

# Flo-Direct® 2.0 Complete Thermal Exchange Gas Fired Water Heater

## Installation, Operation, and Maintenance Manual



Certified to



U.S. patent 5,924,391

**Please read and save  
these instructions**

706-EN V7.0



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

**Failure to comply with instructions following a safety icon may result in adverse consequences including, property damage, personal injury, or, in extreme cases, death.**

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### General Safety Guidelines:

1. Inappropriate use of this product (beyond typical, intended use) could cause damage to the product and other property. It may also result in personal injury or, in extreme cases, death.
2. Only designated, qualified, and competent personnel should conduct installation, maintenance, and service in accordance with the directions in this product instruction manual.
3. Installation shall comply with all applicable federal, state, and local, electrical and construction, regulatory codes.
4. Improper installation, start-up, operation, maintenance, or service may void the product warranty.
5. When installing, commissioning or servicing this product:
  - a. ALWAYS select and wear appropriate personal protective equipment (PPE) before carrying out any physical work at the job site. Appropriate PPE may include hard hats, safety glasses, gloves, boots or shoes w/ non-slip soles and toe guards, and protective overalls.
  - b. ALWAYS scan the work area and take note of potential hazards before entering. Adjust your travel path or work position to avoid hazards and personal injury.
  - c. ALWAYS observe designated safety procedures when working in hazardous locations (areas containing explosive and combustible gases, vapors, and dusts) and confined spaces (locations where the breathable air supply may be limited or variable or where entrapment could occur).
  - d. ALWAYS use appropriate lockout-tagout procedures to disconnect power sources and de-energize machinery before conducting installation, service, and repair.
  - e. ALWAYS use great care and appropriate safety gear when working above ground level, especially on ladders and platforms or in the presence of overhead, electrical power lines.
  - f. ALWAYS ensure that all “live” steam, water supply, and condensate return lines are isolated before breaking or loosening any plumbing joints.
  - g. ALWAYS carefully relieve any residual internal pressure in the system or connecting pipe work before breaking or loosening any plumbing joints.
  - h. ALWAYS allow hot parts to cool before commencing work to avoid the risk of skin burns.

# Warnings and Cautions



## Warning!

If the information in these instructions is not followed exactly, a fire or explosion may result causing property damage, personal injury, or death.

- Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.
- What to do if you smell gas
  - Do not try to light any appliance.
  - Do not touch any electrical switch; do not use any phone in your building.
  - Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.

If you cannot reach your gas supplier, call the fire department.

- Installation and service must be performed by a qualified installer, service agency, or gas supplier.

**Note: Operating with any safety device bypassed will void the warranty.**



## Danger!

Applicable codes must be followed and supersede any other instructions. Generally applicable codes in the US include:

- NEC
- NFPA #86



## Danger!

- Read this manual.
- Improper installation or operation may cause a fire or explosion resulting in property damage, personal injury, or death. Armstrong strongly recommends that a qualified installer be used.
- Service must be performed by a qualified person.
- Improper installation, start-up, operation, maintenance, or service may void the warranty.



## Danger!

- Do not attempt to use the heater if it has been submerged in water. Contact a qualified service technician to inspect it and replace compromised parts.



## Danger!

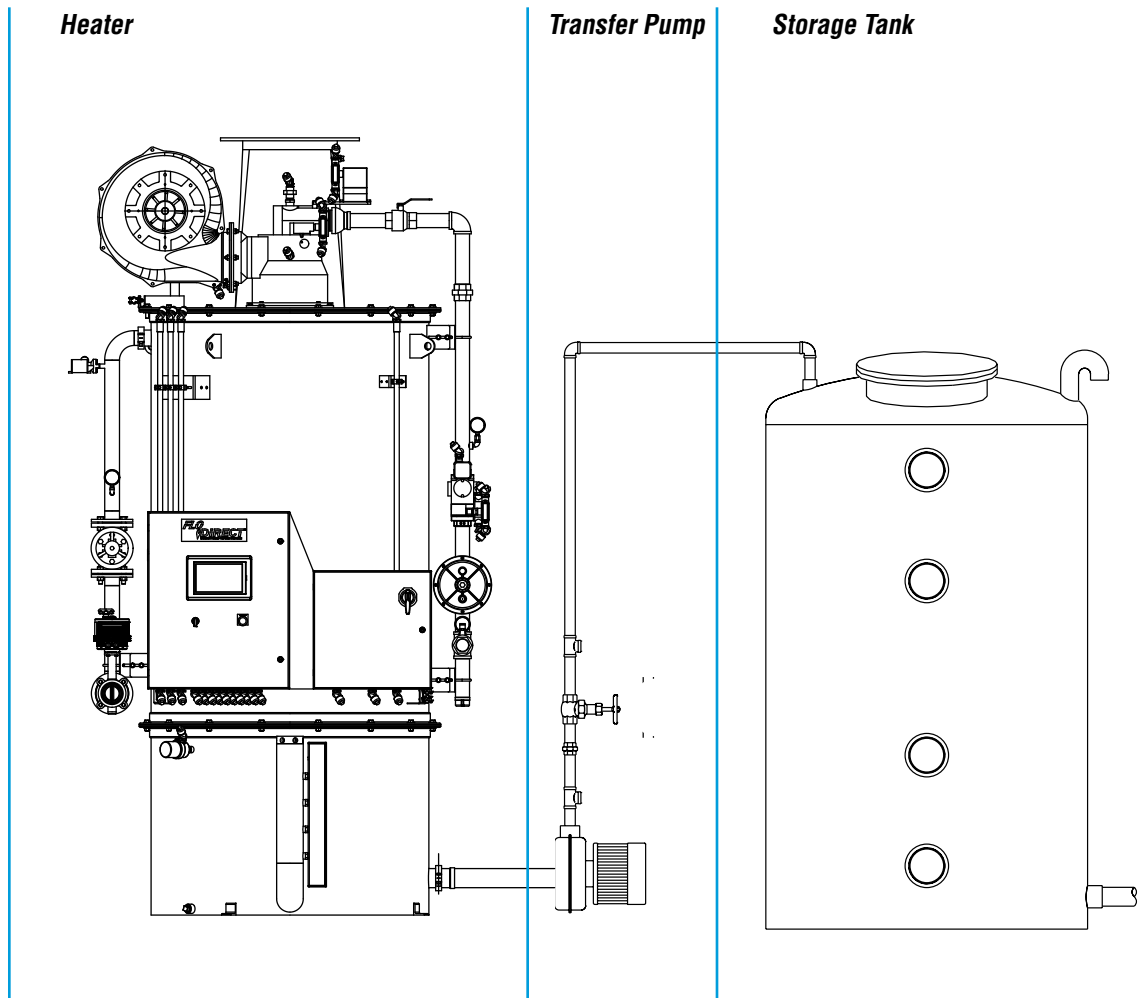
Hot water or metal may cause scald burns. Skin exposure to 140° water or metal for only five seconds may cause a second degree burn.

# The Flo-Direct® System

Armstrong's Flo-Direct® water heaters:

- Are designed for industrial applications
- Use complete thermal exchange technology
- Come in sizes from 1 to 12 million Btu/hr
- Heat water up to 185°F maximum

## Typical System



Flo-Direct® water heaters are highly efficient, low maintenance systems.

- Complete thermal exchange technology means no fuel is used for warm-up or idle time and no energy is lost through conversion or exchange.
- Without internal moving parts, there is very little to maintain.
- Water conditioning is not required.

Flo-Direct® systems are highly customizable at both a system and component level. **The information in this manual generally uses a 5 million Btu/hr unit and is intended to be typical. Illustrations are not intended to be complete or correct in every detail. System-specific drawings, including wiring schematics, are provided with each unit and should be referred to when installing and operating your system.**

Common options:

- Gravity drain (without a transfer pump)
- Standard (consistent incoming water temperature) or modulating burner actuator
- Natural gas or propane fuel
- Remote or integral tank

Other available options include:

- Skid-packaged heaters
- Performance matched components
- Ultra-low NOx emissions
- Non-standard fuels
- Storage tank heating element

Peripheral components:

- Digital mixing valves
- Variable frequency drive pump
- Hose stations

Optional services:

- Turn-key installation
- Installation project management
- System assessment and optimization
- Energy conservation measures (ECM)

**Note:** Armstrong provides separate IOMs for the burner, blower, and for optional components. Consult the appropriate document for more information.

# Specifications

## Heater

### Materials of Construction

| Component       | Material                                    |
|-----------------|---|
| Canister        | 304 SS (10 ga. ≤ AFD-9000; 3/16 > AFD-9000) |
| Canister gasket | WARCO white (food grade buna rubber)        |
| Flame tube      | 304 SS                                      |
| Gas piping      | Malleable iron with standard yellow finish  |
| Water piping    | Welded stainless steel (304)                |
| Spray ring      | 304/316 SS                                  |
| Pall ring       | 304 SS                                      |

### Operational Specifications

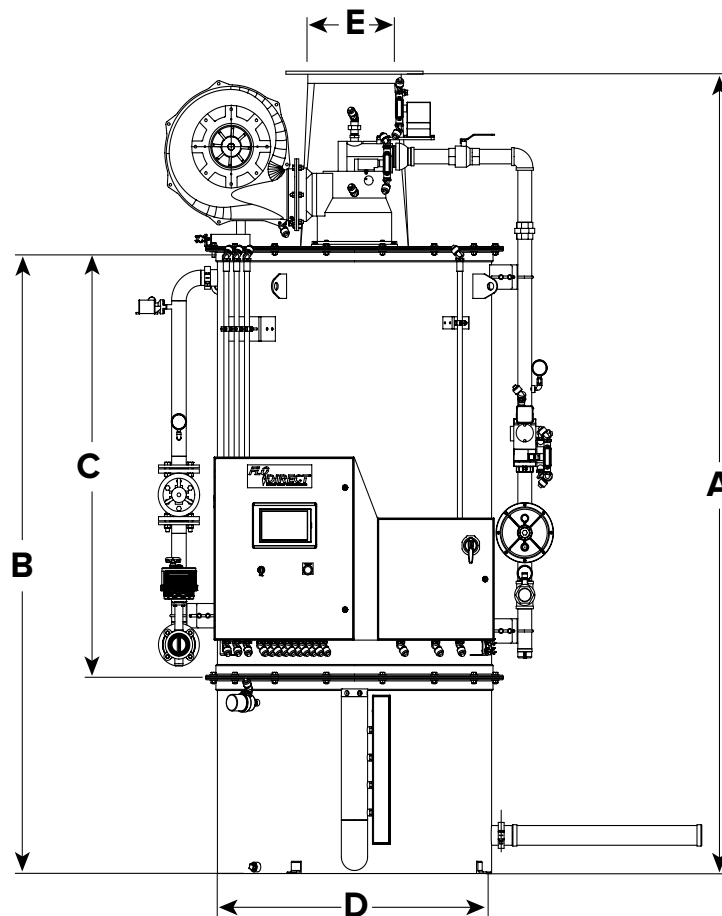
| Spec                           | English Units                       | SI Units                                |
|--------------------------------|-------------------------------------|---|
| Gas supply pressure            | 2–6 psig (optimum 4–5.5 psig)       | 0.14–0.41 bar (optimum 0.28–0.38 bar)   |
| Water supply pressure          | 30–100 psig with ± 5 psig variation | 2.07–6.84 bar with ± 0.34 bar variation |
| Inlet water temperature        | 32 °F to 100°F                      | 0 °C to 37.7 °C                         |
| Outlet water temperature       | 180 °F                              | 82.2 °C                                 |
| Water temperature differential | 10 °F to 140 °F                     | 5.6 °C to 77.8 °C                       |
| NOx emission                   | 60–70 ppm                           |   |
| Thermal efficiency             | 99.7%                               |   |

### Technical Specifications

- Flo-Direct® water heaters are built to UL standard 795
- May be manufactured to comply with various other electrical or water quality standards
- Three-phase power is required; most available voltages may be accommodated

**\*Consult factory for additional information.**

## Dimensions



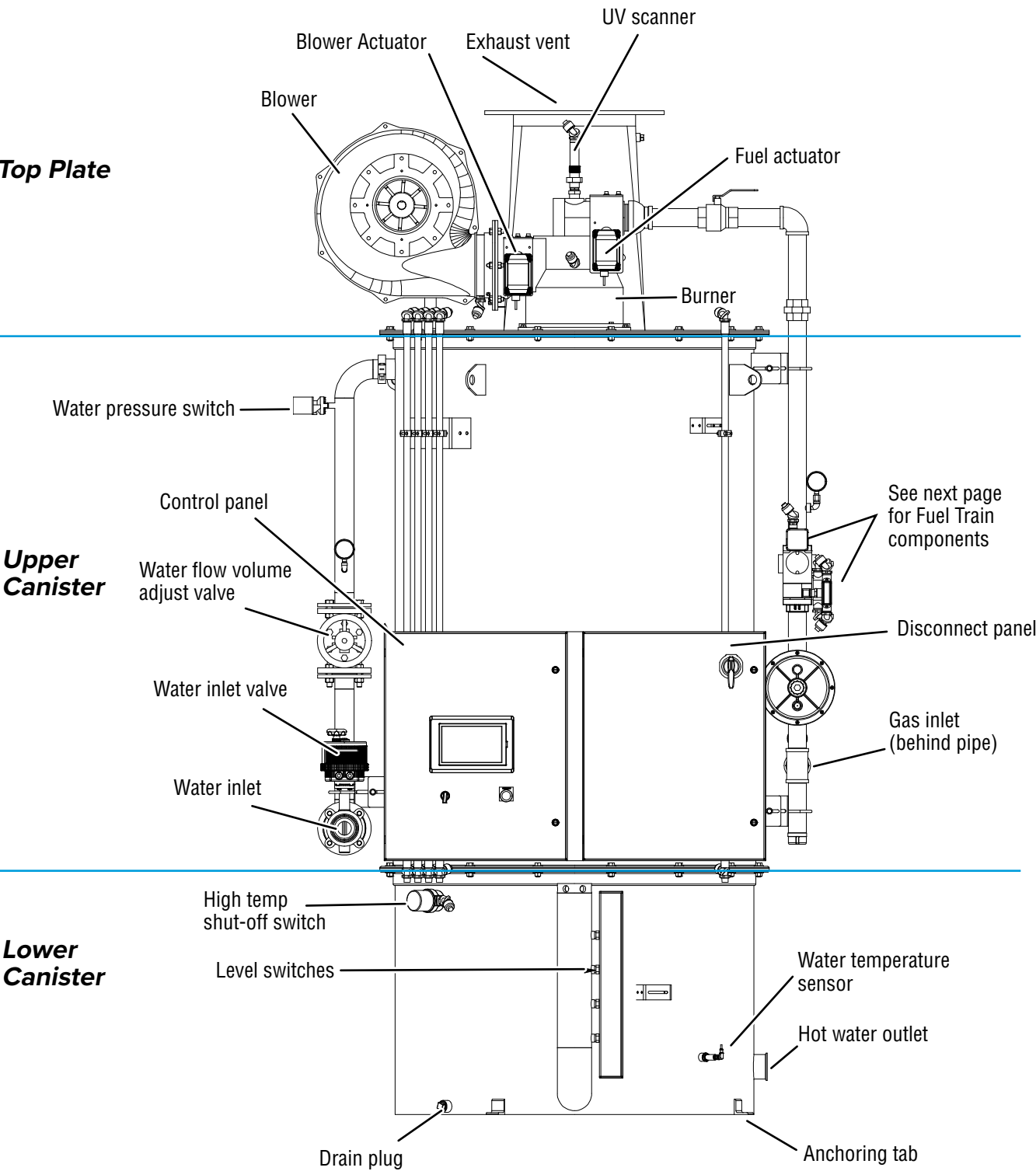
| Flo-Direct® Dimensions and Weights |             |    |       |    |            |      |     |      |     |      |    |      |        |     |        |      |            |      |
|------------------------------------|-------------|----|-------|----|------------|------|-----|------|-----|------|----|------|--------|-----|--------|------|------------|------|
| Model                              | Connections |    |       |    | Dimensions |      |     |      |     |      |    |      |        |     | Weight |      | btu/hr     | kW   |
|                                    | 1           |    | 2     |    | A          |      | B   |      | C   |      | D  |      | E      |     |        |      |            |      |
|                                    | in          | mm | in    | mm | in         | mm   | in  | mm   | in  | mm   | in | mm   | in     | mm  | lb     | kg   |            |      |
| AFD-1000                           | 1           | 25 | 1     | 25 | 95         | 2413 | 71  | 1803 | 39  | 991  | 24 | 610  | 8      | 203 | 825    | 375  | 1,000,000  | 292  |
| AFD-1500                           | 1           | 25 | 1     | 25 | 97         | 2464 | 73  | 1854 | 41  | 1041 | 26 | 660  | 8      | 203 | 850    | 386  | 1,500,000  | 439  |
| AFD-2000                           | 1-1/2       | 40 | 1-1/2 | 40 | 100        | 2540 | 76  | 1930 | 44  | 1118 | 30 | 762  | 10-3/4 | 273 | 1500   | 680  | 2,000,000  | 585  |
| AFD-3000                           | 2           | 50 | 1-1/2 | 40 | 100        | 2540 | 76  | 1930 | 44  | 1118 | 36 | 914  | 12     | 305 | 1600   | 725  | 3,000,000  | 878  |
| AFD-5000                           | 2-1/2       | 65 | 2     | 50 | 127        | 3226 | 97  | 2464 | 65  | 1651 | 44 | 1118 | 16     | 406 | 2500   | 1136 | 5,000,000  | 1464 |
| AFD-6000                           | 3           | 80 | 2     | 50 | 132        | 3353 | 100 | 2540 | 70  | 1778 | 47 | 1194 | 18     | 457 | 2900   | 1316 | 6,000,000  | 1757 |
| AFD-7000                           | 3           | 80 | 2     | 50 | 139        | 3531 | 107 | 2718 | 77  | 1956 | 50 | 1270 | 18     | 457 | 3200   | 1455 | 7,000,000  | 2050 |
| AFD-9000                           | 3           | 80 | 2     | 50 | 169        | 4293 | 139 | 3531 | 107 | 2718 | 60 | 1524 | 20     | 508 | 5000   | 2273 | 9,000,000  | 2635 |
| AFD-10000                          | 3           | 80 | 2     | 50 | 181        | 4597 | 151 | 3835 | 119 | 3023 | 61 | 1549 | 20     | 508 | 5200   | 2405 | 10,000,000 | 2928 |

\*Connections may be NPT, flanged, or use a sanitary ferrule as required.

\*AFD capacity ratings are subject to a +/- 5% total output variance based on supply conditions variables and combustion requirements. If actual installation conditions differ from those listed in the product IOM then the 5% variance may be additionally impacted.

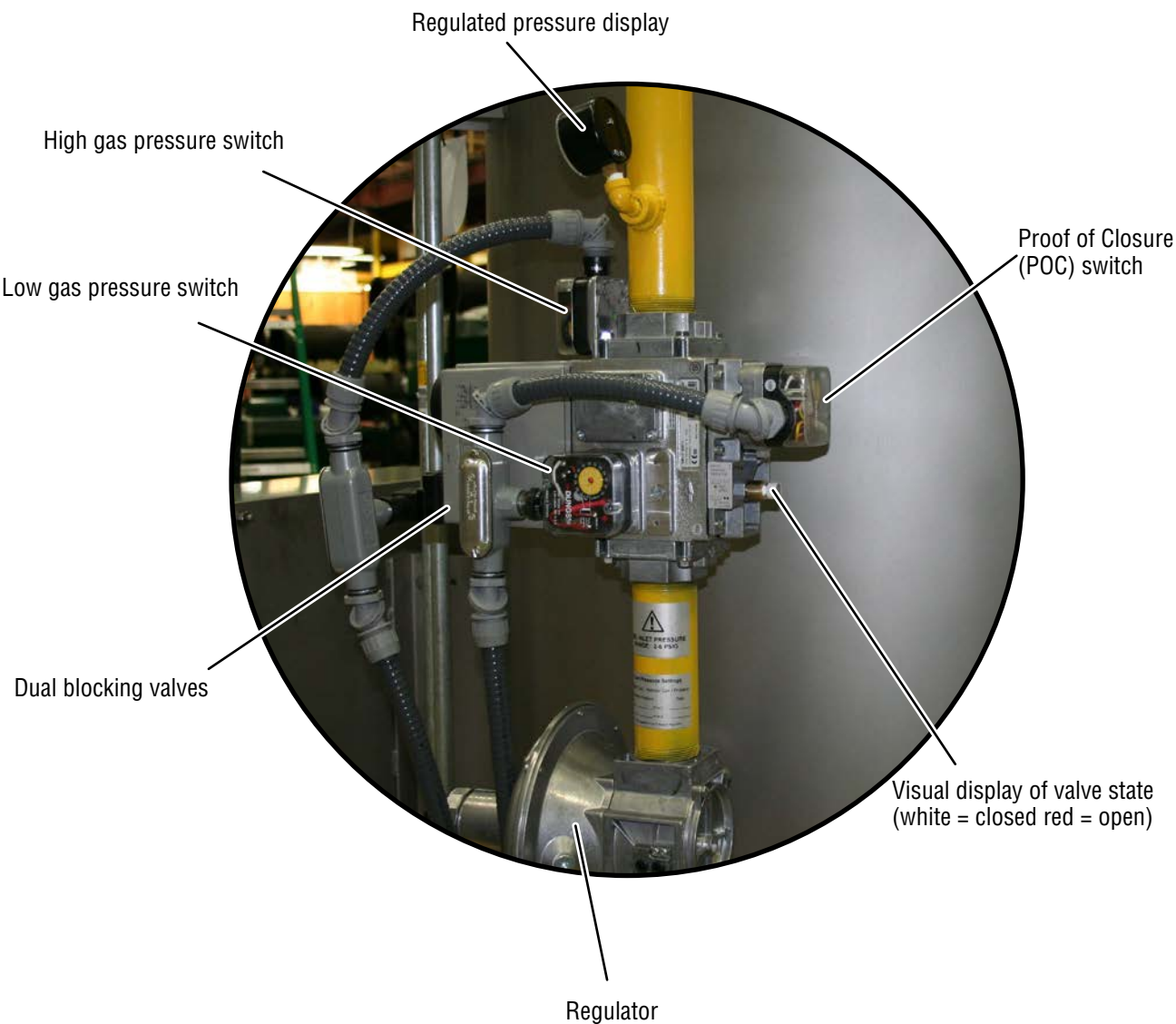


Orientation



Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit [armstronginternational.com](http://armstronginternational.com) for up-to-date information.

Fuel Train Components



# Transfer Pump Assembly

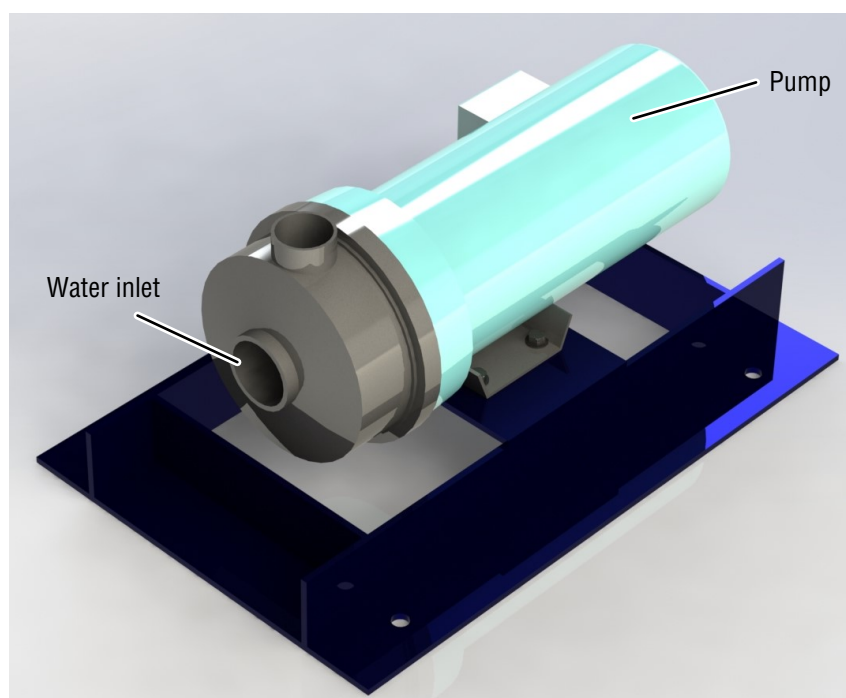
## Materials of Construction

| Component         | Material                     |
|-------------------|------------------------------|
| Piping            | 304 OR 316 stainless steel   |
| Braided flex hose | Stainless steel              |
| Pump              | Stainless steel (TEFC motor) |
| Globe valve       | Stainless steel              |
| Stand             | Carbon steel (painted)       |

## Dimensions and Operational Specifications

| Model  | Maximum Flow Rate |       | Inlet Connection |    | Outlet Connection |     | Flow Control Valve |    | Pump Power |      |
|--------|-------------------|-------|------------------|----|-------------------|-----|--------------------|----|------------|------|
|        | GPM               | m³/hr | in.              | mm | in.               | mm  | in.                | mm | HP         | kW   |
| TP-50  | 50                | 11.4  | 1-1/2            | 40 | 1-1/2             | 40  | 1                  | 25 | 2          | 1.49 |
| TP-90  | 90                | 20.4  | 1-1/2            | 40 | 2                 | 50  | 1-1/2              | 40 | 3          | 2.24 |
| TP-135 | 135               | 30.7  | 2                | 50 | 2-1/2             | 65  | 2                  | 50 | 5          | 3.73 |
| TP-200 | 200               | 45.4  | 2-1/2            | 65 | 3                 | 80  | 2                  | 50 | 7-1/2      | 5.59 |
| TP-275 | 275               | 62.5  | 2-1/2            | 65 | 4                 | 100 | 2-1/2              | 65 | 10         | 7.46 |
| TP-350 | 350               | 79.5  | 3                | 80 | 4                 | 100 | 3                  | 80 | 10         | 7.46 |

## Orientation



# Storage Tank

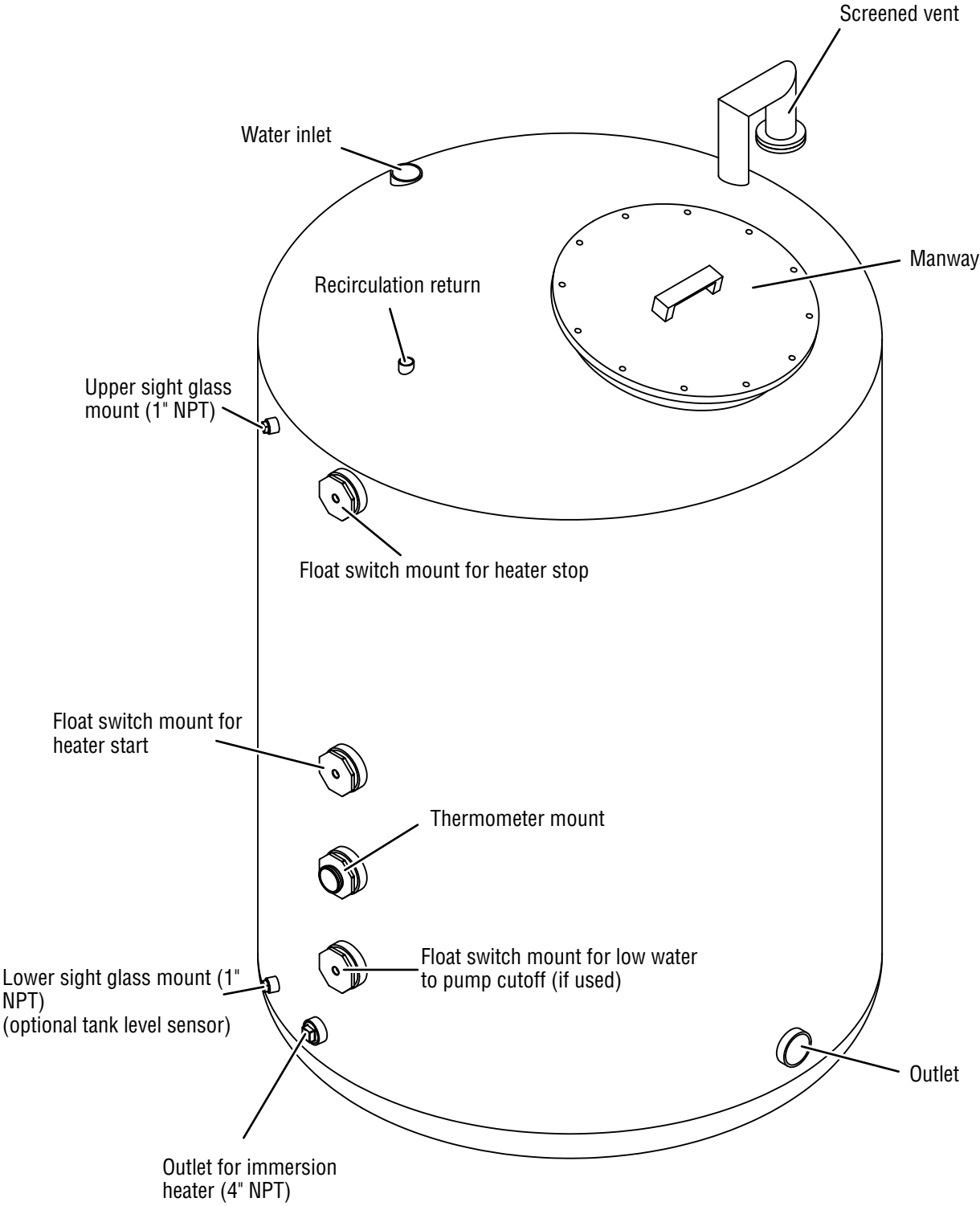
## Materials of Construction

| Component                  | Material                   |
|----------------------------|----------------------------|
| Structural layer           | Fiber-reinforced plastic   |
| Structural and liner resin | Derakane™ 441-400          |
| Exterior layer resin       | Isophthalic polyester      |
| Tank finish                | Gel coat with UV inhibitor |
| Color                      | Gray (AT071)               |
| Tank fittings              | Fiber-reinforced plastic   |
| Vent                       | Fiber-reinforced plastic   |
| Manhole and cover          | Fiber-reinforced plastic   |
| Manhole cover bolts        | Stainless steel            |
| Manhole gasket             | EPDM                       |
| Hold down and lifting lugs | Powder-coated carbon steel |

## General Specifications

|                       |                 |
|-----------------------|-----------------|
| Design standard       | ASTM D49097-00  |
| Maximum pressure      | Atmospheric     |
| Vacuum                | None            |
| Maximum temperature   | 180°F (82.2 °C) |
| Specific gravity      | 1.2             |
| Seismic code/design   | None            |
| Wind load             | 0 mph/kph       |
| Immersion heater port | 4" NPT          |
| Sight glass port      | 1" NPT          |
| Insulation thickness  | 2" (50 mm)      |

Orientation



# Assembly and Installation

## Unpacking

### Note:

- Obvious damage should be noted on delivery paperwork. Hidden damage must be reported to carrier within ten days.
- Cleaning heater using local plant standard is recommended prior to installation.
- Storage tanks are typically shipped directly from vendor.

Depending on heater size and mode of shipping, one of two scenarios may apply.

Small heaters (approximately AFD-5000 and under) when shipped with adequate height clearance in vehicle:

- Top plate and upper canister will be attached and upright.
- A fork lift will usually be adequate for moving. Use of a strap or chain is recommended.

Large heaters:

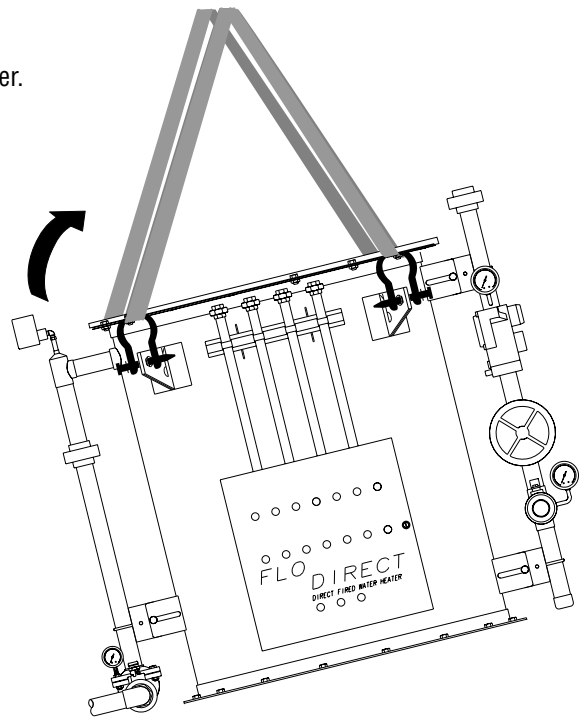
- Top plate will be bolted to lower canister.
- Upper canister will be on its side with top covered.
- A crane or hoist of some kind will be needed for moving. At least two, preferably four straps or chains will be needed.

## Installing Large Heaters

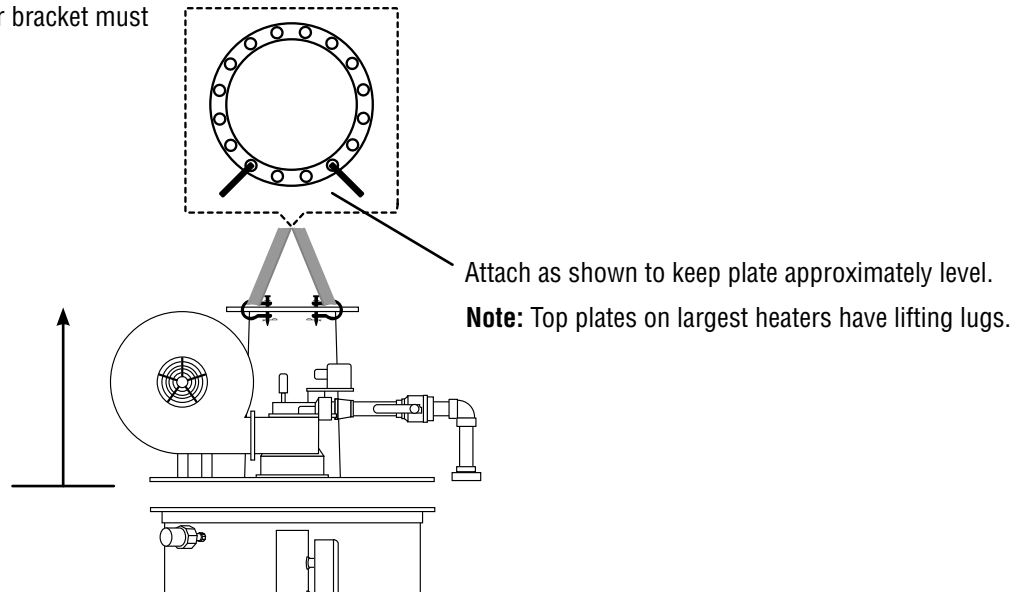
1. Stand upper canister upright and position near final heater location.

**Note:** Remove cover and, if necessary, rearrange palls until they are approximately level and do not interfere with spray nozzles.

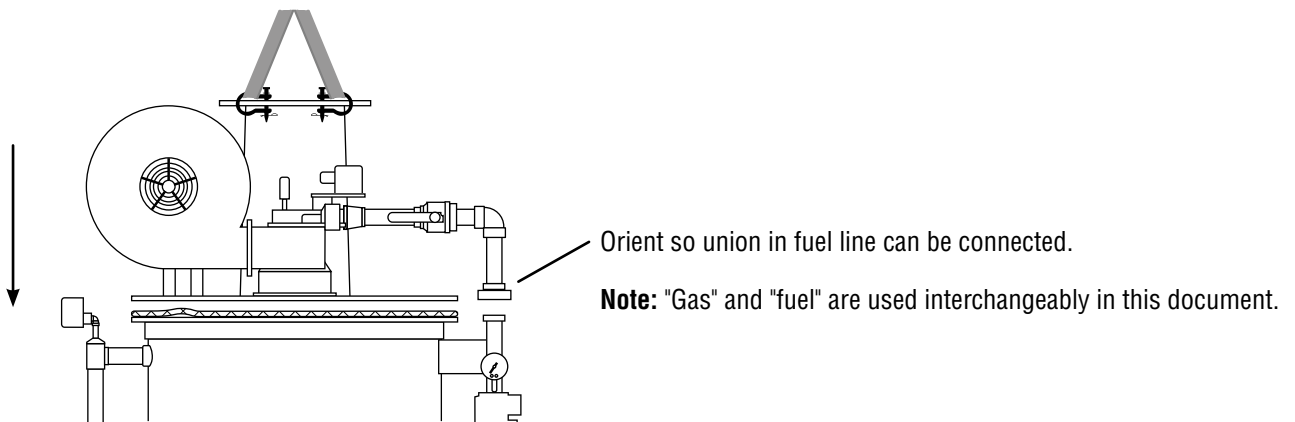
2. Wipe off flange and place gasket on it with holes aligned.
3. Remove cable ties from wiring and unbolt top plate from lower canister.



**Note:** Long bolt in blower motor bracket must be reinstalled in that hole.



4. Remove top plate from lower canister.

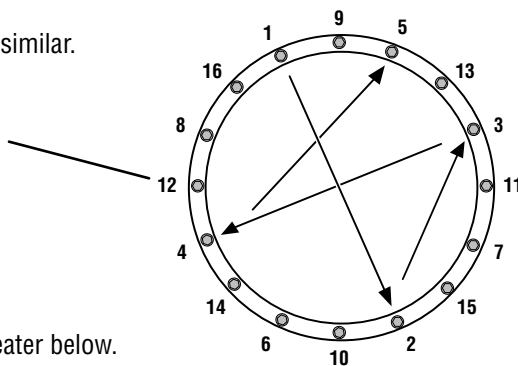


5. Position top plate on top of upper canister with holes aligned.

6. Install all bolts and start nuts. Liberal use of an anti-sieze compound is strongly recommended.

7. Tighten all bolts using pattern shown or similar.

**Note:** This pattern is for heaters with 16 bolts. 24-bolt patterns should be tightened similarly.



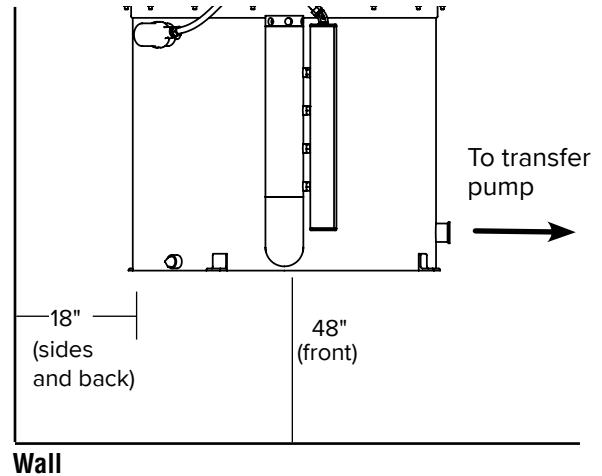
8. Attach canister sections as for a small heater below.

# Installing Small Heaters

1. Place lower canister in final heater position:

- On level surface
- With adequate clearances
- With adequate support for operating weight
- With outlet facing transfer pump location
- Not near flammable or combustible materials

2. Wipe flange and gasket to remove any dirt or debris and place gasket on flange of canister with holes aligned.

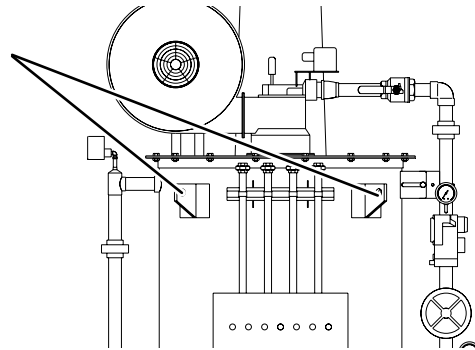


3. Move upper canister into position over lower canister using lift lugs.

4. Lower carefully until a few bolts can be inserted.

**Tip:** Using several tapered pry bars or long screwdrivers will aid in aligning.

**Note:** Control panels are typically above standpipe (see approval drawing for actual orientation). If slight indexing is required to align outlet, some rewiring may be necessary between canister sections.



5. Lower upper canister completely, insert all bolts, and start nuts. Liberal application of an anti-sieze compound is strongly recommended.

6. Raise entire heater slightly above floor to allow self-aligning.

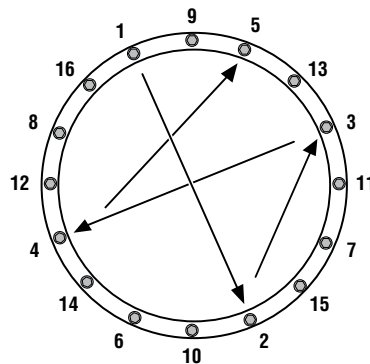
7. Snug all bolts using pattern shown or similar

8. Lower onto floor and tighten all bolts using pattern shown or similar.

**Note:** Leakage is normal pending stress relief. Tighten applicable bolts as required when leaks appear.

9. Armstrong recommends anchoring heater in place.

10. Repeat tightening sequence after several hours and after a few days of operation or as leaks occur.

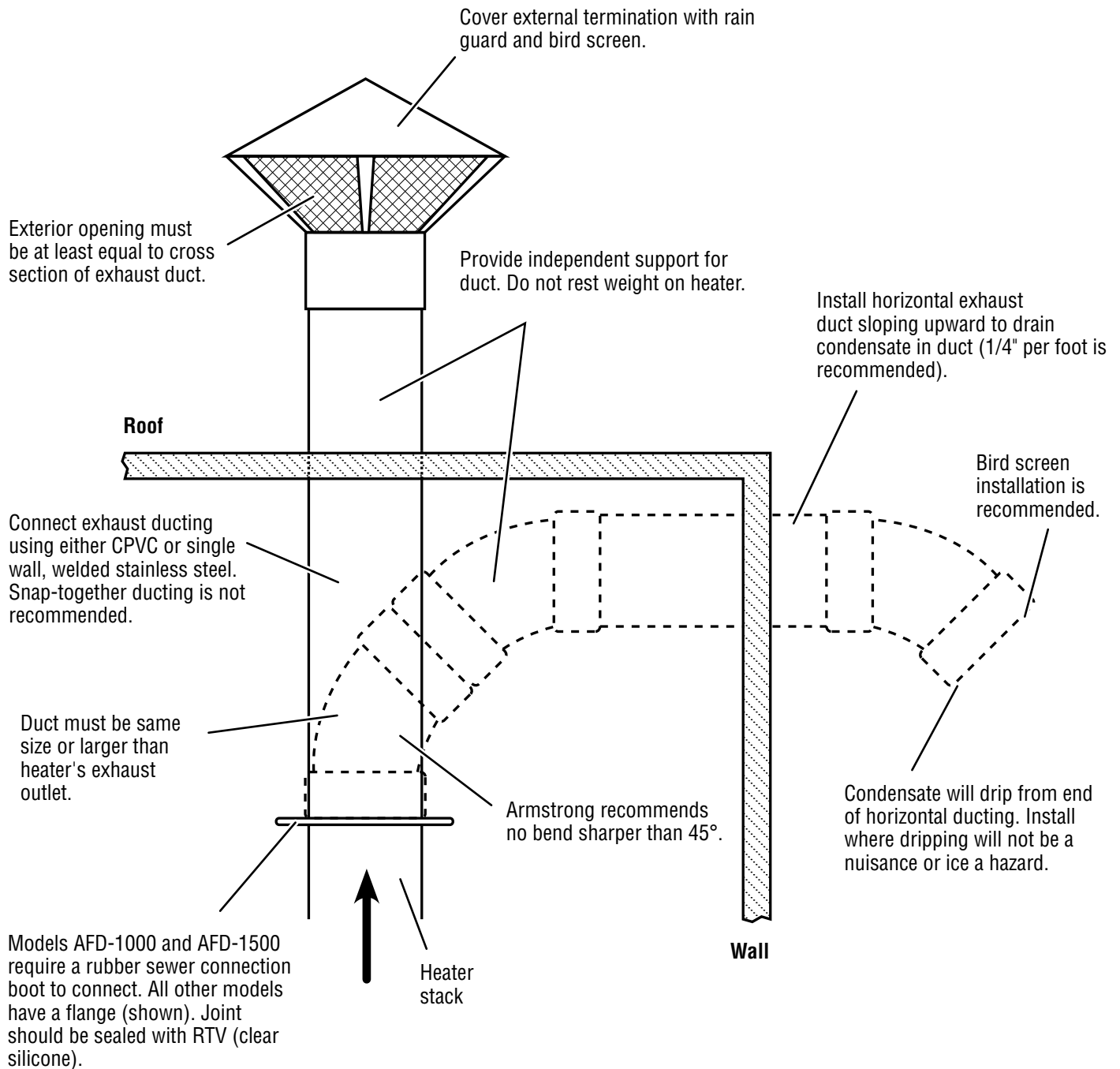




# Installing Exhaust Ducting

## Note:

- Roof installation preferred.
- Flo-Direct heater is not naturally drafting; exhaust is under slight pressure.
- Insulation is not required because exhaust temperature is only a few degrees above incoming water temperature.

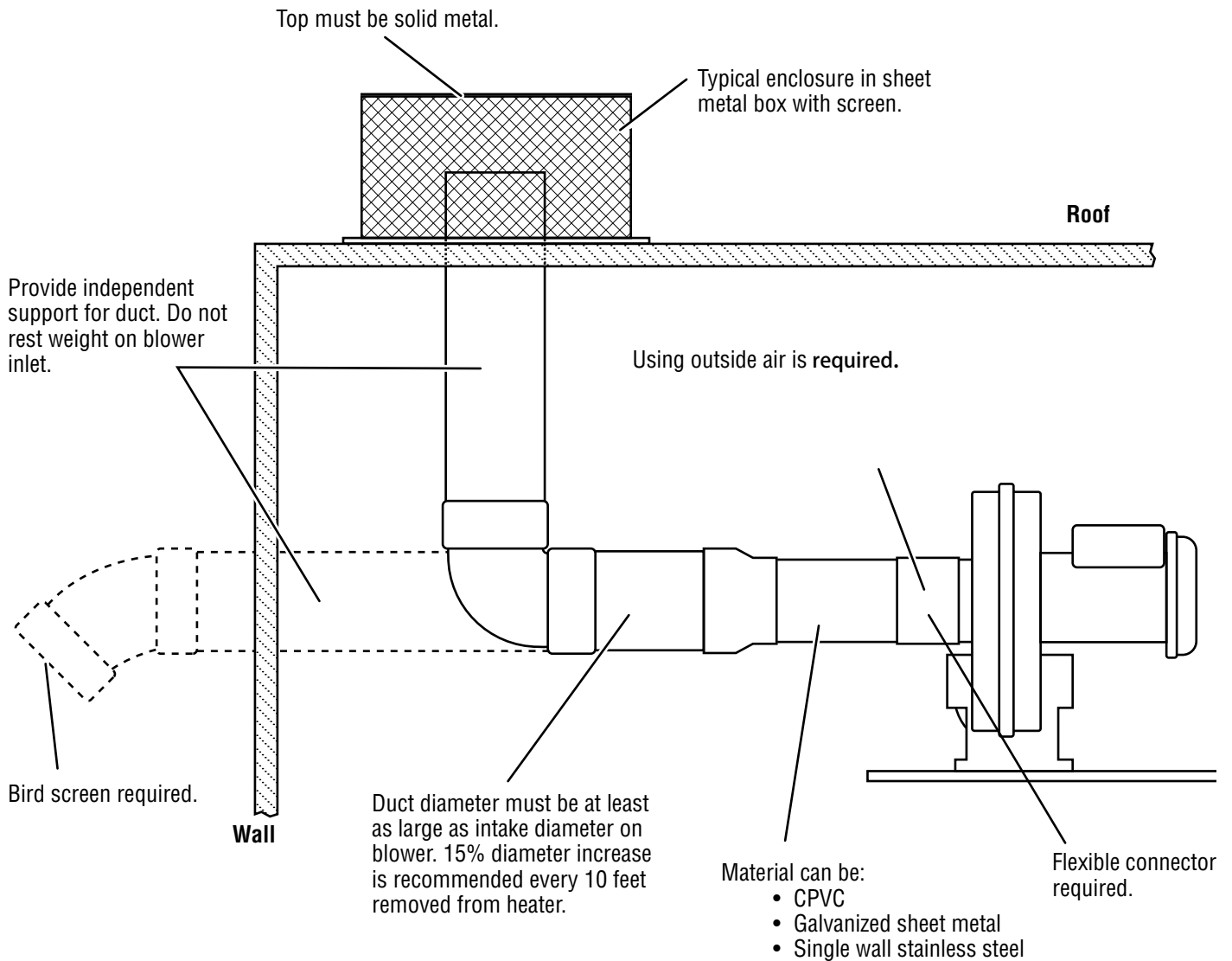


# Installing Intake Air Ducting

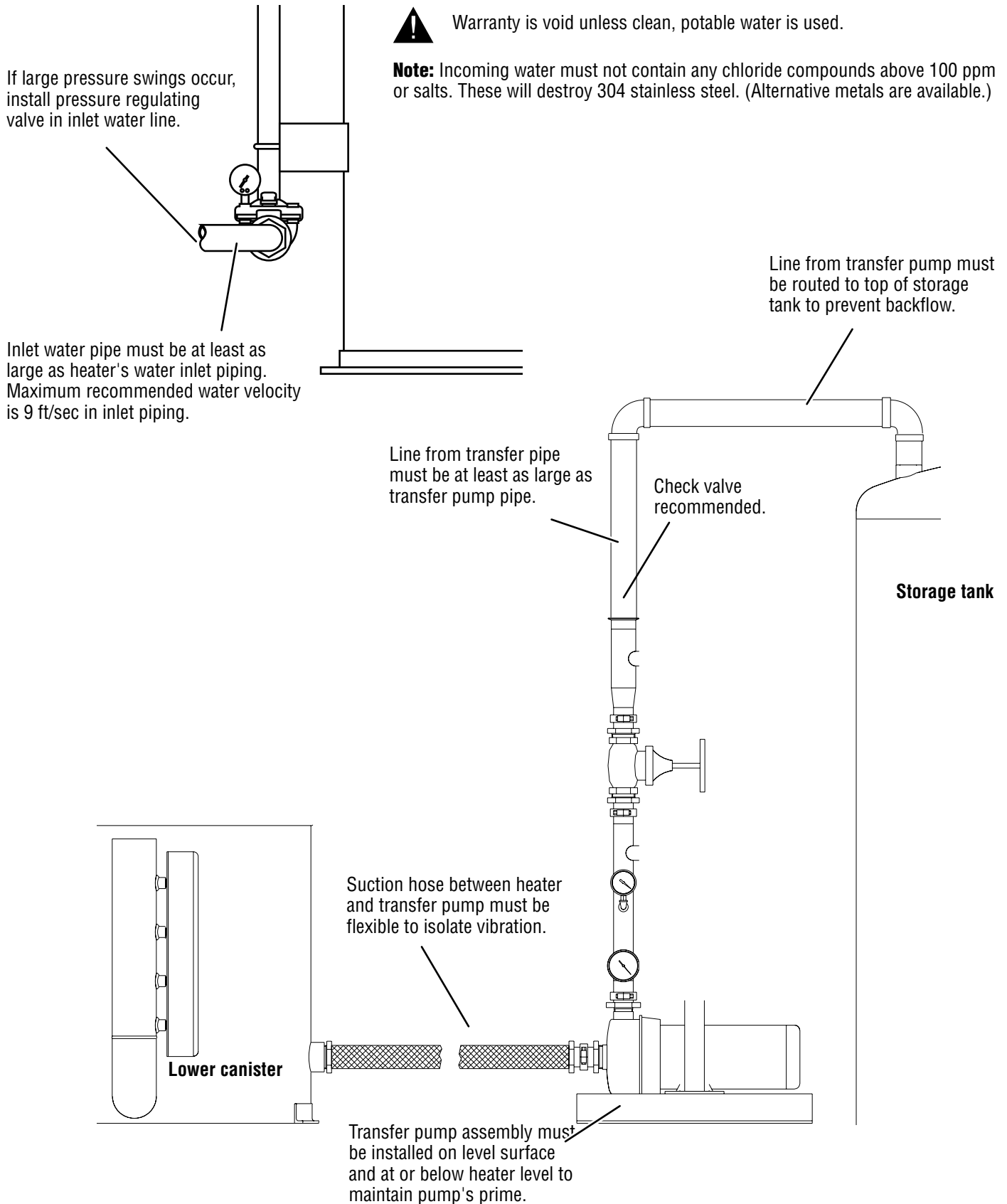
**Note:**

**Do not** use manifold connected to other appliances.

**Do not** run heater under negative air pressure.



# Water Connections



Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit [armstronginternational.com](http://armstronginternational.com) for up-to-date information.

## Fuel Connection

1. Connect union in line between top plate and upper canister.

**Note:** Local codes may require routing regulator vent outside.

2. Connect gas supply (applicable codes may govern connection type). Provide adequate support.

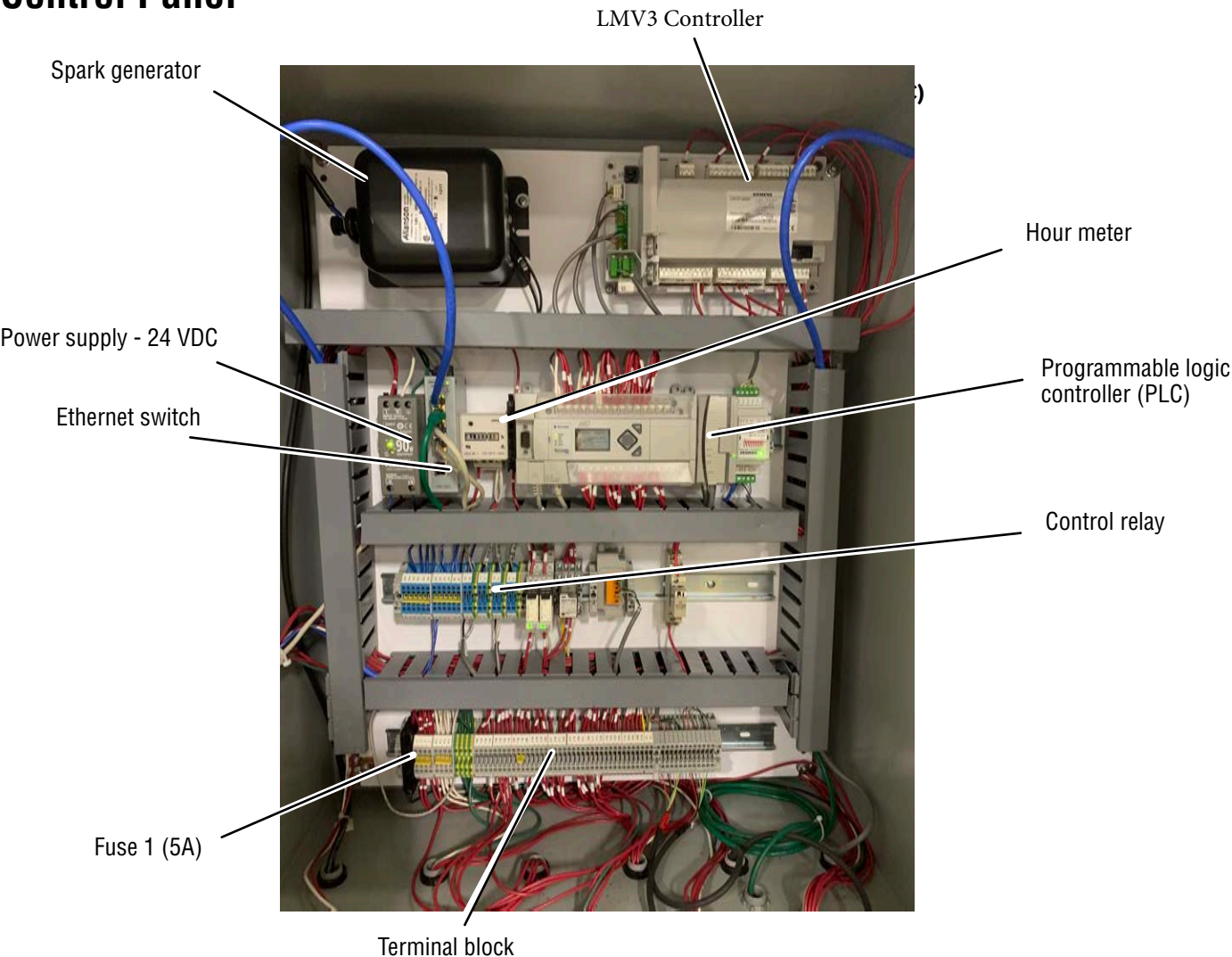


**Note:** If codes require pressure test of fuel line, close ball valve entering fuel train to heater. Failure to do so may damage fuel regulator.

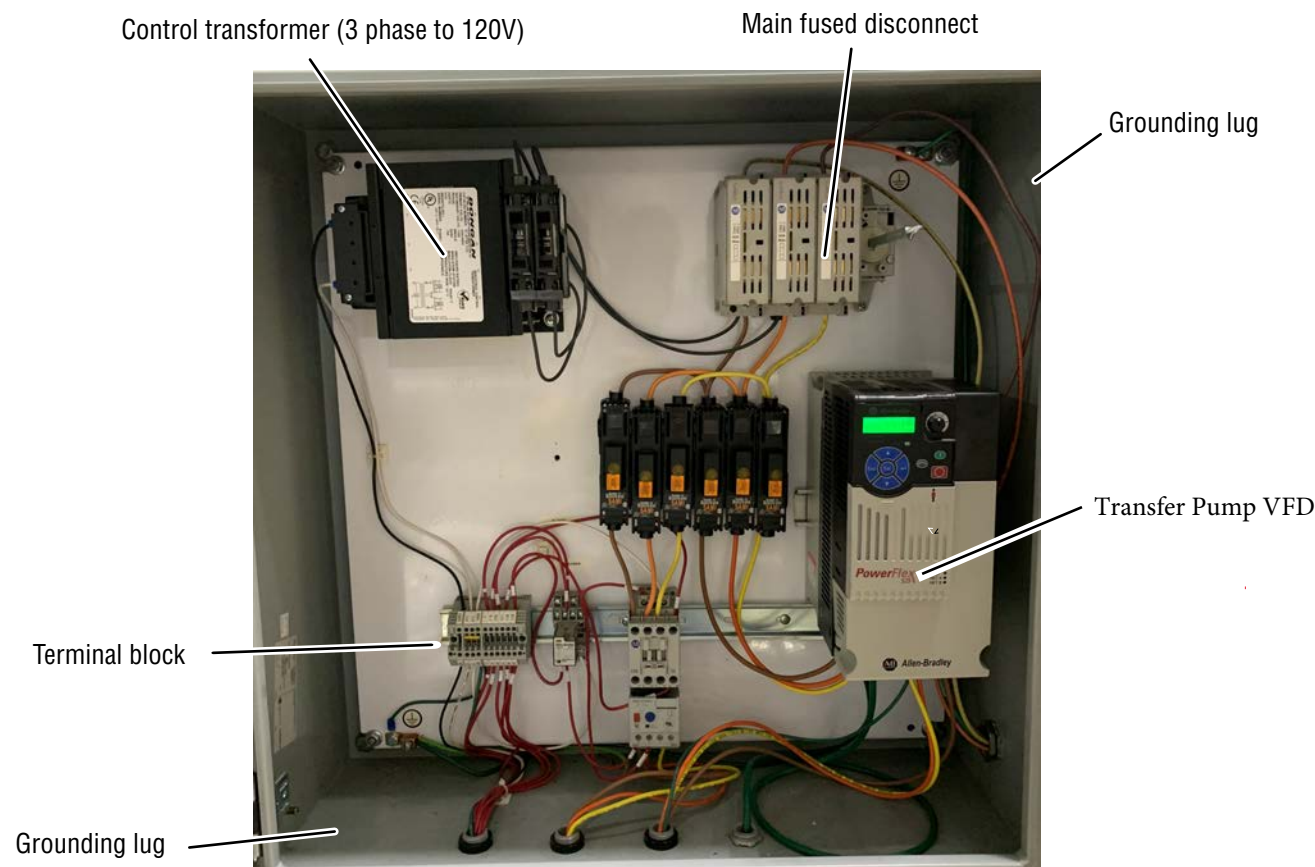
3. With ball valve entering fuel train closed, purge air from fuel line.

# Electrical Panels

## Control Panel



# Disconnect Panel



# Heater Label

**Note:** This is a sample label. All electrical work must conform to the specifications on this label as found on your heater.

| Armstrong Flo-Direct®    |             |
|--------------------------|-------------|
| MODEL                    | AFD-5000    |
| FUEL TYPE                | NATURAL GAS |
| MAX CAPACITY             | 5 MMBTU/HR  |
| LINE VOLTAGE             | 460/3/60    |
| CONTROL VOLTAGE          | 120/1/60    |
| MAX MOTOR HP             | 5 HP        |
| FULL LOAD CURRENT        | 20A         |
| MAIN FUSING              | 25A LP-J    |
| FEED PUMP FUSING         | 20A LP-J    |
| BLOWER FUSING            | 8A LP-J     |
| AUX. FUSING              | --N/A--     |
| CONTROL FUSING PRI       | 3A FNQ-R    |
| CONTROL VOLTAGE FUSE SEC | 5A AGC      |
| INTERRUPT CAPACITY       | 100KA/10KA* |
| AMPACITY                 | 40A/6A*     |
| WIRING SCHEM NUMBERS     | S33929W-1   |
| PART NUMBER              | S33929      |

\*CONTROL PANEL VALUE

# Electrical Connections

**Note:** Consult wiring schematic provided with your heater for exact details. Remove all cable ties, bubble wrap, and tape from wiring.

## Top Plate to Upper Canister

- 5** Reconnect threaded fitting to burner flame sensor port.



- 1** Route blower motor wiring through conduit and into disconnect panel.

- 2** In disconnect panel, connect wires to motor overload connection terminals below motor starter.

- 3** Route actuator wiring through conduit and into control panel.

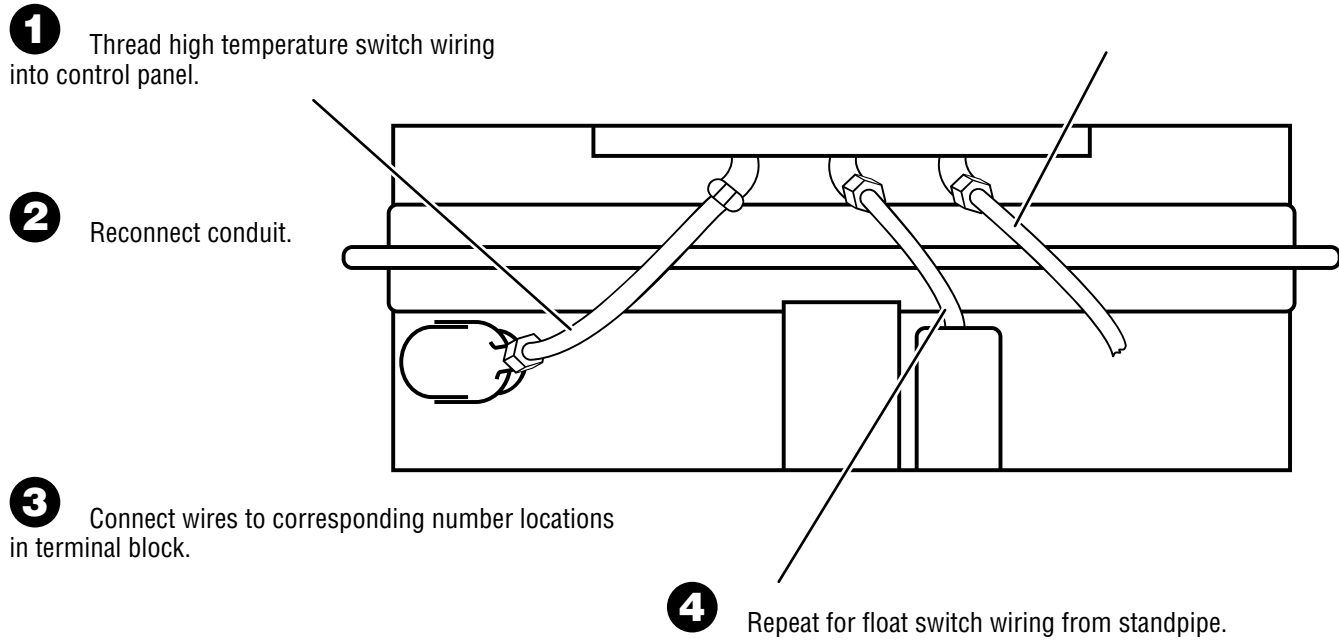
- 6** Reconnect water pressure switch wiring on top plate to water pressure switch on upper canister.



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## Upper to Lower Canister

**Note:** Depending on how canister sections were oriented during installation, wires and conduit for these connections may not be the correct length. Rewire if necessary.



## Transfer Pump

1. Thread wires into control box and reattach conduit.
2. Connect motor wires to overload terminal below motor starter with wire colors opposite same color on input side.
3. Connect numbered wires to corresponding terminals on terminal strip.

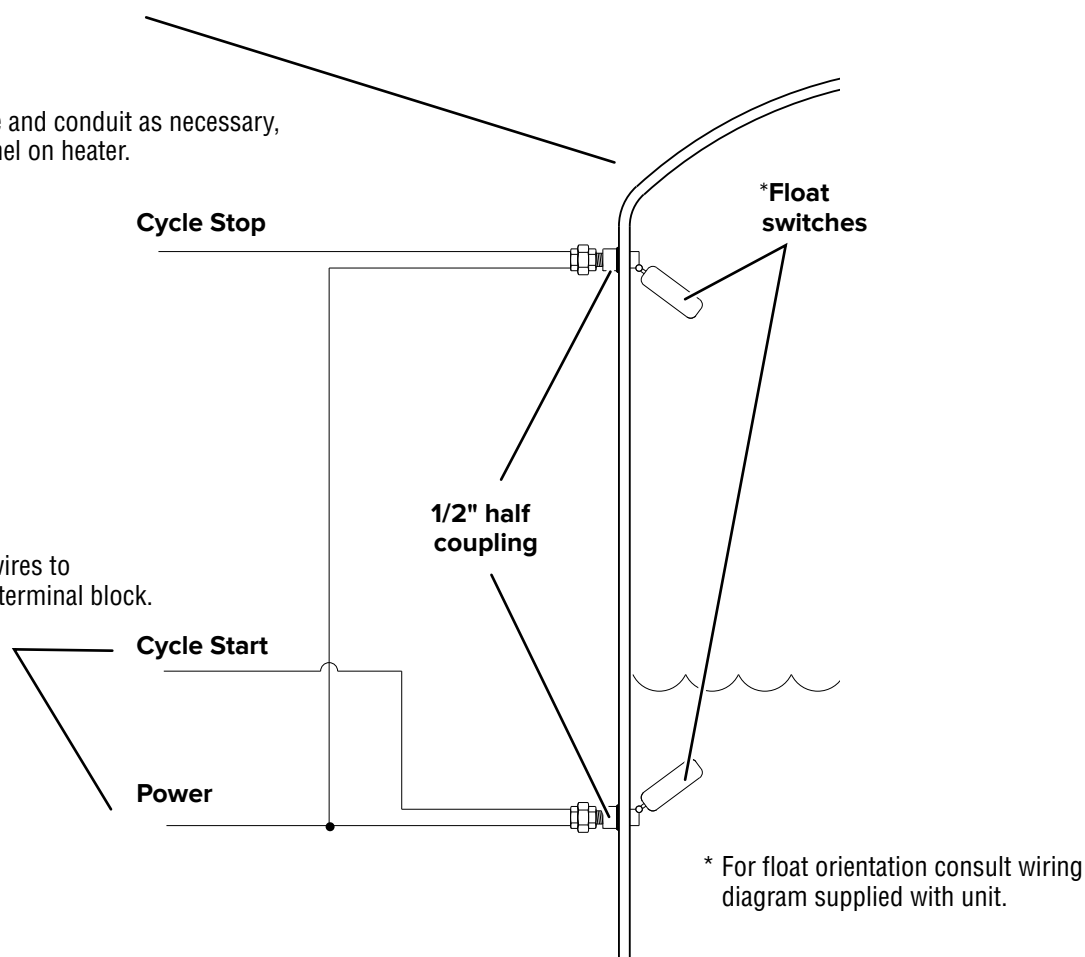


## Storage Tank

- 1 Install float switches from Armstrong in tank oriented as shown.

- 2 Using additional wire and conduit as necessary, thread wires into control panel on heater.

- 3 Connect numbered wires to corresponding terminals on terminal block.



## Main Power Connection

**Note:** If facility does not have surge and lightning protection, Armstrong recommends both for heater.

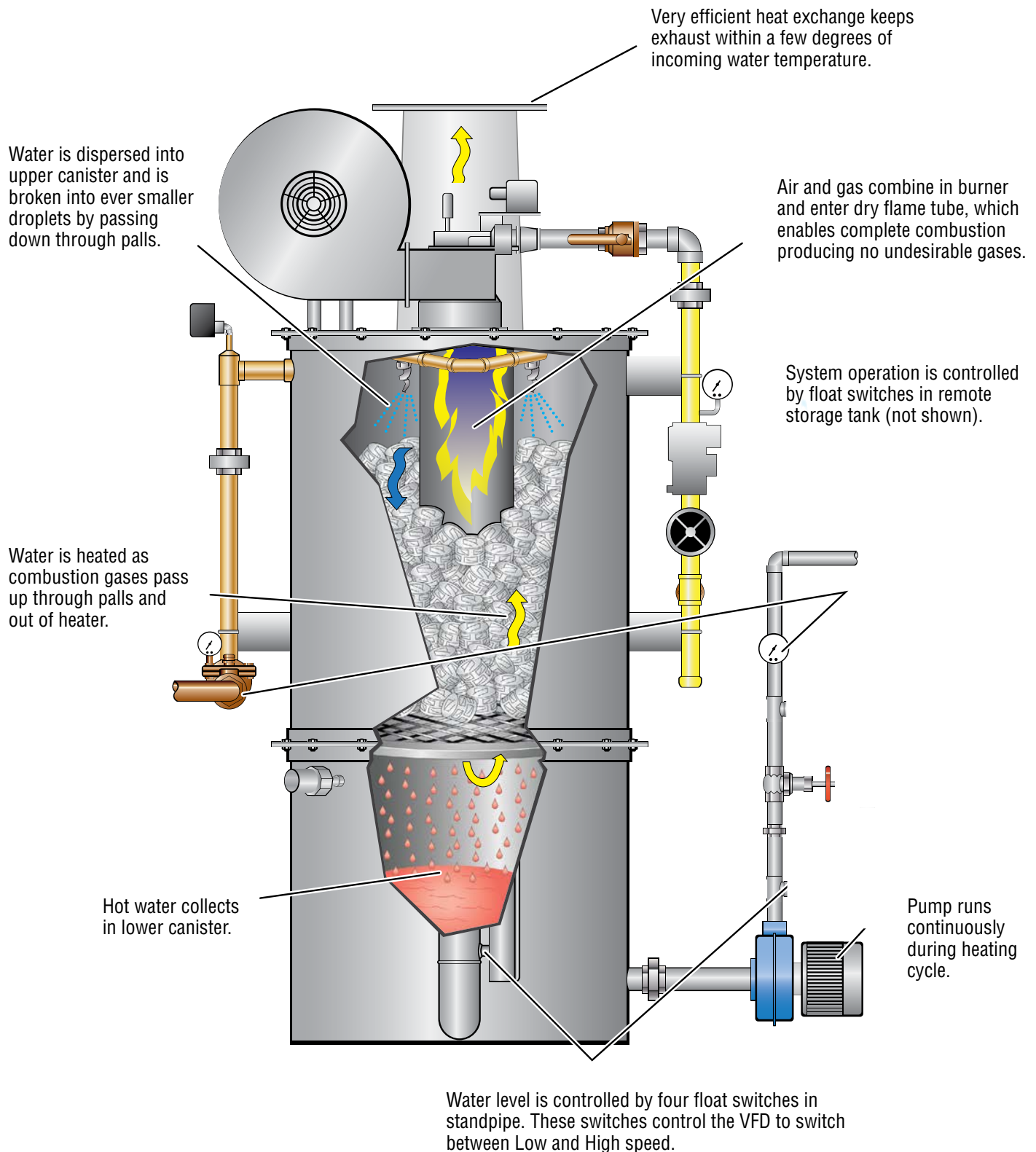
1. Connect supply voltage to top terminals of main fuse disconnect inside disconnect panel.
2. Manually test each starter ("bump the starter") to check for correct motor rotation, as indicated on motor housing.

**Note:** If rotation is incorrect, change any two phases on input side of applicable starter and recheck.

3. Connect supply ground to grounding lug at top right of disconnect panel.
4. Tighten all conduit connections.

# Operation

## Description of Operation



# Sequence of Operation

## Notes:

- The description in this section assumes that the AFD is in automatic mode and not in a Fault Condition.
  - The numbers in parenthesis refer to the operating phase of the LMV3 Flame Safety.
1. The AFD is in Standby (Phase 12). When the PLC receives the Auto Start Input, it will then send a run command to the LMV3 and the start-up sequence will begin.
  2. The blower will start (Phase 22). Then the actuators will drive to their programed Pre-purge Position (Phase 24).
    - The Air flow switch must be made at the end of this Phase.
  3. Once the actuators reach their Pre-purge Position, a 30 second Pre-purge will begin (Phase 30).
  4. After the Pre-purge, the actuators will drive to their programed Ignition Position (Phase 36).
  5. Once the actuators reach their Ignition Position, the Spark rod will ignite (Phase 38).
  6. After the Spark rod is ignited for 2 seconds, the Inlet Water Valve and Main Fuel Valve will open (Phase 40).
  7. The Spark overlaps the Main Fuel for 5 seconds and then the Spark rod will de-energize (Phase 42).
    - A Flame Signal must be detected by the end of this Phase.
    - The HMI displays the Flame Signal ranging from 0-100%. A Flame Failure occurs when the Flame Signal drops below 24% at any time between Phases 42 and 60.
  8. After the Flame Signal stabilizes for 2 Seconds (Phase 44), the Normal Operation will begin (Phase 60). The Burner will begin to Modulate to maintain your desired set temp.
  9. The Pump will start when the water in the lower canister reaches the second float switch.
  10. During operation when correctly set, the transfer pump should switch between LOW and HIGH SPEED keeping the level in the lower canister between the second and third float switch.
  11. Once the PLC receives the Auto Stop input, it will remove the run command from the LMV3 and start the shutdown sequence.
  12. The Main Fuel Valve and Inlet Water Valve will close. An 8 second Afterburn will begin (Phase 70).
    - \*Afterburn:** Permissible time for a flame to be detected after the main fuel valve is closed without causing an alarm.
  13. Upon completion of the Afterburn, the actuators will drive to their programed Post-purge Position (Phase 72).
  14. Once the actuators reach their Post-purge Position, a 15 second Post-purge will begin (Phase 74).
  15. After the Post-purge, the blower will turn off and the actuators will reference to their Home Position (Phase 10).
  16. Once the actuators complete their reference, the AFD will now be in Standby (Phase 12).

# Pre-Start-Up Checklist

**Note:** This section to be performed by installer. Consult other information, such as schematics, as necessary.

- ☐ Heater in permanent location on level surface sufficient for load and anchored
- ☐ Heater assembled
- ☐ Transfer pump (if used) in place with flexible water pipe connected
- ☐ Wiring reconnected
  - Water pressure switch
  - Blower motor
  - UV scanner
  - Spark rod
  - Burner modulation, if used
  - Lower canister float switches
  - High temperature switch
  - Transfer pump
  - Remote storage tank switches or field-supplied relay coil in control panel
- ☐ Fuel line connected
  - Adequately sized
  - Adequately supported
  - Pressure checked if required
  - Purged
- ☐ Water piping connected
  - Sufficient inlet flow and pressure
  - Adequately supported
  - PRV if large pressure swings
- ☐ Exhaust piping connected
  - CPVC welded or stainless steel
  - No unsealed joints
  - No bends sharper than 45°
  - Properly sized (no back pressure)
  - Adequately supported
  - Properly terminated
- ☐ Intake air piping connected or filters installed if necessary
  - CPVC, stainless steel, or galvanized
  - Adequately sized
  - Adequately supported
  - Proper termination
- ☐ Storage tank
  - Properly piped
  - Float switches installed correctly
  - Float switches correctly wired to heater
- ☐ Main power supply properly connected
  - Three phase
  - Voltage as specified on nameplate and connections

# Commissioning

## Inspecting Installation

1. Confirm all checks in start-up checklist above.
2. Check all field connections in control panels.
3. Identify any additional wiring in panels.
4. Confirm rotation of blower and pump motors.
5. Confirm what fuel is supplied and note label on fuel train.

## Inspecting Water System

1. Run cold water first to prevent damage in lower canister.
2. Press "MANUAL START".
3. Set water inlet pressure to about 20 psi.
4. Visually confirm proper flow.
5. Check for leaks.
6. Confirm adequate pressure.
7. Confirm pump operation.
8. Close water valve.
9. Set main water valve to normal operation.

# Commissioning

1. Turn on fuel.

- Check for leaks in piping
- Verify that gas pressure is between 2 and 6 psi

**Note:** Start-up process requires running heater in "Manual" mode, which overrides all automation and produces hot water continuously until heater is manually turned off.



Never leave heater unattended in "MANUAL" mode.

2. Press "MANUAL START."

**Note:** During initial start-up, low gas pressure fault light may come on. Once pressure is established, reset pressure switch several attempts to start may be required until fuel enters burner.

3. Verify the Burner Status on the HMI is in Normal Operation.

4. Set your desired Set-point on the HMI.

5. Check temperature on gauge above transfer pump. Adjust incoming water pressure to obtain target output temperature if necessary.

6. Adjust Low and High Speed on Transfer Pump Screen so the VFD cycles between the two speeds. **Level should fluctuate slowly between second and third float switches without seeing a tank full fault or pump turning off.**

7. Check exhaust piping for leaks.

8. Insert combustion analyzer in port in exhaust stack and tune heater.

- Oxygen reading must be 3.5–6%

**Note:** Low efficiency may be due to back pressure in exhaust piping if opening at cap is too small.

9. Adjust for minimum carbon monoxide (CO)

10. Record regulator pressure on fuel train label.

11. Confirm operation of all safety features:

- Low gas pressure switch
- High gas pressure switch
- Proof of closure switch
- Low water pressure
- High temperature
- Flame failure (UV scanner)

12. Perform at least ten start cycles in "MANUAL" mode, allowing heater to reach high fire condition each time, to ensure reliable starting and operation.


13. Run heater in "AUTOMATIC" mode to confirm proper operation in that mode.

14. Allow heater to sit and cool for several hours, then check for cold start.

# Periodic Maintenance

## Maintenance Schedule

**Note:** Periodic maintenance for blower and burner is not shown below. See those IOMs for required maintenance. The Flo-Direct heater is designed to require very little maintenance. The list below is recommended, but only safety items (\*) are required.

| Frequency  | Task   |
|--|--|
| Daily  | Check <b>outlet</b> temperature.   |
| Weekly   | Check air filters if present. Clean or replace as necessary (see manufacturer's information).  |
|  | Check for water leaks.   |
| Monthly  | Check fuel train for leaks.  |
|  | Remove and wipe off quartz lens below flame sensor.  |
|  | *Check water pressure switch: <ul style="list-style-type: none"> <li>• Turn off water supply while heater is in operation</li> <li>• Confirm that heater shuts down within 10 seconds and "water pressure fault" light comes on</li> </ul>   |
|  | *Check low gas pressure switch: <ul style="list-style-type: none"> <li>• Turn off the fuel supply while heater is in operation</li> <li>• Confirm that heater shuts down and "LOW GAS PRESSURE" fault light comes on</li> </ul>  |
|  | *Check high temperature switch (see instructions below).   |
|  | Inspect burner's air damper linkage (use a borescope through burner's window).   |
|  | Check spark rod connection and wire.   |
|  | *Check the Siemens controller:<br>With heater running, close ball valve in fuel train just upstream of burner. <ul style="list-style-type: none"> <li>• Burner should go out</li> <li>• The Siemens controller should Fault</li> <li>• This should shut down the AFD.</li> </ul>   |
|  |  If results are not as described, a hazard condition exists. Shut down heater and contact Armstrong.  |
| Annually   | Check all electrical connections.  |
|  | Check all nuts and bolts.  |
|  | Check float switches for proper operation.   |
|  | Check all fuel train connections and fittings.   |
|  | Check all water train connections and fittings.  |
| As Needed<br>(Typically done not less than when warmer is cleaned) | If in a bottling warming application - Perform a Unit Clean In Place (CIP) <ul style="list-style-type: none"> <li>• Dump all bad/dirty water (including in the AFD basin)</li> <li>• Heat up and run Clean in Place <ul style="list-style-type: none"> <li>–Up to facility on chemical additives and duration</li> </ul> </li> <li>• Dump all water again (including in the AFD basin)</li> <li>• Fill with fresh clean water</li> <li>• Run unit</li> </ul> |

# High Temperature Switch Check

- 1** With heater on but not running, unscrew cover on switch (shown removed below).

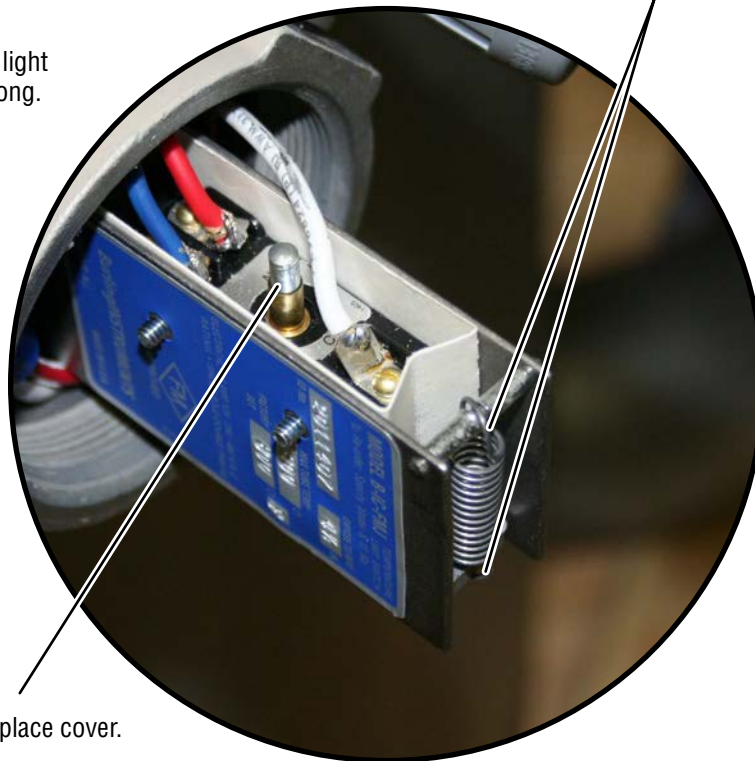


**Caution: Wiring is live! Avoid touching connections!**

**2**

Compress spring to trip switch.

- 3** Confirm that heater shuts down and high temperature fault light comes on. If not, contact Armstrong.



- 4** Press reset button and replace cover.



**Caution: Wiring is live! Avoid touching connections!**




# Troubleshooting

## Troubleshooting Table



**Caution:** Turn off power to heater prior to beginning. During troubleshooting, turn it on only when and only for as long as required for specific steps below.

| Problem   | Probable Cause   | Correction   |
|---|--|--|
| Flame Safety Fault  |  |  |
|   | Flame safety has faulted                                       | Reference fault code to Siemens LMV3 manual<br><a href="#">LMV3 manual download link</a> |
|   |  |  |
|   |  |  |
| Low Gas Pressure  | Transitory alarm or to confirm fault                           | Press red reset button on low gas pressure switch on fuel train.                         |
|   | Upstream fuel valve closed                                     | Open all upstream valves.  |
|   | Defective pressure regulator spring                            | Replace spring.  |
|   | Defective pressure regulator                                   | Replace regulator.   |
| High Gas Pressure   | Transitory alarm or to confirm fault                           | Press red reset button on high gas pressure switch on fuel train.                        |
|   | Regulator pressure set too high                                | Turn regulator adjustment screw CCW to reduce pressure.                                  |
|   | Defective pressure regulator spring                            | Replace spring.  |
|   | Defective pressure regulator                                   | Replace regulator.   |
| High Temperature Fault<br> <b>Contact Armstrong!</b><br>Do not operate heater! | Water pressure switch failed and "dry fire" start-up attempted | Check water pressure. If correct, replace pressure switch. If not, continue.             |
|   | Nozzles clogged  | Remove top plate and clean nozzles.  |
| Tank Full Fault:<br>Pump not keeping up with water production   | Transfer pump inoperable                                       | Check and repair or replace.   |
|   | Downstream valves closed or restricted                         | Confirm that all downstream valves are fully open. Press "FAULT RESET" on HMI.           |

| Problem              | Probable Cause                    | Correction   |
|----------------------|-----------------------------------|--|
| Water Pressure Fault | Flow control valve restricted     | Open flow control valve.   |
|                      | Shut-off valve defective          | Repair or replace valve.   |
|                      | Restriction in inlet line         | Check filters and piping for obstructions.   |
|                      | Low system pressure               | Correct system pressure.<br>Press "FAULT RESET" on HMI.  |
| VFD Fault            | VFD for Transfer pump has Faulted | Reference Fault Code to Allen Bradley Power Flex 520 Series Manual<br><a href="#">Power Flex 520 download link</a> |

## PLC I/Os

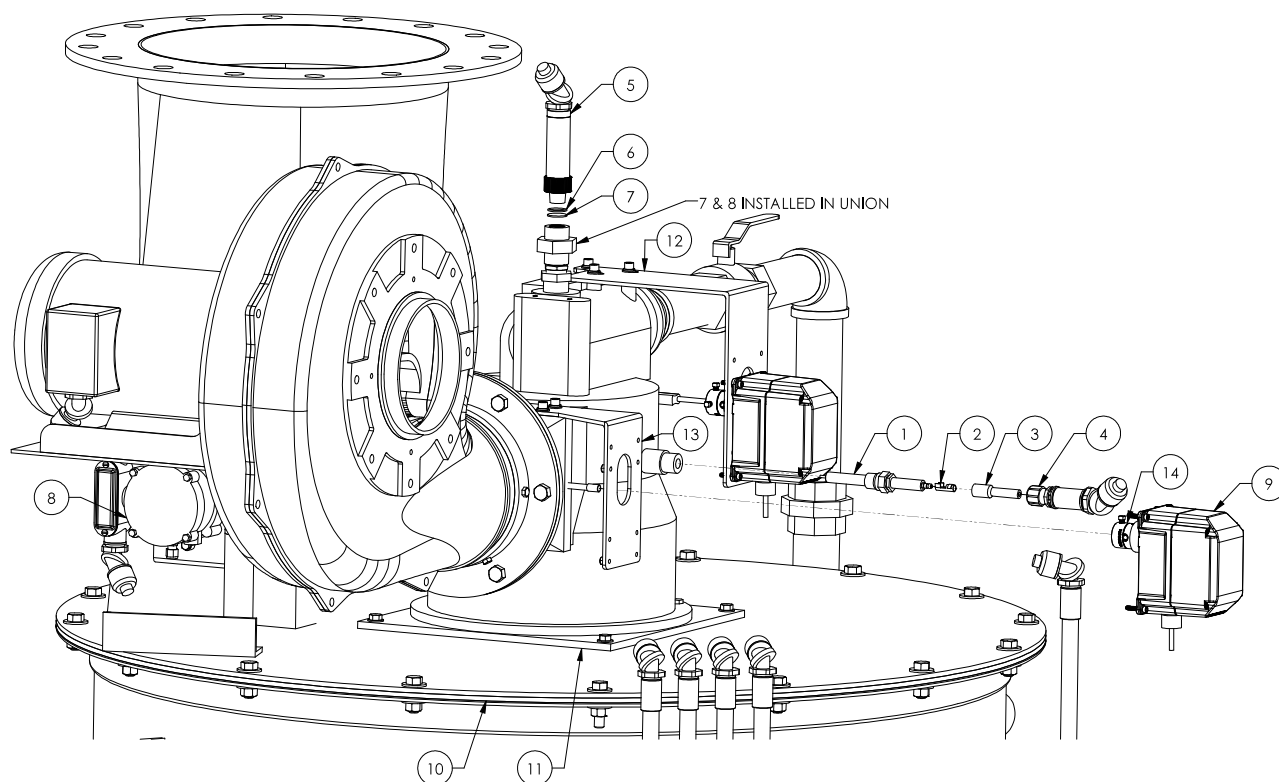
The following PLC inputs and outputs are shown to facilitate more advanced troubleshooting.

| INPUTS                 |       | OUTPUTS               |       |
|------------------------|-------|-----------------------|-------|
| AUTO START INPUT       | IN 0  | RUN PERMISSIVE        | OUT 0 |
| AUTO STOP INPUT (NC)   | IN 1  | INLET WATER ON        | OUT 1 |
| PILOT FUEL ON          | IN 2  | FLAME SAFETY RESET    | OUT 2 |
| WATER PRESSURE SW      | IN 3  | P.O.C. FAULT          | OUT 3 |
| BOTTOM FLOAT SW        | IN 4  | GENERAL FAULT         | OUT 4 |
| SECOND FLOAT SW        | IN 5  |                       |       |
| THIRD FLOAT SW         | IN 6  |                       |       |
| TOP FLOAT SW (NC)      | IN 7  |                       |       |
| MAIN FUEL ON           | IN 8  | <b>DRIVE COMMANDS</b> |       |
| SPARK ON               | IN 9  | PUMP STOP             | CMD 1 |
| BURNER HIGH FIRE       | IN 10 | PUMP START            | CMD 2 |
| BLOWER ON              | IN 11 | PUMP SPEED: LOW       | CMD 3 |
| FLAME SAFETY FAULT     | IN 12 | PUMP SPEED: HIGH      | CMD 4 |
| LOW GAS PRESSURE SW    | IN 13 |                       |       |
| HIGH GAS PRESSURE SW   | IN 14 |                       |       |
| HIGH TEMPERATURE SW    | IN 15 |                       |       |
| E-STOP CLOSED (NC)     | IN 16 |                       |       |
| RUN INTERLOCKS CLOSED  | IN 17 |                       |       |
| AIR FLOW               | IN 18 |                       |       |
| FUEL VALVE P.O.C. (NC) | IN 19 |                       |       |

# Parts Lists

## Top Plate

**Note:** Some wiring in this drawing has been removed for clarity.



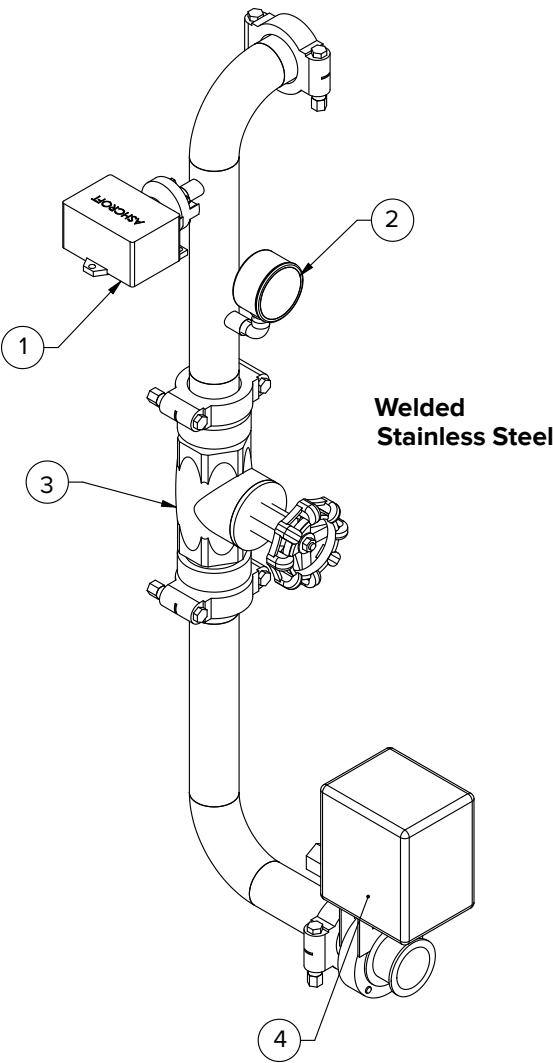
| Ref No. | Description  | Part No. |
|---------|--|----------|
| —       | Spark Plug Wire, 7 mm, SCS7-100  | D17513   |
| 1       | Spark Rod, #47232  | D19194   |
| 2, 3    | AFD Spark Plug Wire Kit. Includes Pug End Connector, Spark Plug Boot, 15' Spark Plug Wire and Terminal Ring. | D89821   |
| 4       | Cord grip, ½", Appleton CG1850   | D29166   |
| 5       | Siemens, UV scanner  | D115431  |
| 6       | O-Ring, Viton, 7/8" x 1"   | D17086   |
| 7       | Quartz lens, 1" Dia x 1/16"  | D17085   |
| 8       | Air Pressure Switch, 1950-5-2F   | D16919   |
| 9       | Actuator   | D115429  |

For burner parts, contact MAXON Corp., 765-284-3304  
(fax: 765-286-8394)

For blower assembly parts, contact Cincinnati Corp.,  
513-573-0600 (fax: 513-573-0640)

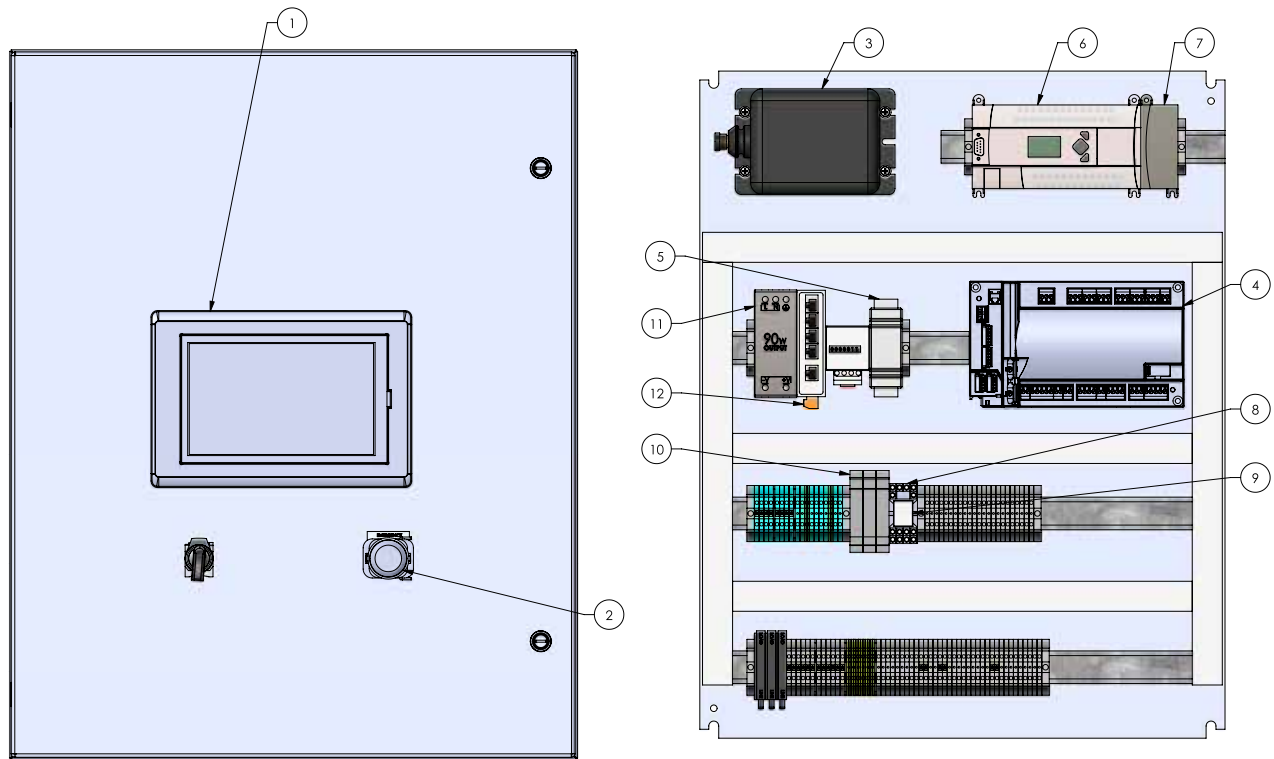
| Ref No.                            | Description          | Part No. |
|------------------------------------|----------------------|----------|
| <b>Flange Gasket – WARCO White</b> |                      |          |
| 10                                 | AFD-1000             | D7564    |
|                                    | AFD-1500             | D7565    |
|                                    | AFD-2000             | D7566    |
|                                    | AFD-3000             | D7567    |
|                                    | AFD-4000             | D7568    |
|                                    | AFD-5000             | D7569    |
|                                    | AFD-6000             | D7570    |
|                                    | AFD-7000             | D7571    |
|                                    | AFD-9000 to 12000    | D7576    |
| <b>Flame Shield</b>                |                      |          |
| 11                                 | AFD-2000             | D27183   |
|                                    | AFD-3000 & 4000      | D27184   |
| 12                                 | Bracket Fuel         | D118183  |
| 13                                 | Bracket Air          | D118184  |
| 14                                 | Burner Shaft Adapter | D115432  |

# Water Train



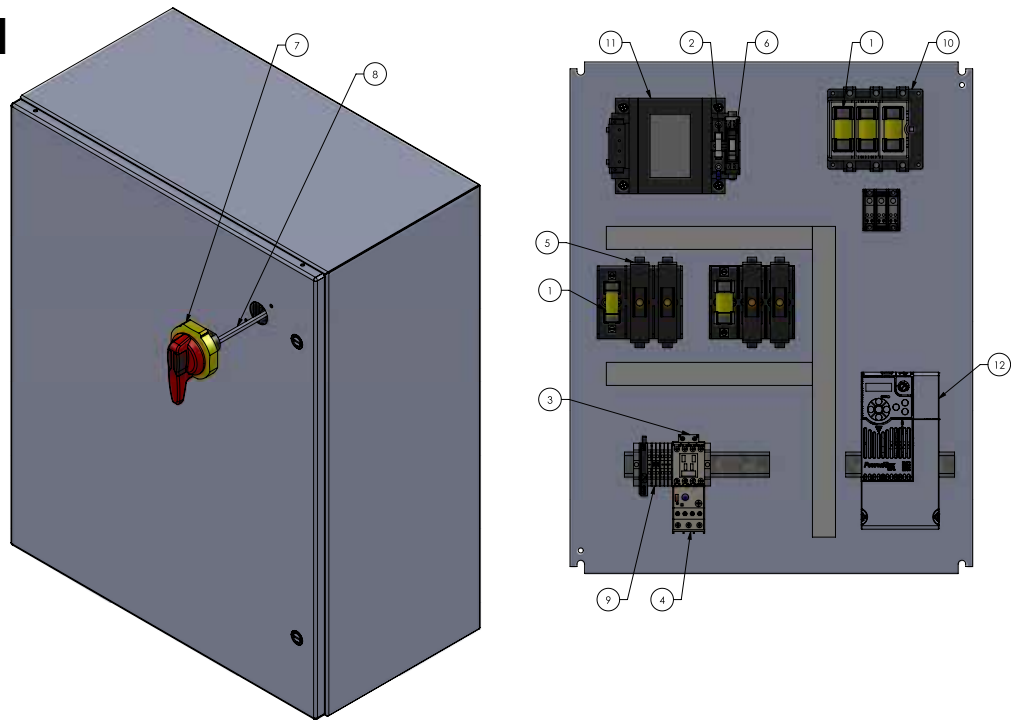
| Ref No.                      | Description               | Part No. |
|------------------------------|---------------------------|----------|
| 1                            | Water Pressure Switch     | D16905   |
| 2                            | Pressure Gauge; 0-110 psi | D11554   |
| Globe Valve, Stainless Steel |                           |          |
| 3                            | 1"                        | D14596   |
|                              | 1-1/2"                    | D14597   |
|                              | 2"                        | D14598   |
|                              | 2-1/2" (flanged)          | D14599   |
|                              | 3" (flanged)              | D14600   |
|                              | 4" (flanged)              | D14601   |
| Actuated Valve Assembly      |                           |          |
| 4                            | 1-1/2"                    | D53299   |
|                              | 2"                        | D30041   |
|                              | 2-1/2"                    | D76536   |
|                              | 3"                        | D76537   |
|                              | 4"                        | D76750   |
|                              | VB030 Electric Actuator   | D76170   |
|                              | VB060 Electric Actuator   | D70728   |

# Control Panel



| Ref No. | Description                      | Part No. |
|---------|----------------------------------|----------|
| 1       | HMI Panelview Plus 7 9 Inch      | D106961  |
| 2       | Emergency Stop Button            | D106011  |
| 3       | Ignition Transformer             | D19185   |
| 4       | Siemens LMV3                     | D115428  |
| 5       | Modbus Module                    | D115434  |
| 6       | PLC Micrologix 1400              | D60067   |
| 7       | PLC Analog Module 2 IN 2 OUT     | D90858   |
| 8       | Relay Base 14 Blade              | D16886   |
| 9       | Relay 4PDT 120VAC Coil           | D16903   |
|         | Relay 4PDT 24VDC Coil            | D56376   |
| 10      | Relay Slim 2PDT 120VAC Coil      | D30776   |
| 11      | Power Supply 24VDC 90W           | D34094   |
| 12      | Ethernet Switch Unmanaged 5 Port | D60074   |

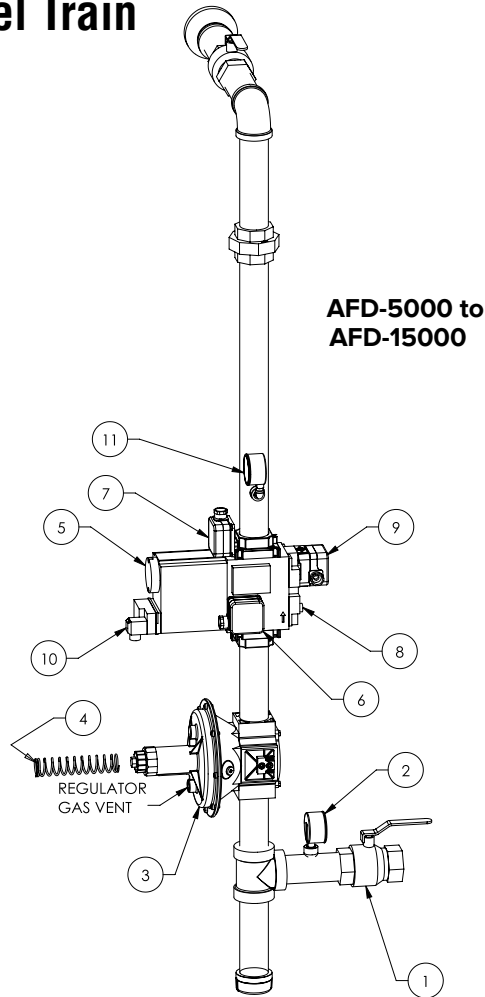
# Disconnect Panel



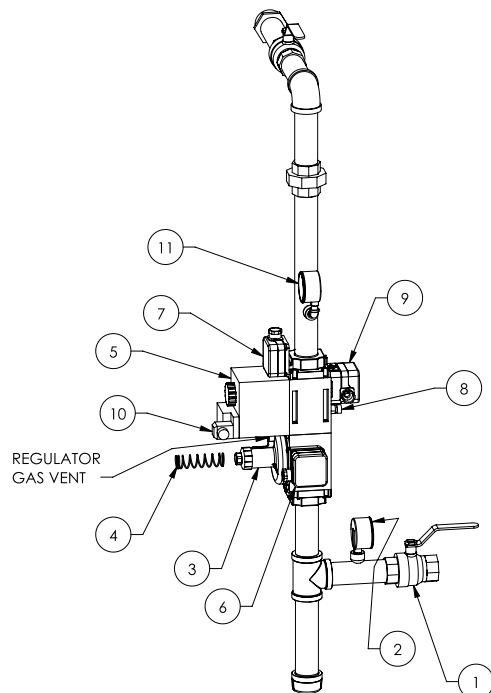
| Ref No.                 | Description | Part No. |
|-------------------------|-------------|----------|
| Fuse, Low Peak, Class J |             |          |
| 1                       | 3A          | D19610   |
|                         | 5A          | D17885   |
|                         | 7A          | D19611   |
|                         | 10A         | D19612   |
|                         | 12A         | D19613   |
|                         | 15A         | D19614   |
|                         | 17 1/2A     | D19615   |
|                         | 20A         | D19616   |
|                         | 25A         | D19617   |
|                         | 30A         | D19618   |
|                         | 35A         | D19619   |
|                         | 40A         | D19620   |
|                         | 50A         | D19621   |
|                         | 60A         | D19622   |
|                         | 70A         | D19623   |
|                         | 80A         | D19624   |
|                         | 100A        | D19625   |
| Fuse, Class CC, FNQ-R   |             |          |
| 2                       | 6A          | D21849   |
|                         | 8A          | D19763   |
|                         | 15A         | D18692   |
| Motor Starter           |             |          |
| 3                       | 5 HP        | D7655    |
|                         | 7 1/2 HP    | D7656    |
|                         | 10 HP       | D7657    |
|                         | 15 HP       | D7658    |
|                         | 20 HP       | D7659    |
|                         | 25 HP       | D7660    |
|                         | 30 HP       | D7661    |

| Ref No.                     | Description                     | Part No. |
|-----------------------------|---------------------------------|----------|
| Motor Overload              |                                 |          |
| 4                           | 1.6–5A                          | D17910   |
|                             | 3.2–16A                         | D7663    |
|                             | 5.4–27A                         | D7664    |
|                             | 9–45A                           | D7665    |
| Fuse Cover, Bus, Indicating |                                 |          |
| 5                           | 30A                             | D19762   |
|                             | 60A                             | D22629   |
|                             | 100A                            | D21900   |
| 6                           | Fuse Cover, Bus, Non-Indicating | D17413   |
| Disconnect Handle           |                                 |          |
| 7                           | 30A & 60A                       | D15638   |
|                             | 100A                            | D21901   |
| Connecting Rod, Disconnect  |                                 |          |
| 8                           | 30A & 60A                       | D17218   |
|                             | 100A                            | D21902   |
| 9                           | Circuit Block, IEC, Single Feed | D10789   |
| Fused Disconnect            |                                 |          |
| 10                          | 30A                             | D17179   |
|                             | 60A                             | D19671   |
|                             | 100A                            | D21903   |
| Control Voltage Transformer |                                 |          |
| 11                          | 750VA 480 x 240 – 120           | D17409   |
|                             | 750VA 575/380 – 115             | D13662   |
| 12                          | Inverter                        | D111381  |

# Fuel Train



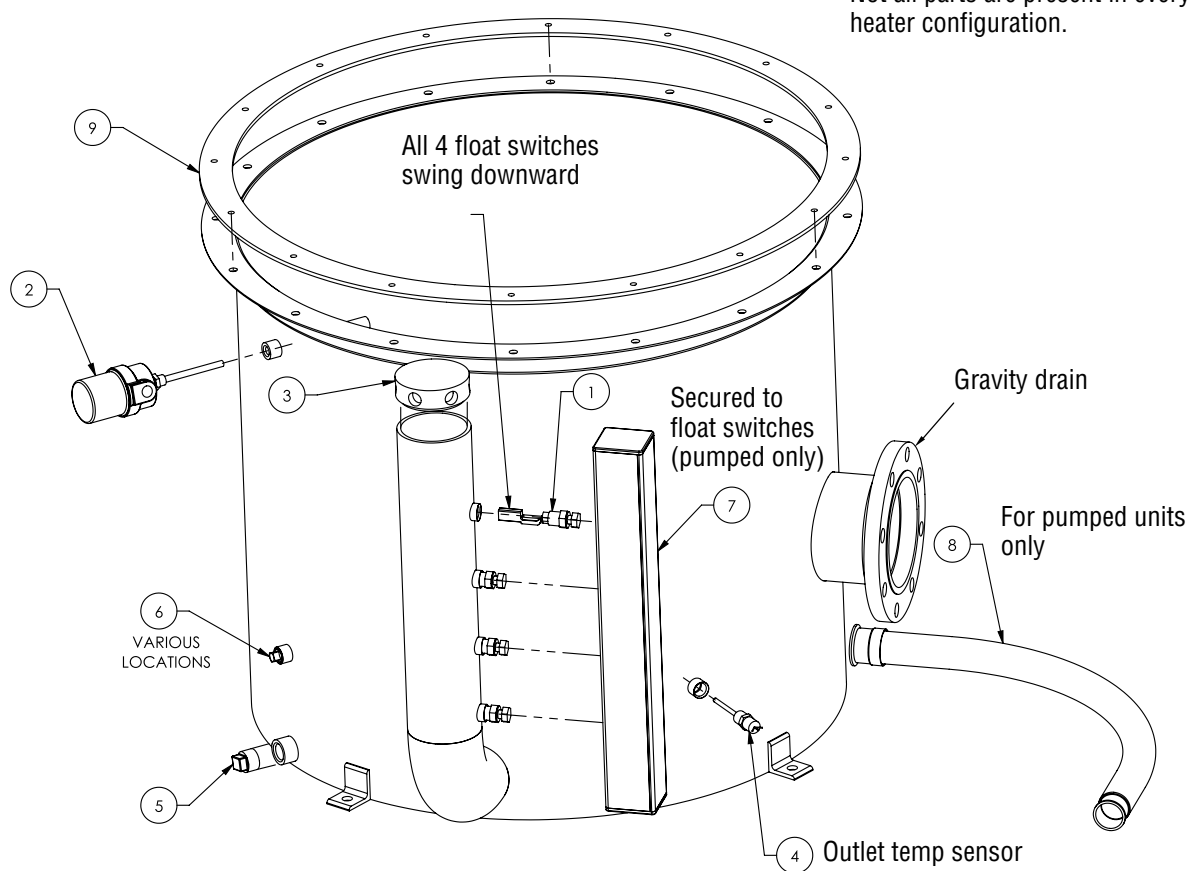
| Ref No.                             | Description                                       | Part No. |
|-------------------------------------|---|----------|
| <b>Gas Rated Ball Valve</b>         |   |          |
| 1                                   | AFD-1000 and AFD-1500 (1" NPT)                    | D15432   |
|                                     | AFD-2000 and AFD-3000 (1-1/2" NPT)                | D15433   |
|                                     | AFD-4000 to AFD-10000 (2" NPT)                    | D15434   |
| 2                                   | Pressure Gauge, 0–15 psi                          | D14800   |
| <b>Gas Pressure Regulator</b>       |   |          |
| 3                                   | AFD-1000 to AFD-4000 (FRI 710/6)                  | D14806   |
|                                     | AFD-5000 to AFD-10000 (FRS 720/6)                 | D14807   |
| <b>Gas Regulator Spring</b>         |   |          |
| 4                                   | AFD-1000 to AFD-4000 Yellow 12"–28" w.c.          | D11555   |
|                                     | AFD-1000 to AFD-4000 Black 24"–44" w.c.           | D14809   |
|                                     | AFD-5000 to AFD-10000 Yellow 12"–28" w.c.         | D19189   |
|                                     | AFD-5000 to AFD-10000 Black 24"–44" w.c.          | D14810   |
|                                     | AFD-5000 to AFD-10000 Pink 40"–60" w.c.           | D12543   |
| <b>Dual Blocking Valve Assembly</b> |   |          |
| 5                                   | AFD-1000 to AFD-4000 (DMV-D 703/11)               | D14823   |
|                                     | AFD-5000 to AFD-10000 (DMV-D 525/11)              | D14824   |
| 6                                   | Low Gas Pressure Switch 12"–60" w.c. (GMH-A2-4-6) | D11538   |
| <b>High Gas Pressure Switch</b>     |   |          |
| 7                                   | AFD-1000 to AFD-14000 12"–60" w.c. (GMH-A2-4-6)   | D14829   |
| 8                                   | Visual Proof of Closure Indicator                 | D11573   |
| 9                                   | Electrical Proof of Closure Indicator (CPI-400)   | D14826   |
| 10                                  | DIN Connector (D210319)                           | D14827   |
| 11                                  | Pressure Gauge, 1"–100" w.c.                      | D14828   |



Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit [armstronginternational.com](http://armstronginternational.com) for up-to-date information.

# Lower Canister

**Note:** This drawing is a composite. Not all parts are present in every heater configuration.

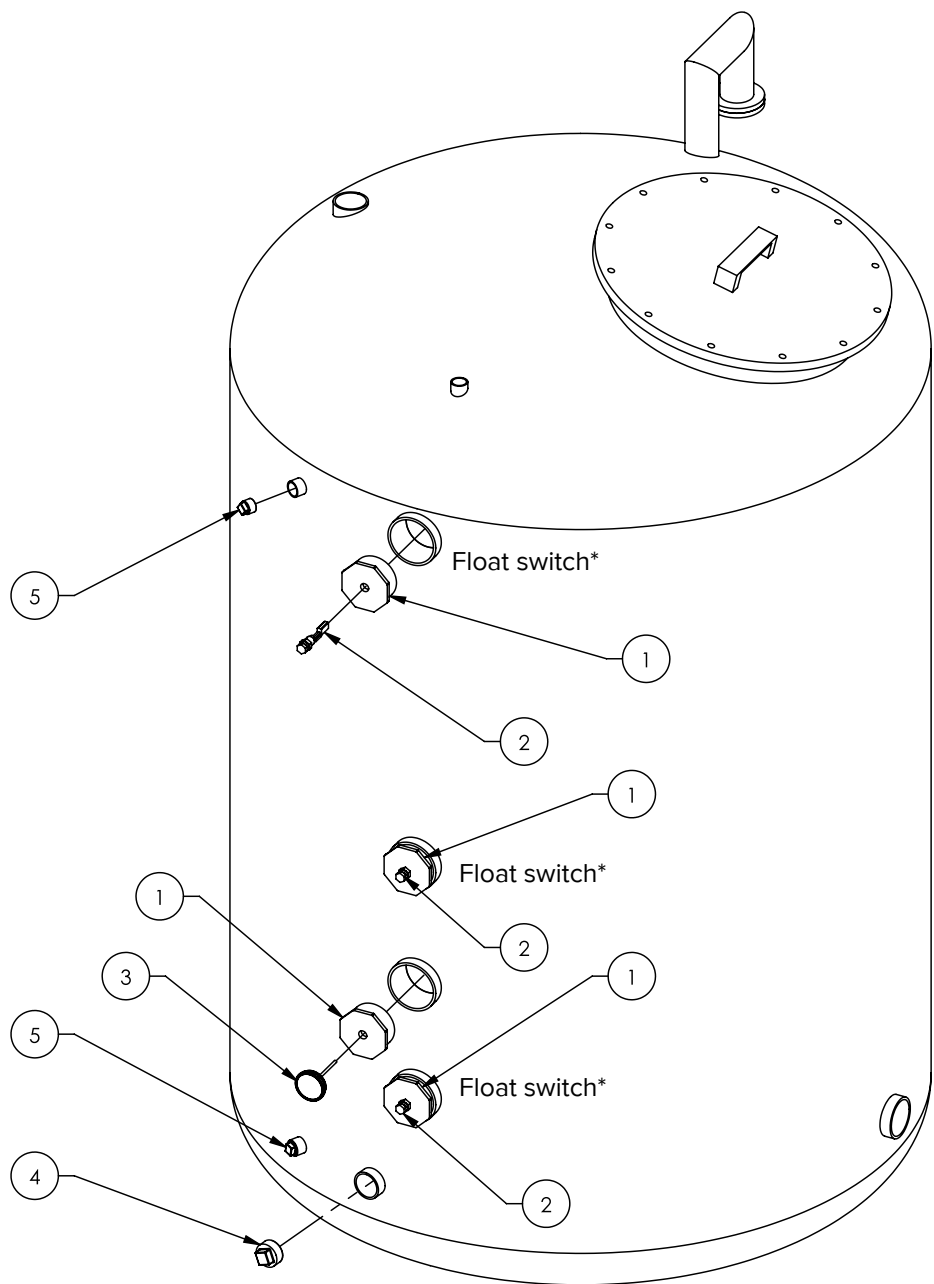


| Ref No.         | Description                         | Part No. |
|-----------------|-------------------------------------|----------|
| 1               | Float Switch, Polypropylene         | D16907   |
| 2               | High Temp Shutoff Switch, 600 °F    | D16916   |
| 3               | Standpipe Cap                       | D18110   |
| RTD Temp Sensor |                                     |          |
| 4               | 1-1/2", 100Ω                        | D13273   |
|                 | 2", 100Ω                            | D10210   |
|                 | 3", 100Ω                            | D17584   |
|                 | 5", 100Ω                            | D27358   |
| 5               | Drain Plug, 1" NPT, 304 SS          | D16918   |
| 6               | Plug, ½" NPT, 304 SS                | D11018   |
| 7               | Wiring Trough Drilled for Standpipe | D17265   |

| Ref No.                          | Description           | Part No. |
|----------------------------------|-----------------------|----------|
| SS Braided Flex Hose, Clamp Ends |                       |          |
| 8                                | 1-1/2" Dia x 36" long | D15722   |
|                                  | 2" Dia x 36" long     | D15723   |
|                                  | 3" Dia x 36" long     | D15724   |
|                                  | 4" Dia x 36" long     | D15725   |
| Flange Gasket – WARCO White      |                       |          |
| 9                                | AFD-1000              | D7564    |
|                                  | AFD-1500              | D7565    |
|                                  | AFD-2000              | D7566    |
|                                  | AFD-3000              | D7567    |
|                                  | AFD-4000              | D7568    |
|                                  | AFD-5000              | D7569    |
|                                  | AFD-6000              | D7570    |
|                                  | AFD-7000 & 8000       | D7571    |
|                                  | AFD-9000 to AFD-12000 | D7576    |



# Storage Tank



\*For float orientation, consult wiring diagram supplied with unit.

| Ref No. | Description                      | Part No. |
|---------|----------------------------------|----------|
| 1       | Bushing, CPVC 4" x 1/2" NPT      | D18785   |
| 2       | Float Switch, Polypropylene      | D16907   |
| 3       | Thermometer, Back Mount, 4" Stem | D8969    |
| 4       | Plug, 2" NPT, 304 SS             | D18789   |
| 5       | Plug, 1" NPT, 304 SS             | D16918   |

# Appendix: HMI Interface

This water heater package includes an HMI (Human-Machine Interface) terminal with displays and controls for heater status and operation, along with related system information.

This section will explain in detail on navigating through the HMI.

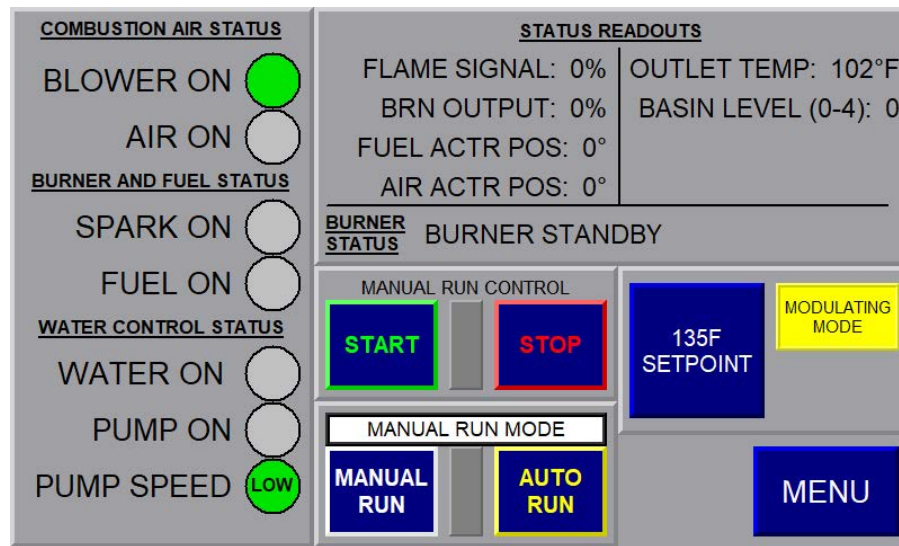
Depending on the options installed additional selections may be available. The base selections are shown below.

**NOTE:** BLUE denotes a user selection, button or input.



## Main Screen

Below is a picture of the Main Screen which is the default display on machine startup. This screen contains general information on the heater run status. It also contains the selection of MODES and SETPOINT.



Each status and selection of this screen is explained below.

### **COMBUSTION AIR STATUS**

Blower On: The combustion air blower has been energized.

Air On: The combustion air proving switch has been made.

### **BURNER AND FUEL STATUS**

Spark On: The burner spark igniter has been energized.

Fuel On: The main fuel valves have been energized.

### **WATER CONTROL STATUS**

Water On: The inlet water valve is energized.

Pump On: The transfer pump is energized.

(Not Shown) Pump Speed: This will display when the transfer pump is energized and switch between Low and High depending on level in the lower basin.

### **STATUS READOUTS**

Flame Signal: Strength of the flame signal in a scale of 0-100%.

Brn Output: Commanded output of the burner in a scale of 0-100%.

Fuel Actr Pos: Position of the fuel actuator in degrees.

Air Actr Pos: Position of the air actuator in degrees.

Outlet Temp: Outlet water temperature in degrees Fahrenheit.

Basin Level: Level of the lower basin corresponding with the float switches in the lower basin. Burner Status: Phase of the burner management system.

### **MANUAL RUN CONTROL**

When the heater is in manual run mode use the START and STOP buttons to control the heater.

### **RUN MODE**

The Flo-Direct has two run modes: MANUAL and AUTO. This panel is used to switch between them. In MANUAL mode the heater is started and stopped by the buttons on the panel above (manual run control). Pressing the AUTO RUN button will switch to auto run mode and the heater will start and stop via an external input. This can be float switches in a storage tank, a remote run control relay or a remote run bit via Ethernet connection.

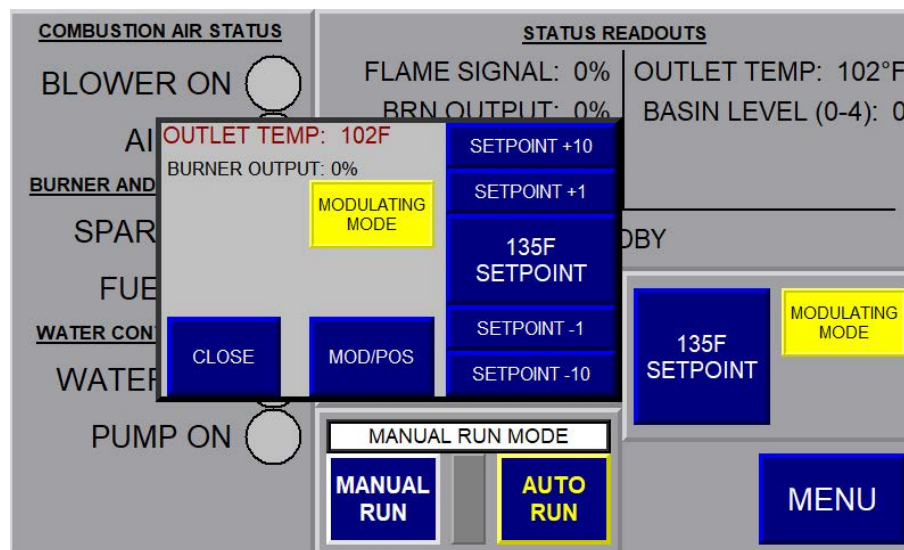
**NOTE:** If running the heater in MANUAL mode it will not STOP unless the STOP button is pushed. Constant monitoring is required running in this mode.

## Setpoint and Mode

The setpoint and mode are changed from this screen. By pressing the SETPOINT button (picture below) a secondary screen will appear. From here you can select to run in MODULATING or POSITIONING mode simply by pressing the MOD/POS button.

**NOTE:** POSITIONING mode can only be used while running in MANUAL mode. When, AUTO mode is selected the heater will switch to MODULATING mode.

To adjust your setpoint either degrees Fahrenheit in Modulating mode or Output position in Positioning mode. You can type in your desired setpoint by pressing on the right-hand center push button or increase/decrease by increments of 1 or 10 by pressing the corresponding buttons.



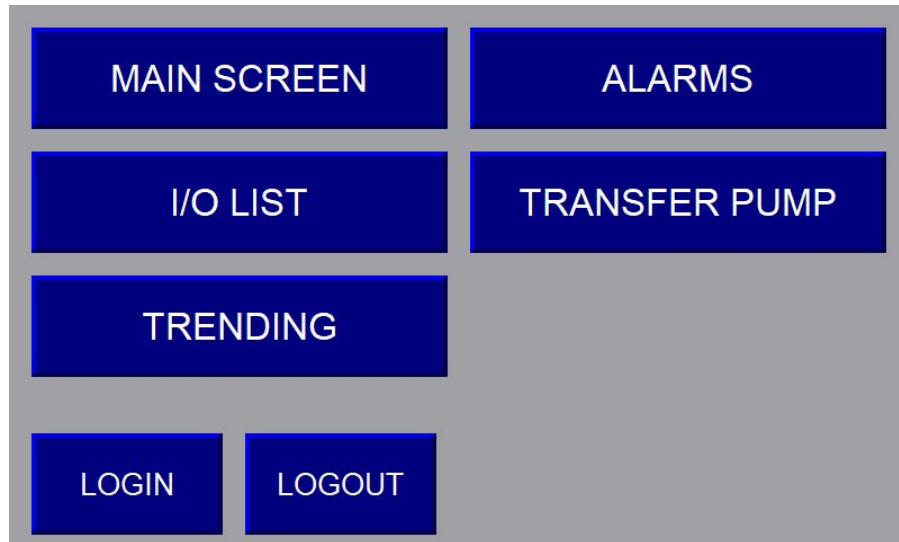
(SETPOINT AND MODE SELECTION)

## Menu

This button will take you to the MENU screen. The menu screen is used to navigate through the HMI.

## Menu Screen

Below is a picture of the Menu Screen. This screen is used to navigate through the HMI. Each button will take you to its corresponding screen. These screens will be explained in detail below.



## Main Screen

This button takes you to the main screen that was explained above.

## I/O List

The I/O List screen displays all the PLC inputs/outputs and VFD commands with an indicator denoting their status. The indicator will be lit when the input/output or command is on. Pressing the BACK button will return you to the MENU screen.

| INPUTS                 |    | OUTPUTS                             |  |
|------------------------|----|-------------------------------------|--|
| AUTO START INPUT       | 0  | <input checked="" type="checkbox"/> |  |
| AUTO STOP INPUT (NC)   | 1  | <input checked="" type="checkbox"/> |  |
| NOT USED               | 2  | <input type="checkbox"/>            |  |
| WATER PRESSURE SW      | 3  | <input type="checkbox"/>            |  |
| BOTTOM FLOAT SW        | 4  | <input checked="" type="checkbox"/> |  |
| SECOND FLOAT SW        | 5  | <input checked="" type="checkbox"/> |  |
| THIRD FLOAT SW         | 6  | <input type="checkbox"/>            |  |
| TOP FLOAT SW (NC)      | 7  | <input checked="" type="checkbox"/> |  |
| MAIN FUEL ON           | 8  | <input checked="" type="checkbox"/> |  |
| SPARK ON               | 9  | <input checked="" type="checkbox"/> |  |
| BURNER HIGH FIRE       | 10 | <input type="checkbox"/>            |  |
| BLOWER ON              | 11 | <input type="checkbox"/>            |  |
| FLAME SAFETY FAULT     | 12 | <input type="checkbox"/>            |  |
| LOW GAS PRESSURE SW    | 13 | <input type="checkbox"/>            |  |
| HIGH GAS PRESSURE SW   | 14 | <input type="checkbox"/>            |  |
| HIGH TEMPERATURE SW    | 15 | <input type="checkbox"/>            |  |
| E-STOP CLOSED (NC)     | 16 | <input type="checkbox"/>            |  |
| RUN INTERLOCKS CLOSED  | 17 | <input type="checkbox"/>            |  |
| AIR FLOW               | 18 | <input checked="" type="checkbox"/> |  |
| FUEL VALVE P.O.C. (NC) | 19 | <input type="checkbox"/>            |  |

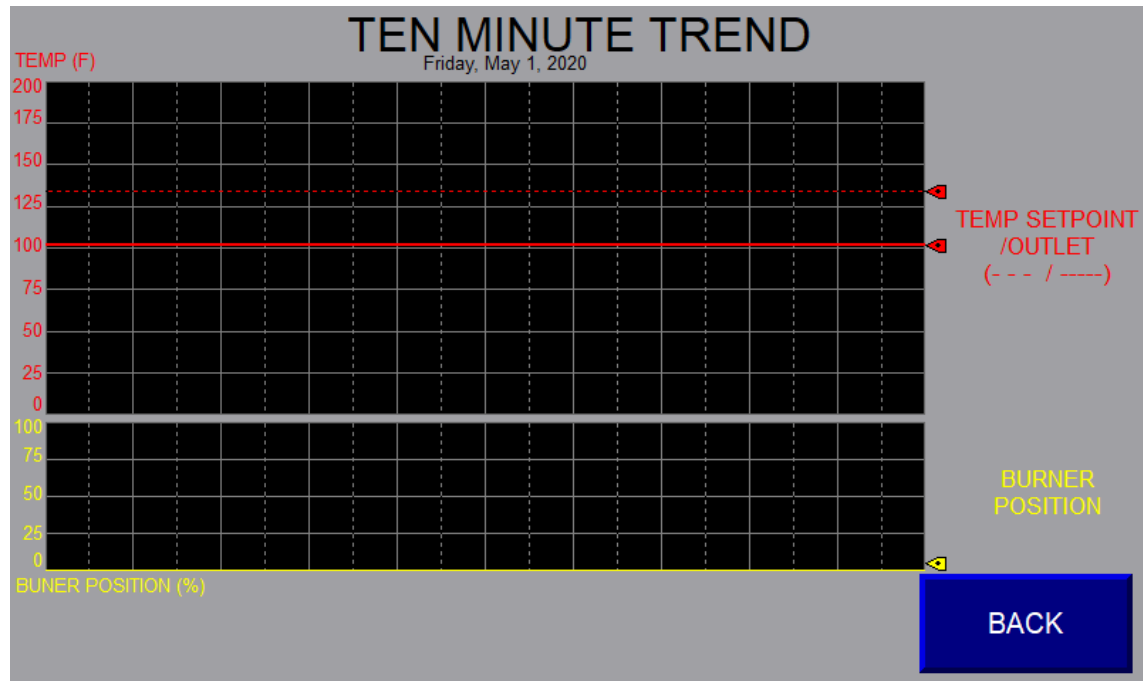
  

| DRIVE COMMANDS           |                      |
|--------------------------|----------------------|
| <input type="checkbox"/> | 0 RUN PERMISSIVE     |
| <input type="checkbox"/> | 1 INLET WATER ON     |
| <input type="checkbox"/> | 2 NOT USED           |
| <input type="checkbox"/> | 3 P.O.C. FAULT       |
| <input type="checkbox"/> | 4 GENERAL FAULT      |
| <input type="checkbox"/> | 5 FLAME SAFETY RESET |

BACK

# Trending Screen

The Trending screen records a 10-minute trend of the heaters Setpoint, Outlet Water Temp, and Burner Position. Pressing the BACK button will return you to the MENU screen.



# Alarms

The Alarms screen tracks all active and non-active alarms. Active alarms are indicated by a # symbol. As an example, in the picture below. This heater has 3 active alarms, an FSF (Flame Safety Fault) Special Position Undefined, Transfer Pump VFD Fault, and an E-Stop Tripped. The FAULT RESET button appears when non-critical faults are active, such as (FSF, Water Pressure, or High Basin). To reset, press the FAULT RESET button. Critical alarms (High Temperature Fault, Low Gas Pressure, and High Gas Pressure) require a manual reset of that component.

All active FSF will display an Error and Diagnostic Code at the bottom of the screen, for more details on these alarms reference the SIEMENS LMV3 manual (link provided below).

VFD fault codes are displayed on the VFD, for more details on these alarms reference the PowerFlex 520-Series Adjustable Frequency AC Drive Manual (link provided below).

The screenshot displays the Alarms screen interface. It features a table with two columns: 'Alarm time' and 'Message'. The table lists several alarms, with three marked as active (indicated by a # symbol). To the right of the table are four blue buttons with white arrow icons: up, up, down, and down. Below the table, the text 'FLAME SAFETY FAULT CODES' is displayed. Underneath, the 'ERROR CODE: 71' and 'DIAGNOSTIC CODE: 1' are shown. At the bottom right, there are two buttons: 'FAULT RESET' (red text on a blue background) and 'MENU' (white text on a blue background).

| Alarm time              | Message                          |
|-------------------------|----------------------------------|
| # 4/30/2020 12:29:07 PM | FSF - SPECIAL POSITION UNDEFINED |
| # 4/30/2020 12:29:07 PM | TRANSFER PUMP VFD FAULT          |
| # 4/30/2020 12:29:07 PM | E-STOP TRIPPED                   |
| 4/30/2020 12:27:50 PM   | FSF - SPECIAL POSITION UNDEFINED |
| 4/30/2020 12:26:09 PM   | FSF - ERROR AIR ACTUATOR         |
| 4/30/2020 12:16:04 PM   | E-STOP TRIPPED                   |
| 4/30/2020 12:16:04 PM   | TRANSFER PUMP VFD FAULT          |
| 4/30/2020 12:12:02 PM   | HIGH BASIN FAULT                 |
| 4/30/2020 12:10:30 PM   | PROOF OF CLOSER FAULT            |
| 4/30/2020 11:52:25 AM   | PROOF OF CLOSER FAULT            |
| 4/30/2020 11:47:02 AM   | HIGH BASIN FAULT                 |
| 4/30/2020 11:06:31 AM   | TRANSFER PUMP VFD FAULT          |
| 4/30/2020 11:06:31 AM   | PROOF OF CLOSER FAULT            |
| 4/30/2020 11:06:30 AM   | E-STOP TRIPPED                   |
| 4/30/2020 10:59:17 AM   | E-STOP TRIPPED                   |
| 4/30/2020 10:59:17 AM   | TRANSFER PUMP VFD FAULT          |
| 4/30/2020 10:59:17 AM   | PROOF OF CLOSER FAULT            |
| 4/30/2020 10:56:41 AM   | TRANSFER PUMP VFD FAULT          |
| 4/30/2020 10:56:41 AM   | E-STOP TRIPPED                   |

**FLAME SAFETY FAULT CODES**

ERROR CODE: 71

DIAGNOSTIC CODE: 1

**FAULT RESET** **MENU**

**NOTE:** An ALARM button will appear on the MAIN screen if an alarm is active. This button will take you directly to the ALAMRS screen.




[SIEMENS LMV3 Linkageless Burner Management System](#)

[PowerFlex 520-Series](#)



# Transfer Pump

The Transfer Pump screen allows you to set the LOW and HIGH speed of the VFD. This screen also displays the status of the transfer pump. See example below.

| TRANSFER PUMP SPEED CONTROL |            | TRANSFER PUMP STATUS   |   |
|-----------------------------|------------|--|---|
| LOW SPEED                   | HIGH SPEED | BASIN LEVEL (0-4): 2   |   |
| 15Hz                        | 40Hz       | PUMP ON  |  |
|                             |            | PUMP SPEED   |  |
|                             |            |  |   |

*The water level in the lower basin is at the second float switch. The transfer pump is running at LOW speed.*

To adjust the speeds of the VFD press either the LOW or HIGH speed button to enter your desired speed. The BACK button will return you to the MENU screen.

# Limited Warranty and Remedy

Armstrong Hot Water, Inc. ("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.**

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Special Warranty Periods are as follows:

- The stainless steel structure and stainless steel internals (flame tube, pall rings, supports, etc.): Seven (7) years from the date of installation, but not longer than eighty seven (87) months from the date of shipment, provided only clean potable water is heated and commercially available fuel is used as well as clean air.
- In applications such as bottle or can warming, special consideration must be placed on routine and preventative maintenance to ensure clean water is used throughout the operation of the unit. Any failures as a result of dirty water will void the warranty.
- The other components on the Flo-Direct®, such as valves, combustion equipment, electrical controls, and the burner: Two (2) years from the date of installation, but not longer than twenty-six (26) months from the date of shipment.

*Designs, materials, weights and performance ratings are approximate and subject to change without notice.  
Visit [armstronginternational.com](http://armstronginternational.com) for up-to-date information.*



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