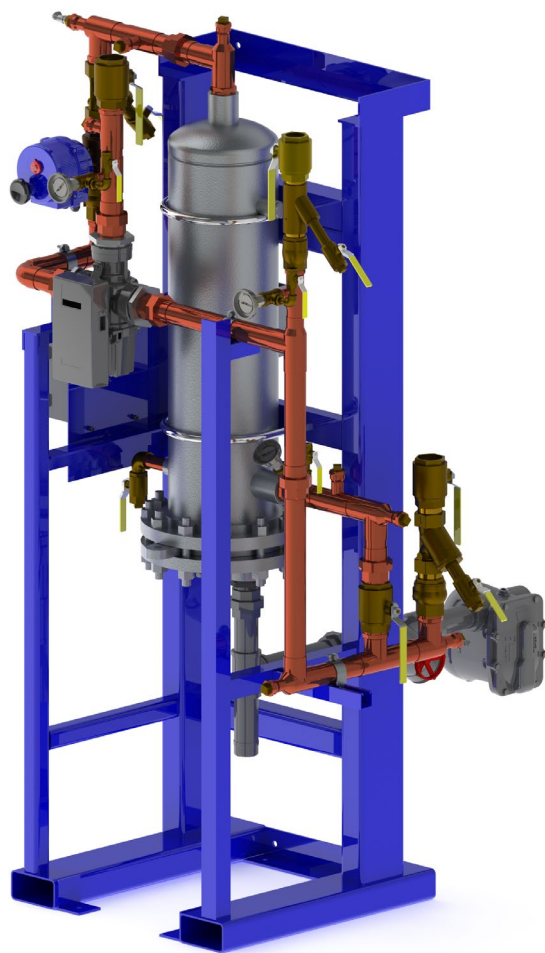


# Digital-Flo® Semi-Instantaneous Steam-to-Water, Shell and Tube, Water Heater Installation Operation & Maintenance Manual



**Please read and save  
these instructions.**

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# Safety

## Icon Legend



— **DANGER!** ... Injury or death and property damage are imminent



— **WARNING!** ... Injury or death and property damage are possible



— **CAUTION!** ... Potential property damage, expensive repairs, and/or voiding the equipment warranty may result



**BURN HAZARD!** Contact with steam, hot water, or hot metal surfaces can cause severe skin burns. Skin exposure to 140°F (60°C) water or metal for only five (5) seconds may cause a second degree burn.

**If the instructions following a safety icon are not followed, adverse consequences may occur – including property damage, personal injury, or, in extreme cases, death.**

---

### General Safety Guidelines:

1. This product is designed and constructed to withstand conditions expected during normal use.
2. Inappropriate use of this product could cause damage to the product and other property. It may also result in personal injury or, in extreme cases, death.
3. Installation or maintenance must be carried out in accordance with the instructions provided in this product manual by designated, qualified and competent personnel.
4. Installation shall comply with all applicable federal, state, and local sanitary, construction, plumbing and regulatory codes.
5. Improper installation, start-up, operation, maintenance, or service may void the warranty.
6. When installing, commissioning or servicing this product:
  - a. ALWAYS ensure that all steam and water supply, recirculation, and return lines are isolated.
  - b. ALWAYS carefully relieve any residual internal pressure in the system or connecting pipe work before breaking or loosening any plumbing joints.
  - c. ALWAYS allow hot parts to cool before commencing work, to avoid the risk of burns.
  - d. ALWAYS wear appropriate personal protective equipment (PPE) before carrying out any installation or maintenance work

# General Description

**Note:** In this manual “DFSI” stands for “Digital-Flo Semi-Instantaneous” and is the brand designation.

DFSI is a semi-instantaneous-type of water heater, i.e., it heats on-demand with minimal on-board hot water storage. DFSI transfers heat from steam to cold water and it precisely controls the blended hot water and cold/return water, discharge temperature.

DFSI water heaters employ digital technology to monitor the inlet hot water supply, the mixed inlet cold/system return water, and the blended water temperatures. DFSI is supplied pre-piped and pressure tested with an integral, digital re-circulating valve (The Brain® – Models DRV40 / 50 / 80).

Two (2) inlet and two (2) outlet thermistors integral to the digital re-circulating valve (DRV) in addition to the time-proven, water temperature control accuracy of the DRV eliminate the requirement for separate components typically associated with steam-to-water, heat exchangers:

- PID temperature controller
- High temperature limit thermostat
- High temperature limit controller
- Cold water injection valve
- Internal circulating pump
- Compressed air requirement

All DFSI water heaters may be integrated into building automation systems (BAS) that communicate via Modbus RTU. In the presence of other protocols (Modbus, BACnet™, and LonWorks™) SAGE™ can provide seamless monitoring, measuring, and reporting directly to office PC's or mobile apps.

DFSI is precision engineered and crafted with pride to deliver years of superior performance and customer satisfaction provided:

1. Installation, commissioning, operation and maintenance are in accordance with the recommendations provided in this product installation and operation manual (IOM) in addition to generally-accepted plumbing, pipe-fitting and maintenance guidelines.
2. Periodic attention is given, as necessary, to maintaining the product, the accessory fittings & components and the overall plumbing/distribution system in sound functional order.

Standard components include (refer to the Typical Layout diagram that follows for specific locations):

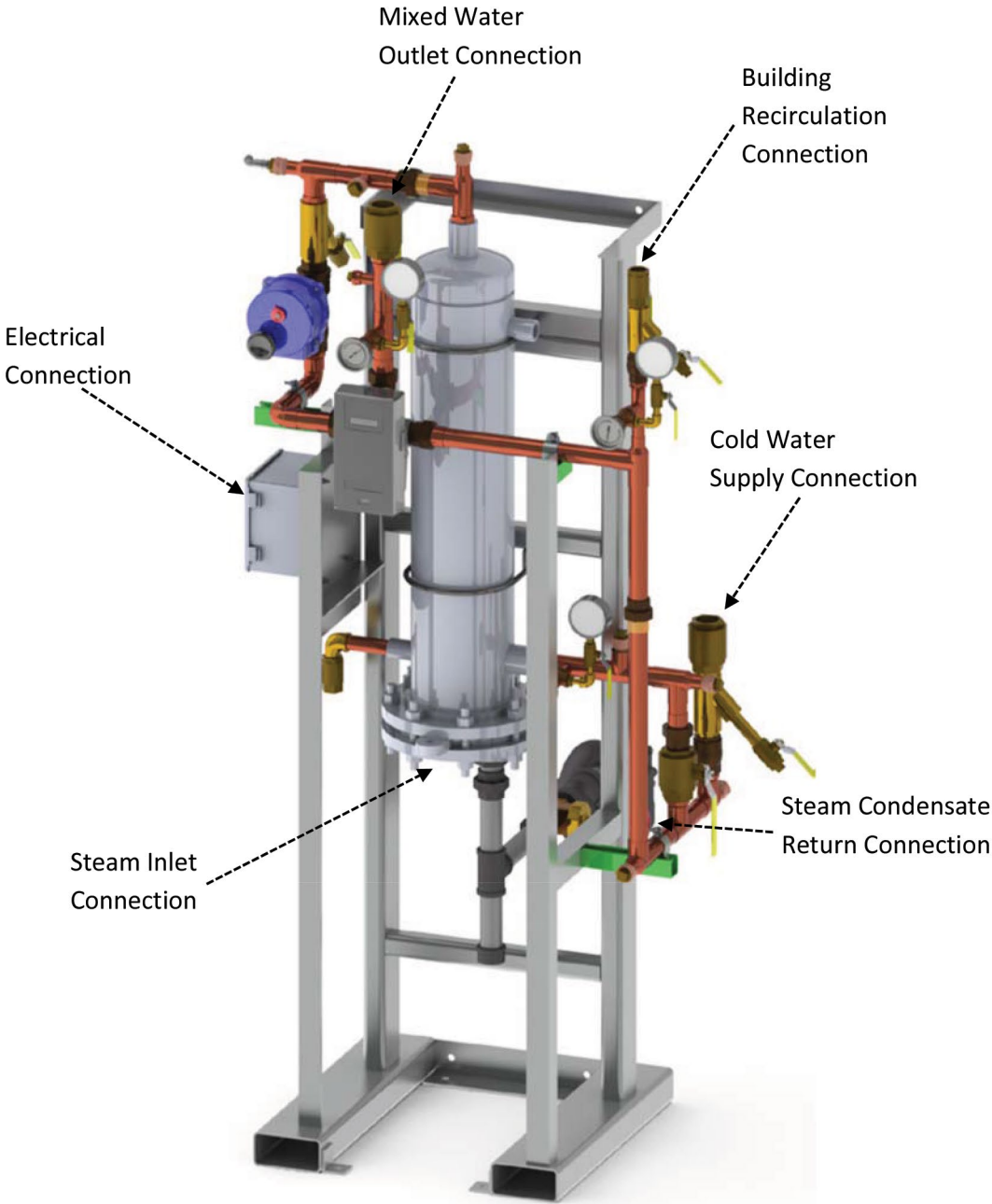
- The Brain® DRV40, DRV50, or DRV80 Digital Recirculating Valve
- Heat exchanger module (fabricated in accordance with the ASME Section VIII Division 1 Boiler and Pressure Vessel Code, aka, an ASME “U-stamped” pressure vessel)
- Thermometers & Pressure Gauges
- Check valves
- Inlet strainer(s)
- Isolation valves
- Safety shut-off valve

An application-related, low surface temperature option is available that requires a secondary, steam control valve for conditions where high mineral content water indicate excessive heat exchanger scaling could occur.

**Note:**

1. Because the DFSI is customizable, there may be optional components that are not addressed in this installation and operation manual (IOM).
2. Armstrong reserves the right to make design or specification changes without notification.
3. Refer to IOM-501 for The Brain® – Model DRV50/80 and IOM-775 for The Brain® – Model DRV40 for specific DRV content and information.
4. Refer to IOM-690-B for specific SAGE content and information.

# Typical Piping Layout



# Specifications

## Technical Specifications

Operating Specifications	
Steam Supply Pressure	2-15 PSIG (0.14-1 barg)
Water Supply Pressure	20-150 PSIG (1.4-10 barg)
Minimum Inlet Supply Water Temperature	34°F (1°C)
Set Point Range (DRV)	81-158°F (27-70°C)
Minimum System Recirculation Flow	10 GPM (38 LPM) for DRV80 or 50 / 5 GPM (19 LPM) for DRV40
Minimum System Draw Off	0 GPM / LPM
Minimum Distance to First Outlet	25 ft (7.62 m)
Minimum Recirculation Loop Temperature Loss	2°F (1°C)
General Specifications	
Control Circuit Fuse	3 A (5A w/ SAGE®)
Enclosure Protection Rating	Electrical Enclosure – Nema 12 DRV – Nema 3S
Signal Cable Fittings (DRV)	3/8" liquid-tight, conduit fitting
Battery (DRV)	Qty. 2, type CR-P2, 6V rating
Power Supply Requirements	120/240 VAC / 50-60 Hz / 1 Ph.
Insulation Jacket	Removeable Jacket

## Single-Wall, Heat Exchanger

Component	Material
Heat Exchanger Shell	Duplex 2205 Stainless Steel, ASME "U" Stamped
Heat Exchanger Tube Bundle	3/4" x 20 BWG Copper
Heat Exchanger Tube Sheets	304 Stainless Steel
Integral Supply Pipe Work	"Lead-free" brass/Type L copper
Integral Valves and Fittings	"Lead-free" brass or bronze
Condensate Piping	Cast iron & carbon steel
DRV Body	AISI 316L Stainless Steel

# Specifications - continued

## Double-Wall, Heat Exchanger

Component	Material
Heat Exchanger Shell	Duplex 2205 Stainless Steel, ASME “U” Stamped
Heat Exchanger Tube Bundle	5/8” Double Wall Copper
Heat Exchanger Tube Sheets	304 Stainless Steel
Integral Supply Pipe Work	“Lead-free” brass/Type L copper
Integral Valves and Fittings	“Lead-free” brass or bronze
Condensate Piping	Cast iron & carbon steel
DRV Body	AISI 316L Stainless Steel

## Specification Matrix

Model	Heat Exchanger	Tube Bundle	DRV		SAGE™		Stand Height		Insulation Jacket
<b>DFS</b> Digital-Flo Semi-Instantaneous	<b>15</b>	<b>DW</b> Double-Wall Optional	<b>40</b>	<input type="checkbox"/>	<b>BS</b> Optional	<input type="checkbox"/>	<b>HT6</b> HT6=6” Taller Optional	<input type="checkbox"/>	<b>RF</b> Removable Fiberglass Optional
	<b>35</b>		<b>50</b>				<b>HT12</b> HT12=12” Taller Optional		<b>SS</b> Stainless Steel Casing Optional
	<b>50</b>		<b>50</b>				<b>HT18</b> HT18=18” Taller Optional		
	<b>90</b>		<b>80</b>				<b>HT24</b> HT24=24” Taller Optional		

# Specifications - continued

Digital-Flo® Semi-Instantaneous Shell & Tube w/ Single-Wall, Tube Bundle						
Model	Water Side Connections @ 7.5ft/sec [2.3m/s]				Steam Side Connections	
	Hot/Cold	Recirc.	HX Capacity @ 100°F [55°C] Delta T*	Max Package Capacity at 120°F [49°C] Blend Outlet*	Steam/ Condensate Inlet/Outlet	Capacity @ 15psi [1bar]
DFS1540	1" [25mm]	1" [25mm]	14gpm [53lpm]	18gpm [68.1lpm]	2" [50mm]	737lb/hr [334kg/hr]
DFS3540	1.5" [40mm]	1" [25mm]	27gpm [102lpm]	35gpm [132.5lpm]	3" [80mm]	1421lb/hr [645kg/hr]
DFS5050	2" [50mm]	1.5" [40mm]	46gpm [174lpm]	60gpm [227.1lpm]	3" [80mm]	2421lb/hr [1098kg/hr]
DFS9080	3" [80mm]	2" [50mm]	84gpm [318lpm]	106gpm [401.3lpm]	4" [101.6mm]	4422lb/hr [1714kg/hr]
*Assumes 40 to 140°F [4.4 to 60°C]; Using Blend Formula w/ a mixing valve setpoint of 120°F [49°C] to determine Max. Package Capacity						

Digital-Flo® Semi-Instantaneous Shell & Tube w/ Double-Wall, Tube Bundle						
Model	Water Side Connections @ 7.5ft/sec [2.3m/s]				Steam Side Connections	
	Hot/Cold	Recirc.	HX Capacity @ 100°F [55°C] Delta T*	Max Package Capacity at 120°F [49°C] Blend Outlet*	Steam/ Condensate Inlet/Outlet	Capacity @ 15psi [1bar]
DFS15DW40	1.5" [40mm]	1" [25mm]	14gpm [53lpm]	18gpm [68.1lpm]	2" [50mm]	737lb/hr [334kg/hr]
DFS35DW40	1.5" [40mm]	1" [25mm]	27gpm [102lpm]	35gpm [132.5lpm]	3" [80mm]	1421lb/hr [645kg/hr]
DFS50DW50	2" [50mm]	1.5" [40mm]	46gpm [174lpm]	60gpm [227.1lpm]	3" [80mm]	2421lb/hr [1098kg/hr]
DFS90DW80	3" [80mm]	2" [50mm]	84gpm [318lpm]	106gpm [401.3lpm]	4" [101.6mm]	4422lb/hr [1714kg/hr]
*Assumes 40 to 140°F [4.4 to 60°C]; Using Blend Formula w/ a mixing valve setpoint of 120°F [49°C] to determine Max. Package Capacity						

## Operational Limitations (all models):

Steam pressure, maximum allowable = 150 PSIG (10 barg) and maximum operating = 15 PSIG (1 barg)

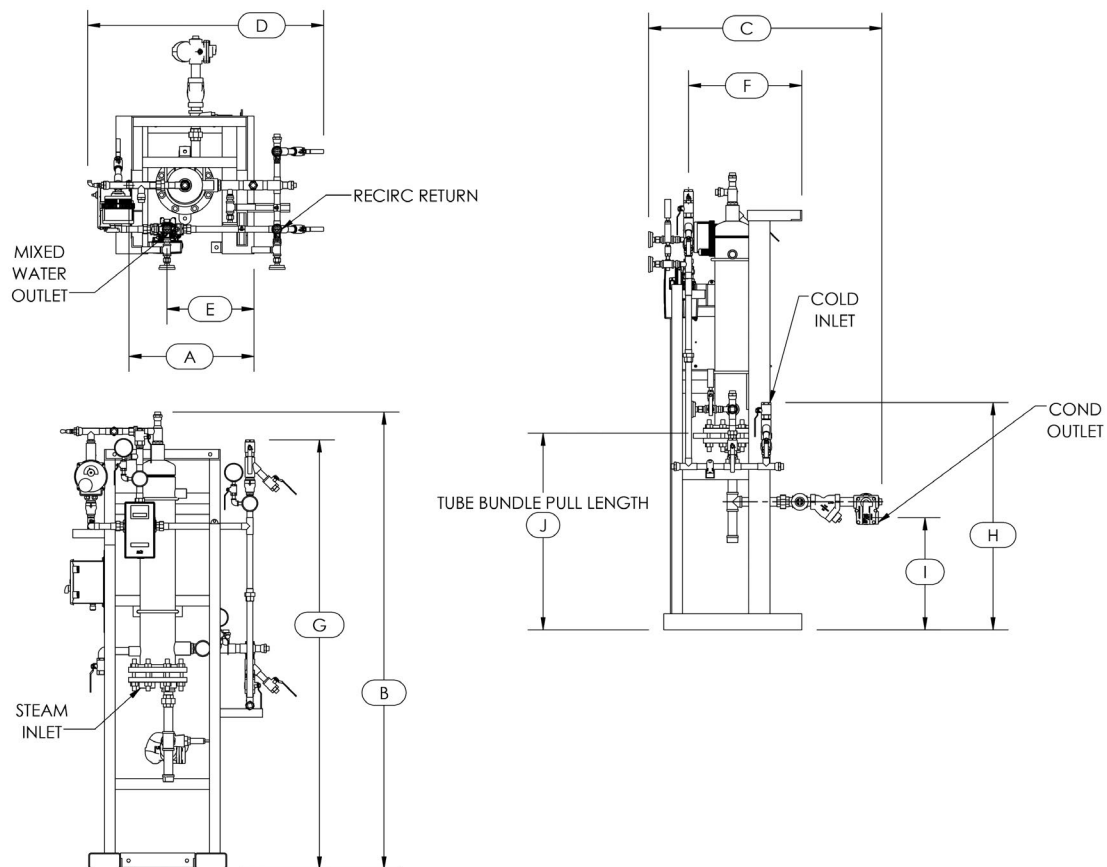
Water pressure, maximum allowable = 150 PSIG (10 barg)

Setpoint temperature, maximum allowable = 158°F (70°C)

Factory connections are US nominal pipe sizes (NPS) w/ ANS taper pipe threads (NPT) or ASME/ANSI B16.5, Class 150, bolted flange connections, as noted. The nearest equivalent pipe sizes in SI (the metric system), known as "diametre nominel", are listed in parentheses. Consult factory for pressure drop information.










# Dimensions



Dimensions and Weight						
Model	Dimensions In (mm)					Weight
	A	B	C	D	E	
DFS1540	23.5" (598mm)	86.0" (2185mm)	43.9" (1116mm)	44.4 (1129mm)	16.4" (416mm)	SW = xxx lbs [xxx kgs] DW = xxx lbs [xxx kgs]
DFS3540	25.0" (636mm)	86.9" (2207mm)	48.5" (1231mm)	48.8" (1240mm)	17.1" (434mm)	SW = xxx lbs [xxx kgs] DW = xxx lbs [xxx kgs]
DFS5050	26.1" (663mm)	88.4" (2245mm)	56.7" (1440mm)	54.6" (1387mm)	18.8" (477mm)	SW = xxx lbs [xxx kgs] DW = xxx lbs [xxx kgs]
DFS9080	29.6" (752mm)	91.5" (2324mm)	57.6" (1463mm)	65.4" (1662mm)	4.4" (113mm)	SW = xxx lbs [xxx kgs] DW = xxx lbs [xxx kgs]
	F	G	H	I	J	
DFS1540	21.3" (542mm)	80.8" (2052mm)	42.8" (1087mm)	SW=21.1" (536mm) DW=20.3" (515mm)	35" (899mm)	
DFS3540	22.8" (578mm)	81.4" (2067mm)	45.3" (1150mm)	SW=19.2" (488mm) DW=18.4" (467mm)	35" (899mm)	
DFS5050	25.5" (646mm)	82.6" (2098mm)	46.8" (1189mm)	SW=17.3" (439mm) DW=16.3" (413mm)	35" (899mm)	
DFS9080	28.0" (712mm)	81.7" (2076mm)	49.6" (1259mm)	SW=15.4" (390mm) DW=14.4" (365mm)	35" (899mm)	
All dimensions apply to both single wall and double wall units. Refer to drawings on previous page for locations.						

# Precautions

-  **WARNING!** The design of the DFSI electrical system is NOT suitable for installation in interior spaces classified as “hazardous locations”, i.e., spaces containing explosive and combustible vapors or dusts, as defined in the National Electrical Code, NEC.
-  **WARNING!** Always use appropriate lockout-tagout procedures when turning off and disconnecting power sources during installation, service, and repair. Failure to follow safety precautions may result in property damage, shock causing personal injury, or even electrocution and death.
-  **WARNING!** Always use appropriate personal protective equipment (PPE) when working with high-voltage electricity.
-  **WARNING!** Water conducts electricity. DO NOT stand in water or touch wet surfaces while working with “live” electrical equipment.
-  **WARNING!** The factory-supplied, pressure relief valve is a required safety device.
- DO NOT remove the relief valve from the heater
  - DO NOT plug the open end of the relief valve
  - DO NOT install any valve(s) or restrictions in the pressure relief valve, drain line
-  **CAUTION!** The requirements of all applicable local and regional equipment installation codes supersede the installation instructions in this manual. Governing codes must be followed. In the absence of these codes, installation shall conform to these instructions and the guidelines contained in the latest edition of the National Electrical Code (NEC), NFPA 70.
-  **CAUTION!** For long & satisfactory service, Armstrong recommends the facility use, or install, effective electrical surge and lightning protection to protect this equipment.

Only designated, qualified and competent personnel shall conduct product installation in accordance with these instructions.

## Water Treatment Requirements:

The end user shall be responsible for providing effective water treatment systems suitable to his application. The heater design does not incorporate a water quality control system.

Since the DFSI design incorporates a steam-to-water, shell & tube type, heat exchanger, minimizing scaling and deposit formation on heat exchange surfaces is critical to maintaining satisfactory operation. Therefore, consistent control of system water quality could be a very important factor in maintaining the water heating performance of the DFSI. Under certain conditions (e.g., water with a high dissolved mineral content or high discharge water temperatures), scale build-up in the heater and associated plumbing may be rapid & excessive causing heater performance to deteriorate to a noticeable level. Periodic cleaning and descaling may be required under these conditions.

Where chloramine / chlorine disinfection is practiced, DO NOT exceed a chloramine / chlorine concentration of 50 mg/l (ppm) in water, per one hour dwell time. Such procedures must be conducted strictly in accordance with the information supplied with the disinfectant and with all relevant Guidelines/Approved Codes of Practice. Water must have levels of chloramine / chlorine lower than or equal to 4 mg/l (ppm) for continual usage.

In any case, routine inspection & maintenance of the entire heater, especially the heat exchanger, the control valves, and other wetted components, is highly encouraged to monitor normal wear and to detect and correct abnormal conditions that could cause damage, system failure, and a subsequent hot water outage occur.

# Installation Requirements

The DFSI water heater requires connections to adequate sources of low-pressure, saturated steam; electrical power (120VAC / 60 Hz / 1 Ph., typ.); and clean (usually potable) cold water. Connections to a steam condensate return system, a recirculated return water circuit, and to a system that will utilize, distribute, or store the mixed (heated), potable water are also required.

Although the physical construction of the heater incorporates highly corrosion-resistant materials and watertight control enclosures, the device is intended to be located within a structure or protective enclosure furnished by the end user. The enclosure should provide adequate free space around the heater for service and maintenance. In locations w/ severe climates, means to protect the heater from low (freezing) and high ambient temperatures may also be required.

Proper installation usually requires mounting and securing the heater to a rigid base or foundation that can provide adequate bearing support, prevent movement and tipping, and resist differential settling. The base or foundation material should be able to withstand, without significant degradation, occasional exposure to moisture and wetting.

Support all steam and water piping connecting to the heater from a fixed structure capable of independently holding the operational weight of the piping. Consider employing design features in the piping and supports to accommodate thermal expansion and contraction of the piping during normal operation.

## Plumbing:

A licensed plumber or pipe fitter familiar with local code requirements should install the DFSI water heater and they should also oversee commissioning. Refer to the typical installation diagram that follows for a depiction of the location of connection points.

1. Before beginning any installation or maintenance procedure, always ensure that all supply, return, and recirculation water and steam lines are isolated, i.e. shutoff valves are closed.
2. Ensure any residual internal pressure in the system or connecting pipework is carefully relieved.
3. Allow hot parts to cool before commencing work, to avoid the risk of burns.
4. Always wear appropriate personal protective equipment (PPE) before carrying out any installation or maintenance work.
5. Place the DFSI water heater in the desired mounting location ensuring that there is adequate free space from adjacent walls and other obstructions for service and maintenance access. If movement or tipping of the water heater could occur, secure the heater stand or base to the floor.
6. Connect an appropriately-sized, boiler steam supply line to the heat exchanger steam connection.

**Note: In the event the tube bundle must be extracted from the heat exchanger, allow sufficient clearance between the removable head end of the heat exchanger and any obstructions to enable complete tube bundle removal from the heater (refer to the “Dimensions” table for tube bundle lengths). Assure sufficient clearance distances on all other sides of the heater assembly for service access.**

7. Connect an appropriately-sized, condensate return line to the outlet of steam trap(s).
8. Connect inlet cold water supply to the inlet piping, isolation valve (tagged accordingly).

**Note: The water supply pressure must be controlled such that the maximum operating conditions (refer to page 8) are not exceeded. Use a pressure reducing valve (PRV) to control pressure fluctuations or reduce line pressure where necessary. Water pressure must exceed steam pressure at all times.**

9. Connect outlet mixed water supply to the discharge piping, isolation valve (tagged accordingly).
10. Connect recirculation return line to the recirculation piping, isolation valve (tagged accordingly).
11. Pipe the outlet from the factory-supplied water, pressure relief valve to a sanitary drain to avoid contact with hot water should a pressure release occur. The drain line should terminate over the drain with the open end exposed to atmospheric pressure. The relief valve, drain line should slope downward toward the sanitary drain in a manner that allows all water to completely flow from the line. Standard cracking pressure for the factory-supplied, pressure relief valve is 165 PSI.

**Note: The DRV is designed for continuous recirculation. A recirculation pump (not supplied) must be installed on the recirculation line to the unit. The recirculation pump should operate continuously. Avoid switched power sources, timer-controlled power sources, and power sources tied to energy conservation circuits.**

Each DRV40 requires a minimum continuous recirculation of 5 gpm.

Each DRV50 or DRV80 requires a minimum continuous recirculation of 10 gpm.

# Installation Requirements - continued

## Electrical:

The DFSI water heater requires external electrical power to operate the DRV and the hot water, safety shutoff valve.

A licensed electrician, or electrical contractor, should run electrical current from a 120-240 VAC / 50-60 Hz / 1 Ph. power source to the DFSI control cabinet. An electrical schematic for a DFSI control system w/ a single DRV mixing valve and a single HW shutoff valve appears in Figure 1 below.

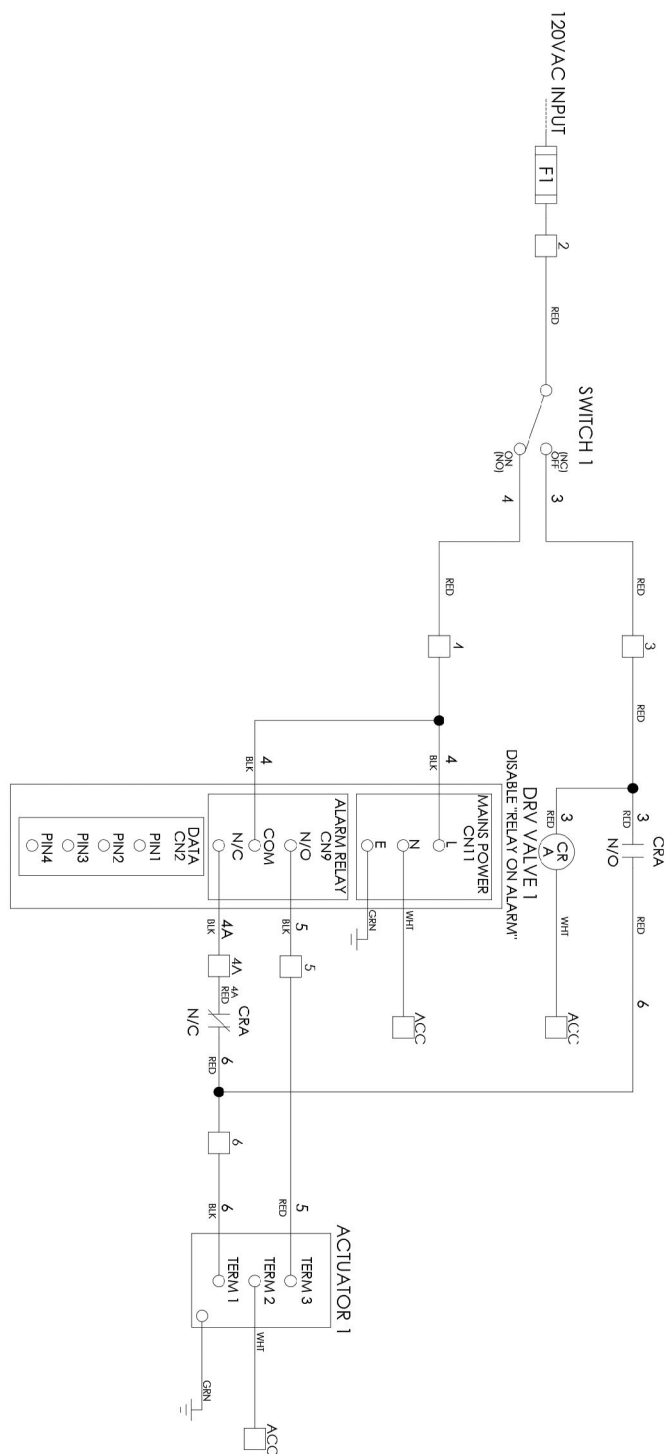
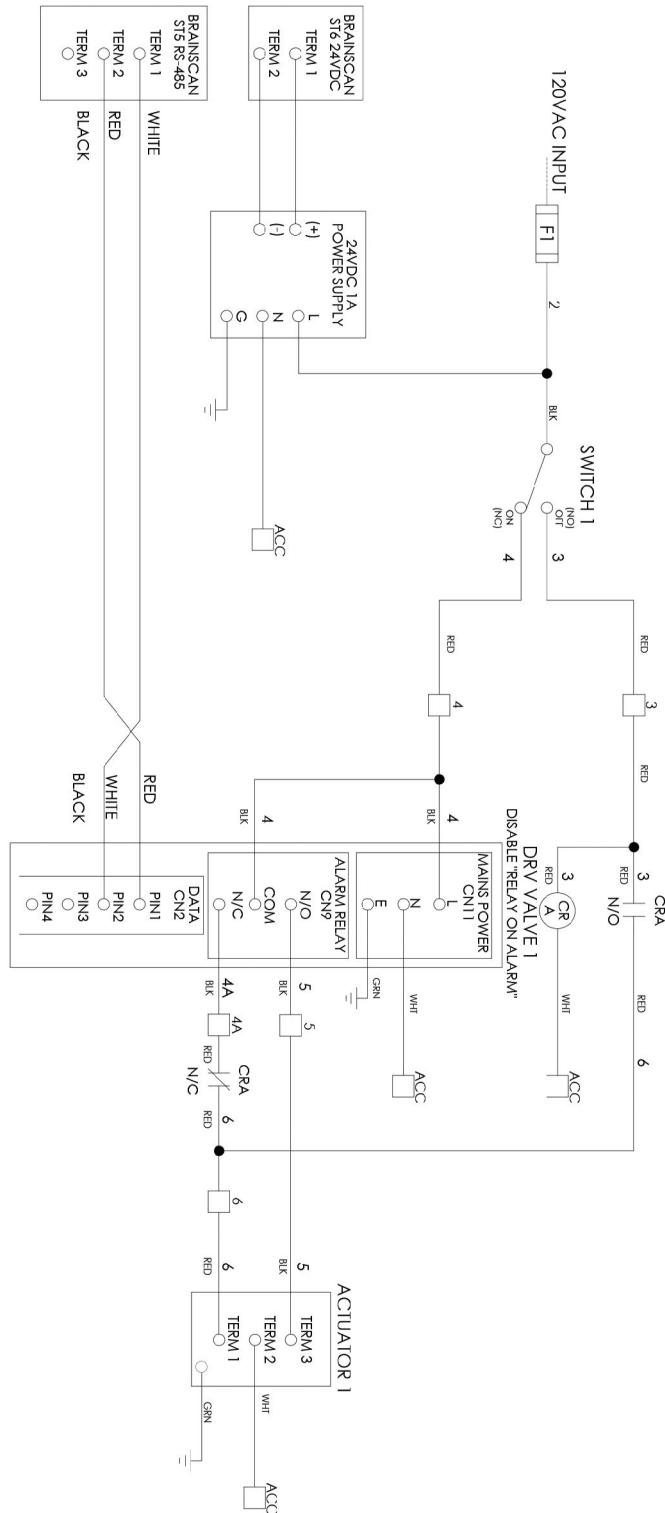


Figure 1: Electrical Schematic for a Standard DFSI w/ a Single DRV

# Installation Requirements - continued

An electrical schematic for a DFSI control system when equipped w/ a single DRV mixing valve, a single HW shutoff valve, and the optional SAGE™ feature appears in Figure 2 below.



**Figure 2: Electrical Schematic for a Standard DFSI w/ a Single DRV and the SAGE™ Option**

An electrical schematic for a DFSI control system when equipped with two DRV mixing valves, and two HW shutoff valves appears in Figure 3 below.



# Installation Requirements - continued

An electrical schematic for a DFSI control system when equipped with two DRV mixing valves, two HW shutoff valves, and SAGE™ appears in Figure 4 below.

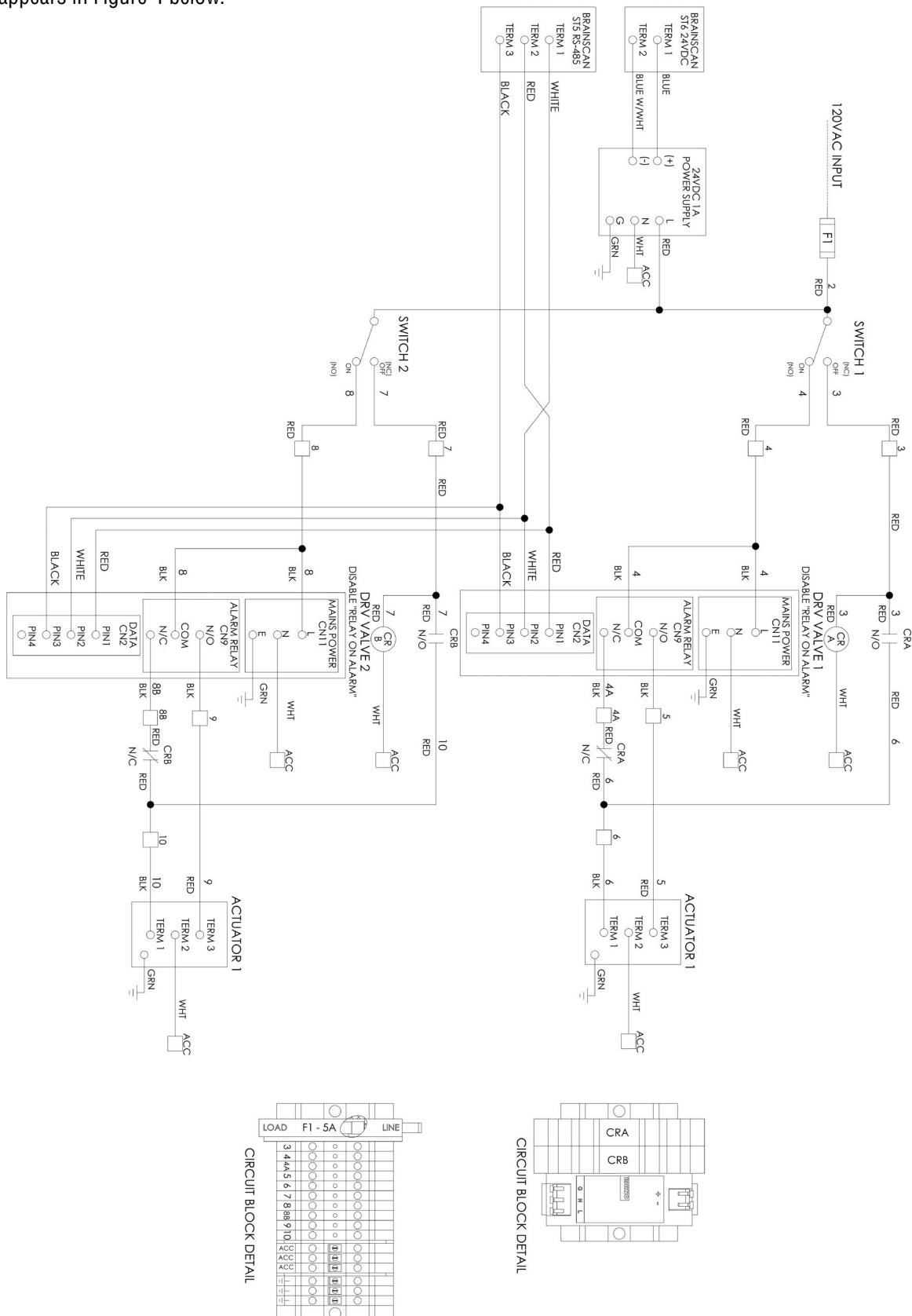




Figure 4: Electrical Schematic for a DFSI with Two DRV's and SAGE™

# Installation Requirements - continued

## *Electrical Connection Procedure:*

1. Connect the line voltage wire to the side of the fused terminal block marked “LINE”.
2. Connect the neutral wire to a terminal block marked “ACC”.
3. Connect the ground wire to the ground terminal block marked “”.
4. Energize the power source to the control panel and turn the manual selector switch to the “ON” position.
5. The display of the DRV should illuminate, and the safety shutoff valve should power open. Confirm that the safety shutoff valve position indicator moves from “CLOSED” to the “OPEN” position.
6. Turn the manual selector switch to the “OFF” position.
7. The display of the DRV should deactivate and the safety shutoff valve should power closed. Confirm that the safety shutoff valve position indicator returns to the “CLOSED” position.

 **WARNING!** The manual selector switch DOES NOT completely de-energize the DRV, and it DOES NOT de-energize the safety shutoff valve. The control panel must be de-energized (following standard lock-out tag-out procedures) from the source before opening the control panel, and before servicing the DRV or the safety shut-off valve.

## **Notes:**

The DRV is designed for continuous recirculation. A recirculation pump (not supplied) must be installed on the recirculation line to the unit. The recirculation pump should operate continuously. Avoid switched power sources, timer-controlled power sources, and power sources tied to energy conservation circuits.

Each DRV40 requires a minimum continuous recirculation of 5 gpm.

Each DRV50 or DRV80 requires a minimum continuous recirculation of 10 gpm.



# Commissioning



**WARNING!** The following procedure should **ONLY** be performed by qualified persons.

**DO NOT** attempt any of the following actions if you are:

1. NOT experienced with handling high-voltage, electrical power
2. NOT using appropriate personal protective equipment (PPE)

**DO** contact a qualified HVAC or electrical contractor instead.



**WARNING!** Water conducts electricity. **DO NOT** stand in water or touch wet surfaces while working with “live” electrical equipment.



**WARNING!** Failure to follow these instructions may result in a fire, explosion, or electrocution causing property damage, personal injury, or even death.



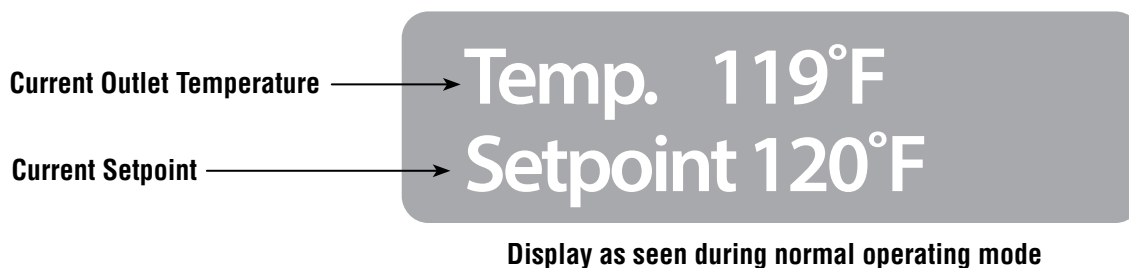
**CAUTION!** If cold water pressure is lost while steam is present, overheating and hydraulic pressure shock “water hammer” damage may occur in the heater and the plumbing system. Verify that adequate water volume and pressure is supplied to the DFSI **BEFORE** introducing steam into the heat exchanger.

**Only designated, qualified and competent personnel shall conduct commissioning in accordance with these instructions.**

1. Perform a visual overview and confirmation that the DFSI is installed per our installation schematics located in our IOM's
  - a. Confirm all water supply lines are connected correctly, and that all isolation valves are closed.
    - i. Hot Water
    - ii. Cold Water
    - iii. Mixed Water
    - iv. Recirculation return from the system loop to the DFSI
  - b. Confirm all steam/condensate lines are connected correctly, and that all isolation valves are closed.
2. Energize the DFSI control panel, turn switch(es) on, and verify DRV display(s) is/are illuminated.
  - a. Confirm the safety shutoff valve(s) opens (blue actuator valve on hot supply line to DRV)
3. Flood the system slowly and in the following sequence:
  - a. Cold water supply
  - b. Mixed water outlet
  - c. Hot water supply
4. Create a demand in the system loop
  - a. Open 4-5 fixtures (slop sinks, showers, baths, etc...)
5. Turn on recirculation pump(s)
  - a. Confirm continuous minimum flow of  $\geq 5$  gpm to each DRV40,  $\geq 10$  gpm to each DRV50, or  $\geq 10$  gpm to each DRV80.

# Commissioning - continued

6. Open the condensate discharge isolation valves on the DFSI
7. Supply steam to the DFSI, slowly
  - a. Purge any condensate/water in the system
  - b. DO NOT exceed 15 psi of steam pressure
8. Confirm all supply temperatures and pressures are sufficient
  - a. Hot water
  - b. Cold water
  - c. Recirculation return
9. Observe the DRV adjust to and maintain the setpoint pre-programmed at the factory (based information provided on the IDF). Give open fixtures time to evacuate air from the system.



10. Shut off all open fixtures and confirm presence of continuous recirculation.
11. Monitor DRV outlet and confirm it is maintaining set point
  - a. New systems may take some time for the recirculation return temperature to rise to an appropriate level.

**Note: The setpoint of the DRV is preset based on information provided to Armstrong. To adjust the DRV setpoints, high limit error temp, or to enable/disable other integral valve features, refer to the DRV installation and operation manual (IOM).**

**Note: When starting-up a DFSI, it is very important that the water supply is turned on to the unit BEFORE any steam is turned on. Once the unit is operating, the inlet water valve should NEVER be closed unless the steam is turned off first. When shutting down a unit, BEFORE closing off the supply water to the unit, always first shut off the steam and then allow water to run through the unit until it has cooled and completely condensed all remaining steam in the heat exchanger.**

**Note: During system start-up, the DRV display may read a “temp low” condition. This error condition should clear during commissioning. If the error condition does not clear, refer to the DRV IOM Troubleshoot Guide.**

# Safety Shutoff Valve

The electrically actuated safety shutoff valve is a redundant safety feature linked to a relay in the DRV. The DRV is self-diagnostic and configured to assure closure of the hot water inlet under the following conditions:

- Power failure
- DRV Temp Error
- DRV Motor Error
- DRV PCB Error
- DRV Thermistor Error
- DRV Battery Error

In the event of a power failure, the DRV and the safety shutoff valve are configured to close the hot water inlet via internal battery power. The DRV battery (non-rechargeable/replaceable) does not provide back-up power to the DRV during a power outage; only power to actuate closure of the hot water inlet. The safety shutoff valve battery (rechargeable/replaceable) will only actuate the valve to the closed position; the valve will not actuate to the open position in the presence of battery power only. The system will return to normal when power is restored.

In the event of a DRV error listed above, the DRV and the safety shutoff valve (via the closed DRV relay) are configured to close the hot water inlet via the building power source.

In response to a DRV error, the DRV relay remains closed until personnel have had an opportunity to diagnose the error, correct the cause of the error, and perform a manual restart of the DRV (power off for 10 seconds). This is an intentional, pro-active safety measure.



Turning a DRV control panel power switch to the off position does not completely de-energize the DRV, or the safety shutoff valve. Both are internally “live” unless the DFSI control panel is locked-out/tagged-out from the building power source.

**NOTE: The DRV relay is programmed at the factory to only close in response to a DRV ERROR. If the relay is responding to ALERTS and closing the safety shutoff valve, connect to the DRV and confirm via the programming software that the Activate Relay on Alert box is unchecked.**

# Periodic Maintenance



**BURN HAZARD!** Contact with hot water or metal surfaces can cause severe skin burns. Skin exposure to 140°F (60°C) water or metal for only five (5) seconds may cause a second degree burn.

- Prior to performing any invasive procedure, close the steam inlet following lockout/tagout procedures and allow the heat exchanger to cool. (Always close steam inlet before closing water inlet!)
- De-energize the DFSI electrical control panel following lockout/tagout procedures.
- Stop recirculation pump(s), close cold water inlet, and relieve water pressure before breaking any couplings and joints.

## Critical Preventive Maintenance

**Batteries:** Replace DRV battery every 12 months\*\*, or more frequently if frequent power interruptions compromise battery life. See DRV IOM for comprehensive maintenance details.

**O-Rings & Seals:** Replace DRV O-Rings & Seals every 12 months\*\*, or more frequently if exposed to harsh water conditions. See DRV IOM for comprehensive maintenance details.

**Safety Shutoff Valve:** Exercise the safety shutoff valve every 6 months\*\*, or more frequently if exposed to harsh water conditions. Turn off the DF control panel power switch to the DRV, confirm closure of the safety shutoff valve, turn power switch back on, and confirm the safety shutoff valve fully opens. (See page 19 for more on the safety shutoff valve)

**Strainers:** Clean supply strainers every 6 months\*\*, or more frequently if exposed to harsh water conditions. Blowdown strainer, remove and thoroughly clean basket screens, flush strainer body.

\*\* Intervals are recommended. Site conditions and maintenance trends may support extending or reducing preventive maintenance intervals. (Exception: DRV battery replacement should not exceed one year interval)

Interval**	Task
Quarterly	Check heat exchanger temperatures and flow rates against standard specifications.
Quarterly	Check bolted joints for loose fasteners, and for signs of steam or water leakage. Tighten or replace excessively corroded parts and fasteners as needed.
Quarterly	Check condition of heat exchanger and two-pass head for signs of leakage and excessive corrosion. Tighten joints or replace parts as required.
Quarterly	Wipe down assembly. Check for damaged components. Touch-up paint as required.
As required	Descale system (frequency depends on water quality).
As required	If excessive leakage is found, replace worn or damaged plumbing, parts, and heat exchanger gaskets as required.

# Periodic Maintenance - continued

**Heat Exchanger Maintenance:** As needed, based upon water quality.

Performance: Check temperatures and flow rates against the commissioning data. If there is a noticeable reduction in heat exchanger capacity, temperature, or an elevated pressure drop across the exchanger, excessive mineral scale or fouling may be present.

Two scale remediation options are: 1. Manual disassembly, descaling, and cleaning. 2. Clean-in-Place method that floods the heat exchanger with a descaling solution, such as Rite-Qwik™

Before attempting manual cleaning, confirm that an appropriately sized DFSI heat exchanger gasket kit is on-site.

## 1. Manual Cleaning by Removing Heat Exchanger Tube Bundle

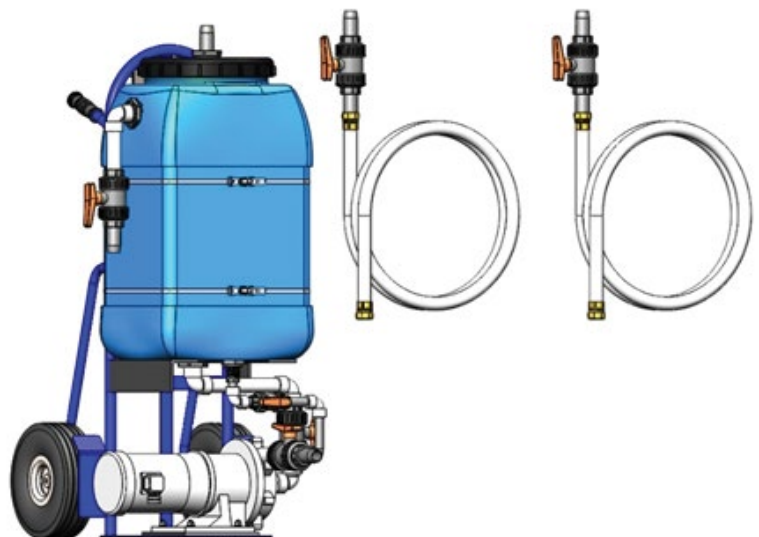
- a. De-energize the DFSI control panel following lockout/tagout procedures. Close the steam inlet following lockout/tagout procedures, stop recirculation pump(s), close recirc return line and the mixed water outlet. Allow the heat exchanger to cool.
- b. With cold water supply still on; drain all liquids from the heat exchanger shell by opening the drain valve and isolating the cold water supply (all other water supply lines should still be isolated).
- c. Route a heavy duty strap or chain fall around and through the tube bundle removal tabs (located on the tube sheet) and then up and over a sufficient cross brace support that can bear the weight of the tube bundle. Ensure secure before proceeding.
- d. Disconnect all steam & condensate piping.
- e. Loosen & remove the heat exchanger bolts & nuts holding the head cover to the shell.
- f. With the tube bundle now supported by only the strap &/or chain fall, slowly lower the tube bundle (one may choose to further support the tube bundle weight by use of a heavy duty floor jack or equipment mover).
- g. If the tube bundle won't lower, turn it slightly using the removal tabs in order to break loose from the shell.
- h. Extract the tube bundle from the heat exchanger for inspection and manual cleaning. Gentle cleaning of the tube bundle using manual or power tools or pressure washing may be effective in removing deposits from the tube bundle. Soaking the tube bundle in chemical cleaning agents and descalents may expedite the manual cleaning process.
- i. Heat exchanger head and inside of the shell may also require cleaning and flushing to remove deposits and sediment.
- j. Thoroughly-clean all mating surfaces of the heat exchanger.
- k. Reassemble the heat exchanger. Replace the flange gasket and any questionable fasteners w/ identical, new parts.
- l. Re-commission the water heater (see pages 17-18).

## 2. Clean-in-Place (CIP) Method

Armstrong offers a suitable cleaning agent called Rite-Quik™, a nonhazardous chemical cleaner that has been proven effective for removing deposits without damaging or causing deterioration to internal surfaces the DFSI heater.

Rite-Qwik™ can be pumped directly into the heat exchanger by using an Armstrong Clean-In-Place unit, conveniently assembled on a portable hand-cart. See CIP connections detail on page 23.

If ordering Rite-Qwik™, a minimum of 10 gallons is recommended. Review the Rite-Qwik™ safety data sheet before using the solution, and follow appropriate safety and disposal guidelines.



**P/N D42760**

# Periodic Maintenance - continued

## Clean-in-Place (CIP) Instructions for DFSI

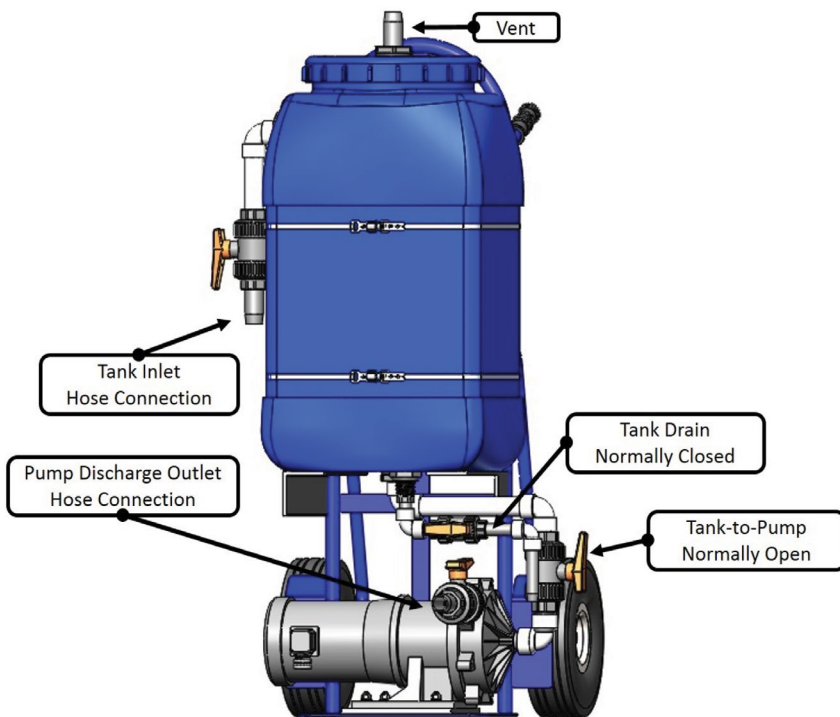
- a. Close the steam inlet following lockout/tagout procedures.
- b. Close the condensate line.
- c. Stop recirculation pump(s), close the cold water inlet, recirc return line and mixed water outlet, depressurize the exchanger (via drain valve).
- d. De-energize the DFSI control panel following lockout/tagout procedures.
- e. Connect a close pipe nipple and then hose to the HX drain valve and position to drain.
- f. Open the cold water inlet to flow water through the heat exchanger, and through the hose to drain. Flush for 10 minutes, or until the outside of the heat exchanger is cool to the touch.
- g. While the heat exchanger is being flushed, prepare the Armstrong CIP unit for service: Connect CIP hoses – with ball valves closed – to the pump discharge and tank inlet connections. Verify that the tank drain valve is closed. Open the pump discharge and tank inlet valves. Fill the holding tank with Rite-Qwik™ (minimum of 10 gallons). See CIP unit detail on following pages.
- h. Close the DFSI cold water inlet, and allow flush-water to drain completely.
- i. Disconnect hose.
- j. Remove the 1” NPT pipe plug from the DFSI cold water inlet CIP connection and replace it with the close pipe nipple supplied on union-end of the CIP hose. See CIP unit detail on following pages.
- k. Remove the 1” NPT pipe plug from the DFSI hot water outlet CIP connection and replace it with the close pipe nipple supplied on union-end of the CIP hose.
- l. Connect the CIP hose from the pump discharge outlet to the close pipe nipple installed on the hot water outlet. Verify ball valve is closed.
- m. Connect the CIP hose from the tank inlet to the close pipe nipple installed on the cold water inlet. Verify ball valve is closed, and leave tank fill opening uncapped to allow venting.
- n. Connect the Armstrong CIP unit power cord to a GFI protected circuit, verify the tank-topump valve is open, and start the pump.
- o. Slowly open the ball valve on CIP hose connected to hot water outlet.
- p. Slowly open the ball valve on CIP hose connected to cold water inlet. The CIP unit will begin circulating Rite-Qwik™ through the heat exchanger.
- q. Fizzing and foaming in the CIP unit tank will indicate scale is being actively dissolved. Monitor level of foaming, and be prepared to stop pump to prevent overflow.
- r. When the Rite-Qwik™ is no longer fizzing or foaming, the cleaning process is complete. Note that the maximum Rite-Qwik™ circulation time is three hours.
- s. Stop the pump, close the CIP hose ball valve connected at the hot water outlet, and allow the heat exchanger to drain to the CIP tank.
- t. Close the CIP hose ball valve connected at the cold water inlet.
- u. Disconnect the hose from the CIP tank inlet, and position to drain.
- v. Open the cold water inlet to allow fresh water to flush through the heat exchanger, and through the CIP hose to drain. Flush for 15 minutes.
- w. Close the cold water inlet, and disconnect the CIP hoses from the Digital-Flo.
- x. Remove the close pipe nipples and replace the 1” NPT pipe plugs. Return the close pipe nipples to the CIP hoses for safekeeping.
- y. Recommission the DFSI following IMPORTANT instructions on pages 17-18.
- z. See Clean-in-Place unit maintenance details on following page.



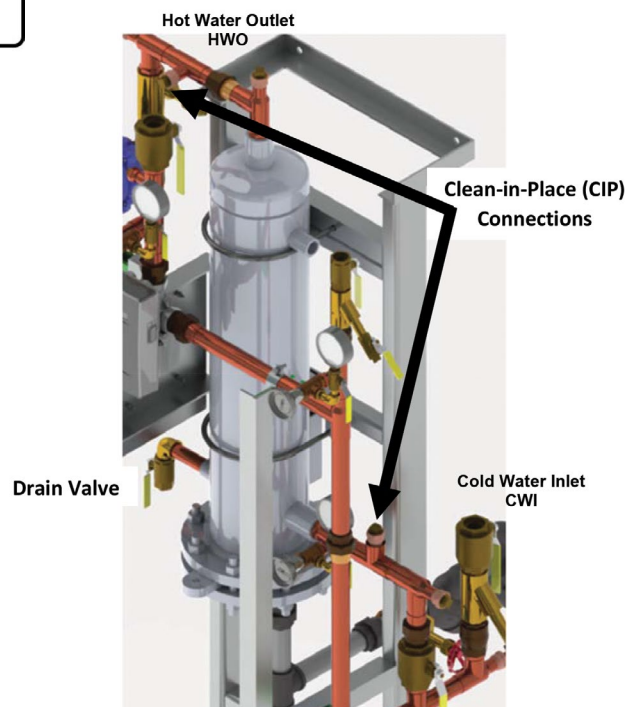
# Periodic Maintenance - continued

## Clean-in-Place Unit Maintenance Details

- Rite-Qwik™ that remains active may be stored for later use. Test the solution by dropping a calcium antacid tablet into the tank. Fizzing indicates the solution is still active, and can be returned to the original shipping container via the CIP tank drain outlet. If the solution does not fizz, it is inactive and not worthy of storing.
- Unused product can be flushed with water into a sanitary sewer. Used solution may be hazardous as a result of the pre-existing contaminants present in the equipment being cleaned. Dispose of material in accordance with the Local, State, Provincial, and Federal regulations for your location.
- After draining and properly storing or disposing of contents in the CIP unit tank, close the tank drain and fill the CIP tank with fresh water.
- Connect a CIP hose to the pump discharge outlet, position to drain, and open ball valve.
- Perform a brief flush of the CIP tank drain by opening and closing tank drain ball valve.
- Start CIP unit pump. Immediately stop the CIP unit pump once the tank is empty.
- Perform manual flush of the second CIP hose. Allow components to air dry.
- Store the Armstrong CIP unit in a warm and dry place. Do not expose to freezing temperatures.



**Armstrong Clean-in-Place Unit Detail**



# Preventative Maintenance and Fitting Spare Parts



**WARNING! Isolate power to the DRV. Ensure that the circulating pump is not operating.**

DRV components should be inspected annually, or more frequently where acknowledged site conditions such as high mineral content water dictate.

Each DRV has a serial number that is maintained on file with the Technical Department at Armstrong.

For any installation, operation, maintenance or technical support details not covered in this guide, please call our Technical Department quoting the model and/or serial number.

## Batteries

Batteries are supplied to ensure the DRV switches to **Full Cold** in the event of a primary power supply failure, they should **not** be considered to be a backup power supply.

Battery life is variable depending upon usage. A battery error message appears on the DRV display when they require replacing.

Where primary power supply failure occurs regularly or the DRV is installed within a supply system where safety is critical, the batteries **must** be changed at least every 12 months as part of an annual maintenance routine.

In noncritical systems or where battery usage is low, longer replacement cycles may be considered up to a maximum of 5 years. Inspection of critical compounds and/or assemblies.

## O-Rings/Seals

All “wetted” O-Rings/Seals must be replaced at least every 12 months as part of an annual maintenance routine. In systems where water quality conditions are poor, more frequent replacement may be required.

## Strainers

All supply strainers must be thoroughly cleaned at least every 12 months as part of an annual maintenance routine. Cleaning includes physically taking the strainer screen/basket out of the body and cleaning as well as flushing water through body. In systems where water quality conditions are poor, more frequent cleaning may be required.



# Troubleshooting



**WARNING!** Always use appropriate lockout/tagout procedures when closing the steam inlet and de-energizing the DFSI control panel during installation, service, and repair. Failure to follow safety precautions may result in property damage, burns and or shock causing personal injury, including electrocution and death.



**WARNING!** Always use appropriate personal protective equipment (PPE) when handling high-voltage electricity.



**WARNING!** Water conducts electricity. **DO NOT** stand in water or touch wet surfaces while working with “live” electrical equipment.



**BURN HAZARD!** Contact with hot water or metal surfaces can cause severe skin burns. Skin exposure to 140°F (60°C) water or metal for only five (5) seconds may cause a second degree burn.

- Prior to performing any invasive procedure, close the steam inlet following lockout/tagout procedures and allow the heat exchanger to cool. (Always close steam inlet before closing water inlet!)
- De-energize the DFSI electrical control panel following lockout/tagout procedures.
- Stop recirculation pump(s), close cold water inlet, and relieve water pressure before breaking any couplings and joints.

**Note:** For problems exclusive to the DRV, refer to the DRV IOM.

Generally, performance problems with the DFSI can be categorized under three (3) areas.

1. System faults – performance issues associated w/ steam or water supplies to the heater or the return lines for mixed water and condensate from the heater.
2. DRV faults / process errors – performance issues associated w/ inappropriate settings, out-of-bounds operating conditions, or component failures in the digital recirculation valve (DRV).
3. Heat exchanger faults – performance issues associated w/ the heat exchanger, such as fouling, scaling, or leakage.

Consult the following DFSI Troubleshooting Table for assistance in determining the cause of a performance problem and suggestions for actions to remedy or alleviate the problem.

# DFSI Troubleshooting Table:

Problem	Probable Cause	Corrective Action
Unable to bring DFSI up to temperature.	System fault.	<ul style="list-style-type: none"> <li>a. Open steam isolation valve.</li> <li>b. Increase steam pressure. Do not exceed 15 psi.</li> <li>c. Reduce domestic water flow rate.</li> <li>d. Correct condition causing high temperature shutoff valve to close.</li> <li>e. Open steam trap isolation valve, if equipped.</li> <li>f. Steam trap is blocked. Disassemble trap and clear blockage(s).</li> <li>g. Back pressure in the condensate line may be too high. Temporarily disconnect the pipework downstream of the steam trap. While running the condensate to drain, determine if the hot water comes up to temperature. If so, investigate potential problems on the condensate return system or install a pump trap to overcome the higher back pressure.</li> <li>h. A check valve may be defective and requires replacement. If the re-circulation line is not hot, a failed check valve may cause cold water to bypass the heat exchanger.</li> </ul>
	DRV fault.* DRV Troubleshoot Guides.	See DRV Troubleshooting Guide in the following section.
	Heat exchanger fault.	<ul style="list-style-type: none"> <li>a. Vent trapped air (gases) from heat exchanger shell.</li> <li>b. Clean scaled or fouled heat exchanger tubes.</li> </ul>
Water from DFSI is too hot.	System fault.	<ul style="list-style-type: none"> <li>a. Reduce steam pressure</li> <li>b. Steam is superheated – reduce superheating.</li> </ul>
	DRV fault.* DRV Troubleshoot Guides.	See DRV Troubleshooting Guide in the following section.
System temperature rises during periods of no system demand.	System fault.	<ul style="list-style-type: none"> <li>a. Confirm continuous recirculation of at least 5 gpm to each DRV40, and at least 10 gpm to each DRV50 or DRV80.</li> <li>b. Check for air locks and closed valves.</li> <li>c. Blowdown strainers, then <u>remove and thoroughly clean all strainer screens</u>.</li> <li>d. Confirm return temperature is at least 2°F below DRV set point</li> <li>e. Confirm installation and location of check valves is correct. Refer to schematics. Ensure that check valves are fully functional.</li> <li>f. Verify hot water and cold water supply pressures are balanced and constant. Ensure that there is adequate mixed return flow to the <u>cold water inlet</u> of the water heater.</li> <li>g. Rule out that a higher temperature cross-connection (from kitchen or laundry loop) is feeding water into the return line. Eliminate cross-connections.</li> </ul>
	DRV fault.* DRV Troubleshoot Guides.	See DRV Troubleshooting Guide in the following section.

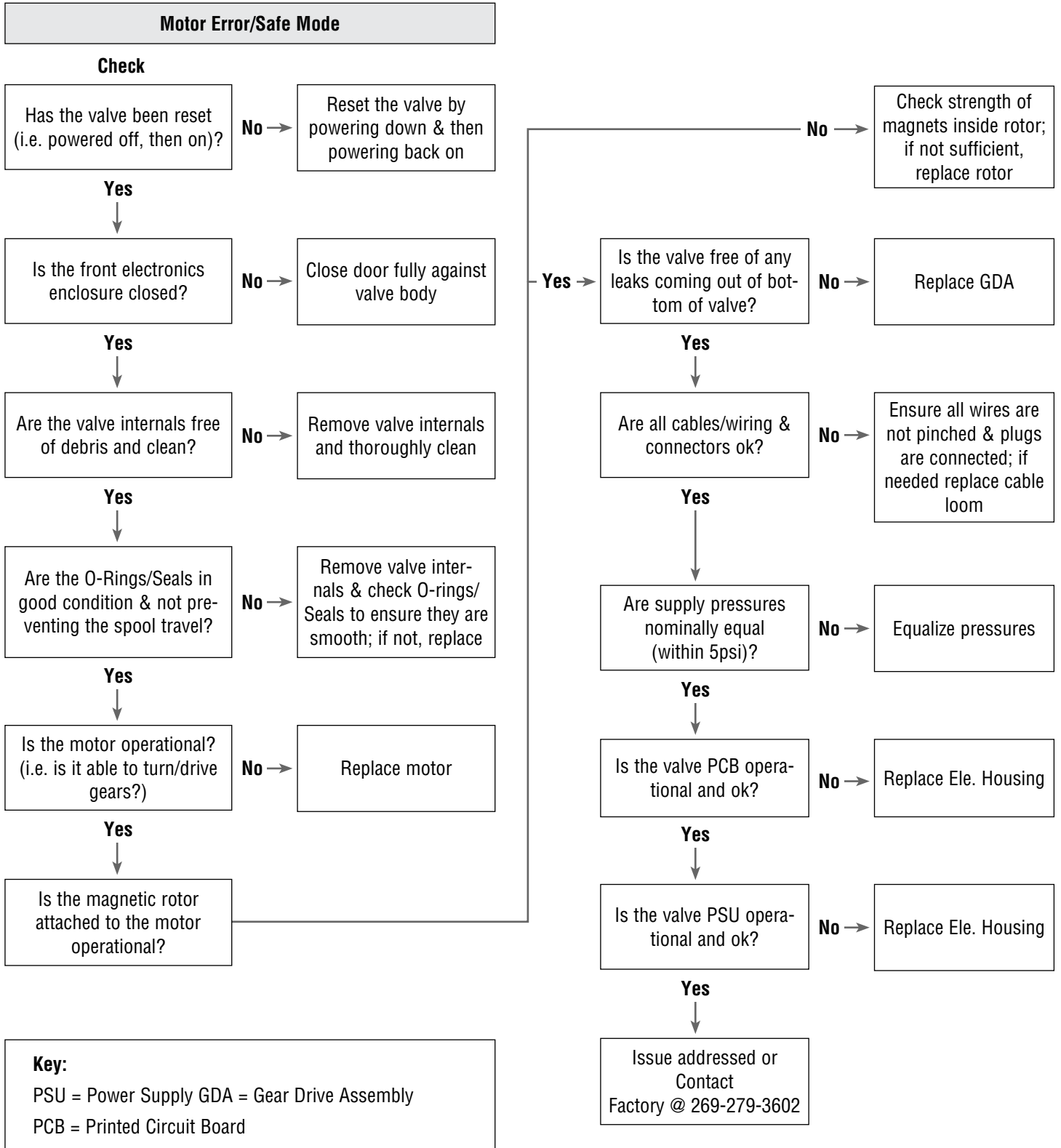
# DFSI Troubleshooting Table – continued

Problem	Probable Cause	Corrective Action
System temperature fluctuates more than +/- 5°F (2.8°C) or DRV displays “Emergency Mode”.	System fault.	a. Confirm continuous recirculation of at least 5 gpm to each DRV40, and at least 10 gpm to each DRV50 or DRV80. b. Confirm hot water and cold water supply pressures are nominally equal. Correct supply pressure differential greater than 15 psi. c. Check for air locks and closed valves. d. Blowdown strainers, then <u>remove and thoroughly clean all strainer screens.</u> e. Confirm return temperature is at least 2°F below DRV set point. f. Check the steam pressure at the heat exchanger shell. If the steam pressure is decreasing under normal conditions, there may be insufficient steam available to meet the hot water demands
	DRV fault.	See DRV Troubleshooting Guide in the following section.
DRV display shows any of the following: 1. Temp High – Alert 2. Temp Low - Alert 3. Temp High - Error	System fault.	See DRV Troubleshooting in the next section
	DRV fault.	See DRV Troubleshooting in the next section
Reduced heater capacity.	Heat exchanger fault.	Heat exchanger may be partially blocked due to scaling. Clean the heat exchanger using a suitable de-scaling fluid via the CIP connections. If the heat exchanger has become completely blocked, major disassembly and manual cleaning may be required.

# DFSI Troubleshooting Table – continued

Problem	Probable Cause	Corrective Action
Unable to adjust system temperature.	System fault.	<ul style="list-style-type: none"> <li>a. Confirm continuous recirculation of at least 5 gpm to each DRV40, and at least 10 gpm to each DRV50 or DRV80.</li> <li>b. Confirm hot water and cold water supply pressures are nominally equal. Correct supply pressure differential greater than 15 psi.</li> <li>c. Check for air locks and closed valves.</li> <li>d. Confirm installation and location of check valves is correct. Refer to schematics. Ensure that check valves are fully functional.</li> <li>e. Blowdown strainers, then <u>remove and thoroughly clean all strainer screens.</u></li> <li>f. Confirm return temperature is at least 2°F below DRV set point.</li> <li>g. Check the steam pressure at the heat exchanger shell. If the steam pressure is decreasing under normal conditions, there may be insufficient steam available to meet the hot water demands.</li> </ul>
	DRV fault.	See DRV Troubleshooting Guide in the following section.
No display on DRV and/or no control.	System fault.	<ul style="list-style-type: none"> <li>a. Confirm uninterrupted power to DFSI control panel.</li> <li>b. Check status of DRV power switches on the DFSI control panel.</li> </ul>
	DRV fault.	See DRV Troubleshooting Guide in the following section.
DFSI “bangs” and “hammers” during operation.	System fault.	<ul style="list-style-type: none"> <li>a. Steam pressure has dropped and a vacuum has formed inside the heat exchanger. Increase steam pressure or reduce water flow through the heater.</li> <li>b. Water pressure has dropped below the steam pressure and steam is forming inside the tubes. Increase water pressure or water flow through the heater.</li> </ul>
	Heat exchanger fault.	<ul style="list-style-type: none"> <li>a. The shell of the heat exchanger is not properly drained. Confirm condensate is draining freely (steam trap is not blocked &amp; return line is not pressurized).</li> <li>b. Remove and inspect tube bundle for tube or seal failures.</li> </ul>
Water leaking from DRV.	DRV fault.	<ul style="list-style-type: none"> <li>a. Check all DRV seals for wear and/or damage. Clean, lubricate or replace.</li> <li>b. Body casting failure – replace DRV.</li> </ul>

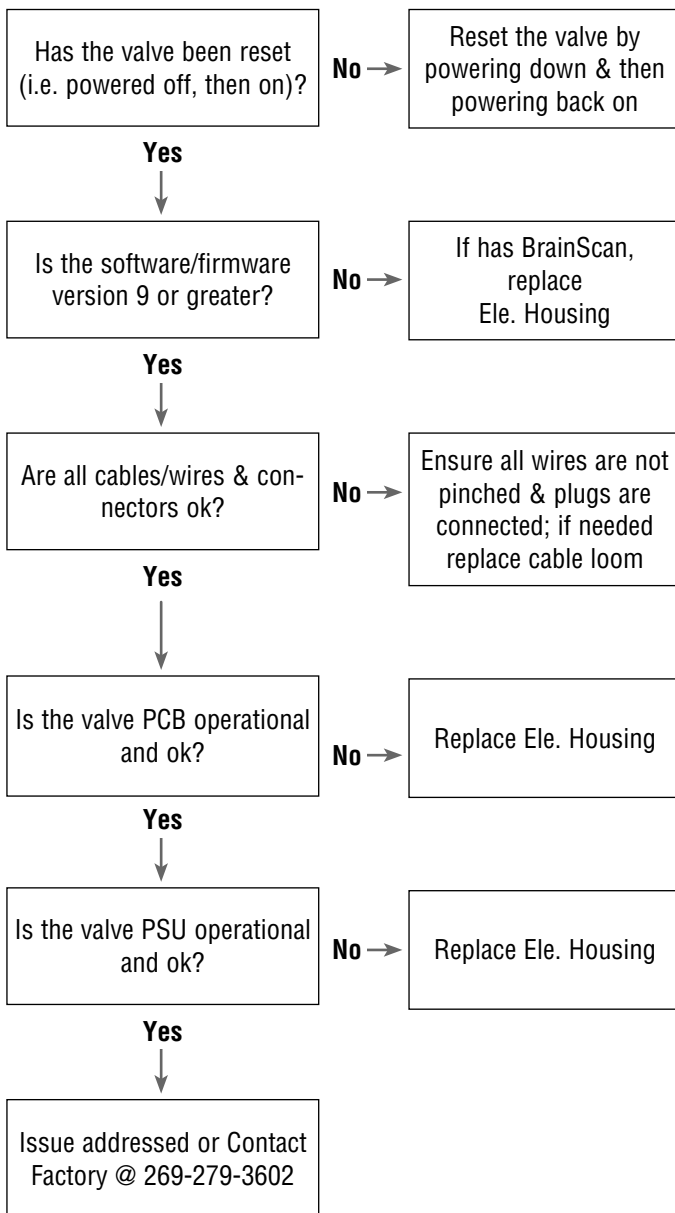
# DRV40-80 Gen. 2 Troubleshoot Guide



# DRV40-80 Gen. 2 Troubleshoot Guide

## PCB Error

### Check

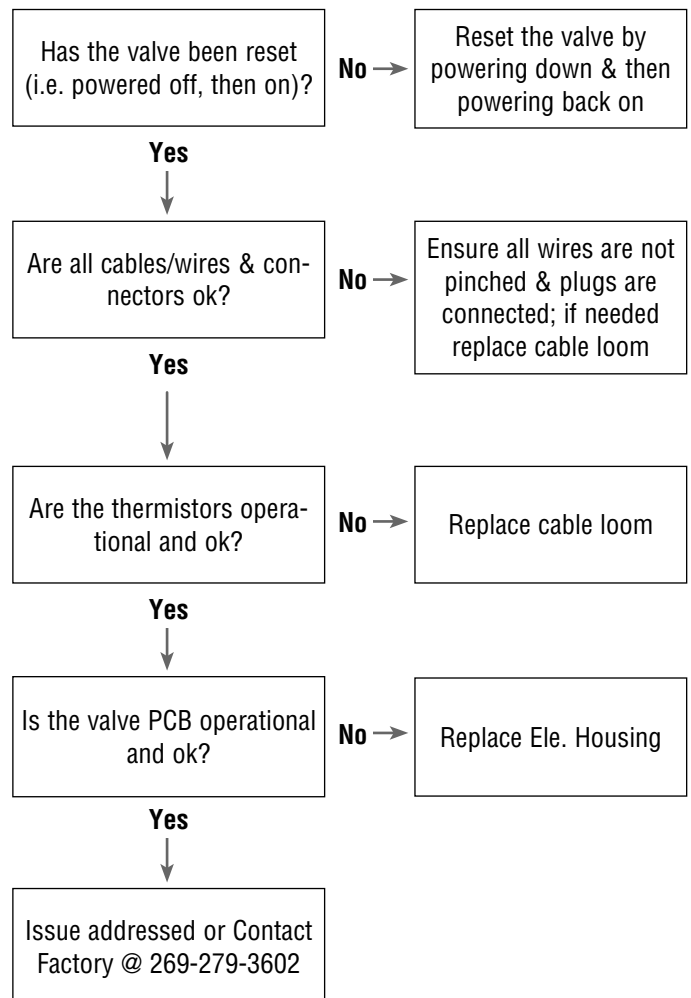


### Key:

PSU = Power Supply  
GDA = Gear Drive Assembly  
PCB = Printed Circuit Board

## Thermistor Error

### Check



# DRV40-80 Gen. 2 Troubleshoot Guide

## Battery Error

### Check

Has the valve been reset  
(i.e. powered off, then on)?

No →

Reset the valve by  
powering down & then  
powering back on

Yes  
↓

Have the batteries been  
replaced within last year?

No →

Replace Batteries

Yes  
↓

Are all cables/wires & con-  
nectors ok?

No →

Ensure all wires are not  
pinched & plugs are  
connected

Yes  
↓

Is the valve PCB operational  
and ok?

No →

Replace Ele. Housing

Yes  
↓

Is the valve PSU operational  
and ok?

No →

Replace Ele. Housing

Yes  
↓

Issue addressed or Contact  
Factory @ 269-279-3602

### Key:

PSU = Power Supply

GDA = Gear Drive Assembly

PCB = Printed Circuit Board

## Display Issues

### Check

Has the valve been reset  
(i.e. powered off, then on)?

No →

Reset the valve by  
powering down & then  
powering back on

Yes  
↓

Is the lighting/brightness  
sufficient?

No →

Adjust brightness via  
POT adjustment screw  
on PCB

Yes  
↓

Is the display  
numerals/characters ok?

No →

Replace display & keep  
original to allow for  
a spare in event heat  
affects again

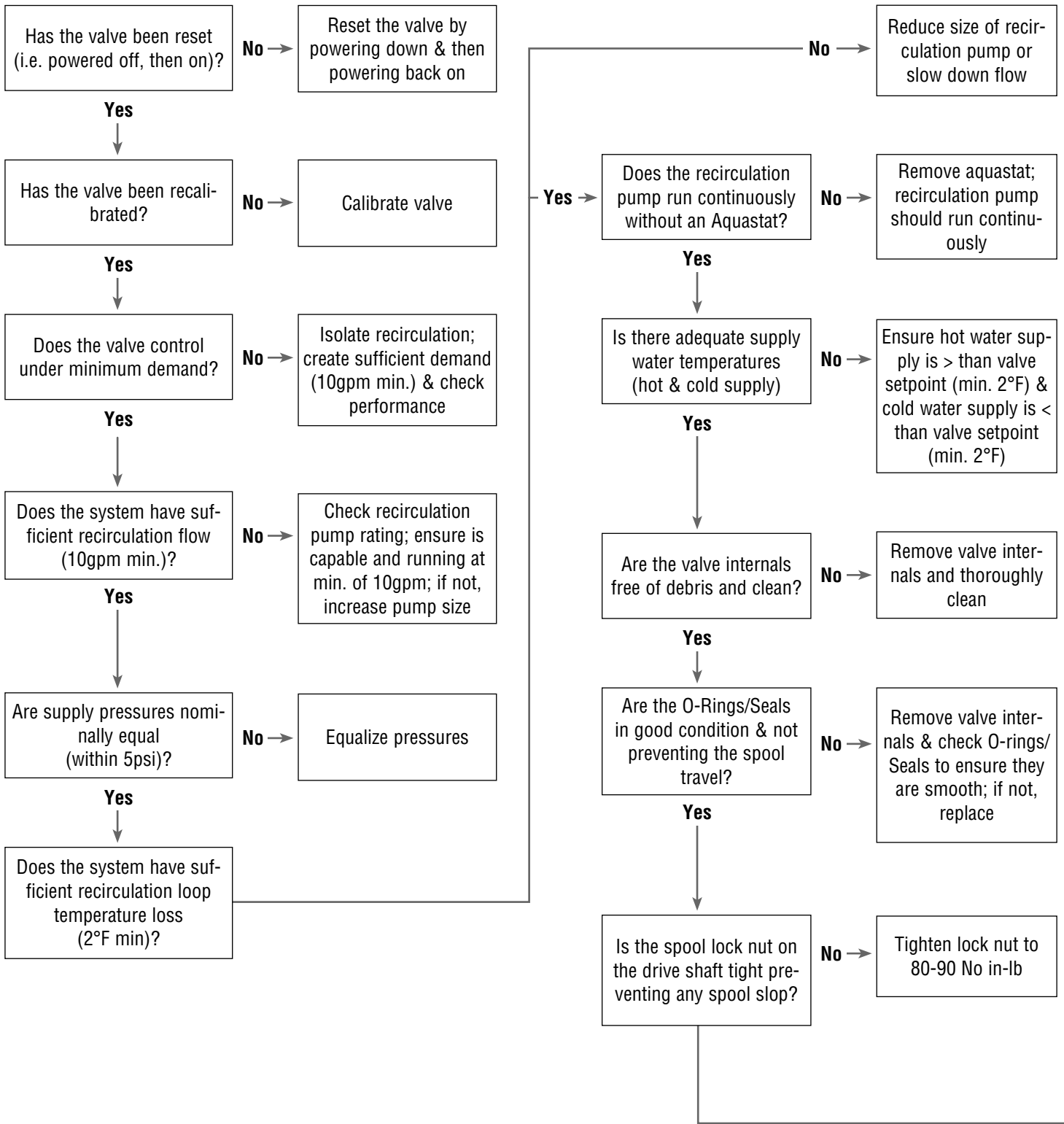
Yes  
↓

Issue addressed or Contact  
Factory @ 269-279-3602

# DRV40-80 Gen. 2 Troubleshoot Guide

## Temperature Control Issues

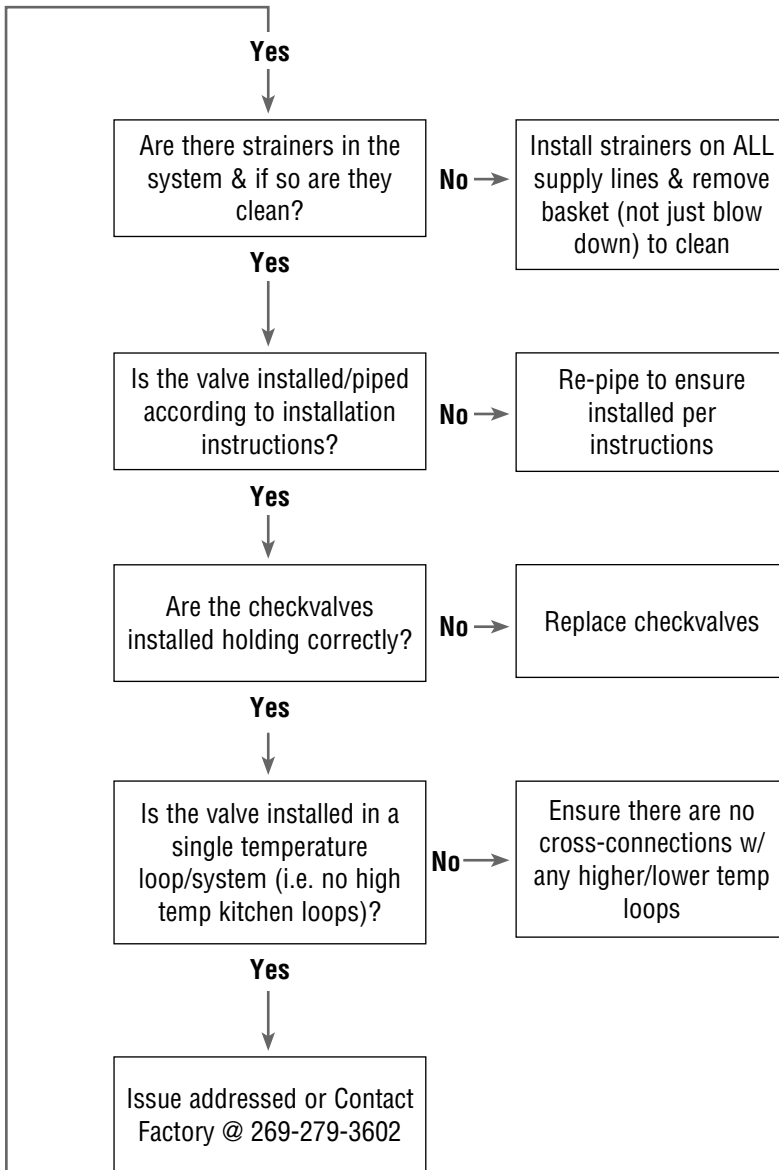
### Check





# DRV40-80 Gen. 2 Troubleshoot Guide

## Temperature Control Issues - Continued



# DFSI Spare Parts

## Single Wall Tube Bundle & Heat Exchanger Gasket Kit

Single Wall Model	Part Number
DFS15	D80717
DFS35	D80719
DFS50	D80721
DFS90	D80723



DFS Single Wall Tube Bundle with Gasket Kit

## Double Wall Tube Bundle with Heat Exchanger Gasket Kit

Double Wall Model	Part Number
DFS15DW	D80718
DFS35DW	D80720
DFS50DW	D80722
DFS90DW	D80724



DFS Double Wall Tube Bundle with Gasket Kit

## Heat Exchanger Gasket Kit for DFSI

Single or Double Wall	Part Number
DFS15	D82028
DFS35	D82029
DFS50	D82030
DFS90	D82031



Not Compatible with FRT Models

Needed if You Service a DFSI Tube Bundle

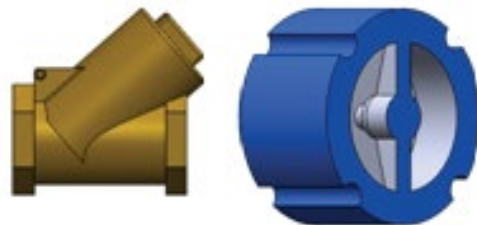
## Insulation Jacket & Covers (Single or Double Wall)

Aluminum Cover (Standard)	Part No.
DFS15	D80896
DFS35	D80897
DFS50	D80898
DFS90	D80899
Stainless Steel Cover (Replaces Aluminum)	Part No.
DFS15	D80904
DFS35	D80905
DFS50	D80906
DFS90	D80907
Removeable Fiberglass	Part No.
DFS15	D80900
DFS35	D80901
DFS50	D80902
DFS90	D80903

# DFSI Spare Parts – continued

## Check Valves

Size	Description	Part Number
1"	VALVE CHK SWING 1" NPT BRZ LF	D30028
1.5"	VALVE CHK SWING 1.5" NPT BRZ LF	D39479
2"	VALVE CHK SWING 2" NPT BRZ LF	D30024
3"	VALVE CHK DISC 3" WAFER EPOXY COATED	D34291



## DRV Preventive Maintenance Parts

Size	Description	Part Number
	Battery CR-P2 6 Volt	D9022
DRV40	DRV40 O-Ring & Seal Kit	D45792
DRV50 / DRV80	DRV50 & DRV80 O-Ring & Seal Kit	D51825
DRV40,50,80	USB to DRV RS485 Programming Cable	D48023



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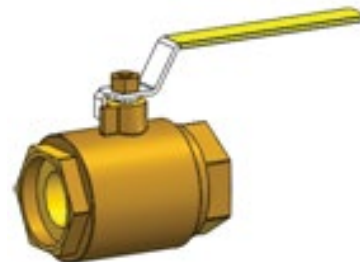
For Comprehensive DRV Spare Parts List, Refer to the DRV IOM



D48023

## Isolation Valves (Ball Valves)

Size	Description	Part Number
.25"	.25" NPT BRZ 150 LF FULL PORT	D65344
.5"	.5" NPT BRZ 150 LF FULL PORT	D65345
.5"	.5" NPT BRZ 150 LF FULL PORT LOCKING	D69333
.75"	.75" NPT BRZ 150 LF FULL PORT	D65346
.75"	.75" NPT BRZ 150 LF FULL PORT LOCKING	D69351
1"	1" NPT BRZ 150 LF FULL PORT	D65347
1"	1" NPT BRZ 150 LF FULL PORT LOCKING	D68881
1.5"	1.5" NPT BRZ 150 LF FULL PORT	D65349
2"	2" NPT BRZ 150 LF FULL PORT	D65350



# DFSI Spare Parts – continued

## Isolation Valves (Butterfly Valves)

Size	Description	Part Number
3"	BTFL VALVE 3" CI	D8743



## Isolation Valves (Safety Shutoff Valves)

Size	Actuator & Valve Assembly	Part No.
1"	BALL VALVE ELE ACT 1" NPT BRZ LF	D40163
1.5"	BALL VALVE ELE ACT 1.5" NPT BRZ LF	D40164
2"	BALL VALVE ELE ACT 2" NPT BRZ LF	D40165
3"	BTFL VALVE ELE ACT 3" LUG E501S	D40168



Size	Actuator Only	Part No.
1"	ACTUATOR ELEC VB030-013 W/ ADAPTER	D70878
1.5"	ACTUATOR ELEC VB030-013 W/ ADAPTER	D70878
2"	ACTUATOR ELEC VB030-013 W/ ADAPTER	D70878
3"	ACTUATOR ELEC VB030-013 W/ ADAPTER	D70878



Size	Valve Only	Part No.
1"	VALVE BALL 1 NPT LF LESS ACTR	D70727
1.5"	VALVE BALL 1-1/2 NPT LF LESS ACTR	D70729
2"	VALVE BALL 2 NPT LF LESS ACTR	D70731
3"	VALVE BTFL 3 LUG 150 DI 501S LESS ACTR	D70733



# DFSI Spare Parts – continued

## Pressure Gauge

Size	Description	Part Number
.25" NPT	Pressure Gauge 0-200 PSI	D20932



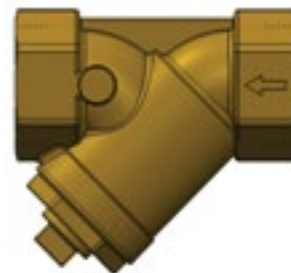
## Strainers

Size	Description	Part Number
1" NPT	Strainer 1" NPT BRS LF	D30039
1" NPT	Strainer Replacement Screen	D82483
1" NPT	Replacement Screen Gasket	D82484

Size	Description	Part Number
1.5" NPT	Strainer 1.5" NPT BRS LF WATTS	D38922
1.5" NPT	Strainer Replacement Screen	D76663
1.5" NPT	Replacement Screen Gasket	D76661

Size	Description	Part Number
2" NPT	Strainer 2" NPT BRS LF	D30036
2" NPT	Strainer Replacement Screen	D76662
2" NPT	Replacement Screen Gasket	D76660

Size	Description	Part Number
3" FLG	Strainer 3" 150FF CI Epoxy Coated NSF	D39199
3" FLG	Strainer Replacement Screen	D66469
3" FLG	Replacement Screen Gasket	D77010



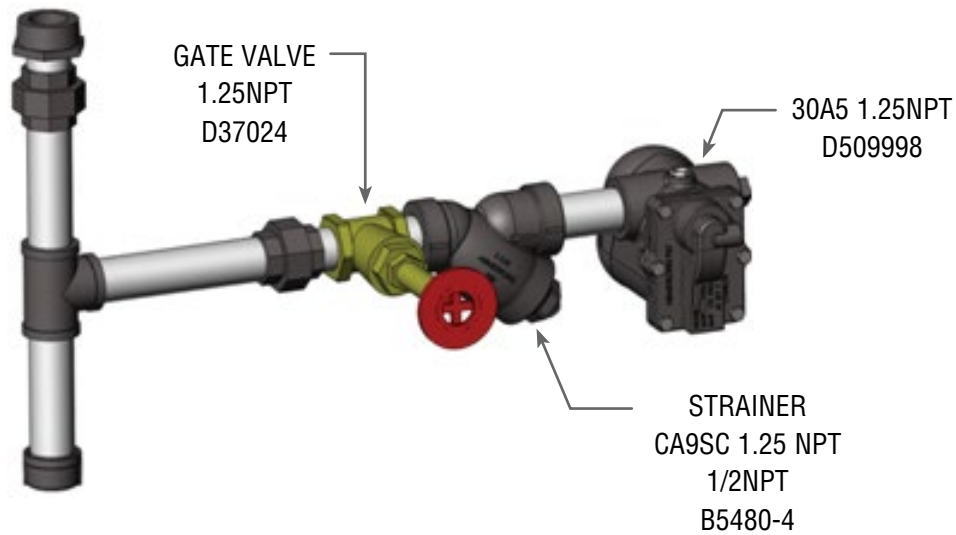
## Thermometers & Thermowells

Size	Description	Part Number
6"	Thermometer .5"NPT x 6"	D8746
6"	Thermowell .5" FNPT X 3/4 MNPT X 6" SS	D36848
9"	Thermometer .5" NPT X 9"	D44955
9"	Thermowell .75" NPT X 9" SS	D44903

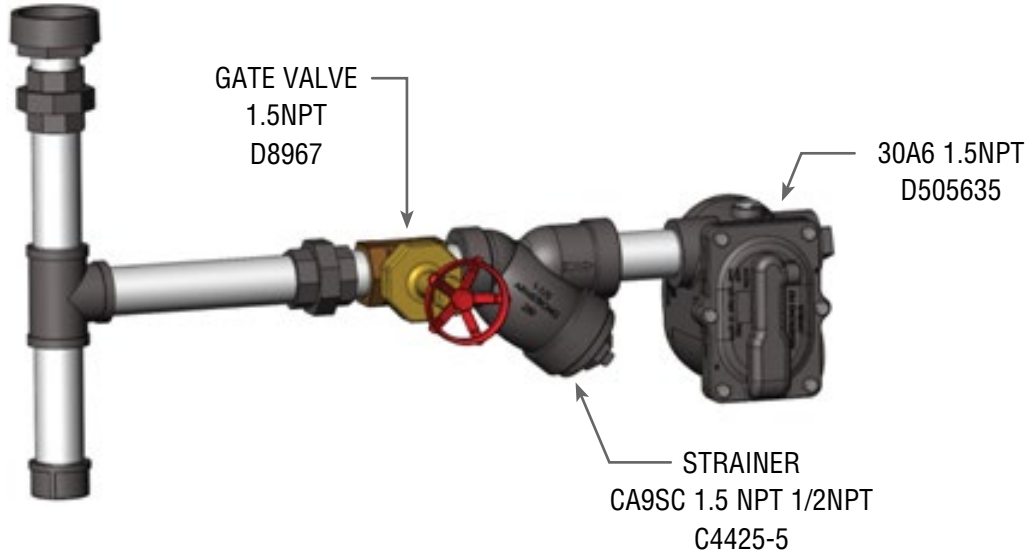


# Steam Trap Assemblies

## DFS15 – DFS15 F&T Condensate Trap Assembly



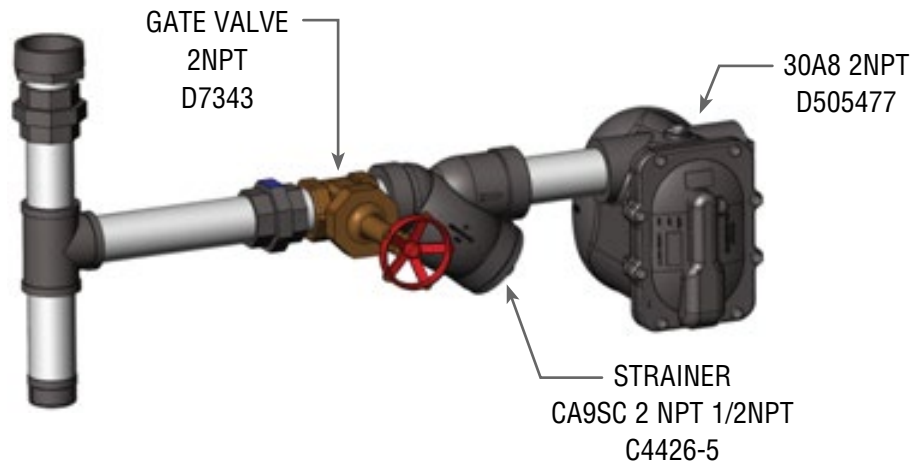
## DFS35 – DFS35 F&T Condensate Trap Assembly



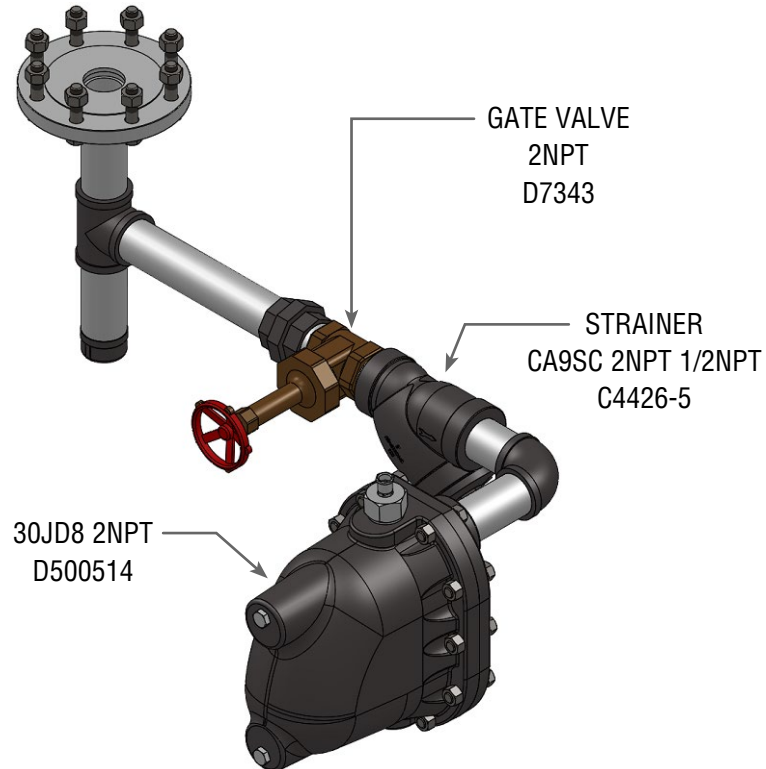
# Steam Trap Assemblies – continued

## DFS50 – DFS50 F&T Condensate Trap Assembly

Needed if You Service a DFSI Tube Bundle



## DFS90 – DFS90 F&T Condensate Trap Assembly



# Limited Warranty and Remedy

Armstrong International, Inc. or the Armstrong division that sold the product ("Armstrong") warrants to the original user of those products supplied by it and used in the service and in the manner for which they are intended, that such products shall be free from defects in material and workmanship for a period of one (1) year from the date of installation, but not longer than 15 months from the date of shipment from the factory, [unless a Special Warranty Period applies, as listed below]. This warranty does not extend to any product that has been subject to misuse, neglect or alteration after shipment from the Armstrong factory. Except as may be expressly provided in a written agreement between Armstrong and the user, which is signed by both parties, Armstrong **DOES NOT MAKE ANY OTHER REPRESENTATIONS OR WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR ANY IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE.**

The sole and exclusive remedy with respect to the above limited warranty or with respect to any other claim relating to the products or to defects or any condition or use of the products supplied by Armstrong, however caused, and whether such claim is based upon warranty, contract, negligence, strict liability, or any other basis or theory, is limited to Armstrong's repair or replacement of the part or product, excluding any labor or any other cost to remove or install said part or product, or at Armstrong's option, to repayment of the purchase price.

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Special Warranty Periods are as Follows:

Pre-packaged skid shall have a 2 year warranty from date of installation but not longer than 27 months from date of shipment.

DRV shall have a 5 year all components parts warranty from date of shipment other than preventative maintenance service items which include batteries and all 'wetted' O-Rings/Seals.

The heat exchanger shall have a 1 year warranty from date of installation but not longer than 18 months from date of manufacturing.



## Notes

## Notes

## Notes

# Digital-Flo® Semi-Instantaneous Steam-to-Water, Shell and Tube, Water Heater Installation Operation & Maintenance Manual

*Designs, materials, weights and performance ratings are approximate and subject to change without notice.*  
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