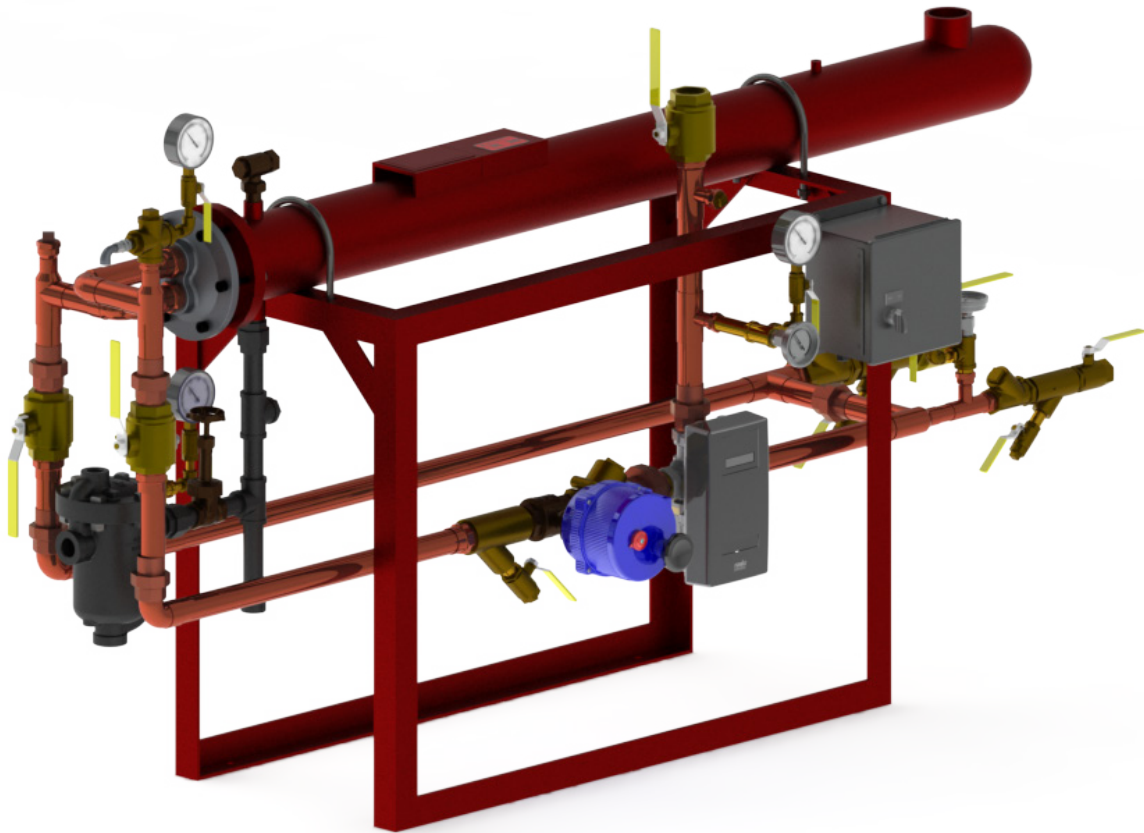


Digital-Flo® Steam-to-Water, Shell and Tube, Water Heater Installation, Operation & Maintenance Manual



**Please read and save
these instructions**

Contents

Safety 1

General Description 2

Specifications 3-4

 Specification Matrix 3-4

 Materials of Construction..... 4

Connection Detail..... 5

Dimensions 6-7

Precautions 8-9

Installation Requirements..... 9-16

Commissioning..... 17-18

Safety Shutoff Valve 19

Preventative Maintenance..... 20-24

Troubleshooting 25-33

Spare Parts 34-39

Steam Trap Assemblies..... 40-41

Limited Warranty and Remedy 42

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

Digital-Flo® is an instantaneous water heater that heats on demand and stores very little hot water. Digital-Flo® transfers heat from steam to cold water and then precisely blends hot water, cold water, and recirc return water to a programmable mixed water outlet setpoint.

Digital-Flo® water heaters utilize digital technology to monitor the hot water inlet, the cold water/recirc return inlet, and the mixed water outlet. Digital-Flo® is supplied pre-piped and pressure tested with a Digital Recirculating Valve (The Brain® – Models DRV40, DRV50, and DRV80).

Two (2) inlet and one (1) outlet thermistors integral to the DRV provide time-proven water temperature control accuracy. The precise control of the DRV eliminates 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 Digital-Flo® water heaters may be integrated directly 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.

Digital-Flo® is engineered to precision 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 (see Typical Layout diagram that follows for specific locations):

- The Brain DRV40, DRV50, or DRV80 Digital Recirculating Valve
- Heat exchanger module (shell 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 causes excessive heat exchanger scaling.

Please note:

1. Because the Digital-Flo® 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.

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 EACH DRV80 or DRV50, and 5 GPM (19 LPM) for EACH DRV40
Minimum System Draw Off	0 GPM / LPM
Minimum Distance to First Outlet	50 ft (15 m)
Minimum Recirculation Loop Temperature Loss	2°F (1°C)
Control Circuit Fuse	3 A (5A w/ SAGE™)
Enclosure Protection Rating (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.

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)

Specification Matrix

Digital-Flo®: Single Heater & Single DRV					
		Optional	Standard	Optional	
Model	Heat Exchanger	Double-Wall Tube Bundle	DRV	SAGE™	For Building System (BS) Integration
DF	415	DW	40	BS	
DF	535	DW	40	BS	
DF	665	DW	50	BS	
DF	8120	DW	80	BS	
Example of Single-Wall Tube Bundle, with SAGE™: DF41540BS					
Example of Double-Wall Tube Bundle, without SAGE™: DF415DW40					

Specifications – continued

Digital-Flo® Parallel: Two Heaters & Single DRV Configured for Two Heaters Flowing Through One DRV						
		Optional	Optional	Standard	Optional	
Model	Heat Exchanger	Double-Wall Tube Bundle	Redundant Heaters	DRV	SAGE™	For Building System (BS) Integration
DF	415	DW	P	40	BS	
DF	535	DW	P	50	BS	
DF	665	DW	P	80	BS	
DF	8120	DW	P	80	BS	
Example of Single-Wall Tube Bundle, with SAGE™: DF415P40BS						
Example of Double-Wall Tube Bundle, without SAGE™: DF415DWP40						

Digital-Flo® Redundant: Two Heaters & Two DRV's Second Heater & DRV Configured for Redundant Backup Service Only						
		Optional	Optional	Standard	Optional	
Model	Heat Exchanger	Double-Wall Tube Bundle	Redundant Heaters	DRV's	SAGE™	For Building System (BS) Integration
DF	415	DW	P	40-40	BS	
DF	535	DW	P	40-40	BS	
DF	665	DW	P	50-50	BS	
DF	8120	DW	P	80-80	BS	
Example of Single-Wall Tube Bundle, with SAGE™: DF415P40-40BS						
Example of Double-Wall Tube Bundle, without SAGE™: DF415DWP40-40						

Single-wall, heat exchanger

Component	Material
Heat Exchanger Shell	Carbon steel, ASTM SA-106, Gr. B, ASME "U" stamped with 316 SS two-pass head
Heat Exchanger Tube Bundle	5/8-in OD x 16 BWG wall, admiralty brass
Heat Exchanger Tube Sheets	"Lead-free" brass
Heat Exchanger Tube Bundle End Cap	"Lead-free" brass
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

Double-wall, heat exchanger

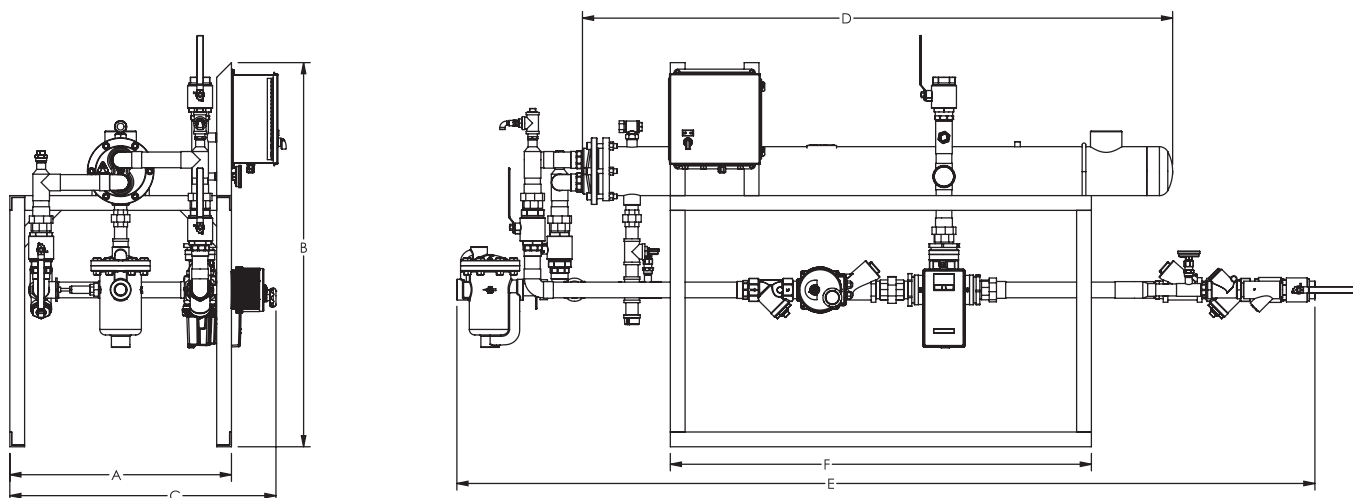
Component	Material
Heat Exchanger Shell	Carbon steel, ASTM SA-106, Gr. B, ASME "U" stamped with 316 SS two-pass head
Heat Exchanger Tube Bundle	Copper tubes - 5/8" OD inner w/ 3/4" OD grooved outer
Heat Exchanger Tube Sheets	Steam-side – Carbon steel Water-side - "Lead-free" brass
Integral Supply Pipe Work	"Lead-free" brass / Type L copper
Integral Valve and Fittings	"Lead-free" brass or bronze
Condensate Piping	Cast iron & carbon steel
DRV Body	AISI 316L stainless steel

Connections Detail

Digital Shell & Tube						
Model	Water Side			Steam Side		
	Connections @ 7.5 ft/sec (2.3 m/s)		Flow @ 7.5 ft/sec (2.3 m/s)	Connections		Capacity @ 15 psi (1 bar)
	Hot/Cold	Recirc.	Capacity @ 90°F (50°C) Delta T Typical @120°F (49°C) Setpoint	Steam Inlet	Condensate Outlet	
DF41540	1"	1"	18 GPM	2 NPT	3/4 NPT	858 lb/hr (389 kg/hr)
DF415DW40	1"	1"	18 GPM	2 NPT	3/4 NPT	858 lb/hr (389 kg/hr)
DF415P40	1-1/2"	1"	36 GPM	2 NPT	3/4 NPT	1,716 lb/hr (778 kg/hr)
DF415DWP40	1-1/2"	1"	36 GPM	2 NPT	3/4 NPT	1,716 lb/hr (778 kg/hr)
DF53540	1-1/2"	1"	41 GPM	2-1/2 NPT	1 NPT	1,954 lb/hr (886 kg/hr)
DF535DW40	1-1/2"	1"	41 GPM	2-1/2 NPT	1 NPT	1,954 lb/hr (886 kg/hr)
DF535P50	2"	1-1/2"	73 GPM	2-1/2 NPT	1 NPT	3,479 lb/hr (1,578 kg/hr)
DF535DWP50	2"	1-1/2"	73 GPM	2-1/2 NPT	1 NPT	3,479 lb/hr (1,578 kg/hr)
DF66550	2"	1-1/2"	73 GPM	3 NPT	1-1/4 NPT	3,479 lb/hr (1,578 kg/hr)
DF665DW50	2"	1-1/2"	73 GPM	3 NPT	1-1/4 NPT	3,479 lb/hr (1,578 kg/hr)
DF665P80	3"	2"	165 GPM	3 NPT	1-1/4 NPT	7,720 lb/hr (3,502 kg/hr)
DF665DWP80	3"	2"	165 GPM	3 NPT	1-1/4 NPT	7,720 lb/hr (3,502 kg/hr)
DF812080	3"	2"	165 GPM	4 FLG	2 NPT	7,863 lb/hr (3,567 kg/hr)
DF8120DW80	3"	2"	165 GPM	4 FLG	2 NPT	7,863 lb/hr (3,567 kg/hr)
DF8120P80	3"	2"	165 GPM	4 FLG	2 NPT	7,863 lb/hr (3,567 kg/hr)
DF8120DWP80	3"	2"	165 GPM	4 FLG	2 NPT	7,863 lb/hr (3,567 kg/hr)

* 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 nominal", are listed in parentheses. Consult factory for pressure drop information.

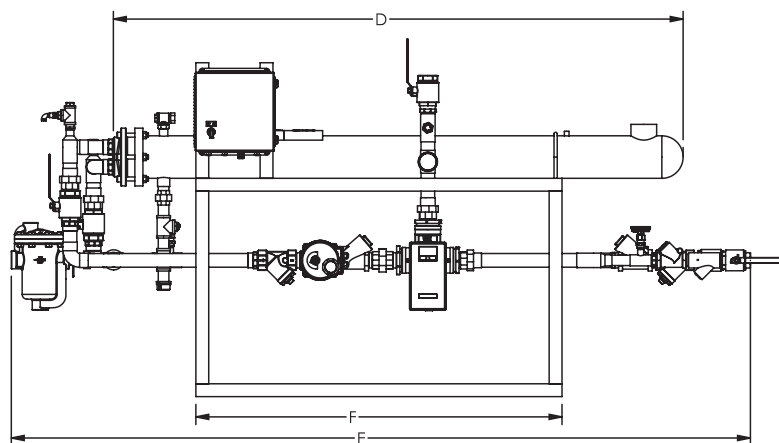
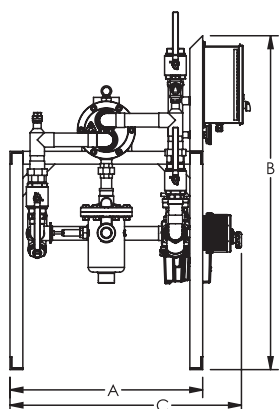
Dimensions



Refer to column D for minimum tube bundle replacement distance.

Dimensions and Weight							
Model	Dimensions in (mm)						Weight
	A	B	C	D	E	F	
DF41540	20.0 (508)	43.2 (1,097)	25.4 (645)	54.7 (1,389)	72.3 (1,837)	36.0 (915)	385
DF41540BS	20.0 (508)	52.0 (1,321)	25.4 (645)	54.7 (1,389)	72.3 (1,837)	36.0 (915)	410
DF415P40	20.0 (508)	75.5 (1,918)	26.4 (670)	54.7 (1,389)	79.8 (2,027)	36.0 (915)	580
DF415P40BS	20.0 (508)	75.5 (1,918)	26.4 (670)	54.7 (1,389)	79.8 (2,027)	36.0 (915)	605
DF53540	20.0 (508)	44.5 (1,129)	26.4 (670)	66.9 (1,698)	66.9 (1,698)	45.0 (1,143)	804
DF53540BS	20.0 (508)	52.0 (1,321)	26.4 (670)	66.9 (1,698)	66.9 (1,698)	45.0 (1,143)	829
DF535P50	20.0 (508)	76.7 (1,948)	27.1 (687)	66.9 (1,698)	66.9 (1,698)	45.0 (1,143)	1,234
DF535P50BS	20.0 (508)	76.7 (1,948)	27.1 (687)	66.9 (1,698)	66.9 (1,698)	45.0 (1,143)	1,259
DF66550	30.0 (915)	50.0 (1,270)	36.0 (915)	79.9 (2,029)	116.2 (2,950)	57.0 (1,448)	1,094
DF66550BS	30.0 (915)	52.0 (1,321)	36.0 (915)	79.9 (2,029)	116.2 (2,950)	57.0 (1,448)	1,119
DF665P80	30.0 (915)	74.1 (1,883)	40.3 (1,024)	79.9 (2,029)	111.0 (2,818)	57.0 (1,448)	1,835
DF665P80BS	30.0 (915)	74.1 (1,883)	40.3 (1,024)	79.9 (2,029)	111.0 (2,818)	57.0 (1,448)	1,860
DF812080	34.0 (864)	53.0 (1,345)	43.5 (1,105)	83.0 (2,107)	128.1 (3,253)	57.0 (1,448)	1,507
DF812080BS	34.0 (864)	53.0 (1,345)	43.5 (1,105)	83.0 (2,107)	128.1 (3,253)	57.0 (1,448)	1,532
DF8120P80	34.0 (864)	75.9 (1,929)	42.9 (1,090)	83.0 (2,107)	129.1 (3,279)	57.0 (1,448)	3,011
DF8120P80BS	34.0 (864)	75.9 (1,929)	42.9 (1,090)	83.0 (2,107)	129.1 (3,279)	57.0 (1,448)	3,036

Dimensions – continued



Refer to column D for minimum tube bundle replacement distance.

Dimensions and Weight							
Model	Dimensions in (mm)						Weight
	A	B	C	D	E	F	
DF415DW40	20.0 (508)	43.2 (1,097)	25.4 (645)	76.4 (1,941)	71.6 (1,819)	36.0 (915)	465
DF415DW40BS	20.0 (508)	52.0 (1,321)	25.4 (645)	76.4 (1,941)	71.6 (1,819)	36.0 (915)	490
DF415DWP40	20.0 (508)	75.5 (1,918)	26.4 (670)	76.4 (1,941)	87.9 (2,232)	36.0 (915)	740
DF415DWP40BS	20.0 (508)	75.5 (1,918)	26.4 (670)	76.4 (1,941)	87.9 (2,232)	36.0 (915)	765
DF535DW40	20.0 (508)	44.5 (1,129)	26.4 (670)	76.5 (1,944)	89.6 (2,277)	45.0 (1,143)	1,080
DF535DW40BS	20.0 (508)	52.0 (1,321)	26.4 (670)	76.5 (1,944)	89.6 (2,277)	45.0 (1,143)	1,105
DF535DWP50	20.0 (508)	76.7 (1,948)	27.1 (687)	76.5 (1,944)	98.1 (2,492)	45.0 (1,143)	1,317
DF535DWP50BS	20.0 (508)	76.7 (1,948)	27.1 (687)	76.5 (1,944)	98.1 (2,492)	45.0 (1,143)	1,342
DF665DW50	30.0 (915)	50.0 (1,270)	36.0 (915)	88.7 (2,253)	115.1 (2,923)	57.0 (1,448)	1,373
DF665DW50BS	30.0 (915)	52.0 (1,321)	36.0 (915)	88.7 (2,253)	115.1 (2,923)	57.0 (1,448)	1,398
DF665DWP80	30.0 (915)	74.1 (1,883)	40.3 (1,024)	88.7 (2,253)	110.7 (2,811)	57.0 (1,448)	1,892
DF665DWP80BS	30.0 (915)	74.1 (1,883)	40.3 (1,024)	88.7 (2,253)	110.7 (2,811)	57.0 (1,448)	1,917
DF8120DW80	34.0 (864)	53.0 (1,345)	43.5 (1,105)	77.3 (1,963)	126.6 (3,216)	57.0 (1,448)	1,550
DF8120DW80BS	34.0 (864)	53.0 (1,345)	43.5 (1,105)	77.3 (1,963)	126.6 (3,216)	57.0 (1,448)	1,575
DF8120DWP80	34.0 (864)	75.9 (1,929)	42.9 (1,090)	77.3 (1,963)	127.6 (3,242)	57.0 (1,448)	3,050
DF8120DWP80BS	34.0 (864)	75.9 (1,929)	42.9 (1,090)	77.3 (1,963)	127.6 (3,242)	57.0 (1,448)	3,075

Precautions



WARNING! The design of the Digital-Flo® 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 the application. The heater design does not incorporate a water quality control system.

Since the Digital-Flo® 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 Digital-Flo®. 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.

Precautions – continued

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 4mg / l (ppm) for continual usage.

Installation Requirements

The Digital-Flo® 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 (NEMA 12-rated) 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 Digital-Flo® water heater and 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 Digital-Flo® 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. (See Steam Piping Installation Detail on following pages.)

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.

Installation – continued

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 4) 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.

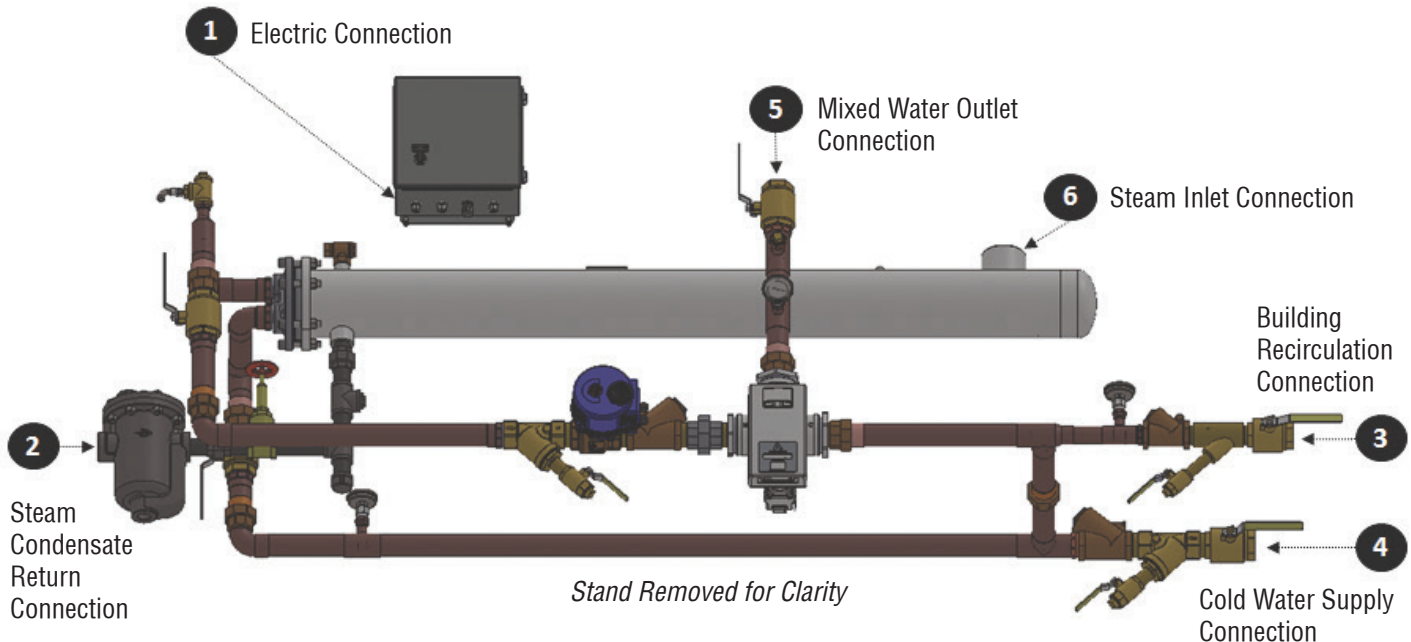
Notes:

- 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.

See Steam Piping Installation Detail on following pages.



Installation – continued

Steam Piping Installation:

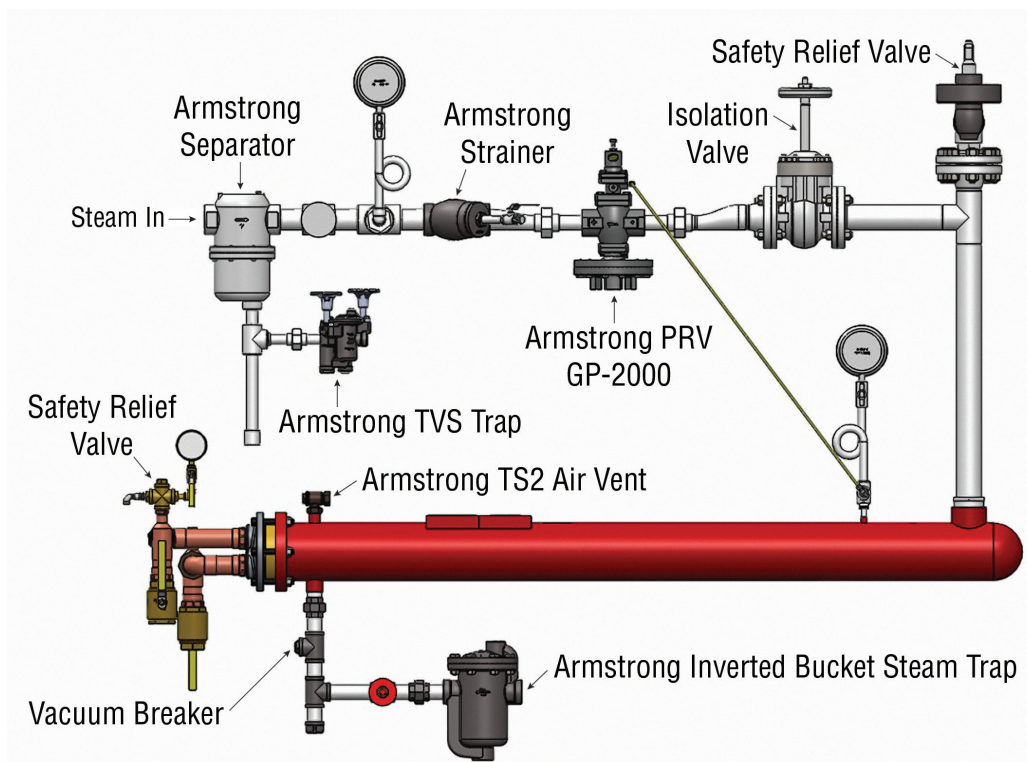
1. Install the Digital-Flo® with adequate room to allow for tube bundle removal when cleaning is required. See Table 12-1 for specific dimensions.
2. If 2-15 psig of steam is available a pressure reducing valve is NOT required. If a pressure reducing valve is required, an Armstrong Inverted Bucket Steam Trap is recommended to drain condensate at the inlet of the pressure reducing valve.
3. An Armstrong Y-strainer should be installed before the pressure reducing valve to reduce the chance of dirt fouling.
4. If an externally piloted pressure reducing valve is used, the control pipe should be pitched away from the PRV and installed at the pressure gauge on the shell of the heat exchanger.
5. A steam safety relief valve should be used prior to the heat exchanger if either or both of the following conditions exist.
(1) If the maximum steam pressure could exceed the minimum water pressure in the tubes, or (2) The maximum steam pressure could exceed 150 psig (the maximum steam pressure rating of the shell).

IMPORTANT -Steam supply pipe size coming to the heat exchanger should NOT be smaller than the steam connection supplied on the heater, otherwise steam flow could be restricted. If a pressure reducing valve is used, installation should be as close as possible to the Digital-Flo®. Downstream piping from the Pressure Reducing Valve should be expanded immediately after the PRV to accommodate the expanded volume of steam.

6. To vent start-up air, an Armstrong Thermostatic Air Vent is included and installed on the top connection, opposite the trap drain connection of the heat exchanger. This discharge can be piped to drain or the floor if preferred.
7. Install a suitable steam pressure gauge in the 1/4" coupler located in the top mid section of the heat exchanger shell. This gauge will help diagnose pressure problems should they occur. This port may also be used for a PRV external control pipe if a PRV is required.

Typical installation shown. Always consult local codes and standards for detailed installation requirements.

NOTE: Digital-Flo® assembly is provided with (1) Armstrong Steam Trap, (1) Vacuum Breaker (1) Safety Relief Valve, and (1) Thermostatic Air Vent. All other items shown in gray not included.



Installation – continued

Electrical:

The Digital-Flo® 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 Digital-Flo® control cabinet. An electrical schematic for a Digital-Flo® control system with a single DRV mixing valve and a single HW shutoff valve appears in Figure 1 below.

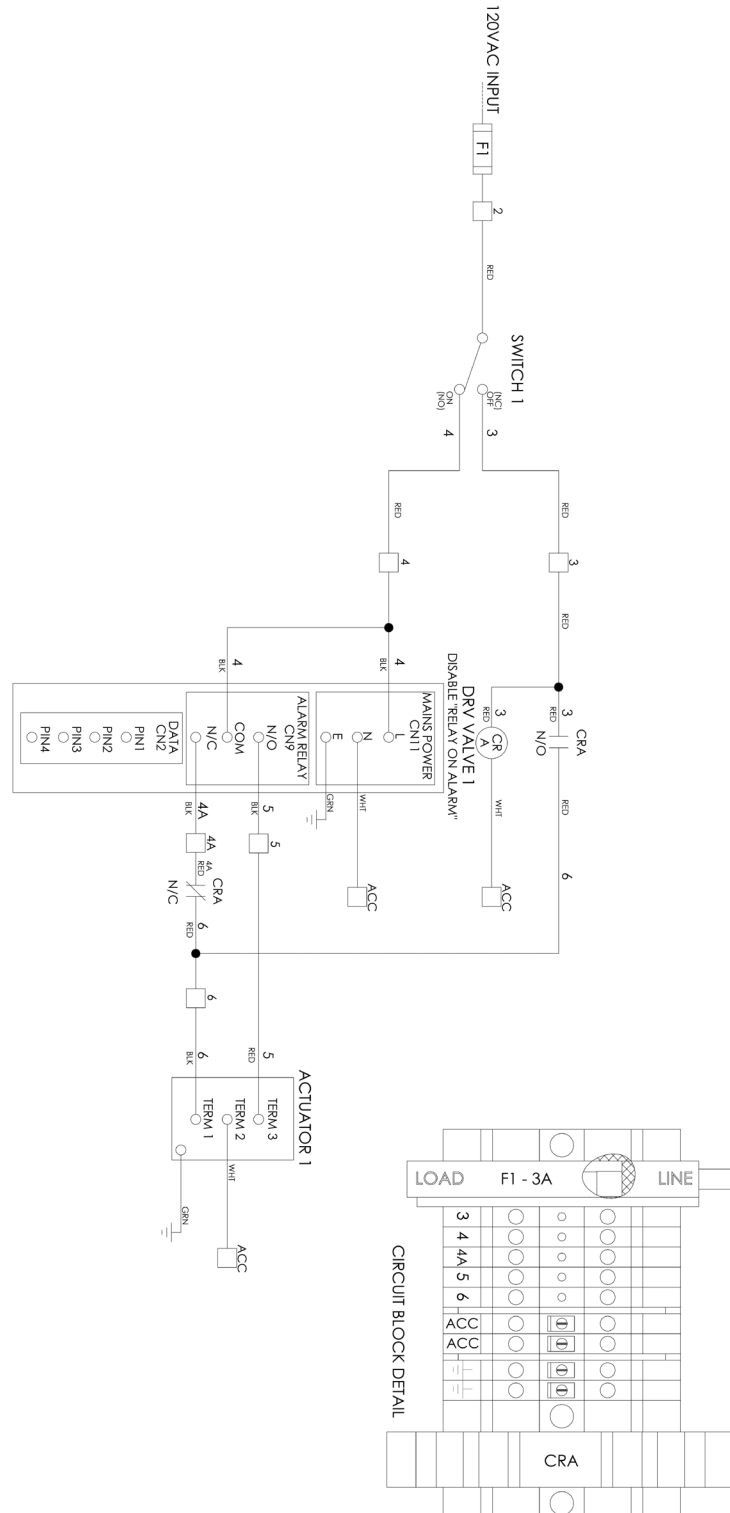


Figure 1: Electrical Schematic for a Standard Digital-Flo® with a Single DRV

Installation – continued

An electrical schematic for a Digital-Flo® control system when equipped with a single DRV mixing valve, a single HW shutoff valve, and the optional SAGE™ feature appears in Figure 2 below.

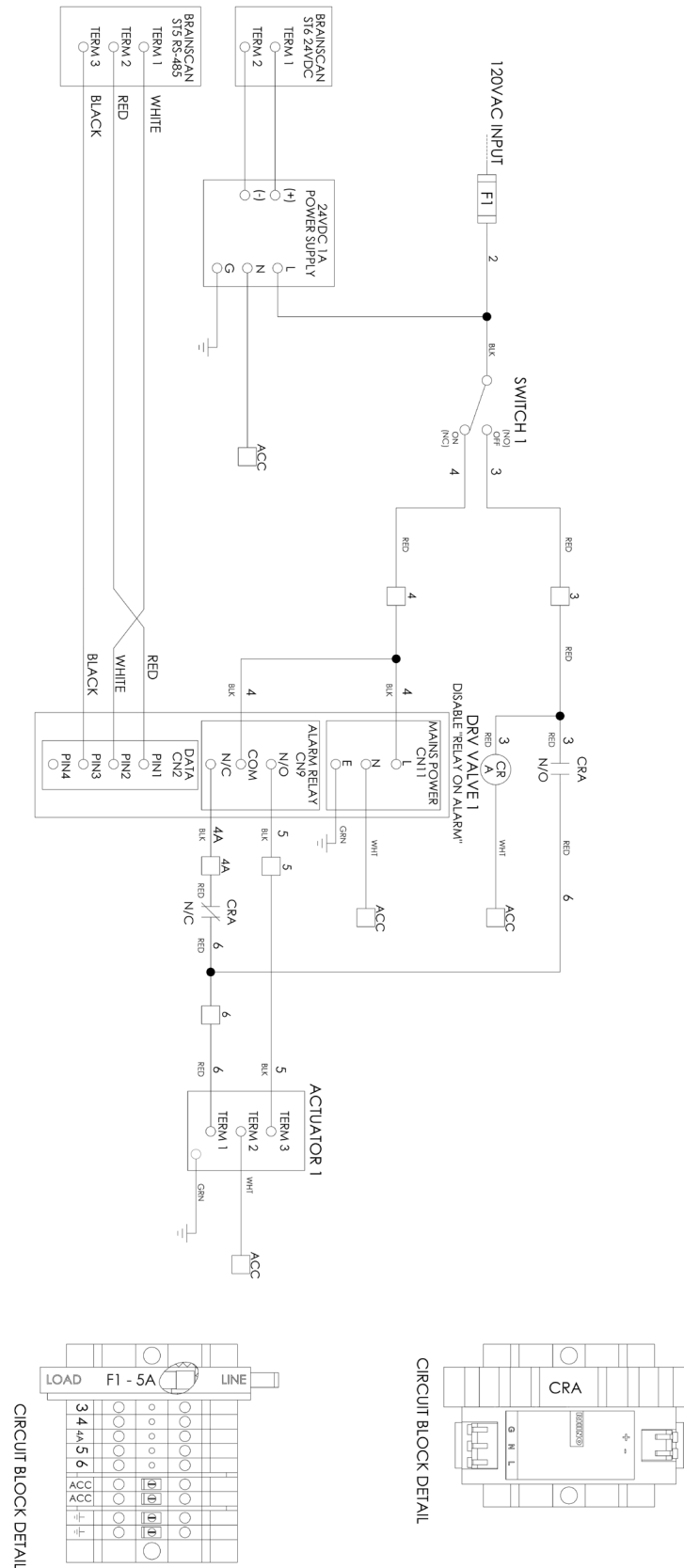


Figure 2: Electrical Schematic for a Standard Digital-Flo® with a Single DRV and SAGE™

Installation – continued

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

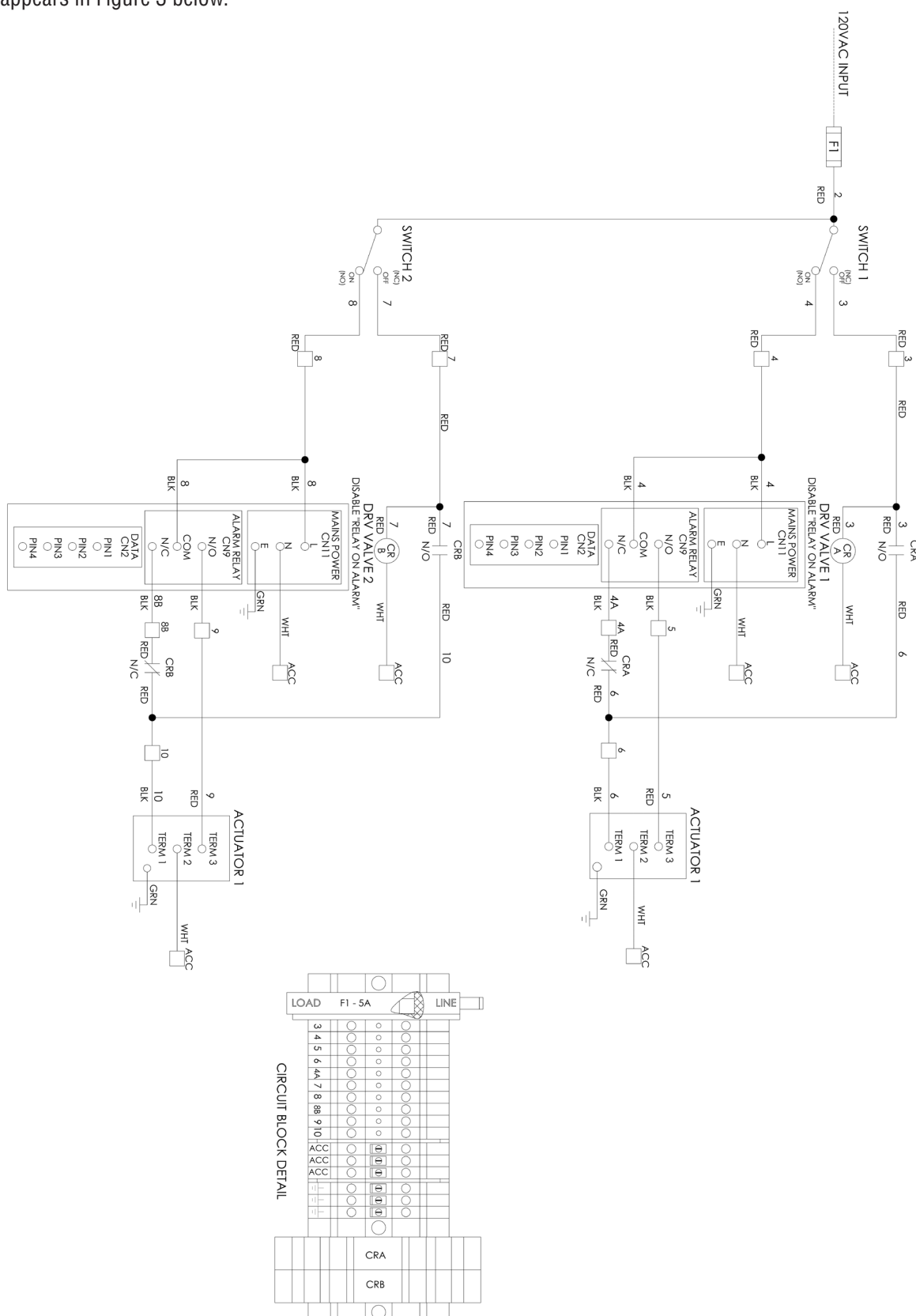


Figure 3: Electrical Schematic for a Digital-Flo® with Two DRV's

Installation – continued

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

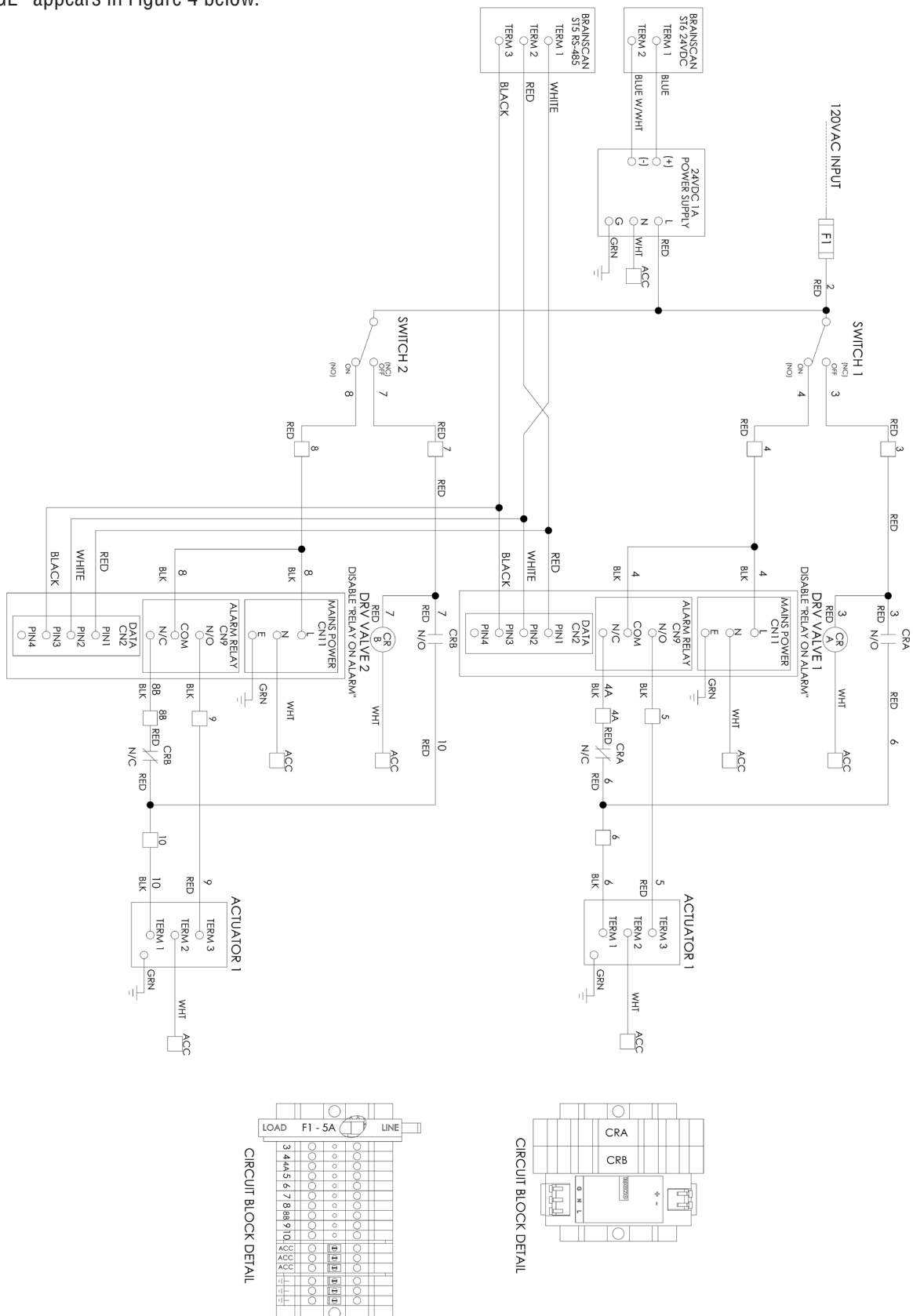


Figure 4: Electrical Schematic for a Digital-Flo® with Two DRV's and SAGE™

Installation – 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.



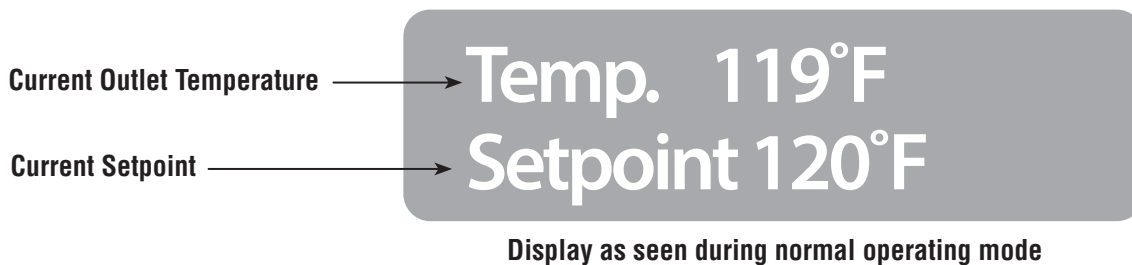
CAUTION! If cold water pressure is lost while steam is present, overheating and hydraulic pressure shock “water hammer” damage may occur in the heater and the plumbing system. Verify that adequate water volume and pressure is supplied to the Digital-Flo® **BEFORE** introducing steam into the heat exchanger.

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

1. Perform a visual overview and confirmation that the Digital-Flo® 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 Digital-Flo®
 - b. Confirm all steam/condensate lines are connected correctly, and that all isolation valves are closed.
2. Energize the Digital-Flo® 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 ≥ 5 gpm to each DRV40, ≥ 10 gpm to each DRV50, or ≥ 10 gpm to each DRV80.

Commissioning – continued

6. Open the condensate discharge isolation valves on the Digital-Flo®
7. Supply steam to the Digital-Flo®, 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 Digital-Flo®, 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 Digital-Flo® 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.

Preventive 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 Digital-Flo® 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.

Preventive 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 Digital-Flo® heat exchanger gasket kit is on-site.

1. Manual Cleaning by Removing Heat Exchanger Tube Bundle

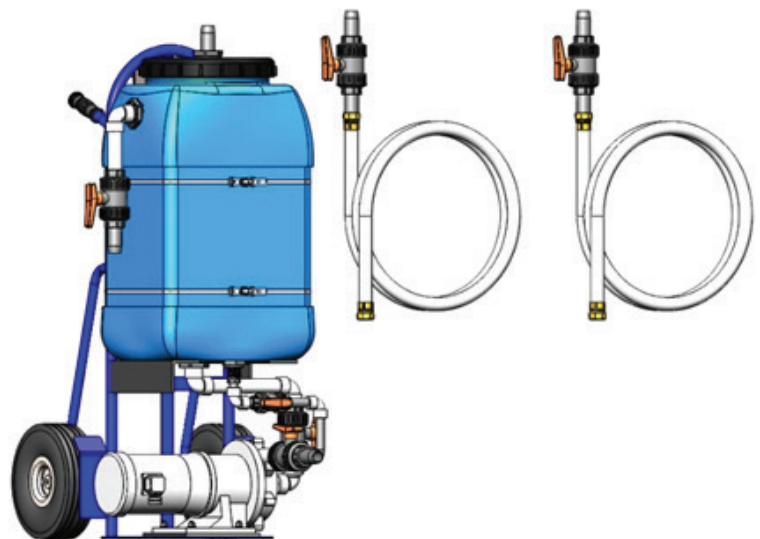
- a. De-energize the Digital-Flo® control panel following lockout/tagout procedures. Close the steam inlet following lockout/tagout procedures, stop recirculation pump(s), close cold water inlet, and close recirc return line - in that order. Allow the heat exchanger to cool. Drain all liquids from the heat exchanger shell.
- b. Remove the two-pass head from the shell of the heat exchanger.
- c. Extract the tube bundle from the heat exchanger for inspection and manual cleaning. Gentle mechanical cleaning or pressure washing may be effective in removing deposits from the tube bundle. Soaking the tube bundle in a chemical cleaning agent, such as Rite-Qwik™, may expedite the manual cleaning process.
- d. If cleaning a single wall tube bundle, remove the floating end cover. Descal and remove any mineral deposits on the inside surface of end cover.
- e. Two-pass head, inlet & outlet tubes, and the internal surface of the heat exchanger shell may also require cleaning and flushing to remove mineral deposits and sediment.
- f. Thoroughly, but gently, clean all mating surfaces of the heat exchanger and two-pass head.
- g. Reassemble the tube bundle and heat exchanger using new gaskets and O-rings. Replace any compromised fasteners with identical new parts.
- h. Recommission the water heater following IMPORTANT instructions on page 17.

2. Clean-in-Place (CIP) Method

Armstrong offers a suitable cleaning agent called Rite-Quik™, a non-hazardous chemical cleaner that has been proven effective for removing deposits without damaging or causing deterioration to internal surfaces the Digital-Flo® 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 pages 23 and 24.

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

Preventive Maintenance – continued

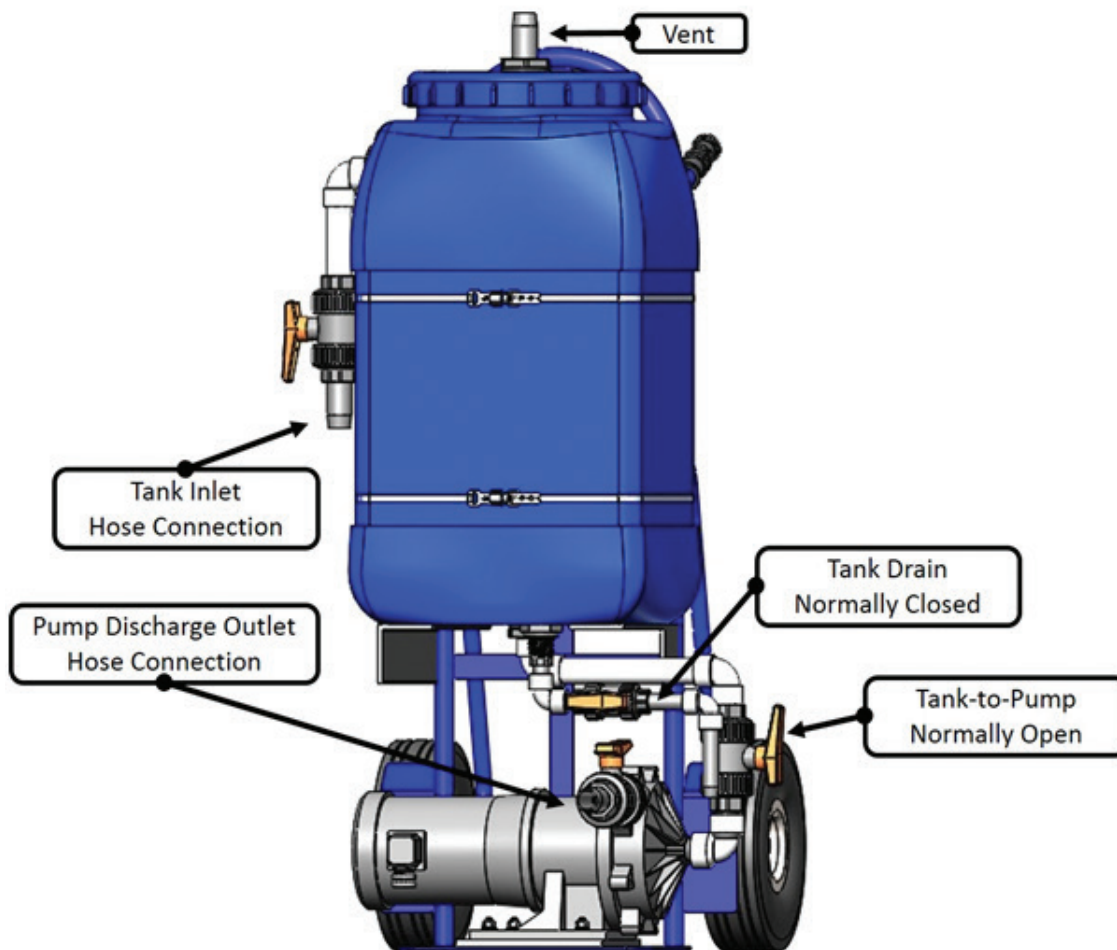
Clean-in-Place (CIP) Instructions for Digital-Flo® (DF)

- a. Close the steam inlet following lockout/tagout procedures.
- b. Close the condensate line.
- c. Stop recirculation pump(s), close the cold water inlet and recirc return line, depressurize the exchanger (via blowdowns or HWO pressure gauge ball valve with hose to drain), then close the hot water outlet.
- d. De-energize the DF control panel following lockout/tagout procedures.
- e. Remove the 1" NPT pipe plug from the DF 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.
- f. Connect a hose to the close pipe nipple and position to drain.
- g. Open the cold water inlet to flow water through the heat exchanger, and through the garden hose to drain. Flush for 10 minutes, or until the outside of the heat exchanger is cool to the touch.
- h. 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.
- i. Close the DF cold water inlet, and allow flush-water to drain completely.
- j. Disconnect garden hose.
- k. Remove the 1" NPT pipe plug from the DF 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-to-pump 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 Digital-Flo® following IMPORTANT instructions on page 17.
- z. See Clean-in-Place unit maintenance details on following page.

Preventive Maintenance – continued

Clean-in-Place Unit Maintenance Details

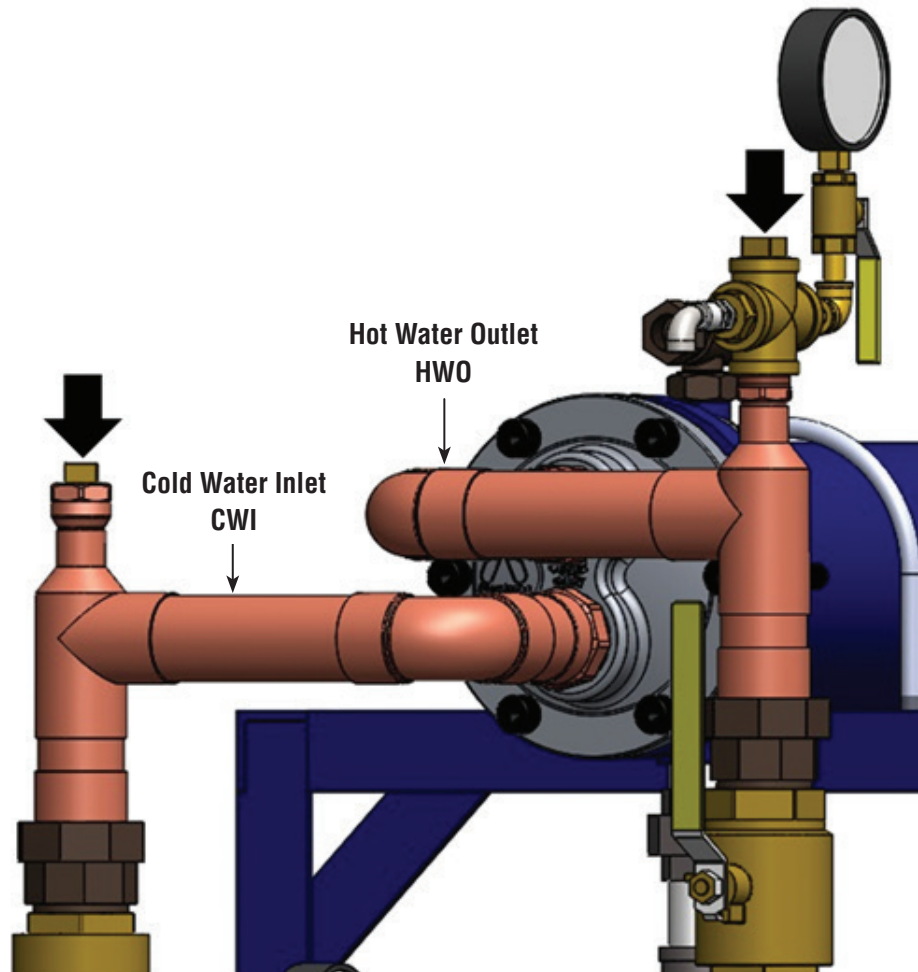
- a. Rite-Qwik™ that remains active may be stored for later use. Test the solution by dropping a calcium antacid tablet into the tank. Fizzing indicates the solution is still active, and can be returned to the original shipping container via the CIP tank drain outlet. If the solution does not fizz, it is inactive and not worthy of storing.
- b. 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.
- c. 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.
- d. Connect a CIP hose to the pump discharge outlet, position to drain, and open ball valve.
- e. Perform a brief flush of the CIP tank drain by opening and closing tank drain ball valve.
- f. Start CIP unit pump. Immediately stop the CIP unit pump once the tank is empty.
- g. Perform manual flush of the second CIP hose. Allow components to air dry.
- h. Store the Armstrong CIP unit in a warm and dry place. Do not expose to freezing temperatures.



Armstrong Clean-in-Place Unit Detail

Preventive Maintenance – continued

Detail Continued



Clean-in-Place (CIP) Connections

Troubleshooting



WARNING! Always use appropriate lockout/tagout procedures when closing the steam inlet and de-energizing the Digital-Flo® 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 Digital-Flo® 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 Digital-Flo® 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 Digital-Flo® Troubleshooting Table for assistance in determining the cause of a performance problem and suggestions for actions to remedy or alleviate the problem.

Digital-Flo® Troubleshooting Table:

Problem	Probable Cause	Corrective Action
Unable to bring Digital-Flo® up to temperature.	System fault.	<ul style="list-style-type: none"> a. Open steam isolation valve. b. Increase steam pressure. Do not exceed 15 psi. c. Reduce domestic water flow rate. d. Correct condition causing high temperature shutoff valve to close. e. Open steam trap isolation valve, if equipped. f. Steam trap is blocked. Disassemble trap and clear blockage(s). 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. 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.
	DRV fault.* DRV Troubleshoot Guides.	See DRV Troubleshooting Guide in the following section.
	Heat exchanger fault.	<ul style="list-style-type: none"> a. Vent trapped air (gases) from heat exchanger shell. b. Clean scaled or fouled heat exchanger tubes.
Water from Digital-Flo® is too hot.	System fault.	<ul style="list-style-type: none"> a. Reduce steam pressure b. Steam is superheated – reduce superheating.
	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"> a. Confirm continuous recirculation of at least 5 gpm to each DRV40, and at least 10 gpm to each DRV50 or DRV80. b. Check for air locks and closed valves. c. Blowdown strainers, then remove and thoroughly clean all strainer screens. d. Confirm return temperature is at least 2°F below DRV set point e. Confirm installation and location of check valves is correct. Refer to schematics. Ensure that check valves are fully functional. 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. g. Rule out that a higher temperature cross-connection (from kitchen or laundry loop) is feeding water into the return line. Eliminate cross-connections.
	DRV fault.* DRV Troubleshoot Guides.	See DRV Troubleshooting Guide in the following section.

*Add DRV T-Shoot Guides

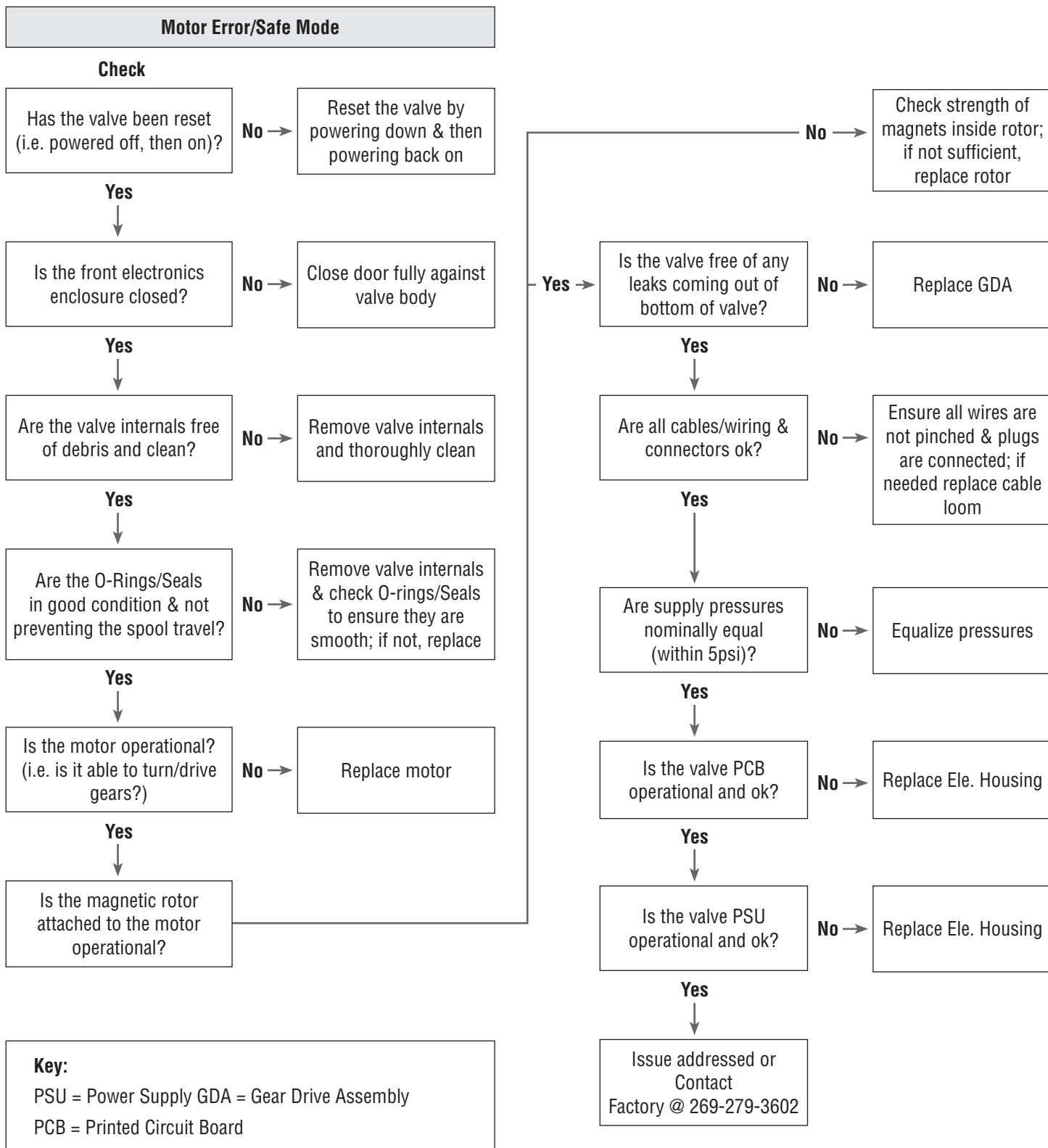
Digital-Flo® Troubleshooting Table – continued

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.

Digital-Flo® Troubleshooting Table – continued

Problem	Probable Cause	Corrective Action
Unable to adjust system temperature.	System fault.	<ul style="list-style-type: none"> 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. Confirm installation and location of check valves is correct. Refer to schematics. Ensure that check valves are fully functional. e. Blowdown strainers, then <u>remove and thoroughly clean all strainer screens.</u> f. Confirm return temperature is at least 2°F below DRV set point. 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.
	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"> a. Confirm uninterrupted power to Digital-Flo® control panel. b. Check status of DRV power switches on the Digital-Flo® control panel.
	DRV fault.	See DRV Troubleshooting Guide in the following section.
Digital-Flo® “bangs” and “hammers” during operation.	System fault.	<ul style="list-style-type: none"> a. Steam pressure has dropped and a vacuum has formed inside the heat exchanger. Increase steam pressure or reduce water flow through the heater. 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.
	Heat exchanger fault.	<ul style="list-style-type: none"> a. The shell of the heat exchanger is not properly drained. Confirm condensate is draining freely (steam trap is not blocked & return line is not pressurized). b. Remove and inspect tube bundle for tube or seal failures.
Water leaking from DRV.	DRV fault.	<ul style="list-style-type: none"> a. Check all DRV seals for wear and/or damage. Clean, lubricate or replace. b. Body casting failure – replace DRV.

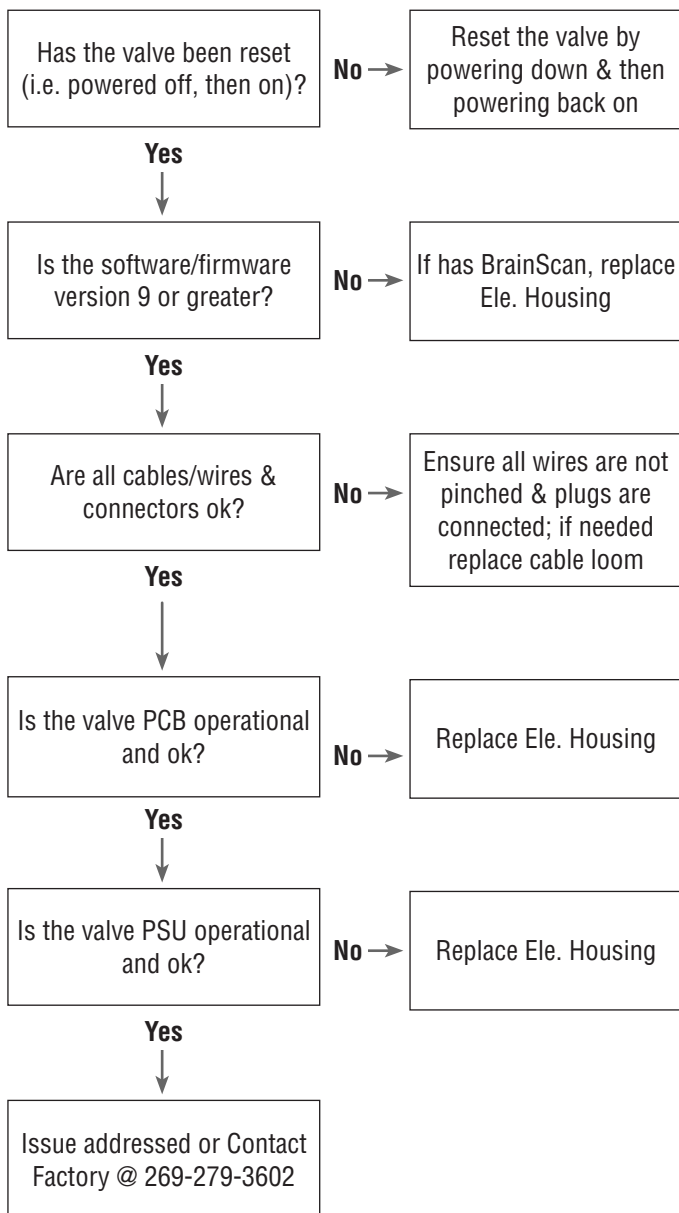
DRV40-80 Gen. 2 Troubleshoot Guide



DRV40-80 Gen. 2 Troubleshoot Guide

PCB Error

Check



Key:

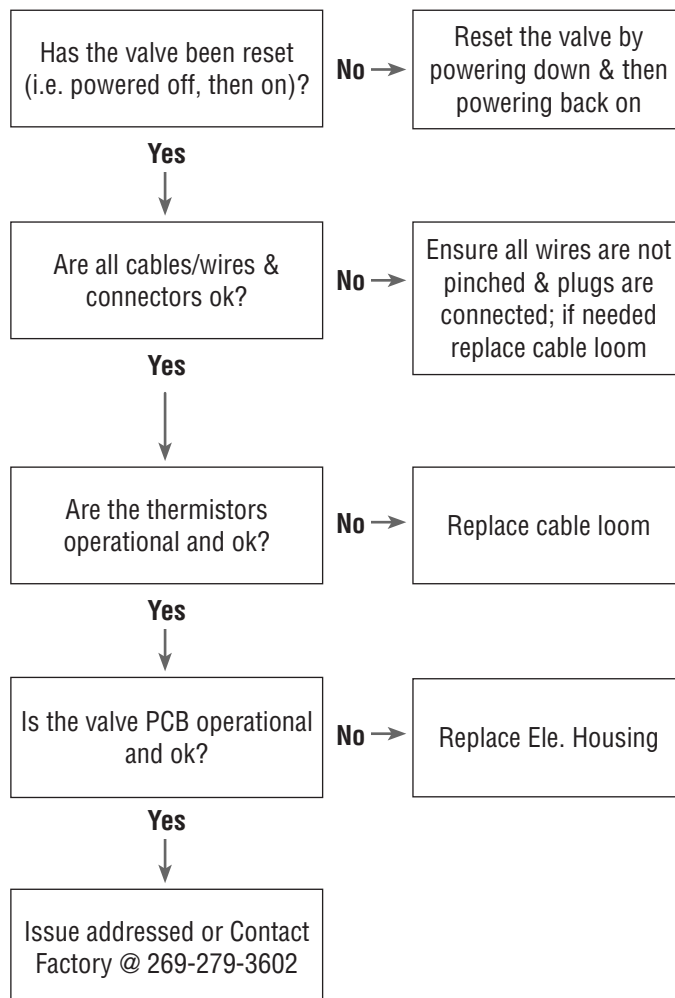
PSU = Power Supply

GDA = Gear Drive Assembly

PCB = Printed Circuit Board

Thermistor Error

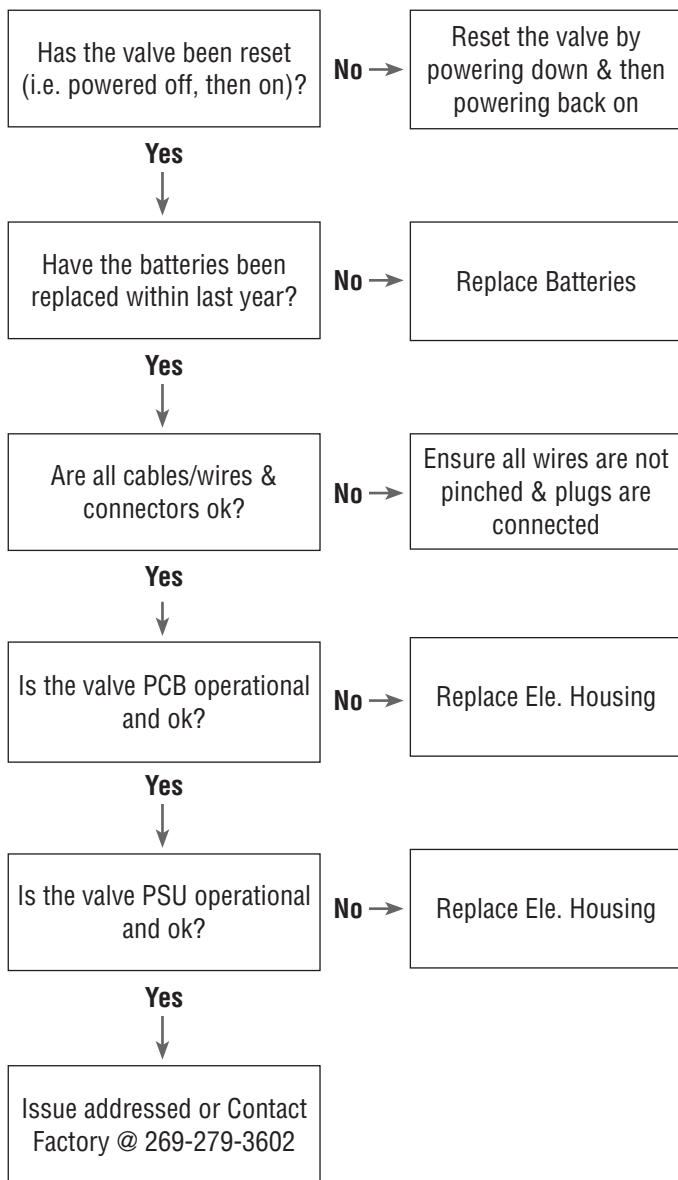
Check



DRV40-80 Gen. 2 Troubleshoot Guide

Battery Error

Check



Key:

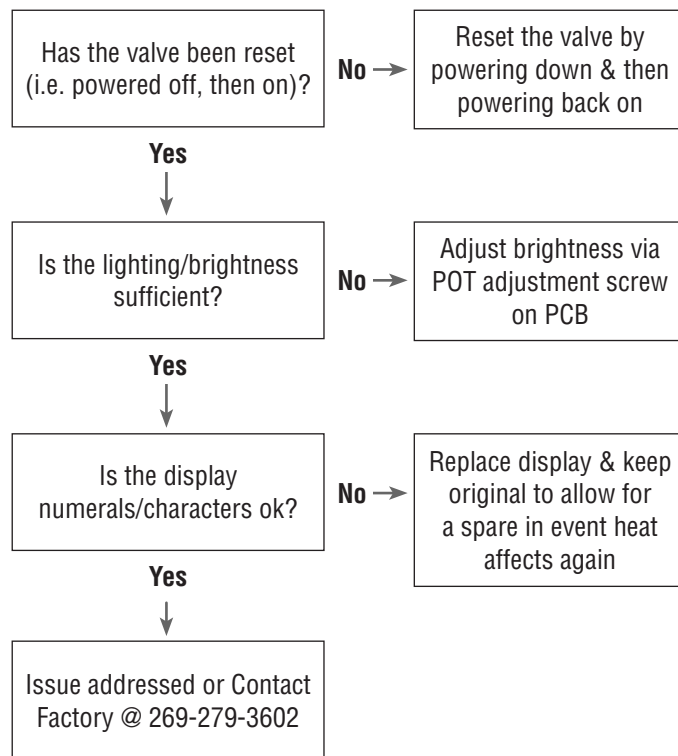
PSU = Power Supply

GDA = Gear Drive Assembly

PCB = Printed Circuit Board

Display Issues

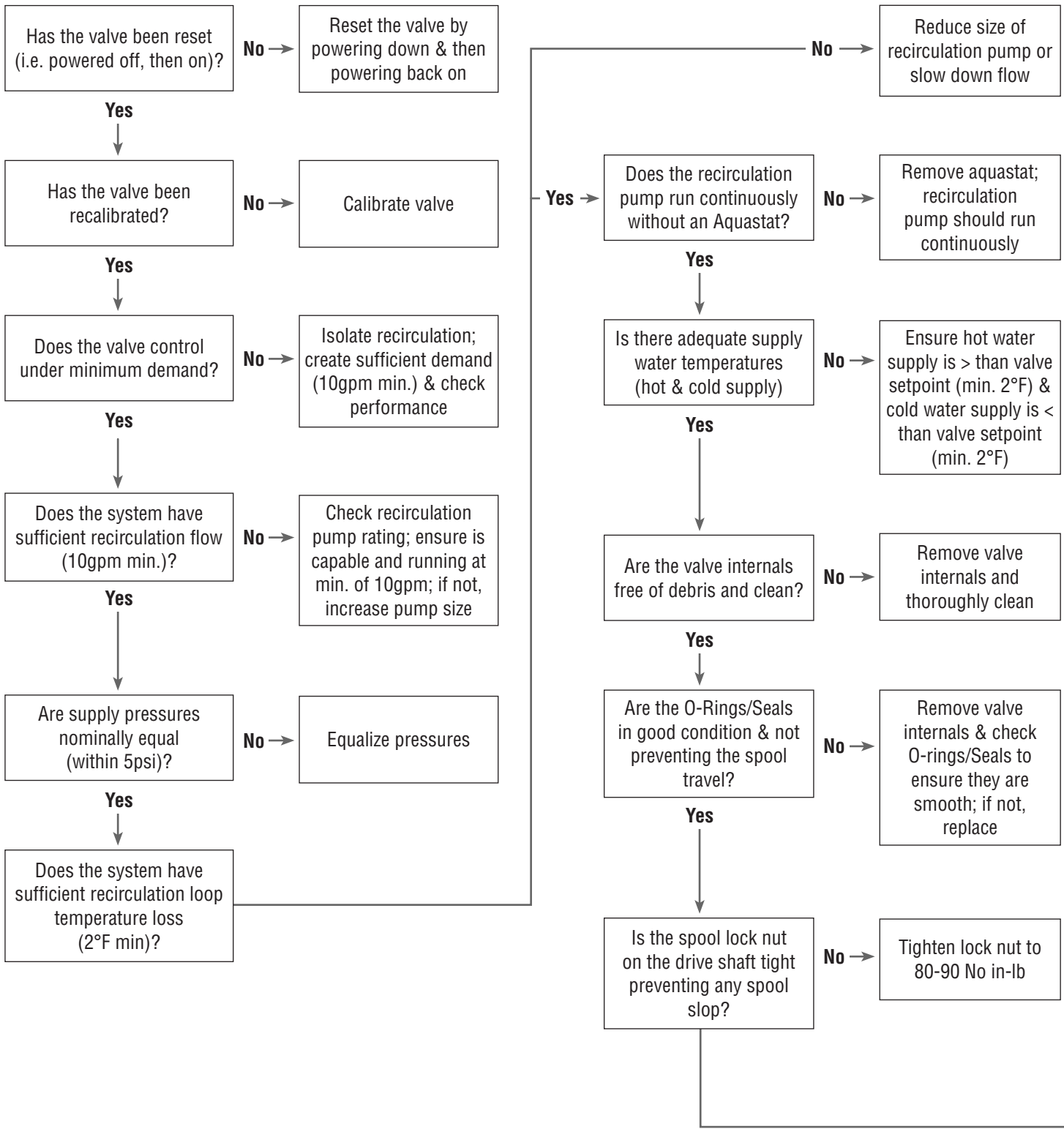
Check



DRV40-80 Gen. 2 Troubleshoot Guide

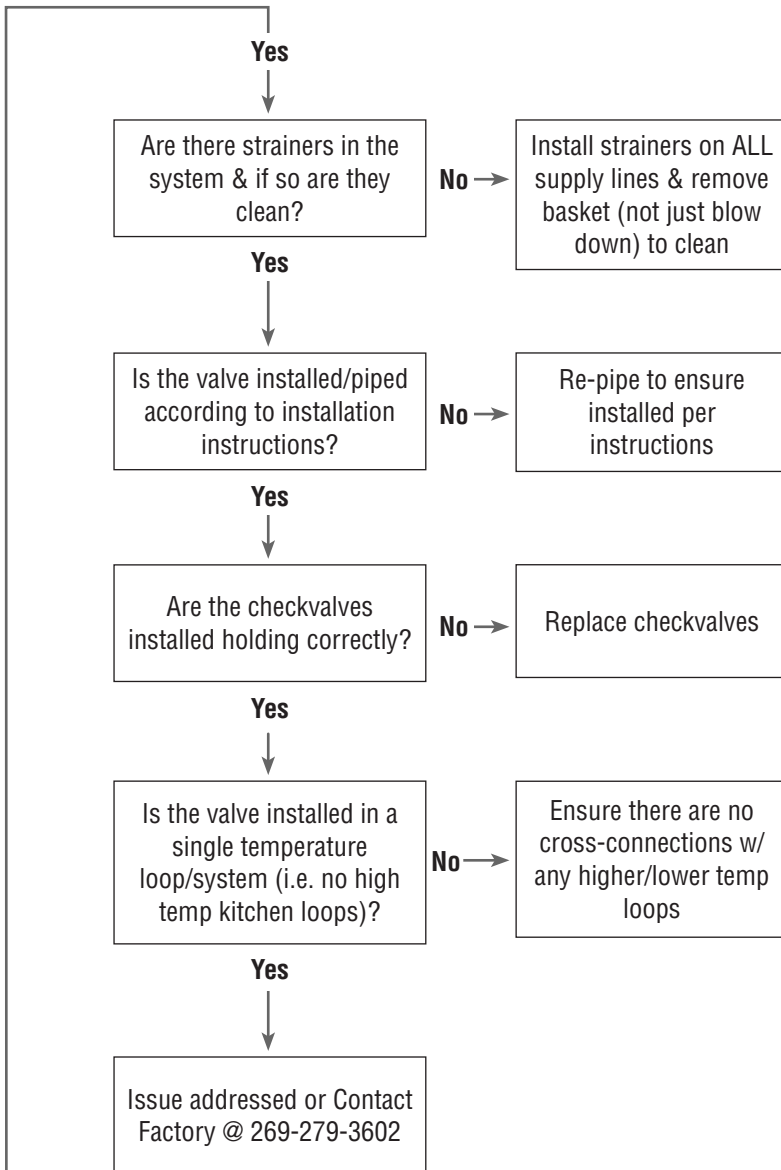
Temperature Control Issues

Check



DRV40-80 Gen. 2 Troubleshoot Guide

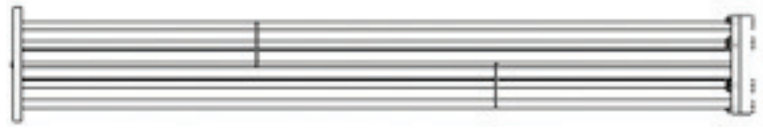
Temperature Control Issues - Continued



Digital-Flo® Spare Parts

Single Wall Tube Bundle & Heat Exchanger Gasket Kit

Single Wall Model	Part Number
DF415 or 442ST	D60696
DF535 or 552ST	D60697
DF665 or 662ST	D60698
DF8120 or 862ST	D60699



DF or ST Single Wall Tube Bundle with Gasket Kit

Double Wall Tube Bundle with Heat Exchanger Gasket Kit

Double Wall Model	Part Number
DF415DW or 442DW ST	D60700
DF535DW or 552DW ST	D60701
DF665DW or 662DW ST	D60702
DF8120DW or 862DW ST	D60703



DF or ST Double Wall Tube Bundle with Gasket Kit

Heat Exchanger Gasket Kit for Digital-Flo® & ST

Single or Double Wall	Part Number
DF415 or 442ST	D32594
DF535 or 552ST	D32595
DF665 or 662ST	D33790
DF8120 or 862ST	D33791

Not Compatible with FRT Models



Needed if You Service a DF Tube Bundle, or if You Order a Two-Pass Head Below.

Two-Pass Head for Digital-Flo® and ST

Single or Double Wall	Part Number
DF415 or 442ST	D33012
DF535 or 552ST	D33005
DF665 or 662ST	D33002
DF8120 or 862ST	D33008



Gasket Not Included - Order Gasket Kit Above

Digital-Flo® Spare Parts – continued

Digital-Flo® Gasket Detail



Single Wall Tube Bundle



Double Wall Tube Bundle



New Style Shown

Digital-Flo® 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



D9022
Order Qty
of 2

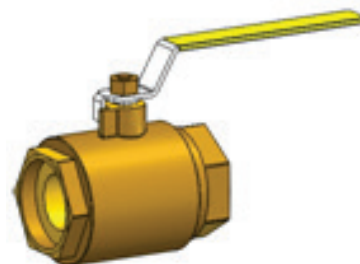
For Comprehensive DRV Spare Parts List, Refer to the DRV IOM



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



Digital-Flo® Spare Parts – continued

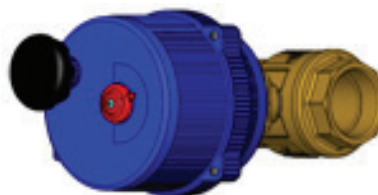
Isolation Valves (Butterfly Valves)

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



Digital-Flo® Spare Parts – continued

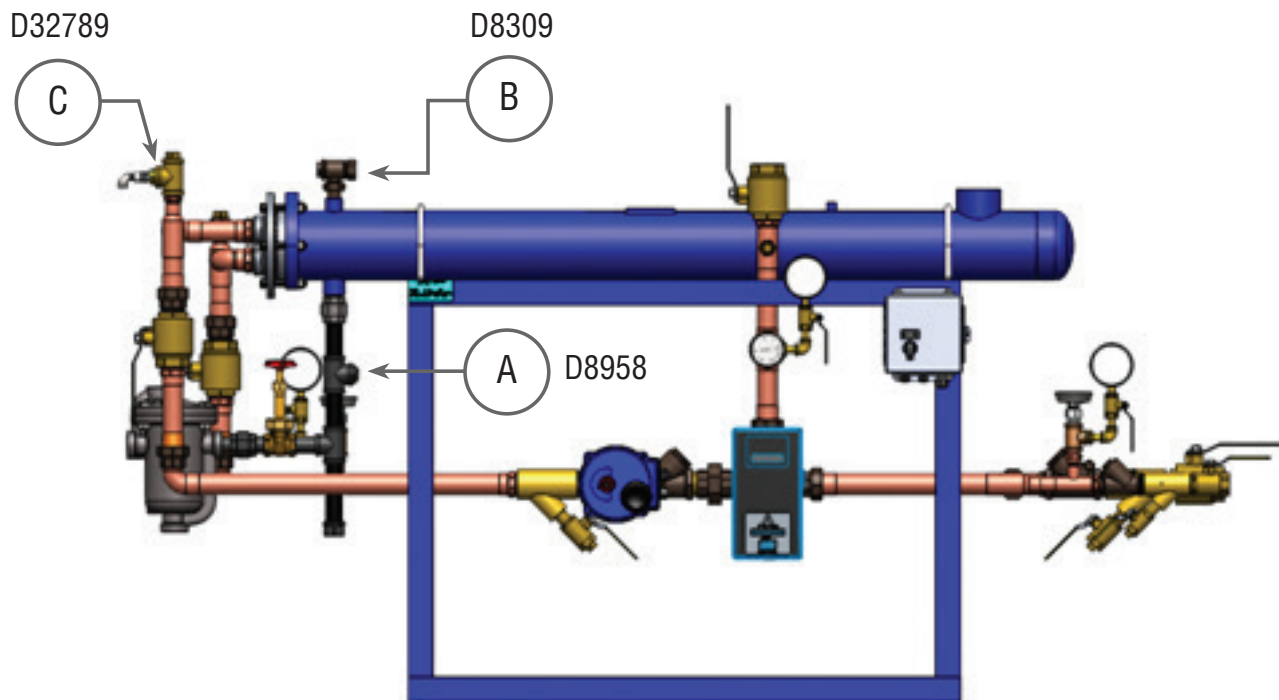
Pressure Gauge

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



Relief Valves

Item	Description	Part Number
A	1/2" Vacuum Breaker-Brass	D8958
B	TS2 3/4" Angle Air Vent-Bronze	D8309
C	VRVHI 150 psi Relief Valve 1/4" NPT	D102817



Spare Parts Lists

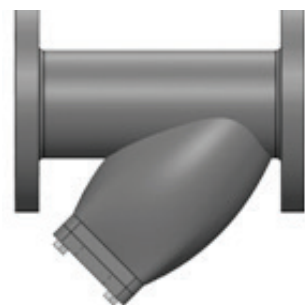
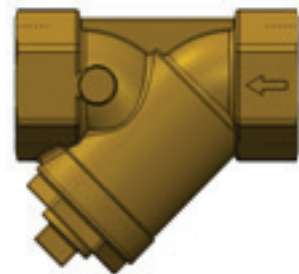
Strainers

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	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



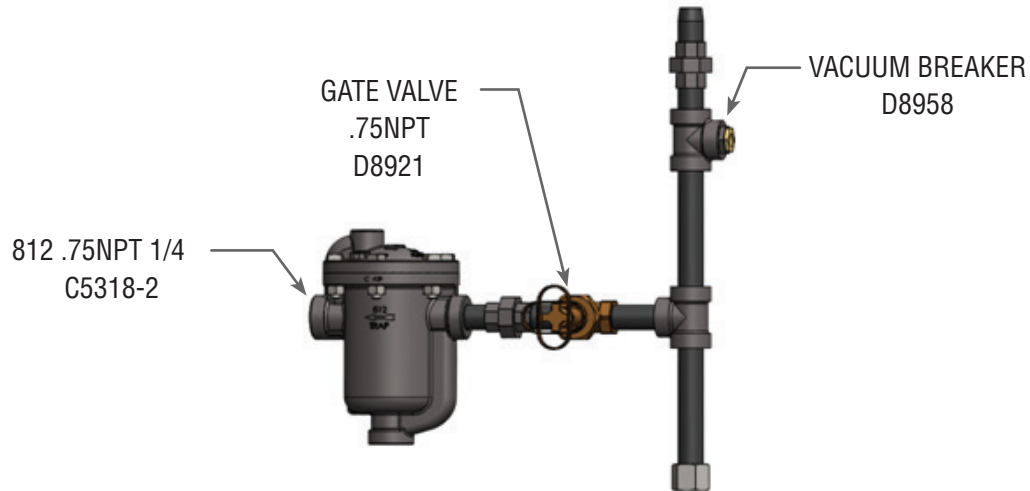
Thermometers & Thermowells

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

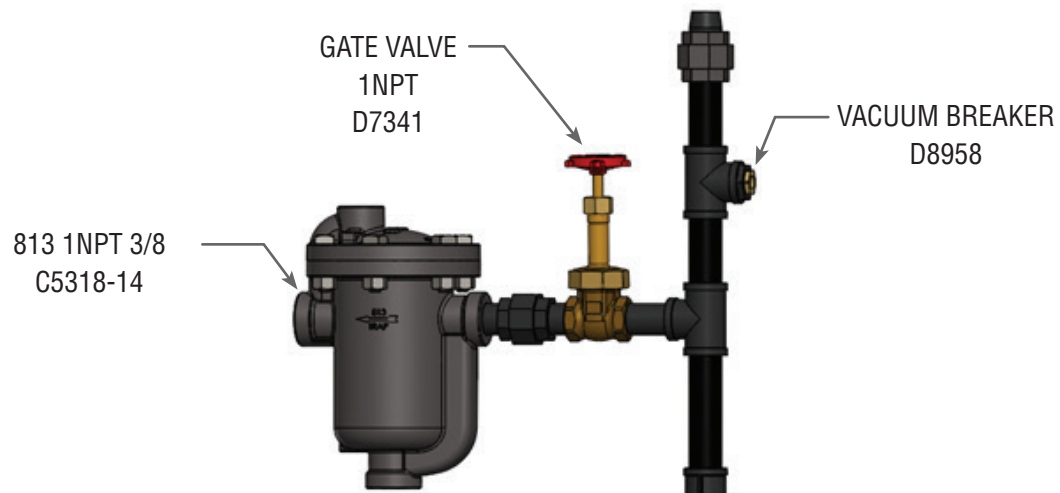


Steam Trap Assemblies

DF415 – 812 IB Condensate Trap Assembly

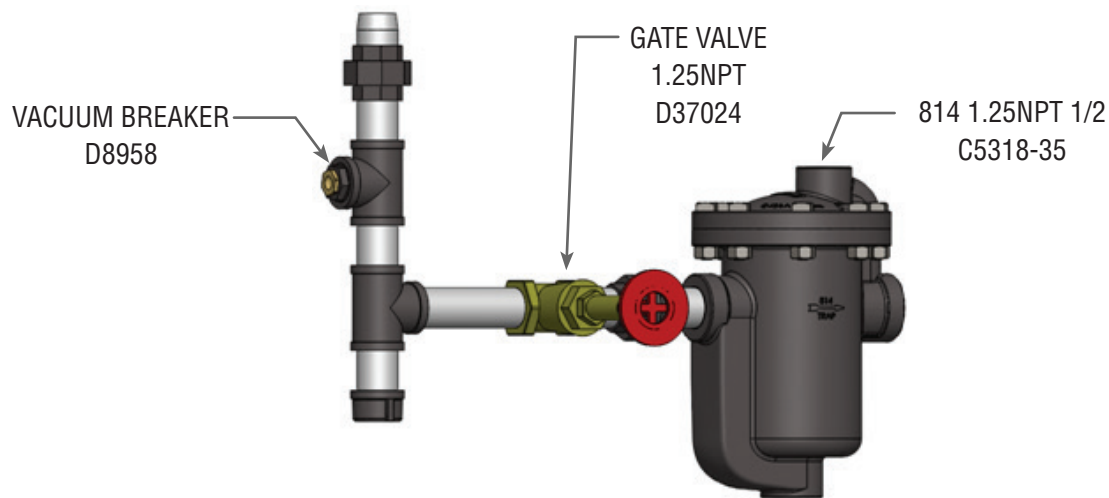


DF535 – 813 IB Condensate Trap Assembly

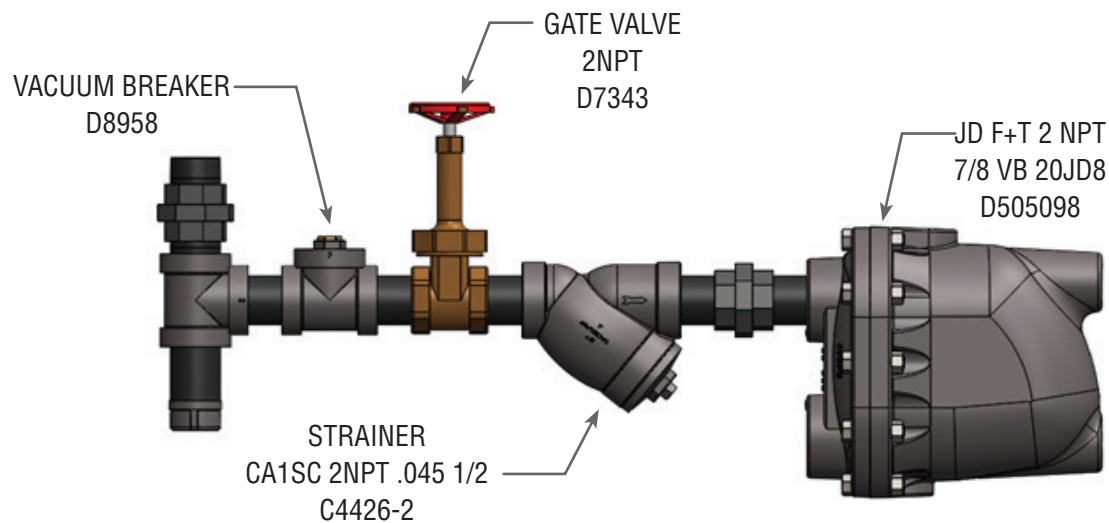


Steam Trap Assemblies – continued

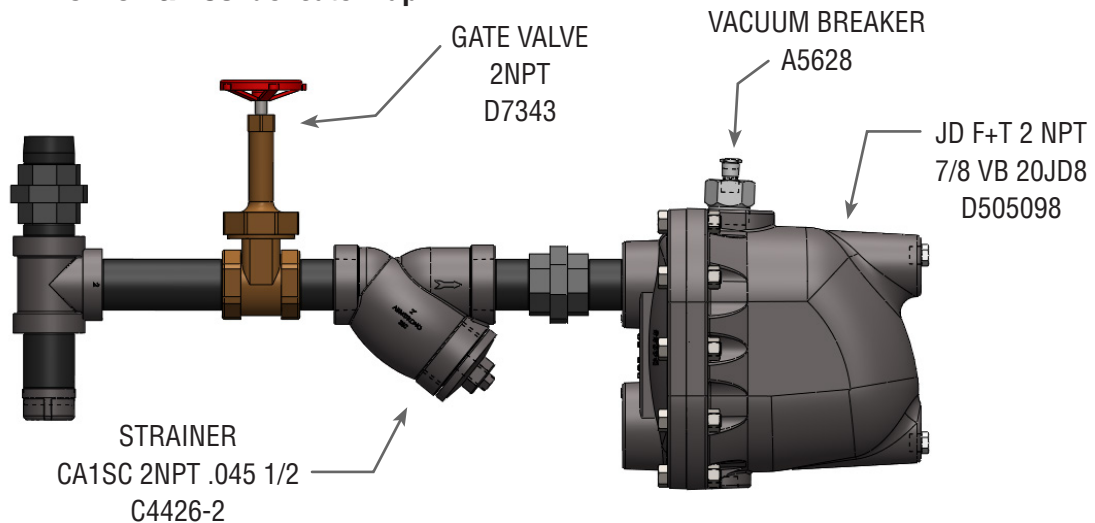
DF665 – 814 IB Condensate Trap Assembly



DF8120 – 20JD8 F&T Condensate Trap Assembly



Latest Revision: DF8120 F&T Condensate Trap



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. As a condition of enforcing any rights or remedies relating to Armstrong products, notice of any warranty or other claim relating to the products must be given in writing to Armstrong: (i) within 30 days of last day of the applicable warranty period, or (ii) within 30 days of the date of the manifestation of the condition or occurrence giving rise to the claim, whichever is earlier. **IN NO EVENT SHALL ARMSTRONG BE LIABLE FOR SPECIAL, DIRECT, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING, BUT NOT LIMITED TO, LOSS OF USE OR PROFITS OR INTERRUPTION OF BUSINESS.** The Limited Warranty and Remedy terms herein apply notwithstanding any contrary terms in any purchase order or form submitted or issued by any user, purchaser, or third party and all such contrary terms shall be deemed rejected by Armstrong.

Special Warranty Periods are as follows:

Digital-Flo® Instantaneous Water Heater: The tube bundle shall have a 10-year guarantee against failure caused by materials or workmanship provided by Armstrong but not against gasket failure or damage caused by corrosion, water hammer or lack of proper maintenance.

Digital-Flo® Instantaneous Water Heater Pre-Piped Assemblies: Two (2) years from the date of installation, but not longer than 27 months from the date of shipment.

Digital Recirculation Valve: DRV shall have a 5 year all components parts warranty from date of shipment (except for batteries, wetted O-rings and seals).

Notes

Digital-Flo® 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.
Visit armstronginternational.com for up-to-date information.



Armstrong International
North America • Latin America • India • Europe / Middle East / Africa • China • Pacific Rim
armstronginternational.com