ST Controller Manual: A Guide to Installation and Programming
RE260-123 ◆ Rev. G ◆June 99

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Preface

This chapter explains:

- **Installation Notices**
- **Definition of Important Terms**

Installation Notices

It is important that time be taken to read and understand this manual thoroughly before installing and using the ST Controller.

Warning! **Before beginning an installation, programming, or operating procedures, carefully read the instructions. All installation and programming procedures for the Red Jacket ST Controllers should be preformed by personnel who have received factory training.**

Please take all necessary precautions when working around hazardous materials and in hazardous areas. Follow all applicable electrical codes. DO NOT use electrically powered tools or equipment when in a hazardous location. If you are not sure about your actions, consult with the Fire Marshal or other local authorities.

For Technical Assistance, Call:

In the United States:	1-800-777-2480, 24 Hours a Day
In Canada or Mexico:	1-800-367-3117
In Europe and Middle East:	31-34-461-7909 (Holland)
In Asia:	65-345-4960 (Singapore)
In Australia and New Zealand:	61-35-221-6144 (Australia)
In South America:	913-498-5669 (USA)

Please have your Red Jacket tech number when calling

Notice **Please contact Marley Pump for information relevant to the operation of Red Jacket Petroleum equipment with equipment from other manufacturers.**

Definition of Important Terms

The following terms are used throughout this manual to bring attention to the presence of hazards of various risk levels, or to important information concerning the life of the product.

Danger!! **Indicates the presence of a hazard that *will* cause *severe* personal injury, death, or substantial property damage if ignored.**

Warning! **Indicates the presence of a hazard that *can* cause *severe* personal injury, death or substantial property damage if ignored.**

Caution **Indicates the presence of a hazard that *will* or *may* cause *minor* personal injury or property damage** if ignored**.**

Notice **Indicates special instructions on installations, operation, or maintenance that are important but not related to personal injury hazards.**

Chapter 1: The ST Controller

This chapter explains:

- **ST Controller System Description**
- **ST Controller Types and Associated Capabilities**
- **ST Controller Specifications**
- **Master Parts List**

Accessories
Kits
Boards
Cables
Covers and Barriers
Inventory Sensor Parts
Line Pressure Parts
Basic Components of an ST Controller
Ultrasonic Inventory Sensor
The Interconnect Cable
Hanging Bracket
Miscellaneous Parts
Peripheral Sensors
Printer Parts
Installation Instruction Sheets
Parts List for Units & Sensor Accessories
Part Numbers for Inventory Sensors

System Description

Notice **This manual provides instructions for the installation and programming of the ST1400, ST1401, ST1401L, ST1800, ST1801, and ST1801L Controllers.**

The Red Jacket ST1400 and ST1800 Controllers are electronic tank gauging devices used for complete leak detection and inventory management of underground storage tanks (USTs) containing petroleum based products. The ST1401 and ST1801 Controllers provide all the same functions as the ST1400 and 1800 series controllers plus sump, dispenser pan, interstitial space, groundwater, and vapor monitoring. The ST1401L and 1801L models provide added electronic line leak detection and positive shutdown.

The ST Controller uses ultrasonic technology with a patented design specific to UST (Underground Storage Tank) monitoring that provides high performance characteristics. It can collect level and density data from up to eight ultrasonic probes and report various volumetric quantities while including temperature corrected volume (net). This temperature can be left at 60°F (15°C factory default), or custom programmed.

The ST Controller can communicate with specific POS (Point of Sale) devices. It can collect "Product Dispensed" information for reconciling deliveries, beginning and ending inventories, and throughput. Several programming options for ST Controllers are available to report conditions and events. These conditions and events are recorded in memory, and may be displayed on the Liquid Crystal Display (LCD) or printed on the optional built-in printer.

The owner or operator can obtain information from their facility, such as low product, overfill, delivery, high water, tank leak detection, and line leak detection. This information can be displayed using one or more of the following: the ST Controller LCD, the ST Controller's built-in printer, or a computer using the data analysis software package Pathway. Pathway can be connected to the ST Controller by either a modem or directly connected using an RS232 cable.

The data stored covers at least the last 33 events (depending on model) of any particular report for each tank being monitored. If an event such as overfill or theft should occur, an audible alarm may be activated to alert the operator.

The ST Controller also features a real-time clock, RS232 communications port, an alpha-numeric LCD with two lines of 16 characters each, an annunciator, and an optional printer.

All tank reports include date, time, station information, report name, tank number, product type, and tank capacity. Printed reports can be scheduled, event driven, or initiated by the keypad. The following reports can be produced by the ST Controller: Inventory, Reconciliation, Delivery, Tank Leak Detection, Line Leak Detection, Overfill Alarm, Product Low, High Water, System Status, Sensor Alarm, and Line Pressure.

ST Controller Types and Capabilities Chart

The following chart represents the different ST Controller models, and their capabilities.

ST Controller Capabilities						
Model No.	Monitoring Capability			# of Tank Input Channels	# of Line Pressure Channels	# of Output Relays*
	Tanks	Peripherals	Line			
ST 1400	**YES**	**N/A**	**N/A**	**4**	**0**	**N/A**
ST 1401	**YES**	**YES**	**N/A**	**4**	**0**	**4**
ST 1401L	**YES**	**YES**	**YES**	**4**	**4**	**8**
ST 1800	**YES**	**N/A**	**N/A**	**8**	**0**	**N/A**
ST 1801	**YES**	**YES**	**N/A**	**8**	**0**	**8**
ST 1801L	**YES**	**YES**	**YES**	**8**	**8**	**8**

* Each Line Pressure Channel requires an output relay.

ST Controller Specifications

ST Controller	
Level Resolution	0.000004-in./0.0001mm
Temperature Resolution	0.0001°C
Number of Tanks	1 to 8 tanks*
Number of Temperature Sensors	Every 6 in (150mm), 13 sensors in 8' (250mm)
Water Level Resolutions	0.011 in. / 0.28mm
Voltage Requirements	115/220 VAC 50/60 HZ
Microprocessor	Hitachi 6303Y
ROM, RAM	128K each
Maximum Probe Length	12-ft., 3600mm
Leak Test Time	2 hours, 15 minutes**
Wait Time Before Testing after Delivery	10 hours
Display Size	2 lines x 16 characters
Enclosure Dimensions	22 in. x 10.5 in. x 4 in.(267mm H x 546mm L x 105mm W)
Weight	23lbs., 10.4 Kg
Operating Temperature (controller only)	32°F to 122°F, 0^0C - 50^0C
UL Listing	E133027
Battery Operation	Approximately 1 day***
EPA Third Party Testing	ADA Technologies Inc.

* depending on the model
** typical under ideal conditions
*** with memory conservation

ST Inventory Sensor	
Transceiver	Ultrasonic, sealed in proprietary epoxy
Crystal Frequency	1 MHz
Probe	316 Stainless steel
Cable	Twinaxial, Teflon® Jacket 100% shielded, 78 ohm impedance
Transceiver Block	Brass (316 Stainless Steel for aviation fuels)

Applicable Products
100% Gasoline
100% Diesel
100% Methanol
100% Ethanol
M-85
E-85
Kerosene
Jet Fuel
Gasoline/Methanol Mixtures
Gasoline/Ethanol Mixtures
Gasoline with up to 15% MTBE
Diesel with up to 15% MTBE
Special Products as Recommended by Manufacturer

Master Parts List

The following sections include all the parts associated with the installation of the ST Controller. Contact Red Jacket Customer Service at 1-800-952-8348 with any questions regarding parts.

Accessories

Part Number	Description
RE400-305-5	12-ft.(3.65m) Coax Drop Tube (single)
RE400-306-5	12-ft. (3.65m) Coax Drop Tube (4 pack)
RE400-308-5	12-ft. (3.65m) Creased Drop Tube (single)
RE400-309-5	12-ft. (3.65m) Creased Drop Tube (4 pack)
RE400-310-5	Offset Hanger (for up to 48-in./122cm delivery risers)
RE400-589-5	Straight Hanger (for PVC Cap)
RE400-312	Installation Tool (for use on offset hanger install)
RE400-380-5	Riser Pipe Extraction Tool
RE400-585-5	Hanger-Straight (for Locking Well Cap and Adapter Collar)
RE400-538-5	Offset Hanger 6-ft./183cm (for risers over 48-in./122cm)
RE400-620-5	Remote Audible Alarm
RE400-379-5	Riser Pipe Adapter (3-in./7.6cm Pre-drilled for offset hanger)
RE330-098-5	Replacement PC board for SIB 1401L
RE330-099-5	Replace PC board for SIB 1401/1801 ST Controllers
RE330-102-5	Replacement PC board for SIB 1801L

Kits

Part Number	Description
RE400-590-5	Well Cap, 4-in. (10.1 cm) PVC
RE-340-009-5	Well Cap, 2-in. (5cm) PVC
RE346-011-5	Locking Cap and Adapter Collar
RE400-589-5	Straight Hanger for 4-in. (10.1 cm) PVC Well Cap
RE400-307-5	Straight Hanger for the 3-in.(7.6cm) PVC Well Cap
RE400-585-5	Straight Hanger for 4-in. (10.1 cm) Locking Well Cap and Adapter Collar
RE400-592-5	Straight Hanger with 4-in. (10.1 cm) PVC Well Cap
RE400-593-5	Straight Hanger with 4-in. (10.1 cm) Locking Well Cap and Adapter Collar

Replacement Circuit Boards

Part Number	Description
RE330-093-5	Display Board
RE170-101-5	Keyboard Control Panel
RE200-016-5	Power Supply Board
RE330-058-5	CPU Board
RE330-059-5	4 Channel Analog Board
RE330-060-5	8 Channel Analog Board
RE330-068-5	4 Channel Fused Analog Board
RE330-069-5	8 Channel Fused Analog BD.
RE330-083-5	Sensor Interface Board (SIB) - 01 upgrade
RE330-089-5	Sensor Interface Board (SIB) - 1401L upgrade
RE330-097-5	Sensor Interface Board (SIB) - 1801L upgrade
RE330-067-5	Connector Board - ST Sensor
RE170-098-5	Spacer Board

Cables

Part Number	Description
RE400-324	Cable Twinaxial (HDPE)
RE400-325	Cable Twinaxial (Teflon®)
RE350-112-5	Ribbon Cable (CPU to SIB, keyboard and RS232)
RE350-119-5	ST Interface Cable to PC
RE350-120-5	POS Interface Cable - 25-ft.
RE350-121-5	POS Interface Cable - 50-ft.
RE350-122-5	POS Interface Cable - 75-ft.

Covers and Barriers

Part Number	Description
RE170-093-5	Side A/C Cover
RE170-095-5	Side I/S Cover
RE170-096-5	I/S Shield (Between Analog/SIB)
RE170-097-5	R/F Shield (Between CPU/Analog)
RE170-099-5	Bottom Cover (red)
RE170-100-5	Top Cover (gray)
RE170-106-5	CPU Cover

Inventory Sensor Parts

Part Number	Description
RE400-322-5	Water Float Kit (included 3-in.(7.6cm) Riser Diesel Clip)
RE400-396-5	Water Float Kit (included diesel clip)
RE400-397-5	Diesel Clip
RE400-394-5	Transceiver (for use with inventory sensor 8-ft.(2.44m) and under in length)
RE400-444-5	Transceiver (for use with inventory sensor over 8-ft. (2.44m) in length)

Line Pressure Parts

Part Number	Description
RE076-370-5	Packer-Manifold Seal
RE323-002-5	Adjustable Functional Element
RE101-054-5	Accumulator
RE400-100-5	AG Line Pressure Kit
RE144-184-5	Check Valve Kit
RE400-534-5	Standard Domestic (non-conduit) Transducer
RE400-535-5	Standard Canada (non-conduit) Transducer
RE400-584-5	Transducer Adapter

Miscellaneous Parts

Part Number	Description
RE090-010-5	Battery
RE110-024-5	Alarm/Piezo
RE170-102-5	Grounding Bar
RE230-005-5	Lock Assembly
RE350-113-5	Wire Harness Power Supply to CPU, Printer, Keyboard, and Battery
RE170-169-5	Connector Housing Assembly
RE400-093-5	Scotchcast® Connector Kit (12 per kit)
RE400-399-5	Feedthrough Assembly for the Inventory Sensor

Peripheral Sensors

Part Number	Description
RE400-058-5	High Level Sensor - 2-in.(5cm)
RE400-059-5	High Level Sensor - 4-in.(10.1)
RE400-042-5	Hydrostatic Sensor
RE400-111-5	Liquid Sump Sensor
RE400-180-5	Liquid Refraction Sensor
RE400-204-5	Dispenser Pan/Sump Sensor
RE400-219-5	Vapor/Conductivity - 2-in. (5cm) Floating Sensor
RE400-5220-5	Vapor/Conductivity - 4-in. (10.1) Floating Sensor
RE400-377-5	Groundwater Monitor 10-ft.(3m)
RE400-378-5	Groundwater Monitor 15-ft.(4.6m)
RE400-381-5	Groundwater Monitor 20-ft.(6.1m)
RE400-203-5	Optical Liquid Refraction Sensor (OLDS)
Various	High/Low Sensor 2-in.(5cm) and 4-in.(10.1cm) for lengths 4-ft.(1.22m), 6-ft.(1.83m) 8-ft.(2.44m) 10-ft.(3.05m), and 12-ft.(3.66m)

Printer Parts

Part Number	Description
RE030-012-5	Printer Head
RE150-118-5	Printer Paper (1 roll)
RE150-119-5	Paper Roll Axle
RE330-057-5	Printer Controller Board
RE400-341-5	Printer Paper (12 Rolls)

Installation Instruction Sheets

Part Number	Description
RE260-182	Vapor Conductivity Sensor Installation Instruction Sheet
RE260-069	Containment Sump Sensor Installation Instruction Sheet
RE260-100	Refraction Sensor Installation Instruction Sheet
RE260-201	OLDS Sensor Installation Instruction Sheet
RE260-083	Hydrostatic Sensor Installation Instruction Sheet
RE260-085	High/Low Sensor Installation Instruction Sheet
RE260-061	High Level Sensor Installation Instruction Sheet
RE260-135	Groundwater Sensor Installation Instruction Sheet
RE260-185	Dispenser Pan Sensor Installation Instruction Sheet
RE260-092	Line Pressure Transducer Kit Manual
RE260-244	Remote Audible Alarm Installation Instruction Sheet

Parts List For Units & Sensors Accessories & Replacement Parts

Part Number	Description
	Tank Gauge Units
RE400-343-5	ST1400 - 4 channels with printer
RE400-342-5	ST1400 - 4 channels without printer
RE400-345-5	ST1800 - 8 channels with printer
RE400-344-5	ST1800 - 8 channels with printer
	Tank Gauge and Peripheral Sensor Units
RE400-500-5	ST1401 - 4 channels with printer
RE400-501-5	ST1401 - 4 channels without printer
RE400-502-5	ST1801 - 8 channels with printer
RE400-503-5	ST1801 - 8 channels without printer
	Tank Gauge and Peripheral Sensor Units with Electronic Line Leak Detection
RE400-461-5	ST1401L - 4 channels with printer
RE400-461-5	ST1401L - 4 channels without printer
RE400-467-5	ST1801L - 8 channels with printer
	Pressure Transducer
RE400-100-5	AG Line Pressure Kit
RE340-040-5	No Dedicated Conduit (Domestic)
RE341-040-5	No Dedicated Conduit (Canada)
	Line Pressure Kit (includes transducer, accumulator and functional element)
RE101-054-5	Accumulator
RE400-534-5	No Dedicated Conduit (Domestic)
RE400-535-5	No Dedicated Conduit (Canada)
	Misc.
RE110-023-5	Paper-Out Switch

Part Numbers for Inventory Sensors

To select proper sizing for the Inventory Sensor for the straight hanger installation, refer to the section titled ***Sizing Instructions for Inventory Sensors Using a Straight Hanger*** in **Chapter 4** of this manual. To select proper sizing for the Inventory Sensor for the offset hanger installation, refer to the section titled ***Sizing Instructions for Inventory Sensors Using an Offset Hanger*** in **Chapter 4** of this manual.

Part Number	Bottom of plate to bracket, cm	Inches	Feet
RE400-339-5	342.63	134.89	11.24
RE400-338-5	326.23	128.44	10.70
RE400-337-5	312.26	122.94	10.24
RE400-562-5	304.61	119.93	10.00
RE400-319-5	295.86	116.48	9.71
RE400-561-5	288.21	113.47	9.46
RE400-318-5	281.89	110.98	9.25
RE400-560-5	274.24	107.97	9.00
RE400-336-5	265.49	104.52	8.71
RE400-559-5	257.84	101.51	8.46
RE400-335-5	251.52	99.02	8.25
RE400-558-5	243.87	96.01	8.00
RE400-334-5	235.12	92.57	7.71
RE400-557-5	227.47	89.56	7.46
RE400-317-5	221.15	87.07	7.26
RE400-556-5	213.50	84.06	7.00
RE400-333-5	204.75	80.61	6.72
RE400-555-5	197.10	77.60	6.47
RE400-316-5	190.78	75.11	6.26
RE400-554-5	183.13	72.10	6.01
RE400-332-5	174.38	68.65	5.72
RE400-553-5	166.73	65.64	5.47
RE400-315-5	160.41	63.15	5.26
RE400-552-5	152.76	60.14	5.01
RE400-314-5	144.01	56.70	4.72
RE400-551-5	136.36	53.69	4.47
RE400-331-5	130.04	51.20	4.27
RE400-550-5	122.39	48.19	4.02
RE400-330-5	113.64	44.74	3.73
RE400-549-5	105.99	41.73	3.48
RE400-313-5	99.67	39.24	3.27
RE400-548-5	92.02	36.23	3.02

Basic Components of an ST Controller

This section provides a system description, parts list, and installation instructions. After unpacking the equipment, please inspect the parts to be sure all accessories are included and that no damage occurred during shipping (see figure 1.1 for the complete parts guide). Carefully compare the equipment and accessories with the enclosed packing list. Report any damage to the shipper immediately and inform your local customer service representative at 1-800-952-8348(in the United States only), of any ***equipment damage*** or ***missing equipment***.

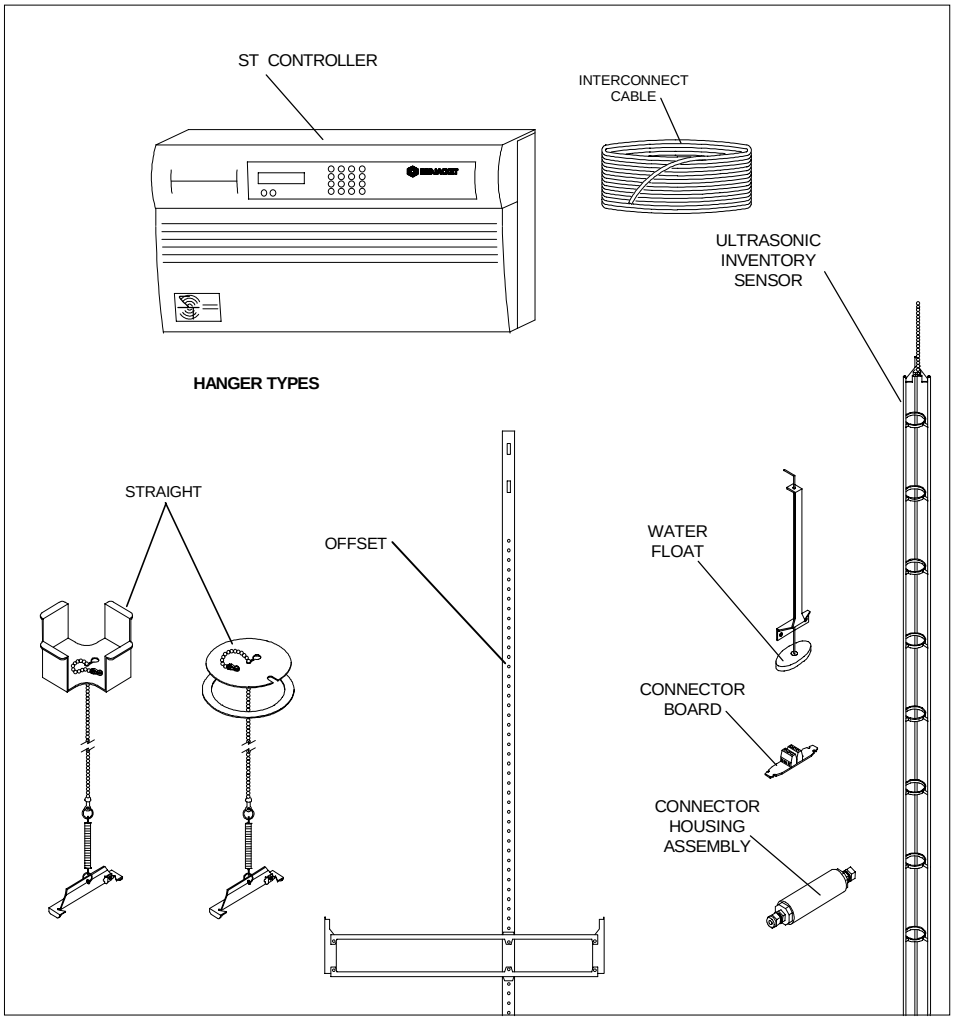


Figure 1.1 ST Controller and Components

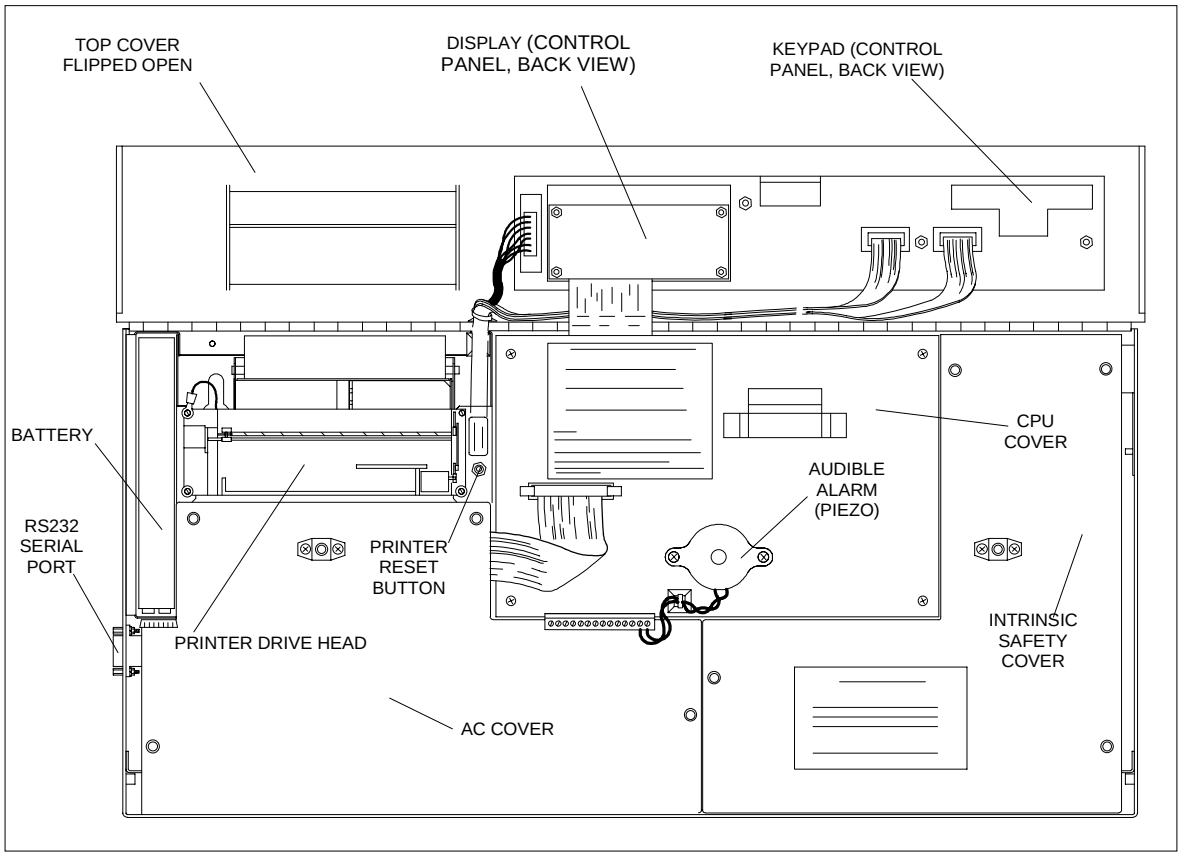


Figure 1.2 ST Controller Layout

The ST Controller must be installed in a non-hazardous area (refer to ***Chapter 2: Intrinsic Safety Information***). Choose a location where the ST Controller will experience minimum temperature changes and will be protected from physical harm. The ST Controller must be installed in a climate controlled environment that is immediately accessible to the owner and operator.

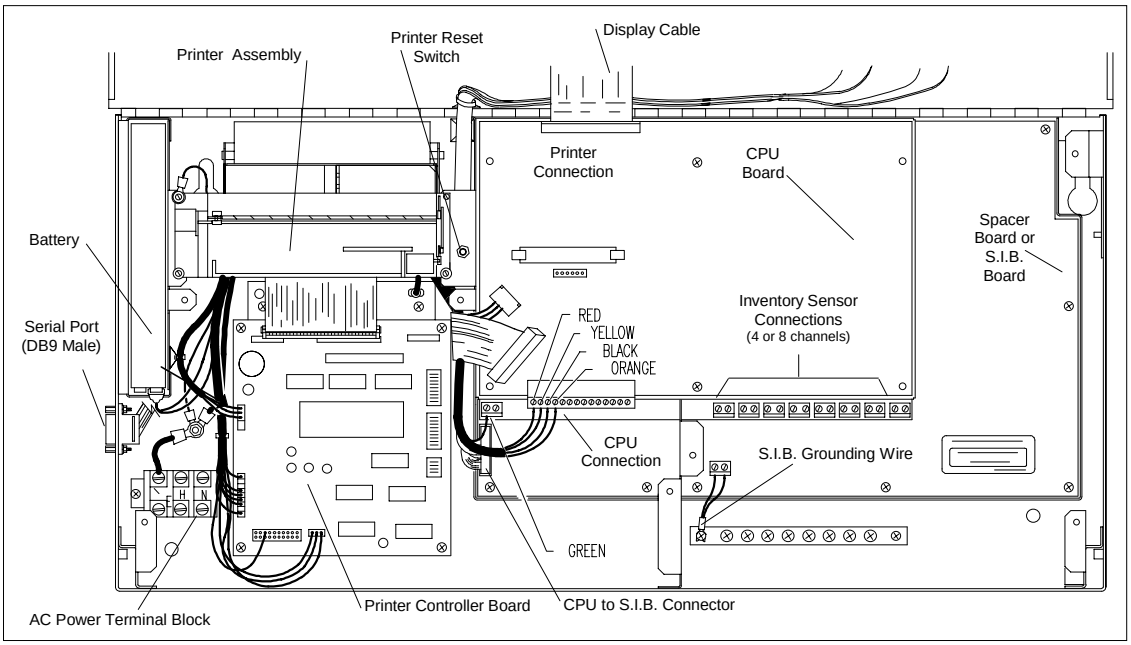


Figure 1.3 ST Controller with Covers Removed

Ultrasonic Inventory Sensor

The ultrasonic inventory sensor can be installed in a dedicated riser pipe (with a straight hanger) or in a fill pipe using an offset hanger installation tool and a creased drop tube, with little or no downtime for the station.

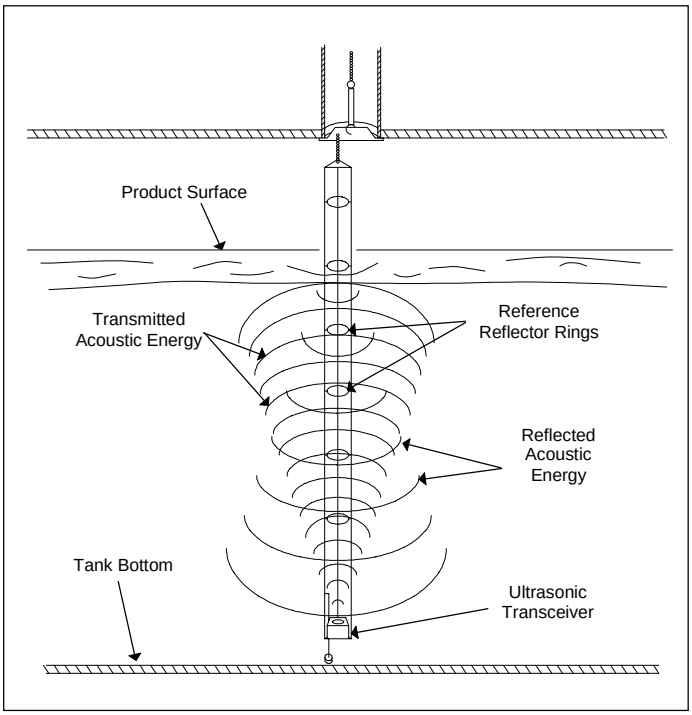


Figure 1.4 Ultrasonic Action

The ST Controller transmits an electrical signal that drives the ultrasonic transceiver through a burial grade interconnect cable. The transceiver, affixed to a probe, located at the bottom of the tank (pointing upward), converts this signal to a burst of high frequency, acoustic energy. Reference rings, located at known distances, and the product's surface reflect this energy downward, back toward the transceiver. The soundwaves are received by the transceiver and converted back to electrical signals. These signals are carried through the interconnect cable back to the ST Controller where they are amplified, digitized, and sent to the microprocessor. The information from this signal provides a correction factor for product density changes that occur with changes in the temperature. Figure 1.4 illustrates this process.

The Interconnect Cable

Installation requires the use of one of the following cables that can be used in direct-bury situations or conduit applications.

HDPE (High Density Polyethylene): Is cost effective and approved for direct bury and meets the requirements for most installations.

Teflon® (This cable is UL-Classified and should be used in cases where UL-Classified cable is required.) For installations with more stringent requirements, Teflon interconnect cable offers a Teflon outer jacket as well as Teflon jacket inner conductors.

Notice **The use of *any* other cables *will* void product warranty.**

The interconnect cables have outer jackets constructed of high-density polyethylene or Teflon. The Teflon jacket provides the conductors with protection against elements when they are installed in pavement or buried directly in sawcut applications.

Caution **Splicing an interconnect cable should be considered *only* in emergency situations. A splice *will* cause degradation to the systems performance and *will* void the normal warranty.**

Hanging Bracket

The Straight Hanging Bracket, shown in figure 1.5, should be used in inventory sensor installations where dedicated risers are used. The offset hanging bracket, shown in figure 1.6, is only used when an inventory sensor must be installed in an existing delivery riser.

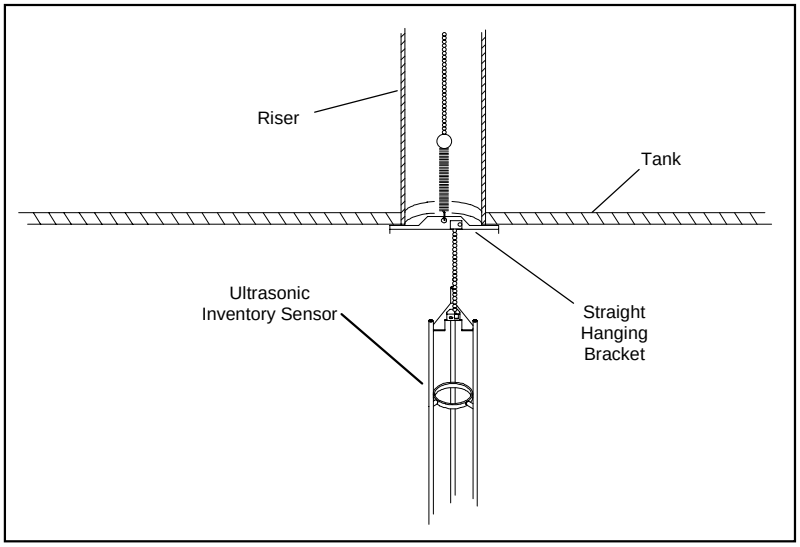


Figure 1.5 Straight Hanger in a Dedicated Riser

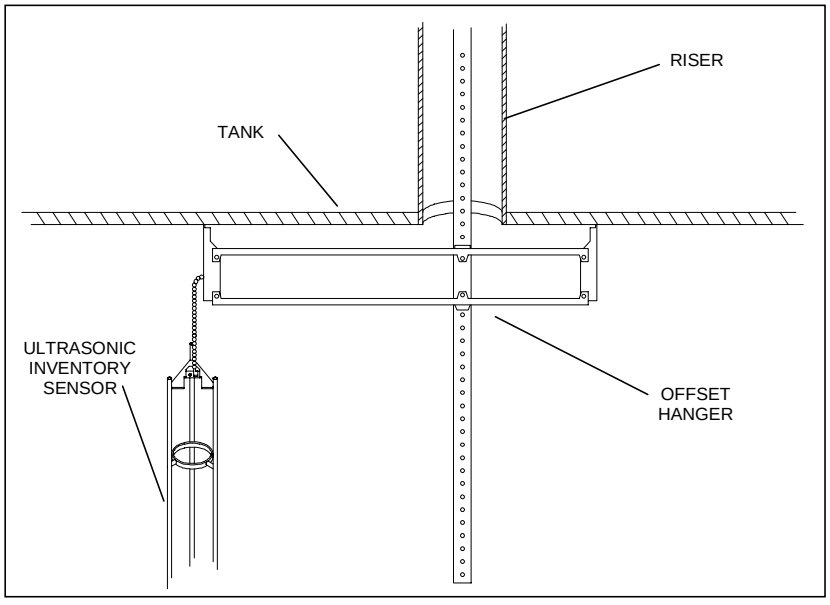


Figure 1.6 Offset Hanger in a Delivery Riser (creased tube not shown)

Notice **The preparation, adjustments, and installation procedures are covered in the section** *Installation Steps* **in Chapter 3.**

Chapter 2: Installing the ST Controller

This chapter explains:

- **Intrinsic Safety Information**
- **Installation Do's and Don'ts**
- **ST Controller Enclosure Installation**
- **Conduit Installation**
- **Direct Bury and Retrofit Installations**

Intrinsic Safety Information

ATTENTION INSTALLER

READ THIS IMPORTANT SAFETY INFORMATION BEFORE BEGINNING WORK

Portions of this product will be installed and operated in the highly combustible environment of a petroleum product storage tank. It is essential that you carefully read and follow the warnings and instructions in this manual to protect yourself and others from serious injury, explosion, electrical shock, or death.

Warning!

All installation and programming of Red Jacket ST Controllers must be performed by factory trained personnel only. Before beginning any installation procedure, carefully read and understand all instructions.

Failure to follow these guidelines can result in severe personal injury, death, or substantial property damage. Retain a copy of this manual on site with the ST Controller system as required by EPA regulations in paragraph 40CFR 280.45.

Precautions must be taken in the installation of this product to limit power in the wiring to the fuel tanks and to keep that wiring physically separated from any other wiring (*intrinsically safe*).

Notice **It is your responsibility to maintain the effectiveness of the safety features by installing this product in accordance with the instructions and warnings that follow. Failure to do so could create danger to life and property and will result in voiding all warranties connected with this product.**

Danger!! **Conduit or wiring trough from sensors to the ST Controller must not contain *any* non-intrinsically safe wires.**

All conduit must enter the ST Controller through pre-formed factory supplied knockouts.

Do not install the ST Controller in a volatile, combustible, or explosive environment.

Installation and use of this product in the United States must comply with the National Electrical Code. Please refer to section 504 of NEC article 300. NFPA 70, Automotive and Marine Service Stations Code NFPA 30A; and all Federal, State, Local Codes; and other applicable safety codes.

Shut off all power before installation of the system.

The ST Controller must have proper earth ground (for example, a station ground rod).

Failure to follow these instructions *will* result in severe personal injury, death, or substantial property damage.

Installation Do's and Don'ts

Warning! **Failure to follow these guidelines could result in severe personal injury, death or substantial property damage.**

The following list represents the ***Don'ts*** for installing the ST Controller unit. Please read through this list before beginning the installation.

Don't short circuit power supply.

Don't handle the CPU or other circuit boards of the ST Controller without proper grounding straps.

Don't mount the ST Controller in a hazardous area or a volatile, combustible, or explosive environment.

Don't allow unauthorized field service personnel to work on the internal circuits of the controller. Unauthorized work will adversely affect the intrinsic safety of the system and void product warranty.

Don't run any other lines or power devices through the ST Controller. The ST Controller is a low voltage device.

Don't hammer the cable into the sawcut.

Don't operate the system without the protective covers installed over barrier terminals.

Don't drill any holes in the ST Controller Enclosure.

Don't pull peripheral sensor wires more than 2,000 feet(600m) maximum from the ST Controller.

Don't Cross wire the pressure transducer.

The following list represents the ***Do's*** for installing the ST Controller unit. Please read through this list before beginning the installation.

Do **Plan** all conduit or direct bury runs and junction box installations before mounting the ST Controller.

Do Install the system to meet **the National Electric Code(United States), all Federal, State, Local codes, and any other applicable safety codes.**

Do **Disconnect all power** before making final connections.

Do **Maintain intrinsic safety**. Sensor and pressure transducer wires must be separated from all other non-intrinsically safe wiring. Sensor and transducer wiring may share the same conduit. **Install the safety tag** on all intrinsically safe junction boxes.

Do Observe proper conduit access into the ST Controller.

Do **Mount** the ST Controller in a dry, climate controlled environment.

Do **Install earth ground wire**.

Do **Connect backup battery**.

Do **Hardwire** the ST Controller to a **dedicated isolated power source**.

Do **Use accurate tank charts**, especially if tank(s) have been relined. Tank floors should be clean. **Store these chart's on-site.**

Do **Print the setup reports and store them on-site**. (after all programming is complete.)

Do **install a station ground rod** if one is not present and attach the ST Controller's earth ground.

ST Controller Enclosure Installation

Warning! **Failure to follow all instructions in proper order can cause personal injury or death. Read all instruction before installing.**

To maintain intrinsic safety, the conduit containing wires connected to "Intrinsic Safe Devices" MUST BE ISOLATED FROM ALL OTHER WIRES.

Notice **Install safety tags in all junction boxes and conduit that contain intrinsically safe wiring.**

Install the ST Controller on an even, flat surface. If an uneven surface is being used such as a brick wall, warped wall or uneven concrete wall, install a sheet of plywood between the ST Controller and the wall when mounting. This will prevent the enclosure from warping and twisting. ¼-in. wall standoffs may be used to accomplish level enclosure mounting.

Caution **Do Not drill any holes in the enclosure, this will void product warranty. Use the mounting holes in back of the enclosure to secure to a permanent surface.**

Step 1: Install the ST Controller in a visible and accessible location, indoors and away from hazardous areas using the mounting hole template provided.

Step 2: In conduit, run a three conductor, minimum16-gauge cable from a dedicated isolated power source to the AC terminal block on the ST Controller, as shown in Figure 2.1.

Caution ***DO NOT*** **apply AC power to the ST Controller until *all* connections are made and final inspection is completed by qualified personnel.**

The ST Controller is shipped with the battery disconnected. Upon installation, battery must be connected or loss of AC power will erase all programming. Battery backup is approximately 12 hours. Refer to Figure 2.1 when connecting.

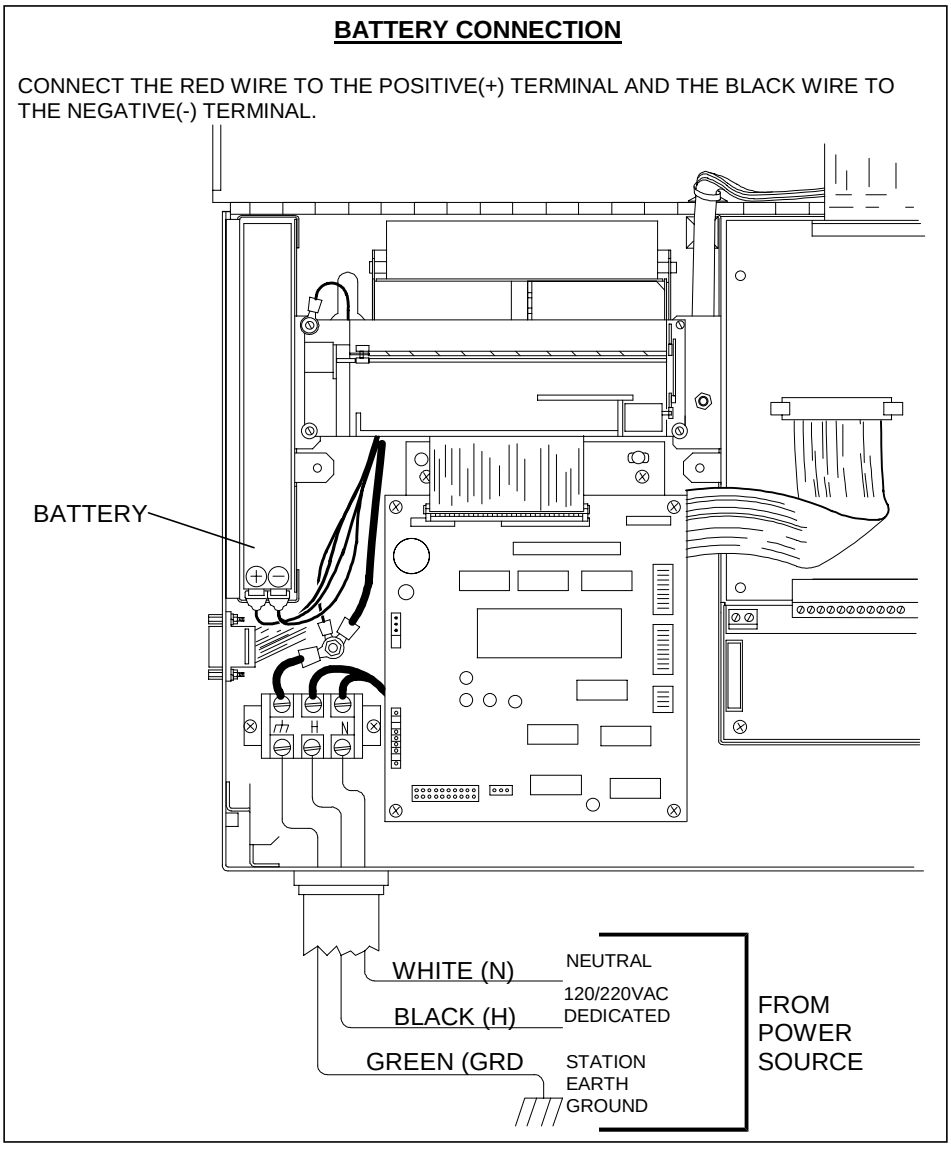


Figure 2.1 ST Controller Power Connections Diagram

AC Power Connections:

Step 1: Make that power is OFF at the electrical service panel.

Step 2: The ST Controller **MUST** be connected to a dedicated isolated circuit. Use a minimum of 16ga wire contained in conduit from the electrical service panel to the ST Controller housing. The ST Controller may be connected to either 110/220VAC, 50/60HZ.

Step 3: Connect the White conductor to the neutral terminal, the Black conductor to the hot terminal, and the Green to the ground terminal on the ST Controller AC power terminal block.(See *figure 2.1)* Note: These conductor colors will differ outside the United States.

Battery Connections:

Connect the battery to the red and black leads from the ST Controller chassis as follows:

Red conductor to the positive(+) terminal and the Black conductor to the negative(-) terminal on the battery.(See *figure 2.1*)

Conduit Installation:

When installing the inventory sensor wiring in conduit, the following guidelines should be followed:

Conduit or wiring from sensor to the ST Controller **must not** contain any other non-intrinsically safe wires.

Run the proper interconnect cable from the inventory sensor to the ST Controller. ***Do Not*** drill any holes in the enclosure. Use the appropriate knockouts to access the controller. Follow all local and federal codes.

Allow for a 3**-ft.** to 4**-ft.** service loop on the inventory sensor side of the cable.(See figure 2.2)

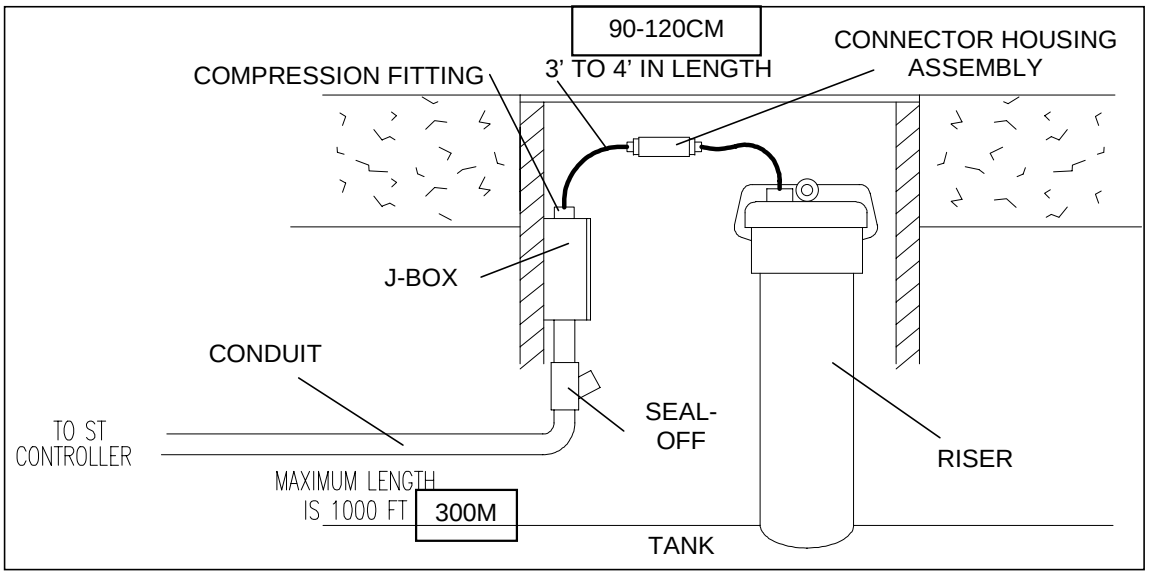


Figure 2.2 Installation Diagram for Conduit

Direct Bury and Retrofit Installation

The dimensions of the width of the sawcut are ¼-in**.** x 2 - 3-in(0.6 x 5 x 7.6cm). The depth of the sawcut is determined by the number of cables being inserted into the sawcut, (one cable per sensor is required).

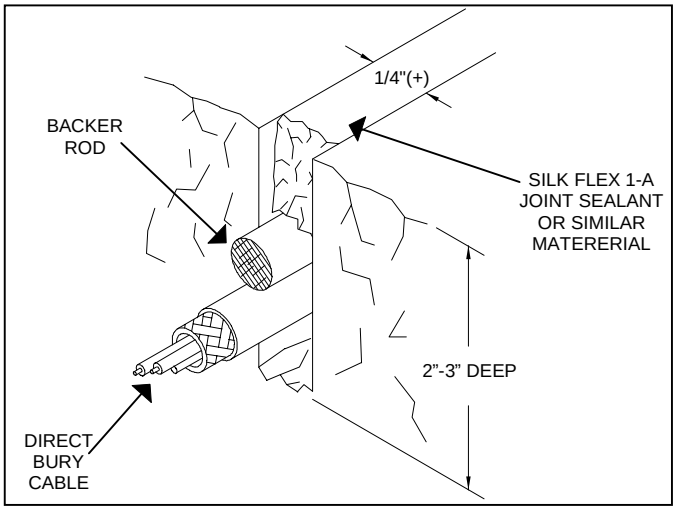


Figure 2.3 Direct Bury Sawcut

Use normal industry standards when cutting the pavement slit or trenching. The slit should be slightly wider than ¼-in. and 2-in. to 3-in. deep. Teflon® cable may be required in order to comply with local codes. All steps taken to prevent damage to the conductors will help maintain the electrical characteristics of the cable. Sawcut all corners at a 45° angle. The cable is not designed to make a 90° bend. Exercise caution when inserting the cable into the sawcut. Do not use sharp objects, such as screwdrivers. A backer rod may be used to help fill the sawcut after the cable has been inserted.

The cable must be concealed in conduit from the point where it leaves the ground until it enters the ST Controller. Follow all local and federal codes when performing direct bury installations. Allow for a 3-ft. to 4-ft. long service loop on the inventory sensor side of the cable.(See *figure 2.4*)

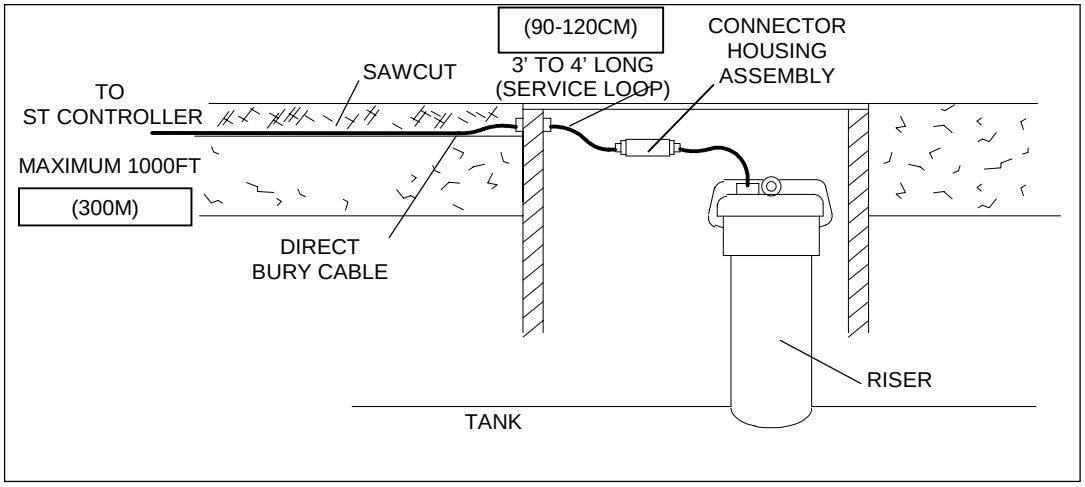


Figure 2.4 Installation Diagram for Direct Bury or Retrofit

Chapter 3: Inventory Sensor Installation

This chapter explains:

- **Installing an Inventory Sensor in a Dedicated Riser**
  - Sizing Instructions for Inventory Sensors Using a Straight Hanger
  - Preparing the Inventory Sensor to Install in Dedicated Riser
  - Installing Feedthrough Assembly in Existing Riser Cap
  - Inventory Sensor Wiring Connections
  - Wiring the Inventory Sensor to Interconnect Cable
  - Wiring Interconnect cable to the ST Controller
- **Installing an Inventory Sensor in a Delivery Riser**
  - Installation Considerations
  - Preparing the Tank
  - Preparing the Delivery Riser
  - Sizing Instructions for Inventory Sensors Using an Offset Hanger
  - Sizing the Offset Hanger
  - Preparing Inventory Sensor for Installation in Delivery Riser
  - Installing Inventory Sensor
  - Sensor Deployment
  - Modification and Installation of the Drop Tube
- **Un-installing the Inventory Sensor from a Delivery Riser**

Installing an Inventory Sensor in a Dedicated Riser

Sizing Instructions for Inventory Sensors Using a Straight Hanger

Step 1: Using the tank stick, measure the distance from the bottom of the tank to the top of the riser, measurement (**A**). This is shown in figure 3.1.

Step 2: Using a rigid measuring tape, measure the length of the riser from the bottom, inside edge to the top of the pipe. This is measurement (**B**). Figure 3.1 is an example of this.

Notice **The riser length required for this installation is a minimum of 14in(35cm) and a maximum of 48in(120cm) If the riser is longer than 48in(120cm), contact Red Jacket sales for a special chain length.**

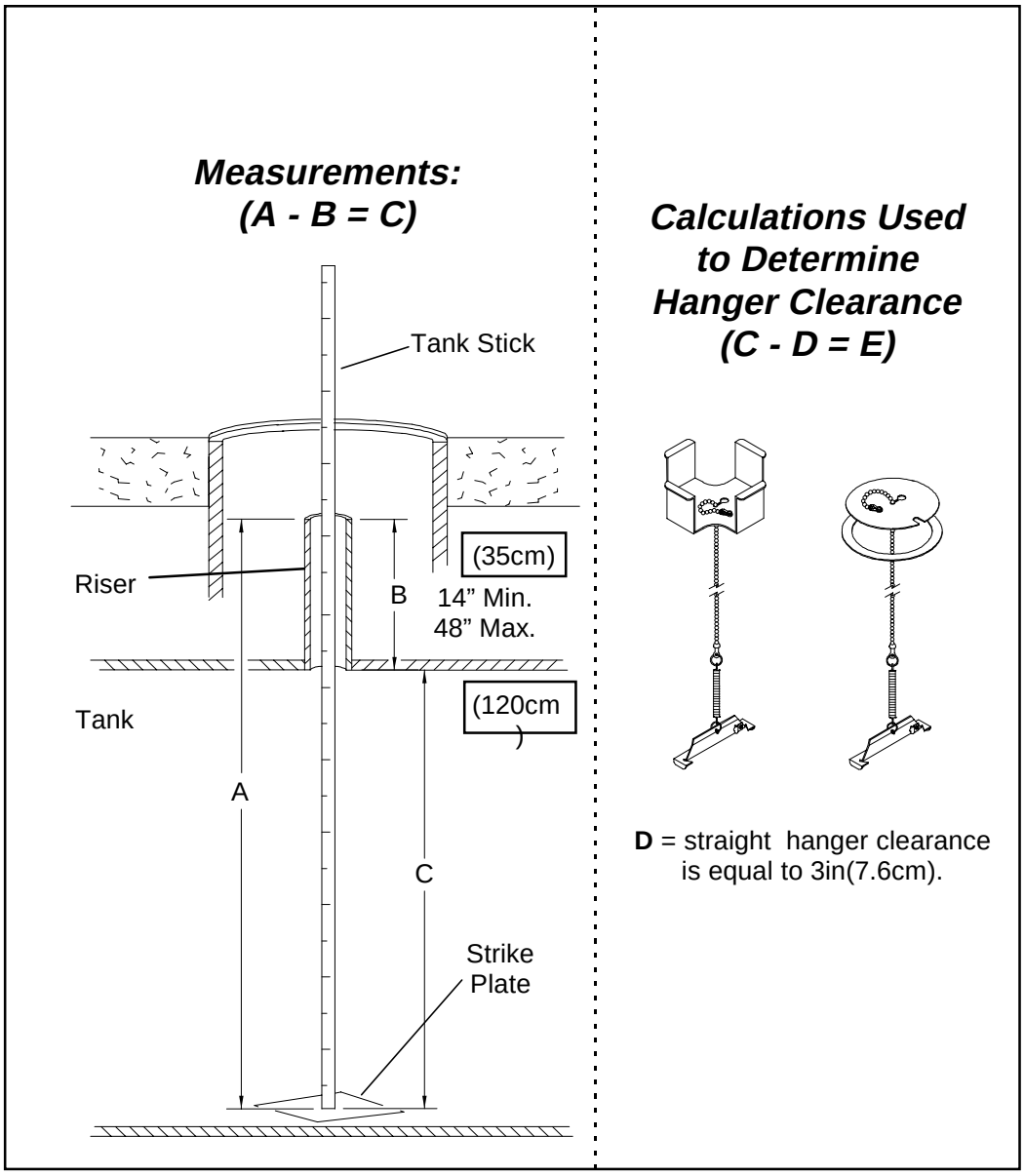


Figure 3.1 Calculating Tank Diameter

Step 3: Subtract measurement (**B**) from measurement (**A**) to calculate the actual inside diameter of the tank, measurement (**C**). Refer to figure 3.1.

Step 4: If using the straight hanger, subtract3in.(7.6cm) (**D**) from (**C**), (**C - D = E**). If using the offset hanger, refer the section titled ***Installation of Inventory Sensor in Delivery Riser*** later in this chapter.

Step 5: Round calculation (**E**) **down** to the nearest length and refer the section named ***Part Numbers for Inventory Sensors*** in **Chapter 1** of this manual.

Preparing the Inventory Sensor to Install in Dedicated Riser

Step 1: Lay the inventory sensor on the ground and install the water float. Refer to figure 3.2.

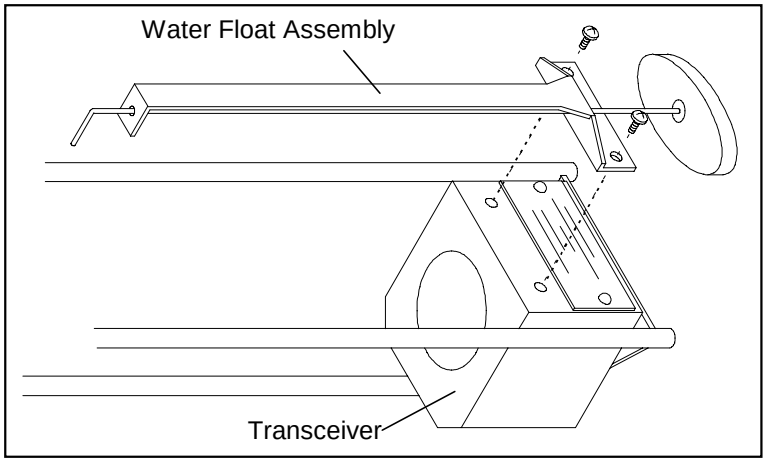


Figure 3.2 Water Float Installation for Use in a Dedicated Riser

Notice **Use specific gravity of the product when determining if the diesel clip should be installed on the water float. If clip is required refer to figure 3.3 for installation.**

Specific Gravity of Product	Number of Clips
Gasoline - 0.69 to 0.78	0
Kerosene/Diesel - 0.78 to 0.87	1

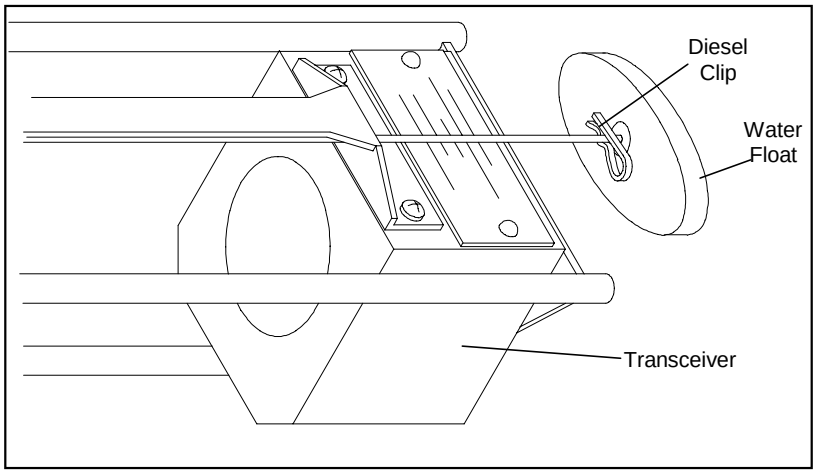


Figure 3.3 Diesel Clip Attachment for Use in Dedicated riser

Step 2: To get the correct overall length, lay the tank stick on the ground next to the sensor. Place the bottom of the transceiver block at the 2in(5cm) mark on the tank stick, as shown in *figure 3.4*. Attach the chain to the lower riser bracket (figure 3.5) so that the bracket is at the calculated inside tank diameter (***measurement C***) in *figure 3.4*.

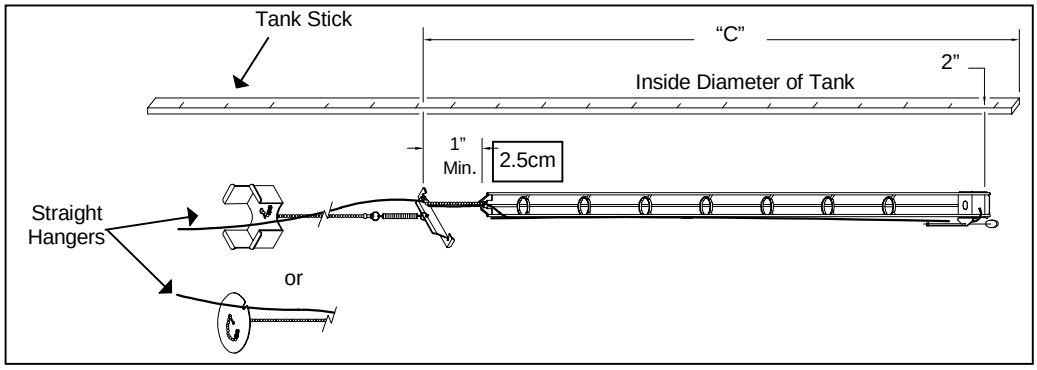


Figure 3.4 Measurement for Straight Hanger Installation

Notice ***Do Not*** **overtighten the cable or chain retainer. The cable should be able to slide easily.** ***Do Not*** **attach the sensor closer than 1-in(2.5cm) from the hanger lower riser.**

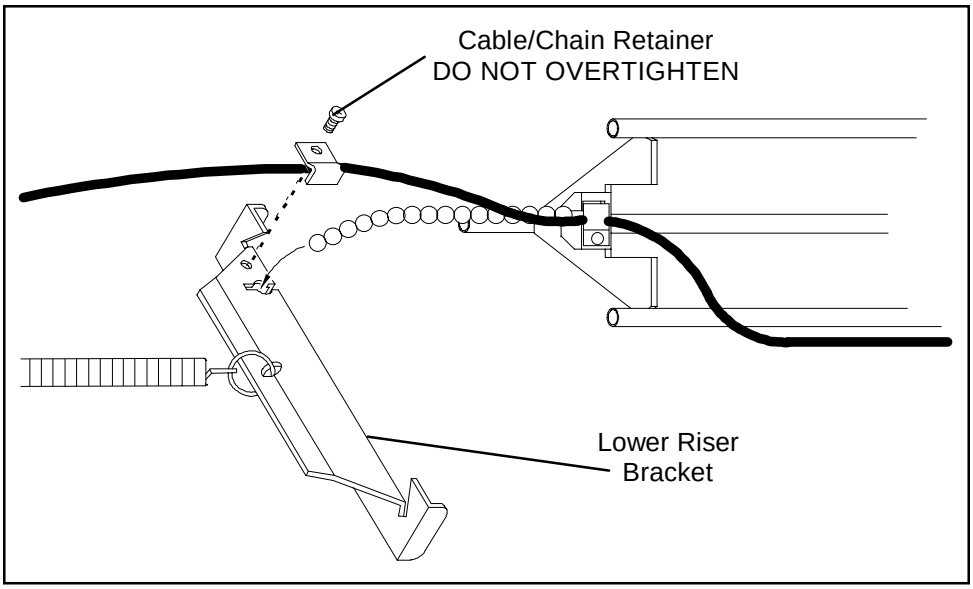


Figure 3.5 Attaching the Chain to Lower Riser Bracket

Notice **Take care not to bend or break the water float when starting its descent into the riser.**

Step 3: Lower the probe into the riser using the hanger's chain, until it touches the bottom of the tank. ***Do not use the interconnect cable as a means of lowering the sensor into the tank.*** An example of this is shown in *figure 3.6A*.

Step 4: Pull up on the chain to catch the lower riser bracket on the bottom of the riser pipe (see figure 3.6B).

Step 5: While holding the chain taut, slide the upper riser bracket down the chain until it is seated in the riser opening. Refer to *figure 3.7A* while performing this task.

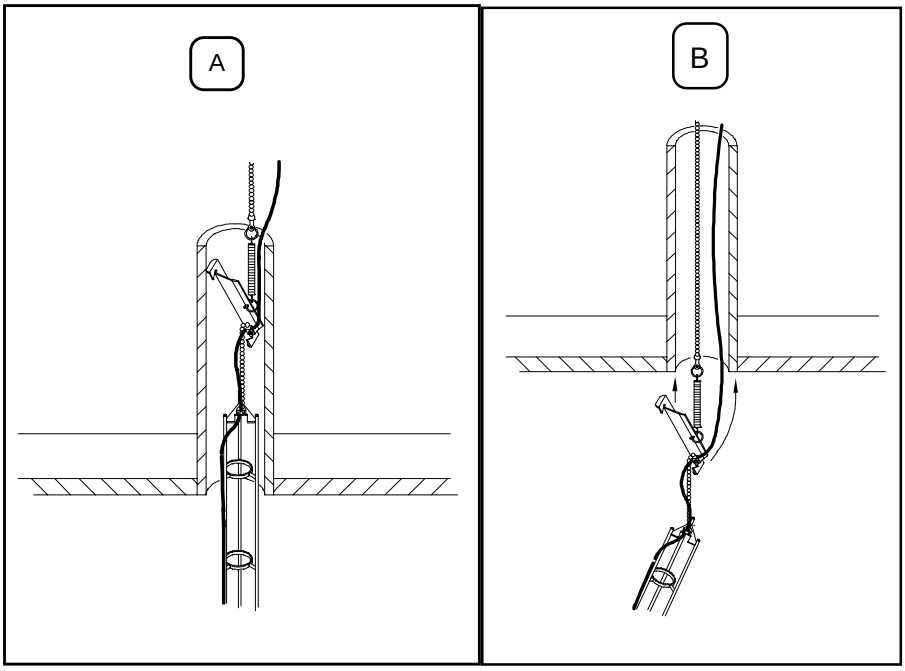


Figure 3.6 A & B Lowering the Sensor into Tank & Securing the Straight Hanger into Position

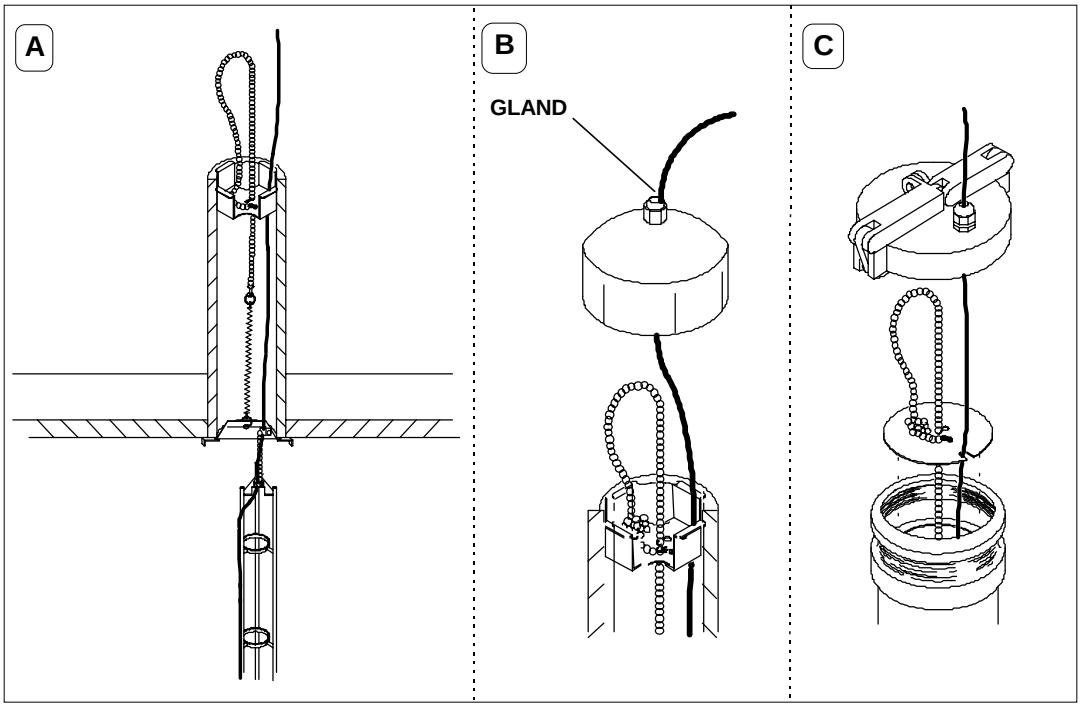


Figure 3.7 A, B, and C: Compression Fitting Used for Existing Riser Cap

Step 6: Pull on the chain until the spring has extended 3in to 4in(7.6-10.1cm) or 9 to 13 chain links to create tension, as shown in figure 3.7A. Slide the chain in the slot provided in the upper riser bracket. Allow the remaining chain length dangle into the riser.

Step 7: Once installed, pull upward on the inventory sensor cable so as to ***feel*** that the sensor moves up and down freely. Be sure the sensor is hanging from the chain and not from the cable.

Step 8: Thread the inventory sensor cable through the compression fitting in the cap and tighten the gland around the cable. Refer to figures 3.7 B and C.

Notice **The feedthrough assembly attached to the inventory sensor cable should be used, unless an existing compression fitting is available that is able to seal properly around the cable.**

When installing the riser cap, be sure not to affect the inventory sensor cable by twisting or lifting. The sensor MUST hang by the chain and NOT the cable.

Installing Feedthrough Assembly in Existing Riser Cap

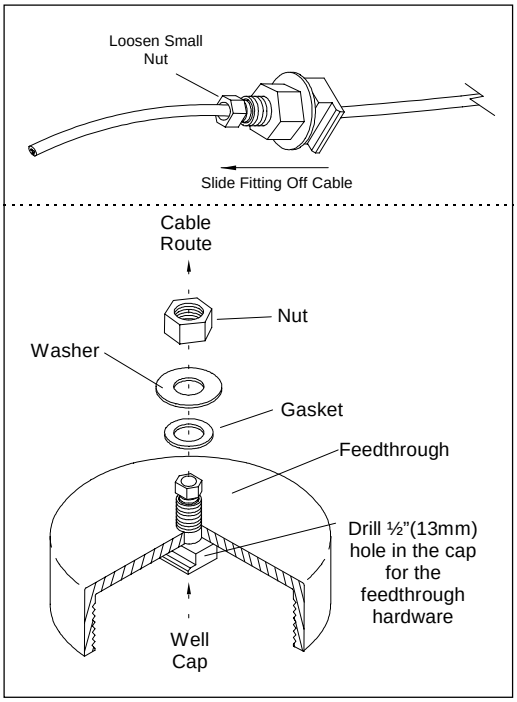


Figure 3.8 A & B Removing and Installing Feedthrough Assembly in Existing Riser Cap

Inventory Sensor Wiring Connections

Once the inventory sensor is installed in the tank, wiring connections are required at two points:

- **Wiring the inventory sensor to the interconnect cable.**
- **Wiring the interconnect cable to the ST Controller.**

Wiring the Inventory Sensor to the Interconnect Cable

A waterproof connector housing is supplied with each inventory sensor for connecting to the interconnect cable. The connector board provides a secure, low impedance connection while the housing protects the wires from corrosion. The following steps describe the installation of the connector board and housing. Refer to *figure 3.9* when performing steps 1 through 10.

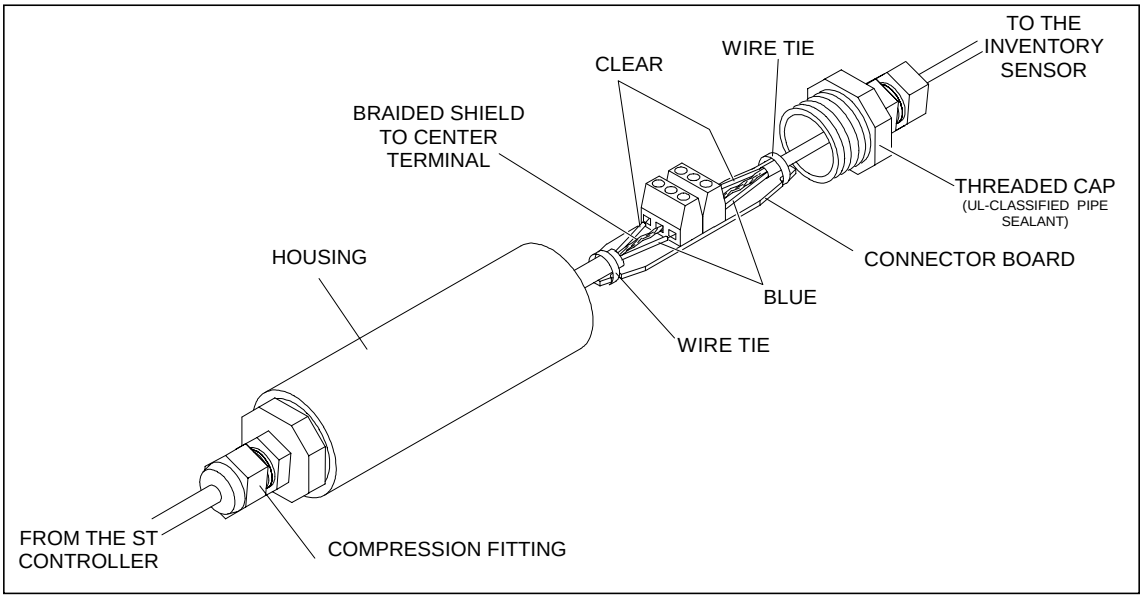


Figure 3.9 Connector Board and Housing

Step 1: Remove the threaded end cap (not the compression fitting) from the housing.

Step 2: Feed the cables through the compression fittings in each threaded cap. Pull enough cable through one threaded cap to accommodate sliding the housing over it.

Step 3: Strip the outer jacket of both the interconnect and inventory sensor cables ¾ in(2cm).

Step 4: Pull back the braided shielding, on both cables, and twist to form a third conductor.

Step 5: Strip the insulation on the remaining conductors 1/8 in(3mm).

Step 6: Connect the braided shielding to the center terminals of both connectors. Connect the remaining conductors to the connectors (Blue with Blue, Clear with Clear).

Step 7: With the wire ties provided, strap each cable securely to the connector board. This will provide strain relief for the connections.

Step 8: Pull the connector board into the housing and place the desiccant pouches (8 inside) with it.

Step 9: Apply UL-Classified pipe sealant to the threads of the threaded cap and screw it into the housing.

Step 10: Tighten the compression fittings around the cables to ensure moisture does not enter the connector housing. Firm hand pressure is enough to seal. ***DO NOT*** overtighten.

Wiring the Interconnect Cable to the ST Controller

Refer to *figure 3.10* when performing steps 1 through 6.

Step 1: Strip back the outer jacket 4in(10cm).

Step 2: Insert the cable through the aluminum grounding bar and tighten the screw down on the shield of the cable.

Step 3: Cut away the shield of the cable between the grounding bar and the green screw terminals.

Step 4: Strip back the outer jacket of both conductors ¼ in(6.5mm).

Step 5: Insert the conductors into the screw terminals and tighten the screw down on the conductors. Polarity of the conductor wires does not matter.

Step 6: Connect Tank 1 to Terminal 1, as pictured in figure 3.10. Continue connecting the tanks to the appropriate terminals. Terminals 5 though 8 are available on the ST1800 controller.

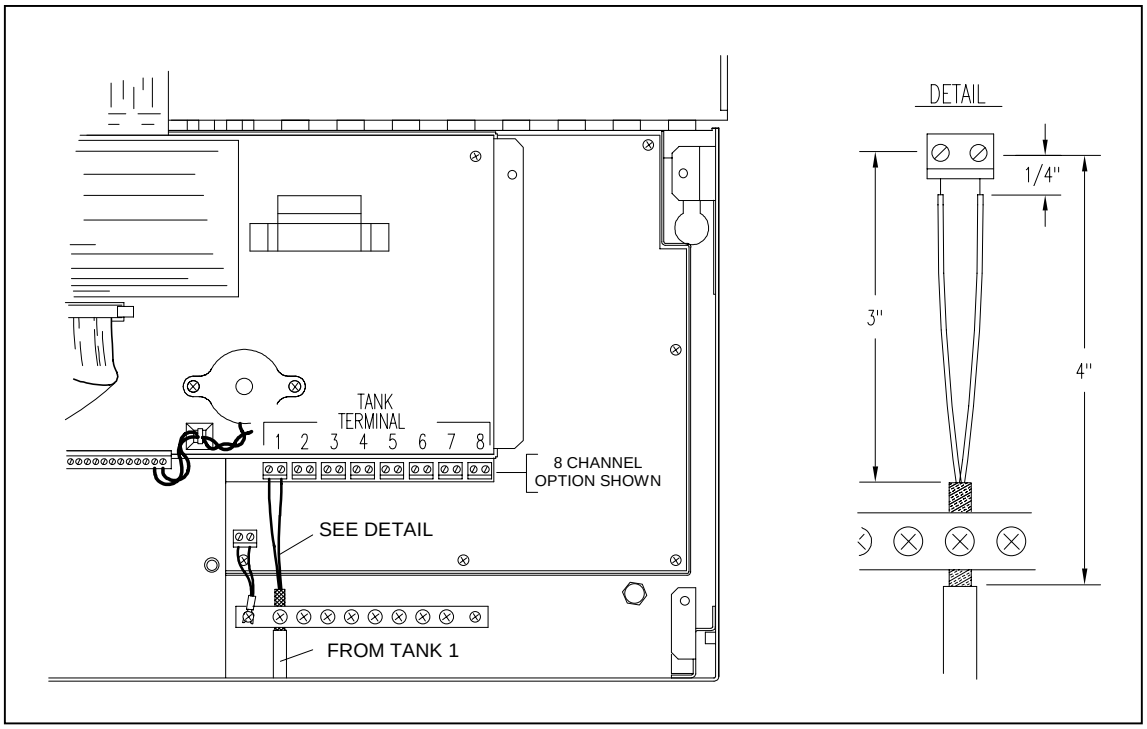


Figure 3.10 Wiring Interconnect Cable to the ST Controller

Warning! **Replace the intrinsic safety cover before applying power to system.**

Installing an Inventory Sensor in a Delivery Riser

There are a few things to be considered when installing a probe into a delivery riser using an offset hanger. The existing delivery riser, the drop tube, fill pipe, containment sump and probe cable need preparation. If sawcuts are being used, the riser and possibly the containment sump will require openings for the cable to be passed through.

Notice **When a containment sump is used, consult the containment sump manufacturer for proper installation procedures.**

Installation Considerations

When reviewing the installation considerations, refer to *figure 3.11.*

The inside diameter of the riser must be greater than 4 in(10cm) for ease of installing and un-installing.

The riser pipe length must be greater than 18 in(45cm) and less than 48 in(120cm). If the riser pipe does not fall between these dimensions, contact Red Jacket for special instructions.

The riser pipe cannot extend more than 1½ in(3.8cm) inside the tank.

The distance from the center of the riser pipe to the end of the tank must be greater than 9 in(23cm).

A minimum of 20 in(50cm) must be left between the center of the fill riser and the next tank fitting in the direction toward the center of the tank.

A distance of 48 in(120cm) between the center of the fill riser and the pump is recommended.

Preparing the Tank

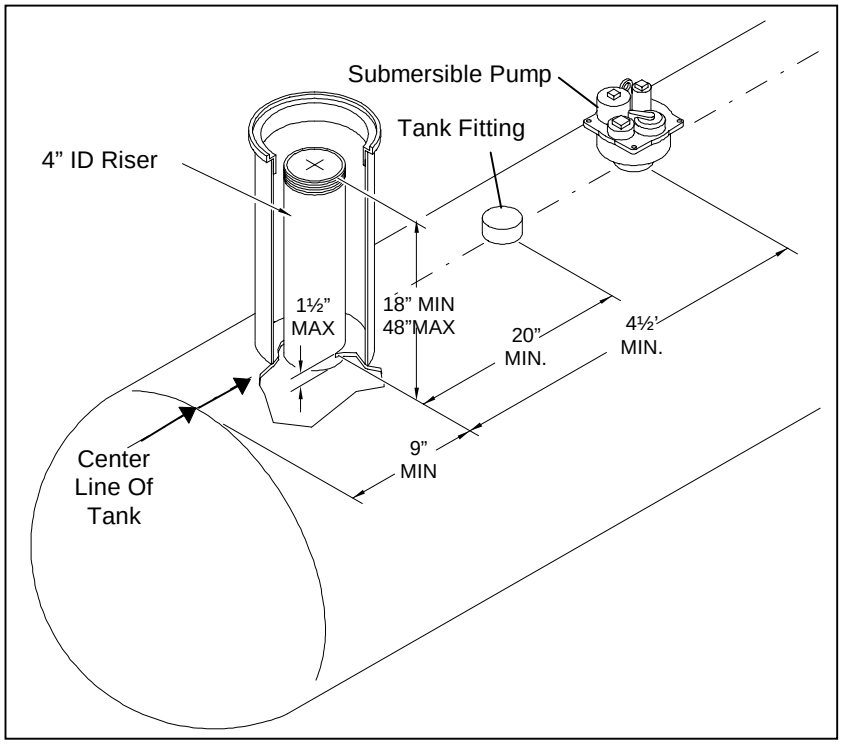


Figure 3.11 Top View of Tank

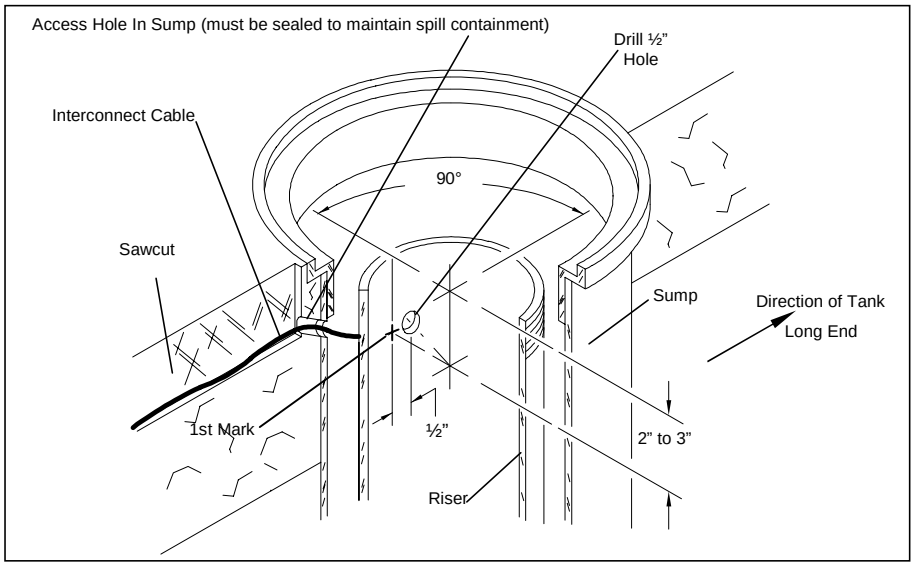


Figure 3.12 Modifications to the Riser

Step 1: If preparing an installation using a sawcut, enter as low as possible in the sump to ensure the manway lid does not crush the cable. This can be accomplished most easily by stopping the sawcut just short of the sump collar. Drill a ¼ in(6.3mm) to $^3/_8$ in(9.5mm) hole, at a downward angle, through the sump wall.

Notice **If the riser pipe has a spill containment sump, a seal must be made around the interconnect cable at the point where it passes through the wall.**

Step 2: Find the point on the riser that is at a right angle, (90 degrees), to the long direction of the tank. From this point, make a mark 3-4 in(7.5-10cm) down from the top of the riser. ***DO NOT DRILL HERE***. Refer to *figure 3.12* when performing this step.

Step 3: Measure ½ in(13mm), from the mark made in step 2, in the direction toward the center of the tank, and place another mark. At this point, drill a ½ in(13mm) hole. This hole location will ensure the inventory sensor will be positioned at the center line of the tank.

Step 4: Remove feedthrough assembly from inventory sensor cable and install it into riser with the lip in facing upward. Refer to *figure 3.13*.

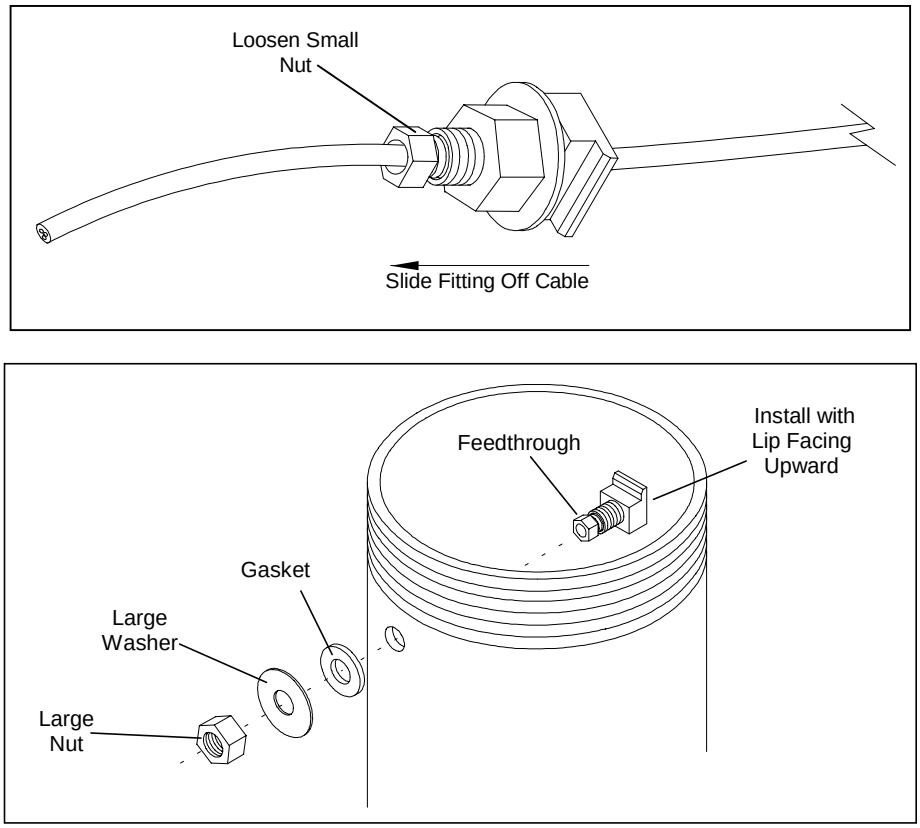


Figure 3.13 Removal and Installation of Feedthrough Assembly

Sizing Instructions for Inventory Sensors Using an Offset Hanger

Measurements must be accurately performed before inserting the probe into the fill pipe.

Warning! **It is important to take the accurate measurements to be sure the inventory sensor *DOES NOT REST ON THE BOTTOM OF THE TANK!***

The inventory sensor should be installed high enough off the bottom that only the water float touches the tank's bottom. The inventory sensor must be free to move so it remains perpendicular to the surface of the liquid in the tank.

Step 1: Using the tank stick to measure the distance from the bottom of the tank to the top edge of the feedthrough assembly, measurement (**A**). This is shown in *figure 3.14.*

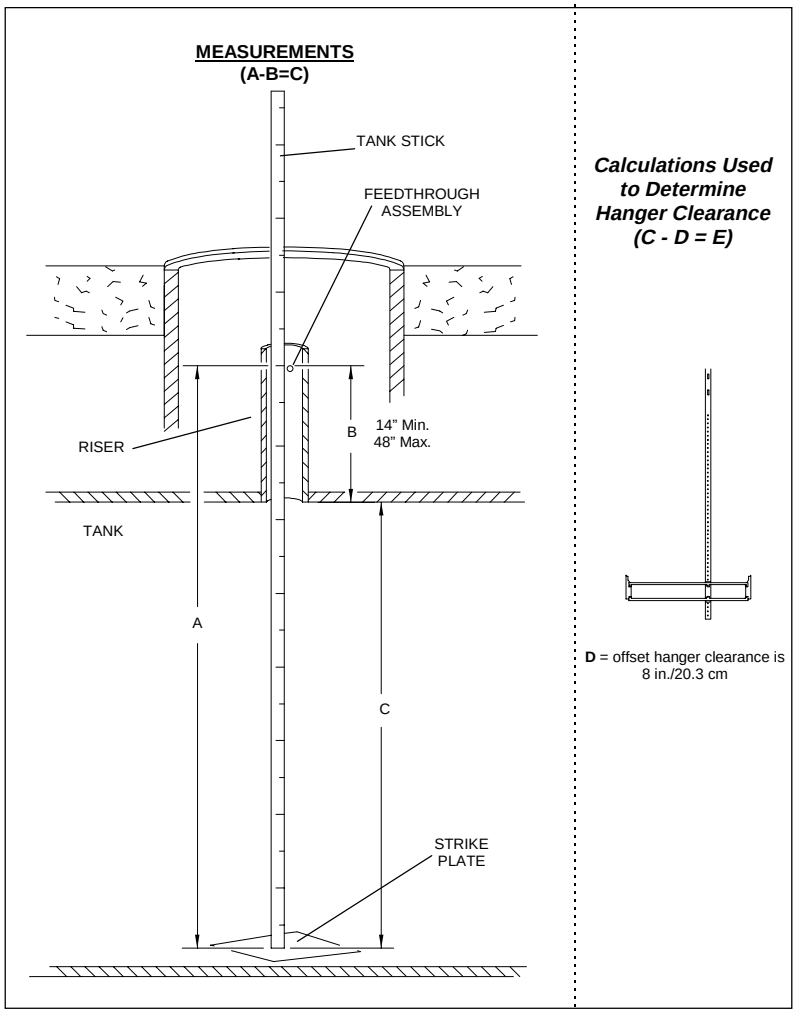


Figure 3.14 Measurements for Mounting Inventory Sensor in Tank

Step 2: Using a rigid measuring tape, measure the length of the riser from the bottom, inside edge to the top edge of the feedthrough assembly, measurement (**B**). Refer to figure 3.14.

Notice **The riser length required for this installation is a minimum of 14-in. and a maximum of 48-in. If the riser is longer than 48-in., contact Red Jacket sales for a special chain length.**

Step 3: ***Subtract*** measurement (**B**) from measurement (**A**) to calculate the actual inside diameter of the tank measurement (**C**), (***A-B=C***). This is demonstrated in figure 3.14.

Step 4: Subtract measurement (**B**) from measurement (**A**) to calculate the actual inside diameter of the tank, measurement (**C**). Refer to figure 3.14.

Step 5: If using the offset hanger, subtract 8 in./20.3 cm (**D**) from (**C**), (**C - D = E**). If using the straight hanger refer the section titled ***Installation of Inventory Sensor in Dedicated Riser*** earlier in this chapter.

Step 6: Round calculation (**E**) down to the nearest length and refer the section, ***Part Numbers for Inventory Sensors*** in ***Chapter 1*** of this manual.

Caution ***DO NOT*** **over-tighten the screw that attaches the lower riser bracket to the end plate or hanger channel. Overtightening the pivot points *will* cause the hanger to buckle and the sensor may be irretrievable.**

Sizing the Offset Hanger

Step 1: Add 2-in. to the (**B**) measurement (see *figure 3.15*) and use this distance to relocate the crossarm. Remove crossarm and relocate it with the top mounting hole at this measurement. If the measurement falls between two holes select the higher position.

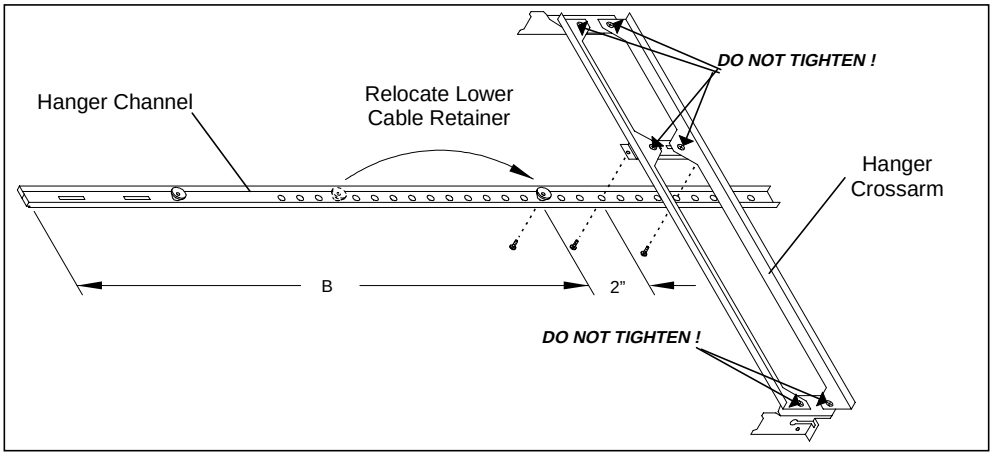


Figure 3.15 Relocation of Hanger Crossarm

Step 2: Relocate lower cable retainer to measurement (**B**).

Step 3: It may be helpful to install the hanger (without the probe) as a trial installation to verify all measurements are correct. Attach the probe installation tool to the rectangular slots in the hanger channel and tighten it by rotating the tool's upper knob, clockwise. Fold crossarm as indicated in *figure 3.16*.

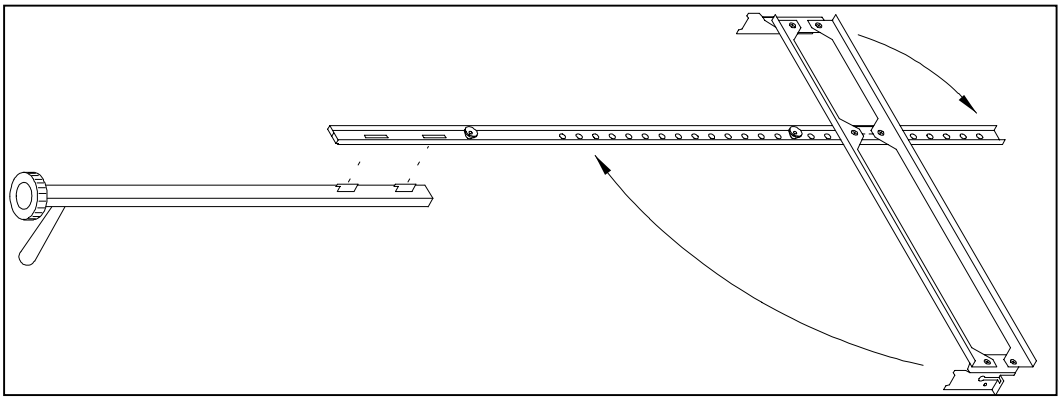


Figure 3.16 Installation Tool Connection to Offset Hanger

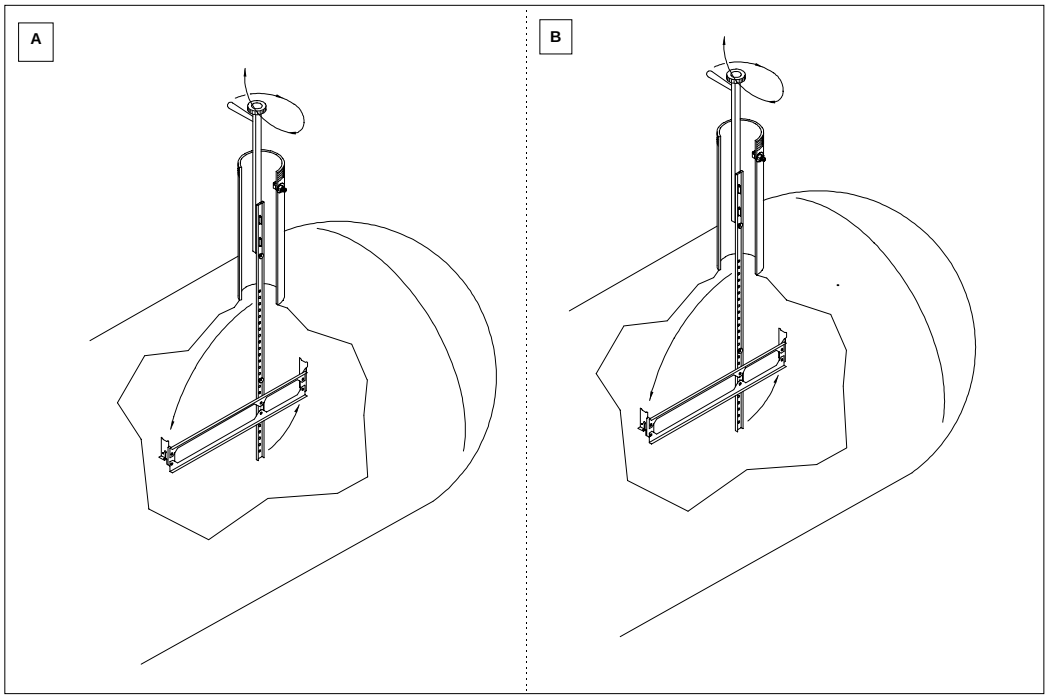


Figure 3.17 A and B Lowering the Offset Hanger into Tank

Step 4: Lower the folded hanger into the fill pipe until the crossarm is below the top of the tank as depicted in *figure 3.17A* A **quick** twisting motion will force the crossarm outward. ***Quickly*** pull up so the short end of the crossarm is caught by the top of the tank as shown in *figure 3.17B*. If the crossarm folds back up, remove hanger and refold crossarm as indicated in *figure 3.17B*. Repeat step 4.

Caution **DO NOT apply excessive force when pulling up on the installation tool. This will cause the offset hanger to bend out of shape and the damage will be *irreparable*. If the hanger does not hook on the feedthrough with relative ease, the crossarm may be mounted too high in the channel and must be lowered. If damage occurs, call the Red Jacket representative before continuing. Proceed with Step 5.**

Step 5: Once the hanger is deployed, pull up on the installation tool until the spring mechanism compresses to about $^{2}/_{3}$ of its travel. Hook the channel over the lip on the feedthrough. If the hanger rests loosely on the feedthrough lip; the crossarm may be too low on the channel and must be raised by one hole.

Step 6: Apply lateral force to the hanger by pulling on the installation tool. If crossarm appears to be tight against the top of the tank, and the hanger is firmly hooked on the feedthrough assembly, then the hanger is adjusted properly (see *figure 3.18*).

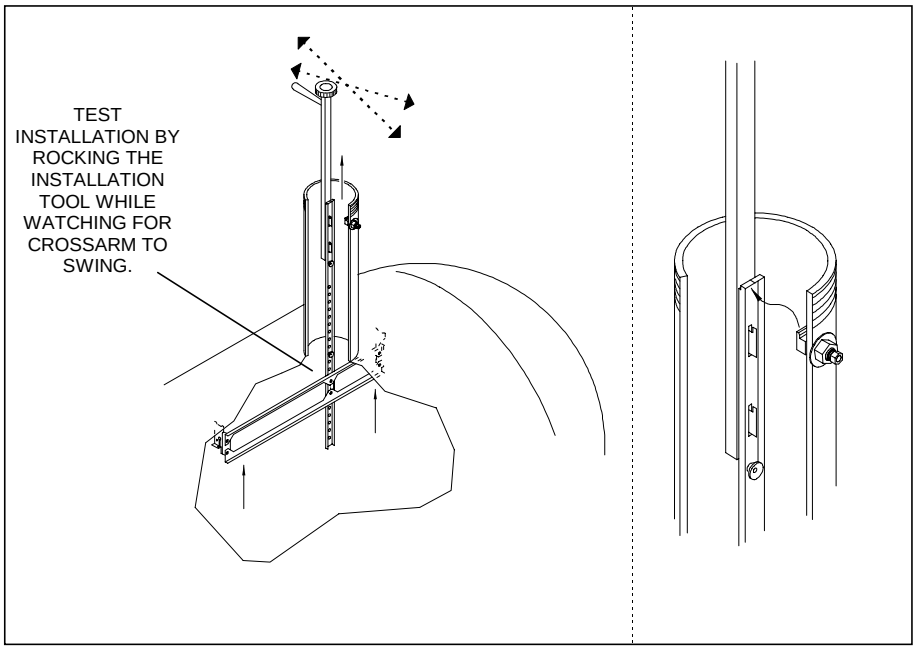


Figure 3.18 Deploying Offset Hanger

Step 7: Remove the hanger by unhooking the channel from the feedthrough and lower it so the crossarm folds. Remove the hanger from the delivery riser. Refer to *figure 3.19.*

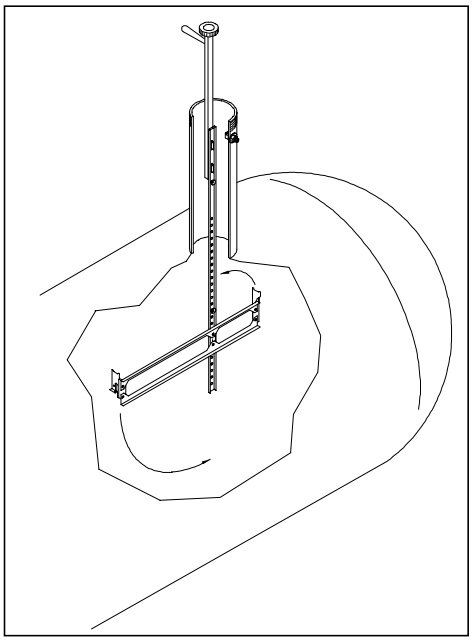


Figure 3.19 Offset Hanger Removal

Preparing the Inventory Sensor for Installation in Delivery Riser

Caution **Improper alignment of the water float assembly will cause incorrect readings. The water float guide should be aligned parallel with the vertical rods of the sensor. this can be accomplished by *eyeing* the alignment and bending by hand. If the water float tilts inward too much (0.5-in. or 13-mm) the ultrasonic reflection from the water float bracket will degrade sensor performance.**

Step 1: Lay the inventory sensor on level ground and install the water float (see *figure 3.20*).

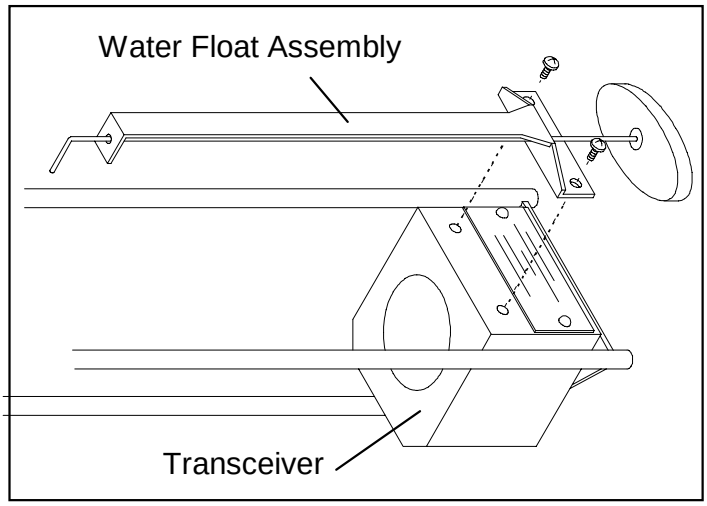


Figure 3.20 Water Float Installation for Use in a Delivery Riser

Notice **Use the specific gravity of the product when determining if the diesel clip should be installed on the water float. If a clip is required refer to *figure 3.21*.**

Specific Gravity of Product	Number of Clips
Gasoline - 0.69 to 0.78	0
Kerosene/Diesel - 0.78 to 0.87	1

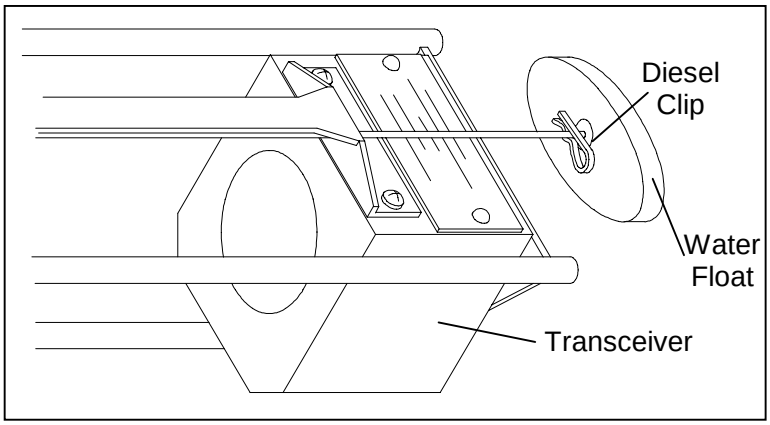


Figure 3.21 Diesel Clip Attachment for Use in Delivery Riser

Installation of Inventory Sensor

Step 1: Loosen, then swing the cable/chain retainer from the slot, at the crossarm end plate as shown in *figure 3.22.*

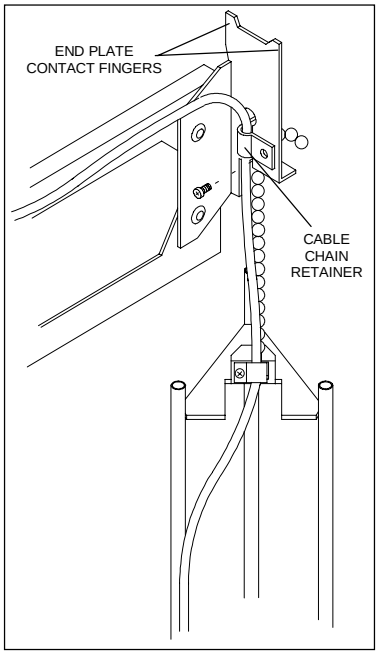


Figure 3.22 Removing the Cable/Chain Retainer

Step 2: To configure the correct overall length, lay a tank stick on level ground next to the inventory sensor and offset hanger.

Step 3: Attach the chain to the endplate so the bottom of the transceiver block is at the 2 - in. mark on the stick and the endplate contact fingers are at the (**C**) measurement. (see *figure 3.22*).

Notice **The top of the sensor can be no closer than 1-in. from the lowest point of the crossarm. Refer to *figure 3.23*.**

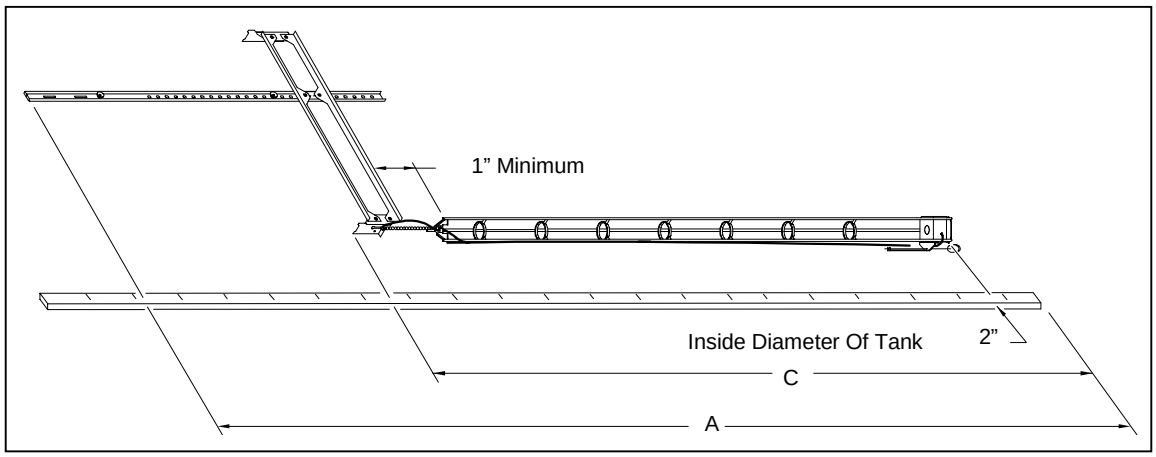


Figure 3.23 Measuring for Offset Hanger Installation

Notice **For inventory sensors greater than 8 feet, perform the following sub-steps prior to deployment.**

a) Count the number of chain links between the top of the inventory sensor and the endplate. Detach the sensor from the endplate.

b) Insert the inventory sensor into the tank. Use a wooden dowel to temporarily support the sensor by passing it through the sensor below the top plate. ***DO NOT*** support the sensor on any of its rings.

c) Reattach the sensor to the endplate of the offset hanger leaving the same number of links between the sensor and the hanger determined in step 3.

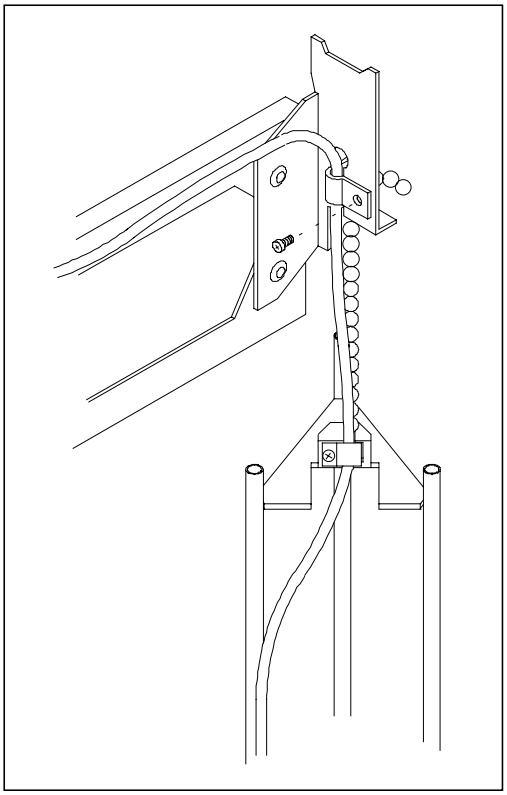


Figure 3.24 Attaching the Cable and Chain to the End Plate

Notice ***DO NOT*** **overtighten the cable/chain retainer. The cable must be able to slide easily.**

Step 4: Route the cable through the cable/chain retainer. Turn the retainer's screw until the retainer can no longer back out of the channel.

Notice ***DO NOT*** **weave the cable through the hanger crossarms. The *scissor* action during installation and un-installation will cut the cable. Leave enough slack in the cable to allow the hanger to close up for installation.**

Step 5: Route the sensor cable through the hanger channel behind the cable retaining clips as shown in *figure 3.24*.

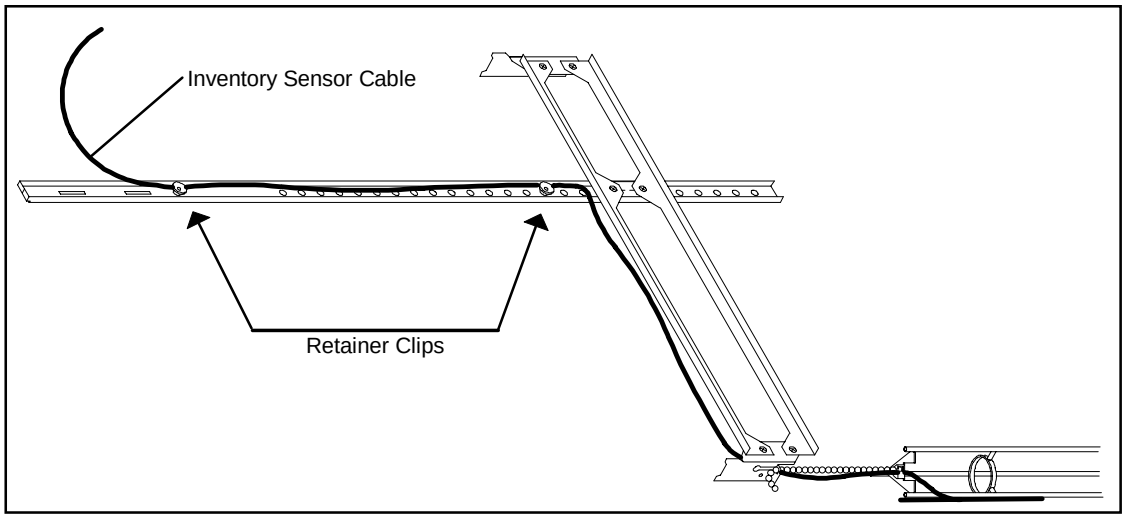


Figure 3.25 Inventory Sensor Cable Routing with Offset Hanger

Step 6: Attach and lock the inventory sensor installation tool onto the hanger channel and fold crossarm. Refer to *figure 3.25*.

Notice **Be careful not to bend the water float when lowering it into the riser.**

Sensor Deployment

Notice **Avoid pulling excessively on the sensor cable during sensor installation because the sensor cable may pull out of the retainer clips making it impossible to keep the cable inside the hanger channel.**

Step 1: Fold up the long end of the hanger against the channel as shown in *figure 3.26*. Lower hanger and sensor carefully into riser until the assembly unfolds.

Step 2: While resting the installation tool on the riser, route the sensor cable through the feedthrough assembly mounted in the riser.

Step 3: Pull up on the installation tool until the crossarm contacts the tank. As the sensor is being raised, cable slack must be pulled from the feedthrough assembly.

Step 4: Once the crossarm makes contact, further upward motion compresses the spring in the crossarm. After the crossarm makes contact with the tank, pull up on the installation tool until the hanger channel can be lowered onto the feedthrough assembly. Since the crossarm is spring loaded, this step will be a quick “up and over” operation, and should have a “snug” feel.

Step 5: Check the installation by making sure the sensor cable stayed inside the hanger channel and by applying lateral force as in *figure 3.18*.

Step 6: Tighten the large outer feedthrough nut and the inner cable compression fitting to seal off the tank. See *figure 3.26*.

Caution **Make sure that the all feedthrough hardware is tight. Loose hardware will result in an incomplete seal allowing water to enter the tank and/or produce a failing result of the vapor recovery nitrogen test.**

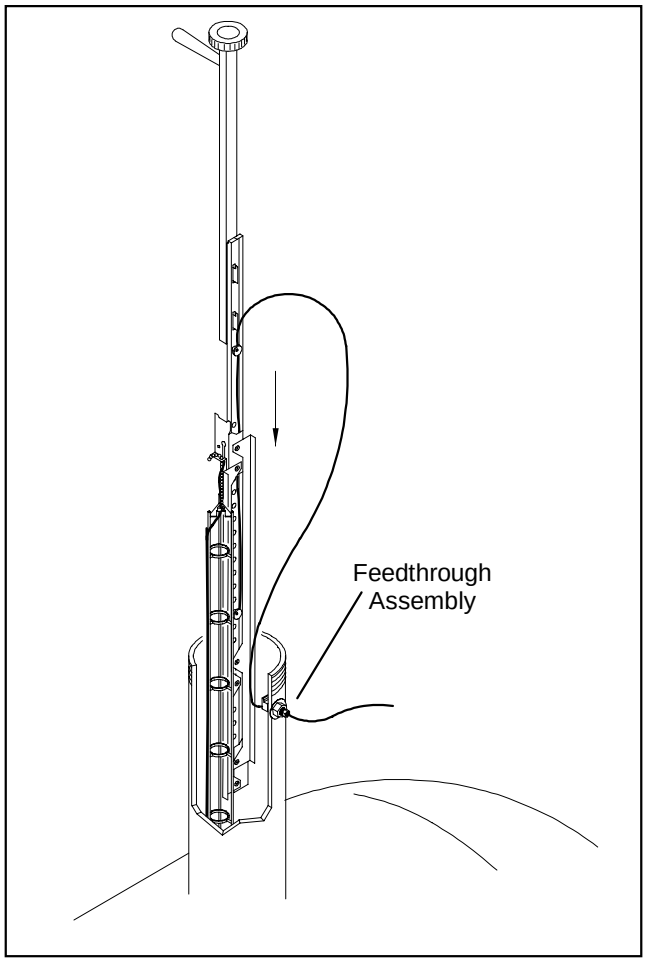


Figure 3.26 Inserting Hanger with Sensor and Routing into Riser

Modification and Installation of the Drop Tube

Step 1: The drop tube may have to be shortened to fit into the tank. Refer to *figure 3.27* for corresponding ***(measurement A***) and cut the tube to that length.

Step 2: The drop tube must be cut at an angle to enhance proper operation of the inventory sensor. Measure 2-in. and remove material. Refer to *figure 3.27*.

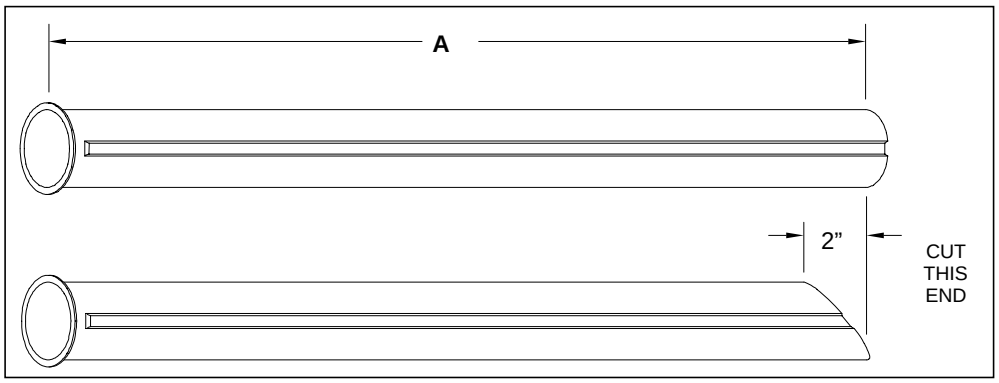


Figure 3.27 Sizing Drop Tube

Step 3: Align the groove in the drop tube with the channel of the offset hanger. Insert the drop tube until it is seated on the lip of the riser, as shown in *figure 3.28.*

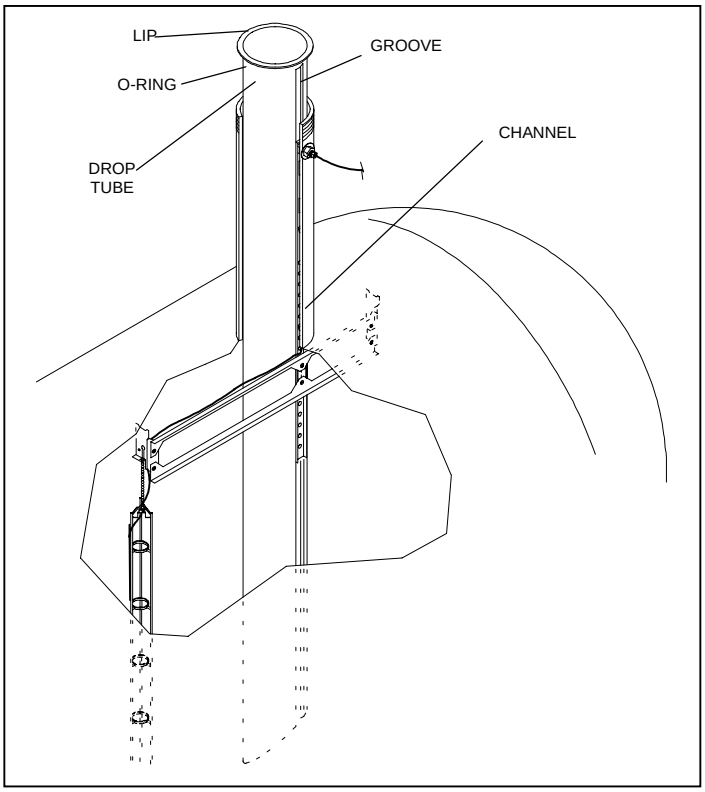


Figure 3.28 Aligning the Drop Tube

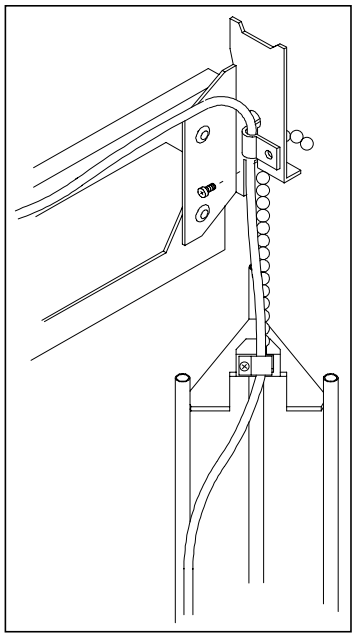


Figure 3.29 Attaching the Chain to the Offset Hanger

Notice ***DO NOT* weave the cable through the hanger crossarms. The "scissor" action during installation and un-installation will cut the cable. Leave enough slack in the cable to allow the hanger to close up for installation.**

Step 4: Route the sensor cable through the hanger channel behind the cable retaining clips as shown in *figure 3.30*.

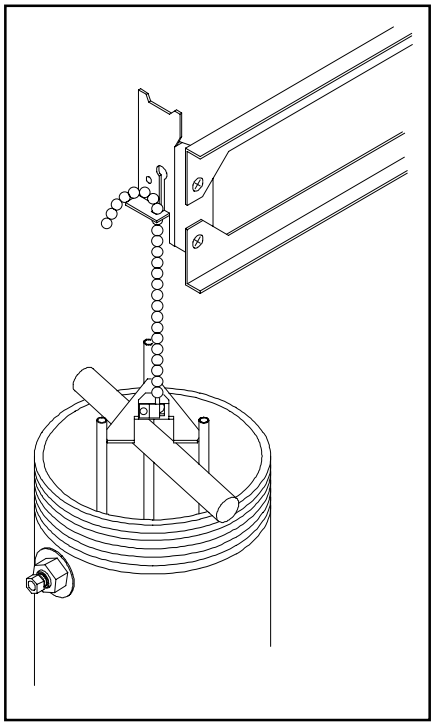


Figure 3.30 Inventory Sensor Cable Routing with Offset Hanger

Step 5: Attach and lock the inventory sensor installation tool onto the hanger channel.

Step 6: Route the sensor cable through the hanger channel(behind the cable retaining clips. This is demonstrated in *figure 3.30*.

Un-installing the Inventory Sensor from a Delivery Riser

Step 1: Loosen the feedthrough nut and remove the drop tube.

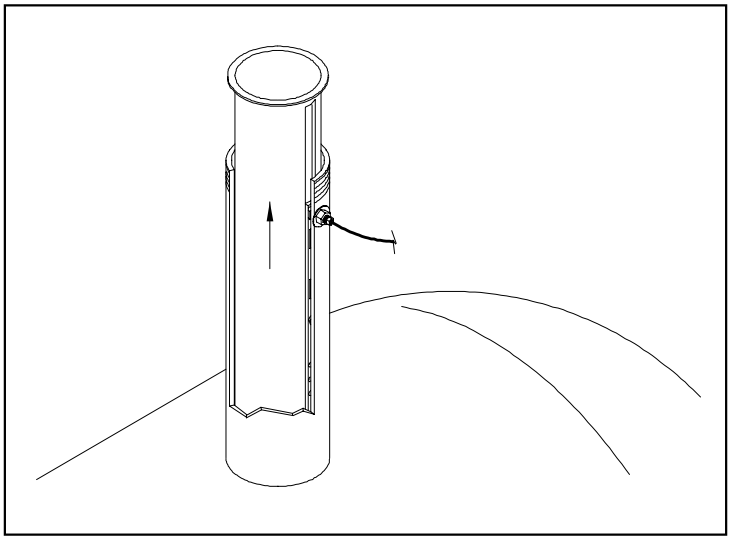


Figure 3.31 Feedthrough Nut Location

Step 2: Attach the probe installation tool to the rectangular slots in the hanger channel and tighten it by rotating the tool's upper knob clockwise. Lift up on the installation tool removing the channel from the feedthrough nut. Lower the sensor allowing the hanger to fall away from the top of the tank.

Step 3: Pull gently on the sensor cable to release it from the retainer clips. After the crossarm has folded up carefully remove the sensor and hanger from the tank.

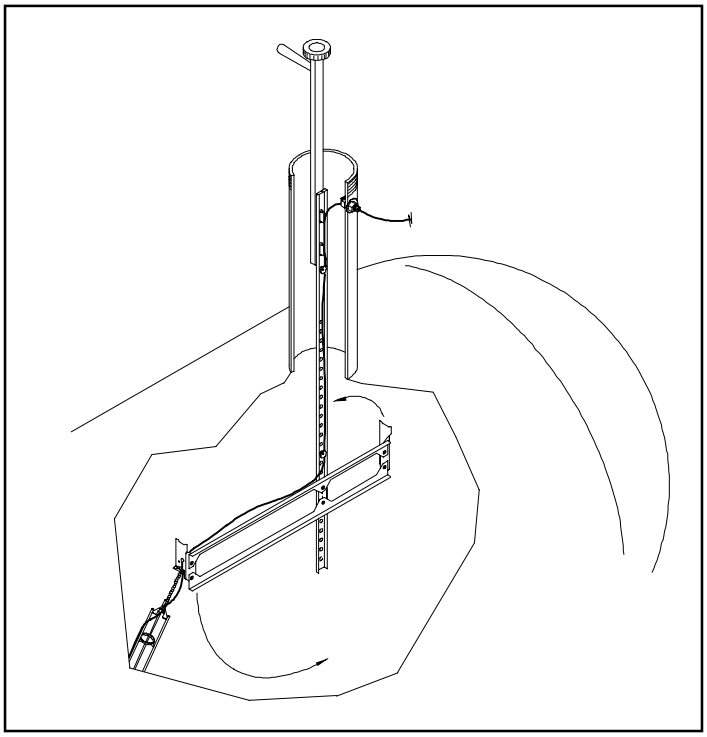


Figure 3.32 Removing the Hanger From the Tank

Caution **DO NOT use the inventory sensor cable to pull the sensor from the tank. This could result in a damaged cable.**

When un-installing the inventory sensor, use caution to avoid bumping the water float against the riser with excessive force. If this happens, the water float will be damaged or broken.

Chapter 4: Accessories

This chapter explains:

- **Optional External Printer**
- **External Alarm Box(ST1401, ST1801, ST1401L, ST1801L)**
- **ST Controller Communications**

Optional External Printer

The internal printer installed in the ST Controller is a Seiko Thermal model. For external printing, a serial printer that meets the following criteria will operate successfully with the ST Controller.

- A minimum of 40 columns
- Serial interface (serial to parallel converters are available)
- Baud rate 300, 1200, 9600
- Xon/Xoff software handshaking
- 8 bits, one stop, no parity
- Linefeed = carriage return and linefeed
- Carriage return = carriage return

Warning! **DO NOT connect the printer cable to the ST Controller or external printer when the optional printer's power switch is in the ON position.**

Check with Red Jacket customer service at 1-800-952-8348(in the United States) for recommended printer options. Follow the printer manufacturers' guide for installation details.

External Alarm Box(ST1401, ST1801, ST1401L, ST1801L)

An optional remote audible alarm provides an alternative to the internal, audible alarm located on the ST Controller's front panel. The internal alarm usually cannot be heard by the fuel delivery driver in the event of an overfill. A remote alarm solves this problem by providing an additional audible alarm near the UST fill area. The alarm duration is programmable from 1 to 99 seconds or it can be silenced by pressing the E key. The ST1401 and ST1801, including the (L) models, have the capability to directly drive external alarms with solid state relays rated at 100/250 VAC drawing less than 200 milliamperes, utilizing the SIB (Sensor Interface Board). To use an external audible alarm with the ST1400 and ST1800 contact a Red Jacket representative for instructions. For installation instructions and wiring diagram, refer to Appendix A: Installation Instruction Sheets at the end of this manual.

ST Controller Communications

The ST Controller communications options allow flexibility for installations that require remote data access, alarm condition report, and retrieval of reports. Pathway provides this using either direct connect (RS232) or a modem to connect to a personal computer. As an example, if multiple facilities are operated from a central location, Pathway can provide automated scheduling and reporting for a variety of functions associated with the ST Controller. Contact your Red Jacket distributor for additional information.

Chapter 5: Peripheral Sensors

This chapter explains:

- **Sensor Connection Introduction**
  - Vapor Sensor Terminal Connections
  - Containment Sump Sensor Terminal Connections
  - Liquid Refraction Sensor Terminal Connections
  - Optical Liquid Discrimination Sensor Terminal Connections
  - Hydrostatic Sensor Terminal Connections
  - High/Low Sensor (2-in. and 4-in.) Terminal Connections
  - High Level Sensor (2-in. and 4-in.) Terminal Connections
  - Groundwater Monitor Terminal Connections
  - Dispenser Pan Sensor Terminal Connections
- **Line Pressure Kit Installation**
  - Pressure Regulating Kit Installation Instructions
  - Replacing the Check Valve
  - Accumulator Installation
  - Pressure Transducer Installation
  - Functional Element Adjustment
  - Pump Control Connection

Sensor Connection Introduction

Notice **It is strongly recommended that the introduction section be read *before* the installation of any peripheral sensor.**

The following chapter gives instructions for making terminal connections for peripheral sensors to the ST Controller 1401/1801. The “01” is a reference to the Sensor Interface Board (SIB). Installation instructions for any of the peripheral sensors described in this chapter may be found in this manual and are included in each sensor's packaging. If the installation instruction sheet is not available, contact Red Jacket customer service at 1-888-262-7539(in the USA) to order one.

The SIB is divided into three banks of eight channels. The first two banks of channels (CH1 to CH 8 and CH9 to CH16) can accept all peripheral sensors except the line pressure transducer. The last bank of eight channels (CH17 to CH24) can accept all peripheral sensors including line pressure transducers. Each group of channels has a corresponding DIP switch bank:

CH1 To CH8	DIP Switch bank 2 (SW2)
CH9 to CH16	DIP Switch bank 3 (SW3)
CH17 to CH24	DIP Switch bank 1 and 4 (SW1 and SW4)

Each DIP switch bank has eight switches in it and each switch corresponds, in order, to the channels in its bank (for example, SW3, switch 1 affects CH9). DIP switch banks SW2, SW3, and SW4 produce a “pull up voltage” on the (CH) terminals (+5VDC) for certain sensors. DIP switch bank SW1 controls the individual +5VDC terminals on CH17 through CH24 to be active continuously for sensors that require full time power such as the line pressure transducer. All other +5VDC terminals are active just prior to the moment the SIB reads the sensor. This prevents a meter reading of +5VDC on those terminals.

Channel number (CH) and sensor number ***MAY NOT*** necessarily correspond. Check the SIB programming to determine which physical channel number the ST Controller expects to find the sensor (refer to the ***Programming Tree***). *Figure 5.1* illustrates the channel bank shown in each of the wiring diagrams throughout this chapter. Notice that the channel numbers alternate left and right, along the channel bank.

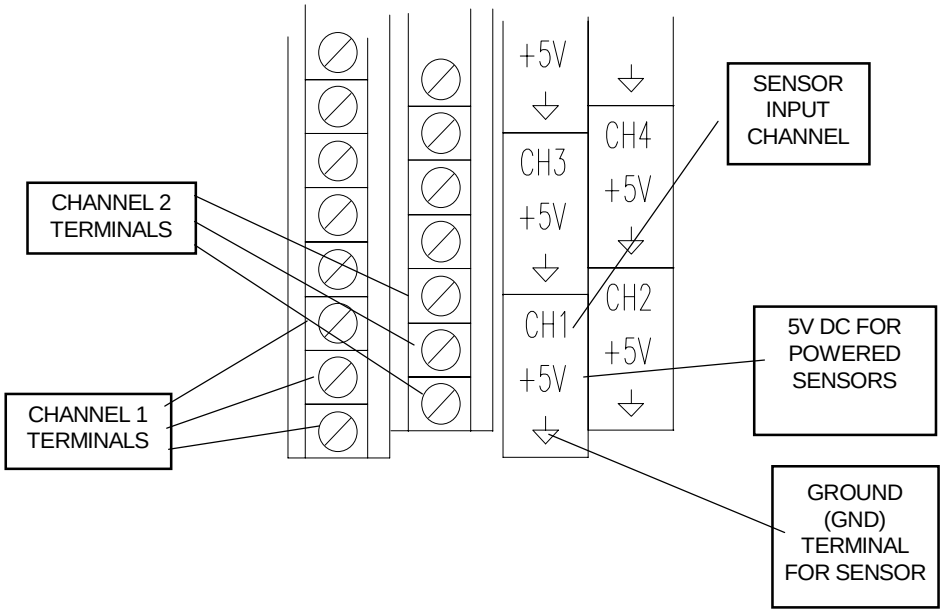


Figure 5.1 Channel Bank

Notice Proper DIP switch setting must be established. Set switch that corresponds to the channel being used to the specified position.(OPEN or CLOSED)

Use the waterproof connectors provided with the sensor to make the wiring connections at the junction box. Maximum distance between the ST Controller and the peripheral sensors is 2000 feet.

The following symbols will be used throughout this chapter:

(CH) Channel

Earth ground.

Ω Resistance (ohms).

(GND) Chassis ground

Terminology:

In the following sensor installation procedures the term **CH#** is used when describing which **SIB** terminal to connect sensor wires to. This refers to the channel number which has been selected for a particular sensor. When installing sensors, refer to Chapter 10, Programming Level 3, #2: Sensor

Location to determine which channels are available for each type of sensor and also to program the ST Controller **SIB** for the sensor type and channel location being installed.

Notice **All sensors can be connected to the ST Controller by one of two methods. The connecting cable can be run either in conduit from the ST Controller to a junction box at the sensor, or direct bury certified cable can be run in a sawcut to the sensor and the connection made using a Red Jacket connector board and housing.**

Vapor Conductivity Sensor Terminal Connections

The Vapor Conductivity sensor is a three-wire sensor used to detect the presence of hydrocarbon vapor in a well. It is designed to fit in all well casings two inches in diameter or larger. Refer to *figure 5.2* for terminal connections.

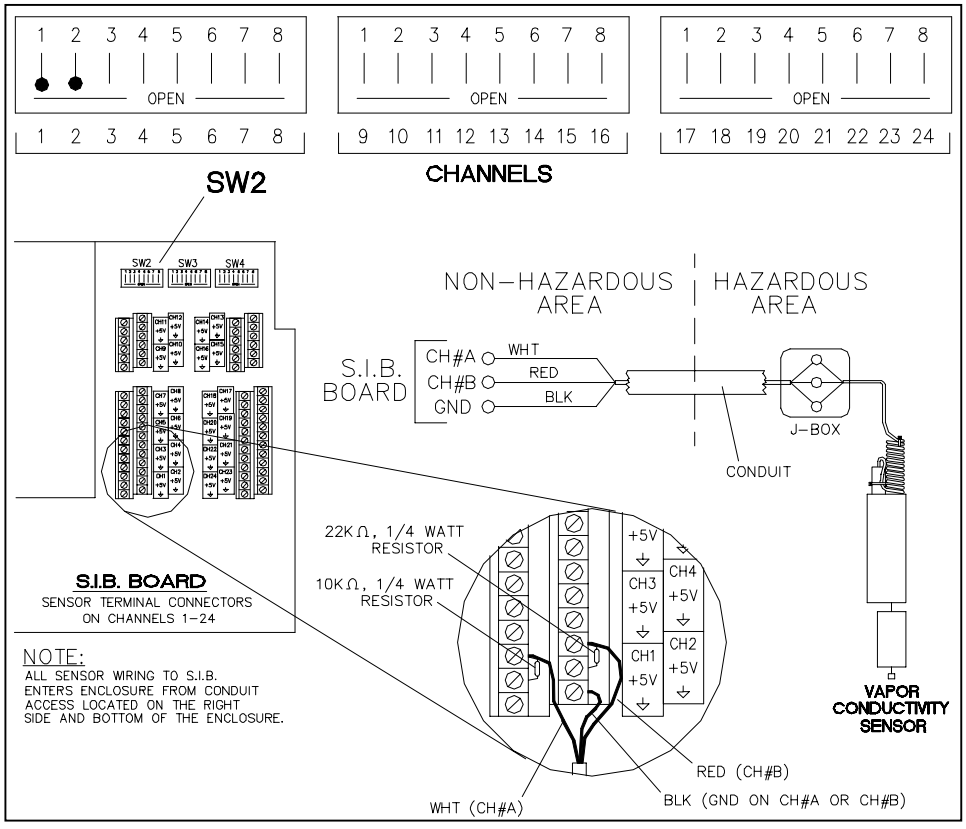


Figure 5.2 Vapor Conductivity Sensor Terminal Connection Diagram

Notice **Included with all Vapor Conductivity sensors are a 22K Ohm and a 10K Ohm resistor. These are used when connecting sensor conductors to the SIB channel terminals during sensor installation.**

Step 1: Run an 18-gauge, gas-, oil-, and water-resistant, three-conductor cable from each vapor sensor to the ST Controller.

Step 2: Attach the white wire (water) to the first CH# terminal. Connect the 10K ohm resistor between the CH# terminal and the +5V terminal.

Step 3: Connect the red (vapor) wire to the next consecutive CH# terminal. Connect the 22K ohm resistor between the CH# terminal and the +5V terminal.

Step 4: Connect the black wire to either CH# GND terminal.

Step 5: The DIP switches for the corresponding channels must be OPEN.

Figure 5.2 is an example of switch settings on ***SW2*** when CH1 is being used. CH1 and CH2 are shown open.

Containment Sump Sensor Terminal Connections

The containment sump sensor is a two wire sensor that monitors a containment sump for the presence of any liquid. It triggers an alarm that requires the owner / operator to inspect the area for product or water. This sensor is a magnetically operated reed switch that creates a mechanical switch closure when an alarm occurs. Refer to *figure 5.3* for terminal connections.

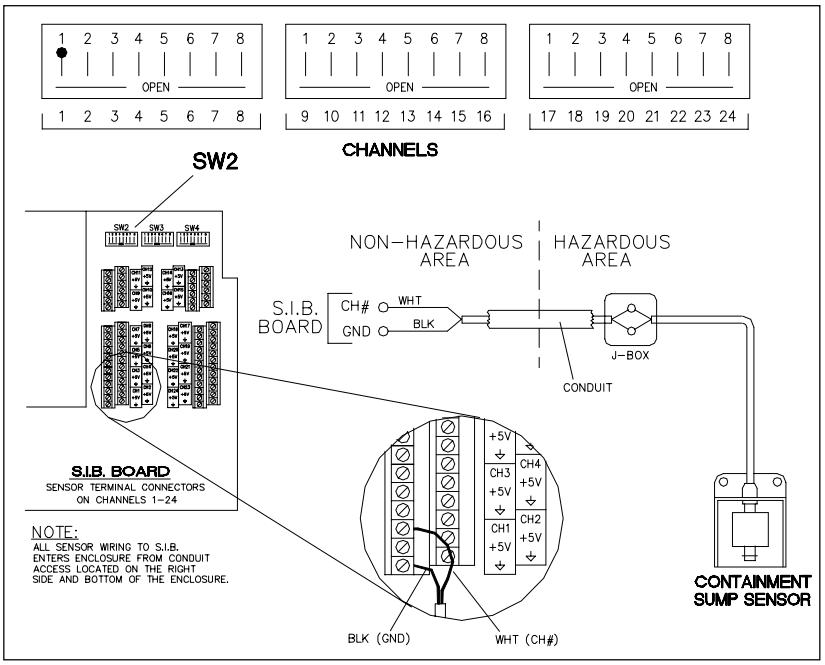


Figure 5.3 Containment Sump Sensor Terminal Connections

Step 1: Mount the sensor in the containment sump area at the level where activation is required.

Step 2: Run an 18-gauge, gas, oil, and water resistant two conductor cable for each sump sensor.

Step 3: Connect the white wire to the CH# terminal.

Step 4: Connect the black wire to the GND terminal.

Step 5: The DIP switch corresponding to the CH# must be set CLOSED.

Figure 5.3 is an example of switch settings on ***SW2*** when CH1 is being used. CH1 is shown closed.

Liquid Refraction Sensor Terminal Connections

The Liquid Refraction Sensor (LRS) is a 3 wire sensor is used to monitor for the presence of a liquid in the interstitial space of double wall tanks and piping sumps. This sensor is a solid state device and uses light refraction technology to detect liquid and trigger an alarm. Refer to *figure 5.4* for terminal connections.

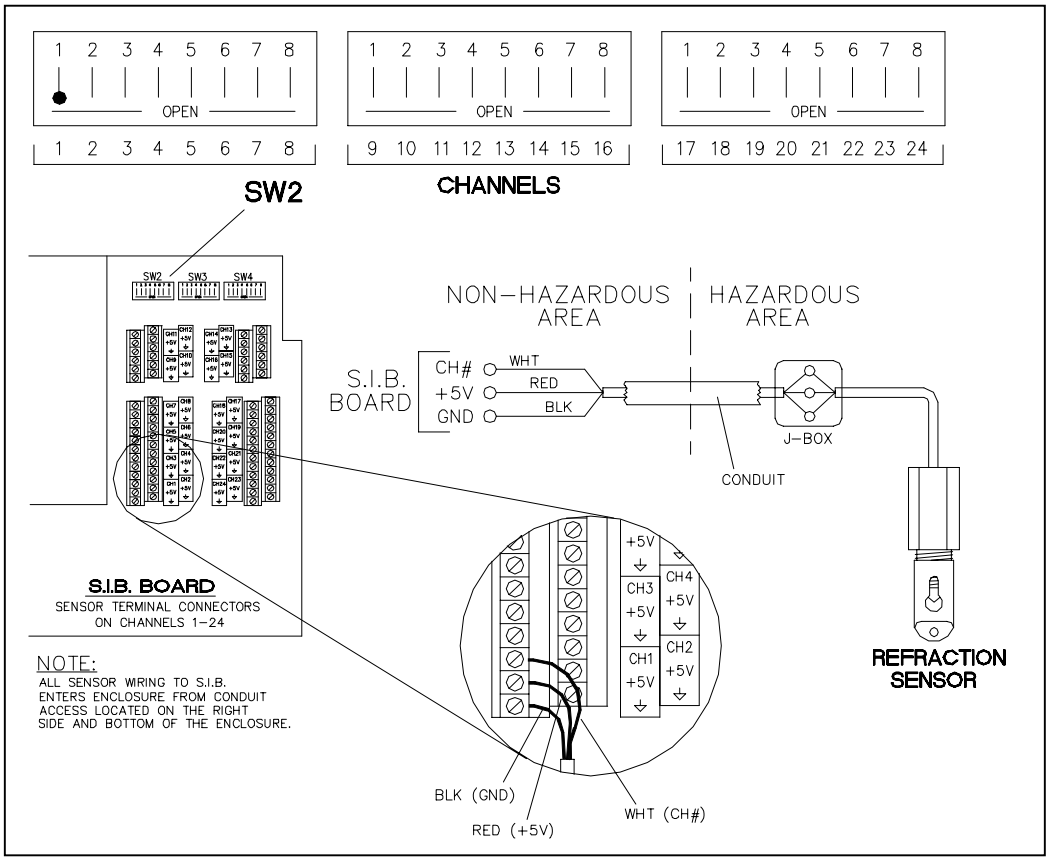


Figure 5.4 Liquid Refraction Sensor Terminal Connections

Step 1: Run an 18-gauge, gas, oil, and water resistant three conductor cable from each Liquid Refraction Sensor.

Step 2: Connect the red wire to the +5V terminal.

Step 3: Connect the white wire to the CH# terminal.

Step 4: Connect the black wire to the GND terminal.

Step 5: The DIP switch for the corresponding CH# must be set OPEN.

Figure 5.4 is an example of switch settings on ***SW2*** when CH1 is being used. CH1 is shown open.

Optical Liquid Discrimination Sensor Installation

The Optical Liquid Discrimination Sensor (OLDS) is a four wire sensor used to monitor for the presence of any liquid in the dry interstitial space of double wall tanks and piping sumps. This sensor uses light refraction technology and conductivity testing to discriminate between product, water, or vapor in the dry interstitial space of the tank. The following steps explain how to install the sensor properly. Refer to *figure 5.5* for terminal connections.

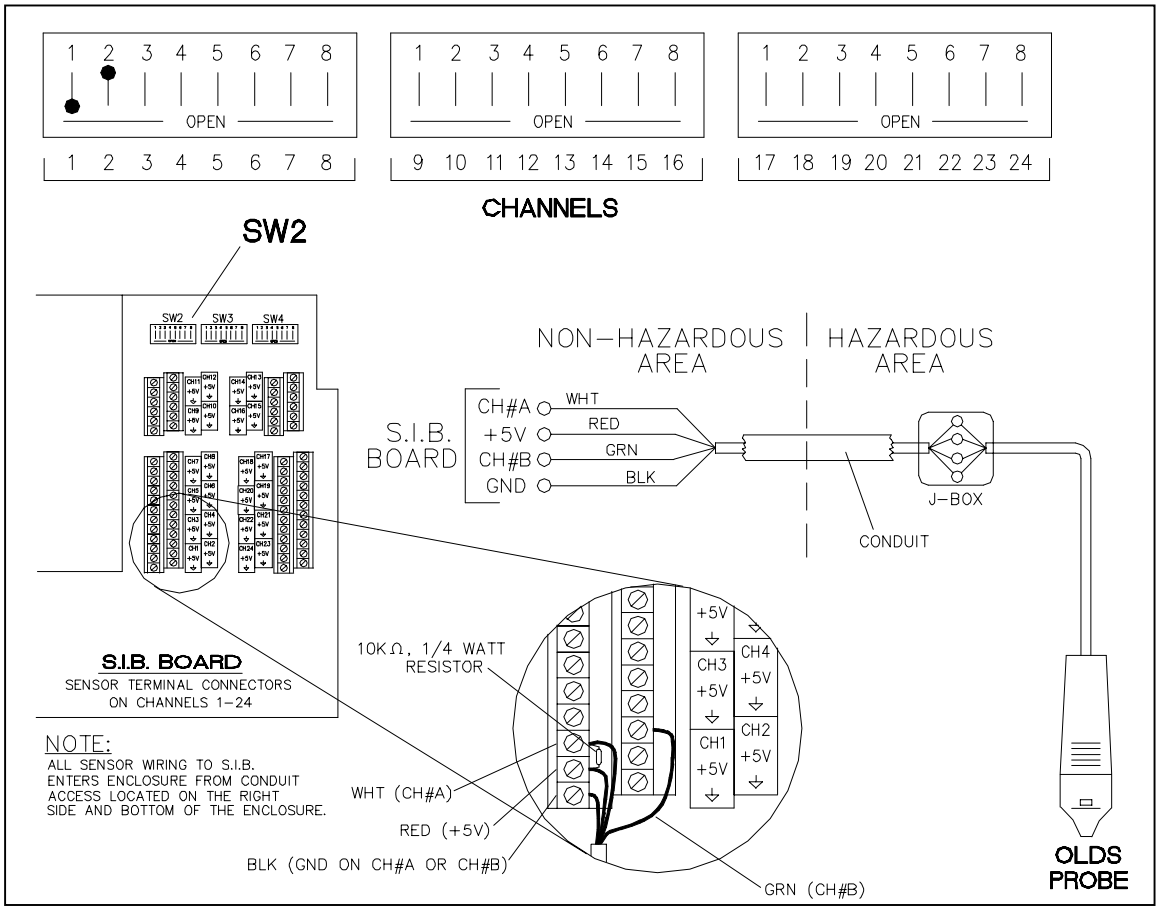


Figure 5.5 Optical Liquid Discrimination Sensor Wiring Diagram

Notice **A 10K Ohm resistor is included with each OLDS sensor**

Step 1: Run an 18-gauge, gas oil and water resistant four conductor cable from each OLDS sensor.

Step 2: Connect the white wire to the CH# terminal. Connect the 10K Ohm resistor between the same CH# terminal and the +5V terminal. The DIP switch corresponding to that CH# should be OPEN.

Step 3: Connect the green (product) wire to the next consecutive CH# terminal. The DIP switch corresponding to that CH# should be CLOSED.

Step 4: Connect the black wire to the GND terminal of either channel.

Step 5: Connect the red wire to the +5V terminal of the channel that the white wire is connected to.

Figure 5.5 is an example of switch settings on ***SW2*** when CH1 and CH2 are being used. CH1 is shown open and CH2 is shown closed.

Hydrostatic Sensor Installation

The Hydrostatic sensor is used for Xerxes or Owens Corning double wall tanks that are filled with brine solution. This sensor monitors for change in level in the interstitial space of the tank. This is a two wire sensor that assumes the bottom float is always floated up to create a normally open condition and the top float is normally in the down position to create a normally open condition. The two floats are wired in parallel so that if either float changes state, an alarm will be triggered. Refer to *figure 5.6* for terminal connections.

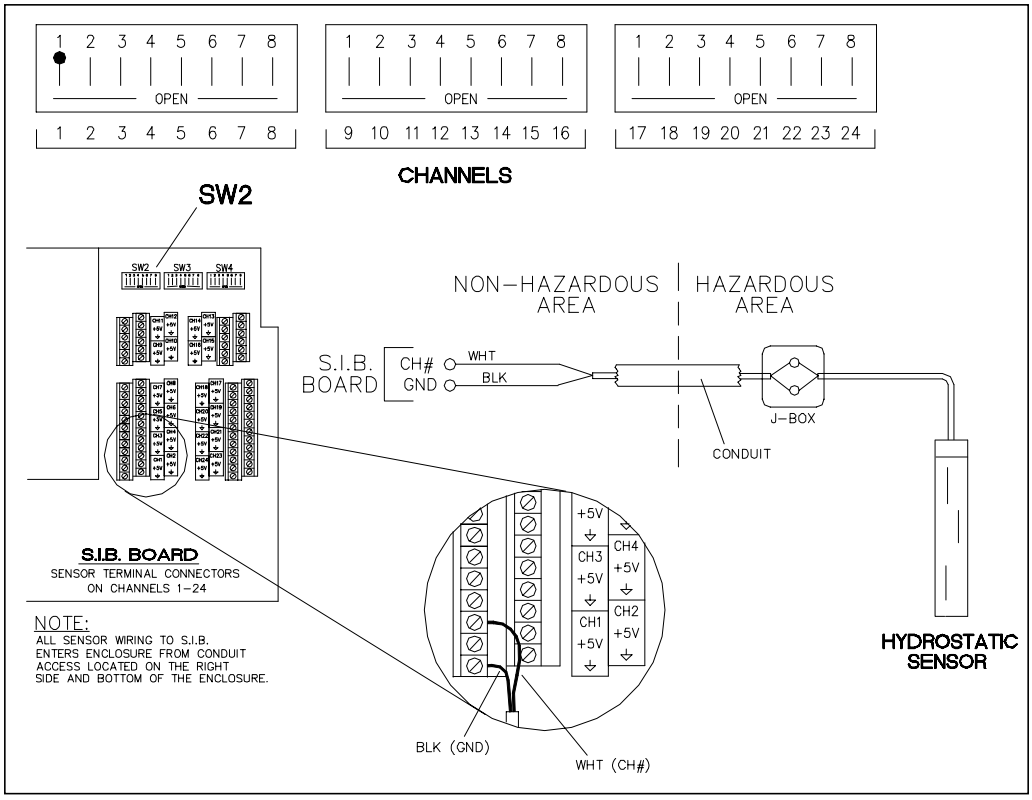


Figure 5.6 Hydrostatic Sensor Wiring Diagram

Step 1: Install the 4-in riser pipe into the tank reservoir. Refer to *figure 5.7*.

Step 2: Feed the sensor cable through the compression fitting in the well cap from the bottom.

Step 3: Slide the sensor into the riser and thread on the well cap.

Notice **Adjustment to the position of the hydrostatic sensor may need to be made at the time of delivery.**

Step 4: Raise or lower the sensor, using the signal cable, until the reservoir fluid level is positioned between the two floats of the sensor. Tighten the nut on the compression fitting around the signal wire.

Notice **Pipe thread sealant is recommended on the threads of the riser pipe for easier removal in the future.**

Step 5: Run an 18-gauge, gas, oil and water resistant two conductor cable or two individual wires in conduit from the ST Controller to a junction box in the manway. Connect the two conductors in the sensor cable to the two conductors from the ST Controller in the junction box. Polarity is not an issue.

Step 6: On the ST Controller, connect one conductor to the CH# terminal and the other conductor to the GND terminal on the same channel. The DIP switch corresponding to this channel must be CLOSED.

Figure 5.6 is an example of switch settings on ***SW2*** when CH1 is being used. CH1 is shown closed.

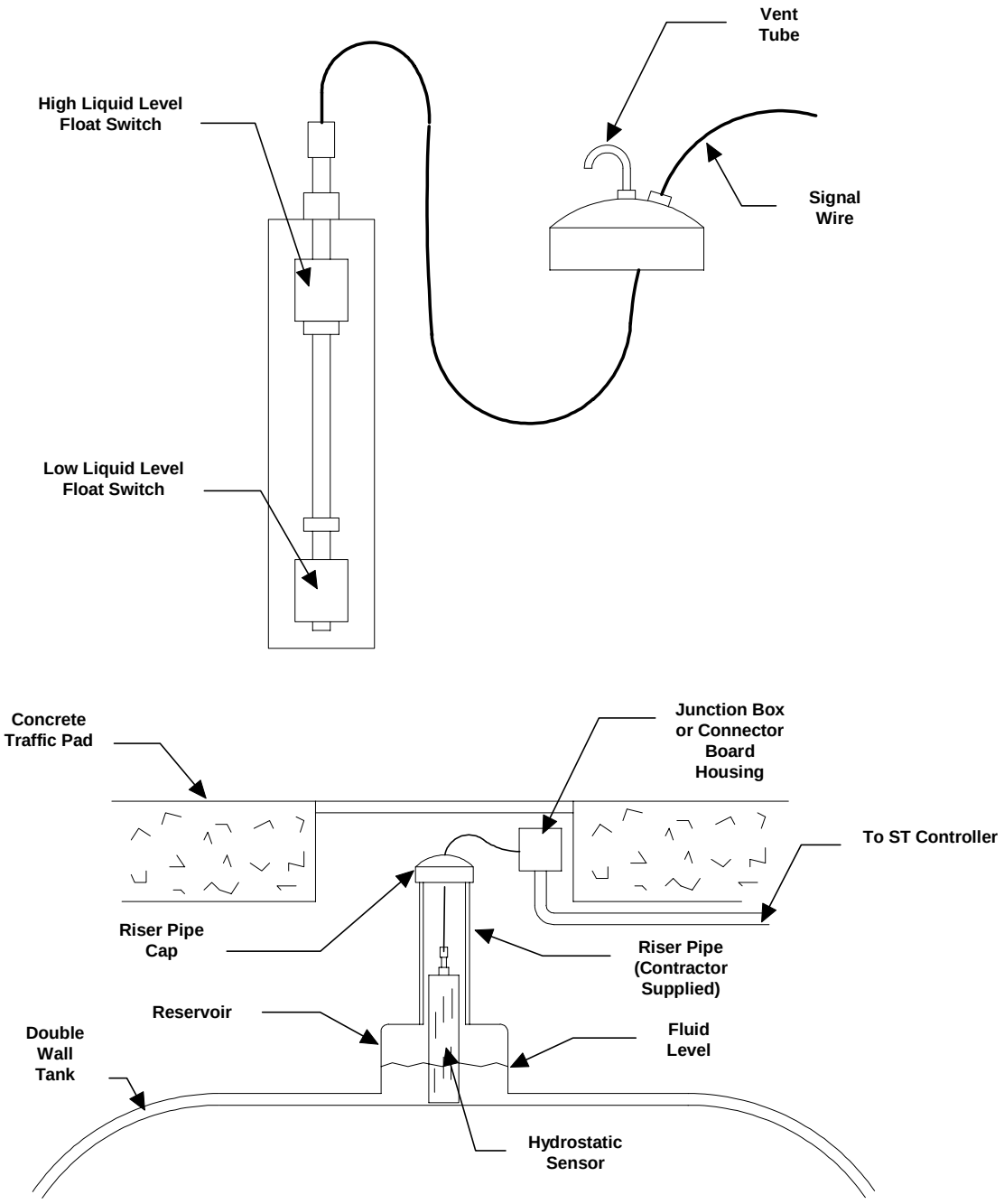


Figure 5.7 Hydrostatic Sensor Installation

High/Low Sensor (2-in. and 4-in.) Installation

The High/Low Sensor is a three wire sensor used for detecting product overfill and low level conditions. The sensor is a normally closed circuit that opens when the magnetic reed floats move up or down past predetermined levels, triggering an alarm. The distance between the overfill float and the low level float is fixed based on tank size. The trip point for the overfill float is designed to operate at 90% of tank capacity while the low level float is set at 10% capacity. Refer to figure 5.7 for terminal connections.

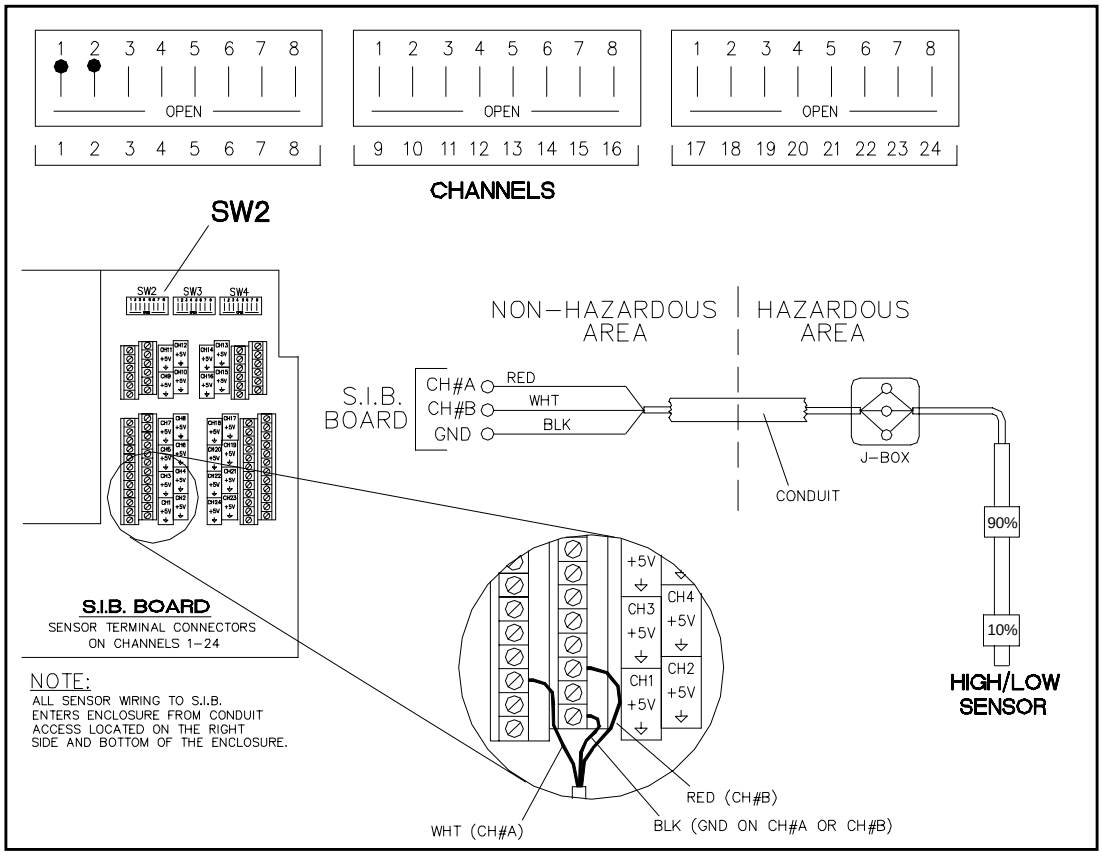


Figure 5.7 High/Low Sensor (2-in. and 4-in.) Wiring Diagram

Step 1: Determine the height above the tank's bottom that corresponds with 10% of the tank's capacity.

Step 2: With the well cap in place, lower the sensor shaft until it rests on the bottom of the tank. Raise the sensor shaft up the number of inches determined in Step 1.

Step 3: Secure the sensor with the well cap lock nut.

Step 4: **Carefully** remove excess sensor tubing with a tubing cutter. Do not adjust the tubing cutter to cut any deeper than absolutely necessary to avoid cutting the sensor cable within the sensor tubing. Slide the sensor wire through the enclosed sensor wire connector with the flexible fitting. Lock the brass fitting into place at the top of the sensor shaft and tighten the plastic lock nut on the flexible fitting.

Step 5: Connect the sensor wires to the interconnect cable in a connector housing or J-box.

Step 6: Connect the white wire to the CH# terminal.

Step 7: Connect the red wire to the next consecutive CH# terminal.

Step 8: Connect the black wire to the GND terminal on either channel.

Step 9: The DIP switches corresponding to the selected channels must be CLOSED.

Figure 5.7 is an example of switch settings on ***SW2*** when CH1 and CH2 are being used. CH1 and CH2 are shown closed.

Notice **Sufficient ullage should be maintained in the tank to allow for the delivery hose to disconnect.**

High Level Sensor (2-in. and 4-in.) Installation

The High level sensor is a two wire sensor used for detecting overfill. The sensor is a normally closed circuit that opens when the magnetic reed float moves up past a predetermined level, triggering an alarm. Refer to *figure 5.8* for terminal connections.

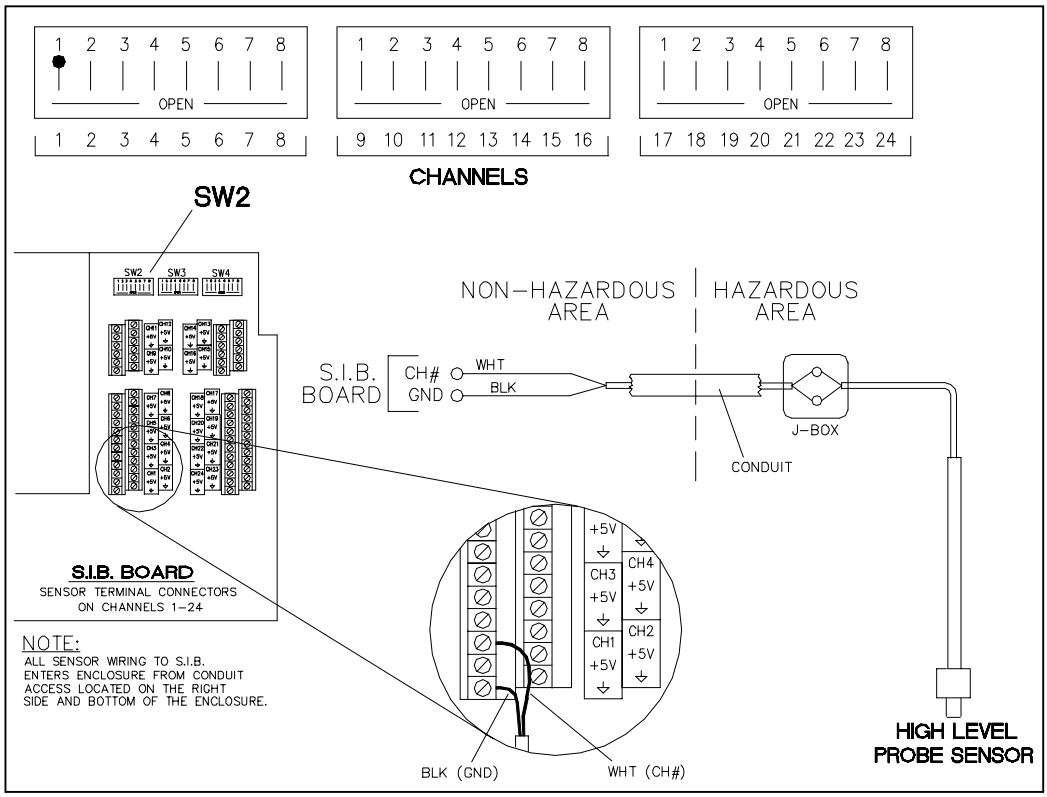


Figure 5.8 High Level Sensor (2-in. and 4-in.) Wiring Diagram

Step 1: Determine the height above the tank bottom that corresponds with 90% of the tank's capacity or the percentage of tank capacity desired for the high level and overfill alarm.

Step 2: With the well cap in place, lower the sensor into the tank and adjust the position of the float by sliding the shaft of the sensor through the compression fitting until the desired alarm level is reached.

Step 3: Secure the sensor with the well cap lock nut.

Step 4: **Carefully** remove excess sensor tubing with a tubing cutter. Do not adjust the tubing cutter to cut any deeper than absolutely necessary to avoid cutting the

sensor cable within the sensor tubing. Slide the sensor wire through the enclosed sensor wire connector with the flexible fitting. Lock the brass fitting into place at the top of the sensor shaft and tighten the plastic lock nut on the flexible fitting.

Step 5: Run an 18-gauge, gas, oil and water resistant 2 conductor cable from each high level sensor.

Step 6: Connect the white wire to the CH# terminal.

Step 7: Connect the black wire to the GND terminal on the selected channel.

Step 8: The DIP switch corresponding to the selected channel must be set CLOSED.

Figure 5.8 is an example of switch settings on ***SW2*** when CH1 is being used. CH1 is shown closed.

Groundwater Sensor Connection

The Ground Water Sensor is a four wire sensor which detects if any product is present in the ground water surrounding the tank. The sensor can be programmed as a shut down device when product is detected outside the tank. The following steps explain how to install the sensor properly. Refer to *figure 5.9* for terminal connections.

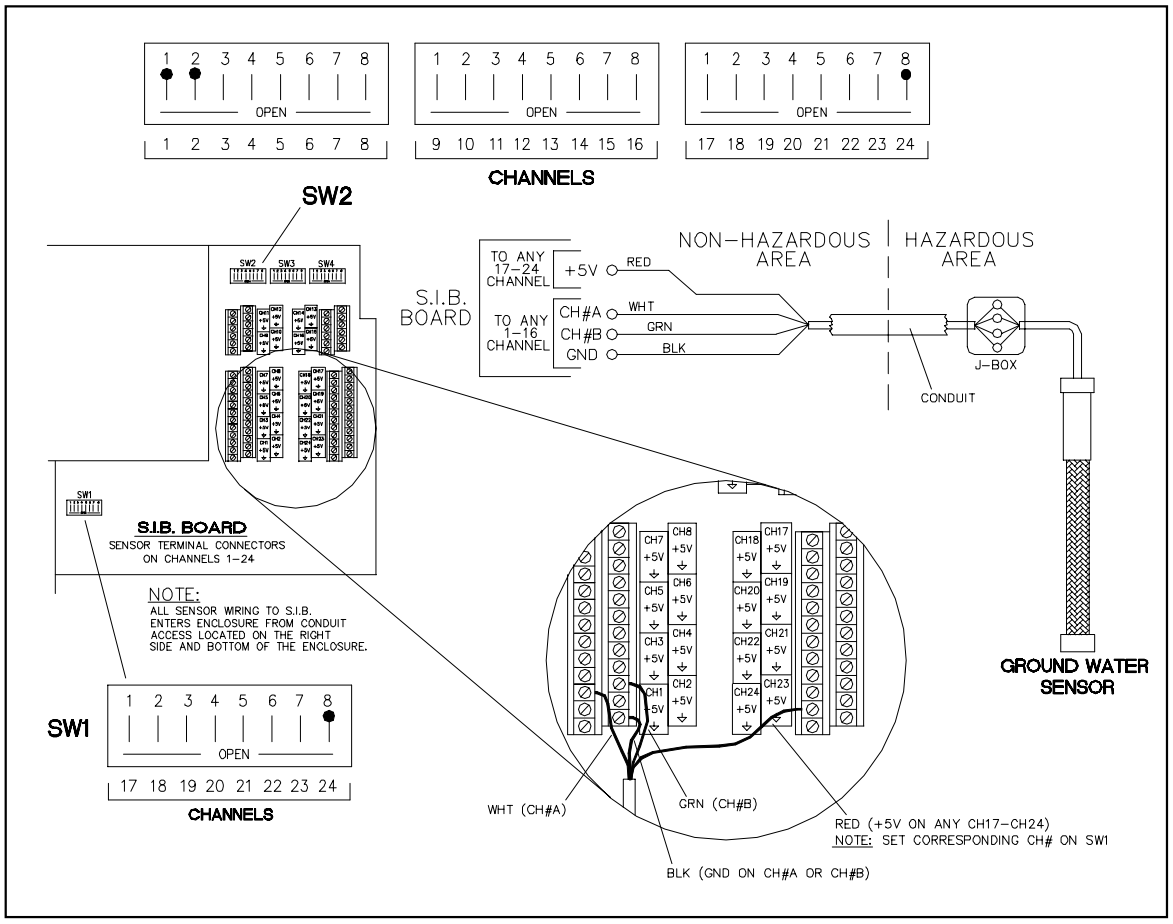


Figure 5.9 Groundwater Sensor Wiring Diagram

Step 1: Run an 18-gauge, gas, oil and water resistant four conductor cable from each groundwater sensor.

Step 2: Drill a ½ in. hole in the center of the monitoring well cap(installer supplied). Install the supplied compression fitting through this hole.

Step 3: Measure the depth of the well from riser top to well bottom.

Step 4: Layout the GWM and measure from the bottom of the anchor, the length recorded in the previous step.

Step 5: Loop any excess sensor cable between this point and the well cap and secure it to itself with the supplied wire tie. The object is to have the sensor cable hanging taut from the well cap to the well bottom without any slack.

Step 6: Lower the sensor into the well and secure the well cap.

Step 7: Connect the white wire to CH# terminal.

Step 8: Connect the green (vapor) wire to the next consecutive CH# terminal.

Caution **The red wire must be connected to +5V terminal of CH 17-24 *only*. The line leak switch must be closed.**

Step 3: Connect the black wire to the (GND) terminal on either of the first two CH#s.

Step 4: Connect the red wire to the +5V terminal.(On channel 17-24 **ONLY**)

Step 5: The DIP switches corresponding to each of the first two selected channels must be set CLOSED.

Step 6: The DIP switches on SW1 and SW4 corresponding to the third channel must be set CLOSED.

Figure 5.9 is an example of switch settings on ***SW2*** when CH1 and CH2 are being used. The switch setting on SW1 and SW4 are shown using channel 24 as an example.

Dispenser Pan Sensor Connection

The Dispenser Pan Sensor detects if any product or water is present beneath the dispenser. When product or water is detected, an alarm is triggered. The following steps explain how to install the sensor properly. Refer to *figure 5.10* for terminal connections.

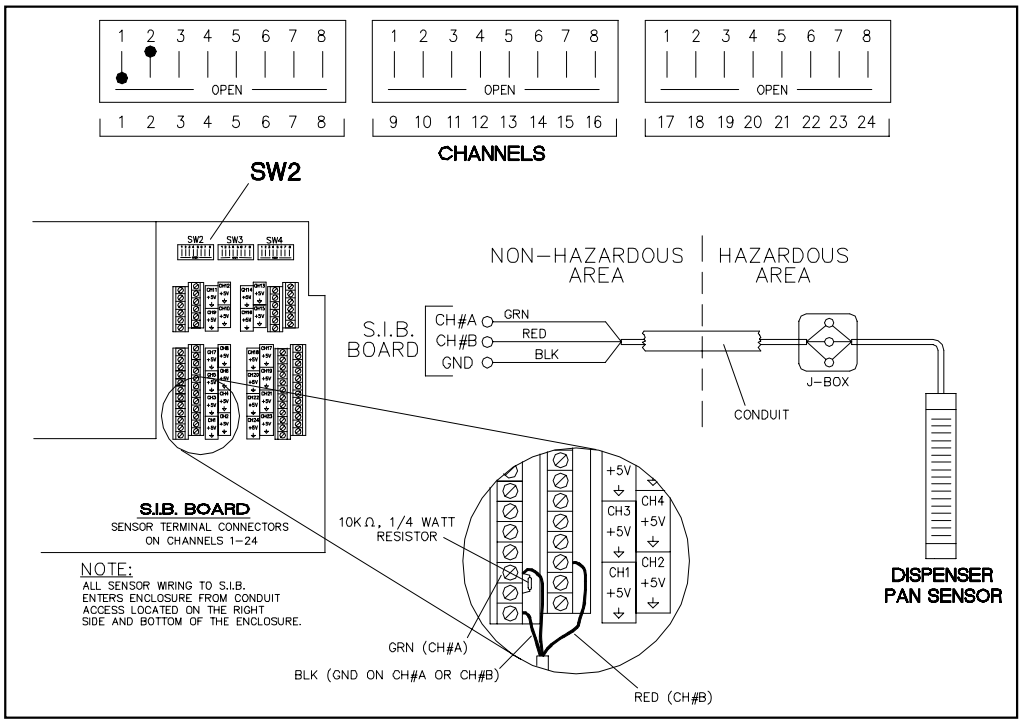


Figure 5.10 Dispenser Pan Sensor Wiring Diagram

Step 1: Run an 18-gauge, gas, oil and water resistant 4 conductor cable from each groundwater sensor.

Step 2: Connect the green wire to the CH# terminal.

Step 3: Connect the 10K Ohm resistor between that same CH# terminal and the +5V terminal. The DIP switch corresponding to that CH# should be set OPEN.

Step 4: Connect the red wire to the next consecutive CH# terminal. The DIP switch corresponding to that CH# should be set CLOSED.

Step 5: Connect the black wire to the GND terminal of either channel.

Figure 5.10 is an example of switch settings on ***SW2*** when CH1 and CH2 are being used.

Line Pressure Kit Installation

The ST Controller is capable of performing two different, user selected, line leak detection tests. One is Red Jacket's standard line test used by all PPM and RLM units. The second is Red Jacket's high pressure line test that does not require the use of the accumulator. Installation for the high pressure line test is simpler and less expensive than the standard accumulator style kit. Additionally, the high pressure line test conducts line tests faster than the older style. Either line test may be used with the ST Controller. Both have successfully completed independent third party certification per EPA protocols. Please note the differences in the installation instructions between the two.

Pressure Regulating Kit Installation Instructions

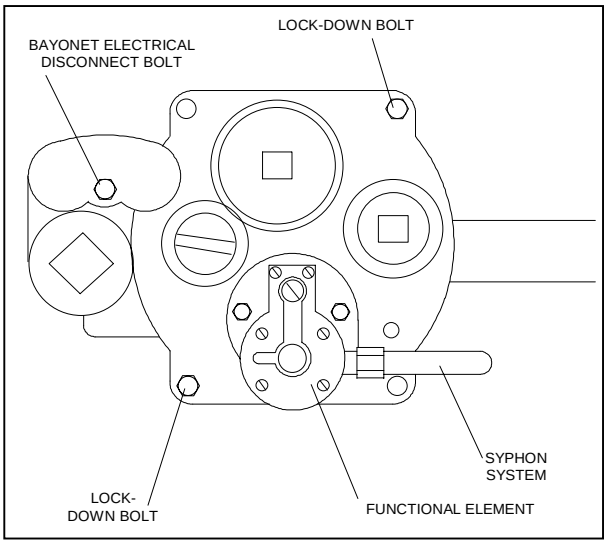


Figure 5.11 Dismantling The Pump

Step 1: Disconnect the power to the pump at the electrical service panel.

Step 2: Remove siphon system, if present. Refer to *figure 5.11*.

Step 3: Separate the packer from the manifold to remove the existing 2-in. discharge O-ring and 7-in. packer manifold O-ring. Examine the o-ring seat or glands for corrosion or roughness. Clean if necessary.

Step 4: Install the new 2-in. discharge O-ring provided in the kit with retaining lip (wide edge) facing up against the packer.

Warning! **Packer manifold seat must be smooth and nick-free to provide proper sealing**

between the packer and the manifold. If not, the manifold may have to be replaced.

Step 5: Install new 7-in. packer manifold seal. Replace packer and tighten to re-seal against manifold.

Notice **If the latest version of the pump with an adjustable functional element is being used, continue to the section *Accumulator Installation.***

Replacing the Check Valve

Step 1: Remove functional element and check valve from the packer.

Step 2: Install the new check valve and spring (supplied with the kit). The smaller end of the spring should rest on the check valve hub.

Step 3: Place the new O-rings (3) on the functional element and install on the packer.

Step 4: Complete the installation of the adjustable functional element by tightening the two cap screws (removed earlier).

Accumulator Installation

Notice **Use the accumulator *ONLY* if the standard Red Jacket line leak detection line test is used.**

The Red Jacket accumulator is to be installed only in the two inch threaded port located in the top of Red Jacket 4-in. submersible pumps manufactured after 1963. The accumulator and pressure transducer may share this port if the Red Jacket transducer adapter is used. Refer to the parts list located in Chapter 1 of this manual.

Step 1: Disconnect power to the pump at the electrical service panel.

Step 2: Remove the 2-in. plug from the top of the pump. If the 2-in. plug is found to be so tight that it cannot be removed, the submersible pump should be removed from the tank and placed in a vise. Remove the functional element assembly next to the pipe plug. The plug should then come out readily if a large pipe wrench is used. Replace the functional element assembly securely and replace the pump in the tank.

Step 3: Apply UL-Classified pipe thread sealant to the 2-in. thread on the accumulator.

Step 4: Screw the accumulator into the pump. Tighten with a wrench. (Top hex is 2-in. to 2½-in.).

Step 5: Remove the $^{3}/_{8}$-in. plug from the tank test port on top of the pump. Apply UL-Classified pipe thread sealant on the straight vent tube fitting and install in the tank test port on the pump manifold.

Step 6: Align the accumulator so that the vent opening at the top of the accumulator is as close to the tank test port as practical.

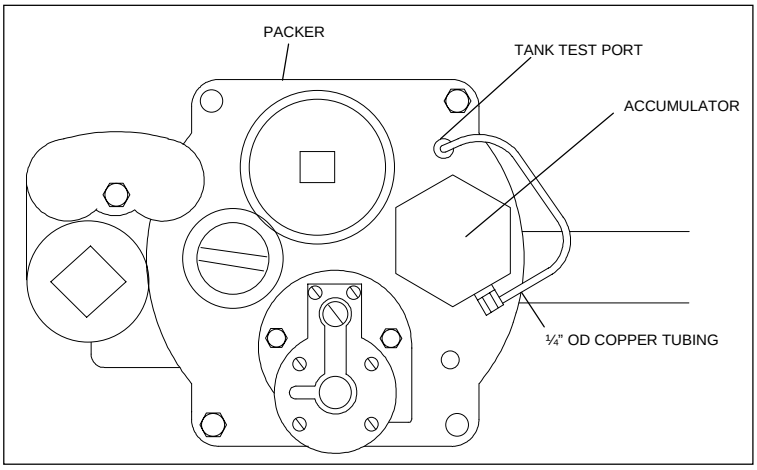


Figure 5.12 Tube Venting Installation

Step 7: Remove the plastic thread protector plug from the vent port on the accumulator. Apply UL-Classified pipe thread sealant to the vent tube elbow fitting and install the accumulator vent port. Elbow should be positioned downward for best protection of tubing.

Step 8: Install tubing vent line into both fittings as shown in *figure 5.12.*

Caution **Make sure both fittings are tight to prevent possible leakage into the ground and/or water into tank.**

Pressure Transducer Installation

Danger!! **To maintain intrinsic safety, separate the transducer wiring from all other wiring. Use proper conduit access at the controller. Failure to follow these directions will result in severe personal injury, death or substantial property loss.**

Caution **Use shielded wire to decrease the possibility of transducer signal interference owing to electronic noise emissions. Direct-bury cable eliminates the need for conduit once the cable leaves the building.**

Fast Pass Line Test

Step 1: Disconnect the power to the pump at the electrical service panel and bleed line pressure to 0 psi. Refer to figure 5.14 while performing this task.

Step 2: Remove the 2-in. leak detector plug from the leak detector port.

Step 3: Carefully install the transducer in the 2-in. leak detector port using UL-Classified pipe thread sealant. Tighten all fittings with a wrench.

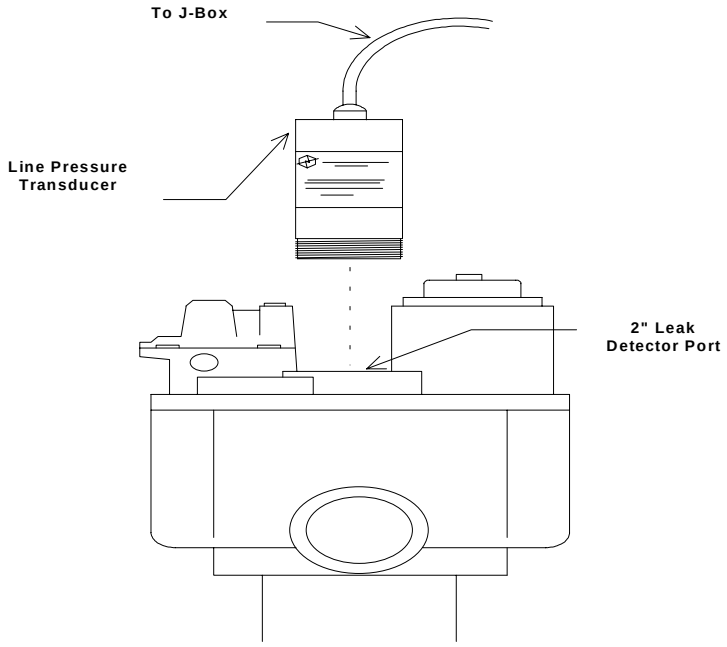


Figure 5.13 Pressure Transducer Installation

Standard Line Test with Accumulator

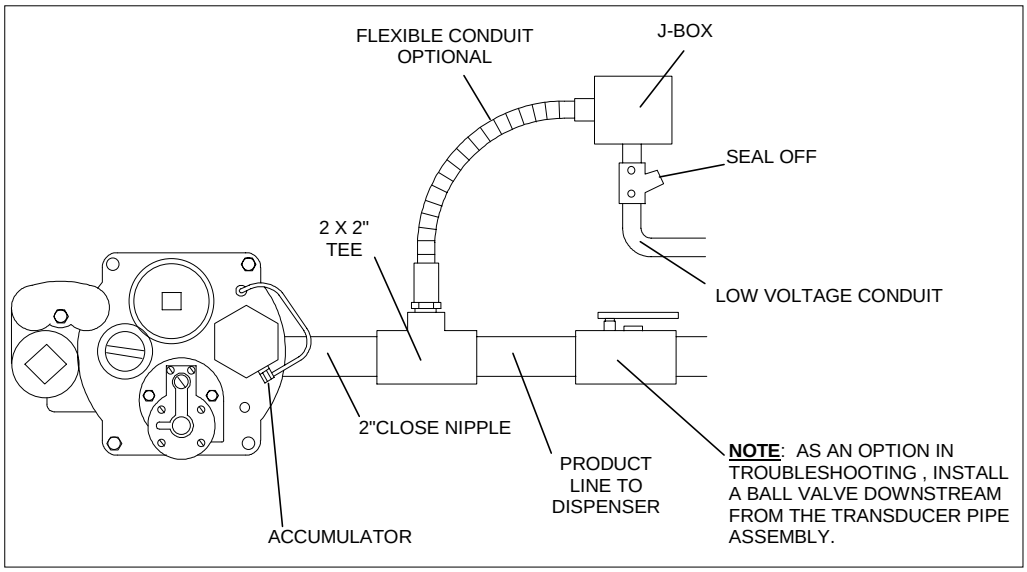


Figure 5.14 Using Standard Line test, No Transducer Adapter

Step 1: Disconnect the power to the pump at the electrical service panel.

Step 2: Install a 2 x 2 in. tee as shown in *figure 5.15*.

Step 3: Carefully install the transducer in the tee using UL-Classified pipe thread sealant. Tighten all fittings with a wrench.

Step 4: Remove the 2 in. plug from the leak detector port.

Step 5: Using UL-Classified pipe thread sealant, install the accumulator in the 2 in. port.

Step 6: Install the vent tube and fittings onto the accumulator and into the tank test port of the packer.

Notice **Shielded wire is recommended to decrease the possibility of transducer signal interference due to electronic noise emissions.**

When using direct bury cable, conduit is not required once the cable leaves the building. When using shielded cable, connect shield cable signal to ground at the ST Controller only.

Recommended Direct Bury Cable		
*If approved by State and Local Regulators		
Manufacturer	**Model Number**	**No. of Conductors**
Belden	88489	4
Belden	85102	2
Belden	85103	3
Belden Shielded	88723	4
Belden Shielded	82723	4
Belden Shielded	87723	4

Figure 5.15 Recommended* Direct Bury Cables

Step 7: Make wire connections to the transducer using either the included insulating pouch or the optional cable connector board and housing. The connector board provides a secure, low impedance connection while the housing protects the wires from corrosion and provides a water tight seal. Connect the drain wire to a suitable earth ground if required by a code agency.

Step 8: Connect the red wire to the +5V terminal.

Step 9: Connect the black wire to the (GND) terminal.

Step 10: Connect the green wire to the pressure signal.

Step 11: Connect the white wire (Canadian Model) to earth ground at the j-box.

Step 12: Connect transducer wire to the ST Controller as shown in figure 5.18.

Step 13: Reconnect power to the pump at the electrical service panel and clear the air from the pipeline as follows.

a) Turn on the dispenser that is farthest from the submersible pump but **DO NOT** open nozzle. Wait four to five minutes or more. Look for leaks in the parts worked on.

b) Shut off pump and allow it to stand four or five minutes. Start the pump and open the nozzle farthest from the submersible pump.

c) Continue to dispense enough gasoline (about 20 to 30 gallons(75-100liters)) to pump ***ALL*** air from the system.

d) Look for any fluid seepage from the functional element. If necessary, refer to the sections entitled **Pressure Transducer** or **Packer Manifold Installation**.

e) Install a new or re-install existing siphon tube, if necessary.

Sealing Wire Connections in Insulating Resin

Step 1: Match the correct wires together that run from the ST Controller to the transducer. Make sensor wire connections using the provided wire nuts. Remove resin pouch from its package.

Step 2: Grip both edges of the bag at the center barrier and wrinkle and flex the bag across the barrier. This will weaken the barrier.

Step 3: Squeeze the ***clear side*** of the resin, forcing the resin through the center barrier.

Step 4: Mix thoroughly to a uniform color by squeezing the contents back and forth 25-30 times.

Step 5: Squeeze the resin to one end of the bag and cut off the other end. Insert all three wire nuts.

Step 6: Slowly insert wire nut connections into the sealing pack, moving them around to insure complete immersion in the resin. Fit connections snugly against the opposite end of pack so that the cable jacket coming from the sensor is also submerged in resin. Failure to do so will cause moisture to wick up the cable and destroy the transducer.

Step 7: Wrap open end of bag with electrical tape, (not included), and position the bag, with tape end up, until the resin cures.

Caution **Do Not turn the resin pouch upside down until it has hardened.**

Sealing wire connections in the optional Connector Board and Housing

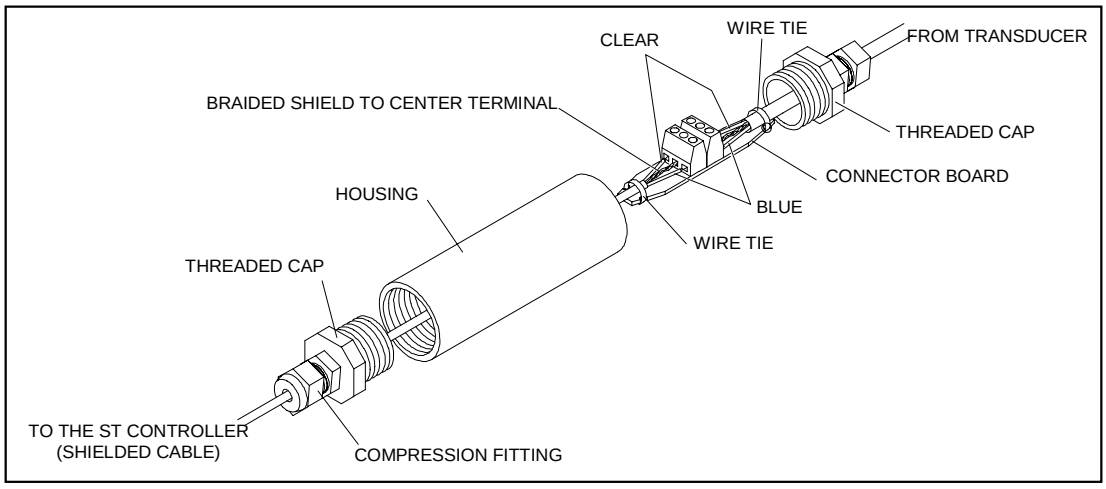


Figure 5.16 The Connector Board and Housing

Danger!! **Make sure that the power is turned off until the connector board and housing are installed.**

Step 1: Remove the threaded end caps, (not the compression fitting), from the housing.

Step 2: Feed the cables through the compression fittings in each threaded cap. Pull enough cable through one threaded cap to accommodate sliding the housing over it.

Step 3: Strip the outer jacket back approximately 3/4-in.

Step 4: Pull back the braided shielding, on both cables, and twist to form a third conductor.

Step 5: Strip the insulation on the remaining conductors 1/8-in.

Step 6: Connect the braided shielding to the center terminals of both connectors. Connect the remaining conductors to the connectors. (Blue with Blue, Clear with Clear).

Step 7: With the wire ties provided, strap each cable securely to the connector board. This will provide strain relief for the connections.

Step 8: Apply approved, non-seizing and non-hardening pipe sealant to the threads of one of the threaded caps and screw it into the housing. Pull the connector board into the housing and place the desiccant pouches along with it.

Step 9: Apply pipe sealant to the threads of the remaining threaded cap and screw it into the housing.

Step 10: Tighten the compression fittings around the cables to insure moisture does not enter the connector housing.

Notice **Proper dip switch setting must be established. Using SW1, close the corresponding pressure channel's dip switch. Move all DIP switches on SW4 that will be used for pressure transducers to the open position. The switches on SW1 correspond to the channels 17-24 in order.**

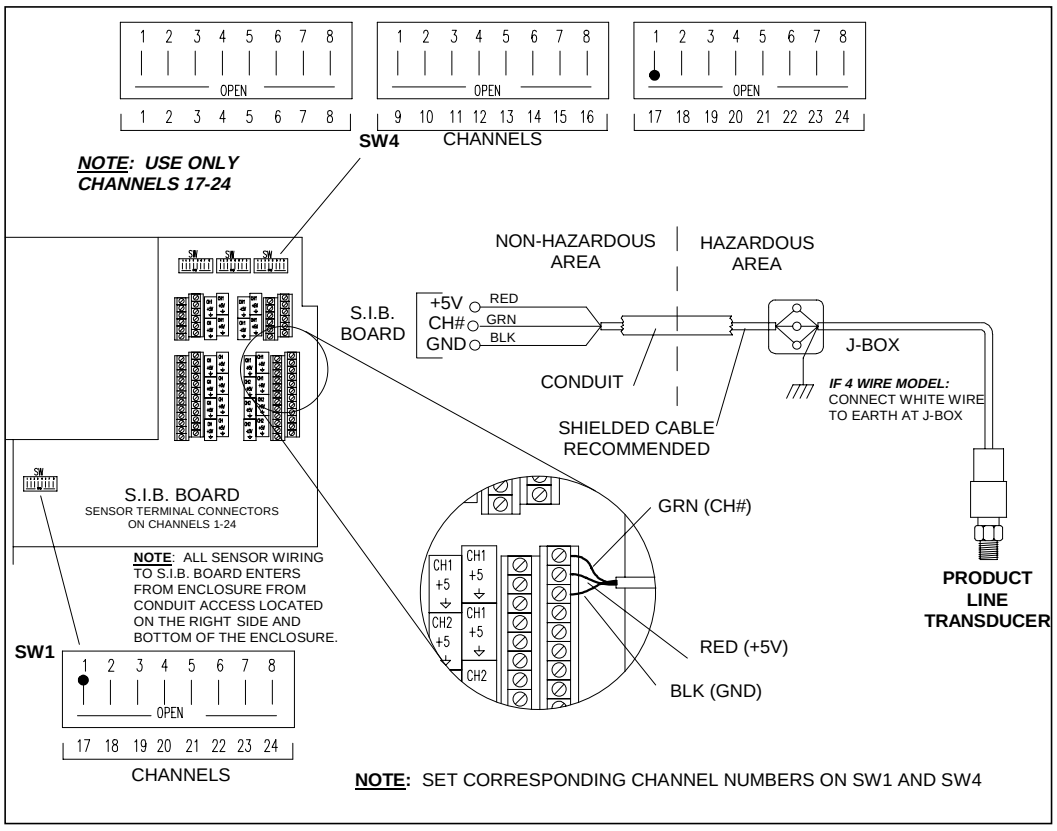


Figure 5.17 Product Line Transducer Wiring Diagram

Danger!! **To maintain intrinsic safety, the transducer wiring must be separated from all other non-intrinsically safe wiring.**

Notice **Pressure transducers can be used only on channels 17-24.**

Caution **Make sure that a brass siphon check valve (not included in this kit) is used when installing a siphon system. See the mechanical parts list.**

Notice **If excessive air is trapped in the line, the ability to sense a leak may be hampered. Therefore, clearing the air from the pipeline is extremely important.**

Functional Element Adjustment

If the line will be configured for using the standard pressure leak detection line test, remove the hex shaped brass protective cap, and turn the adjustment screw gradually counter-clockwise to decrease relief pressure, to within 11-16 psi(758-1100mBar).

If the line will be configured for using the high pressure leak detection line test, remove the hex shaped brass protective cap, and turn the adjustment screw gradually clockwise to increase relief pressure, to within 1 - 2 psi (65-130mBar) of pump pressure, for non-siphon systems. For example, if pump on pressure is 28 psi(1930 mBar), set the functional element to relieve at about 27 psi(1860mBar).

For siphon systems, set relief pressure 5 psi(344mBar) below pump pressure. Setting can be checked by turning the pump on and off and monitoring line pressure.

Notice **The ST Controller will stop the operations of the submersible pump if it senses loss of line pressure. Make sure all fittings in the system are tight and that pressure holds.**

Pump Control Connection

The ST Controller is designed to control the 115/220VAC coil of the product relays which in turn control the submersible pumps. The ST Controller is not designed to power the pumps directly. A dispenser handle signal is wired to the ST Controller input terminal. the ST Controller will then turn the pump on and off based on the dispenser signal, unless a leak has been detected. Refer to *figure 5.19* while performing the following steps.

Step 1: Disconnect power to the pump at the electrical service panel.

Step 2: Wire 115/220VAC from the electrical service panel to the AC HOT and AC Neutral inputs of the ST Controller as shown in figure 5.19. This power source must be in the same phase as all the product relays.

Step 3: Connect the dispenser handle signal from the product line designated as line #1 to the ST Controller input channel 25, line #2 to the input channel 26 and so on.

Step 4: Connect the ST Controller coil relay output from output relay channel #1 to the S2 terminal of the pump relay controlling the product line #2 and so on.

Step 5: Make sure that all other connections are made according to figure 5.19.

Step 6: Reconnect power to the pump at the electrical service panel. **Note:** the pump will not operate until the ST Controller is correctly programmed.

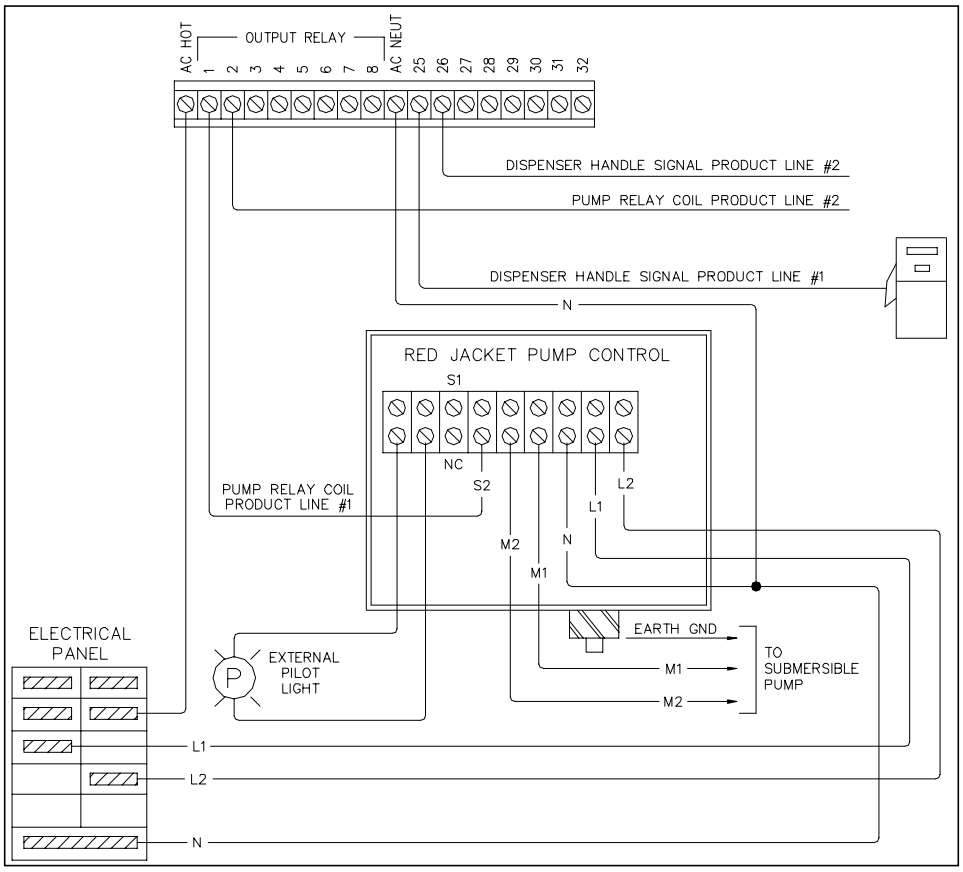


Figure 5.18 Pump Control Connection Diagram

Chapter 6: Introduction to Programming

This chapter explains:

- **Keyboard and Control Panel**
- **Programming Tips**
- **Programming Levels**
- **Quick Reference Worksheet**

Keyboard and Control Panel

This section includes a description of the control panel keys and indicator lights along with a brief overview of their functions.

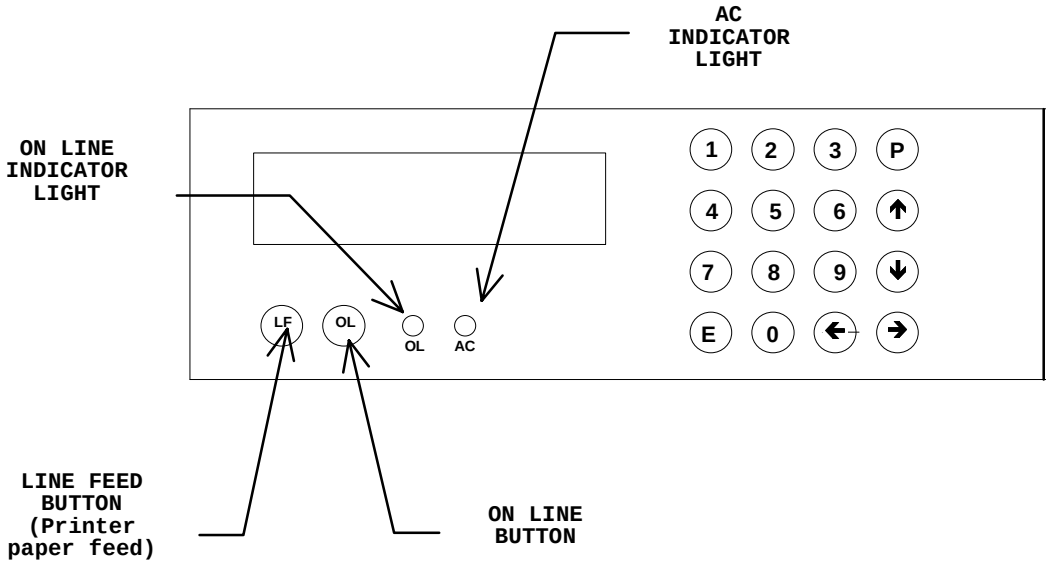


Figure 6.1 ST Controller Front Panel

Line Feed Button: This button will feed the printer paper forward one line at a time. The ST Controller must be off line in order for this function to work.

On Line Button: This button will switch the ST Controller internal printer on and off. The printer must be on line in order for the ST Controller to print reports automatically.

On Line Indicator Light: This light will be lit when the ST Controller internal printer is on line.

AC Indicator Light: This light will be lit when the ST Controller is connected to AC power. This light will always be lit unless there has been a power failure or unless power has been disconnected for some reason.

The Number Keys: These keys(0-9) are used to choose different functions and also to enter numerical values when programming the ST Controller.

The ↑ and ↓ Keys: These keys are used to move between different programming levels, options, and to change settings.

The ← and → Keys: These keys are used to move between different programming screens and to move the cursor between fields within a screen.

The (E) key: This is a multifunction key. It will store settings and return to the main programming screen and move to a different programming screen.

The (P) key: This is also a multifunction key. It's primary function is to print reports but is also used to move between some programming screens

Programming Tips

- **When programming the ST Controller, be sure to wait a moment between pressing each key, otherwise the controller will not recognize the key strokes.**
- **During programming, if an entry is not made in X minutes, the ST Controller will time out and return to the "Select Display" screen. If this happens, it is necessary to reenter the desired programming level and function in order to continue programming.**

Programming Levels

These procedures will allow you to enter a security code(if needed) and select a programming level.

Step 1: Upon power-up, the display will appear as follows:

```
SELECT DISPLAY
01JAN90 12:00:00
```

Step 2: Press the **0** key to move to the "Programming Level" screen.

```
PROGRAM LEVEL
ENTER SECTY CODE
```

Step 3: Enter the 4 digit security code for the desired level of programming. The factory default setting for Level 1, and Level 2 programming is **0000.** The owner's default security code, which allows Level 3 programming, is **2222**. To use diagnostic functions, a Red Jacket Technician's code is required. This code is issued to technicians after completing Red Jacket factory training.

Step 4: Press the ➔ key to move to the "Programming Level 1" screen

```
PROGRAM LEVEL 1
 SELECT NUMBER
```

Step 1: If you would like to program Level 2 or Level 3 functions, press the ↑ or ↓ key to select the desired programming level.

Step 2: After the desired programming level is selected, press a number key to select the function to be programmed.

Notice **Each function will appear with the cursor positioned under one of the fields. Follow each instruction and use the appropriate keys to input the data for each function . Once programming is complete for each function , press the E key to return to the program level screen. To move to other programming levels, use the ↑ or ↓ key.**

Step 7: Press the (E) key to return to the "Select Display" screen. To re-enter Programming Level 1, complete steps 1 through 4.

```
SELECT DISPLAY
01JAN90 12:00:00
```

Quick Reference Worksheet

Function Key	Programming Level 0: System Information and Report Printing
➔	Print Menu
0	Access Programming Levels
1	Product Height
2	Gross Volume
3	Ullage
4	Water Height
5	Product Temperature
6	Chronological History
7	Product Dispensed
8	System Status
9	Leak Detection Active
Function Key	**Programming Level 1: Basic System Configuration**
0	Facility Active
1	Date/Time (Changing Daylight Savings Time)
2	Active Probes
3	Tank Information
4	Product Type (Special Product Type)
5	Initial Product Height
6	Initial Water Height
7	Height of Transceiver
8	Calibrate Temperature
9	Printer Type

Function Key	Programming Level 2: System Customization and Configuration
0	Security Code
1	Name/Address
2	Alarm Duration
3	Units of Measure
4	Alarm Thresholds
5	Water Float Status
6	Reconciliation Interval
7	Inventory Report Scheduled
8	Leak Detect Mode (Manual, Automatic, Scheduled, Facility Closed)
9	POS Terminal Type

Function Key	Programming Level 3: Communications and Peripherals
0	Auto Dial
1	Sensor Location
2	Sensor Type
3	Relay Programming
4	Panel Alarms
5	Program Up-date
6	Line Pressure Diagnostics
7	None
8	None
9	None

Chapter 7: Programming Level 0

This chapter explains:

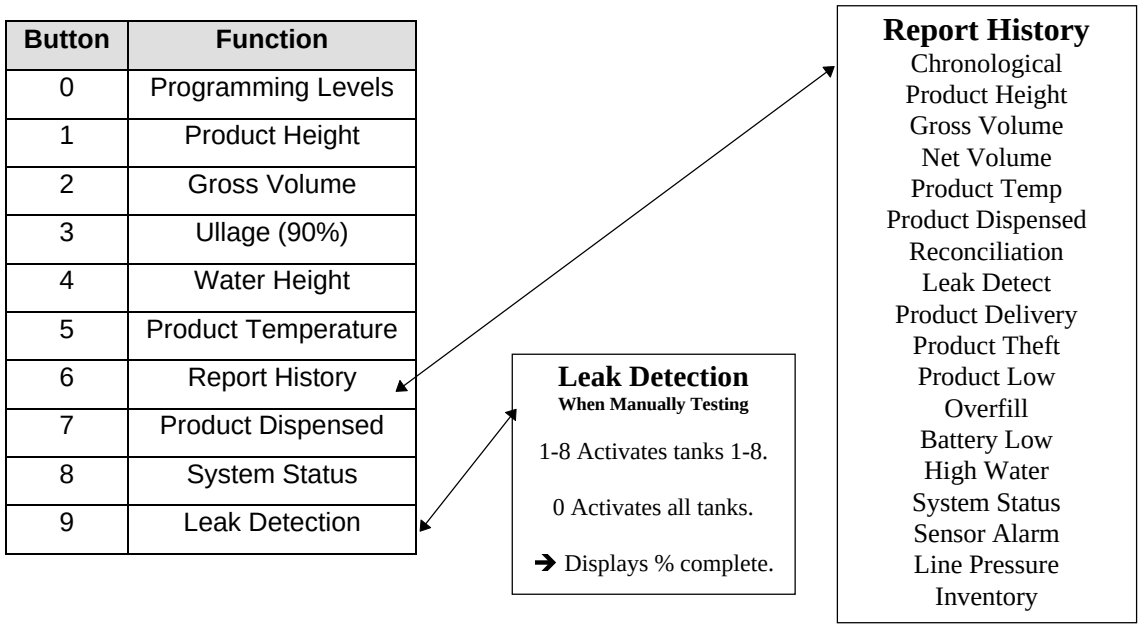
- **Print Level functions**
- **Program Level**
- **Product Height**
- **Gross Volume**
- **Ullage**
- **Water Height**
- **Product Temperature**
- **Chronological History**
- **Product Dispensed**
- **System Status**
- **Leak Detection Active**

Overview:

The functions available in this programming level are used on site to view basic system information and print reports. There is no security code required to access these functions. No changes to system settings or configurations are possible at this level.

Quick Reference for Programming Level 0

Button	Function
0	Programming Levels
1	Product Height
2	Gross Volume
3	Ullage (90%)
4	Water Height
5	Product Temperature
6	Report History
7	Product Dispensed
8	System Status
9	Leak Detection



Print Menu (➔)

The following basic reports can be generated using the Print Menu:

- **Inventory**
- **Product Height**
- **Net Volume**
- **Water Height**
- **Product Temperature**
- **Ullage Leak Summary**
- **Tank Chart**
- **System Programming**
- **Diagnostics**
- **Tank Calibration Data**

The initial display on the ST Controller is shown below.

```
  SELECT  DISPLAY
02JAN90  09:13:16
```

Step 1: From this screen, use the → key to move to the "Print Menu" screen.

Step 2: There is a "Print Menu" screen for each of the functions listed above. Use the ↑ and ↓ keys to move between these screens.

As an example, here are the steps to follow to print an inventory report.

```
PRINT MENU
INVENTORY
```

Step 3: From the "Print Menu", Inventory screen, press the **P** key to move to the "Print Menu", Tanks screen.

```
PRINT MENU
    TANKS1
```

Step 4: To select a report for a specific tank, press the **0** key to move to the next "Print Menu" screen.

```
PRINT MENU
    TANKS1
```

Step 1: In this screen, use the number keys to choose a specific tank. To choose all tanks, press the **0** key to move to the next screen.

```
PRINT MENU
   TANKS1234
```

Note: The **OL** light must be lit to enable printing. If this light is off, press the **OL** key.

Step 6: To print the report, press the P key which will start printing the report and will move to the next screen.

```
PRINTING . . . .
HIT 'E' TO ABORT
```

Step 7: If you wish to stop printing this report, press the E key to move to the next screen.

```
END PRINTING?
NO
```

Step 8: Use the ↑ or ↓ keys to choose YES and abort the print job.

```
END PRINTING?
YES
```

Step 9: In a few seconds, the display will return to the "Printing" screen, and then return to the "Print Menu" screen. Continue to another "Print Menu" screen to select another report or press the E key to return to the "Select Display" screen

Product Height (1)

This function displays the product height in the selected tank.

Step 1: Press the **1** key to move to the "Product Height" screen.

```
PRODUCT HEIGHT
T1    27.71 INCH
```

Step 2: Use the ↑ and ↓ keys to choose which tank to view. Press the **E** key to return to the "Select Display" screen.

```
PRODUCT HEIGHT
T2   27.71 INCH
```

Note: To view Gross Volume (2), Ullage%(3), Water Height(4), and Product Temperature(5), refer to the table at the beginning of this chapter for the function number, and then follow steps 1 and 2 above.

Chronological History (6)

This function allows the user to view the complete event history from the time the ST Controller was initially installed and programmed.

Step 1: Press the 6 key to move to the "Chronological History" screen.

```
HISTORY     0000
CHRONOLOGICAL
```

This screen shows the *total* number of system events, of all types, that have occurred.

Step 2: Use the ← and → keys to select from one of the following events to view and/or print.

- Product Height
- Gross Volume
- Net Volume
- Water Height Product Temperature
- Product Dispensed
- Reconciliations
- Leak Detections
- Product Deliveries
- Product Theft
- Product Low
- Overfill
- Battery Low
- High Water
- System Status
- Sensor Alarm
- Line Pressure
- Leak Det
- Inventory Report

Step 3: When the desired screen is reached, press the ↑ key to view the most recent event of this type.

```
HISTORY        0174
   PROD HEIGHT
```

Step 4: Use the ↓ key to view each event from the most recent to the oldest.

Step 5: Press the → key to move to the next screen. This screen provides more detail for the selected event.

```
PROD HEIGHT   0003
18DEC97 07:00:00
```

Step 6: To print a report press the **P** key from any event history screen to move to the "Start Printing" screen.

```
START PRINTING
01DEC97  00:00:00
```

Step 7: Use the ↑ and ↓ to change the starting date and time settings and the ← and → keys to move between fields. Press the **E** key to move to the "End Printing" screen. Set the end date and time as above.

```
END PRINTING
30NOV97  00:00:00
```

Step 8: Press the **E** key to start printing the report and move to the next screen.

```
PRINTING. . . .
HIT 'E' TO ABORT
```

Step 9: If you wish to stop printing this report, press the **E** key to move to the next screen.

```
END PRINTING?
     NO
```

Step 10: Use the ↑ key to choose **YES** and press the **E** key to return to the "Event History" screen.

Step 11: Press the E key again to return to the "Select Display" screen.

Product Dispensed(7)

This section describes the procedure for viewing the amount of product dispensed from each tank and allows storing this information.

Step 1: Press the **7** key to move to the "Product Dispensed" screen. Use the↑ and ↓ keys to select a tank to view.

```
PROD DISPENSED
T1     125.5 GAL
```

Step 2: Press the → ← key to move to the negative value screen.

```
PROD DISPENSED
T1  -  .0 GAL
```

Step 3: Press the **E** key to move to the "Store Product Dispensed" screen. If the product dispensed amount is zero, then pressing the **E** key will return to the "Select Display" screen

```
STORE PROD DISP
NO
```

Step 4: Use the ↑ and ↓ keys to select Yes or No to store the amount of product dispensed in the ST Controller memory.

Step 5: Press the **E** key to return to the "Select Display" screen.

System Status (8)

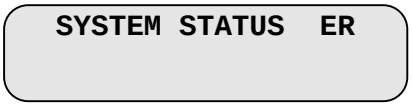
This function allows you to check on the various system components.

- Software Version
- EPROM signature
- RAM
- Battery
- Leak Mode
- Printer
- Tank Probes
- SIB version
- SIB signature
- SIB Sensors

Step 1: Press the **8** key to start the system status check and move to the "System Status" screen.

```
SYSTEM STATUS  OK
```

OR



Step 2: If the screen displays the **ER** code(alarm), use the ↑ and ↓ keys to scroll through the system screens to determine which function has caused the alarm code.

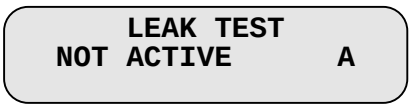
Step 3: Press the **E** key to return to the "Select Display" screen.

Contact Red Jacket Technical Support for more information on software versions.

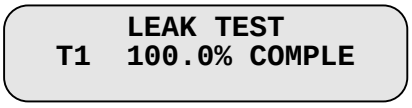
Leak Detection Active (9)

This function displays the status of the leak detection tests on all active tanks.

Step 1: Press the **9** key to move to the "Leak Test" screen. This screen will show whether leak detection is active or not.



Step 2: Press the → key to move to the "Leak Test" (tank) screen.



Step 3: Use the ↑ and ↓ keys to select which tank leak status to view. Press the **E** key to return to the "Select Display" screen.

Chapter 8: Programming level 1

This chapter explains:

- **Calibration and Configuration**
  - Facility Active (0)
  - Date/Time (1)
  - Active Probes (2)
  - Tank Information (3)
  - Product Type (4)
  - Initial Product Height (5)
  - Initial Water Height (6)
  - Height of Transceiver (7)
  - Calibrate Temperature (8)
  - Printer Type (9)

Caution **Level 1 programming is for calibration and configuration of the system. Each Level 1 feature *MUST* be programmed. The ST Controller will not operate properly without this information.**

Calibration and Configuration

Facility Active (0)

The Facility Active feature establishes times when the station is closed and the ST Controller can go into shutdown leak detection mode.

Notice **If facility is a 24 hour operation, no entry is required in this section.**

Step 1: Enter Program Level 1 then press the (**0**) key. The display will appear similar to the following with the cursor positioned under the **DAY** field.

```
FACILITY  ACTIVE
SU   00:00 00:00
```

Step 2: Press the → key to move the cursor to the “opening time” field.

Step 3: Use the → key to move between time fields and the ↑ and ↓ keys to set the time (in 24 hour format) the facility will open on Sundays.

Step 4: Press the → key to move the cursor to the “closing time” field.

Step 5: Use the → key to move between time fields and the ↑ and ↓ keys to set the time (in 24 hour format) the facility will closed on Sundays.

Notice **If a mistake is made when entering the time, press the (P) key twice and re-enter the correct time. Remember when setting the time that 12:00:00 equals noon and 00:00:00 equals midnight.**

Step 6: Press the ← key until the cursor is positioned back at the DAY field.

Step 7: Use ↑ or ↓ key to scroll to the next day.

Step 8: When a day is selected, follow steps 2-7 to enter the opening and closing times for the remaining days.

Step 9: Press the (**E**) key to complete the entry and return to *Programming Level 1*.

Date/Time (1)

The ST Controller uses the Date/Time information to time-stamp and date-stamp reports and data. The following steps outline the procedure for programming or changing the date and time.

Step 1: Enter Programming Level 1 by following the procedure outlined in Entering Programming Levels.

Step 2: Press the (**1**) key to move to the "Date/Time Set" screen.

```
SELECT DISPLAY
01JAN90 12:00:00
```

Step 3: Use the number keys or the ↑ or ↓ keys to select the day of the month.

Notice **If an incorrect entry is made, press the (P) key and re-enter the correct information.**

Step 4: Press the → key to move the cursor to the month field.

Step 5: Use the ↑ or ↓ key to scroll to the correct month.

Step 6: Press the → key to move the cursor to the year field.

Step 7: Use the number keys or the ↑ or ↓ keys to scroll to the correct year.

Step 8: Press the → key. Continue on with the time (24-hour format), remembering that 12:00:00 equals noon and 00:00:00 equals midnight.

Step 9: When the time entry is complete, move to the upper line of the display by pressing the → key. The display will appear as shown below with the cursor positioned under the **S**.

```
DATE/TIME S A 00
01OCT96  13:30:00
```

"S" represents Standard Time and "D" represents Daylight Savings Time. An "A" or "M" represents Automatic or Manual. The two digits on the right are used to indicate the time zone. If Manual is chosen, either Standard or Daylight Savings time MUST be chosen. The ST Controller will NOT automatically switch between the two. If Automatic is chosen, the ST Controller will switch between Standard time and Daylight Savings time on the scheduled date and hour. This date and hour may be changed.

Step 10: If no changes are needed here, press the E key to return to the "Programming Level 1" screen. If changes are desired, continue on with Step 11.

The following steps can be used to change the default settings for the Daylight Savings time day and hour.

Step 11: Press the → key to position the cursor under the **A** or **M**. Use the ↑ or ↓ key to scroll to the (**A**). Press the (**P**) key to move to the "Daylight Start" screen

```
DAYLIGHT START
APR SU 02:00 1ST
```

Step 12: Press the → key to move the cursor to the Month field. Use the ↑ or ↓ key to scroll to the month in which the time change will take place.

Step 13: Press the → key to move the cursor to the Day-of-the-Week field. Use the ↑ or ↓ key to scroll to the day of the week that the time change will occur.

Step 14: Press the → key to move the cursor to the Hour field. Use the number keys or the ↑ or ↓ key to enter the correct hour (in 24-hour format) that the time change will occur.

Step 15: Press the → key to move the cursor to the Minute field. Use the number keys or the ↑ or ↓ key to enter the correct minutes.

Step 16: Press the → key to move the cursor to the Week-of-the-Month field. Use the ↑ or ↓ key to scroll to the correct week of the month that the time change will occur.

Step 17: Press the → key to move the cursor under the (**D**) in Daylight. Press the ↑ or ↓ key. The display will appear as follows. Repeat steps 11–17 to program the ***End*** time for daylight savings time.

```
DAYLIGHT END
OCT SU 02:00  LST
```

Step 18: To return to the Date/Time screen, press the (**E**) key.

```
DATE/TIME S A 00
01OCT96 13:30:00
```

Step 19: Press the → key to move the cursor to the Time Zone field. An entry is not required in this location as it is used only with remote communications. Typically, this option should remain at ***00***.

Notice **Each ST Controller, no matter where it is physically located, will be referenced to Greenwich Mean Time. Time zone codes for North America are:**

Code	Time Zone
04	Atlantic
05	Eastern
06	Central
07	Mountain
08	Pacific
09	Alaska
10	Hawaii

Step 20: Use the ↑ or ↓ key to scroll to the number that corresponds to the time zone that corresponds to where the ST Controller is installed.

Step 21: Press the (**E**) key to complete the entry and return to *Programming Level 1*.

```
PROGRAM LEVEL 1
SELECT NUMBER
```

Active Probes (2)

Step 1: Enter *Programming Level 1*; then press the (**2**) key to move to the "Active Probes" screen.

```
ACTIVE PROBES
                00
```

Step 2: Press the number on the keypad that corresponds to the number of probes currently installed on the ST Controller.

Notice **If an incorrect entry is made, press the (P) key and enter the correct information.**

Step 3: Press the → key to move to the "Configure Probes" screen.

```
CONFIG PROBES
                00
```

Step 4: Press the ↑ or ↓ to select the number of probes. If the number of active probes is less than 8, the ST Controller can be programmed to maximize its internal memory for the number of inventory sensors being used. This allows the ST Controller to maximize data history information.

Notice **Changing the configured probes will erase all data previously stored in data history.**

Step 5: Press the → key to move to the "Active Probes" screen

```
ACTIVE PROBES
                    08
```

Step 6: Press a number key (1–8), or use ↑ or ↓ to select the correct number of inventory sensors to be configured for the ST Controller.

Step 7: To manifold two tanks together, press the → key to move to the "Manifolded" screen.

```
MANI-       ABCD
FOLDED      1234
```

Step 8: Use the → key to move the cursor above the letter designations for the tanks to be manifolded. Using the ↑ or ↓, change the letters above the two tanks to the same letter. An example display below shows Tanks 1 and 2 are manifolded together as designated by the letter **A**.

```
MANI-       AACD
FOLDED      1234
```

Step 9: This will complete the manifold programming. Move the cursor using the → key until it returns to the Active Probes screen displays. Continue programming until all tanks are programmed. Press the (**E**) key to complete entries and return to *Programming Level 1*.

Tank Information (3)

The ST Controller requires the tank chart to correctly report volume information. If more than one tank has the same dimensions, refer to the notice at the end of this section concerning copying tank information.

Step 1: Enter *Programming Level 1*; then, press the (**3**) key on the number keypad. The cursor should be positioned under the Tank Number field as follows.

```
T1 DATA DIA VOL
 96 IN 1200 G
```

Warning! **The ST Controller will use tank volume when calculating the overfill threshold, and the true capacity must be used.**

Notice **If a typical flat-ended cylindrical tank is used, programming of the tank chart will be complete after step 2. If a fiberglass or a cylindrical tank is used, continue with step 3.**

Step 2: Enter the highest diameter from the tank chart. Press the → key and enter the volume that corresponds to the highest ***ACTUAL*** inch level.

Step 3: Press the → key to move to the "Tank Chart" screen. Enter the volume level from the tank chart for the corresponding level. Use the ↑ to move the cursor to the next strapping point. Enter the volume for that level according to the tank chart.

```
TANK CHART      01
6 IN           0GA
```

Step 4: Press the → key to program the ***Probe Type***. "Standard" is the default selection. This type is used for probes 12 ft and under. "Serial" (not currently available) will be used for specialized applications. ***Leave this set to Standard.***

```
PROBE TYPE
STANDARD
```

Step 5: Press the → key to go to the next tank number. Repeat steps 1–5 until all tanks are programmed.

Step 6: Press the ← key three times to return the cursor under the Tank Number, as shown in the following example.

```
T1 DATA DIA VOL
 96 IN 12000 G
```

Step 7: To copy the information from one tank to another, use the ↑ or ↓ key to scroll to the tank you want to copy data ***TO***. Press the (**P**) key. The display will appear as follows, with the cursor positioned under the ***FROM TANK*** number.

```
COPY TANK DATA
FROM TANK 01
```

Step 8: Use the number keys or the ↑ or ↓ keys to enter the tank number the information is to be copied ***FROM***. Press the (**E**) key, and the data will be copied.

Notice **If Copy Tank Data programming is initiated in error, press the (0) key then the (E) key to return to the previous screen No copying will be performed.**

Step 9: When the tanks are programmed, press the (**E**) key to move to the "Configure Tanks" screen. Press the ↑ key to select ***YES*** to confirm programming.

```
CONFIGURE TANKS?
NO
```

Step 10: Press the (**E**) key. The ST Controller will process the data and build the tank strapping tables for each tank, and then return to *Programming Level 1*.

Notice **Configuring tanks will erase all data previously stored in data history.**

Product Type (4)

Product Type allows the user to select and edit standard products whose properties are stored in the ST Controller's memory. A special product type can be created and properties can be programmed. The following selections describe these options.

Select Product Type (4)

The following directions describe selecting the product name and parameters for preprogrammed options stored in the ST Controller's memory.

Step 1: Enter *Programming Level 1*; then press the (**4**) key to move to the "Product Type" screen.

```
PRODUCT TYPE
T1 UNLEADED REG
```

Step 2: Press the → key. The cursor will be positioned under the Product Type field. Choose the product type for Tank 1 by scrolling through the choices with the ↑ or ↓ key. The following table shows the available choices. Select the correct product type and press the ← key to move the cursor back to the tank number.

Code	Product Type
0	Unleaded Reg
1	Unleaded Plus
2	Unleaded Prem
3	Leaded Reg
4	Diesel #1
5	Diesel #2
6	LPG
7	Jet Fuel
8	100 Octane
9	Kerosine
10	Gasohol
11	Off-Rd Diesel
12	Water
13	Blank (Special Product)
14	Blank (Special Product)

Step 3: Use the ↑ or ↓ key to select the next tank to be configured, and repeat steps 1–3.

Step 4: Press the (**E**) key to return to *Programming Level 1*.

Editing Product Name and/or Product Parameters (4)

The following steps outline editing a product name or product parameters. These functions require a technician level security code.

Step 1: Enter Programming Level 1; then, press the (**4**) key to move to the "Product Type" screen.

```
PRODUCT TYPE  01
T1 UNLEADED REG
```

Step 2: Position the cursor at the Product Type field as shown in the example below. Use the ↑ or ↓ key to scroll through the standard choices until the desired product type appears. Press the (**P**) key to edit the product type.

```
PRODUCT TYPE 01
T1 UNLEADED REG
```

Step 3: Input the first character of the product name by using the ↑ or ↓ key to scroll through the list of characters until the correct one is displayed. **A–Z** and **0–9** are available as well as the following: **!**, **‘**, #, **$**, **%**, **&**, **“**, (**,**), *****, **+**, **-**, (**.**), (**;**), **>**, **?**, and @**.**

Step 4: Press the → key to move to the next character’s position. Continue this procedure until the product name is complete.

Product Type	Velocity	Product Coefficient	Speed of Sound Coefficient
LPG	1.166 mm/usec	0.280000	-.00222
Gasohol	1.166 mm/usec	0.028000	-.00222
Diesel	1.380 mm/usec	0.22500	-.00222
Jet Fuel	1.380 mm/usec	0.22500	-.00222
Kerosine	1.342 mm/ usec	0.25000	-.00200
Motor Oil	1.740 mm/usec	0.18000	-.00222
Water	1.480 mm/usec	-0.08300	0.00133

Step 1: Press the (**P**) key to enter the velocity.

Step 2: Press the (**P**) key again to move to the "Product Coefficient" screen . Use the number keys to enter the product coefficient as instructed by a Red Jacket Technical Representative or from the information provided in the table above.

```
PROD COEFFICIENT
        0.00000
```

Step 7: Press the (**P**) key to complete the entry and return to the ***Product Type*** display. Press the (**E**) key twice to return to *Programming Level 1*.

Creating a Special Product Type (4)

The following steps should be followed when a special product type (one that is not stored already in the ST Controllers memory) needs to be created. These functions require a technician level security code.

Step 1: Enter *Programming Level 1* then press the **4** key to move to the "Product Type" screen.

```
PRODUCT TYPE
T1 UNLEADED REG
```

Step 2: Press the → key to move to the product field. Scroll through the choices using the ↑ or ↓ key. The last field is blank and may be used for creating a special product type.

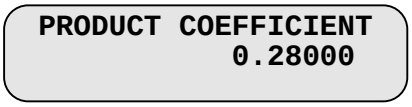
Step 3: Input the first character of the special product name using the ↑ or ↓ key to scroll through the list of characters. The choices are: **A–Z** and **0–9** are available as well as the following: **!**, **‘**, **#**, **$**, **%**, **&**, **“**, **(,)**, *****, **+**, **-**, **(.)**, **(;)**, **>**, **?**, and **@.**

Step 4: Once the first character has been chosen, press the → key to move to the next character field. Continue this procedure until the special product name is complete.

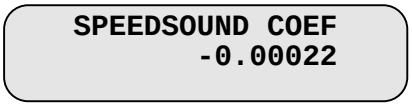
Product Type	Velocity	Product Coefficient	Speed of Sound Coefficient
Gasoline	1.166 mm/ usec	0.280000	-.00222
LPG	1.166 mm/usec	0.280000	-.00222
Gasohol	1.166 mm/usec	0.028000	-.00222
Diesel	1.380 mm/usec	0.22500	-.00222
Jet Fuel	1.380 mm/usec	0.22500	-.00222
Kerosine	1.342 mm/ usec	0.25000	-.00200
Motor Oil	1.740 mm/ usec	0.18000	-.00222
Water	1.480 mm/ usec	-0.08300	0.00133

Press the (P) key to move to the "Velocity" screen. The chart above shows the product types and their parameter values. Enter the applicable velocity value.

Step 6: Press the (**P**) key again to move to the "Product Coefficient" screen. Enter the correct coefficient.



Step 7: Press the(**P**) key to move to the "Speed of Sound Coefficient" screen.



Step 8: Use the ← key and the number keys to enter the correct value. Press the (**P**) key to complete the entry and return to the Product Type display. Press the (**E**) key to return to *Programming Level1*.

Initial Product Height (5)

The ST Controller executes a start-up sequence to determine certain system variables such as cable length. A product height is entered to assist in this procedure. The product height reading may be taken from a tank stick if it can be assured that the tank stick is accurate.

Notice **If a water float is not being used, turn to *Programming Level 2*: Water Float Status in this manual and perform the necessary programming.**

Step 1: Enter *Programming Level 1* then press the (**5**) key to move to the "Enter Product Height" screen.

```
ENTER PRODUCT HT
T1 0.000 IN
```

Step 2: Use the number keys to enter the product height value.

Notice **If an incorrect entry is made, press the → key to erase each character sequentially and re-enter the correct information.**

Step 3: Press the (**P**) key to move to the "Initialize Tank" screen.

```
INITIALIZE TANK 1
NO
```

Step 4: Use ↑ or ↓ key to select ***YES***. Press the (**E**) key to activate the auto-initialization mode. The following displays will appear.

```
INITIALIZING 0
PLEASE WAIT…
```

```
LOCATING SURFACE
PLEASE WAIT…
```

```
INIT. COMPLETE
ANY KEY TO CONT.
```

Step 1: Press any key to exit the "Initialize Complete" screen and move to the "Enter Product Height" screen.

```
ENTER PRODUCT HT
T1 87.234 IN
```

Step 6: Use the ↑ or ↓ key to scroll to the next tank number. Repeat Step's 2-5 until all tanks are complete.

Step 7: Press the (**E**) key to complete the entry and return to *Programming Level 1*.

Initial Water Height (6)

This step should only be done ***after*** the ***Product Height*** has been set and initialized. During initialization of the system, the ST Controller uses the water float reading to determine the vertical position of the inventory sensor in the tank. Since any water changes the position of the float, an initial water height must be entered.

Step 1: Enter Program Level 1 and press the (**6**) key to move to the "Initial Water Height" screen.

```
INITIAL WATER HT
T1    1.234   IN
```

Step 2: Use the number keys to enter the water height value.

Notice **If an incorrect entry is made, press the → key to erase each character sequentially and re-enter the information.**

Step 3: Press the (**P**) key to move to the"

```
INITIALIZE WATER
      NO
```

Step 4: Press ↑ or ↓ key to scroll from ***NO*** to ***YES***.

Step 5: Press the (**E**) key to begin the auto-initialization procedure and return to the "Initial Water Height" screen.

```
  INITIAL WATER HT
T1     1.234     IN
```

Step 6: Press ↑ or ↓ key to scroll to the next tank.

Step 7: Repeat steps 2-6 until all tanks have been entered.

Step 8: Press the **E** key to complete the entry and return to *Programming Level 1*.

Height of Transceiver (7)

Transceiver height is calculated by the ST Controller during the ***Calibrate Height*** process. The purpose of transceiver height programming is to provide a means of forcing the ST Controller to match the tank stick reading. Small Changes to the transceiver height should be done ***after*** all calibration is complete and the ST Controller has had at least 5 minutes of normal operation. Print out or write down the inch level reading from the ST Controller. Measure height using an accurate tank stick and record the figure. Calculate the difference and add or subtract from the current transceiver height.

Example: The ST Controller reads 55 inches, the stick reading is 56 inches, the difference is +1-in. If the current transceiver height is 5 inches, enter that value. If the ST Controller reading is greater than the tank stick reading, the difference will have to be subtracted from the transceiver height.

Warning! **Do not make large changes in transceiver height unless directed to do so by a Red Jacket Technical Support Representative.**

Step 1: Enter Program Level 1 then press the **7** key to move to the "Height of Transceiver" screen.

```
 HT OF TRANSCEIVER
 T1    0.000    IN
```

Step 2: Use the number keys to enter the transceiver height value.

Notice **If an incorrect entry is made, press the → key to erase each character sequentially and re-enter the correct information.**

Step 3: Press the **P** key to move to the "Change Transceiver Top" screen.

```
CHANGE TRANS TOP
       NO
```

Step 4: Use ↑ or ↓ key to scroll from ***NO*** to ***YES***.

Step 5: Press the **E** key to initiate the change and move to the "Transceiver Htop" screen.

```
TRANSCEIVER  HTOP
T1     0.000   IN
```

Step 6: Press the ↑ key to scroll to the next tank.

Step 7: Repeat Steps 2-6 for each tank.

Step 8: Press the **E** key to complete the entry and return to *Programming Level 1*.

Calibrate Temperature (8)

Because of the ultrasonic and reference ring technology, the ST Controller does not determine product temperature directly. The ST Controller can calculate the temperature indirectly if it is programmed with an initial temperature value. Therefore, an average product temperature value must be entered. This step should be done ***after Initial Water Height*** is set and calibrated.

Step 1: Enter Program Level 1 and press the **8** key. The "Calibrate Temp" (tank/temp) display will appear.

```
CALIBRATE TEMP
T1 0.00 DEG F
```

Step 2: Use the number keys to enter the average temperature value of the product in the tank.

Notice **If an incorrect entry is made, press the → key to erase each character sequentially and re-enter the correct information.**

Step 3: Press the **P** key to move to the "Calibrate Temperature" screen.

```
CALIBRATE TEMP
NO
```

Step 4: Use ↑ or ↓ key to scroll from ***NO*** to ***YES***.

Step 5: Press the **E** key to begin the auto-calibration process. When calibration is finished, the display will return to the Calibrate Temp screen.

```
CALIBRATE TEMP
T1 0.00 DEG F
```

Step 6: Press ↑ or ↓ key to select the next tank.

Step 7: Repeat steps 2-6 until entries for all tanks are complete.

Step 8: Press the **E** key to complete the entry and return to *Programming Level 1*.

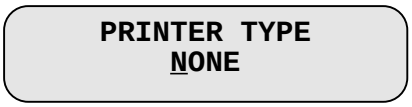
Notice **If the density of the product in the tank is ever changed, (different product or a change in additives) steps 1-8 should be performed after the product change has been made.**

Printer Type (9)

The ST Controller must know which printer, if any, has been connected to the system. This information allows the ST Controller to choose the proper protocol. The ST Controller can communicate with printers using the following criteria:

Baud Rates:	300,1200, and 9600
Flow Control:	XON and XOFF
Data Format:	8 data bits, 1 stop bit, no parity
LF:	CRLF
CR:	CR

Step 1: Enter Program Level 1 then press the **9** key to move to the "Printer Type" screen.



Step 2: Use ↑ or ↓ key to scroll to the proper printer type. If the ST Controller has the internal printer installed, then the “Seiko Printer” option should be selected. The available printers are:

- Seiko Printer (built in printer model)
- STAR Printer(DP8340)
- Serial Printer

Step 3: The default baud rate is 9600. Other supported baud rates are: 300 and 1200. To select a different baud rate, press the → key and use ↑ or ↓ key to select the appropriate rate.

Notice **The ST Controllers’ internal printer must use 9600 baud.**

Step 4: To test the printer, press the **OL** button located on the control panel. Press the **P** button and this will print the station setup.

Step 5: Press the **E** key to complete the entry and return to *Programming Level 1*.

Chapter 9: Programming Level 2

This chapter explains:

- **System Customization**
  - Security Code (0)
  - Name/Address (1)
  - Alarm Duration (2)
  - Units of Measure (3)
  - Alarm Thresholds (4)
  - Water Float Status (5)
  - Reconciliation Interval (6)
  - Inventory Report Scheduled (7)
  - Leak Detect Mode (8)
    - Manual (8)
    - Automatic (8)
    - Scheduled (8)
    - Facility Closed (8)
  - POS Terminal Type (9)

System Customization

The functions described in this chapter are optional and are used to customize and enhance the ST Controller. Enter *Programming Level 2* using the procedure “Entering Programming Levels” described in the previous chapter.

Security Code (0)

The security code protects the system from tampering of the programmable functions. This feature prevents unauthorized changes to programmed parameters during normal usage. The factory default security code is 0000, but the user may enter any combination of four numbers to change and customize this setting. Record the new code and store it in a safe location. Security codes may be entered for each of the three security levels.

Step 1: Enter *Programming Level 2* and press the **0** key to move to the "Security Code" screen

```
SECURITY CODE
LEVEL 1  0000
```

Step 2: Use the number keys to enter the desired security code for *Programming Level 1*, using all four digits. Record the code and store it in a safe location.

Notice **To change the security code for each level, the existing security code for that level must have been entered. Example: A level 1 security code can only change the level 1 code. A level 2 security code can change both level 1 and 2 codes.**

Step 3: Press the ➔ key to change the display to *Programming Level 2* security code. Use the number pad to enter the desired security code for *Programming Level 2*. Use all four digits. When complete, press the **E** key twice to return to the "Select Display.

Name and Address (1)

The ST Controller includes the facility name and address as a header for any printed report. The name and address of the station can be programmed including any message containing up to 40 characters per line, with a total of five lines, can be entered.

Step 1: Enter *Programming Level 2*. Press the **1** key to move to the "Name/Address" screen.

```
NAME/ADDR L1
  CO1 _
```

Step 2: Input the first character in the name by using ↑ or ↓ key to scroll through the list of characters until the correct one is displayed. **A–Z** and **0–9** are available as well as the following: **!**, **‘**, **#**, **$**, **%**, **&**, **“**, (**,**), *****, **+**, **-**, (**.**), (**;**), **>**, **?**, and @**.**

Step 3: Press the ➔ key and scroll to the next character. Continue steps 1 and 2 until the entire name and address or a message is entered. Keep in mind, the information entered in this section will appear on reports. Up to forty characters are available on each line.

Step 4: Press the **P** key to scroll to the next line if necessary. Up to five lines are available. Continue entering the information until finished.

Step 5: Press the **E** key to complete the entry and return to *Programming Level 2*.

Alarm Duration (2)

The ST Controller sounds an audible alarm when an overfill, product theft, or product low event occurs. The duration of the alarm may be changed from its default setting as follows.

Notice **Setting any alarm duration to zero will disable the internal audible alarm.**

Step 1: Enter *Programming Level 2* and press the **2** key to move to the "Alarm Duration" screen.

```
ALARM DURATION
OVFILL 30 THEFT 60
```

Step 2: Use the number keys or ↑ or ↓ key to enter the alarm duration, in seconds (1-99). The default is 30 seconds

Notice **A zero second duration cannot be used when programming the overfill alarm. The minimum is one second.**

Step 3: Press the → key to move the cursor to the theft alarm duration field. Use the number keys or ↑ or ↓ keys to enter the alarm duration, in seconds (1-99), The default is 60 seconds.

Step 4: Press the → key to move to the "Alarm Duration" Product Low and High Water screen. The default for both these alarms is 00 seconds.

```
ALARM DURATION
PRLW00 HIGHW 00
```

Step 1: Proceed to program the product low and the high water alarm durations as described in steps 2-3.

Step 2: Press the → key to move to the "Manifold Equalize" screen.

```
MANIFOLDED DEL
NOT EQUALIZE
```

Step 7: Use the ↑ or ↓ key to allow the manifolded tanks to equalize after product delivery before calculating total product volume.

```
MANIFOLDED DEL
EQUALIZE
```

Step 8: Press the → key and the "Print Inconclusive Test" display will appear. Use the ↑ or ↓ key to scroll to **YES** if you wish to print inconclusive test results on the leak summary of the programmed inventory report.

```
PRNT   INCL   TEST
       NO
```

Step 9: Press the **E** key to complete the entry and return to *Programming Level 2*.

Units of Measure (3)

The ST Controller can display data in either English or Metric units of measure. The following steps outline how to select the units of measure.

Step 1: Enter *Programming Level 2* and press the **3** key to move to the "Units of Measurement" screen.

```
UNITS OF MEASURE
GALLON,INCH,DEGF,
```

Step 2: Use ↑ or ↓ key to select either gallons, IMP gallons or liters.

Step 3: Press the → key to move the cursor to the height measurements. Choose either inches, cm, or mm.

Step 4: Press the → key, then use ↑ or ↓ key to select the correct temperature unit.

Step 5: Press the → key to move to the "Net Volume Temperature" screen.

```
NET VOLUME TEMP
     60.00 DEGF
```

Step 6: Use the number keys to enter temperature and press the → key to return to the "Units of Measurement" screen.

Step 7: Press the **E** key to return to *Programming Level 2*.

Alarm Thresholds (4)

Step 1: Enter *Programming Level 2* and press the **4** key to move to the "Alarm Threshold" screen.

```
ALARM THRESHOLD
    TANK 1
```

Step 2: Press the ➔ key. The "Overfill Alarm" screen will appear. The ST Controller overfill alarm default setting is 90% of tank capacity in accordance with the federal EPA regulations. Other threshold values are available, but must remain within the range from 50-95% of tank capacity.

```
OVERFILL ALARM
      90%
```

Notice **The ST Controller is used as an overfill protection. The EPA requires 90% of tank volume as the overfill threshold.**

Step 3: Use the number keys to enter the threshold value that will trigger the overfill alarm.

Step 4: Press the ➔ key to move to the "Product Low Alarm" screen.

```
PRODUCT LOW ALM
   450 GALLONS
```

Step 1: Use the number keys to enter the threshold value that will trigger the low product alarm(typically 10% of tank volume).

Step 2: Press the ➔ key to move to the "High Water Alarm" screen.

```
HIGH WATER ALARM
  0.50 INCHES
```

Step 7: Use the number keys to enter the threshold value that will trigger the high water alarm. Consult local regulatory agency for recommended levels.

Notice **The ST Controller will not accept a value that it is not capable of detecting.**

Step 8: Press the ➔ key to move to the "Minimum Delivery Volume" screen.

```
MIN DEL VOLUME
500    GALLONS
```

Step 9: Use the number keys to enter the threshold value for product deliveries. Do not leave this field at zero (500 gal is recommended unless smaller deliveries are expected).

Step 10: Press the ➔ key to move to the "Delivery Delay" screen. This is the amount of time after a delivery is completed that the ST Controller waits until the delivery data is stored. This feature is designed to compensate for dual compartment tankers during the delivery process.

```
DELIVERY DELAY
0600   SECONDS
```

Step 11: Press the ➔ key to move to the Minimum Delivery Rate screen. This threshold is the minimum amount of fuel increase in the tank necessary for the ST Controller to recognize that a delivery has begun.

Step 12: Use the number keys to set the minimum delivery rate threshold value.

```
MIN DEL RATE
 25.00  GAL/M
```

Step 13: Press the ➔ key to return to the “Alarm Thresholds” screen.

```
ALARM THRESHOLDS
     TANK 1
```

Step 14: Press ↑ or ↓ key to scroll to the next tank number. Repeat steps 2-12 until the alarm thresholds for all tanks are entered.

Step 15: Press the **E** key to complete the entry and return to *Programming Level 2*.

Water Float Status (5)

Various applications may call for removal of the water float assembly. This feature allows for that provision and must be programmed if the assembly is removed.

Notice **This feature must be performed before any calibration is done, if the water float is removed. Removal of the water float may void local, State and Federal tank gauging requirements.**

Step 1: Enter *Programming Level 2* and press the **5** key to move to the "Water Float Status" screen.

```
WATER FLOAT
T1 ATTACHED
```

Step 2: Press the → key to move the cursor to the “ATTACHED” field.

Step 3: Press ↑ or ↓ key to scroll to “NOT ATTACHED”.

Step 4: Press the ← key to move the cursor back to the tank number field.

Step 5: Use ↑ or ↓ key to scroll to the next tank number.

Step 6: Follow steps 3-6 until float status information has been entered for all tanks.

Step 7: Press the **E** key to complete the entry and return to *Programming Level 2*.

Reconciliation Interval (6)

The ST Controller allows the user the option to schedule six reconciliation report times. The following steps will describe the setup for this option. Up to six separate intervals are possible.

Step 1: In *Programming Level 2*, press the **6** key to enter the "Reconciliation Interval" screen.

```
RECONCIL INT 1
01JAN90 00:00:00
```

Step 2: Press the **P** key to enter the "Reconciliation Mode" (Gross/Net) screen. Use the ↑ or ↓ keys to choose the NET or GROSS mode for the reconciliation. Press the **E** key to return to the "Reconciliation Interval" screen. There will be one difference in this screen once the mode has been set. INT has been replaced by MODE, as shown below. This function can be performed either at the start of this procedure(as in this example), or at the end, in which case the display will continue to display "Reconcil Int"

```
RECONCIL MODE   1
24NOV97 19:00:00
```

Step 3: Press the → key to position the cursor under the day field. Use the number keys or the ↑ or ↓ key to scroll to the day the first reconciliation report is to occur.

```
RECONCIL INT 1
01JAN90 00:00:00
```

Step 4: Press the → key to position the cursor under the month field. Use the ↑ or ↓ key to scroll to the month the first reconciliation report is to occur.

Step 5: Press the → key to position the cursor under the year field. Use the ↑ or ↓ key to scroll to the year the first reconciliation report is to occur.

Step 6: Press the → key to position the cursor under the hour field. Use the ↑ or ↓ keys to scroll to the hour (in 24 hour format) the first reconciliation report is to occur.

```
RECONCIL INT 1
01JAN90 12:00:00
```

Step 7: Press the → key to position the cursor under the minutes field. Use the ↑ or ↓ keys to scroll to the minutes (in 24 hour format) the first reconciliation report is to occur. Follow the same procedure to program the seconds.

Step 8: Press the → key to move to the "Reconciliation Period"(Hours) screen.

```
RECONCIL INT 1
PERIOD      24HRS
```

The Reconciliation Period is programmed as follows:

- **For any period of hourly duration use the hours screen.(Example: 1,2,3.-.99,999hrs)**
- **For any period that is not a full hour duration must be set in seconds.(Example: 6hrs 30min would be 23400 seconds)**
- **Both the hour and seconds screens are programmed using the number keys.**

Step 9: Use the ➔ key to move to the "Reconciliation Period"(Seconds) screen(if necessary).

```
RECONCIL INT 1
PERIOD   23400SEC
```

Step 10: Use the ➔ key to change to the "Print Enable" screen. This will work from either the Hour or Seconds screen.

```
RECONCIL INT 1
  PRINT OFF
```

Step 11: Use the ↑ or ↓ key to enable or disable the print function.

Step 12: Press the ➔ key to return to the "Reconciliation Interval" screen. Follow steps 2-10 until reconciliation programming is complete for all intervals.

Step 13: Press the **E** key to complete the entry and return to *Programming Level 2*.

Notice **If the ST Controller does not obtain dispensed amounts directly from the POS system, an entry stating the final amount of dispensed product must be entered prior to printing the reconciliation report. If not, product dispensed between reconciliation report entries will not be reflected on the report thus creating errors. To ensure correct day-end figures are entered before an automated report is generated, schedule the automated report's printing time several hours later than you expect to enter these figures.**

Inventory Report Scheduled (7)

The user may program the ST Controller to store (and print) an inventory report containing inventory information for all tanks. Six report times may be scheduled to occur within individual periods. The following steps describe this procedure.

Step 1: Enter *Programming Level 2* and press the **7** key. The following display will appear with the cursor positioned under the interval number field.

```
INV RPT SCHED 1
01JAN97 00:00:00
```

Step 2: Press the → key to position the cursor under the day field. Use the number keys or the ↑ or ↓ key to set the day the first inventory report is to occur.

```
INV RPT SCHED 1
01JAN97 00:00:00
```

Step 3: Press the → key to position the cursor under the month field. Use the ↑ or ↓ key to scroll to the month the first inventory report is to occur.

Step 4: Press the → key to position the cursor under the year field. Use the ↑ or ↓ key to scroll to the year the first inventory report is to occur.

Step 5: Press the → key to move the cursor to the hour field. Use the number keys or the ↑ or ↓ key to set the hour (in 24 hour format) the first reconciliation report is to occur.

```
INV RPT SCHED 1
01JAN90 12:00:00
```

Step 6: Press the → key to move the cursor to the minutes field. Use the number keys or the ↑ or ↓ key to set to the minutes (in 24 hour format) the first inventory report is to occur. Follow the same procedure to program the seconds.

Step 7: Use the → key to move to the "Inventory Report Schedule Period "(hours) screen.

```
INV RPT SCHED 2
PERIOD      3HRS
```

The Reconciliation Period is programmed as follows:

- **For any period of full hour duration use the hours screen.(Example: 1,2,3. . .99,999hrs)**
- **Any period that is not a full hour must be set in the seconds screen.(Example: 6hrs 30min would be 23400 seconds)**

- **Both the hours and seconds screens are programmed using the number keys.**

Step 8: Use the → key to move to the "Inventory Report Schedule Period "(Seconds) screen(if necessary).

```
INV RPT SCHED 1
PERIOD   23400SEC
```

Step 9: Use the → key to change to the "Print Enable" screen. This will work from either the Hour or Seconds screen.

```
INV RPT SCHED 1
   PRINT OFF
```

Step 10: Use the ↑ or ↓ key to enable or disable the print function.

Step 11: Press the → key to return to the "Inventory Report Schedule" screen. Follow steps 2-10 until inventory report programming is complete for all intervals.

Step 12: Press the **E** key to complete the entry and return to *Programming Level 2*.

Leak Detect Mode (8)

The ST Controller may be programmed to conduct leak detection in four ways:

- **Manual:** A leak test will be initiated on each tank, (one test at a time) and activated with a number key, refer to “Display Options”.
- **Automatic:** Continuously, when conditions permit.
- **Scheduled:** At a selected interval starting from the date and time programmed.
- **Facility Closed:** During facility shut-down times, refer to Programming Level 1, “Facility Active”, to set the facility hours of operation.

Manual

Step 1: Enter *Programming Level 2* and press the **8** key. The "Leak Detect Mode" screen will appear

```
LEAK DETECT MODE
     MANUAL
```

Step 2: Use the ↑ or ↓ keys to scroll to the desired leak detect mode.

Step 3: Press the → key to move to the "Delivery Delay" screen.

```
DELIVERY DELAY
36000
```

Step 4: Use the number keys to enter the delivery delay value(in seconds).

Step 5: Press the ← key to move to the "Leak Detection Mode " screen.

```
LEAK DET MODE
02
```

Step 6: Use the ↑ and ↓ keys to enter the desired leak detection mode.

Step 7: Use the ← key to move to the "Alarm Leak Rate" screen.

```
ALARM LEAK RATE
0.020
```

Step 8: Press the ← key to move to the "Print Leak Test" screen.

```
PRINT LEAK TEST
NO
```

Step 9: Press the **E** key to complete the entry and return to *Programming Level 2*.

Automatic

Step 1: Enter *Programming Level 2* and press the **8** key to move to the "Leak Detect Mode" screen.

```
LEAK DETECT MODE
AUTO
```

Step 2: Press the → key to move to the "Delivery Delay" screen.

```
DELIVERY DELAY
36000
```

Step 3: Use the number keys to set the delivery delay in seconds.

Step 4: Press the ← key to move to the "Leak Detection Mode" screen.

```
LEAK DET MODE
02
```

Step 5: Use the . ↑ or ↓ keys to set the leak detection mode.

Step 6: Press the ← key to move to the "Alarm Leak Rate" screen.

```
ALARM LEAK RATE
0.20
```

Step 7: Use the number keys to set the alarm leak rate value.

Step 8: Press the ← key to move to the "Print Leak Test" screen

```
PRINT LEAK TEST
NO
```

Step 9: Use the ↑ and ↓ keys to enable the leak test print function.

Step 10: Press the ← key to return to the "Leak Detect Mode" screen

```
LEAK DET MODE
02
```

Step 11: Press the **P** key to move to the "Test per Period" screen

```
TEST PER PERIOD
0024     24HRS
```

Step 12: Use the number keys set the number of tests and the period. Use the ← and → keys to move between these fields.

Step 13: Press the **E** key twice to complete the entry and return to *Programming Level 2*.

Notice **The automatic leak mode is capable of producing multiple leak test reports per day, per tank. To conserve paper, switch the print option to off and retrieve the leak test results with the "Report History" in section outlined in the beginning of chapter 6 entitled "Quick Programming Reference".**

Scheduled

Step 1: Enter *Programming Level 2* and press the **8** key to move to the "Leak Detect Mode" screen.

```
LEAK DETECT MODE
SCHEDULED
```

Step 2: Use the ↑ or ↓ key to scroll to "Scheduled".

Step 3: Press the → key to move to the "Delivery Delay" screen.

```
DELIVERY DELAY
36000
```

Step 4: Use the number keys to set the delivery delay in seconds.

Step 5: Press the ← key to move to the "Leak Detection Mode" screen.

```
LEAK DET MODE
02
```

Step 6: Use the . ↑ or ↓ keys to set the leak detection mode.

Step 7: Press the ← key to move to the "Alarm Leak Rate" screen.

```
ALARM LEAK RATE
0.20
```

Step 8: Use the number keys to set the alarm leak rate value.

Step 9: Press the ← key to move to the "Print Leak Test" screen

```
PRINT LEAK TEST
NO
```

Step 10: Use the ↑ and ↓ keys to enable the leak test print function.

Step 11: Press the ← key to return to the "Leak Detect Mode" screen

```
LEAK DETECT MODE
SCHEDULED
```

Step 12: Press the **P** key to move to the "Leak Test Start Time" screen.

```
LEAK STRT TIME 1
01JAN96 00:00:00
```

Step 13: Press the → key to move the cursor to the day field. Use the number keys or the ↑ or ↓ key to set the day the first leak test is to occur.

Step 14: Press the → key move the cursor to the month field. Use the ↑ or ↓ key to set the month the first leak test is to occur.

Step 15: Press the → key to move the cursor to the year field. Use the ↑ or ↓ key to set to the year the first leak test is to occur.

Step 16: Press the → key to move the cursor to the hour field. Use the number keys or the ↑ or ↓ key to set the hour (in 24 hour format) the first leak test is to occur.

```
LEAK STRT TIME 1
01JAN90 12:00:00
```

Step 17: Press the ➔ key to move the cursor to the minutes field. Use the number keys or the ↑ or ↓ key to set the minutes (in 24 hour format) the first leak test is to occur. Follow the same procedure to program the seconds.

Step 18: Press the ➔ key to move to the "Leak Start Time Period" screen.

```
LEAK STRT TIME  1
PERIOD      12HRS
```

Step 19: Use the number keys to set the period value. Example: if the period is set for 12 hours, a leak detection test will be conducted at the date and time previously set and then every 12 hours thereafter. **Note:** If the desired period is not an hourly interval, the period must be set in seconds.

Step 20: Press the ➔ key to move to the "Leaks Start Time Tanks" screen.

```
LEAK STRT TIME 1
    TANKS _
```

Step 21: Enter the desired tank number or **0** to select all tanks. Press the ➔ key to return to the "Leak Start Time" screen. Press the **E** key to return to Programming Level 2.

Notice **If some or all of the leak tests are to be initiated at the same time at the same interval, enter the desired tank numbers now. If each leak test is to start at separate times, the information must be entered for each tank individually. Up to 8 separate intervals are possible.**

Facility Closed

Step 1: Enter *Programming Level 2* and press the **8** key to move to the "Leak Detect Mode" screen. Use the ↑ or ↓ key to scroll to "Facility Closed".

```
LEAK DETECT MODE
FACILITY CLOSED
```

Step 2: Press the ➔ key to move to the "Delivery Delay" screen.

```
DELIVERY DELAY
    36000
```

Step 3: Use the number keys to set the delivery delay(in seconds).

Step 4: Press the ← key to move to the "Leak Detection Mode" screen.

```
LEAK DET MODE
02
```

Step 5: Use the ↑ or ↓ keys to enter the desired leak detection mode.

Step 6: Press the ← key to move to the "Alarm Leak Rate" screen

```
ALARM LEAK RATE
0.20
```

Step 7: Use the number keys to set the leak rate which will trigger the alarm.

Step 8: Press the ← key to move to the "Print Leak Test" screen

```
PRINT LEAK TEST
NO
```

Step 9: Use the ↑ and ↓ keys to enable or disable the printing of a leak test report.

Step 10: Press the **E** key to complete the entry and return to *Programming Level 2*.

POS Terminal Type (9)

Interfacing an ST Controller to a POS terminal eliminates the need to manually enter “dispensed product” information. The ST Controller must be programmed for the specific terminal type so it will use the correct communications protocol. Each dispenser nozzle must be matched to the tank that it is associated with, as a one time entry, so the ST Controller can reconcile the inventory accurately.

Step 1: Enter *Programming Level 2* and press the **9** key. The "POS Terminal" screen will appear

```
POS TERMINAL
NONE
```

Step 2: Use the ↑ or ↓ key to scroll to the type of POS system that will be interfaced to the ST Controller. None, Manual, T.I.M. Elec, or T.I.M. Mech are available. **Note:** If the None option is selected, no other programming is possible.

Note: Steps 1-16 are used to program the Manual, T.I.M. Electric, and T.I.M. Mechanical types of POS terminals. The T.I.M Electric and T.I.M. Mechanical types have other additional functions which are detailed in the next section.

Step 3: Press the → key and the "Baud Rate " screen will appear. Use the ↑ or ↓ keys to scroll to the desired baud rate.

```
BAUD RATE
9600
```

Step 4: Press the → key to move to the “Dispenser Nozzle” screen. This screen associates individual dispenser nozzles to individual tanks.(or groups of tanks if a blend is being used)

```
DSP NOZ 12345678
01 TANK 40000000
```

Step 1: Use the ← or → keys to scroll to each nozzle number and use the number keys to associate it with the tank it is supplied from. In the above example, nozzle number 1 is now associated with tank number 4.

Step 2: If blended fuels are to be used, move the cursor under the desired tank/nozzle field and press the (**P**) key to move to the "Tank Blend Info" screen for that nozzle to program the blend percentages and tanks.

```
TANK BLEND INFO
T01 20% T02 80%
```

Step 7: Use the ← or → keys to scroll to move between tanks and percentages. Use the number keys or the ↑ or ↓ keys to select tank numbers and percentages.(Once both tanks are entered and the first percentage is entered, the ST Controller will calculate the 2nd percentage to total 100%.

Notice **A (B) will be placed on the dispenser nozzle map to represent the blended tank. An example of this display follows.**

```
DSP NOZ 12345678
01 TANK 1B000000
```

Step 8: Press the (**E**) key to exit from blend percentage programming and return to the "Dispenser Nozzle" screen

Step 9: Repeat steps 5-8 to continue associating each nozzle of the dispenser with the tank it is supplied from. Maximum nozzles per dispenser is 8.

Step 10: After all nozzles of the dispenser are programmed, press the ↑ key to select the next dispenser.

```
DSP NO  12345678
02 TANK 00000000
```

Step 12: Continue until all dispensers are programmed. Maximum number of dispensers is 32. Use the → key to move to the "Address Position" screen.

```
ADDRESS POSITION
   OO       OO
```

Step 12: Use the number keys or the ↑ or ↓ keys to select the address and position settings. Use the ← or → keys to move between selections. The default settings of 00,00 are used when there are less than 16 nozzles. If there are more than 16 total nozzles in used, then two TIMs must be installed. The address and position values identify the position of each nozzle on each TIM.

Step 13: Use the **E** key to return to the "Dispenser Nozzle" screen to select the next dispenser.

Step 14: Repeat steps 12 - 14 until all dispensers have been set.(If necessary)

Step 15: Press the **E** key three times to complete the entry and return to *Programming Level 2*.

Mechanical

The T.I.M. Mechanical type of interface has both the ability to autostrap tanks and to store the dispensed nozzle volumes to the ST Controller memory for later retrieval.

Step 1: Select the POS terminal option: T.I.M. Mechanical.

Step 2: Use the ← key to move to the "Tank Strapping" screen.

```
TANKS  12345678
STRAP  11000000
```

Step 3: Press the number of the desired tank (1-8) to move to the "Autostrapping On?" screen.

Step 4: Use the ↑ and ↓ keys to enable or disable the autostrapping function.

Step 5: Press the **E** key to return to the "Tank Strapping" screen and repeat steps 3-5 until all tanks are entered.

Step 6: Press the → key to return to the "POS Terminal" screen.

Step 7: Press the **P** key to move to the "Store Nozzle Volume" screen.

```
STORE NOZ VOLUME
 TO TABLE?   NO
```

Step 8: Use the ↑ and ↓ down keys to enable or disable this function.

Step 9: Press the **E** key to move to the "Configure System" screen.

```
CONFIGURE SYSTEM
       NO
```

Step 10: Use the ↑ and ↓ down keys to enable or disable this function.

Step 11: Press the **E** key to return to the "POS Terminal" screen.

T.I.M Electrical

This T.I.M Electrical type of interface has the same auto strapping function as the T.I.M. Mechanical type. Use steps 2-6 in the previous section to program this function. There are also expanded functions to store and retrieve POS data. These functions simply break down the stored nozzle volumes into categories: Total Nozzle volume, Nozzle Credit volume, Nozzle Cash volume, and Tank cash or credit values.

Step 1: Press the → key to move to the "Store Nozzle Volume" screen.

```
STORE NOZ VOLUME
 TO TABLE   NO
```

Step 2: Use the ↑ and ↓ keys to enable or disable this function.

Step 3: Press the **E** key to move to the "Store Nozzle Credit" screen.

```
STORE NOZ CREDIT
 TO TABLE?   NO
```

Step 4: Use the ↑ and ↓ keys to enable or disable this function.

Step 5: Press the **E** key to move to the "Store Nozzle Cash" screen.

```
STOR NOZ CASH
 TO TABLE  NO
```

Step 6: Use the ↑ and ↓ keys to enable or disable this function.

Step 7: Press the **E** key to move to the "Store Tank Cash/Credit" screen.

```
STORE TANK CASH/
  CREDIT? NO
```

Chapter 10: Programming Level 3

This chapter explains:

- **Communications and Peripherals**
  - Auto Dial (0)
  - Sensor Location (1)
  - Sensor Type (2)
  - Relay Programming (3)
  - Panel Alarms (4)
  - Update Programming (5)
  - Line Pressure Diagnostics (6)

Communications and Peripherals

The features described in *Programming Level 3* are optional and available on 1401, 1401L, 1801, and 1801L models. They may be used to customize and enhance operation of the ST Controller.

Auto Dial (0)

The ST Controller has the capability of calling up to 4 remote locations and transmitting reports over phone lines using a modem. The minimum requirements for modem communications are as follows.

- Hayes or Hayes compatible modem
- Serial cable (9-25-in.)(23-63cm)
- The communications software package Pathway from Red Jacket
- Phone line (analog dialup capabilities)
- PC compatible computer

- Terminal emulation program to configure the modem

- **The following list details available functions of the system when Auto Dial is enabled.**
  - Inventory Report
  - Reconciliation Report
  - Leak test(failed) Report
  - Leak test complete Report
  - Delivery Report
  - Overfill Report and Alarm
  - Theft Report and Alarm
  - Product Low Report and Alarm
  - High Water Alarm
  - Probe Failure Alarm
  - No Pass Report
  - Time, Date, Period Set

Programming the Auto Dial function(0)

Step 1: Enter *Programming Level 3* and press the **0** key to move to the "Auto-Dial" screen. The example below shows that the first auto dial function is inactive.

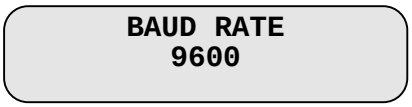
```
AUTO DIAL 1
INACTIVE
```

Step 2: Press the → key to move to the "Enter Phone Number" screen.

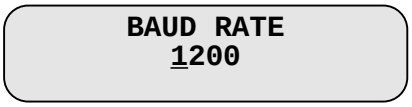
```
ENTER PHONE # 01
_
```

Step 3: Enter the phone number that the ST Controller should call for this auto dial event. This number may be up to 16 characters, including digits 0-9, letters A-Z, and the following: ! " # $ % & ' ( ) * + , - . / : ; < = > ? @. The number in the upper right hand corner of the display indicates which field(of 16 possible) that the cursor is

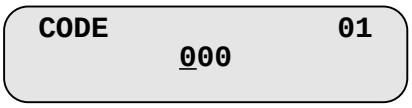
positioned under. After entering the phone number press the → key to move the cursor to the last field on the line. Press the → key to move to the "Set Baud Rate" screen.



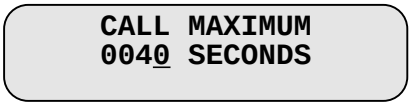
Step 4: Use the ↑ or ↓ key to select the desired baud rate. The following example shows the display with the default baud rate of 9600. Baud rates of 1200 and 300 are also available.



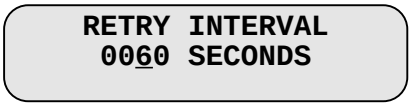
Step 5: Press the → key to move to the "Auto Dial Code" screen. Enter a unique three digit call code that the ST Controller will use to identify the station and the actions to be taken.(Using the last three digits of the station ID number is a convenient way to choose a code.) Use the number keys or the ↑ and ↓ keys to select the desired digit. Press the → key to enter the second and third call code digits. The number field in the upper right hand corner identifies which digit the cursor is positioned under.



Step 6: Press the → key to move to the "Call Maximum" screen. This setting controls the amount of time the phone is allowed to make connection before hanging up. The default is 40 seconds. Use the number keys to enter the desired setting.



Step 7: Press the → key to move to the "Retry Interval" screen. Use the number keys to enter the time interval (in seconds) between call attempts (up to 9999 seconds) after a failed connection.



Step 9: Press the → key to move to the "Retry Attempt" screen. Use the number keys to enter the number of times the ST Controller will attempt to connect after a connection failure.

```
RETRY
05
```

Step 10: Press the → key to move to the "Event" screen. Use the ↑ or ↓ key to scroll through the events that will trigger the ST Controller to send data to the remote locations. Each event type (except "Time") is enabled or disabled by pressing the **P** key.

```
EVENT
INVENTORY        OFF
```

Step 11: From the "Event" "Time" screen use the **P** key to move to the "Time, Date, Period" screen.

```
01JAN90 00:00:00
PERIOD   0012HRS
```

Step 12: Use ↑ or ↓ keys to set the Day field, Use the → key to move to the Month field and use the ↑ or ↓ keys to set the Month. Use the → key to move to the Year field and use the ↑ or ↓ keys to set the Year. Use the → key to move to the Period field. Use the number keys to set the interval period in hours. If this period is not a complete hour, then the period must be set in the Seconds screen. Use the ↑ or ↓ keys to move to the "Seconds" screen and use the number keys to set the period in seconds. Once these variables have been set, use the E key to move to the "Time Events" screen.

```
TIME EVENTS
ACTIVE?     NO
```

Step 13: Use the ↑ or ↓ keys to enable or disable this function. Use the E key to return to the "Event", "Time" screen.

Step 14: Press the **E** key to return to *Programming Level 3*.

Sensor Location (1)

The ST Controller 1401 and 1801 are capable of monitoring up to 24 peripheral sensors. This function allows you to enter a customized sensor name as a label for any printed data or report. These individual names are to enable the operator to easily identify and locate each sensor. For example: Sensor 01 could be named NORTANKGWM(North Tank Ground Water Monitor) Each sensor label can contain up to 10 characters. The available characters are as follows. **A–Z** and **0–9** as well as the following: **!**, **‘**, **#**, **$**, **%**, **&**, **“**, (**,**), *****, **+**, **-**, (**.**), (**;**), **>**, **?**, and @**.**

Step 1: Enter *Programming Level 3* and press **1** to move to the "Sensor Name" screen.

```
SENSOR 01
SENSOR 01
```

Step 2: Press the ➔ key and the cursor will be positioned under the **S** in “sensor” on line two.

```
SENSOR  01  01
 SENSOR  01
```

Notice **The number in the upper right-hand corner of the display and indicates which field(out of 10) that the cursor is positioned under.**

Step 3: Use the ↑ or ↓ key to scroll to the first letter of the sensor name or message that will appear on all printed reports.

Step 4: Press the ➔ key to move to the next character field and set in the same manner as above.

Step 5: Press the ➔ key to continue entering the label characters(maximum 10 characters).

Step 6: When complete, press the ➔ key to position the cursor on the top line under the sensor number.

Step 7: Press the ↑ key to program the next sensor label. Repeat steps 2-6 until programming for all sensors is complete.

```
SENSOR 02
SENSOR 02
```

Step 8: Press the **E** key to store the entry and return to *Programming Level 3*.

Sensor Type (2)

Sensor type programming is necessary to inform the ST Controller which sensors are connected to what channel on the sensor interface board (SIB). The actual sensor interface board channel assignments are made by the ST Controller. The appropriate sensor must be installed on the channel indicated or it may not function.

Step 1: Enter *Programming Level 3* and press the **2** key to move to the "Sensor Type" screen. The display will show the sensor type connected to channel 1. If no sensor type has been programmed, the display will show:

```
SENSOR 01
INACTIVE
```

Step 2: Press the → key to move the cursor under the sensor type.

```
SENSOR 01
INACTIVE
```

Step 3: Use the ↑ or ↓ key to scroll to the desired type of sensor. Sensor options are shown below:

Description	Channels Required
Hydrostatic	1
Hi Level Probe	1
Sump Sensor	1
Refraction Sensor	1
Hi/Low Sensor	2
Optical L. D. S.	2
Floating Vapor	2
Line Pressure	1 (for use with 01L models only - Channels 17-24)

Vapor Probe	1
Dispenser Pan	1
GW Monitor	2
Pump Sensor	N/A for use with 01L models only - (Channels 17-24)

Step 4: Press the → key when the desired sensor type is displayed. When a sensor is selected, the display will appear as follows.

```
AUDIBLE ALARM
30 SECONDS
```

Step 5: Use the number keys or the ↑ ↓ keys to enter the duration of the audible alarm. The default 30 seconds. This alarm can be set for any duration from 00-99 seconds.

Step 6: Press the → key. The following sub-steps describe the special sensor setups.

a) **Single- Channel Sensors**: The display will show the channel on the SIB (sensor interface board) to connect the selected sensor as shown in the following example.

```
SENSOR CHANNEL A
ACINP CHANNEL 01
```

a) **Two- channel Sensors**: The display will show the channels on the SIB to connect the selected sensor as shown in the following example. “Sensor Channel A” refers to channel 1 and can be used in both single and two channel programming. “Sensor Channel B” is the second channel in a two channel sensor).

```
SENSOR CHANNEL B
LEVEL CHANNEL 01
```

a) **Line Pressure**: Line pressure can only be selected on ST Controller 01L units. Use the number keys to enter the desired alarm duration in seconds in the case of a sensor alarm event. The following is an example of how the display will appear.

```
SENSOR 01
LINE PRESSURE
```

1) Press the **P** key to assign a tank to a line.

2) Press the ➔ key and the following display will appear.

```
AUDIBLE ALARM
 30 SECONDS
```

3) Use the number keys to enter the desired alarm duration upon a sensor alarm event. 30 seconds is the default setting. This alarm can be set for any duration from 00-99 seconds.

4) Press the ➔ key. The display will indicate the proper channel connection for the first line pressure transducer. Only channels 17-24 can be used for line pressure transducers.

```
 SENSOR CHANNEL A
LINE P  CHANNEL 17
```

Press the ➔ key. The display will Indicate the 120VAC input signal connection. The following display is an example:

```
 SENSOR CHANNEL B
AC INP CHANNEL 25
```

6) Press the ➔ key and the display will indicate the output that is reserved for pump control.

```
 SENSOR CHANNEL C
 RELAY CHANNEL 01
```

Notice **If connecting a high/low sensor, floating vapor sensor, groundwater sensor, dispenser pan sensor, optical L. D. sensor, or pump sensor press the ➔ key to again to see the second channel assignment and abbreviated function for these sensors. These sensors will require two separate channels. If connecting a floating vapor sensor, the ➔ key must be pressed a third time to enter the threshold value for the vapor side of the sensor (9-9999.9).**

Step 7: Press the **E** until the following display appears.

```
  SENSOR  01
 XXXX    XXXX
```

Step 8: Use the ↑ key to program the next sensor.

Step 9: Follow Steps 2-6 until the information is entered for all sensors.

Step 10: Press the **E** key to complete the entry and return to *Programming Level 3*.

Relay Programming (3)

The ST Controller 1401 and 1801 units can be ordered with up to eight programmable relays. The relays can also be added at any time and the programming updated to include them.

Step 1: Enter *Programming Level 3* and press the **3** key. The display will appear with the cursor positioned under the **1** (relay number).

```
RELAY 1
INACTIVE
```

Notice **When line pressure transducers are programmed (ST01L units only), the ST Controller automatically reserves the correct relay for pump control. The following example defines this.**

Step 2: Each of the relays can be programmed to change its normal state upon the following events (one or all); sensor alarms (peripheral sensors only), probe fail (inventory sensor only), high water, low product, theft, tank overfill, delivery, tank test complete, tank test fail, reconciliation report, inventory report, and time. Press the → key and the display will show:

```
RELAY 1
INVENTORY   NO
```

Step 3: Use the ↑ or ↓ keys to scroll to any of the following options. To activate the option, Press the → key. Use the ↑ or ↓ key to toggle from (NO) to (YES) if this event is to change the state of the relay. Press the ← key after activating a selection to continue scrolling through the options.

Inventory	no
recon	no
test fail	no
test compl	no
delivery	no
overfill	no
theft	no
prod low	no
high water	no
probe fail	no
time	no
special product	no

Step 4: When finished selecting the desired options for the relay, Press the ← key to return to the "Relay Active" screen. If relay status needs to be changed, follow steps 5-7.

Step 5: Press the ← key and the "Relay Status" screen will appear.

Step 6: To change the default setting, use the ↑ key. This will change the relay from normally open to normally closed.

Step 7: From the relay status screen, press the ← key and select the alarm duration. Enter the number of seconds for the ST Controller to activate the alarm. 0000-9999seconds are possible.

```
RELAY 1
ALARM TIME 0030
```

Step 8: Press the **E** key to save the entry and press the **E** key until the display returns to *Programming Level 3*.

Panel Alarms (4)

The ST Controller has eight lighted numbers (1-8) on the control panel that can be programmed to illuminate in the event of a sensor alarm. One sensor can be programmed to activate each light.

Step 1: Enter *Programming Level 3* and press the **4** key to move to the "Panel Alarms" screen.

```
PANEL ALARMS 1
  INACTIVE
```

Step 2: Press the → key and the display will show the sensor name, sensor number and (NO). The following is an example of this.

```
PANEL ALARMS 1
 OLDS  01  NO
```

Step 3: Use the → or ← key to move the cursor under the (**N**) in (NO). Use the ↑ key to change the (NO) to (YES). This will set the panel alarm light for the selected sensor.

Step 4: Press the ← key to move the cursor back to the sensor name field. Select the next sensor to be programmed. Complete the panel alarm set-up then press the ← key to return to the "Panel Alarm" screen.

Step 5: Use the ↑ or ↓ key to scroll to the next panel alarm to be programmed.

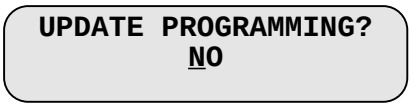
Step 6: Repeat steps 2-5 until all panel alarms are programmed, (up to 8).

Step 7: Press the **E** key to complete the entry and return to *Programming Level 3*.

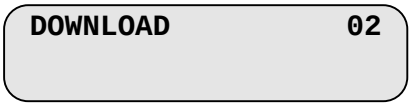
Update Programming (5)

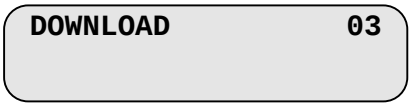
When programming is completed, programming can be downloaded to the SIB automatically. This allows the programmer to view the downloading process and detect any errors occurring. This process should not take more than a few seconds.

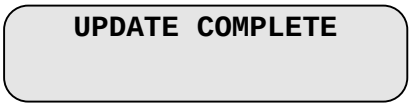
Step 1: Enter *Programming Level 3* and press the **5** key to move to the "Update Programming" screen.



Step 2: Press the ↑ key to toggle from (NO) to (YES) and press the **E** key to begin downloading. The following are examples of the screens displayed during this process.







Step 3: When the update is complete, press the **E** key to return to *programming level 3.*

Line Pressure Diagnostics (6)

Line pressure diagnostics allows the user to view the line pressure status. Programming the sensor type must be completed before line pressure diagnostics can be performed.

Step 1: Enter *Programming Level 3* and press the **6** key. The display will appear with the cursor positioned under the code number. Note: 1psi = 68.95 mBar.

```
#1  PSI:  56.3  A01
 TIME:  0000/0008
```

Step 2: To view the pump pressure press the **P** key. This starts the pump and runs it for five seconds and allows pump pressure to be viewed as it drops back down to seating pressure, (11-15 psi(758-1030mBar)).

Step 3: Press the **E** key to return to *Programming Level 3*.

Precision Test Lockout (7)

This function allows the automatic shutdown of the submersible pump if a precision leak test FAILS. This option is provided to comply with State regulations which may require this feature.

Step 1: Press the 7 key to move to the "Leak Detection Shutdown" screen.

```
LEAKDET SHUTDOWN
   MODE  OFF
```

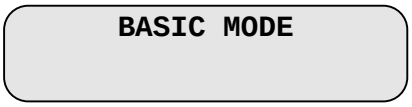
Step 2: Use the ↑ and ↓ keys to select ON or OFF. When the Leak Detection Shutdown Mode is ON, the submersible pump will automatically be shut down when a precision leak test FAILS.

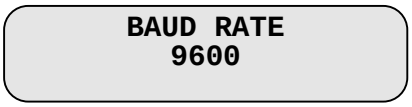
Step 3: Press the **E** key to return to the "Programming Level 3" screen.

Basic Mode (8)

This function allows you to set the basic parameters that the ST Controller uses to communicate with peripheral equipment such as modems.

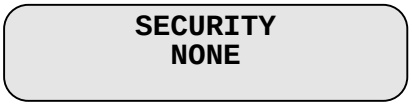
Step 1: Press the **8** key to move to the "Basic Mode" screen, then the ➔ key to move to the "Baud Rate" screen.





Step 2: Use the ↑ and ↓ keys to select the baud rate, then press the ➔ key to move to the "Parity" screen.

Step 3: Use the ↑ and ↓ keys to select the parity(Odd, Even, or None), then press the ➔ key to move to the "Security" screen.



Step 4: Use the ↑ and ↓ keys to select the security parameter, then press the **E** key to return to the "Program Level 3" screen.

Glossary of Terms

µF	Microfarad (10^{-6} farad); 0.000001 farad
AC	Alternating Current
Amp	Ampere; a unit of electric current equivalent to a steady current produced by one volt applied across a resistance of one ohm.
Arc	A luminous discharge of electric current across a gap between two electrodes (arced, arcing).
DC	Direct current
DIP switch	Dual-In-line Package switch with two rows of pins through which signals and power enter and leave the package.
EMI	Electromagnetic interference; interference relating to the magnetic fields developed by a current of electricity.
EPA	U.S. Environmental Protection Agency. The EPA line leak test protocols include hourly, monthly, and annual testing.
ESD	Electrostatic discharge; a discharge created from static electricity.
Farad	A unit of capacitance equal to the capacitance of a capacitor having a charge of 1 Coulomb on each plate and a potential difference of 1 V between the plates.
Flow Rate	The time it takes for a volume of liquid to pass through a pipe or tube, measured in GPM or GPH.
GPH	Gallons per hour.
GPM	Gallons per minute.
Ground	A conductor that connects with the earth; to connect electrically with ground (earth ground, chassis ground, analog ground, digital ground).
HDPE	High-density polyethylene.
Hertz (Hz)	A unit of frequency equal to 1 cycle per second.
High Pressure Line Test	Red Jacket proprietary pressurized line testing algorithm.
i.d.	Inside diameter (lowercase to prevent confusing with ID)
Interstitial Space	A small space between things, in particular the space between the walls of a double-walled tank.

Intrinsically Safe	To keep wiring physically separated from any other wiring.
Junction Box(J-Box)	A box designed as a protective juncture of electrical wiring.
LCD	Liquid crystal display; a display (such as the display of the ST Controller) that consists of segments of a liquid crystal whose reflectivity varies with the voltage applied to them.
Manway	Part of the tank that is removable which allows personnel to enter the tank.
MHz	Megahertz; a unit of frequency equal to one million hertz.
ml	Milliliter; 0.001 liter.
NEC	An abbreviation for the National Electrical Code
od	Outside diameter (see also id).
Ohm (Ω)	A unit of electrical resistance equal to the resistance of a circuit in which a potential difference of one volt produces a current of one ampere.
Peripheral	A device connected to the ST Controller that provides communication or auxiliary functions.
Piezo	A device which uses a piezoelectric crystal to generate sound.
Pressure Transducer	A solid-state component that senses proximal pressure in the tubing circuit and converts this pressure value into a proportional voltage for the control system.
psi	Pounds per square inch.
Siphon	A bent tube through which liquid can be moved by means of atmospheric pressure up and over the lip of one container and down into another situated at a lower level (also spelled syphon).
SW	The abbreviation for switch.
UL-Classified	A designation for products that have been evaluated by Underwriters Laboratories with respect to one or more of the following: (1) specific hazards only — for example, flammability; (2) performance under specified conditions; (3) regulatory codes; or (4) other standards.
Ullage	The amount by which the contents fall short of filling a container.
Volt (V)	The meter-kilogram-second unit of electrical potential difference and electromotive force equal to the difference in potential between two points in a wire carrying a constant current of one ampere when the power dissipated between the points is equal to one watt.
Voltage	A potential difference expressed in volts (V).

Conversion Factors:

Standard	To	Metric	Multiply by:
Inches		cm	2.54
Feet		cm	30.48
Lb		Kg	0.454
PSI		mbar	68.95
°F		°C	(F° - 32) x 5/9

Metric Abbreviations:

Mega	M	10^{6}
Kilo	K	10^{3}
milli	m	10^{-3}
micro	µ	10^{-6}
pico	p	10^{-9}

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