

DEF Recirculation And Temperature Control

Installation, Setup & Operations Manual



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Introduction

Overview

This manual describes the installation of temperature sensors used in Recirculation and Temperature Control primarily for Diesel Exhaust Fluid (DEF). It also details the console setup and diagnostics for each of these features.

RECIRCULATION

A Diesel Exhaust Fluid (DEF) Recirculating Temperature Sensor monitors the temperature in the DEF fluid between the DEF tank and the DEF dispensers to prevent DEF fluid from freezing in the lines or degrading at high temperatures (see Figure 1). When the sensed temperature drops or rises to a preset temperature, the console can turn on the DEF pump to recirculate the DEF fluid throughout the piping until the product temperature reaches a preset stop temperature.

RECIRCULATION LOOP

The recirculation loop is installed by running the line from the pump to the first dispenser and then continuing the line to the next dispenser and so on. At the last dispenser, the line is returned to the tank. With this daisy chain topology, there are no dead end runs to an isolated dispenser or group of dispensers. This ensures all of the fluid in the line can be recirculated from the line back to the tank.

System Requirements

The TLS-450PLUS with the DEF Recirculation feature requires the following system components:

- TLS-450PLUS console with version 8E or higher software, USM module and an I/O module
- Mag Plus probe for alternative fluids
- Pressure gauge on DEF pump discharge

Product Marking Information

RELATED DOCUMENTS

Documents Required to Install Equipment

This intrinsically safe apparatus is only for use as part of a Veeder-Root Automatic Tank Gauging System (ATG Console with probes and sensors). To install intrinsically safe apparatus, use the specific control drawing that appears on the nameplate of the applicable associated apparatus (ATG Console):

Equipment	UL/cUL Control Drawing Document No.
Associated Apparatus	
TLS-450PLUS/8600	331940-008
TLS4/8601	331940-018
TLS-XB/8603	331940-019

The control drawings contain information related to the correct installation of the overall intrinsically Safe System. This includes information such as maximum number of apparatus, specific apparatus allowed in the system, maximum cable lengths, references to codes, proper grounding and so on. Control drawings can be found on the accompanying Compact Disk (TECH DOCS CD) or on the internet at veeder.com under SUPPORT; VR TECHNICAL DOCUMENTS; DRAWINGS.

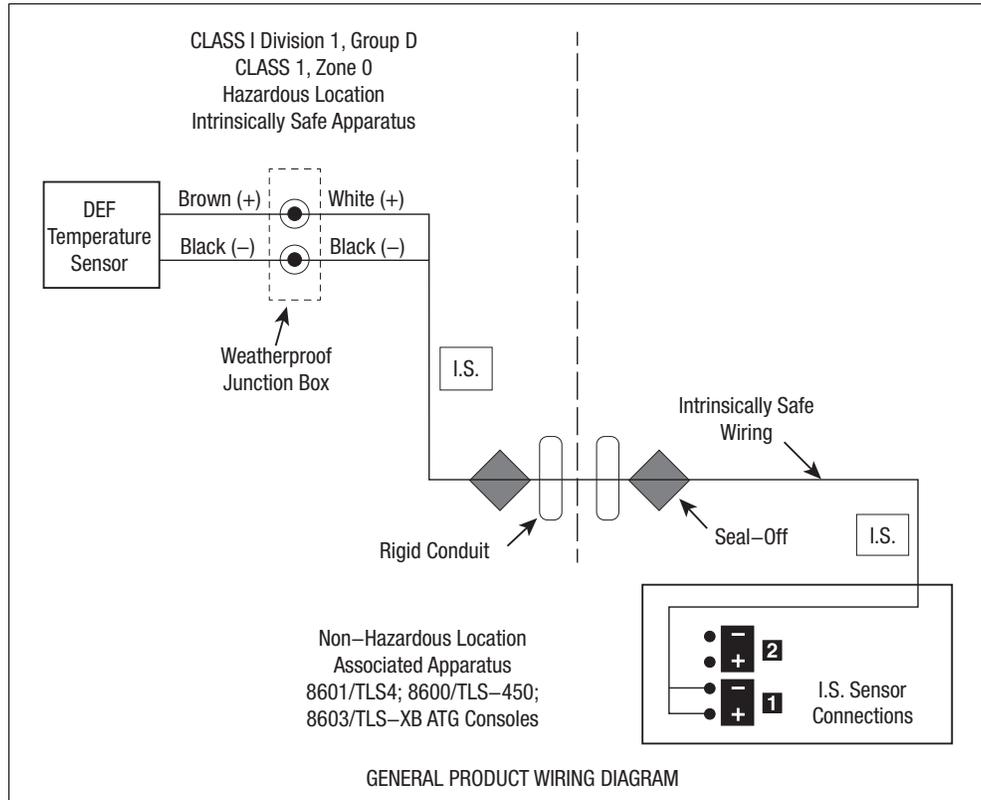


Figure 1. General Product Wiring Diagram

Product Label Contents

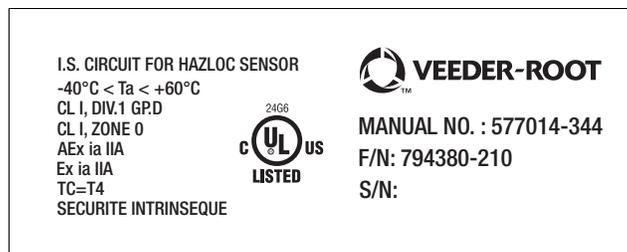


Figure 2. Product Label

Reference Manuals

- 577014-360 The Red Jacket DEF Pump Installation Manual
- 577014-022 8601 Series Console Site Prep Certification Manual

- 577014-033 TLS-XB Console Site Prep and Installation Manual
 577014-073 TLS-450PLUS Console Site Prep and Installation Manual
 577014-110 TLS-450PLUS/TLS4 Operator's Manual

Contractor Certification Requirements

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

Installer (Level 1) Certification: Contractors holding valid Installer Certification are approved to perform wiring and conduit routing; equipment mounting; probe, sensor and carbon canister vapor polisher installation; wireless equipment installation; tank and line preparation; and line leak detector installation.

ATG Technician (Level 2/3 or 4) Certification: Contractors holding valid ATG Technician Certifications are approved to perform installation checkout, startup, programming and operations training, system tests, troubleshooting and servicing for all Veeder-Root Series Tank Monitoring Systems, including Line Leak Detection. In addition, Contractors with the following sub-certification designations are approved to perform installation checkout, startup, programming, system tests, troubleshooting, service techniques and operations training on the designated system.

- Wireless 2
- Tall Tank

Warranty Registrations may only be submitted by selected Distributors.

Safety Precautions

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

 <p>EXPLOSIVE Fuels and their vapors are extremely explosive if ignited.</p>	 <p>FLAMMABLE Fuels and their vapors are extremely flammable.</p>
 <p>ELECTRICITY High voltage exists in, and is supplied to, the device. A potential shock hazard exists.</p>	 <p>TURN POWER OFF Live power to a device creates a potential shock hazard. Turn Off power to the device and associated accessories when servicing the unit.</p>
 <p>WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.</p>	 <p>USE SAFETY BARRICADES Unauthorized people or vehicles in the work area are dangerous. Always use safety cones or barricades, safety tape, and your vehicle to block the work area.</p>
 <p>INJURY Careless or improper handling of materials can result in bodily injury..</p>	 <p>GLOVES Wear gloves to protect hands from irritation or injury.</p>
 <p>WEAR EYE PROTECTION Wear eye protection when working with pressurized fuel lines or epoxy sealant to avoid possible eye injury.</p>	 <p>WEAR RESPIRATOR Wear breathing protection when working in the presence of harmful vapors.</p>
 <p>READ ALL RELATED MANUALS Knowledge of all related procedures before you begin work is important. Read and understand all manuals thoroughly. If you do not understand a procedure, ask someone who does.</p>	 <p>NOTICE is used to address practices not related to physical injury.</p>

GENERAL

Ensure that all local council and regulations are complied with. Also ensure that all recognized safety codes are followed.

⚠️WARNING Every person working with Veeder-Root equipment is expected to take every safety precaution possible in the installation of the TLS Systems.

Contractors must ensure that supervisory personnel on the installation site are aware of their presence and requirements, especially the provision of safe working areas and isolation from AC electrical power.

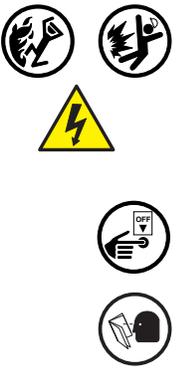
It is the contractor's responsibility to comply with the instructions and warnings found in this manual.

INTRINSIC SAFETY

The design of Veeder-Root products limits the power in the wiring to the sensors and keeps this wiring physically separated from any other. It is the responsibility of the contractor to maintain the effectiveness of these safety features by preparing the installation site in accordance with the instructions and warnings which follow. Failure to do so could create danger to life and property. Only those products contained in the system descriptive documents are certified by Veeder-Root. The safe installation and placing of equipment into service that is not contained on the system descriptive documents is the sole responsibility of the installer, end user and local authority having jurisdiction. All installations must comply with all local, national and international codes.

Circuitry within the console barrier forms an intrinsically safe, energy limited system. This system makes the sensors suitable for use in hazardous locations. Sensor wiring is intrinsically safe only when connected to the TLS console. All sensor wiring must be contained in dedicated ducts.

⚠️WARNING Substitution of specified components may impair intrinsic safety.

⚠️ WARNING	
	<p>This product operates in a potentially dangerous environment of a gasoline/ diesel filling station in which exist flammable fuels, vapors, and high voltage or pressures.</p> <p>FAILURE TO COMPLY WITH THE FOLLOWING WARNINGS AND SAFETY PRECAUTIONS COULD CAUSE DAMAGE TO PROPERTY, ENVIRONMENT, RESULTING IN SERIOUS INJURY OR DEATH.</p> <ol style="list-style-type: none"> 1. All installation work must comply with the latest issue of the National Electrical Code (NFPA 70), PEI/RP1100 Recommended Practices For The Storage And Dispensing Of Diesel Exhaust Fluid (DEF), and any European, national, state, and local code requirements that apply. 2. Explosion could occur if other wires share ducts with intrinsically safe probe or sensor wiring. Ducting from probes and sensors must not contain any other wiring circuits. 3. Turn off, tag, and lockout power to the DEF pump before connecting or servicing it. 4. Do not step on DEF pump when entering or leaving the sump. 5. Before installing pipe threads apply an adequate amount of fresh DEF compatible, non-setting thread sealant.

Warnings and Instructions

IMPORTANT SAFETY INFORMATION



This section introduces the hazards and safety precautions associated with installing, inspecting, maintaining or servicing this product. Before performing any task on this product, read this safety information and the applicable sections in this manual, where additional hazards and safety precautions for your task will be found. Damage to property, environment, resulting in serious injury or death may occur if these safe service procedures are not followed.

PRELIMINARY PRECAUTIONS

You are working in a potentially dangerous environment of flammable fuels, vapors, and high voltage or pressures. Only trained or authorized individuals knowledgeable in the related procedures should install, inspect, maintain or service this equipment.



Read The Manual

Read, understand and follow this manual and any other labels or related materials supplied with this equipment. If you do not understand a procedure, call 1-800-323-1799 to locate a qualified technician. It is imperative to your safety and the safety of others to understand the procedures before beginning work. **Make sure your employees and any service contractors read and follow the instructions.**

Follow The Regulations

Applicable information is available in PEI/RP1100 Recommended Practices For The Storage And Dispensing Of Diesel Exhaust Fluid (DEF)¹, NFPA 70; National Electrical Code (NEC), Occupational Safety and Hazard Association (OSHA) regulations and federal, state, and local codes. All these regulations must be followed. Failure to install, inspect, maintain or service this equipment in accordance with these codes, regulations and standards may lead to legal citations with penalties or affect the safe use and operation of the equipment.

ISO STANDARD FOR DEF

The production, handling and transportation of Diesel Exhaust Fluid (DEF) are governed by the ISO 22241 standard. Guidelines require manufacturers to follow clear procedures for the manufacture and distribution of DEF, ensuring that the product meets the requirements of vehicle manufacturers. The ISO standards are available from the ISO website².

REQUIREMENTS FOR USE

- The selection of any Veeder-Root product must be based upon physical specifications and limitations and the product's compatibility with the materials to be handled. Veeder-Root makes no warranty of fitness for a particular purpose.
- All Veeder-Root products should be used in accordance with applicable federal, state and local laws, ordinances and regulations.

CLEANLINESS OF SURFACES IN CONTACT WITH DEF

All surfaces in direct contact with DEF shall be free of foreign matter (fuel, oil, grease, detergent, dust and any other substance).

1. <http://pei.org/PublicationsResources/RecommendedPracticesExams/RP1100/tabid/849/Default.aspx>

2. http://www.iso.org/iso/search.htm?qt=22241&sort=rel&type=simple&published=on&active_tab=standards

To avoid any contamination of DEF with trace elements, particles and foreign matter, surfaces of equipment not exclusively used with DEF shall be cleaned with distilled or de-ionized water and DEF in the last cleaning step immediately before the use with the DEF to be handled with the equipment.

The use of tap water should especially be avoided due to the high concentrations of alkali and alkali earth metal ions therein. However, if distilled water or de-ionized water is not readily available, the material may be cleaned with tap water, provided the last rinse is done using the DEF to be handled with the equipment.

SAFETY INSTRUCTIONS

- The maximum operating pressure and the operating temperature must be observed.
- Keep fluid away from the motor cable.
- Follow internal instructions.



Wear protective clothing (face and breathing protection, protective gloves, etc.). Deploy safety barricades around work area.



DEF Temperature Sensor Installation Kit

VR Temp Sensor kit (P/N 794380-210) contains the items shown in Table 1:

Table 1.- Kit 794380-210 Contents

Qty.	Part number	Description
1	576048-120	Sensor, Temperature Probe - 6"
1	514100-304	Epoxy Sealing Pack
1	576008-714	Thermocouple Compression Fitting, 1/2" NPT To 1/4" Tube
1	331028-001	Cord Grip, 1/2" NPT
2	576008-461	Wire Nut
2	510901-337	Tie Wrap - 4"
1	577014-344	Manual, Installation
1	577014-041	Manual, Control Drawing

Piping Installation Considerations For Recirculation

The following flow rate and pressure relief functions must be taken into account when installing pumps for Recirculation.

ENSURING PROPER RECIRCULATION FLOW

When installing Recirculation using Red Jacket Core DEF or Franklin Electric pumping systems, the return line to the tank will require a ball valve. This valve controls the return flow rate line pressure to ensure dispensing flow rates are not impacted by the recirculation system.

To maintain proper pressure drop, you must set the DEF recirculation return line ball valve to approximately 1-2 psi below dead head pressure. Reference Figure 3 or Figure 4 depending on your DEF installation.

1. Turn on the pump with no dispensing and the return line Ball Valve A closed. At the pump, note the reading in the return line Pressure Gauge A.
2. Crack open Ball Valve A until there is a 1-2 PSI drop in return line Pressure Gauge A. Leave Ball Valve A at this position.

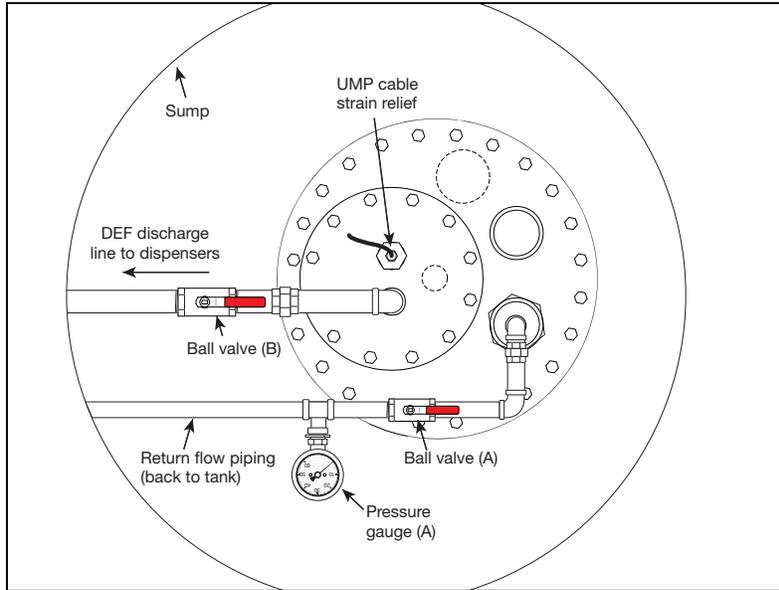


Figure 3. DEF Recirculating Piping With Fixed Pressure Relief Example Installation

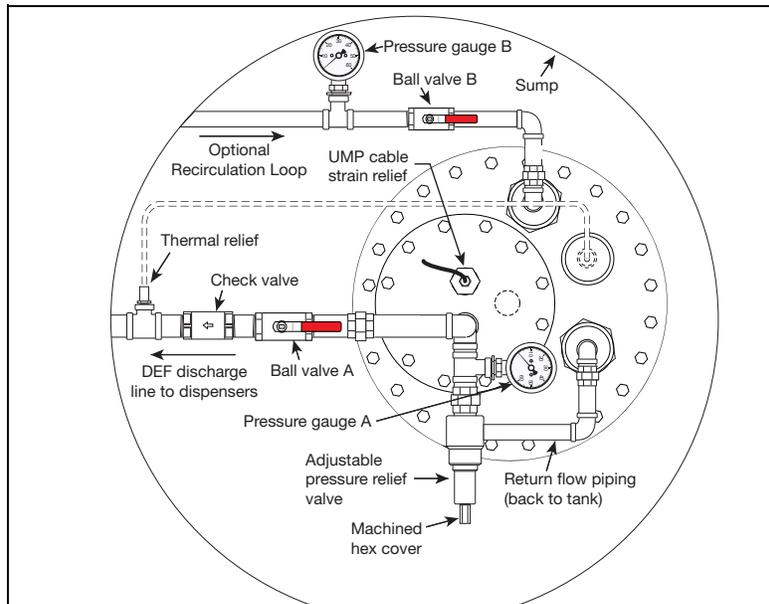


Figure 4. DEF Recirculating Piping With Adjustable Pressure Relief Example Installation

PRESSURE RELIEF VALVE

The Red Jacket Core DEF pump with Recirculation requires a pressure relief valve to be installed in the line at the output of the pump or inside the tank. This provides recirculation in the pump to cool the pump. The relief pressure is below 50 psi. This relief valve will prevent pressure spikes from influencing the calibration of the ball valve. In addition, the external adjustable pressure relief valve can ensure proper flow rate to the dispenser. You can adjust the pressure relief valve if desired.

The Franklin Recirculation pump requires a pressure relief valve to be installed in the line at the output of the pump (inside the tank). This provides recirculation in the pump to cool the pump. The relief pressure is between 30-40 PSI. This relief valve will prevent pressure spikes from influencing the calibration of the ball valve.

LINE-MANIFOLDED TANKS

Recirculation does not support line-manifolded tanks. It is appropriate to return recirculated fluid only to the original tank.

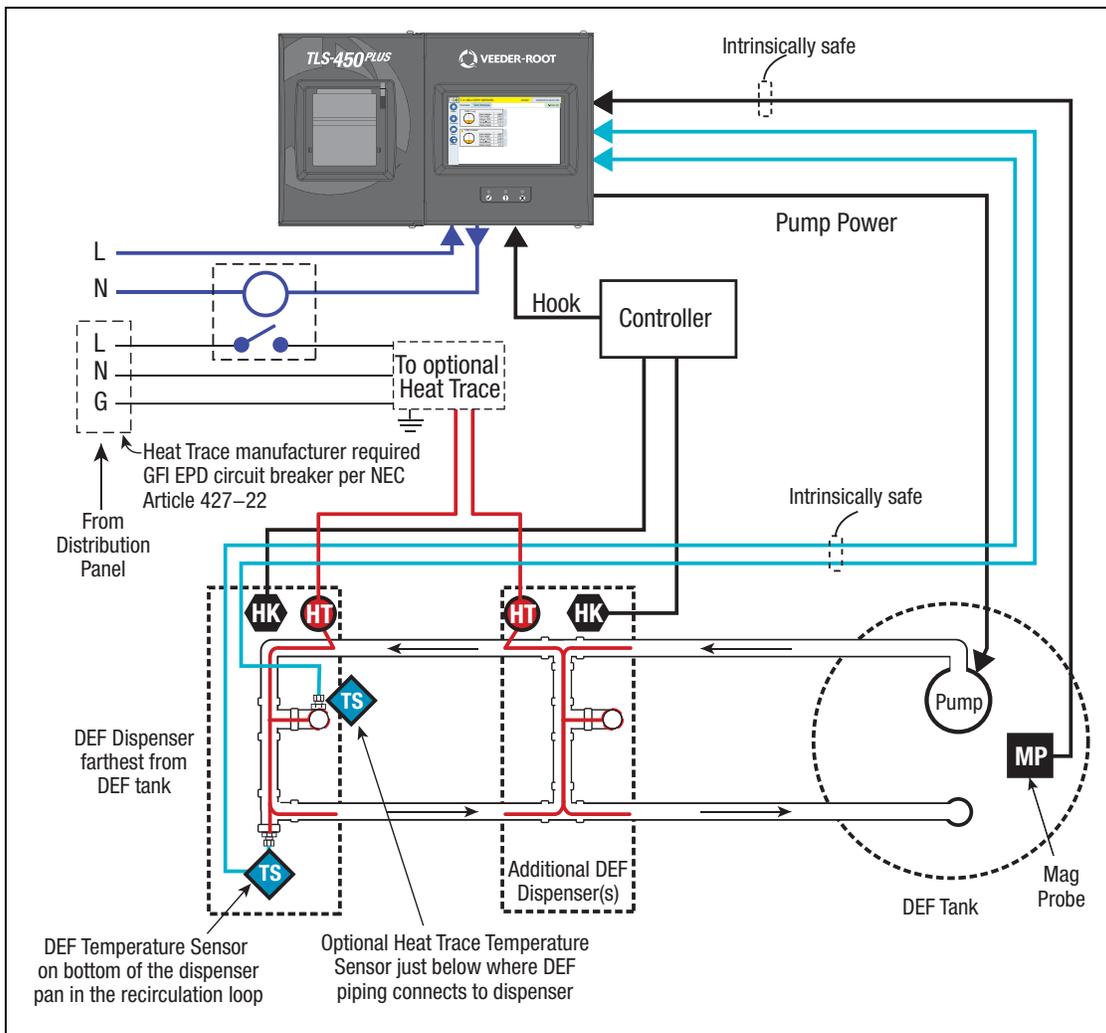


Figure 5. Example DEF Fluid Temperature Monitoring Components

TEMPERATURE CONTROL

For the Temperature Control feature, the ATG can also control a customer supplied Heat Trace System independently or concurrently with the DEF pump (see Figure 5 on page 8). Temperature Control works with temperature sensors to detect temperature changes and trigger relays as a result. It is used where Recirculation may not be able to move product in the line back in the tank.

In Setup > Temp Control, you can associate a relay with temperature sensors and set the temperatures at which the relay will turn on and off. When any of the sensors associated with the relay detect this temperature, the relay turns on and remains on until the Relay Control Off Temp is detected by all of the sensors associated with the relay.

Installation

One or more temperature sensors must be installed in the line. Typically, a temperature sensor is installed at the last dispenser in the line or in the return line in the STP sump. With normal dispensing, the last dispenser is less likely to receive fluid that is at tank temperature.

For each line with a temperature sensor(s), the user can set a low and high temperature threshold. These levels, in effect, define the normal operating temperature the system will try to keep the line temperature within. These two limits will control pump recirculation.

1. Determine the best location for the temperature sensor in the DEF line. Figure 2 shows a typical temperature sensor installation in the DEF dispenser pan furthest from the DEF tank. Each site should be evaluated to determine the best location for the temperature sensor.
2. Install a bushing in the line which has a female 1/2" NPT port at the desired sensor location (see example in Figure 6).

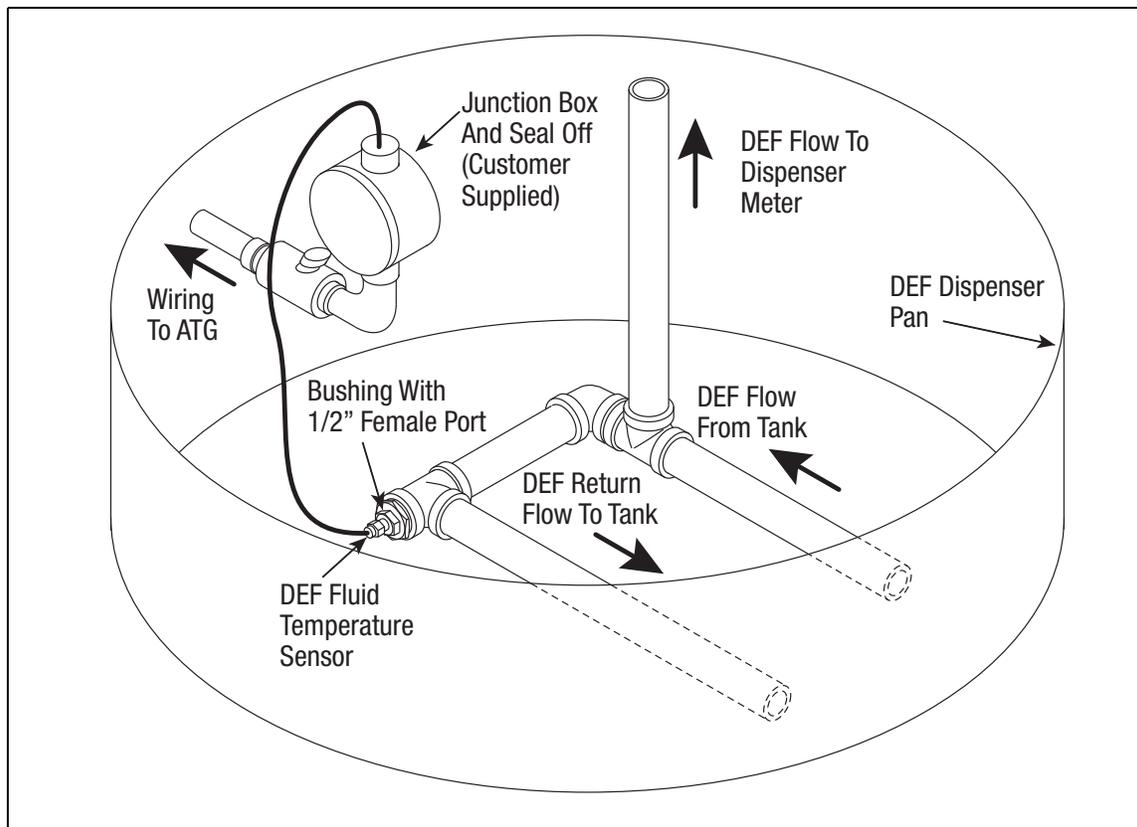


Figure 6. DEF Temperature Sensor Example Installation

3. Apply non-setting, DEF-compatible thread sealant to the external 1/2" NPT threads on the tube fitting and install it into the bushing.
4. Loosen the nut on the tube fitting and insert the temperature sensor into the tube fitting enough, but not more than 6", to ensure the 1/4" diameter section of the sensor is inside the tube fitting.
5. Tighten the nut on the tube fitting 1-1/4 turns beyond hand tight.
6. Figure 3 and Figure 4 show typical DEF recirculation return line fittings in the DEF pump sump.

NOTICE When routing the return to the tank it is recommended that the return line be extended near the bottom of the tank to avoid any disruption to the tank probe's readings.

Sensor Field Wiring

Figure 7 contains diagrams for connecting, at the field junction box, cables from the sensor to cables from the console. Check diagrams closely for polarity requirements.

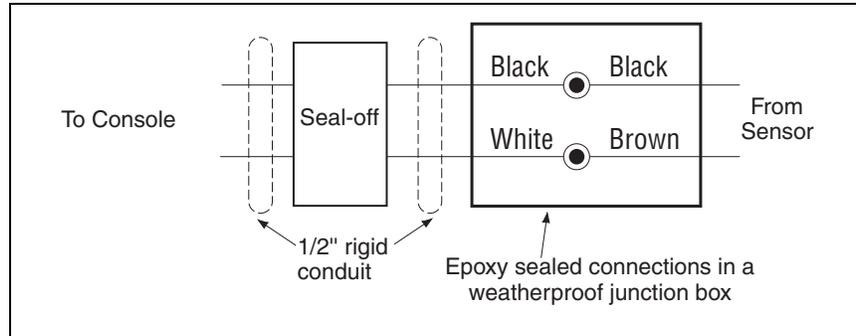


Figure 7. Field Wiring Sensor Cable To Console Cable

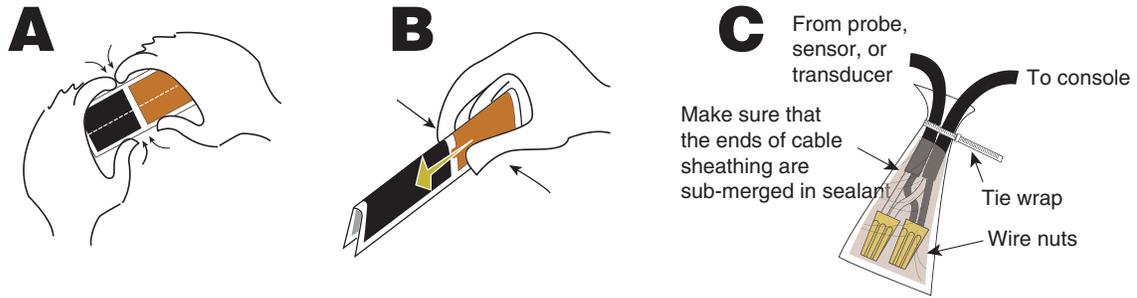
Sealing Field Connections

WIRING RUN THROUGH RIGID CONDUIT

1. Pull the wires from the sensor into the junction box. Pull the two wires from the console through the seal-off box, the conduit attaching the junction box to the seal-off box and into the junction box.
2. Using wire nuts, connect the two wires from the sensor to the two wires coming from the console. Be sure to observe color codes or tags when making these connections so that the sensor outputs are attached to the correct terminals in the console and that polarity is maintained when required.
3. Seal wire nuts with epoxy sealant following the instructions in Figure 8.
4. Do **NOT** terminate shield or drain wire in the field junction box. Ground shield and drain wires at console only.
5. Place the bag with the resin sealed wiring connections in the junction box. Replace and tighten the junction box cover.

DIRECT BURIAL CABLE

When using direct burial cable for sensor-to-console wiring runs, the sealing materials and procedure are completely different. Refer to the Direct Burial Cable Installation Manual 576013-858.



Instructions:

NOTE: When temperature is below 50°F (10°C), keep resin in a warm place prior to mixing (e.g., in an inside pocket next to body).

1. Open epoxy sealant package, and remove resin pak.
2. Holding resin pak as shown in A, bend pak along long length.
3. As shown in B, firmly squeeze the RED SIDE of the resin, forcing it through the center seal and into BLACK SIDE.

4. Mix thoroughly to a uniform color by squeezing contents back and forth 25-30 times.
5. Squeeze mixed, warm resin into one end of bag and cutoff other end.
6. Slowly insert wiring connections into sealing pack until they fit snugly against the opposite end as shown in C.
7. Twist open end of bag and use tie wrap to close it off and position the tie wrapped end up until the resin jells.



CAUTION: Epoxy sealant is irritating to eyes, respiratory system, and skin. Can cause allergic skin reaction. Contains: epoxy resin and Cycloaliphatic epoxy-carboxylate.

Precautions: Wear suitable protective clothing, gloves, eye, and face protection. Use only in well ventilated areas. Wash thoroughly before eating, drinking, or smoking.

879-38.eps

Figure 8. Epoxy Sealing Probe And Sensor Field Connections

Console Wiring Precautions



IMPORTANT - You must read and understand this information prior to wiring devices to console.

NOTICE

During programming, the devices wired to each connector are identified and stored in system memory. If a device is later removed and reconnected to a different set of connectors, the system will not properly recognize the data being received. Once a device has been wired to certain connectors on a USM or I/O Module and the system has been programmed, the wires from that device may not be relocated to other connectors without reprogramming that device.

Connecting Sensor Wiring To The Console

WARNING

intrinsically-safe wiring must enter designated knockouts - refer to the console's Site Prep manual.

Try not to have too much wire in your console. Pull unneeded wire back into your wiring trough and loop it neatly.

1. Following the console's site prep manual instructions open the console doors to access the input connector to which you will connect the DEF Temperature Sensor.
2. Make sure to terminate the sensor wiring ground shield to the ground lug on the module (TLS-450PLUS/TLS-XB) or in I.S. section of the console (TLS4), as the other end at the sensor is NOT grounded.

3. Write in the device name for each wire connection on the connector block in the module's wiring label attached to the inside of the door.
4. Make sure that you loop the wire neatly under the lip of the module. This will keep your wires from interfering with the door when it closes.
5. Close the console door and access **Menu>Setup>Device>Sensor** setup screen and select **Temp Sensor** to set up the new DEF Temperature Sensor. See *Console Setup For Recirculation* on page 15.

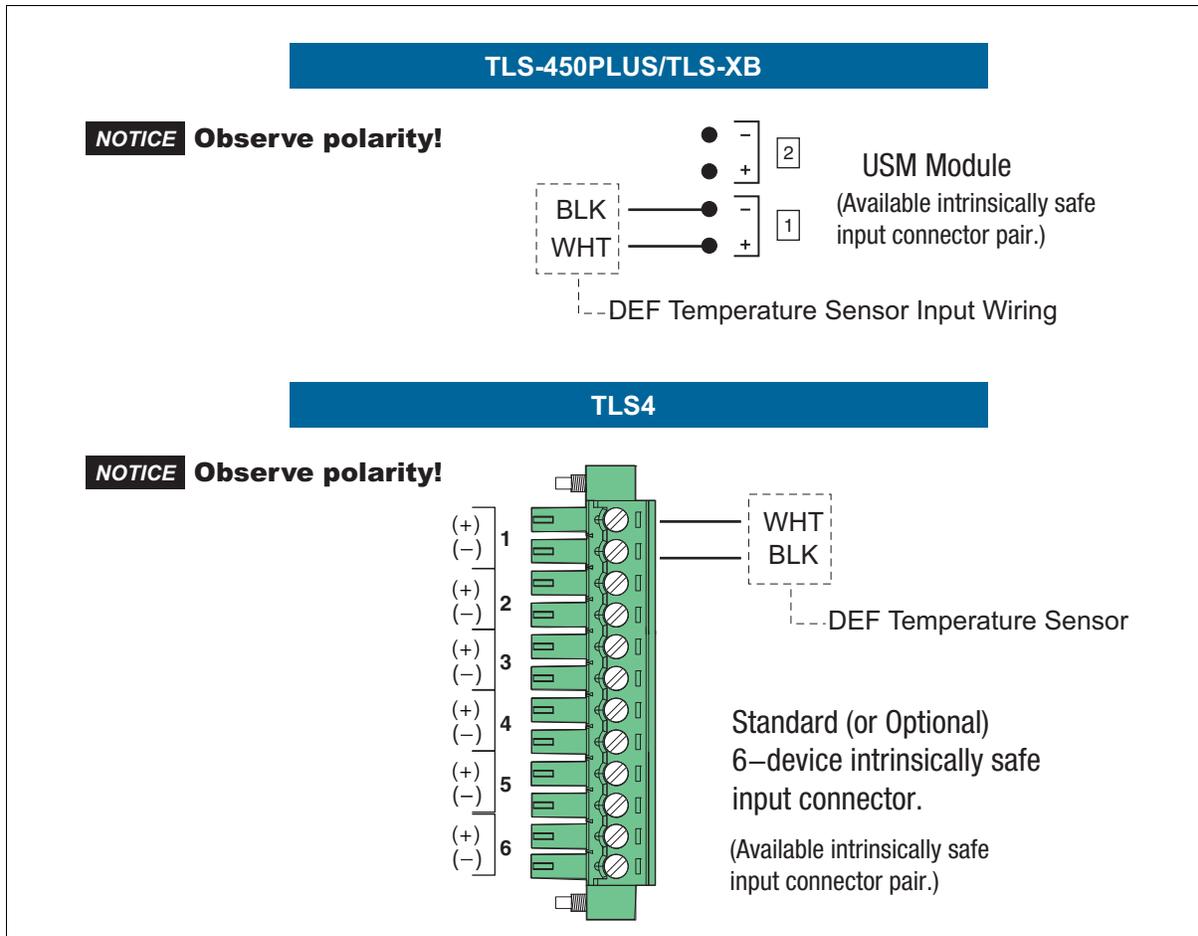


Figure 9. Connecting DEF Temperature Sensor To Console

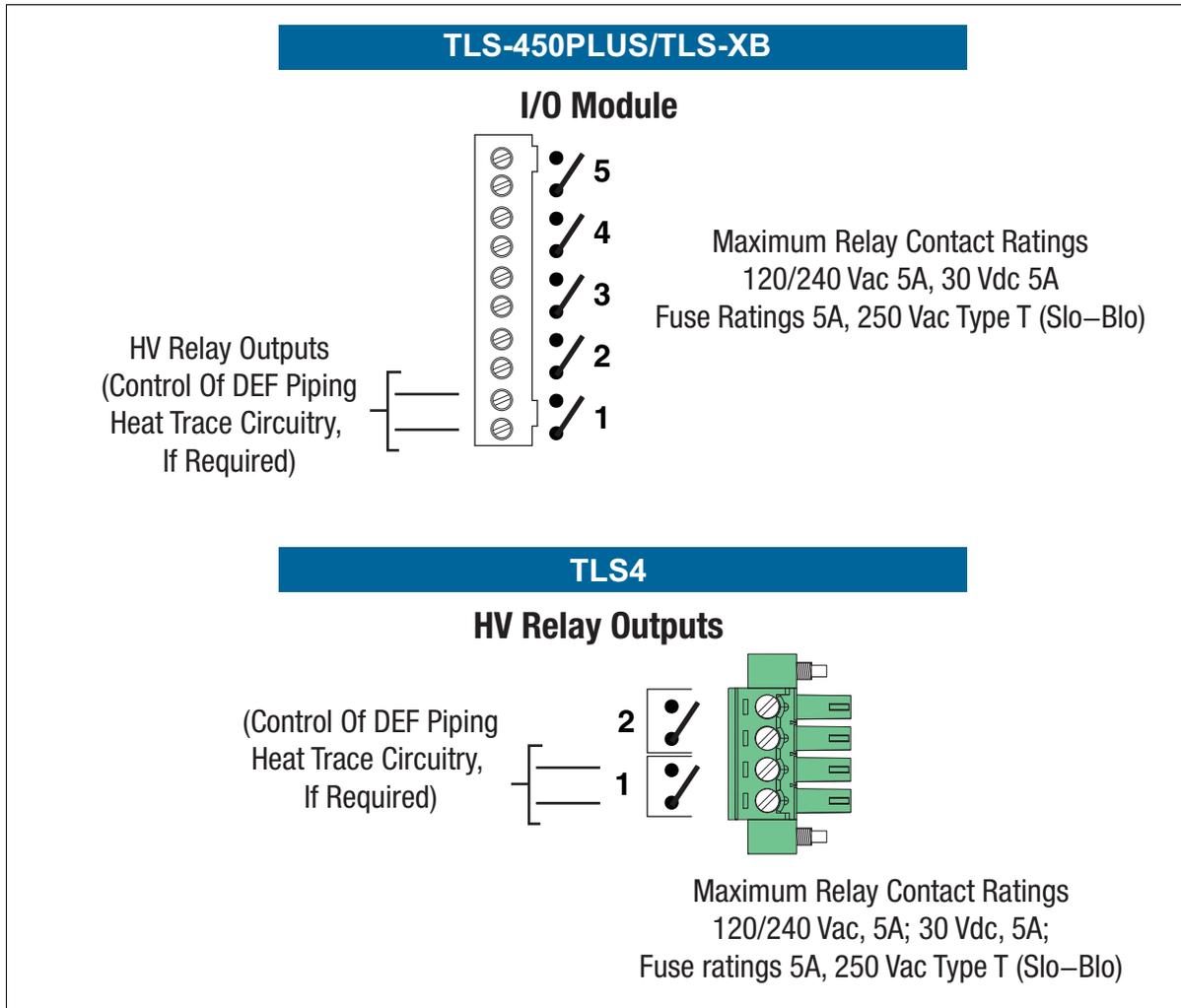


Figure 10. I/O Relay Module Connections For DEF Piping Heat Trace Control (If Required)

Console Setup For Recirculation

The following console setup instructions are for Recirculation.

If you are only installing Temperature Control without Recirculation proceed to Console Set Up For Temperature Control on page 28.

Dispenser and Pump Controller Hook Signals

The hook signal from the dispensers is connected to a high voltage input (EI) in the gauge. A relay in the gauge provides the control signal to the pump controller to activate the pump. The relay will be active when the dispenser signal is active or when the recirculation algorithm has determined the line needs recirculation.

Set Up Dispenser Hook Input (External Input)

In the **Setup>Devices>External Input** screen, add an external input as a **Pump Sense** type. This is used to indicate when the Recirculation dispenser is activated. The label should be defined appropriately.

Physically, the Dispenser Hook Input should be connected to this input.



Figure 11. External Input Setup Screen

Set Up Pump Control (Relay)

In the **Setup>Devices>Relay** screen, add a relay as a **Pump Control Output**. This is used to turn on the pump when Dispenser Hook Input is applied.

*Note: Do not set the Relay type to Temperature Control.

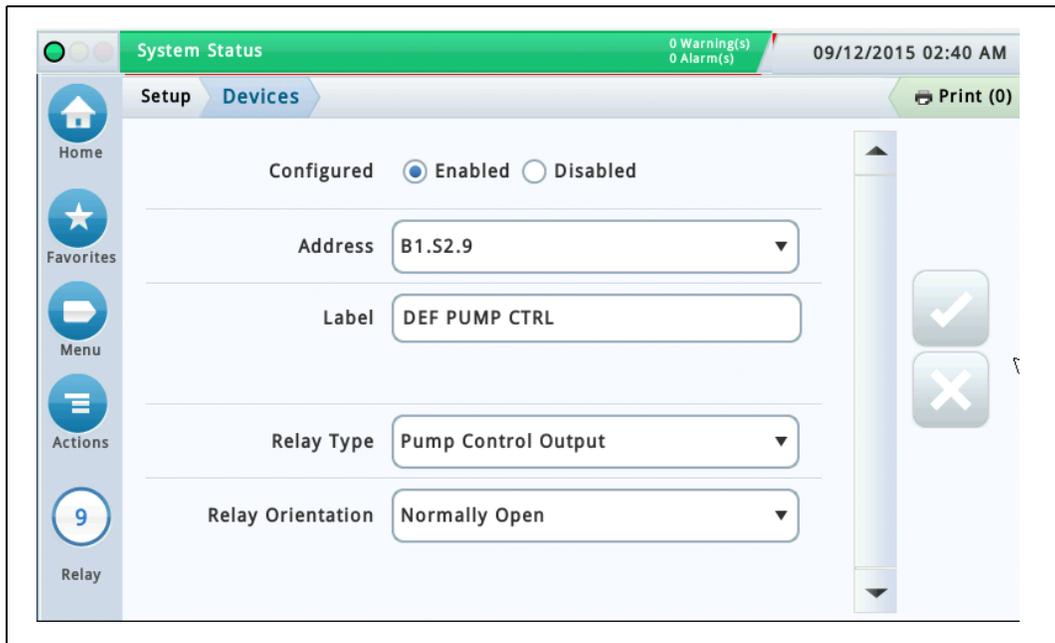


Figure 12. Relay Setup Screen

Set Up Probe

In the **Setup>Devices>Probe** screen assign the probe associated with the DEF tank. This is required to set up the DEF tank.

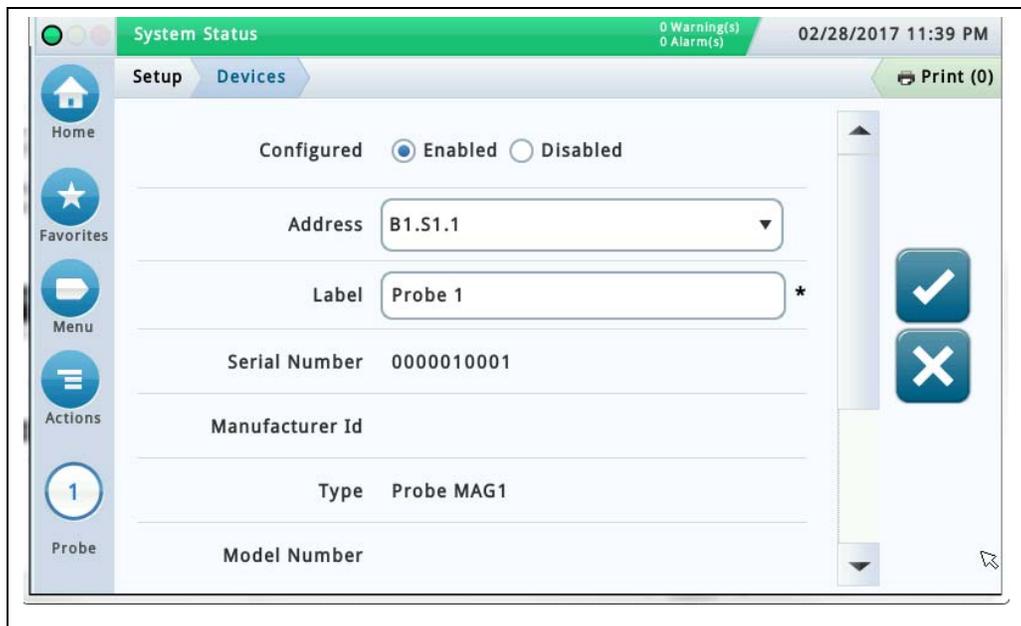


Figure 13. Probe Setup Screen

Set Up Tank

In the **Setup>Tank>General** screen assign the DEF Tank associated with the DEF probe. This will all be brought together when setting up the Pump.

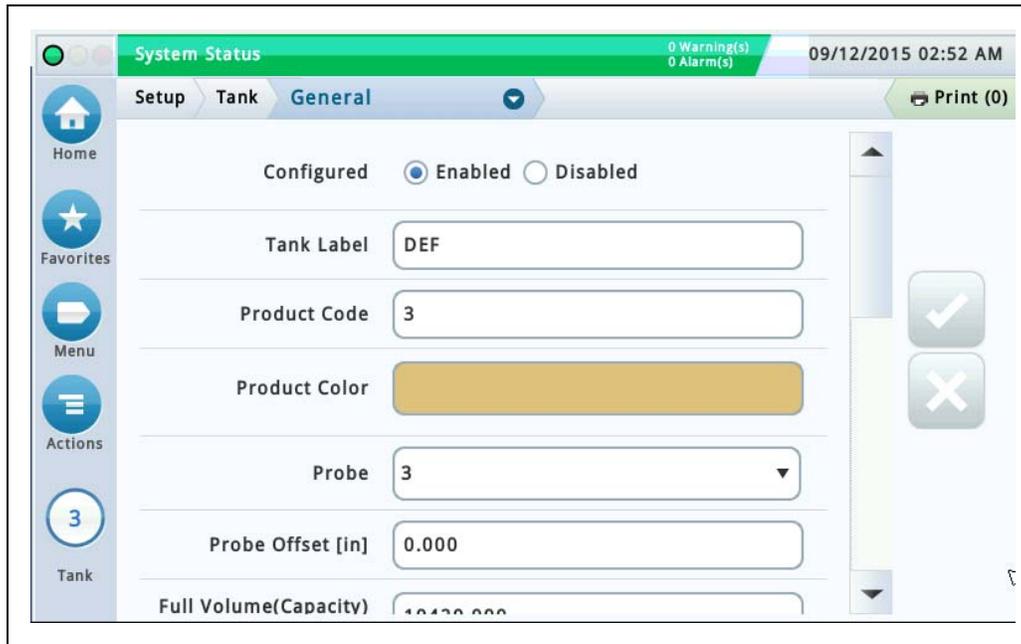


Figure 14. Tank General Setup Screen

Set Up Temperature Sensor

In the **Setup>Devices>Temp Sensor** screen assign the Temp Sensor associated with the DEF tank. This is required to set up the tank.

- Select Temp Sensor 1.
- Select the Address for the Temperature Sensor.
- Enter a Label.
- Select Model: VR-Temp Sensor.
- If the site has additional Temperature Sensors, select the next Temp Sensor and repeat temperature sensor setup.

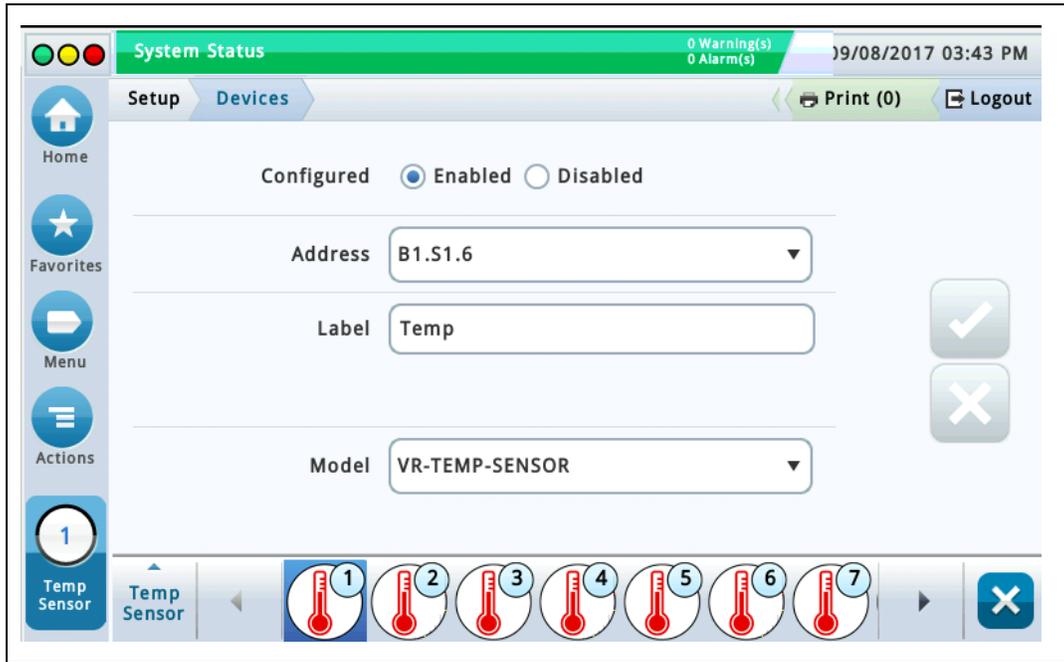


Figure 15. Temperature Sensor Setup Screen

Set Up Pump

In the **Setup>Pumps and Lines>Pumps** screen set up the relay, input and tank. This brings the input and relay together to indicate how to control the pump.

Note that in order for recirculation to function properly, **the pump Mode MUST be set to TLS Pump Control.**

*Note: Pump control must be a relay programmed as a Pump Control Relay in the Mode field.

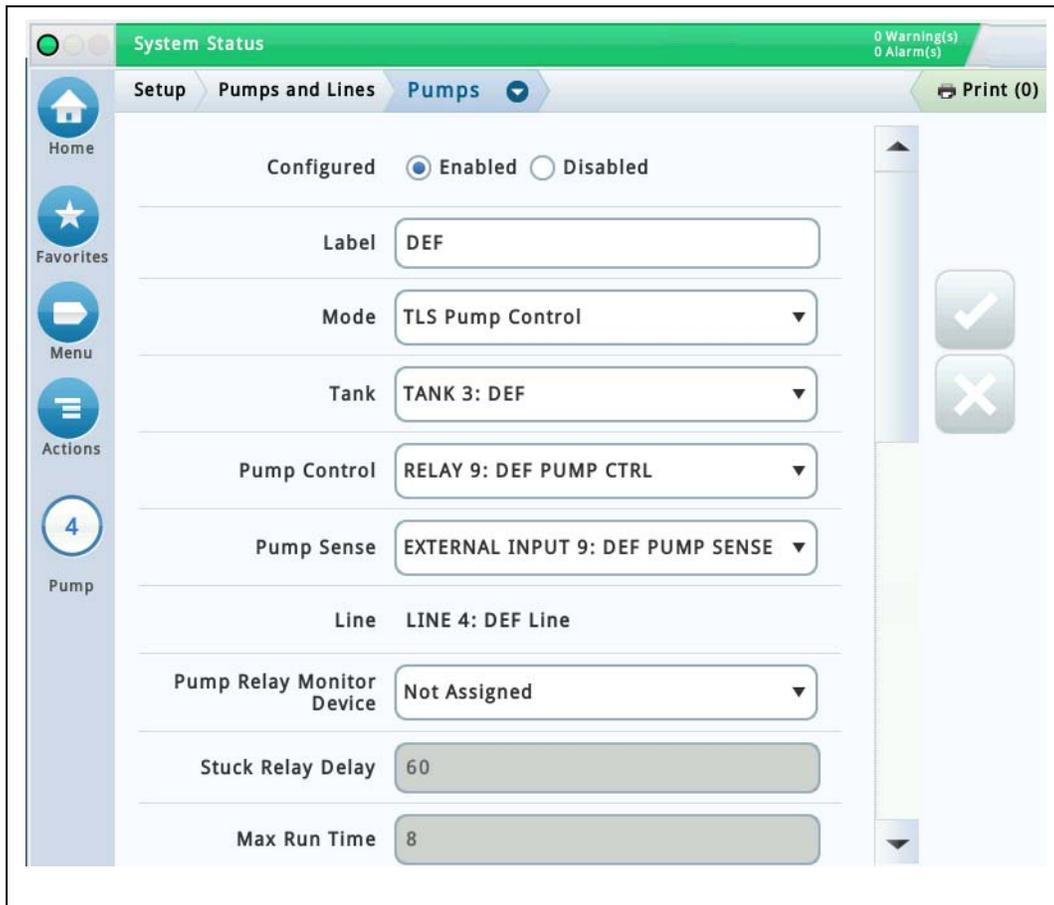


Figure 16. DEF Pump Set Up Screen

Set Up Line

In the **Setup>Pumps and Lines>Lines** screen, the DEF line needs to be assigned to the DEF pump.

The Recirculation field needs to be set to **Standard**. Once Standard Recirculation is set for the line, configuration for recirculation can be done using the **Setup > Pumps and Lines > Recirculation** screen.

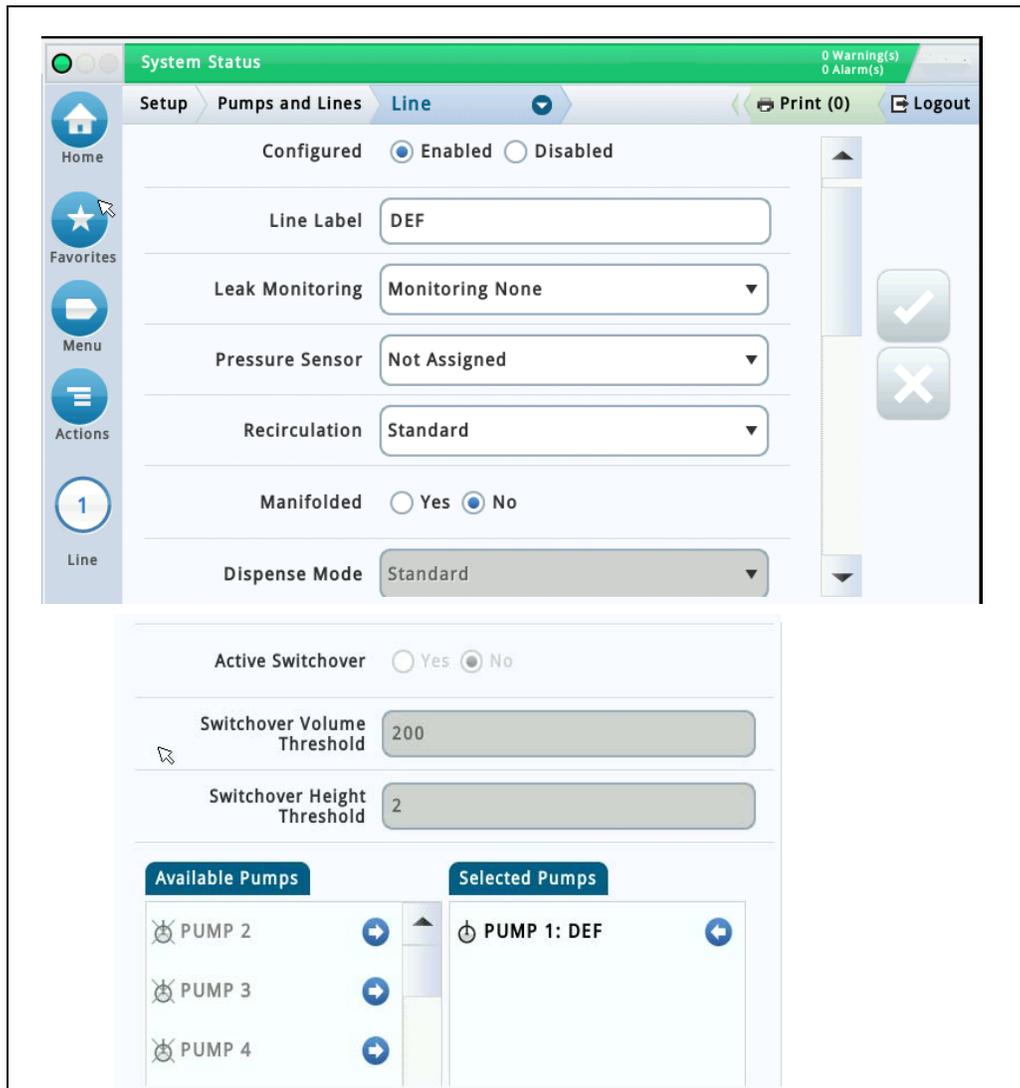


Figure 17. External Input Setup Screen

Recirculation Setup

Recirculation is initiated in three ways: when dispensing DEF fluid; when manually started for testing purposes from the **Diagnostics>Recirculation>Status** screen: and automatically, when set up in the **Setup>Pumps and Lines>Recirculation** screen as discussed below.

In Automatic Recirculation, you define the thresholds that determine what is not a normal range in the **Setup > Pumps and Lines > Recirculation** screen. When the TLS determines that the temperature of the fluid in the line is out of the normal range based on temperature sensors readings, the pump turns on to circulate the fluid and alerts you with a Recirculation Warning. When the temperature reaches the normal temperature range, the relay turns the recirculation pump off and any Recirculation Warnings are cleared.

If the temperature sensors detect progress toward the target temperature, Automatic Recirculation will continue, checking every few minutes for additional progress. If there is no progress made for a considerable amount of time, Recirculation pauses for a Retry Delay of 10 minutes before restarting.

In addition, anytime the temperature sensors determine that the temperature of the fluid in the line is at a Freeze Warning temp that you specify in the **Setup > Pumps and Lines > Recirculation** screen, a Warning communicates the potential for line freezing. This indicates that Recirculation has done what it can to mitigate the temperature and other measures to prevent line freezing need to be taken.

Configure the DEF line for Recirculation on the **Setup>Pumps and Lines>Recirculation** screen by selecting **Enabled** in the **Configured** field and entering the other parameters for the line as necessary.

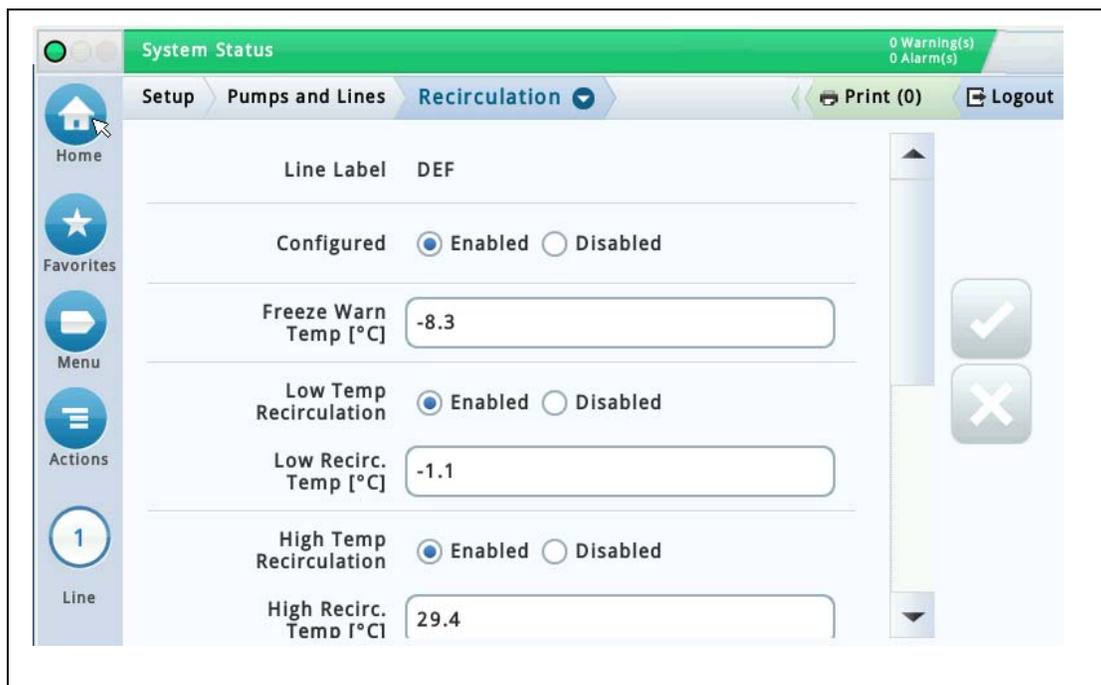


Figure 18. Automatic Recirculation Setup

Table 2.- Recirculation Screen Field Descriptions

Field	Description
Line Label	Description of the line set in Setup > Pumps and Lines > Line.
Configured	Enables the Recirculation functionality for the selected line. Disabling Recirculation does not disable the temperature sensors (seen below) that are associated with a line.
Freeze Warning Temp	When any of the temperature sensors on the line reach this temperature, a Freeze Warning is triggered. This alerts the operator that recirculation has failed to raise the temperature in the line to a level that is above freezing. The default temperature is 17.0°F (-8°C). The range depends on the brand of temperature sensor but the upper limit is 40.0°F (4.4°C).
Low Temp Recirculation	If you want to use Recirculation to control low temperature conditions, enable this field and specify the temperature below.

Table 2.- Recirculation Screen Field Descriptions

Field	Description
Low Recirculation Temp	When any of the temperature sensors on the line reach this temperature, automatic recirculation starts and recirculation will try to bring the temperature back to the normal temperature level. The default temperature is 30.0°F (-1.1°C). The Low Recirculation temperature must be higher than the Freeze Warning Temperature set above.
High Temp Recirculation	If you want to use Recirculation to control high temperature conditions, enable this field and specify the temperature below.
High Recirculation Temp	When any of the temperature sensors on the line reach this temperature, the recirculation starts and recirculation will try to bring the temperature down to the normal temperature level. The default value is 85.0°F (29.4°C).
Available Sensors	Displays configured temperature sensors.
Selected Sensors	Displays the temperature sensors that are associated with this line.

Testing Recirculation

Recirculation Status Screen

The **Diagnostics > Recirculation > Status** screen lets you view the current status and test if a temperature sensor/probe is functioning properly for Recirculation. It allows you to run Manual Recirculation for 15 minutes to check for changes that indicate that Recirculation is working. For example, you could see changes between the Start Temp and the Current Temp. This screen also identifies if there are no temperature sensors or probes defined for Recirculation or other issues with setup.

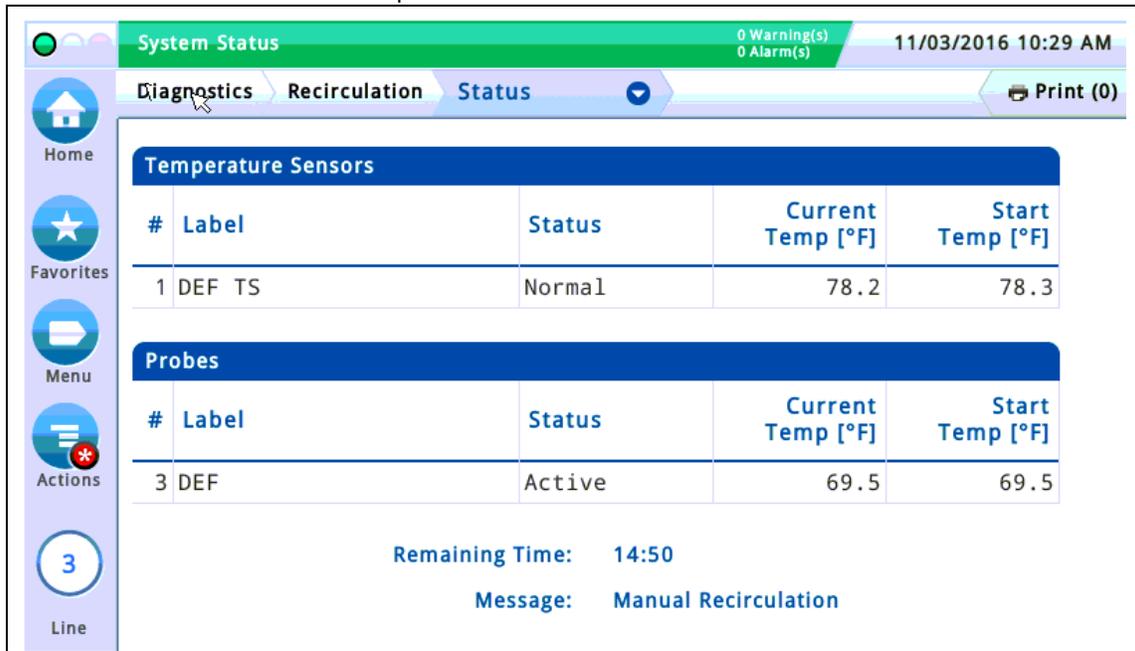


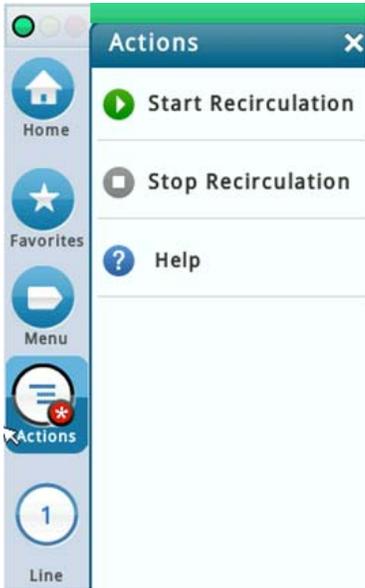
Figure 19. Diagnostics Recirculation Status Screen

NOTE: Manual Recirculation is not available when Automatic Recirculation is actively running. However, it is available during initialization and wait times within Automatic Recirculation.

Table 3.- Recirculation Status Screen Field Descriptions

Field	Description
#	The number of the temperature sensor or probe.
Line Label	The name of the temperature sensor or probe as a reference.
Status	The current status of the temperature sensor (Normal, Out Alarm, Short Alarm, Disabled, Setup Data Warning, etc.) or probe (Active, Inactive).
Current Temp	The current temperature reported by the temperature sensor/probe. This is blank if there is an Out or Short alarm or when the sensor is disabled.
Start Temp	The temperature reported by the temperature sensor at the time Recirculation was started. This field is blank if Recirculation is not running.

Table 3.- Recirculation Status Screen Field Descriptions

Field	Description
<p>Remaining Time / Recirculation Time</p>	<p>If this field displays "Remaining Time," the system is in Manual Recirculation, No Recirculation, Retry Delay or Recirculation Error modes. (See Message field below.) Manual Recirculation runs for 15 minutes unless you manually stop it and this field counts down the time. You may start Manual Recirculation again after it is stopped.</p> <p>If this field displays "Recirculation Time," the system is in Automatic Recirculation mode and the timer counts up. When the temperature reaches the normal temperature range in this mode, the relay turns the recirculation pump off and any Recirculation Warnings are cleared. If the temperature sensors detect progress toward the target temp, Automatic Recirculation will continue checking every few minutes for progress. If there is no progress made for a considerable amount of time, Recirculation pauses for a Retry Delay of a few minutes before trying again.</p>
<p>Message</p>	<p>Displays the following conditions:</p> <ul style="list-style-type: none"> • No Recirculation - no Recirculation is running. • Manual Recirculation - Manual Recirculation is running and the timer counts down. • Automatic Recirculation - Automatic Recirculation is running and the timer counts up. • Recirculation Error - Recirculation cannot run due to setup error or because it is disabled by Automatic Events, disabled pump, disabled line, line manifolding enabled. • Retry Delay - Automatic Recirculation has repeatedly failed to bring the temperature to the normal range and it is paused (for 15 minutes) before trying again.
<p>Start/Stop Recirculation [if using Web Interface]</p>	<p>Start and stop Manual Recirculation as required.</p>
<p>Start/Stop Recirculation [if using Console GUI] With the line selected, go to Actions >Start Recirculation and select Start/Stop Recirculation as required.</p>	 <p>The screenshot shows a mobile-style console interface. On the left is a vertical sidebar with icons for Home, Favorites, Menu, Actions (highlighted with a red star), and Line (numbered 1). The main screen displays an 'Actions' dialog box with a close button (X) in the top right. The dialog contains three items: 'Start Recirculation' with a green play button icon, 'Stop Recirculation' with a grey square icon, and 'Help' with a question mark icon.</p>

Select a line with Recirculation enabled. The default is the first line with Recirculation enabled. Recirculation will run for 15 minutes. The time counts down in the **Remaining Time** field and the Manual Recirculation notification displays in the **Message** field (see Figure 19 above).

When the 15 minutes is over or if the temperature sensors determine that the temperature of the fluid in the line is in the normal range, the manual recirculation stops. You may restart Manual Recirculation again after it has stopped. Recirculation Warnings clear when the temperature is in the normal range.

Alarms and Warnings – Recirculation

The following alarms and warnings are applicable to Recirculation.

Table 4.- Recirculation Alarms And Warnings

Message	Cause	Action
Setup Data Warning	Missing Temp Sensor Assignment	Setup > Pumps & Lines > Recirculation
	Assigned Temp Sensor(s) Disabled: Temp sensor was disabled after configuring Recirculation functionality. NOTE: Does not prevent Recirculation from running if at least one temp sensor is enabled on the line.	Check device setup for Temperature Sensor in Setup > Devices
	Line Manifolding Enabled	Manifolded lines are not supported with the Recirculation feature.
	Line is Not Set for Recirculation.	Check line setup in Setup > Pumps and Lines > Line .
	Line Setup Invalid.	
	Line is Disabled.	
Recirculation Fault Alarm	Recirculation was not started or was interrupted because the line or pump has been disabled (manually or by Automatic Events).	If appropriate, enable the pump (in Setup > Pumps and Lines > Pumps) or line (in Setup > Pumps and Lines > Line). Alternately, disable Recirculation in Setup > Pumps and Lines > Recirculation .
Low Temp Recirc Warning	Temperature has dropped below the Low Temperature setting in Setup > Pumps and Lines > Recirculation .	Follow the established procedures for your site for low temperatures. (The warning will clear when the line returns to normal temperature. NOTE: Warning also clears when feature is disabled and triggers when the feature is enabled if it is still active.)
High Temp Recirc Warning	Temperature has risen above the High Temperature setting in Setup > Pumps and Lines > Recirculation .	Follow the established procedures for your site for high temperatures. (The warning will clear when the line returns to normal temperature. NOTE: Warning also clears when feature is disabled and triggers when the feature is enabled if it is still active.) You can clear a Recirculation Warning by running Manual Recirculation until the line temperature returns to the normal range.
Freeze Warning	Line temperature has dropped below the Freeze Warning Temp set in Setup > Pumps and Lines > Recirculation .	Follow the established procedures for your site to prevent line from freezing. (The warning will clear when the line returns to normal temperature. NOTE: Warning also clears when feature is disabled and triggers when the feature is enabled if it is still active.) You can clear a Recirculation Warning by running Manual Recirculation until the line temperature returns to the normal range.

Diagnostics Recirculation Event History Report

The Diagnostics > Recirculation > Event History screen shows 30 days of history for Recirculation events such as startup and shutdown events, temperature alarms and warnings, timeouts, etc. This gives you a quick summary of recent Recirculation events generated by the temperature sensor. Latest events appear first.

Select **Actions > Select Range** and enter a date range for the data that you want reported. The default is for the last 30 days.

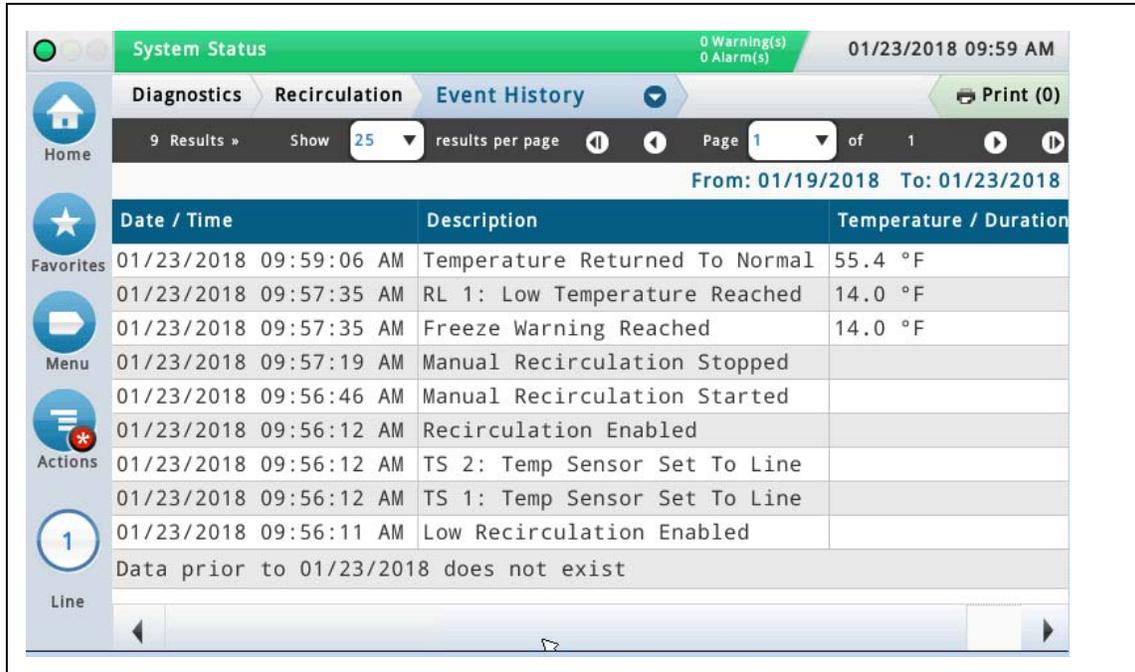


Figure 20. Diagnostics Recirculation Event History Screen

Table 5.- Diagnostics Recirculation Event History Screen Field Descriptions

Column	Description
Date/Time	The time and date of the event
Description	A brief description of the event.
Temperature Duration	The reported temperature and/or amount of time.

Diagnostics Recirculation Line Performance Report

The Recirculation Line Performance report shows when Recirculation ran on a line and what the line and tank temperatures were at the start and end of the event. This gives you information about the effectiveness of Recirculation in moderating temperatures.

Select **Actions > Select Range** and enter a date range for the data that you want reported. The default is for the last 30 days.

NOTE: You must re-enter the screen to load new data. The screen does not dynamically update with new Recirculation runs.

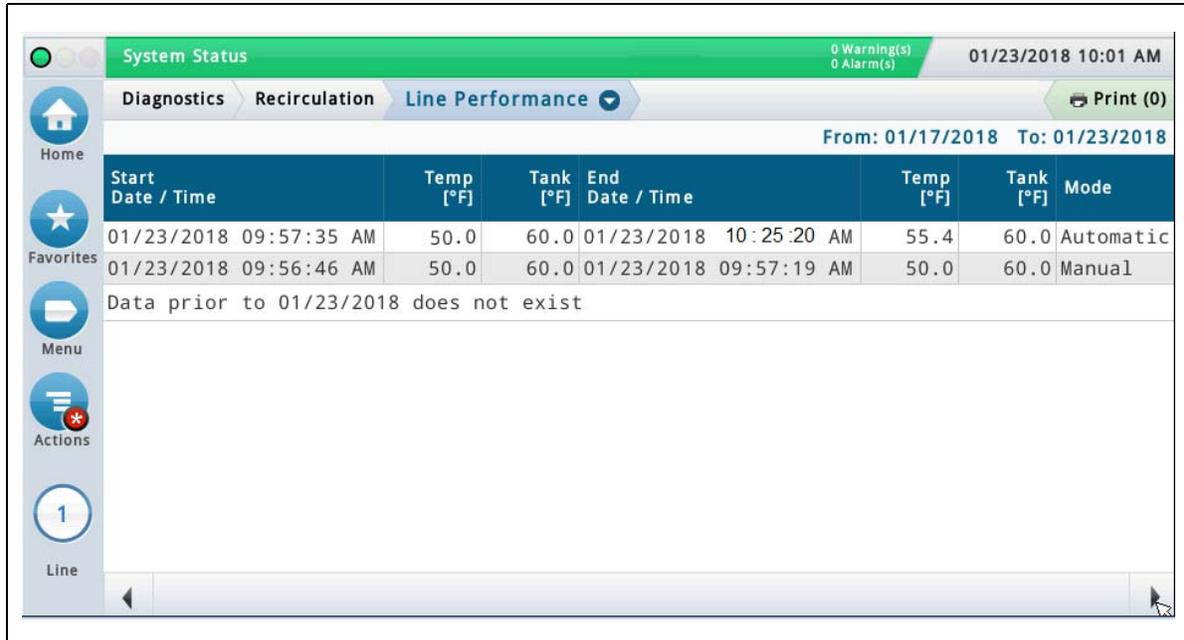


Figure 21. Diagnostics Recirculation Line Performance Screen

Table 6.- Diagnostics Recirculation Line Performance Screen Field Descriptions

Column	Description
Start Date/Time	The date and time that a Recirculation run started on the line.
Temp	The temperature of the product in the line (based on all sensors on the line) at the start of the Recirculation run.
Temperature Duration	The temperature of the product in the tank (based on the thermistor at the bottom of the tank) at the start of the Recirculation run.
End Date/Time	The temperature of the product in the tank (based on the thermistor at the bottom of the tank) at the start of the Recirculation run.
Temp	The temperature of the product in the line (based on all sensors on the line) at the end of the Recirculation run.
Tank	The temperature of the product in the tank (based on the thermistor at the bottom of the tank) at the end of the Recirculation run.

Console Set Up For Temperature Control

Temperature Control can work independently or in conjunction with Recirculation for additional heating or cooling protection.

The following console set up instructions are for Temperature Control.

Set Up Temperature Control Relays

- Configure temperature control relays in the **Setup > Devices > Relay** screen as Relay type: **Temperature Control**.
- Set temperatures for relays to turn on and off as needed, and
- Enable the relay.

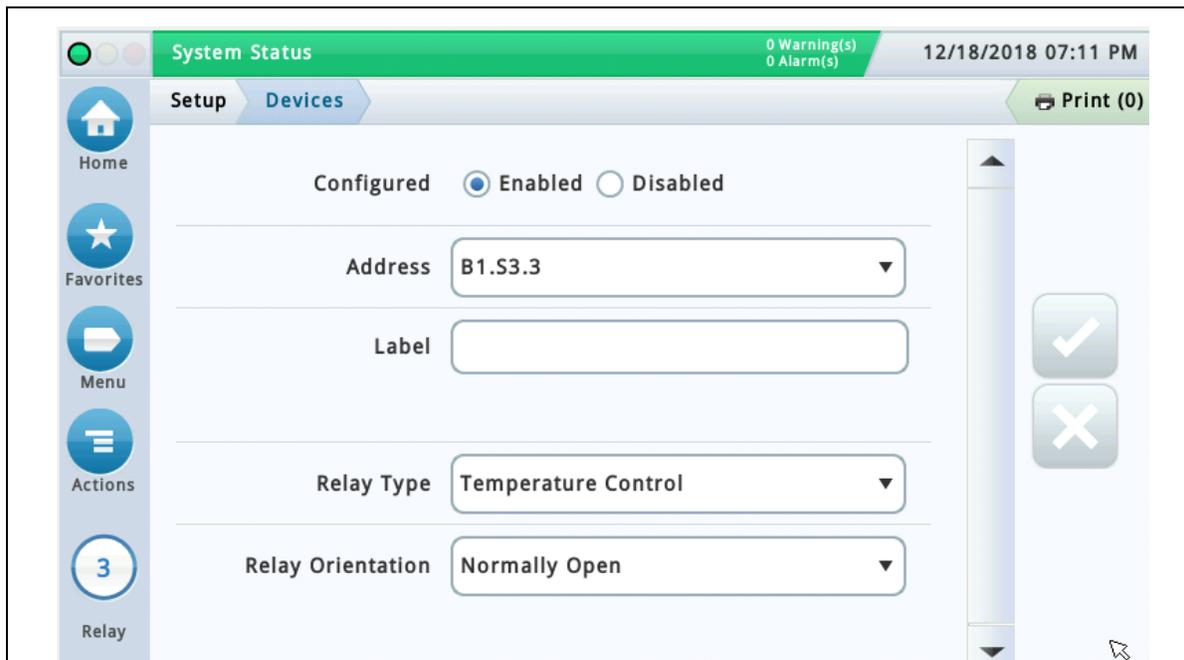


Figure 22. Set Up A Relay For Temperature Control

Set Up Temperature Control

The **Setup > Temp Control** screen lets you associate a relay with temperature sensors and set the temperatures at which the associated relay will turn on and off.

For example:

- In heating mode, you can set up an auxiliary heating system so the relay turns it on when any of the associated temp sensors detect the low temperature, then off when all associated temp sensors detect the high temperature.

If the "On" temperature is 19°F (-7.2°C) and the "Off" temperature is 24°F (-4.4°C), when the fluid temperature reaches 19°F (-7.2°C), the relay turns on the heating system to heat the fluid. When the temperature reaches 24.0°F (-4.4°C), the relay will turn off the heating system.

- In cooling mode, you can set up an auxiliary cooling system so the relay turns it on when any of the associated sensors detect the high temperature, then off when all associated sensors detect the low temperature.

If the "On" temperature is 85.0°F (29.4°C) and the "Off" temperature is 79.0°F (26.1°C), as the temperature rises to 85.0°F (29.4°C), the relay turns on the cooling system to cool the fluid. When the temperature reaches 79.0°F (26.1°C), the relay (and thus the cooling system) turns off.

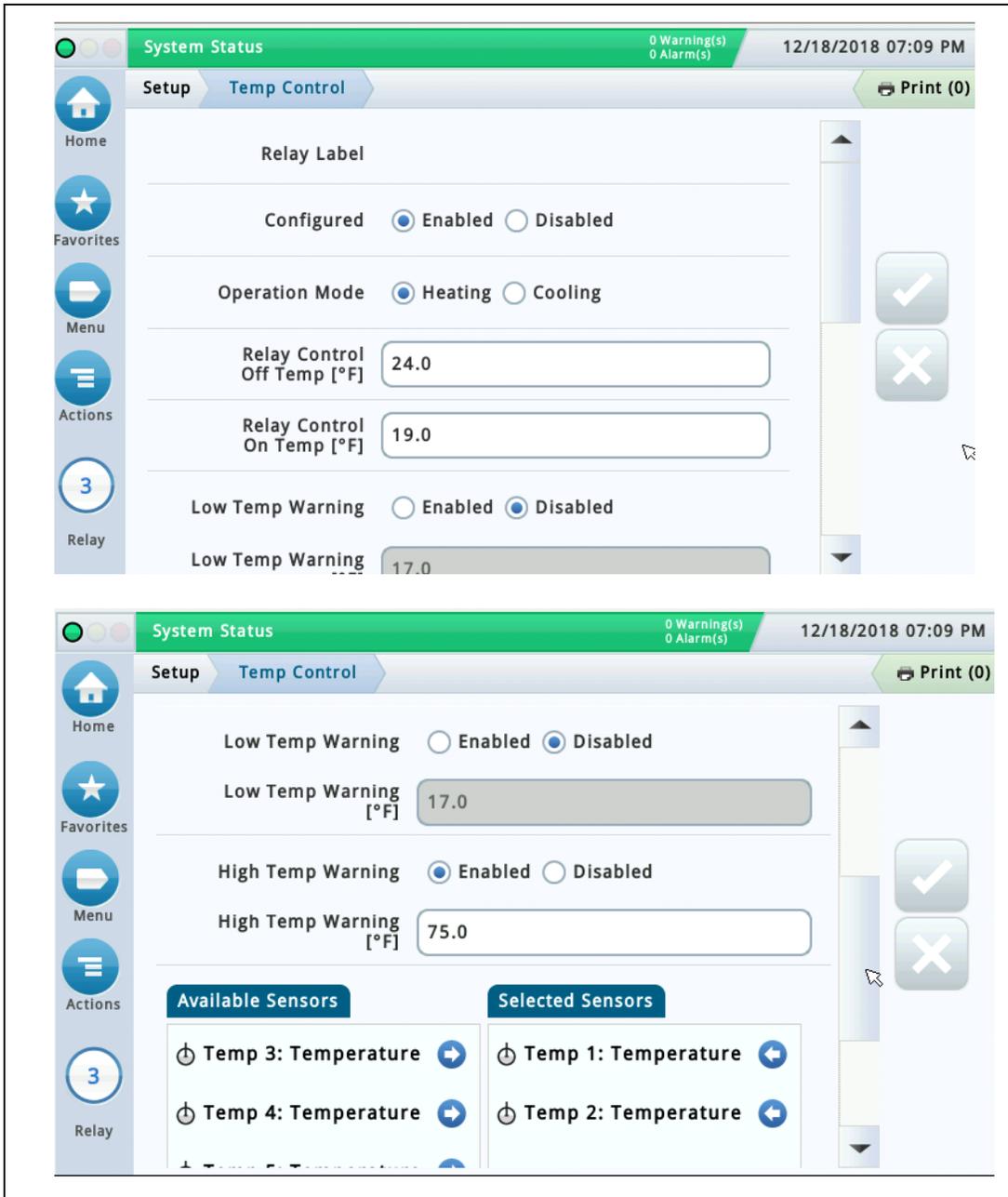


Figure 23. Example Pages Of The Temp Control Screen

Select a relay to configure. At least one temperature sensor must be assigned to a temperature control relay. You may assign multiple sensors to a relay as well as assigning a sensor to multiple relays.

Table 7.- Setup>Temp Control Screen Field Descriptions

Field	Description
Relay Label	The label given to the relay in Setup > Devices.
Configured	Enables or disables this relay for Temp Control.
Operation Mode	Allows you to choose between heating mode and cooling mode, depending on how you want to use this relay.
Relay Control On Temp	When any of the sensors associated with the relay detect this temperature, the relay turns on and remains on until the Relay Control Off Temp is detected by all of the sensors associated with the relay.
Relay Control Off Temp	When all of the sensors associated with the relay detect this temperature, the relay turns off. The range you can enter in this field varies by sensor brand. The default is 24.0°F (-4.4°C).
Low Temp Warning	Enables or disables the Low Temp warning given when an associated temperature sensor detects the Low Temperature set below. This is intended as a warning to the operator that the relay may not be working correctly.
Low Temperature	The temperature that triggers the Low Temp warning. The default is 17.0°F (-8.3°C). In heating mode, the temperature must be lower than the Relay Control On Temp above. In cooling mode, the temperature must be higher than the Relay Control Off Temp above.
High Temp Warning	Enables or disables the High Temp warning given when the temperature sensor detects the High Temperature set below. This is intended as a warning to the operator that the relay may not be working correctly.
High Temperature	The temperature that triggers the High Temp warning. The default is 75.0°F (23.8°C). In heating mode, the temperature must be higher than the Relay Control Off Temp above. In cooling mode, the temperature must be lower than the Relay Control On Temp.
Available Sensors	Sensors that are available to control this relay (any enabled temperature sensor).
Selected Sensors	Sensors that are associated with this relay.

Testing Temperature Control Relay

Diagnostics > Temp Control > Status Screen

This screen lets you view temperature sensor information to determine if a temperature control relay is functioning properly for Temperature Control. It allows you to run a Manual Relay Test to check if the Start Temp and the Current Temp change.

Select a temperature control relay and start the test (see Start/Stop Relay Test Field in Table 8). Once started the relay test will run for 15 minutes (unless you stop it manually). The time counts down in the Remaining Time field.

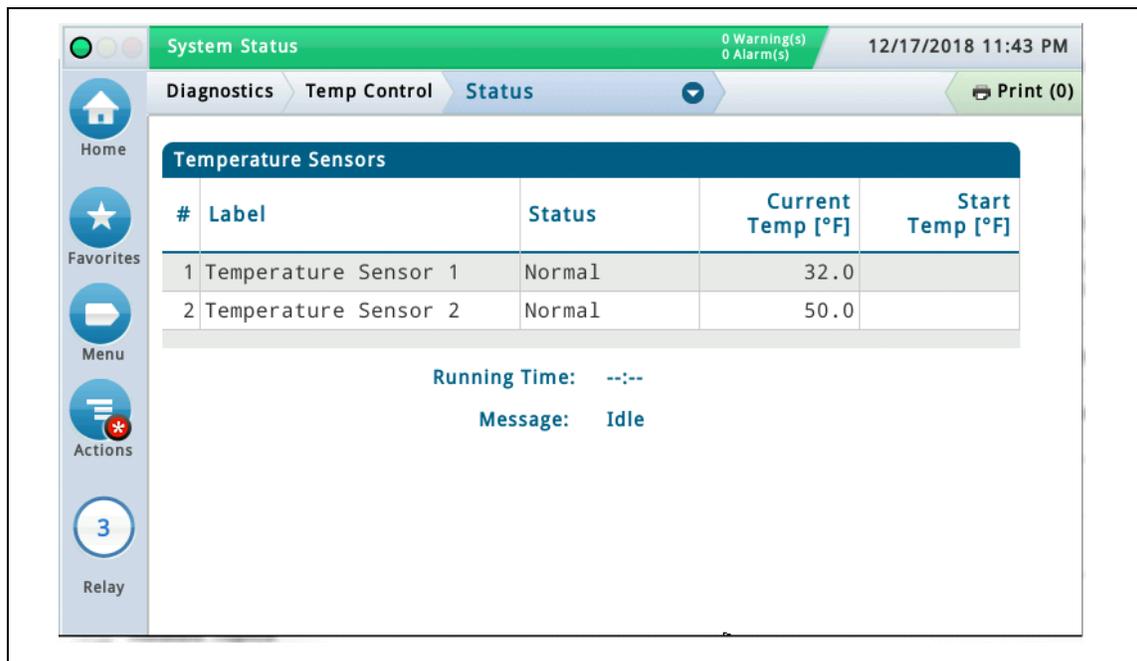
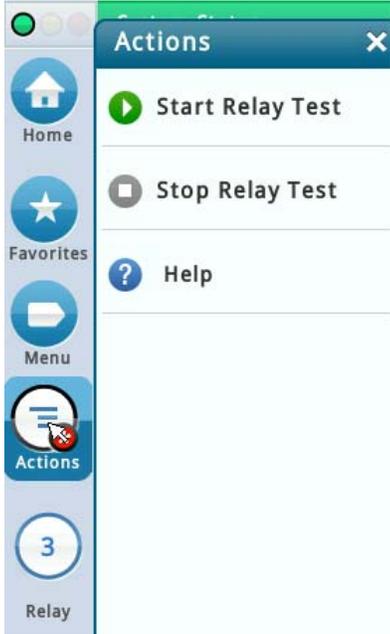


Figure 24. Diagnostics>Temp Control>Status Screen

Table 8.- Diagnostics>Temp Control>Status Screen Field Descriptions

Field	Description
#	The temperature sensor numbers associated with the selected relay.
Label	The names of the temperature sensors associated with the relay.
Status	The current status of the temperature sensors associated with the relay. <ul style="list-style-type: none"> • Normal • Setup Data Warning • Out Alarm • Short Alarm
Current Temp	The current temperature reported by the temperature sensor associated with the relay. This is blank if there is an Out or Short alarm or when the sensor is disabled.

Table 8.- Diagnostics>Temp Control>Status Screen Field Descriptions

Field	Description
Start Temp	The temperature reported by the temperature sensor at the time the test was started. This field is blank if the temperature control test is not running.
Remaining Time / Running Time	If this field displays "Remaining Time," the relay is in test mode. The test runs for 15 minutes (unless you stop it manually by clicking "Stop Relay Test."). If this field displays "Running Time," the relay is currently being used for heating/cooling. It shows the length of time it has been used for this function.
Message	Displays the following conditions: <ul style="list-style-type: none"> • Idle - The relay is not being used to support heating/cooling and is not in test mode. It may also be in an alarm state. • Heating - the relay is active and is being used to support heating. • Cooling - the relay is active and is being used to support cooling. • Manual Relay Test In-Progress - a 15 minute manual relay test is in progress.
Target Temp	The "Relay Off" temperature, which is the temperature you are attempting to achieve. Displays during heating/cooling for reference.
Start/Stop Relay Test [If using Web Interface]	Starts and stops the Manual Relay Test.
<p>Start/Stop Relay Test [if using Console GUI]</p> <p>With the line selected, go to Actions >Start Relay Test and select Start/Stop Relay Test as required.</p>	 <p>The screenshot shows a mobile-style interface with a sidebar menu on the left containing icons for Home, Favorites, Menu, Actions, and Relay (with a '3' notification). The 'Actions' menu is open, displaying three options: 'Start Relay Test' with a green play button icon, 'Stop Relay Test' with a grey square icon, and 'Help' with a question mark icon.</p>

See Table 9 for Temperature Control alarms and warnings and Table 10 for Temperature Sensor alarms and warnings.

Table 9.- Temperature Control Alarms And Warnings

Message	Cause	Action
Setup Data Warning	Assigned Temp Sensor(s) Disabled	Device setup data problem Check device setup for Temperature Control Relay in Setup>Devices .
	Relay Address Not Set: Temperature Control Relay has no address specified.	
	Relay is not a Temp Control.	
	Temp Control Relay is Disabled	Check sensor setup in Setup>Temp Control .
Missing Temp Sensor Assignment: At least one temperature sensor must be assigned to a Temperature Control Relay.		
Temp Control Low Temp Warning	Temperature has dropped below the Low Temperature set in Setup>Temp Control .	Follow the established procedures for your site for low temperatures. (The warning will clear when the line returns to normal temperature.)
Temp Control High Temp Warning	Temperature has risen above the High Temperature set in Setup>Temp Control .	Follow the established procedures for your site for high temperatures. (The warning will clear when the line returns to normal temperature.)

Table 10.- Temperature Sensor Alarms And Warnings

Message	Cause	Action
Setup Data Warning	Address Not Set: Temperature sensor has no address specified.	Check device setup for Temperature Sensor in Setup>Devices .
Temperature Sensor Out Alarm	Temperature sensor is not communicating.	Call for service following the procedures established for your site.
Temperature Sensor Short Alarm	The sensor is reporting invalid values, possibly due to a bad sensor, cabling issues, or noise on the line, etc..	

Diagnostics > Temp Control > Relay Performance Screen

The Temp Control Relay Performance screen shows the selected temp control relay's state changes within a specified date range. Select a temp control relay and then enter a date range, via **Actions>Select Range**, for the Temp Control data you want to view (last 30 days is the default).

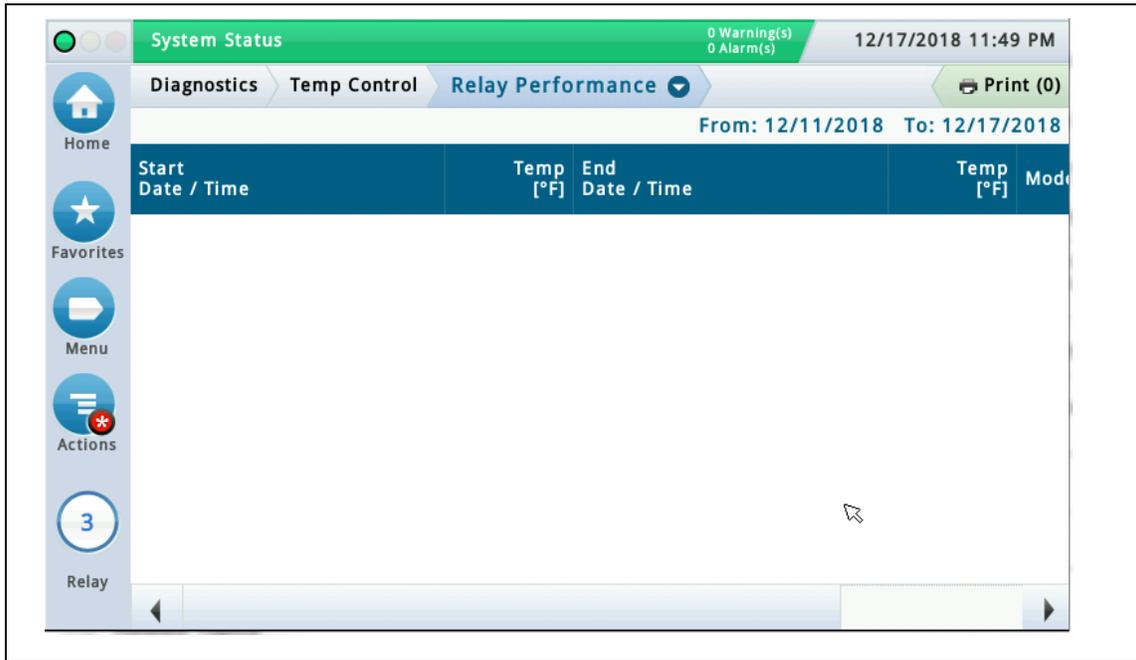


Figure 25. Diagnostics>Temp Control>Relay Performance Screen

Table 11.- Diagnostics>Temp Control>Relay Performance Screen Field Descriptions

Field	Description
Start Date/Time	The date and time that relay changed from inactive to active.
Temp	The temperature reported by the temperature sensor when the state of the relay changed.
End Date/Time	The date and time the relay was changed from active to inactive.
Temp	The temperature reported by the temperature sensor when the state of the relay changed.
Mode	The mode of operation: <ul style="list-style-type: none"> • Heating • Cooling • Manual - The relay was activated manually in Diagnostics>Temp Control>Status.



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