Alarms

HIGH CURRENT

High current has been detected. The motor rotor could be locked. One or more of the phases going to the motor could be open. Check the motor by checking the resistance between the terminals (see Table 12 on page 32). Check all the wiring going to the motor for opens and shorts.

OVER VOLTAGE

High input voltage has been detected. Check the input voltage to make sure that it is within specifications (see Table 10 on page 31).

LOW VOLTAGE

Low input voltage has been detected. Check the input voltage to make sure that it is within specifications (see Table 10 on page 31).

OVER TEMPERATURE

High internal drive temperature has been detected. Check to make sure that the drive has the proper clearance on all sides and that nothing is obstruction the airflow. Check to make sure that the fan is running.

PRESSURE SENSOR FAULT

Pressure transducer has faulted. Check to make sure that the pressure transducer is connected. Check the wiring to the transducer.

SELF-TEST FAULT

Software has detected errors in the drive. Turn off power, check all setup switches and wiring then apply power to the drive.

MOTOR DRIVE FAULT

Drive has detected a problem running the motor. Check all drive wiring (see Table 10 on page 31, Table 11 on page 31, and Table 12 on page 32).

COMMUNICATIONS FAULT

Drive has detected communication errors. In standalone configuration check cable connected to J9 (see Figure 4 on page 8). In multi-unit configuration, check the Slave COM connections and wiring (Figure 18 on page 27) in each drive.

Warnings

LOW CURRENT

The current going to the motor has been less than 1 amp for more than 5 seconds. Check the entire system for proper operation and wiring.

DRY RUN

The drive has detected a dry run. Please check product level in the tank. If fuel levels are sufficient check the wiring going to the motor (see Table 11 on page 31).

LONG RUN

The drive has detected a handle request continuously for more than 2 hours without product being dispensed. Check the wiring and operation of the handle signal from the dispensers. If it is a true dispense of that duration and flow requirement, disable the Long Handle Warning (see Table 2 on page 9).

COMM WARNING

The master VSFC unit has lost communications with another VSFC unit. Check all the communication wires (see Figure 18 on page 27) and power to all drives and then reset the master drive (see Table 11 on page 31).

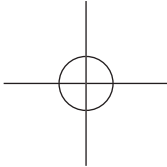
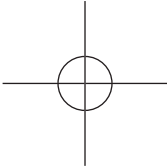
EEPROM WARNING

The VSFC drive had a problem reading from the EEPROM. Reset the master VSFC drive. If the warning persists then the drive has a problem with the EEPROM. The drive will still operate in this state; it will not be able to save any warning or alarm histories.

SETUP WARNING

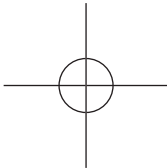
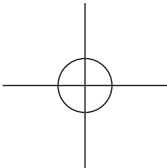
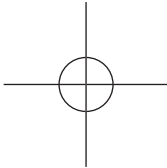
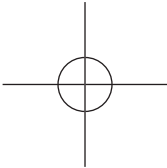
The VSFC drive detected a setup problem. Turn off power, check all setup switches and wiring then re-power the drive.

APPENDIX C



VSFC Unit Mounting Hole Template

redjacket\vsfc\apdxa.eps



cut along dotted line



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other assistance, please visit:
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