ISO 9001 CERTIFIED

FoamLogix™

Model 2.1A Class "A"
Electronic Foam Proportioning System
Description, Installation and Operation Manual

HALE PRODUCTS, INC. • A Unit of IDEX Corporation
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ISO 9001 CERTIFIED

Manual p/n: 029-0020-74-0

APPARATUS INFORMATION

Hale FoamLogic System Serial Number _____

In Service Date _____

Fire Department _____

Engine Number _____

Calibration Factors:

Water Flow Factor _____

Class “A” Foam Factor _____

NOTICE !

Hale Products cannot assume responsibility for product failure resulting from improper maintenance or operation. Hale Products is responsible only to the limits stated in the product warranty. Product specifications contained in this manual are subject to change without notice.

All Hale products are quality components -- ruggedly designed, accurately machined, precision inspected, carefully assembled and thoroughly tested. In order to maintain the high quality of your unit, and to keep it in a ready condition, it is important to follow the instructions on care and operation. Proper use and good preventive maintenance will lengthen the life of your unit.

ALWAYS INCLUDE THE UNIT SERIAL NUMBER IN YOUR CORRESPONDENCE.

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HOW TO USE THIS MANUAL

This manual is divided into seven sections for clarity and ease of use. Each of the following manual sections can be a stand alone section or can be used in conjunction with each other.

SECTION 1 SAFETY

This section must be carefully read, understood and adhered to strictly by all installer/builders, operators and service personnel using the Hale FoamLogix 2.1A Foam Proportioning System. Do not use or install the system until you have thoroughly read this section. Failure to comply could cause risk of serious injury to yourself and others, or damage to the system.

SECTION 2 DESCRIPTION

Provides an introduction to the Hale foam proportioning system along with guidelines for designing and ordering a complete system.

SECTION 3 INSTALLATION

Provides information to assist the OEM with installation and initial setup of Hale foam proportioning systems on an apparatus.

SECTION 4 SETUP AND CALIBRATION

Is used by the installer and end user for start-up and calibration of the Hale foam proportioning system.

SECTION 5 OPERATION

Is primarily used by the apparatus user for proper operation and maintenance of the Hale foam proportioning system.

SECTION 6 TROUBLESHOOTING

If a problem developes, see this section for troubleshooting procedures.

SECTION 7 PARTS IDENTIFICATION

Section 7 includes a parts breakdown of the most commonly used parts of the FoamLogix System.

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SECTION 1 SAFETY

IMPORTANT!

THE HALE "FOAMLOGIX™" MODEL 2.1A CLASS "A" ELECTRONIC FOAM PROPORTIONING SYSTEM IS DESIGNED FOR OPTIMUM SAFETY OF ITS OPERATORS AND TO PROVIDE RELIABLE AND SAFE FOAM CONCENTRATE INJECTION. FOR ADDED PROTECTION AND BEFORE ATTEMPTING INSTALLATION OR OPERATION PLEASE FOLLOW THE SAFETY GUIDELINES LISTED IN THIS SECTION AND ADHERE TO ALL WARNING, DANGER, CAUTION AND IMPORTANT NOTES FOUND WITHIN THIS GUIDE.

THIS SECTION ON SAFETY MUST BE CAREFULLY READ, UNDERSTOOD AND ADHERED TO STRICTLY BY ALL INSTALLERS AND OPERATORS BEFORE ATTEMPTING TO INSTALL OR OPERATE THE FOAMLOGIX PROPORTIONING SYSTEM.

WHEN DEVELOPING DEPARTMENTAL APPARATUS OPERATING PROCEDURES, INCORPORATE THE WARNINGS AND CAUTIONS AS WRITTEN.

GUIDELINES

READ ALL INSTRUCTIONS THOROUGHLY BEFORE BEGINNING ANY INSTALLATION OR OPERATION PROCESS.

- ❑ Installation should be performed by a trained and qualified installer, or your authorized Hale Products service representative.
- ❑ Be sure the installer has sufficient knowledge, experience and the proper tools before attempting any installation.
- ❑ Make sure proper personal protective equipment is used when operating or servicing apparatus.
- ❑ A foam tank low level sensor must be utilized to protect the Hale Foam proportioner from dry running. *Failure to use a low level sensor with the Hale Foam system voids warranty.*
- ❑ DO NOT permanently remove or alter any guard or insulating devices, or attempt to operate the system when these guards are removed.

  Make sure all access/service panels and covers are installed, closed and latched tight, where applicable.
- ❑ DO NOT remove or alter any hydraulic or pneumatic connections, electrical devices, etc. DO NOT tamper with or disconnect safety features or modify protective guards (such as covers or doors). DO NOT add or remove structural parts. *Doing so voids the warranty.*

  Any of the above could affect system capacity and/or safe operation of the system and is a serious safety violation which could cause personal injury, could weaken the construction of the system or could affect safe operation of the FoamLogix Proportioning System.

WARNING!

NO MODIFICATIONS OR ADDITIONS MAY BE MADE TO THE FOAMLOGIX PORPORTIONING SYSTEM WITHOUT PRIOR WRITTEN PERMISSION FROM:

Hale Products, Incorporated
Fire Suppression Equipment Group
700 Spring Mill Avenue
Conshohocken, PA 19428
Telephone: 610-825-6300
Fax: 610-825-6440

- ❑ To prevent electrical shock always disconnect the primary power source before attempting to service any part of the Hale Foam system.

- All electrical systems have the potential to cause sparks during service. Take care to eliminate explosive or hazardous environments during service and/or repair.
- To prevent system damage or electrical shock the main power supply wire is the last connection made to the Hale Foam proportioner distribution box.
- Release all pressure then drain all concentrate and water from the system before servicing any of its component parts.
- Do not operate system at pressures higher than the maximum rated pressure.
- Use only pipe, hose, and fittings from the foam pump outlet to the injector fitting, which are rated at or above the maximum pressure rating at which the water pump system operates.
- Hale Foam proportioning systems are designed for use on negative ground direct current electrical systems only.
- Do not mount radio transmitter or transmitter cables in direct or close contact with the FoamLogix control unit.
- Before connecting the cord sets and wiring harnesses, inspect the seal washer in the female connector.

  If the seal washer is missing or damaged, water can enter the connector causing corrosion of the pins and terminals. This could resulting in possible system failure.
- Always disconnect the power cable, ground straps, electrical wires and control cables from the control unit or other Hale Foam system equipment before electric arc welding at any point on the apparatus

  Failure to do so could result in a power surge through the unit that could cause irreparable damage.
- DO NOT connect the main power lead to small leads that are supplying some other device, such as a light bar or siren.

  The Hale FoamLogix, Model 2.1A requires 40 AMP minimum current.
- When operating the Hale FoamLogix in Simulated Flow mode, an outlet for the foam concentrate must be provided to prevent excessive pressure buildup in the discharge piping or hoses.
- Make sure the foam tank and foam concentrate suction hoses are clean before making final connection to foam pump. If necessary flush tank and hoses prior to making connection.
- Check all hoses for weak or worn conditions after each use. Ensure that all connections and fittings are tight and secure.
- Ensure that the electrical source of power for the unit is a negative (–) ground DC system, of correct input voltage, with a reserve minimum current available to drive the system.
- The in-line strainer/valve assembly is a low pressure device and WILL NOT withstand flushing water pressure in excess of 45 PSI (3 BAR).
- When determining the location of Hale Foam system components keep in mind piping runs, cable routing and other interferences that could hinder or interfere with proper system performance.
- Always position the check valve/injector fitting at a horizontal or higher angle to allow water to drain away from the fitting. This avoids the possibility of sediment deposits or the formation of an ice plug.
- The cord sets provided with each Hale Foam system are indexed to ensure correct receptacle installation (they insert one way only).

  When making cord set connections DO NOT force mismatched connections as damage can result in improper system operation.
- Make sure all connections are sound, and that each connection is correct.
- The cables shipped with each Hale Foam system are 100% tested at the factory with that unit. Improper handling and forcing connections can damage these cables which could result in other system damage.

- There are no user serviceable parts inside Hale Foam system electrical/electronic components. *Opening of the distribution box or control unit voids the warranty.*
- Use mounting hardware that is compatible with all foam concentrates to be used in the system. Use washers, lock washers and cap screws made of brass or 300 series stainless steel.
- When making wire splice connections, make sure they are properly insulated and sealed using an adhesive filled heat shrink tubing.
- ALWAYS connect the primary positive power lead from the terminal block to the master switch terminal or the positive battery terminal. Use a minimum 8 AWG type SGX (SAE J1127) chemical resistant battery cable and protect with wire loom.
- Prevent corrosion of power and ground connections by sealing these connections with silicone sealant provided.
- Prevent possible short circuit by using the rubber boot provided to insulate the primary power connection at the Hale FoamLogix distribution box.

NOTES

SECTION 2 DESCRIPTION

The Hale FoamLogix 2.1A Foam Proportioning System is a completely engineered, factory matched foam proportioning system that provides reliable, consistent foam concentrate injection for Class “A” foam operations.

Hale FoamLogix Foam systems accurately deliver from 0.1% to 10.0% foam concentrate through a check valve/injector fitting, directly into the water discharge stream. It is then fed as foam solution into a standard fog nozzle, an air aspirated nozzle, or CAFS equipment, through the apparatus discharge piping. A properly configured and installed foam system with Hale recommended components virtually eliminates contamination of the booster tank, fire pump and relief valve with foam concentrate.

ROTARY PLUNGER PUMP

The heart of the Hale FoamLogix 2.1A system is an electric motor driven rotary plunger pump. The pump is constructed of anodized aluminum and stainless steel and is compatible with most Class “A” foam concentrates. The pump is close coupled to the electric motor thereby eliminating maintenance of an oil filled gearbox. A relief valve mounted on the foam pump and constructed of brass, protects the foam pump and foam concentrate discharge hoses from over pressurization and damage.

CONTROL UNIT

The control unit, mounted on the operator panel, is the single control point for the FoamLogix system. Pressing the ON button starts foam concentrate injection. A super bright digital LED display shows the:

- ❑ Water flow rate
- ❑ Total water flow
- ❑ Foam concentrate injection percentage
- ❑ Total foam concentrate used, depending on the display mode selected.

A bar graph indicates the approximate system capacity being used. Adjustment of the foam concentrate injection rate is accomplished by pressing the appropriate button.

The control unit display also warns the operator if errors or abnormal operations occur in the system, such as low foam level.

WATER FLOW SENSOR

Foam concentrate injection rate is controlled by a computer chip in the control unit for accurate, repeatable, reliable foam concentrate injection. A water flow sensor constantly monitors water flow through the discharge piping. The information from the flow sensor is provided to the control unit by a shielded cable. When the FoamLogix system is activated at the control unit a signal is sent through the control cable to the distribution box to begin foam concentrate injection. The distribution box then provides power to the electric motor. As the motor rotates the pump, foam concentrate flows through the foam pump discharge to the one piece check valve/injector fitting into the water discharge stream.

Note: All Hale FoamLogix Foam systems require a flow sensor for operation.

FEED BACK SENSOR

A feedback sensor in the foam pump discharge measures foam concentrate flow. The water flow rate and foam concentrate flow rate are constantly compared by the computer chip in the control unit.

The motor speed is constantly adjusted to maintain the operator selected foam concentrate injection rate. Since the system is flow based, injection rate remains constant regardless of changes in system pressure or the number of discharges that are open (within the limits of the sytem).

The maximum rated foam concentrate flow, in gallons per minute, is denoted by the model number. Table 1: “Maximum Foam Solution Flows” shows the system capacity at various foam concentrate injection rates for the Hale FoamLogix 2.1A.

Injection Rate Percent (%)	Maximum Foam Solution Flow	
	Gallons per Minute (GPM)	Liters per Minute (LPM)
0.1	2,100	7,949
0.2	1,050	3,974
0.3	700	2,650
0.5	420	1,590
1.0	210	795

Table 1: Maximum Foam Solution Flows

The Hale FoamLogix 2.1A Foam system configuration is shown in Figure 2-3: “Typical System Overview” on page 20.

LOW PRESSURE STRAINER

A low pressure foam concentrate strainer is mounted at the inlet of the foam pump. The strainer protects the pump from debris that might accumulate in the foam concentrate tank. The strainer/valve assembly has a composite nonmetallic housing with stainless steel mesh strainer element and includes a service shut-off valve.

The valve inlet offers 1/2” NPT (13 mm) threads, with a fitting to connect a 1/2” (13 mm) ID foam concentrate suction hose.

The strainer and valve are low pressure devices and are designed for installations where the strainer IS NOT subject to HIGH pressure flushing water.

ORDERING INFORMATION

Ordering Hale FoamLogix 2.1A Foam System is simple. Using the current Hale FoamLogix 2.1A Foam System Price List and Order Form helps ensure a complete matched system is provided to the end user.

Use the following procedure when ordering a Hale FoamLogix 2.1A Foam system. Following all steps to ensure that a complete system is ordered:

1. Check Hale Foam system product information update (Bulletin 961) for the latest information and advice for foam system selection.

2. Determine the Class “A” foam concentrate to be used in the system and ensure system compatibility by referring to the Hale Foam Concentrate Compatibility list (Bulletin #650).

3. Consult the current Hale FoamLogix 2.1A Price List and Order Form for ordering of the system.

   The Hale FoamLogix 2.1A can be ordered as one of two pre-configured packages that include the pump and motor assembly, control unit, flow sensor cable, stainless steel check valve and injection manifold, and an installation kit.

   Package “A” includes the dual check valve manifold

Package "B" includes single check valve manifold.

Note: If package "B" is selected an additional check valve is required where the foam manifold attaches to the pump discharge for NFPA compliance

4. The Hale FoamLogix 2.1A may also be ordered "a-la-carte" if one of the standard packages does not meet end user requirements. When ordering the system "a-la-carte" for a complete system the Pump and motor assembly, flow sensor cable, low tank sensor and check valve injector fitting must be ordered as a minimum.

   Ordering the components as a complete system allows Hale to configure and test the complete order, to ensure a problem-free system.

5. Additional Hale components available to enhance system operation and ease installation include:

   - ❑ Control Cable Extension
   - ❑ Waterway Check Valves
   - ❑ Manifolds
   - ❑ Flanges
   - ❑ Foam Tanks

System components are shown in the following heading "Foam System Specifications," beginning on page 16.

All components listed are engineered and tested with Hale Foam systems to provide optimum system performance. Using the information provided in this manual and the detailed ordering procedures on the option order form ensures that a complete Hale Foam system is ordered thus eliminating delays caused by missing components.

HALE FOAM SYSTEM SPECIFICATIONS

Foam Pump	Dual Plunger
Maximum Foam Concentrate Output	2.1 GPM (8 LPM)
Maximum System Operating Pressure	250 PSI (17 BAR)
Maximum Operating Temperature	160° F (71° C)
Pump Motor	0.44 HP (0.3 Kw), 12 VDC
Operating Ampere Draw	25 AMPS @ 12 VDC
Maximum Ampere Draw	40 AMPS @ 12 VDC

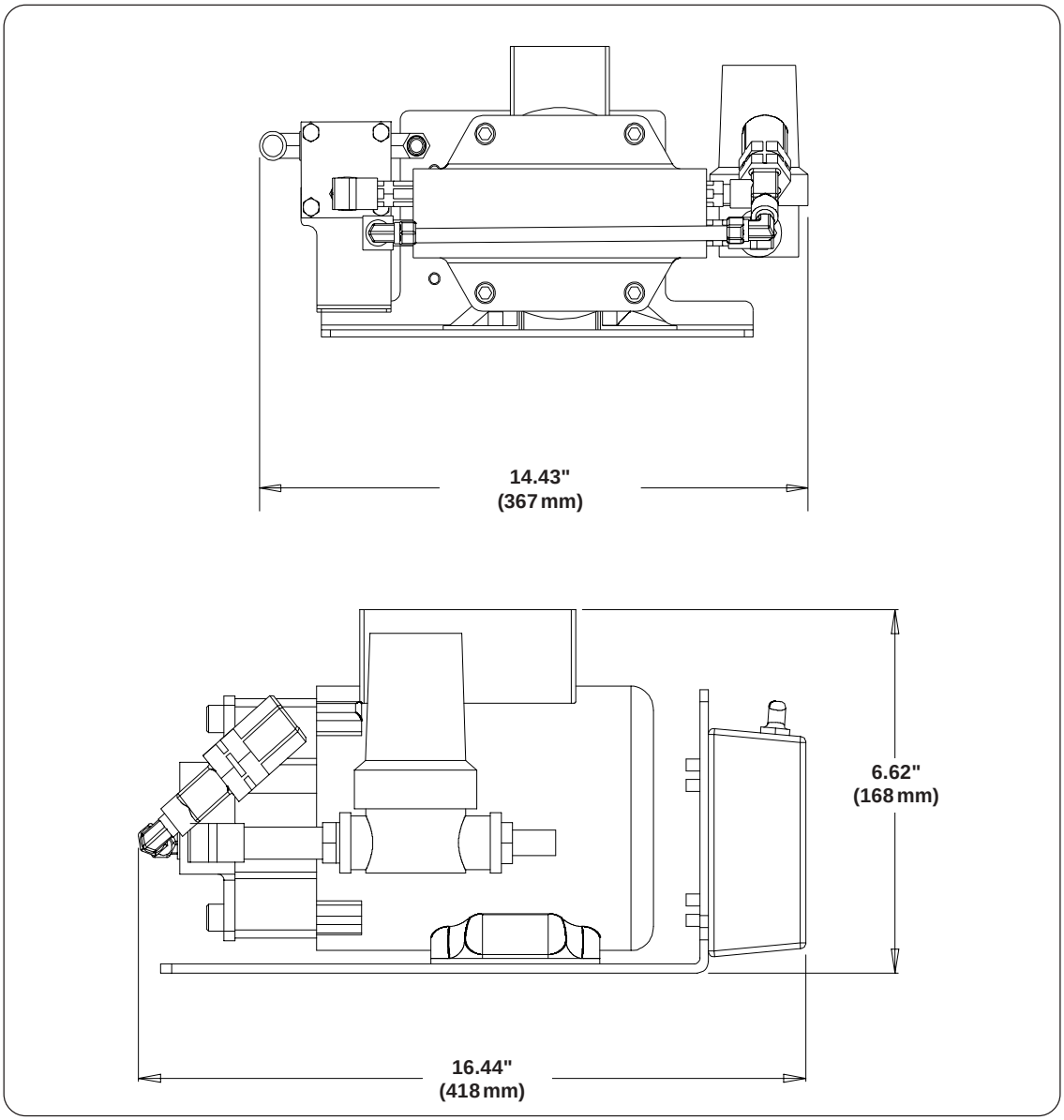


Figure 2: Foam Pump Installation Envelope Dimensions

SYSTEM CONFIGURATION

PACKAGE "A"

Hale p/n: 501-4190-01-0

FoamLogix 2.1A Kit (12 Volt) with *dual* stainless steel valve manifold (recommended for NFPA back flow prevention compliance). Package "A" includes the following:

- ❑ One FoamLogix full-function digital display control. The displays shows - Flow, Foam %, Total Flow and Total Foam
- ❑ One 2.1 GPM foam pump assembly - with strainer bypass and service valves.
- ❑ One 11' (3.4 meter) cable between display and pump and one 10' (3.1 meter) cable between the display and the flow sensor
- ❑ One Foam manifold assembly - with dual waterway check valves, flow sensor and foam injection check valve installed. Includes, 3" (76.2 mm) grooved Victaulic connections. Flow range 30 to 750 GPM (114 to 2,839 LPM).
- ❑ One Installation kit - includes clear reinforced foam inlet hose, hose clamps, positive and ground terminal insulation kit, and low foam level switch (side mount).
- ❑ Two Operation and Installation manuals.
- ❑ One Single tank system instruction placard.

PACKAGE "B"

Hale p/n: 501-4190-01-0

FoamLogix 2.1A Kit (12 Volt) with single stainless steel check valve manifold. Package "A" includes the following:

- ❑ One FoamLogix full function digital display control. The displays shows - Flow, Foam %, Total Flow and Total Foam
- ❑ One 2.1 GPM foam pump assembly - with strainer bypass and service valves.
- ❑ One 11' (3.4 meter) cable between display and pump and one 10' (3.1 meter) cable between the display and the flow sensor
- ❑ One compact foam manifold assembly - with a single waterway check valve, flow sensor and foam injection check valve installed. Includes 3" (76.2 mm) grooved victaulic connections. Flow range 30 - 750 GPM (114 to 2,839 LPM).

Note: A second check valve is recommended to avoid pump/water tank contamination. (See additional options page for loose check valves.

- ❑ One Installation kit - includes clear reinforced foam inlet hose, hose clamps, positive and ground terminal insulation kit, and low foam level switch (side mount).
- ❑ Two Operation and Installation manuals.
- ❑ One single tank system instruction placard.

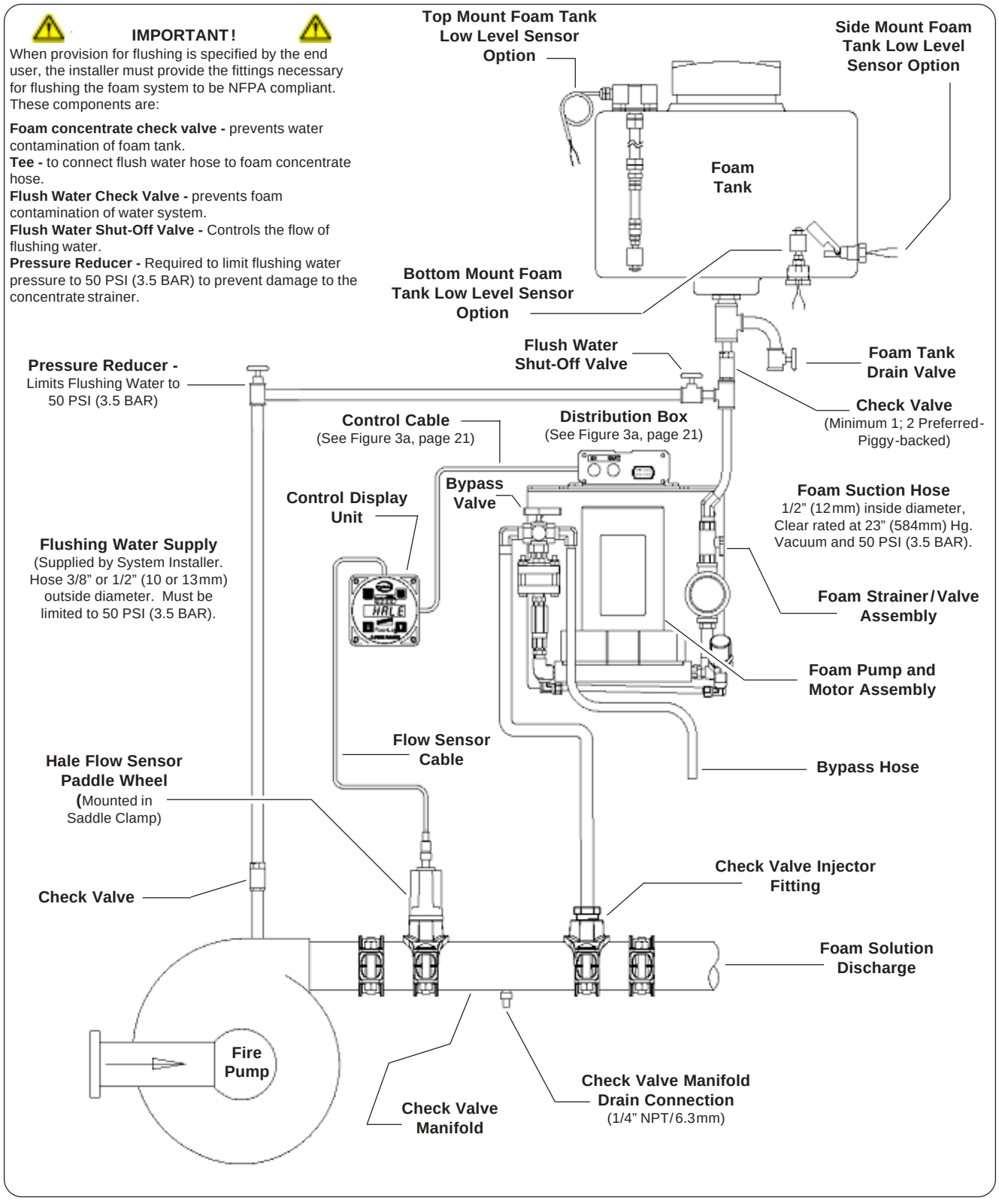


Figure 3: Typical Hale FoamLogix 2.1A System Layout

(Also see Figure 3a: "Typical Hale FoamLogix 2.1A Electrical Layout" on page 21.)

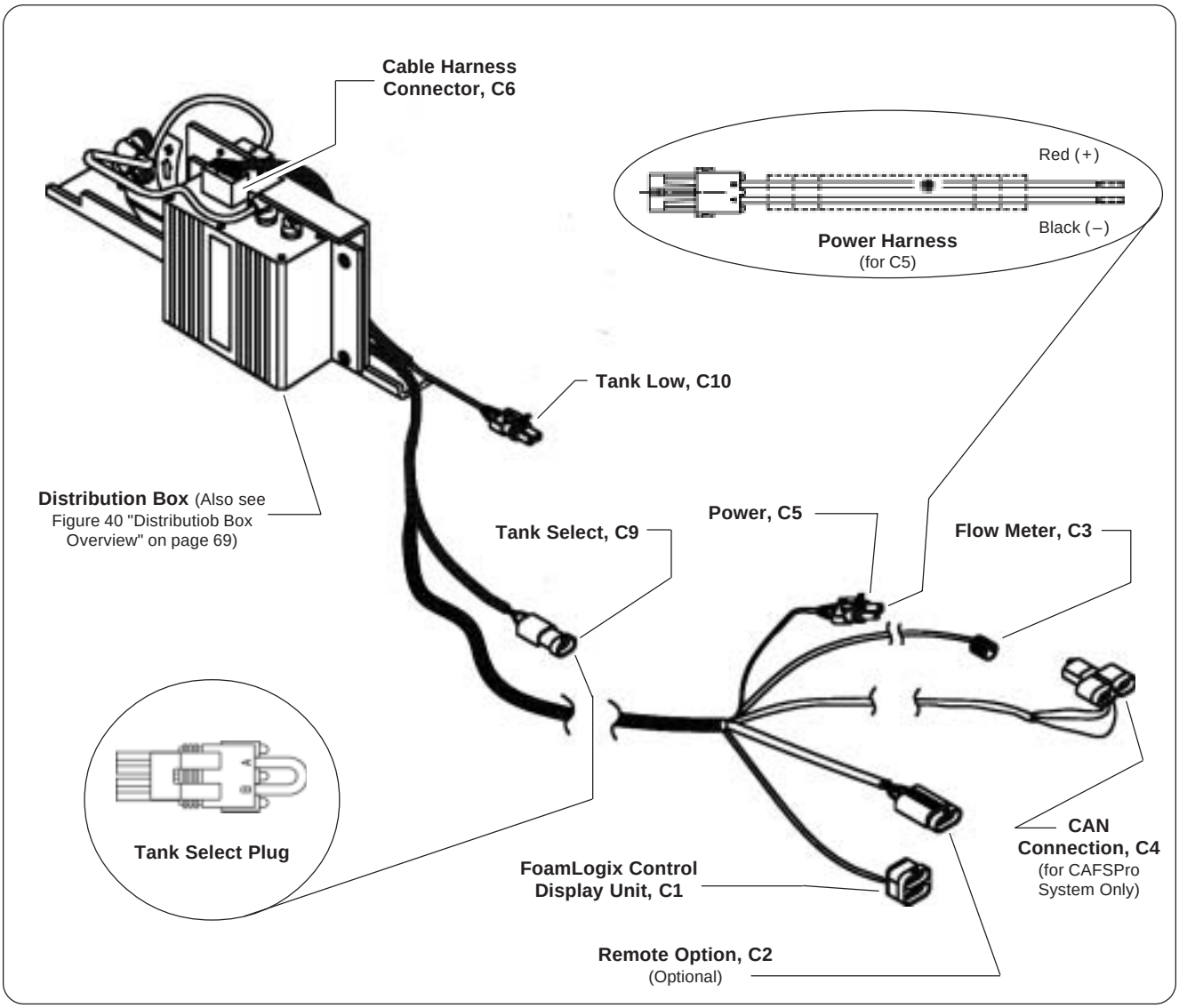
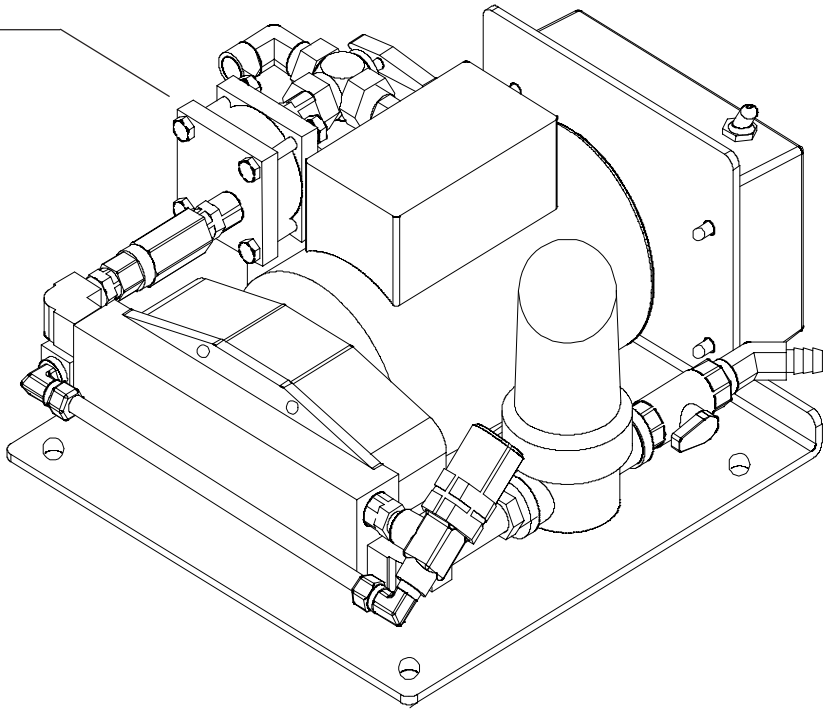


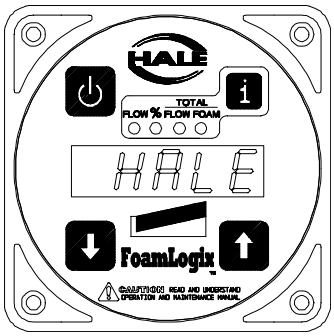
Figure 3a: Typical Hale FoamLogix 2.1A Electrical Layout)

Hale FoamLogix 2.1A Foam Proportioner System

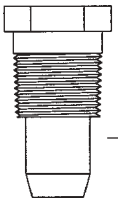
All Hale FoamLogix 2.1A systems include: Foam Pump/Motor Assembly and Control Unit

**FoamLogix 2.1A Base Unit,
Foam Pump/Motor Assembly
p/n: 501-4190-00-0**





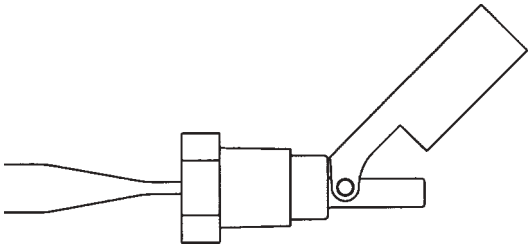
**Control Display Unit
p/n: 111530**



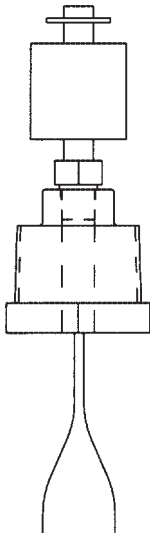
**Check Valve/Injector Fitting
p/n: 038-1790-00-0**

Low Tank Level Sensor Options

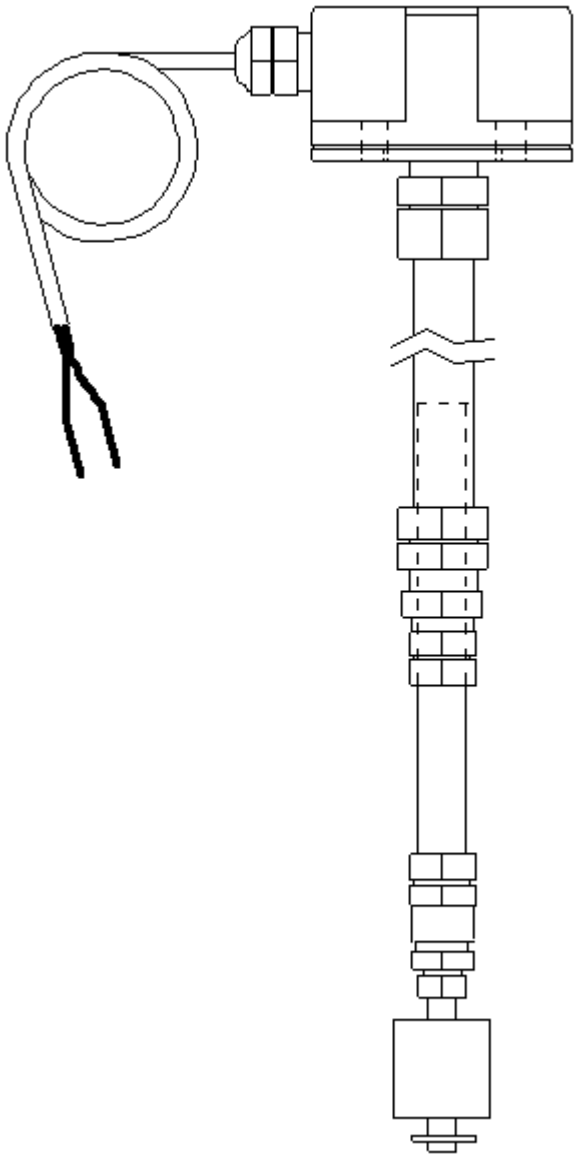
One Low Tank Level Sensor is Required



Side Mount Low Level Tank Sensor
p/n: 200-2110-02-0
(1/2" NPT [13 mm] threaded bushing to mount from outside foam tank.)



Brass Bottom Mount Low Level Tank Sensor
p/n: 200-2110-04-0
(1" NPT [13 mm] threaded bushing to mount from outside foam tank.)



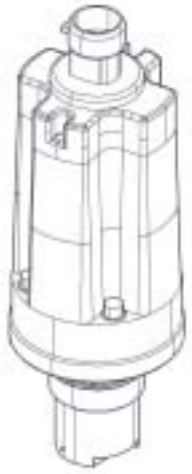
Top Mount Low Level Tank Sensor
p/n: 200-2110-06-0
(Extends from 2-1/2' to 5' [0.8 to 1.5 meters] – may be cut shorter if required.)

Flow Sensors

Each Hale foam system requires a flow sensor for operation. Pipe size must be selected based on the minimum and maximum water flow in the foam capable discharge. Following is a list of pipe size and rated flow ranges, along with flow sensor saddle clamp part number. In all instances, a weld fitting may be substituted for the saddle clamp.

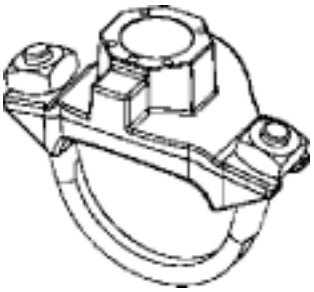
Pipe Size	Flow Range	
	GPM	LPM
1.5" (102mm)	10 - 330	38 - 1,219
2" (76.2mm)	20 - 550	76 - 2,082
2.5" (64mm)	30 - 800	114 - 3,028
3" (64mm)	50 - 1,250	189 - 4,731
4" (64mm)	75 - 1,800	284 - 6,813
SCV or DCV	30 - 750	114 - 2,839

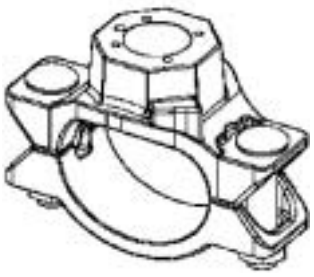
Figure 4: Pipe Size vs. Flow Range



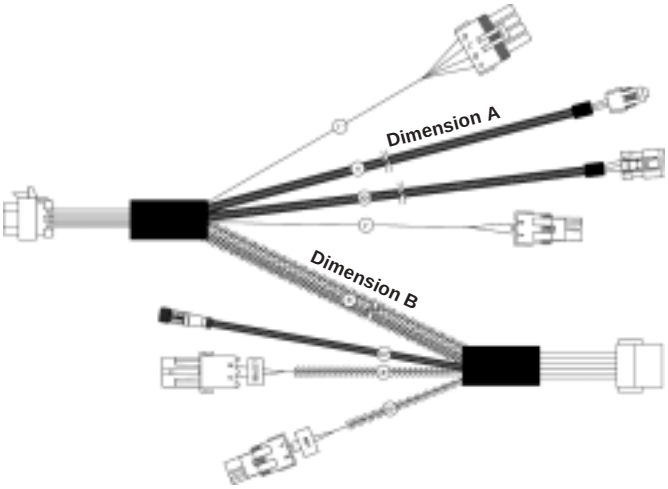
Flow Sensor Paddle Wheel
p/n: 102714

Flow Sensor Weld Fitting
Stainless Steel, p/n: 082-3060-00-0
Steel, p/n: 309020
Aluminium, p/n: 309010





Flow Sensor Saddle Clamp
2" – p/n: 4842010
2.50" – p/n: 4843010
3" – p/n: 4844010
4" – p/n: 4846010

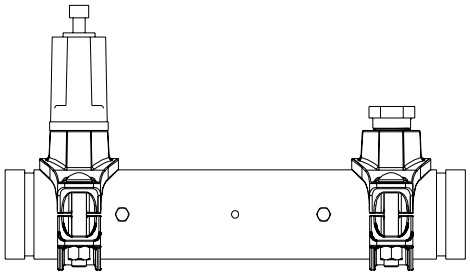


Flow Sensor Cable

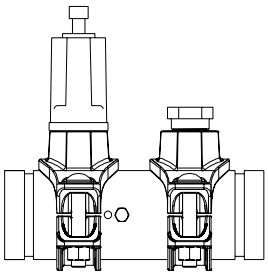
Dimension A & B	Part Number
10' x 15' (3 x 5 meters)	111331
15' x 20' (5 x 6 meters)	111332

Check Valve Manifolds, Flanges and Gaskets

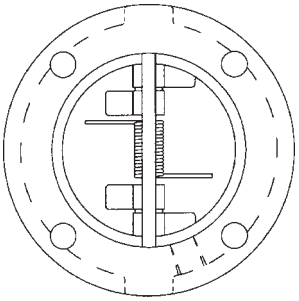
The check valve manifolds include Flow Sensor, Check Valve/Injector Fitting and Single or Dual Waterway Check Valve Flappers. End connections for the manifolds are 3” (76.2 mm) Victaulic.



Dual Check Valve (DCV) Manifold
p/n: 108751

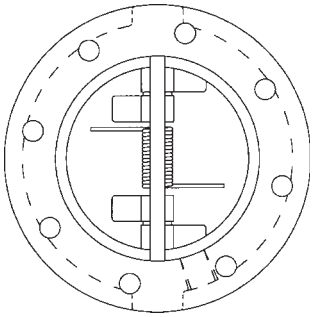


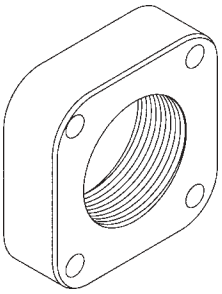
Single Check Valve (SVC) Manifold
p/n: 108893



3" (76.2 mm) 115 Check Valve
p/n: 038-1570-00-0

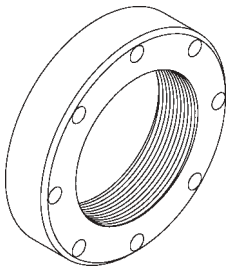
4" (102 mm) Wafer Check Valve
p/n: 038-1570-04-0





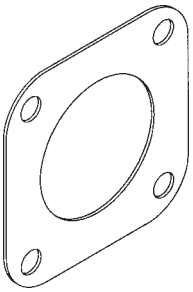
Threads (NPT)	Part Number
3" (76.2mm)	115-0080-00-0
2.5" (64mm)	115-0070-00-0
2" (51mm)	115-0060-00-0
BLANK	125-0050-00-0

Threads (NPT)	Part Number
4" (102mm)	115-0040-00-0
3" (76.2mm)	115-0030-00-0
2.5" (64mm)	115-0020-00-0
BLANK	115-0010-00-0



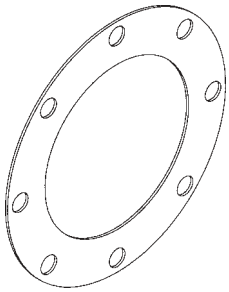
Type 115 Flange
(Use 3” and 2.5” NPT with 3” check valves.
Also available with 1.5” and 2” NPT threads.)

Type 2433D Flange
(Use 4” NPT with 4” check valves.
Also available with 2.5” and 3” NPT threads.)

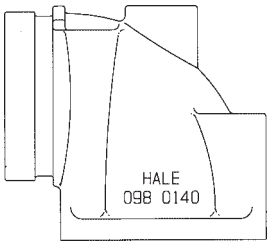


115 Flange Gasket
p/n: 046-0050-00-0

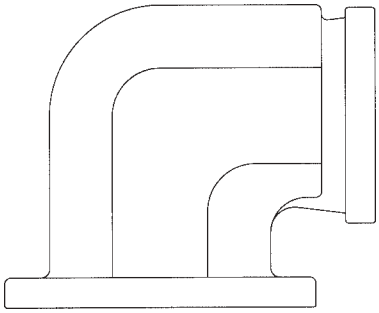
2433D Flange Gasket
p/n: 046-0040-00-0



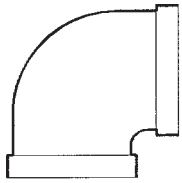
Elbows and Mini-Manifolds



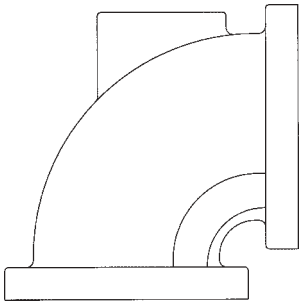
Close Fit Flanged Elbow
p/n: 098-0140-00-0
(115 flange inlet with 3" Victaulic outlet)



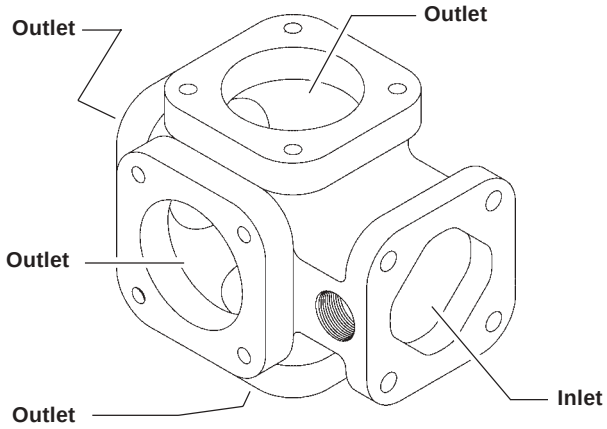
Close Fit Flanged Elbow
p/n: 098-0190-00-0
(2433D flange inlet with 3" NPT female and 4" Victaulic outlet)



Close Fit Flanged Elbow
p/n: 098-0050-00-0
(115 flange inlet with 2.5" NPT female outlet)



Close Fit Flanged Elbow
p/n: 098-0020-00-0
(115 flange inlet with 115 flange outlet)



Mini-Manifold
p/n: 178-0320-02-0

SECTION 3 INSTALLATION

To simplify installation selection, one of the two packages described in previous Section 2 should be ordered. While either package provides most of the components required for installation, the following guidelines are offered to assist the system installer with a complete system installation.

Carefully review the procedures that follow to ensure the system is properly designed. This section lists components that have been tested with Hale FoamLogix and provide the best system performance. Use of the recommended materials and specified parts ensures a virtually maintenance free installation.

Differences in apparatus plumbing and foam system configuration make it impractical to show exactly how the Hale FoamLogix 2.1A system is installed on a particular apparatus. The information contained in this section, however, applies to most situations and should be used when designing and installing a Hale FoamLogix 2.1A system. A system plumbing and electrical diagram is provided at the end of this section to assist with installation.

Before proceeding with system installation, carefully review the procedures that follow to ensure the system is properly designed.

The Hale FoamLogix system is supplied with six major components that must be located on the apparatus.

- ❑ Foam pump and motor assembly
- ❑ Control unit
- ❑ Instruction/system diagram placard
- ❑ Flow Sensor
- ❑ Check valve injector fitting

Notes: The flow sensor and check valve injector fitting may be pre-mounted, if a manifold or pre-configured package is ordered.

Optional components that require mounting on the apparatus include:

- ❑ Mini Manifold
- ❑ Flanged elbows
- ❑ Foam tank

IMPORTANT!

WHEN DETERMINING THE LOCATIONS OF HALE FOAMLOGIX COMPONENTS BEING INSTALLED KEEP IN MIND PIPING RUNS, CABLE ROUTING AND OTHER INTERFERENCES THAT COULD HINDER OR INTERFERE WITH PROPER SYSTEM PERFORMANCE.

FOAM PUMP AND MOTOR ASSEMBLY

Ideally, the foam pump and motor assembly should be located in an area that is protected from road debris and excessive heat buildup. The back of a compartment or a compartment shelf is often an ideal location. The foam system, bypass valve, strainer and shut-off valve are located on the foam pump and motor assembly and access to these components must be provided.

The foam pump and motor assembly must be mounted below the discharge of the foam tank to provide for gravity feed to the foam pump. The foam tank must be located where refilling can be easily accomplished with 5 gallon (19 liters) pails and other methods suitable to the end user. Most water tank manufacturers build the foam tank into the booster tank.

When specifying a foam tank, make sure provisions are made for:

- ❑ Installation of the low tank level sensor

- ❑ Foam suction connections
- ❑ Tank drainage
- ❑ Proper fill openings, per NFPA requirements.

In addition, a foam tank refill system may be required. See Hale EZFill system for these installation requirements.

CONTROL UNIT AND INSTRUCTION/SYSTEM DIAGRAM PLACARD

Determine a location on the operator panel of the apparatus for the control unit and instruction/system diagram placard, if provided. These components must be located at the main pump operator position in close proximity to each other. Consideration must be given for routing the control cable from the control unit to the distribution box on the foam pump and motor assembly. If necessary, order longer or shorter cable assemblies to suit the location demands.

INSTALLER SUPPLIED COMPONENTS

Due to the many differences in apparatus configurations and design requirements the Hale FoamLogix system installer must supply components, such as,

- ❑ mounting brackets
- ❑ piping
- ❑ hoses
- ❑ fittings
- ❑ electrical wiring.

The following guidelines are recommendations for selection of additional components for a complete system installation. These recommendations reflect materials and components that are tested extensively with Hale FoamLogix systems and provide proven reliable performance.

Foam Concentrate Suction Hose

The Hale FoamLogix 2.1A Foam system is provided with 15’ (4.6 meters) of 1/2” (13 mm) ID reinforced PVC foam concentrate suction hose. The system installer may need to supply additional fittings and hose from the foam tank to the inlet of the foam pump.

All components selected transfer foam concentrate, therefore they must be compatible with the foam concentrates being used in the system. Hoses for Class A foam concentrates have minimum 1/2” (13mm) inside diameter.

Hoses for the foam concentrate suction must have a rating of 23” (584.2 mm) Hg vacuum and 50 PSI (3.5 BAR) pressure or greater.

Note: NFPA requires that foam concentrate suction hose be clear to observe foam concentrate flow during foam pump operation.

Recommended Components

- ❑ **Hose:** PVC, Kuriyama Kuri-Tec K3130 or K7130 series
- ❑ **Fittings:** Hose Barb Type; Brass, Stainless Steel or Nylon

A foam tank shut-off valve is provided. A drain valve is recommended in the foam tank suction hose to allow, tank drainage and easier priming.

These components are subject to the same material characteristics and pressure ratings as stated above.

The foam concentrate strainer includes a shut-off valve. This valve is used to shut off foam concentrate flow to service the strainer.

Foam Concentrate Discharge Hose

The system installer must supply fittings and hoses from the foam pump inject connection to the check valve/injector fitting inlet. All components selected transfer foam concentrate, therefore they must be compatible with the foam concentrates being used in the system.

The foam pump discharge connection is a 1/2" (13 mm) compression fitting. The check valve injector fitting connection has 1/2" NPT threads. Hoses and fittings of 1/2" minimum diameter rated at 500 PSI (34.5 BAR) working pressure or maximum discharge pressure of the fire pump must be used. Fittings and hoses must be compatible with all foam agents to be used.

Recommended Components

- **Hose:** Aeroquip 2580-8 or Equivalent Reinforced Hydraulic Hose.
- **Fittings:** Brass or Stainless Steel Hose End Crimp or Reusable Type (Aeroquip 412-9-8 or Equivalent)

Foam Concentrate Bypass Hose

The foam concentrate bypass hose connection is a 1/2" (13 mm) hose barb connection. Hoses and fittings of nominal 1/2" diameter must be used as bypass hose. Since the bypass hose is used for calibration and draining the system it does not see high operating pressures; therefore, a hose with a lower pressure rating than the inject hose may be used.

Fittings and hoses used must be compatible with all foam agents expected to be used. Use fittings made of brass or 300 series stainless steel compatible with all foam concentrates.

Recommended Components

- **Hose:** Low Pressure Hydraulic Hose or Air Brake Tubing
- **Fittings:** Brass or Stainless Steel

It is recommended that the foam concentrate bypass hose be long enough to extend past the apparatus running board to reach five (5) gallon (19 liter) containers, making foam pump setup and calibration simpler.

Check Valves

Check valves must be installed on the apparatus with foam systems to prevent contamination of the foam concentrate with water and contamination of the fresh water tank with foam. (See Figure 3: "Typical Hale FoamLogix 2.1A System Layout" on page 20.)

When a Hale FoamLogix 2.1A foam injection system and related components are properly installed the required check valves are integral parts of the system.

NFPA standards require a check valve in the foam concentrate injection line at the injection point. The Hale p/n: 038-1790-00-0 Integral Check Valve/Injector Fitting, a standard component included with the Hale FoamLogix 2.1A system and installed when a manifold kit is ordered, meets these requirements and threads directly into the foam injection port on Hale manifolds.

Check valves must be installed in all water piping locations where foam concentrate could drain back into pumps or other components of the fire apparatus.

As a minimum one check valve must be installed where the water piping that supplies foam solution connects to the fire pump discharge. To more effectively keep foam contamination out of the fire pump and water tank, double check valves may be used.

Separate two check valves by at least 6” to 8” (152 to 203 mm) of piping to form a dead zone between the check valves. Individual drain lines should be used on each check valve. The waterway check valves must be rated for 500 PSIG (34.5 BAR) test pressure.

Flushing Water Hose

If a Hale and USFS approved Class “A” foam concentrate is used, flushing of the Hale FoamLogix 2.1A system is not necessary as long as the system is used periodically.

If a flushing water hose is required to flush the foam pump, it must have a pressure reducer/regulator that limits the flush water pressure to 25 to 50 PSI (2 to 4 BAR). The tubing and fittings used must be compatible with foam concentrates being used in the system.

To be NFPA compliant, when flushing is required, the system installer must provide proper

- hoses
- shut-off valves
- check valves
- reducer/regulator
- connections for flushing water for the system.

Foam Discharge Drains

Drains must be provided from foam capable discharge piping components to prevent freezing in cold weather. When designing the drain system care must be taken to prevent contamination of the water system with foam and the foam concentrate with water. Some multiple drain systems that allow individual drain lines to communicate also allow foam to bypass the installed check valves causing contamination of fire pump and the water or foam concentrate storage tanks.

Hale offers an optional manual or air-operated 6-port drain valve, Class 1 Model MMD6 (p/n: 104961). The valve provides individual drains with a single control and is use for applications where a single point for multiple drains is required. If a Hale MMD6 drain valve is not used, individual drain lines and valves for foam capable discharge piping is recommended.

Electrical Requirements

The system installer must provide the primary power wire and a ground strap for the Hale FoamLogix system.

Primary power must be supplied from the main apparatus battery to the motor controller box on the foam pump and motor assembly. The Hale FoamLogix 2.1A requires minimum 40 AMP electrical service.

Primary electrical power must be supplied directly from the battery or the battery master disconnect switch or solenoids to the Hale FoamLogix.

IMPORTANT!

OTHER ELECTRICAL COMPONENTS MUST NOT BE SUPPLIED FROM THIS WIRE. DO NOT CONNECT THE PRIMER AND HALE FOAMLOGIX TO THE SAME POWER WIRE.

The primary power connection must be made so that power is supplied to the Hale FoamLogix when the main apparatus electrical system is energized and the pump is in gear. Use of a solenoid with a 150 AMP peak, 85 AMP continuous rating is recommended. Figure 5: “Recommended Relay Wiring Schematic” on page 31, shows the recommended wiring for this relay.

Note: This ensures immediate operation when the operator places the apparatus in PUMP mode, and to prevent battery power drain when the apparatus is not running.

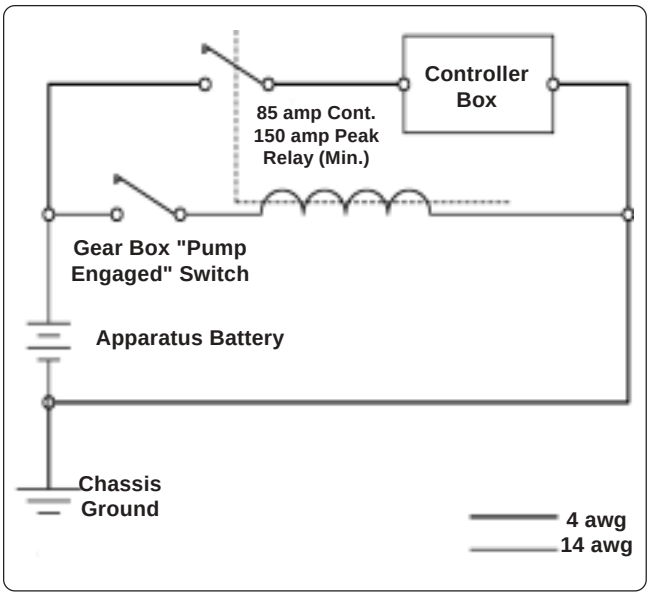


Figure 5: Recommended Relay Wiring Schematic

With Hale FoamLogix 2.1A, cable lengths up to 6’ (1.8 meters) require a minimum 8 AWG type SGX (SAE J1127) battery cable. (See Table 6: “Recommended Power Cable Sizes.”) Use solder lugs on cable ends with a 5/16” (8 mm) diameter hole.

Models 3.3 and 5.0	Maximum Length
8 AWG (8.4mm²)	6' (1.8M) or Less
4 AWG (21.2mm²)	6' (1.8M) to 15' (4.6M)
0 AWG (53.5mm²)	15' (4.6M) or Longer

Table 6: Recommended Primary Power Cable Sizes

When planning cable runs make sure the primary wires are routed by the shortest most direct route.

A braided flat ground strap connected to the apparatus chassis is recommended for the ground connection.

This limits the RFI/EMI interference encountered with radios, computers or other sensitive electronic equipment.

The ground strap should be a minimum of 1-1/4” (32 mm) wide and no longer than 18” (457 mm). It must have soldered flat lug ends with 3/8” (10 mm) diameter holes. If the ground strap length exceeds 18” (457 mm), a wider ground strap should be used or use a double thickness of 1-1/4” (32 mm) wide ground strap.

The ground strap must be connected to the chassis. Use minimum 5/16” (8 mm) diameter bolt or mounting to secure the strap.

Power and ground must also be provided for the display unit using the 2 pin Packard connector. The power must be a minimum 5 amp dedicated and fused circuit. The ground must be connected to the chassis ground stud and protected from corrosion.

Make sure the ground is attached directly to the chassis frame and not to the apparatus body work.

IMPORTANT!

BEFORE MAKING GROUND CONNECTIONS REMOVE ALL PAINT, GREASE AND COATINGS FROM THE CONNECTION AREA. AFTER MAKING CONNECTION, SEAL AGAINST CORROSION. WHEN A FLAT GROUND STRAP IS NOT AVAILABLE USE A BATTERY CABLE ONE SIZE LARGER THAN THE POWER CABLE USED.

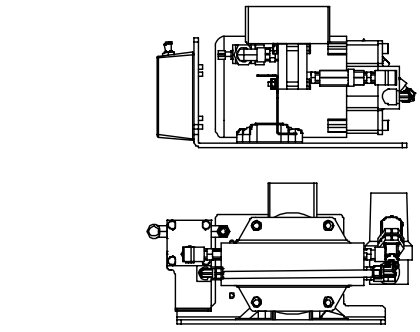
FOAM CONCENTRATE TANK

A foam concentrate tank must be supplied to suit the capacity required for the apparatus application. The tank must meet NFPA minimum standards for their design capacity, including:

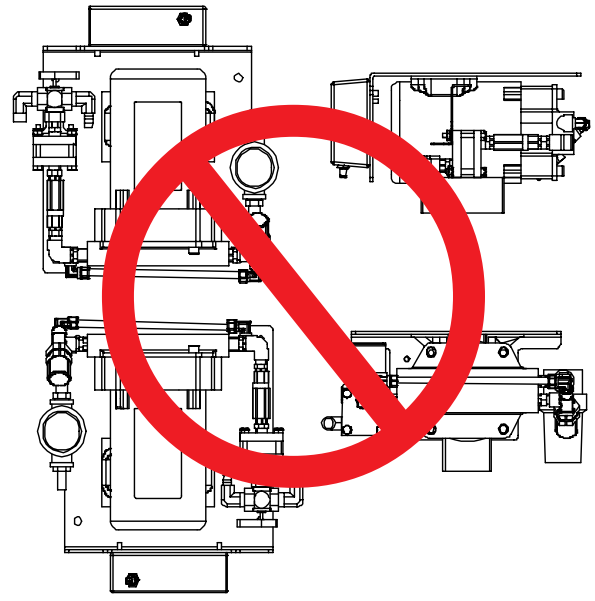
- ❑ Filler size
- ❑ Vapor pressure venting
- ❑ Baffling
- ❑ Drain facilities.

FOAM PUMP MOUNTING

Position the foam pump and motor assembly in the desired location on the apparatus. When installing the foam pump and motor assembly, the assembly should be kept in a **HORIZONTAL** position with the base plate on the bottom (See Figure 7: “FoamLogix Pump Installation.”)



CORRECT



INCORRECT

Figure 7: FoamLogix Pump Installation

Although the system is sealed and designed to be resistant to the harsh environment of fire fighting apparatus, a compartment with easy operator access is recommended.

The base plate of the foam pump and motor assembly must be anchored to a surface or structure that is rigid and of adequate strength to withstand the vibration and stresses of apparatus operation.

Figure 3: “Foam Pump Installation Envelope Dimensions,” on page 20, provides the mounting envelope dimensions for the FoamLogix foam pump and motor assembly.

Position the foam pump so the ON/OFF switch and bypass valve are easily accessible.

When the Hale FoamLogix system is ordered without the ADT option, a separate bypass valve is included that may be removed from the foam pump and mounted on a truck panel for easier access.

When ordered with the ADT option, the operating knob may be removed from the bypass valve actuator and an extension rod installed to permit remote operation. In either instance, the foam pump and motor assembly must be located to permit proper operation of the bypass valve.

Make sure the foam concentrate hoses are properly routed to the inlet and outlet on the foam pump. Foam concentrate must gravity feed to the foam pump inlet from the foam tank(s). The foam pump must be mounted in an area to avoid excessive engine exhaust system heat or accessory heat buildup.

The base of the foam pump and motor assembly includes 5/16” (8 mm) diameter predrilled mounting holes. The apparatus mounting location must to be drilled accordingly. The base plate may be used as a template to mark mounting hole location. Also see Figure 8: “Base Plate Mounting Hole Locations” on page 33.

PLUMBING INSTALLATION

Hale FoamLogix System plumbing diagrams are located at the end of this manual.

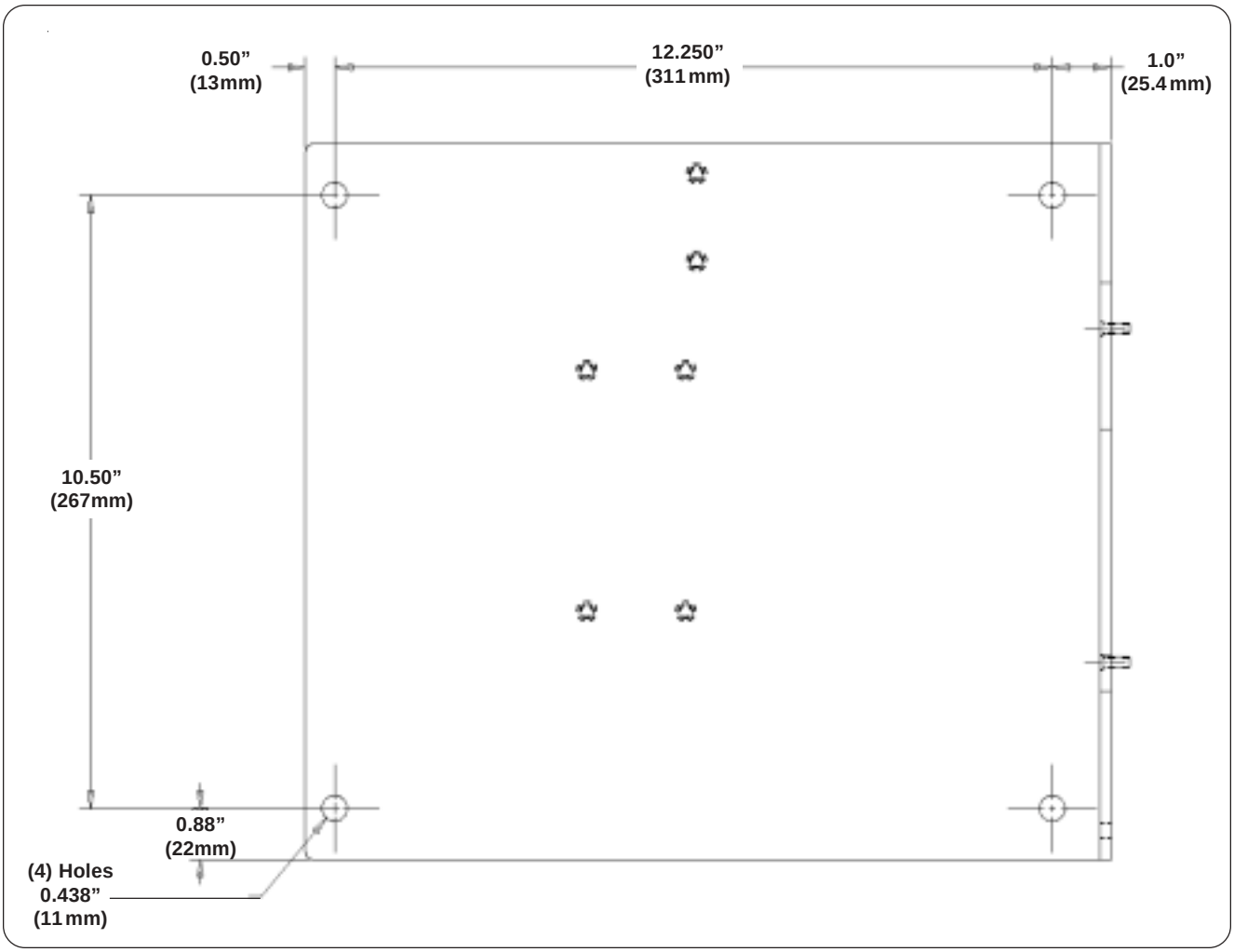


Figure 8: Base Plate Mounting Hole Locations

The diagrams provide recommended guidelines for the installation of system components that handle water, foam concentrate and foam solution. The sequence in which the plumbing installation is completed depends on your individual installation.

Water and Foam Solution Plumbing

When installing water and foam solution piping runs use the best industry practices to install this piping. Use a suitable pipe sealing compound at all joints.

Check Valve Manifold

The Hale pre-made stainless steel foam manifolds are recommended

The manifolds are available in kits and eliminate the extra labor and leaks from large pipe thread connections.

The manifolds use 3” (76 mm) Victaulic connections and are available in single or dual check valve configurations.

Figure 9: “Check Valve Manifold Installation,” on page 34, shows a typical check valve manifold installation.

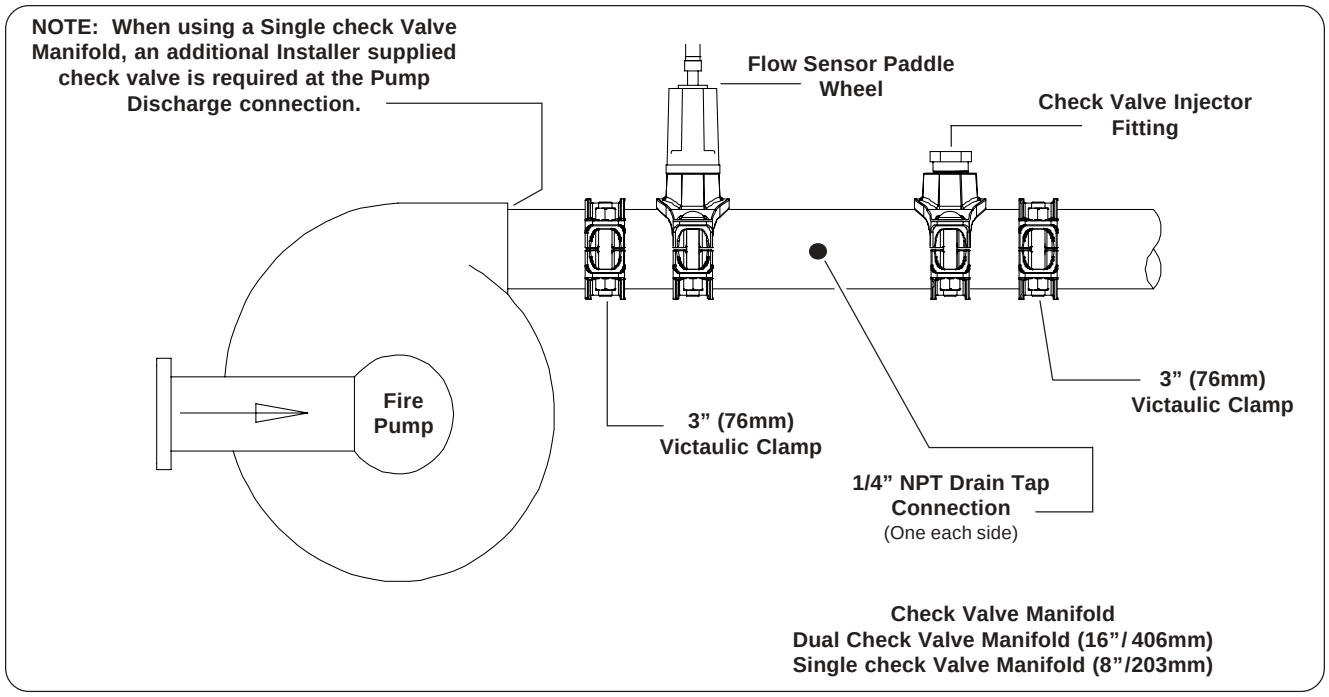


Figure 9: Check Valve Manifold Installation

Note: When the manifold is installed the drain tap that must be placed in the "down" position and plumbed to an individual drain.

When properly mounted, the flow sensor and check valve/injector fitting are on the side of the manifold and one of the drain ports is on the bottom. The flow sensor should point upwards slightly to allow drainage of water and sediment. See Figure 12: "Flow Sensor Tee Position Range," on page 36.

Optional Hale Piping Components

Hale piping components, such as 3" (76mm) and 4" (102mm) wafer-type check valves, 115 and 2433 series flanges, mini manifold, etc. are available to simplify installation of water and foam solution discharge piping.

The arrangement shown in Figure 10: "Typical Midship Pump Installation," on page 35, provides accurate proportioning across a wide range for up to four discharges from the mini manifold.

The Hale mini manifold provides a 1" NPT tap for installation of the check valve/injector fitting.

The Hale mini manifold and elbow components offer 4-3/8" diameter bolt circles and minimize fabrication and pipe work. After installation, make sure all pipes, hoses and tubes are supported using the best industry practices.

Figure 11: "Typical 4" Check Valve Installation, Midship Pump" on page 35 shows a suggested installation arrangement using Hale 4" check valves, pipe and Hale 2433 flanges.

"Waterway" Check Valves

Check valves in the waterway, rated at 500 PSI (34.5 BAR), are required to keep foam solution out of the main pump and allow pump priming without drawing foam into the piping.

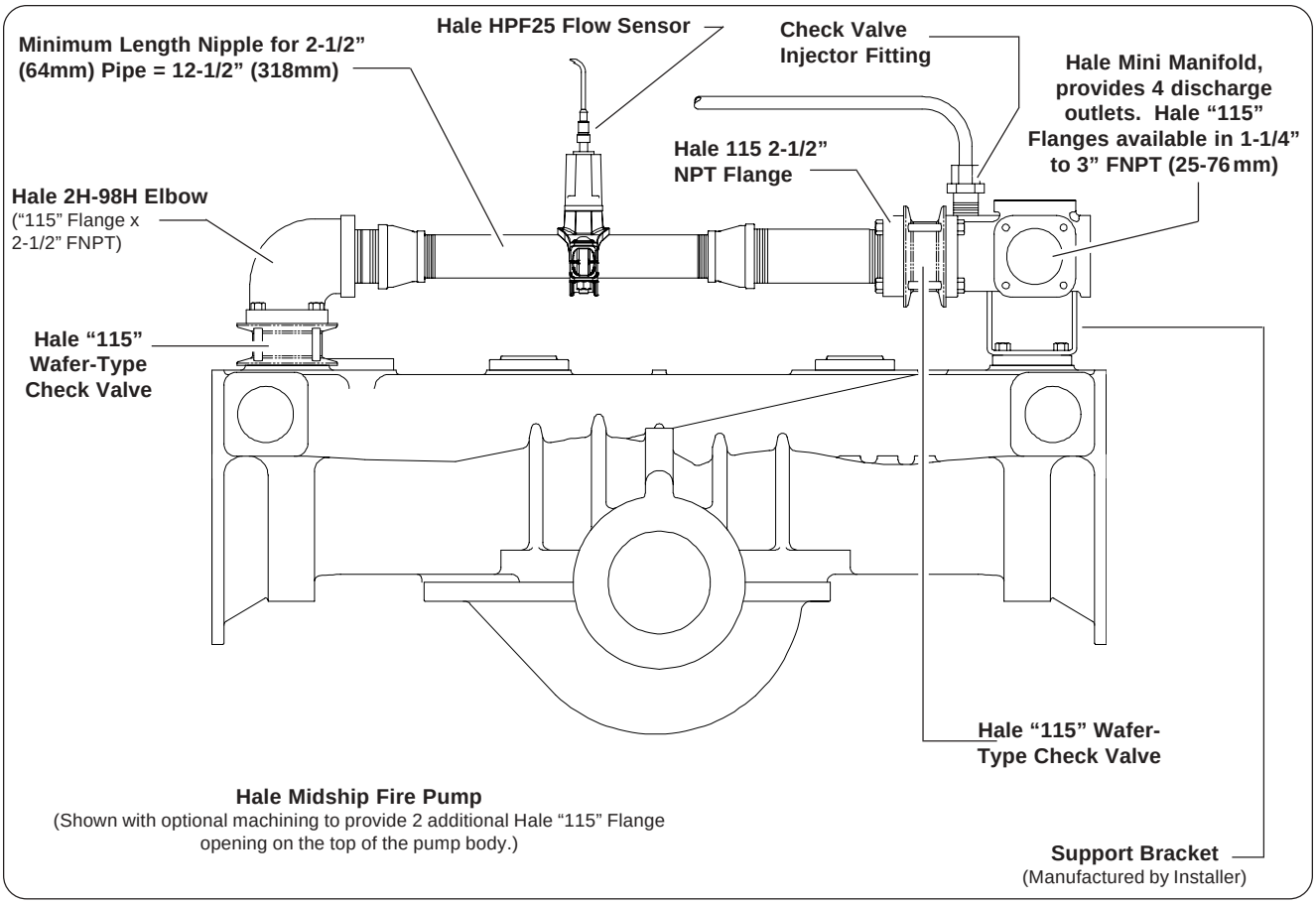


Figure 10: Typical Midship Pump Installation

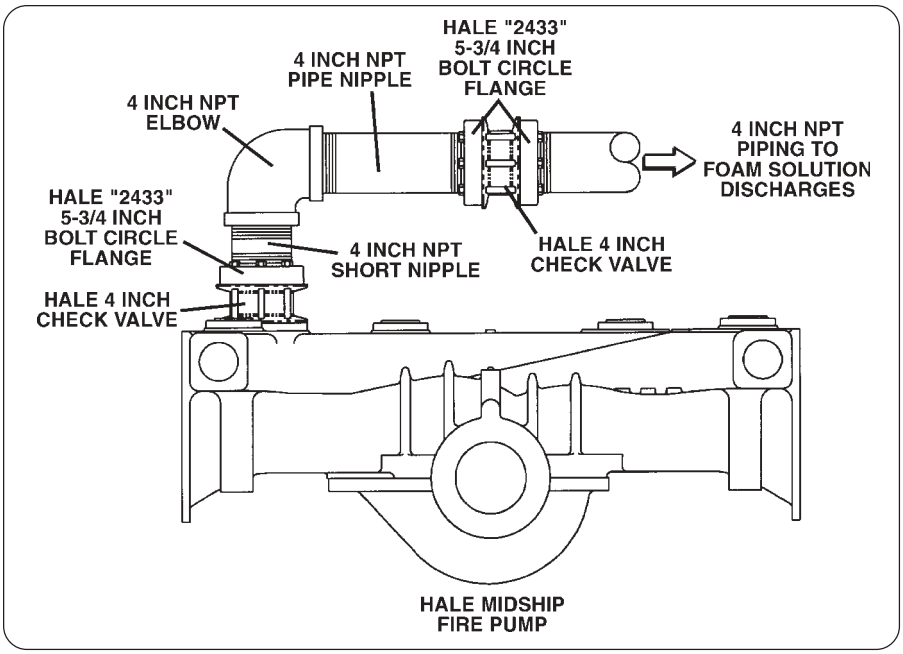


Figure 11: "Typical 4" Check Valve Installation, Midship Pump"

Using double check valves, separated by at least 6” to 8” (152 to 203mm) of pipe before the foam injection point, ensures that the pump and tank water remain uncontaminated.

Flow Sensor

The Hale FoamLogix flow sensor is specially designed to enable quick and easy sensor inspection and maintenance. The flow sensor paddle wheel is installed on a saddle clamp or weld fitting to the foam-capable discharge piping of the apparatus.

In horizontal piping runs, the flow sensor is mounted within the range shown in Figure 12: “Flow Sensor Tee Position Range.”

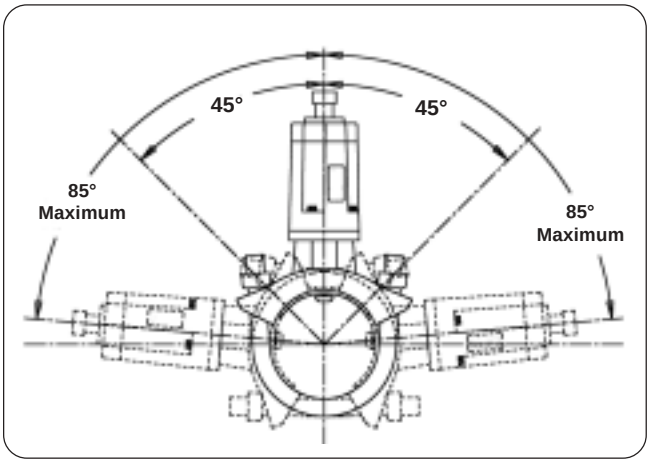


Figure 12: Flow Sensor Tee Position Range

When selecting a flow sensor, it is important to consider the minimum and maximum flow requirements during operation. Refer to the Table 4: “Pipe Size vs. Flow Rate,” on page 23, for the proper pipe size for flow range desired.

The flow sensor is installed in the piping before the foam concentrate injection point.

This is true in applications where the foam system needs to supply a 3” (76mm) deck gun, as well as a 1” (25.4mm) booster line.

Pipe Size	Minimum Recommended Straight Run Pipe
1-1/2" (38mm)	9" (229mm)
2" (51mm)	12" (305mm)
2-1/2" (64mm)	15" (381mm)
3" (76mm)	18" (457mm)
4" (102mm)	24" (610mm)

Table 13: Pipe Size vz. Minimum Straight Run

Pipe size for flow sensor mounting must be selected to provide accuracy at the lowest flow rate. Mounting the flow sensor in a short section of pipe, one pipe size smaller (e.g., 4” to 3”; 3” to 2-1/2”, etc.), provides better accuracy at the lower flows.

Refer to the Table 13: “Pipe Size vs. Straight Run” for pipe size. Selecting the next smaller pipe permits reducing the straight pipe run the required distance prior to the flow sensor paddle wheel.

In the short length of reduced pipe pressure loss is minimal and there is minimal pressure loss through elbows and fittings. See Figure 14: “Typical Reduced Size Sensor Piping Arrangement” on page 3-37.

Excessive turbulence in the flow sensor may produce unstable and inaccurate flow readings. The length of straight pipe prior to the flow sensor must be sufficient to reduce any turbulence in the pipe.

The following guidelines help attain the best readings, and maintain Hale FoamLogix system accuracy.

1. A minimum of **6 times the pipe diameter** of straight run pipe without any fittings is necessary prior to the flow sensor paddle wheel. (See Figure 15: “Flow Sensor Placement” on page 38.)

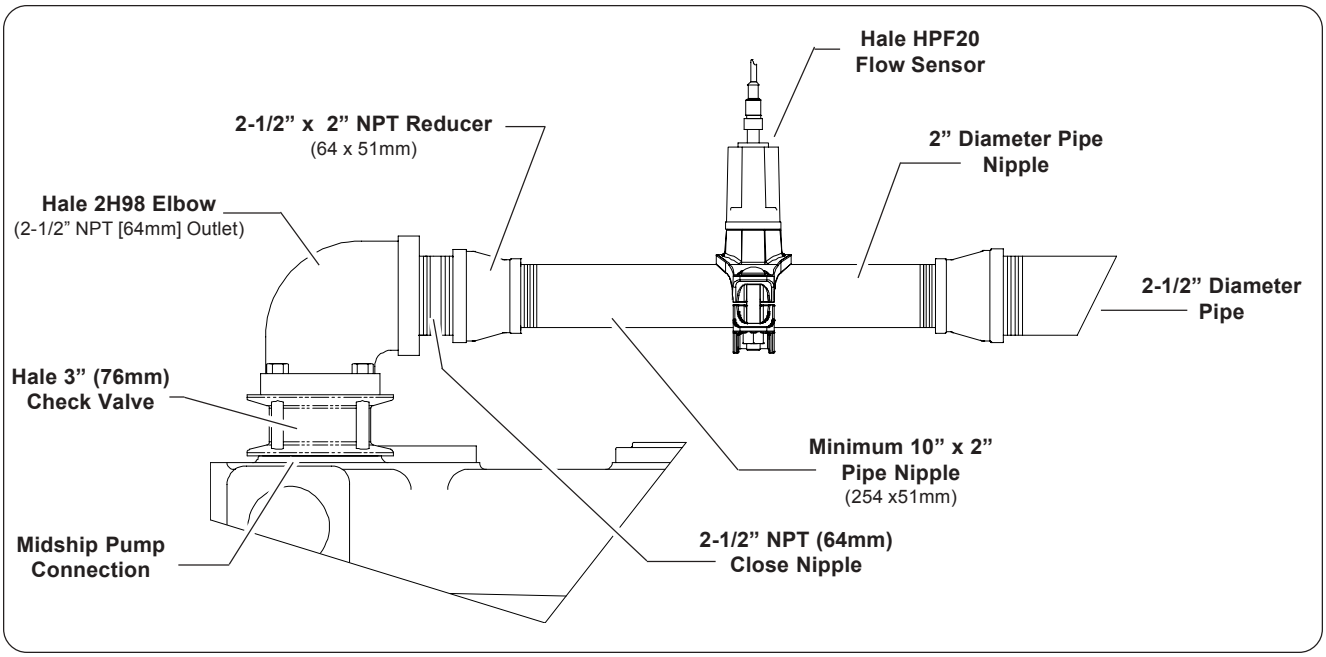


Figure 14: Typical Reduced Size Sensor Piping Arrangement

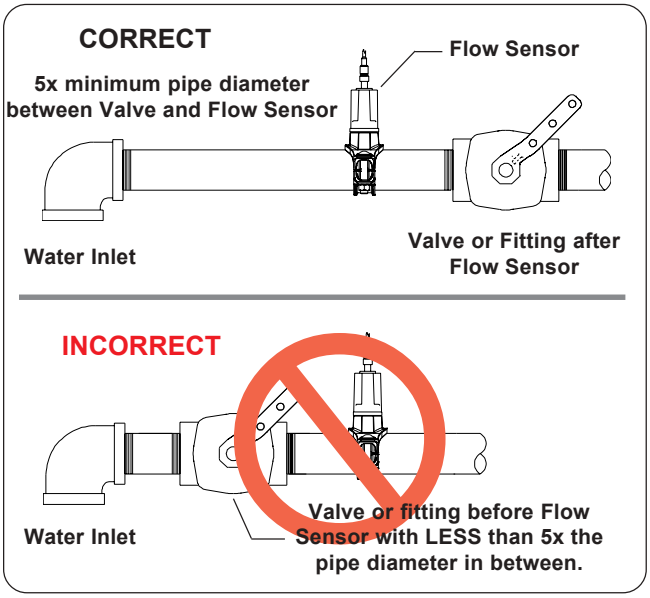


Figure 15: Flow Sensor Placement

2. The downstream piping length is not as critical, but there must be a short length of straight pipe with no fittings or valves immediately after the flow sensor paddle wheel. Two to three times the pipe diameter is recommended.

3. **Do not mount a flow sensor directly after an elbow or valve. Valves create severe turbulence when they are "gated".**

Saddle Clamp Installation

See Figure 16: "Flow Sensor/Saddle Clamp Installation" on page 38.

Installation of the Paddle Wheel Flow Sensor using a saddle clamp requires a 1.385"/1.390" (35/35.3 mm) bored hole in the pipe.

A minimum of six times the pipe diameter of straight run pipe without any fittings is necessary prior to the position of this hole.

The flow sensor requires a spacer and eight stainless steel internal hex head screws. These are supplied with the sensor.

Four 6-32 x 1/2" screws attach the spacer to the saddle clamp mount, and four 6-32 x 3/4" screws with lock washers attach the paddle wheel to the spacer.

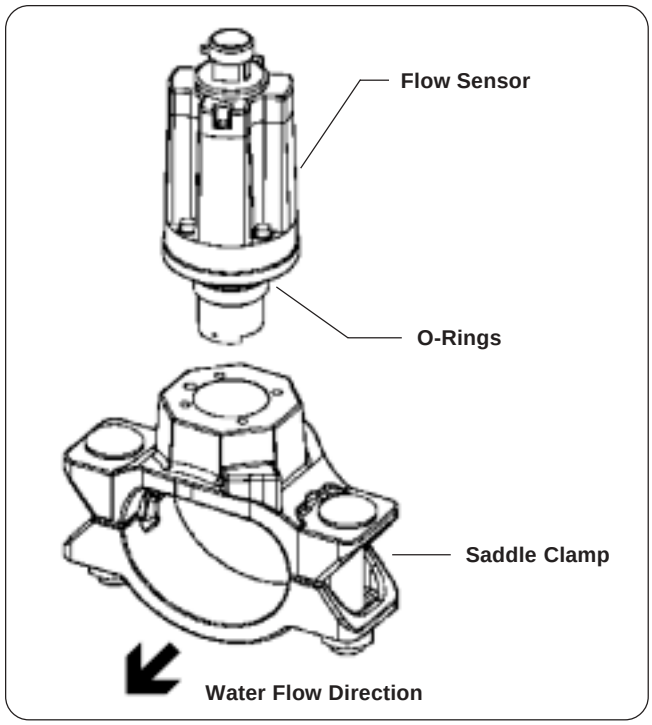


Figure 16: Flow Sensor/Saddle Clamp Installation

Align the indexing pin of the saddle clamp to the indexing hole of the spacer to align the saddle clamp mount.

Secure with four 1/2" machine screws, no lock washers. Torque to 8.5 in.-lbs. (1.0 N-m).

Align the paddle wheel indexing pin to the indexing hole in the spacer and secure using four 3/4" screws and lock washers. Torque to 7.5 in.-lbs. (0.9 N-m).

Apply a small amount of grease to the saddle clamp gasket before the final installation of the assembly onto the pipe. Firmly tighten the saddle clamp onto the pipe.

Foam Pump Flush System

The flushing water hose must be a minimum of 1/2" (12 mm) inside diameter. The flush water supply is provided from one of the pressure taps on the discharge side of the fire pump. It must be reduced to 50 PSI (3.5 BAR). It is recommended to installed a check valve at the pressure tap to prevent contamination.

FOAM CONCENTRATE PLUMBING

CAUTION!

MAKE SURE THE FOAM TANK AND FOAM CONCENTRATE SUCTION HOSES ARE CLEAN BEFORE MAKING FINAL CONNECTION TO FOAM PUMP.

FLUSH TANK AND HOSES PRIOR TO MAKING CONNECTIONS.

MAKE SURE THE FOAM CONCENTRATE IS GRAVITY FED FROM THE TANK TO THE PUMP.

Foam concentrate plumbing consists of:

- ❑ Foam concentrate suction hose
- ❑ Foam strainer
- ❑ Foam concentrate discharge hose
- ❑ Check valve/injector fitting.

Foam Strainer Connection

CAUTION!

THE FOAM CONCENTRATE STRAINER ASSEMBLY, MOUNTED ON THE FOAM PUMP INLET, IS A LOW PRESSURE DEVICE. IT WILL NOT WITHSTAND FLUSHING WATER PRESSURE. IF FLUSHING WATER IS TO BE PROVIDED THE PRESSURE MUST BE LIMITED TO 50 PSI (3.5 BAR).

The strainer/valve assembly has 1/2" (12 mm) NPT female threaded ports. A 1/2" hose barb fitting is supplied to connect the 1/2" ID hose, provided with the Hale FoamLogix 2.1A installation kit.

The hose from the foam tank to the strainer must have adequate wall stiffness to withstand the vacuum of the foam pump while it is operating (23” [584 mm] Hg and 50 PSI [3 BAR], Kuriyama, Kuri-tec K-3130 or K-7130 series or equal).

After the foam pump is mounted on the apparatus, connect the PVC hose provided to the strainer inlet.

Install the clear plastic hose from the foam tank outlet to the inlet of the strainer/valve assembly. The inlet is on the valve end. Wetting the ends of the hose and fittings makes the installation on the hose fittings easier.

CAUTION!

MAKE SURE THE FOAM TANK AND FOAM CONCENTRATE SUCTION HOSES ARE CLEAN BEFORE MAKING FINAL CONNECTION TO FOAM PUMP. IF NECESSARY FLUSH TANK AND HOSES PRIOR TO MAKING CONNECTION.

Check Valve/Injector Fitting

The Hale check valve/injector fitting, supplied with the Hale FoamLogix system, meets NFPA requirements for a non-return device in the foam injection system. It prevents back flow of water into the foam concentrate tank.

When properly installed the brass and stainless steel construction check valve/injector fitting ensures foam concentrate is injected into the center of the water flow for better mixing.

Note: Always position the check valve/injector fitting at a horizontal or higher angle to allow water to drain away from the fitting. (See Figure 17: “Check Valve Injector Fitting Installation.”) This avoids sediment deposits or the formation of an ice plug.

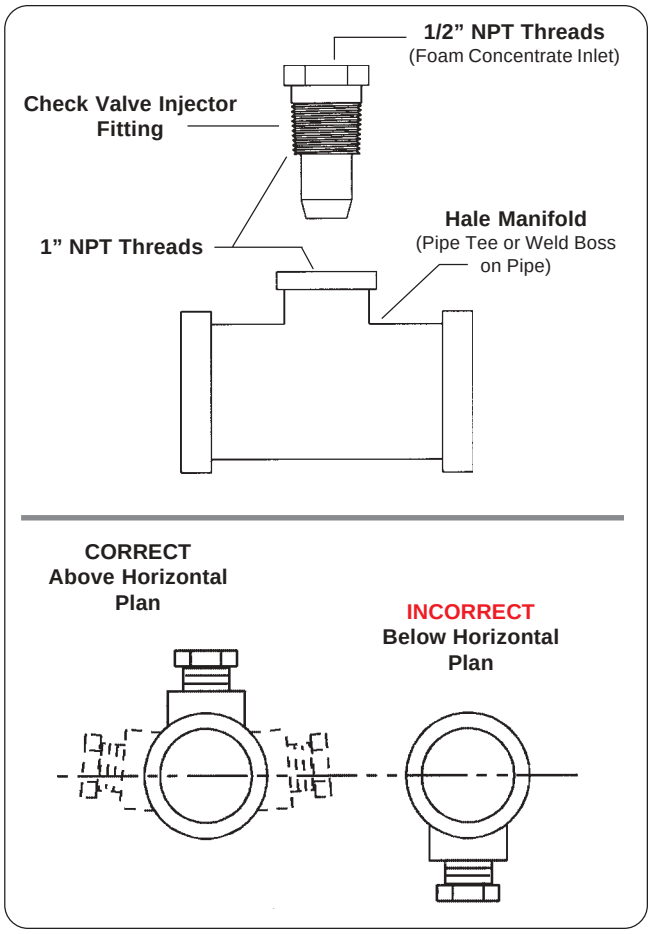


Figure 17: Check Valve Injector Fitting Installation

The check valve/injector fitting MUST be mounted in a location that is common to all discharges which require foam concentrate. (See Figure 17: “Injection and bypass Hose Connections.”)

The Hale FoamLogix system DOES NOT permit a separate injection point for each foam capable discharge.

The check valve/injector fitting has – 1” NPT (25.4 mm) threads on the outside, to fit into the 1” NPT threaded connection on the Hale mini manifold a pipe tee, or a 1” NPT weld fitting installed in the discharge piping of the fire pump. (See Figure 17: “Check Valve Injector Fitting Installation.”)

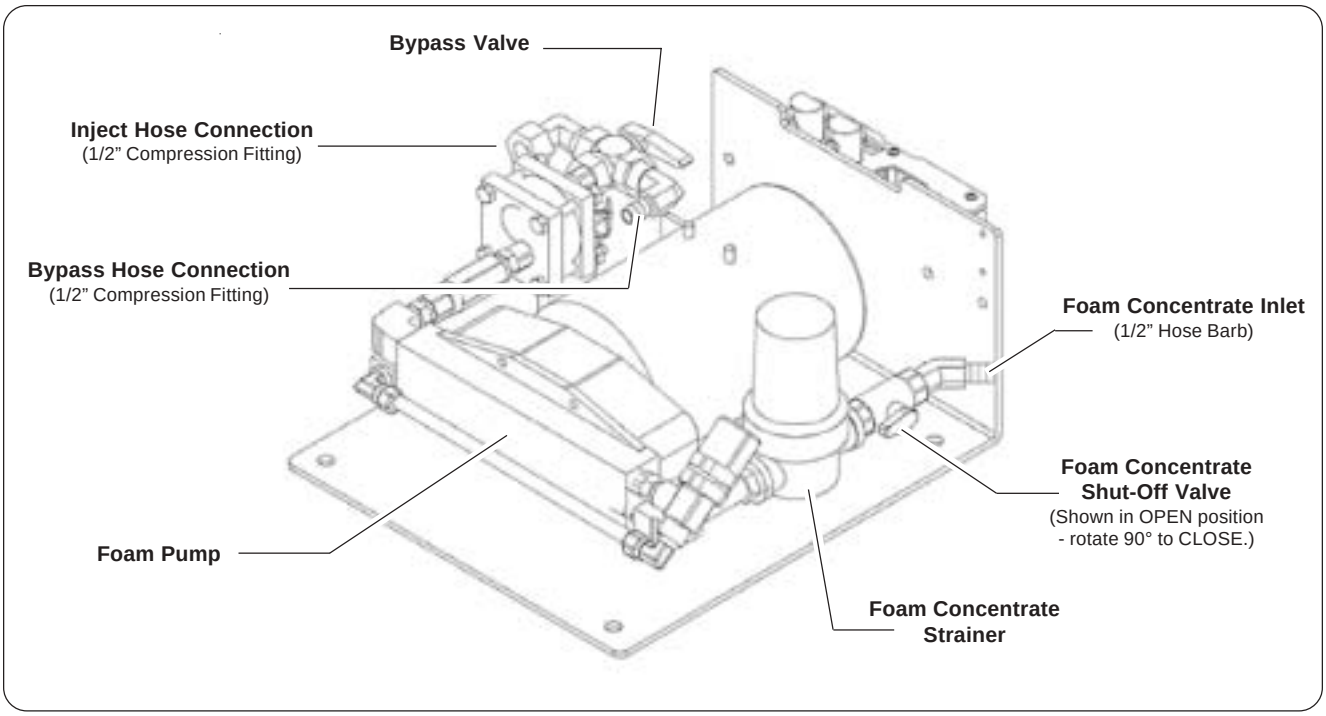


Figure 18: Injection and Bypass Hose Connections

The inlet connection of the check valve / injector fitting uses a 1/2" NPT female thread.

Foam Concentrate Injection Hose

Connect a hose from the foam pump inject port to the inlet of the check valve injector fitting. (See Figure 18 "Injection and Bypass Hose Connections.")

The hose and fittings from the INJECT port to the check valve injector fitting should have minimum 1/2" (13 mm) inside diameter and be rated at 500 PSI (34 BAR) working pressure (Aeroquip 2580-10 or equal).

Bypass Hose Connection

A bypass valve is mounted on the discharge of the foam pump. The bypass handle must be accessible by the pump operator during normal operations.

The bypass is a 3-way directional valve. Determine which port is the INJECT port and which port is the BYPASS. (See Figure 18: "Injection and Bypass Hose Connections.")

Bypass hose connections are 1/2". Hose fittings compatible with all foam concentrates must be provided. The hose from the BYPASS port is plumbed to the atmosphere.

This hose is used for calibrating the foam pump, pumping the concentrate into a container to empty the foam tank or to assist in priming of the foam pump. The hose from the BYPASS port must be long enough to reach a container outside the truck.

ELECTRICAL INSTALLATION

Electrical Connections

Complete system electrical diagrams are provided at the end of this manual. Refer to these diagrams for proper installation of each of the electrical components.

The Hale FoamLogix system is designed to be installed with a minimum of electrical connections. Cables are provided with each Hale FoamLogix system to make the flow sensor, control unit and motor controller box connections.

The system installer must supply primary power wire, low tank level sensor wire and flat braided ground straps.

CAUTION!

- ❑ Review the “Safety” section of this manual, beginning on page 9, in its entirety before proceeding with electrical connections.
- ❑ To prevent system damage or electrical shock the main power supply wire must be the last connection made to the Hale FoamLogix motor controller box. See Figure 3: “Typical Hale FoamLogix 2.1A System Layout” on page 20.
- ❑ The cables provided with each Hale FoamLogix system contain shielded assemblies.

  NEVER attempt to shorten or lengthen the shielded cables.

  If necessary order longer or shorter cables from Hale Products to suit the particular installation.
- ❑ The cables are indexed so they connect to the correct receptacle one way only. When making cable connections DO NOT force mismatched connections as damage can result, causing improper system operation.
- ❑ The cables shipped with each Hale FoamLogix system are tested at the factory with that unit. Improper handling and forcing connections can damage these cables which could result in other system damage.
- ❑ The system can only perform when the electrical connections are sound.

  Make sure each electrical connection is correct.
- ❑ Hale FoamLogix systems are designed for use on direct current, negative (–) ground apparatus electrical systems only.
- ❑ Do not mount radio transmitter or transmitter cables in direct or close contact with the Hale FoamLogix unit.
- ❑ Before connecting the cables, inspect the O-ring seal in the female connector. If the seal washer is missing or damaged, water can enter the connector causing corrosion of the pins and terminals resulting in possible system failure.
- ❑ The ground strap must be a minimum of 1-1/4” (32 mm) wide and no longer than 18” (457 mm).

  A longer ground strap must be wider or a double thickness strap must be used.

  Make sure the ground strap is attached to the chassis frame. Grounding to the body IS NOT acceptable.
- ❑ Always disconnect the power cable, ground straps, electrical wires and cables from the control unit or other Hale FoamLogix equipment before electric arc welding at any point on the apparatus.

  Failure to do so could result in a power surge through the unit that could cause irreparable damage.
- ❑ There are no user serviceable parts inside Hale FoamLogix system electrical/electronic components. Opening of these components (motor controller box or control unit) voids the warranty.

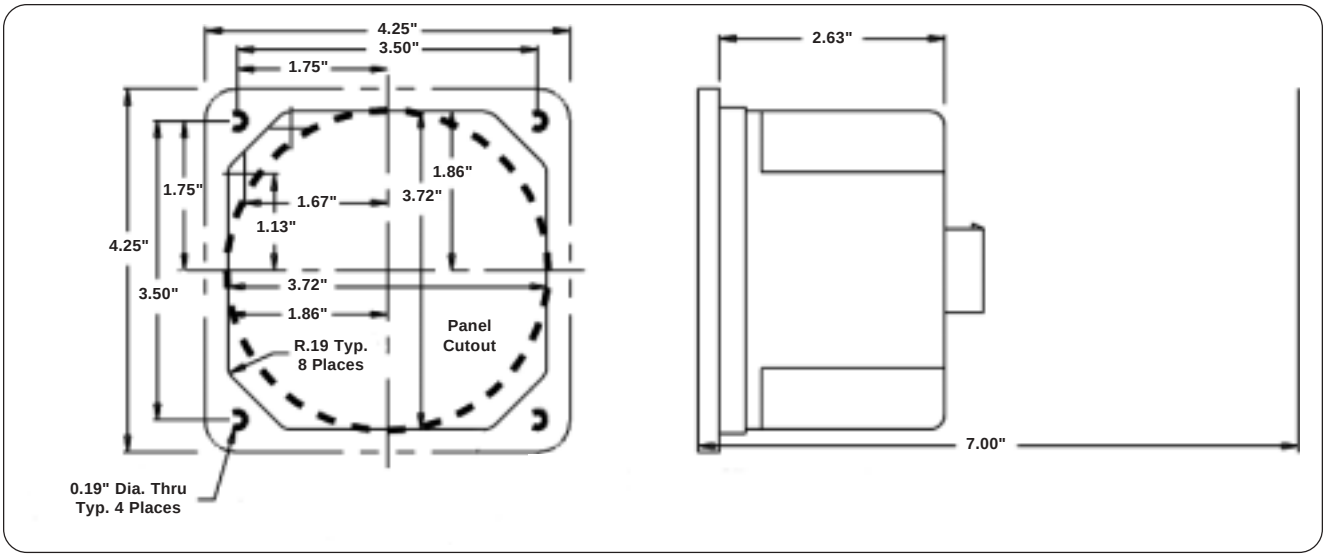


Figure 19: Control Unit Mounting Dimension

Control Unit

The control unit mounts in the operator panel of the apparatus. The display is secured with four #8 socket head screws. (See Figure 19 “Control Unit Mounting Dimension” for mounting dimensions).

The display requires a 7” (178 mm) minimum clearance from the back of the operator panel to allow proper connection of cables. Once the control unit is mounted on the operator panel, attach the 14 pin AMP connector on the cable assembly to the back of the display. Referring to Figure 20: “Control Harness Connections” and Figure 21: “System Power and Ground Connections,” on page 43, make connections to the motor controller box and flow sensor.

Notes: Ensure that the panel where the control unit is mounted has an adequate ground. For stainless steel and vinyl coated panels a ground strap ½ inch (12 mm) wide must be attached from one of the four screws holding the control unit in place to the frame of the fire truck to ensure adequate grounding.

Allow a service loop to prevent “pulling” of the wires or connectors during body and frame flex.

Display Unit Power and Ground Connections

Power must be connected directly to the display unit. The power and ground connection is the 2-pin packard connector on the 12” long pigtail of the harness (see Figure 20 on page 43).

The mating harness provided is approximately 18” long. If additional wire length is required, use minimum 16 AWG type SXL, or GXL (SAE J1128) wire.

Connect the black (B) wire to a chassis ground stud. Protect the ground connection from corrosion.

Connect the red (A) wire to the power supply. It is recommended to connect the power wire to a minimum 5 AMP, fused, dedicated circuit. If a dedicated circuit is not available, the power lead may be connected to a terminal where there is not a HIGH current load. Acceptable additional components powered from this terminal include ENFO IV, Governor, Tank Level Gauge, Etc.

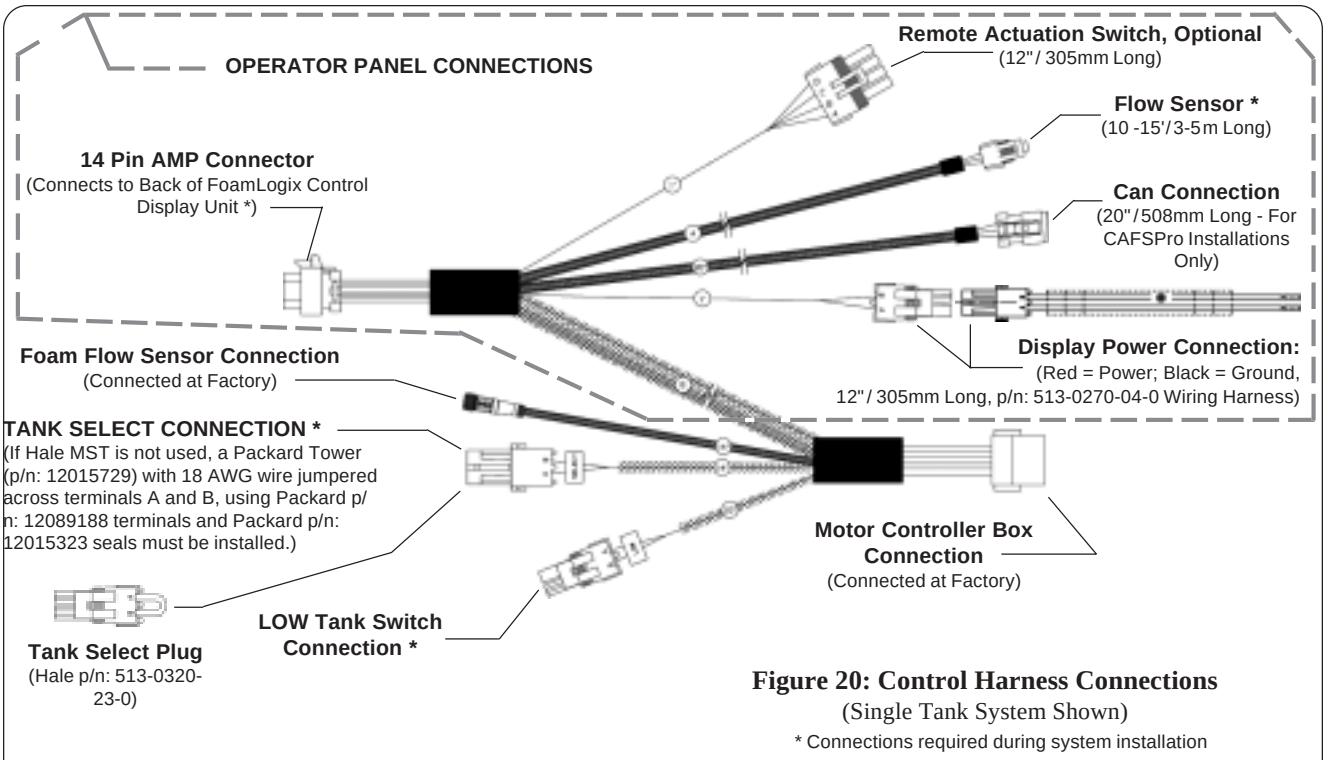


Figure 20: Control Harness Connections
(Single Tank System Shown)
* Connections required during system installation

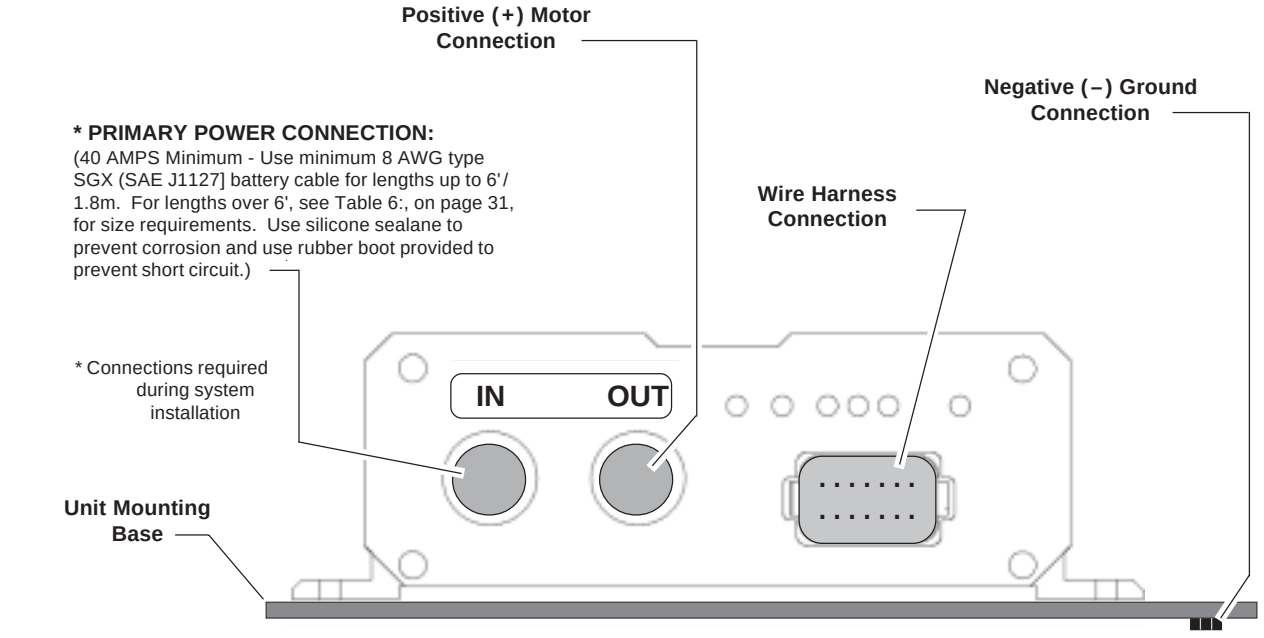


Figure 21: System Power and Ground Connections

Motor Ground / Primary Power

CAUTION!

CONNECT THE PRIMARY POSITIVE LEAD FROM THE TERMINAL BLOCK TO THE MASTER SWITCH TERMINAL OR RELAY TERMINAL USING MINIMUM 8 AWG TYPE SGX (SAE J1127), CHEMICAL RESISTANT, BATTERY CABLE AND PROTECT WITH WIRE LOOM.

PREVENT CORROSION OF POWER AND GROUND CONNECTIONS BY SEALING THESE CONNECTIONS WITH THE SILICONE SEALANT PROVIDED.

Ground Connection

Be sure the Hale FoamLogix system is grounded to the chassis. Use a short length of wide flat ground strap at least 1-1/4" (32 mm) wide and less than 18" (457 mm) long to reduce the potential of RFI emitted by this connection.

A stud is located on the mounting base to attach the chassis ground strap to the Hale FoamLogix system. (See Figure 21: "System Power and Ground Connections" on page 43.)

When making the ground strap connections make sure lugs are soldered to the strap ends for trouble free connections. Seal all connection against corrosion.

When the length of the ground strap exceeds 18" (457 mm) use a wider strap or a double thick strap.

CAUTION!

DO NOT CONNECT THE MAIN POWER LEAD TO SMALL LEADS THAT ARE SUPPLYING SOME OTHER DEVICE, SUCH AS A LIGHT BAR OR SIREN. THE HALE FOAMLOGIX MODEL 2.1A REQUIRES 40 AMP MINIMUM CURRENT.

Primary Power Supply Connection

Make sure adequate switched electrical power from the battery + terminal to the battery connection stud on the motor controller box is provided. (See Table 6: "Recommended Primary Power Cable Sizes" on page 31.)

Use 8 AWG minimum type SGX (SAE J1127) battery cable directly to the battery, battery switch or solenoids for cable runs up to 6' (1.8 meters) long. Longer wire runs may require larger battery cable for proper operation. DO NOT connect power to the same connection as the pump primer.

RFI/EMI

Electrically shielded cables for control unit and flow sensor are provided with the Hale FoamLogix system. The cables are 100% electrically shielded to eliminate the potential problem of EMI/RFI.

Proper installation of system components and cables along with proper grounding will limit radio interference caused by the Hale FoamLogix system. Additionally, make sure radio cables and hardware are not located in the immediate area where Hale FoamLogix equipment is mounted.

Making round coils of extra control and flow sensor cables in the pump compartment can act as an antenna. While the control and flow sensor cables cannot be shortened, various lengths of cable are available to minimize the "extra" cable in the truck.

When routing control and flow sensor cables take care to avoid routing them next to antenna wires, radio power lines and radio components. When there is extra cable, double the cable back on itself and secure with plastic wire ties in a flat bundle instead of making a round coil. (See Figure 22: "Extra Cable Storage" on page 45.)

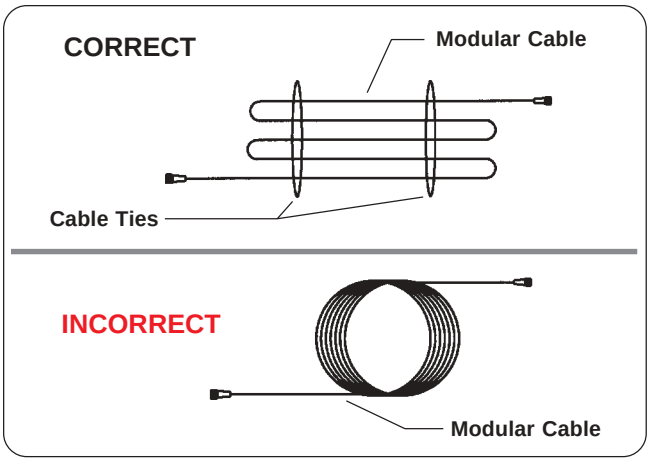


Figure 22: Extra Cable Storage

NOTES

START-UP CHECKLIST

Before energizing the apparatus and Hale Foam-Logix system for the first time make sure the following items are checked:

ELECTRICAL

- ❑ Tank level sensor wires connected to distribution box and sealed from moisture.
- ❑ Tank level sensor functions properly.
- ❑ Control cable connection at distribution box correct and tight.
- ❑ Flow sensor cable properly connected.
- ❑ All cables and wires are secured and protected from damage during operation.
- ❑ Control and flow sensor cables properly folded and secured; radio antennas, power lines and equipment away from cables.
- ❑ Foam pump and motor assembly properly grounded using flat ground strap.
- ❑ Correct voltage provided. Direct current, negative (–) ground.
- ❑ Adequate current, 40 AMPS minimum, available. Main power direct to battery, battery switch or solenoid without primer or other accessories tied in.
- ❑ Primary electrical and ground connections tight and protected from corrosion with silicone sealant.
- ❑ Splices in wires sealed from moisture using adhesive filled heat shrink tubing.

LIQUID

- ❑ Flow sensor mounted with flow arrow in the correct direction for water flow.
- ❑ Check valves are properly mounted in water and foam concentrate lines.
- ❑ Strainer mounted for proper concentrate flow direction in foam tank to pump hose.
- ❑ Foam tank to foam pump valve is in place and open.
- ❑ Check valve/injector fitting lines are proper size and connections are tight.
- ❑ Bypass valve is properly mounted and oriented for direction of concentrate flow.
- ❑ Foam concentrate gravity feeds to foam pump from foam concentrate tank.
- ❑ All hoses free of kinks and sharp bends.
- ❑ No sharp bends that can trap air exist in system.
- ❑ Flush water connections correct and tight.
- ❑ Discharge piping hydro tested in accordance with NFPA/UL requirements.
- ❑ Bypass valve handle is in the INJECT position.

FOAM PUMP

- ❑ Foam pump and motor assembly mounted in horizontal position with base plate down.
- ❑ Foam pump and motor assembly properly secured using proper mounting hardware.
- ❑ Foam pump suction and discharge hoses connected to proper ports.
- ❑ Foam pump suction and discharge hose fittings tight.

SYSTEM INSTALLER START-UP

On initial power-up of the Hale FoamLogix system, at the installer facility, the following procedures must be followed.

INITIAL SYSTEM POWER CHECK

Watch the display on the control unit as the apparatus electrical system is turned ON. Check the control unit readout for:

- ❑ FLOW
- ❑ TOTAL FLOW
- ❑ % FOAM
- ❑ TOTAL FOAM
- ❑ all bar graph LEDs light
- ❑ “88888” appears for several seconds
- ❑ “HALE CLASS 1 2002” scrolls across the display
- ❑ The default display, zero (0), if no water is flowing and FLOW LED

  (See Figure 23: “Control Unit Ready Indication”).

If a default display does not appear, refer to Section 6: TROUBLESHOOTING for possible causes and solutions.

INITIAL SYSTEM CHECK

After initial system power-up, low tank level sensor operation, foam pump operation and flow sensor calibration must be checked per the following:

CAUTION!

WATER IS USED AT THE SYSTEM INSTALLER FACILITY TO VERIFY LOW TANK LEVEL SENSOR OPERATION AND FOAM PUMP OPERATION AS THE END USER SPECIFIED FOAM CONCENTRATES MAY NOT BE READILY AVAILABLE.

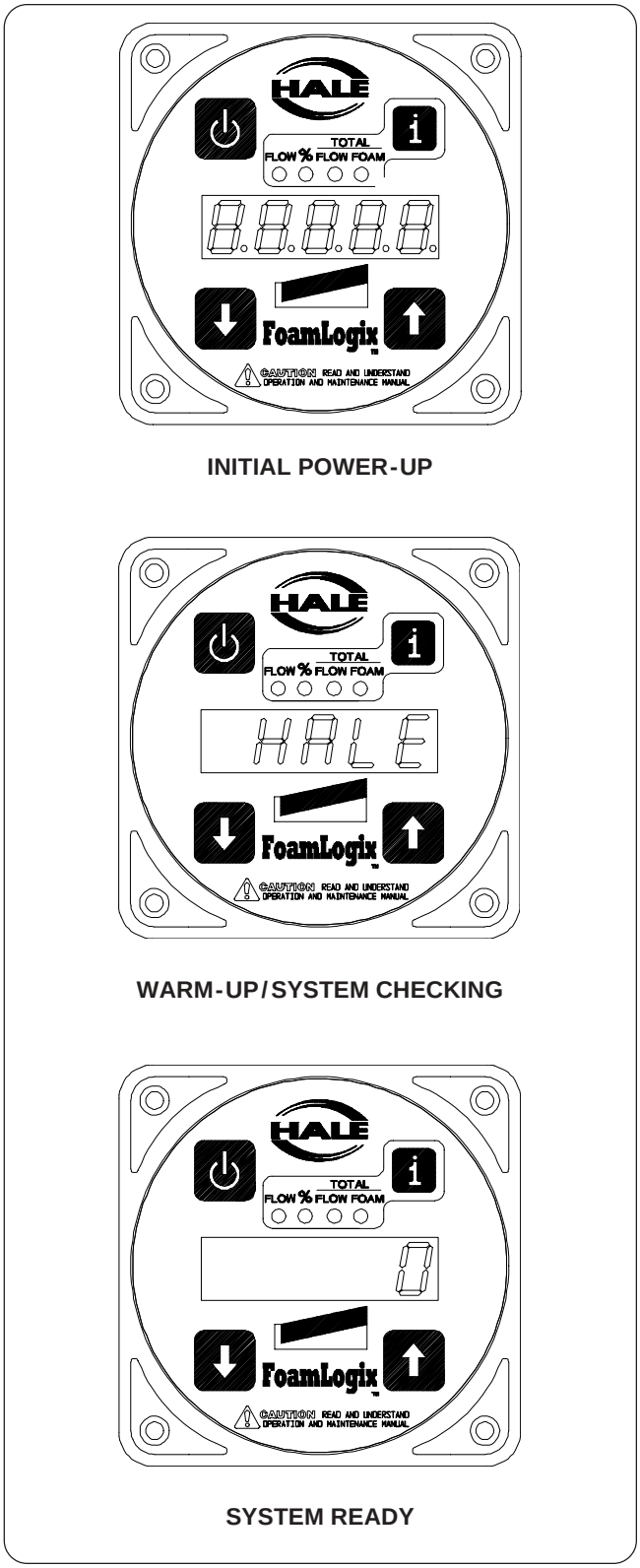


Figure 23: Control Unit Ready Indication

CAUTION! - continued

DO NOT PUMP WATER WITH THE HALE FOAM-LOGIX FOAM PUMP FOR MORE THAN ONE (1) MINUTE. DO NOT ATTEMPT TO CALIBRATE FOAM PUMP FEEDBACK SENSOR WITH OTHER THAN END USER SPECIFIED FOAM CONCEN-TRATE.

MAKE SURE THE BYPASS VALVE IS IN THE BYPASS POSITION WHEN PUMPING WATER WITH THE FOAM PUMP.

1. Upon initial power-up with the foam tanks empty, the display on the control unit alternates between **0** and **Lo A**, indicating the foam tank is empty.

   Fill the foam concentrate tank with WATER. The **Lo A** indication clears from the display, indicating the low tank level sensor is operating properly.

2. Place the bypass valve to the **BYPASS** position to check foam pump operation. Place a calibrated five gallon container at the discharge of the bypass hose.

3. Place the system in simulated flow mode by pressing the SELECT DISPLAY button (**i**) until the LED under **FLOW** lights. Then press both up ↑ and down ↓ buttons simultaneously.

   Set simulated flow value to **100** GPM by pressing UP ↑ or DOWN ↓ button. The display shows **S** at the left most position to indicate the simulated flow. (See Figure 23: “Simulated Flow Display.”)

4. Press the (**i**) button until the LED under **% FOAM** lights. Set foam concentrate injection rate to **1.0** using the UP ↑ or DOWN ↓ button.

5. Cycle the (**i**) button until the LED under **TOTAL FOAM** lights. Press the **ON** button to energize the Hale FoamLogix system.

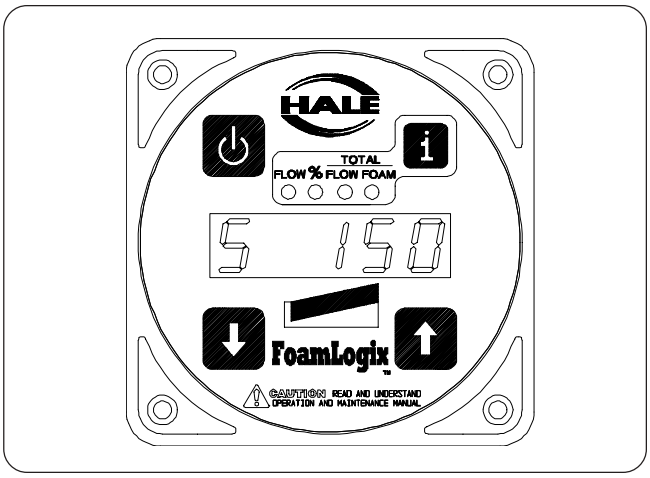


Figure 24: Simulated Flow Display

   Observe the discharge at the bypass hose to make sure the foam pump is operating.

6. After one minute press the **ON** button again to STOP the foam pump. Approxi-mately one gallon (3.8 liters) of water should discharge into the container. The TOTAL FOAM display reads approximately **1.0**.

7. Exit the simulated flow mode by selecting the **FLOW** display and pressing both up ↑ and down ↓ buttons simultaneously.

8. Drain water from foam tanks and concen-trate lines and return the bypass valve to the **INJECT** position.

9. Verify operation of the flow sensor. Also calibrate the flow sensor using the calibra-tion procedures. See heading "User calibration" beginning on page 51.

This completes the Hale FoamLogix system operation checks accomplished at the system installer facility.

Foam pump feedback calibration along with setting of user specified default simulated flow and concentrate injection rates should be accomplished upon delivery to the end user using actual end user specified foam concentrates and default values.

INSTALLATION AND DELIVERY CHECK LIST

After the Hale FoamLogix system is installed, use the following check list to verify installation and ensure proper system setup when the apparatus is delivered to the end user.

INSTALLATION

DATE	INITIALS	
_____	_____	❑ System properly installed. (Review Section 3: “Start-Up Check List” on page 46.)
_____	_____	❑ Tank level sensor function verified. (Review Section 3: “System Installer Start-Up” on page 47.)
_____	_____	❑ Foam pump operation checked. (Review Section 3: “System Installer Start-Up” on page 47.)
_____	_____	❑ Foam tank and hoses drained of water. (Review Section 3: “System Installer Start-Up” on page 47.)
_____	_____	❑ Flow sensor function checked and calibrated. (Review Section 3: “User Calibration” on page 51.)

DELIVERY

DATE	INITIALS	
_____	_____	❑ Foam tank filled with user specified foam concentrate. (Review Section 3: “Initial End User Setup” on page ?.)
_____	_____	❑ Foam pump priming checked. (Review Section 3: “Initial End User Setup” on page ?.)
_____	_____	❑ Flow sensor calibration verified with Pitot. (Review Section 3: “User Calibration” on page 51.)
_____	_____	❑ Default simulated flow value set to end user specification. (Review Section 3: “User Calibration” on page 51.)
_____	_____	❑ Default foam concentrate injection rate set to end user specification. (Review Section 3: “User Calibration” on page 51.)
_____	_____	❑ Foam concentrate feedback value verified and calibrated with end user specified foam concentrate. (Review Section 3: “User Calibration” on page 51.)
_____	_____	❑ Proper Hale FoamLogix system operation demonstrated to end user in accordance with manual procedures. (Review Section 4: “Operation” on page ?.)

DELIVERY - continued

DATE	INITIALS	
_____	_____	❑ End user trained in proper operation of Hale FoamLogix system in accordance with manual procedures. (Review Section 4: “Operation” on page ?.)
_____	_____	❑ Warranty registration card filled out by end user and mailed to Hale Products Inc.
_____	_____	❑ Two copies of Description, Installation and Operation manual provided to end user.

USER CALIBRATION

The complete Hale FoamLogix System; foam pump and motor assembly, control unit and flow sensor, is tested at the factory before shipping to the installer. If the Hale FoamLogix system is properly installed, further calibration IS NOT necessary until delivery to customer.

The system permits easy checking of component calibration to assure accurate operation. The calibration process verifies component calibration and allows adjustments to the flow sensor and feedback sensor display readings, to allow for variations in apparatus piping configurations and end user selected foam concentrate.

Default values for simulated flow and foam concentrate injection rate may be set to end user specifications while in the calibration mode.

> **Note:** The Hale FoamLogix system is calibrated at the factory to U.S. measurement (GPM, PSI, GALLONS, etc.) units. The system may be set to Metric units. (See heading “English to Metric Units” on page 56.) However, the same unit of measurement must be used throughout the calibration process to ensure proper proportioning by the system.

Recalibration of the system may be required ONLY after major repairs or component changes are made to the Hale FoamLogix foam system. Different viscosity foam concentrates may also required recalibration.

ENTERING PASSWORDS

Entering passwords is accomplished using the control unit function buttons.

To enter passwords, press and hold the **DISPLAY** button. The display shows **PASS,** then clears. While continuing to hold the display button press the ↑ or ↓ buttons sequentially to enter the password. See Table 25: “Password Entries.”

Mode	Password Sequence
User Calibration	↑↑↑↑
Rstore Factory Defaults	↑↑↓↑

Table 25: Password Sequence

RESTORE FACTORY DEFAULTS

To return to the factory default values, enter the restore factory values password (↑↑↓↑) as previously described.

Once the password is entered correctly the unit displays **FAC** and returns to normal operation.

Factory default values:

Simulated Flow .... 150 GPM (568 LPM)
% FOAM ..... 0.5% Class “A”

Also see Figure 26: “Display - Entering Password and Calibration Modes” on page 52.

CALIBRATION

1. To enter calibration password press and hold the SELECT DISPLAY button (**i**). The display shows PASS, then clears.

2. While holding **i** pressed, enter the calibration password (↑↑↑↑).

3. The display shows **CALL** for several seconds, followed by **L** *(or* **O** when display is set to metric). (See Figure 26: “Display - Entering Password and Calibration Modes” on page 52.)

   The **FLOW** LED (Water Flow sensor Calibration) also illuminates. (See Figure 27: “Display - Flow Sensor Calibration” on page 52.)

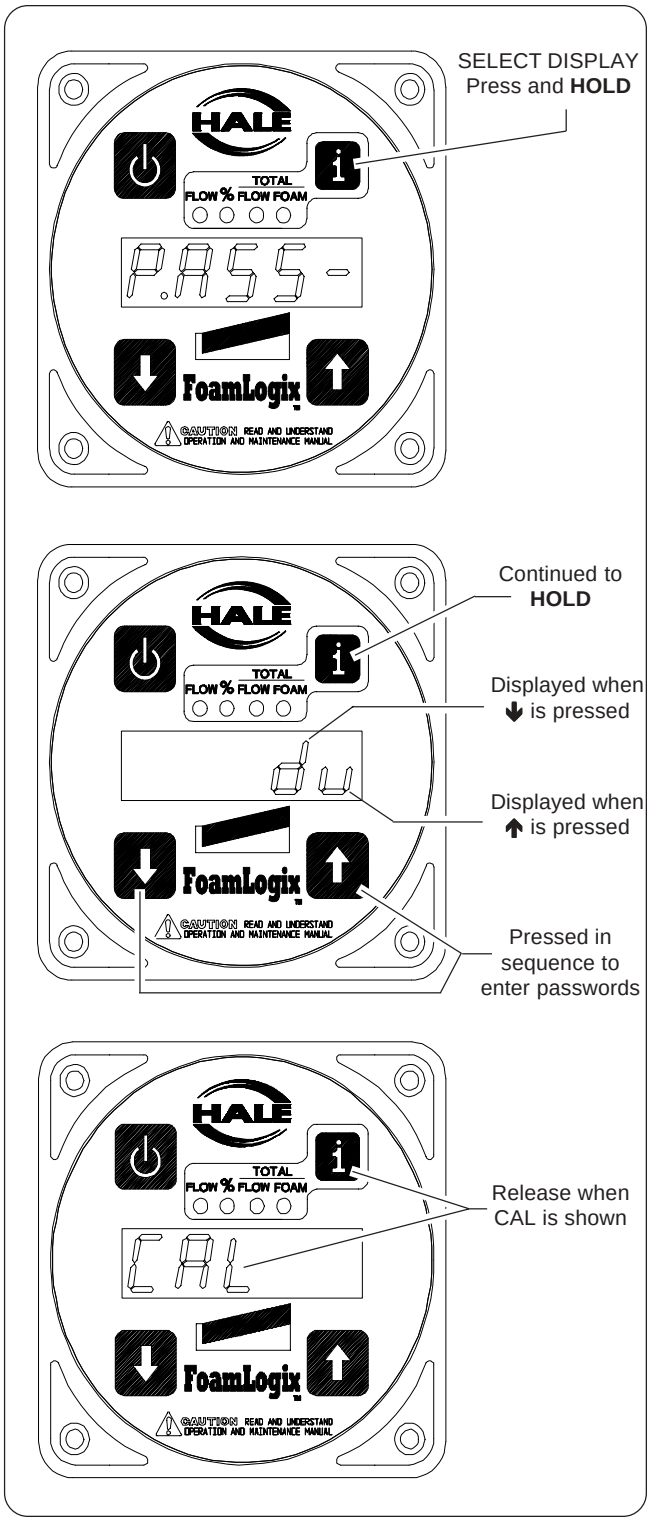


Figure 26: Display - Password and Calibration Modes

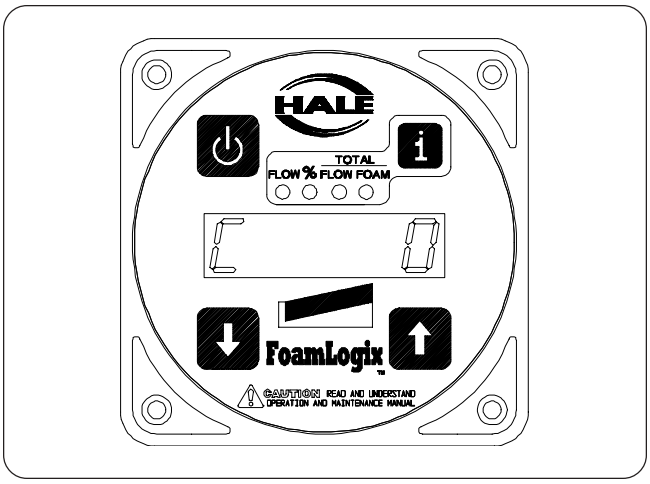


Figure 27: Display - Flow Sensor Calibration

FLOW SENSOR CALIBRATION

Verify flow sensor calibration during NFPA/UL testing of the apparatus and delivery to end user.

IMPORTANT!

AN ACCURATE FLOW MEASURING DEVICE MUST BE USED TO MEASURE THE WATER FLOW WHEN CALIBRATING THE FLOW SENSOR. USE A SUITABLE SIZE, SMOOTH BORE, NOZZLE AND AN ACCURATE AND CALIBRATED PITOT GAUGE INSTRUMENT. HAND HELD PITOT GAUGES ARE USUALLY NOT VERY ACCURATE.

MAKE SURE THE SYSTEM IS CALIBRATED WITH AN ACCURATE FLOW MEASURING DEVICE.

1. Determine the water flow normally expected from the discharge outlet and establish flow.

2. Make sure the water flow established is within the range of the flow sensor monitoring the discharge.

   For example, establish a flow rate of 150 GPM (568 LPM) of water through a nozzle and Pitot system. Compare the calculated flow value to the value shown on the control unit display.

3. Press the ↑ or ↓ button and set the reading to match the actual flow calculated from the Pitot gauge reading.

4. Decrease fire pump pressure by approximately one half (1/2) and recalculate water flow rate.

   Verify the reading on the control unit is within 5% of the actual value.

5. STOP the water flow when adjustments are completed.

Record Flow and Sensor Calibration Factors

Press and release the **i** button. The display show **F xx.x**, which is the water flow sensor calibration factor (See Figure 28: "Display - Flow Sensor Calibration Factor.")

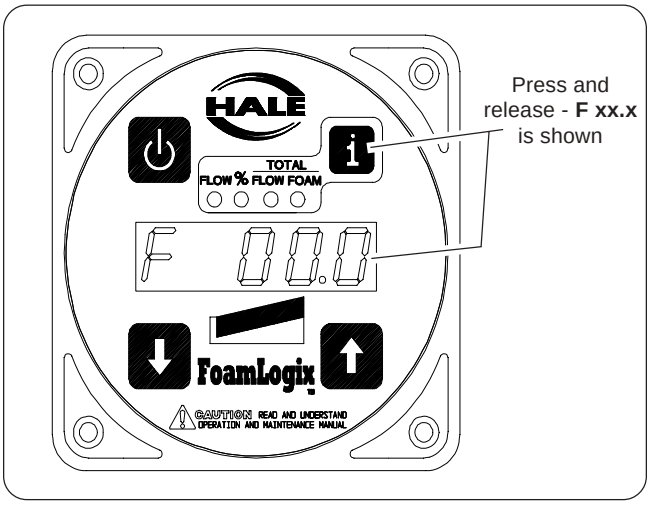


Figure 28: Display - Flow Sensor Calibration Factor

Record this value for future reference. This factor must be programmed into the display if the display is ever replaced.

WATER FLOW SENSOR CALIBRATION FACTOR: _____

SIMULATED FLOW

The default Simulated Flow value is factory set to 150 GPM (568 LPM) and, if necessary, may be adjusted while in the user calibration mode.

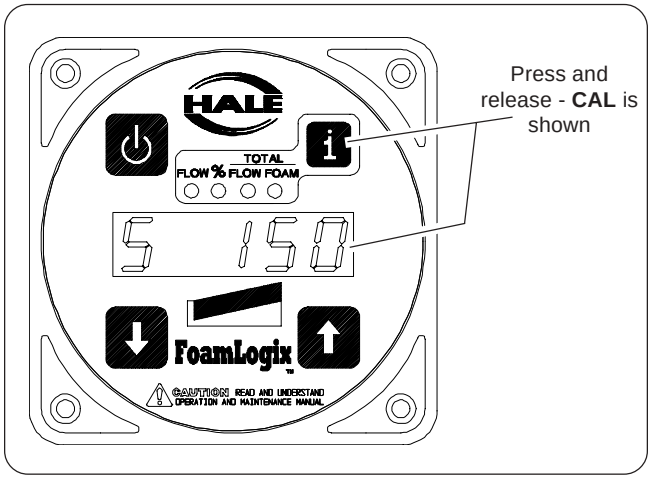


Figure 29: Display - Simulated Flow Calibration

Press the **i** button. The default simulated flow rate is shown. (See Figure 29: "Display - Simulated Flow Calibration.")

Adjust the setting to the required rate by pressing the ↑ or ↓ buttons (e.g., **S 150**).

FOAM CONCENTRATE INJECTION RATE

When the Hale FoamLogix system power is turned ON, the foam concentrate injection rate stored in memory is the default setting. The user specific default concentrate injection rate is adjusted in calibration mode.

1. Press the **i** button.

   The display shows the current default concentrate injection rate stored in the computer memory for the selected foam concentrate tank. (See Figure 30: "Display - Foam Concentrate Injection Rate Default Value" on page 52.)

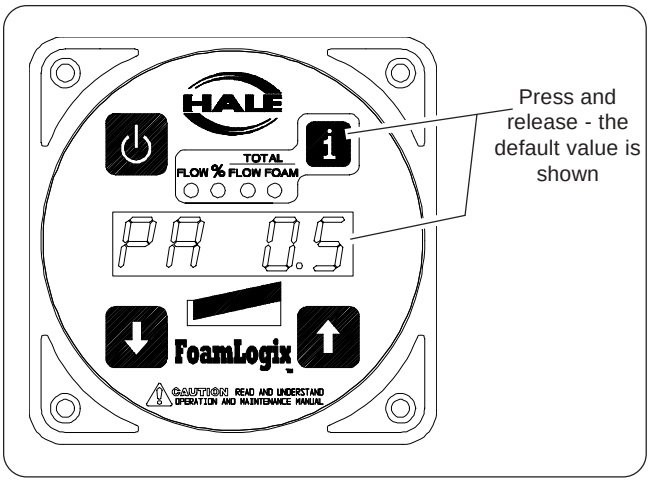


Figure 30: Display - Foam Concentrate Injection Rate Default Value

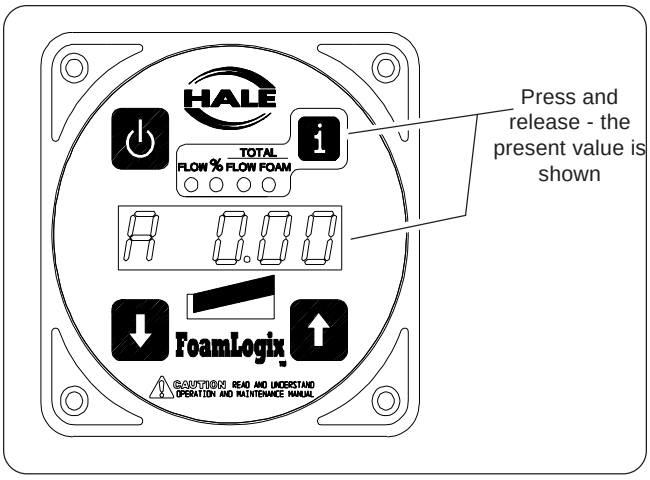


Figure 31: Display - Foam Pump Feedback Calibration

2. If the factory default values have not been changed the display shows **PA 0.5**.

3. Use the ↑ or ↓ buttons to set the user specified default concentrate injection rate.

FOAM PUMP FEEDBACK CALIBRATION

IMPORTANT!

FOAM PUMP FEEDBACK IS CALIBRATED AFTER INSTALLATION TO VERIFY VALUES WITH THE ACTUAL FOAM CONCENTRATE(S) BEING USED. ONLY CALIBRATE USING ACTUAL FOAM CONCENTRATES.

DO NOT USE WATER, TRAINING OR TEST FOAMS FOR FEEDBACK CALIBRATION VERIFICATION.

1. Press the **i** button.

   The display shows **A x.xx,** the total volume of foam concentrate pumped during the last calibration run. (See Figure 31: “Display - Foam Pump Feedback Calibration.”)

2. Set the bypass valve to the **BYPASS.**

3. Place a graduated measure container at the outlet of the bypass hose capable of containing the expected volume of foam concentrate, 5 gallons (19 liters) minimum.

   (See Figure 32: “Foam Concentrate Collection.”).

Note: If an accurate calibrated container is not available an accurate scale can be used to weigh the foam concentrate pumped. The total volume of foam concentrate is then calculated from this weight and the density of the foam concentrate per the MSDS sheet.

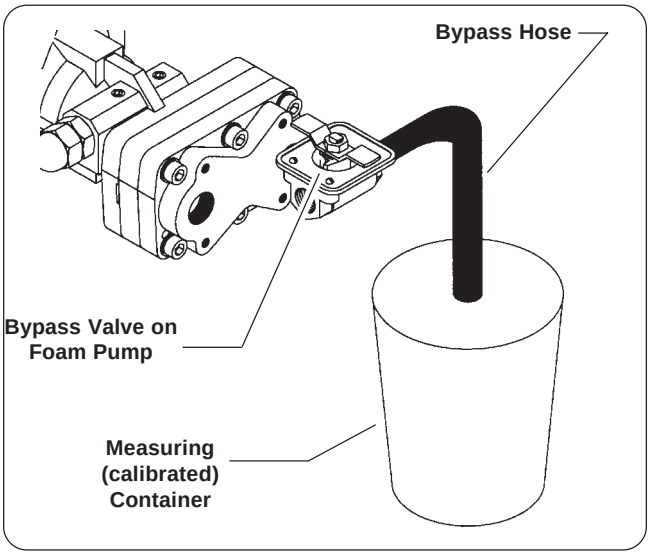


Figure 32: Foam Concentrate Collection

4. Start the Hale FoamLogix foam pump by pressing the red **ON** button.

   The LEDs on the horizontal bar graph lights as the foam pump begins operating at approximately two-thirds speed, pumping foam concentrate into the container.

   The display shows the volume of foam concentrate being pumped.

5. STOP the foam pump and accurately measure the amount of foam concentrate collected.

6. Adjust the reading on the display to match the volume actually pumped using the ↑ or ↓ button.

7. Repeat the procedure to verify the setting is correct.

8. Set the bypass valve handle back to **INJECT** position.

Record Foam Pump Feedback Calibration Factor

1. Press and release the **i** button.

   The display shows **FA xxx**, the foam pump feedback calibration factor. (See Figure 33: "Display - Foam Pump Feedback Calibration Factor.")

2. Record this value for future reference. This factor must be programmed into the display if the display is ever replaced.

FOAM PUMP FEEDBACK CALIBRATION FACTOR: _____

EXIT AND SAVE CALIBRATION

1. To exit calibration and save the set values, press and hold the **i** button.

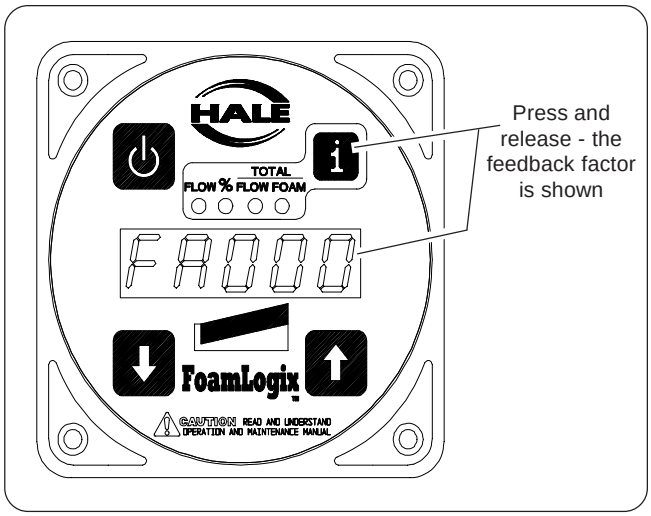


Figure 33: Display - Foam Pump Feedback Calibration Factor

   The display show **PASS**, then clears.

2. While continuing to hold the display button enter the password (↑↑↑↑).

3. The display shows **SCAL** for several seconds then cycles through the start-up sequence followed by the flow display **O**. (See Figure 34: "Display - Exit and Save Calibration.")

This completes verification and adjustment of the system. The Hale FoamLogix system is now ready to be placed in service.

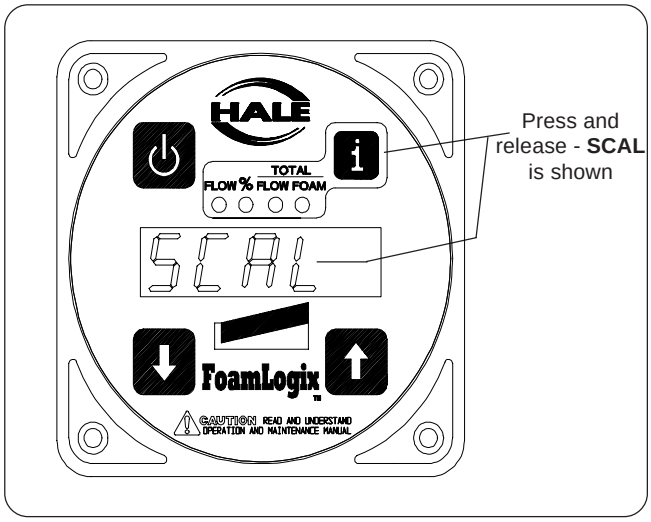


Figure 34: Display - Exit and Save Calibration

RELIEF VALVE

The pressure relief valve is factory tested and set to 300 PSI (21 BAR). (See Figure 35: “Relief Valve.”)

During normal installation and operation, the relief valve does not require adjustment.

If adjustment is necessary during field installation, contact Hale Products Inc. at 610-825-6300 for Relief Valve Service information.

ENGLISH TO METRIC UNITS

The FoamLogix Display offers both English and Metric readouts.

The Hale FoamLogix system is calibrated at the factory to U.S. measurement (GPM, PSI, GALLONS, etc.) units.

To convert to Metric units:

1. Press and hold the **i** button. The display show **PASS**, then clears.
2. While continuing to hold the display button enter the password (↓↑↑↓).
3. The display shows **IN** to indicate Metric units are selected.

Note: Switching to English is accomplished by repeating Steps 1 through 3. The display shows **EN** to indicate English units.

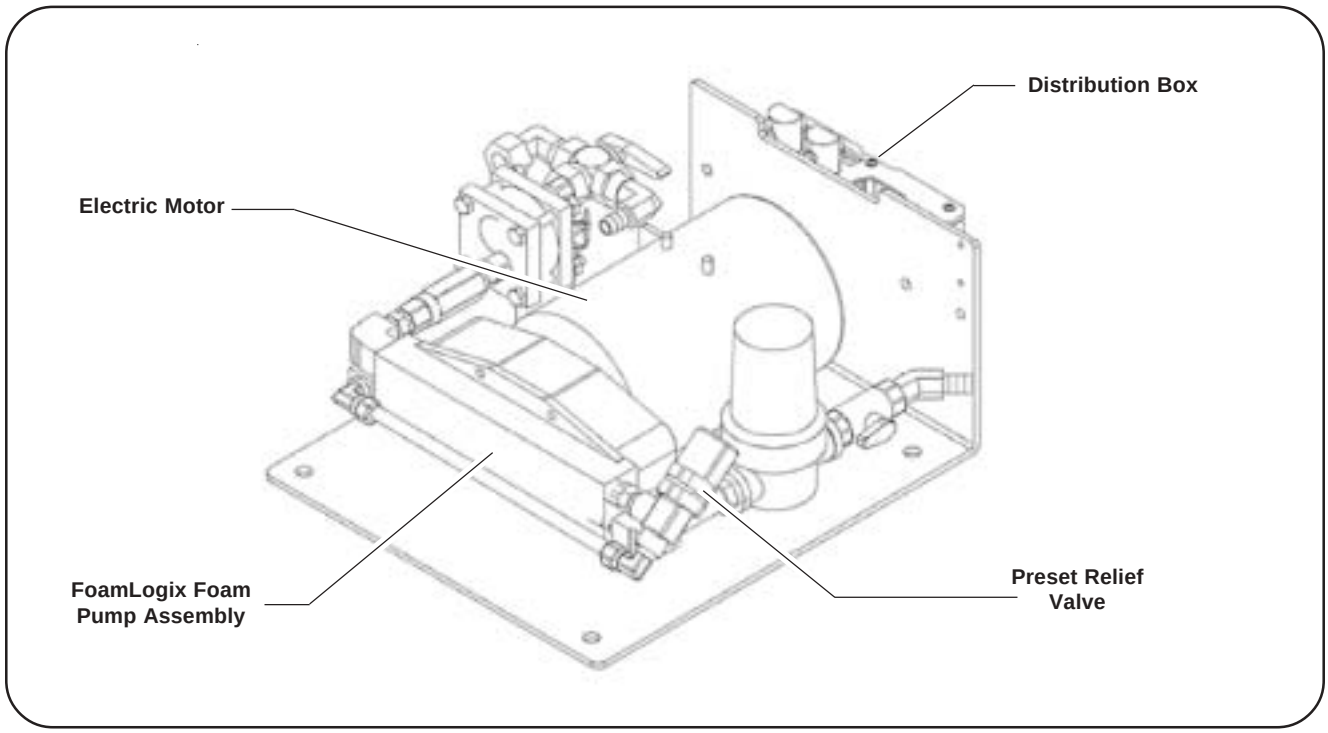


Figure 35: Relief Valve

SECTION 4 OPERATION

DESCRIPTION

Operation of Hale FoamLogix systems is controlled by the Digital Display Control Unit, provided with four push buttons (pads). (See Figure 36: “Digital Diaplay Control Unit Overview.”)

The Hale FoamLogix system constantly monitors water and foam concentrate flow values, maintaining foam injection at the specified concentrate injection rate. The system responds to variations in water flow by increasing or decreasing the speed of the foam pump.

On initial power up of the apparatus, the Hale FoamLogix system begins a brief self-diagnostic routine. When completed, the system enters the STANDBY mode. The **FLOW** LED lights and the dsiplay shows the current water flow rate in the monitored discharge pipe.

Pressing the DISPLAY button (**i**) cycles through the four functions as indicated by the red LED illuminating under each function.

Note: TOTAL FLOW and **TOTAL FOAM** values may be reset any time they are displayed. When the **% FOAM** LED is lit, or in any other function mode, the foam concentrate injection rate may be set to the desired value, if different from the default value. This may be adjusted prior to or during foam operations by pressing the ↑ and ↓ buttons. Also see heading “Control unit functions” on page 58.

When the red **ON** button is pressed, the FLOW LED illuminates indicating that the system is ready. If water flow is present the foam pump starts and injects foam concentrate into the discharge stream.

The bar graph lights when foam is being injected and indicates system capacity.

When the **ON** button is pressed again , the LEDs extinguish, indicating that the system is in STANDBY mode and the foam pump STOPS. However, other system monitoring functions continue.

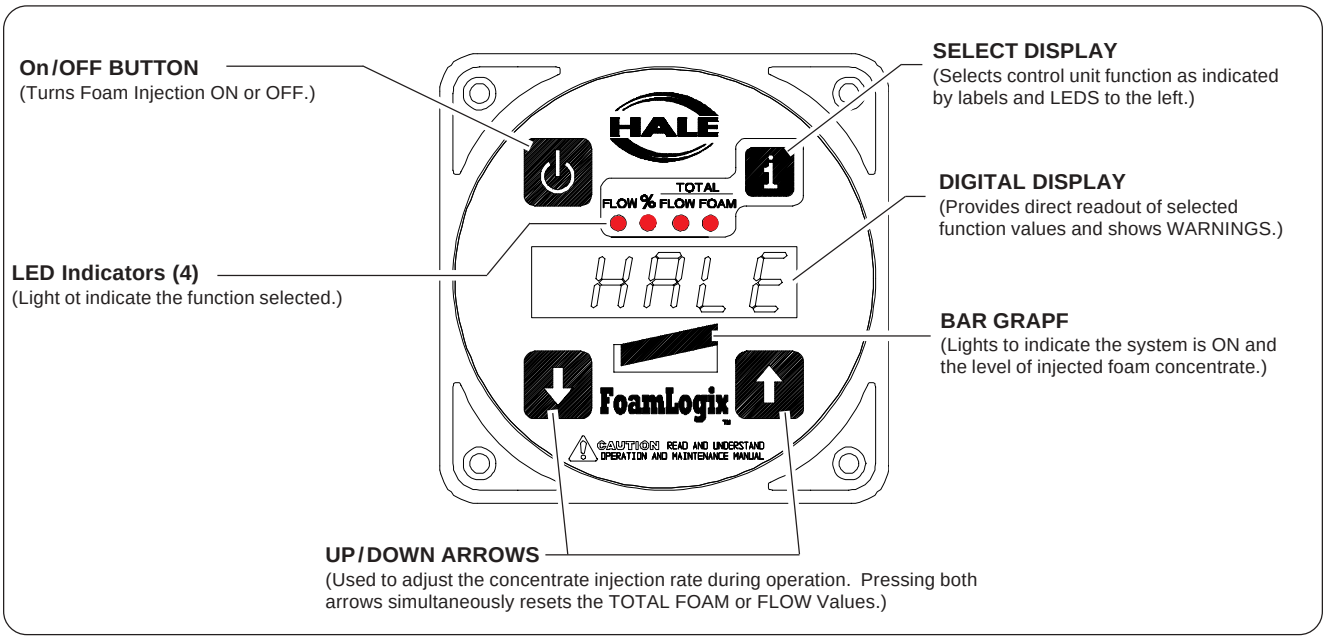


Figure 36: Digital Display Control Unit Overview

DISPLAY INFORMATION

The five digit display on the control unit shows the value of the selected function or provides WARNINGS to the operator as the system is operating.

A function is selected by pressing the grey DISPLAY button (**i**). Each time the button is pressed a new function mode is selected and displayed. LEDs above the digital display denote which function is selected.

Pressing the DISPLAY button (**i**) changes the control unit functions but does not affect injection rate.

Control unit functions

See Figure 37: “Display - Function Modes.”)

FLOW

The display shows the current flow rate of water or foam solution per minute in Hale flow sensor monitored discharges.

% FOAM

The display shows the foam concentrate injection rate setting in the % FOAM mode. (e.g., **A 0.5**).

TOTAL FLOW

The display shows the total amount of water or foam solution pumped through flow sensor monitored discharges. This totalized value may be reset - see heading using procedures outlined in the "Reset Functions" paragraph.

TOTAL FOAM

The display shows the total amount of foam concentrate pumped.

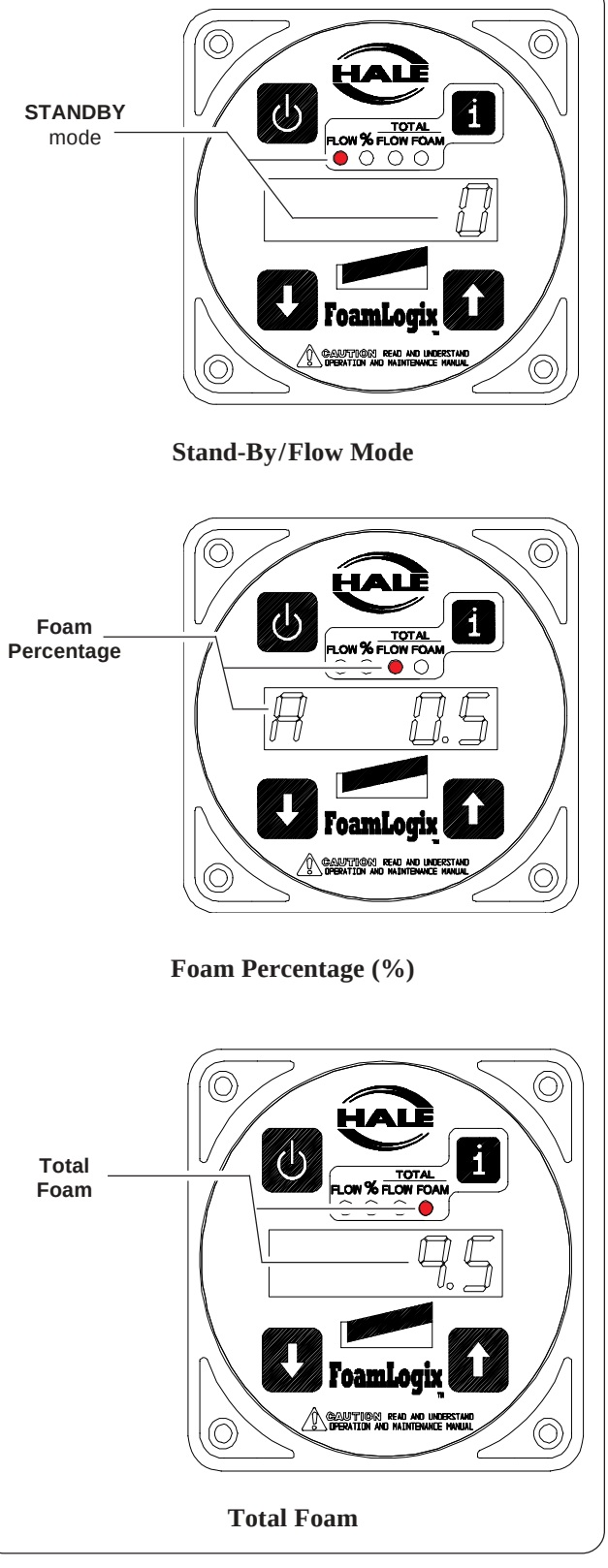


Figure 37: Display - Function Modes

The value is in the same unit of measure as the water flow. This totalized value may be reset - see heading “Reset Function” on page 60.

For example, the display may show **9.5**, indicating 9.5 gallons (36 liters) of foam concentrate have been used. (See Figure 35: “Display - Function Modes” on page 58.)

Bar graph

The bar graph consists of a ten (10) LED array. When the ON button is pressed the left-most LED lights to indicate the system is ON and ready to inject foam concentrate.

When water is flowing, LEDs to the right on the bar graph light indicating foam concentrate is being injected. The amount of LEDs lighted provides an indication of the approximate pump capacity being used.

If water flow requirements exceed the capacity of the pumps ability to deliver foam concentrate, pump speed increases to the maximum rate. All bar graph LEDs light and the right-most LED flashes, warning the operator that the system capacity is being exceeded and is running “lean” on foam concentrate percentage.

If the flow decreases such that the required injection rate is less than the lowest rating of the pump, pump spped decreases to its minimum rate and the first bar graph LED to the left flashes, warning the operator that the system capacity is being exceeded and is running “rich” on foam concentrate percentage.

RESET FUNCTIONS

The totalized values for water and foam concentrate pumped are cleared from memory by performing a **RESET** function.

1. Using the DISPLAY button (**i**), select either **TOTAL WATER** or **TOTAL FOAM**.
2. By pressing and holding both the ↑ and ↓ buttons at the same time, the value shown is cleared and the display shows zero (**0**).
3. Additionally the totalized values for water and foam concentrate reset to zero automatically when the apparatus power is turned OFF.

FOAM CONCENTRATE INJECTION RATE

When **% FOAM** is selected, the ↑ and ↓ buttons respectively increase or decrease foam concentrate percentage.

While operating in any function, with the exception of **FLOW** during simulated flow operation, whenever the ↑ or ↓ buttons are momentarily pressed, the display switches to the **% FOAM** display and shows the current injection rate for 2 seconds.

In any display mode, if either the ↑ or ↓ button is held down for a period of 2 seconds or more, the injection rate value increases or decreases accordingly. Once released, the display returns to the last selected display after 2 seconds.

When a reset is performed in the **% FOAM** display mode, the foam concentrate injection rate returns to the default value.

WARNING MESSAGES

Several safety features are incorporated into the Hale FoamLogix system to protect the foam concentrate pump, electric motor and apparatus wiring while maintaining personnel safety.

Messages appearing on the display alert the operator to adverse conditions that could cause damage to Hale FoamLogix system components, the apparatus and cause personnel injury.

Low Foam Tank Level

The Hale FoamLogix foam pump is interlocked with the foam concentrate tank level switch. If the tank is empty, the pump runs for 1 minute. The low foam concentrate tank level message is shown (**Lo A**) alternating with the normal selected function on the display. See Figure 38: “Low Foam Tank Display.”

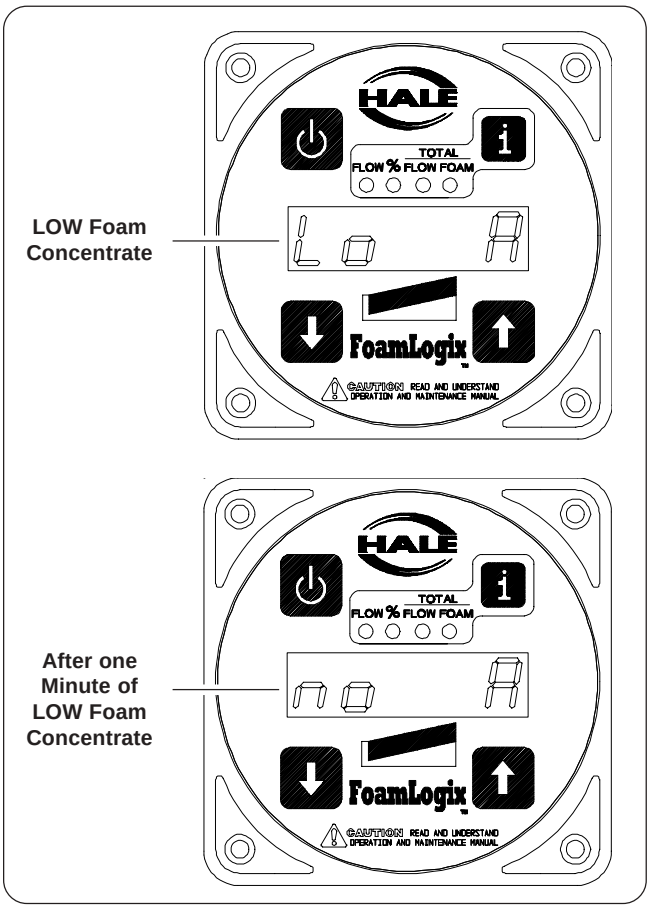


Figure 38: Diaplay - Low Foam Tank Display

If one minute of low concentrate level is detected the display shows **no A**, and the pump STOPS. The left-most LED turns OFF until the foam level is restored and the **ON** button is pressed.

If the **ON** button is pressed before refilling the foam tank, the system runs for 30 seconds before shutting down again.

Priming Error

In the event there is no feedback signal being received when the foam pump starts, indicating a lack of foam concentrate flow, the foam pump motor runs at full speed attempting to establish foam concentrate flow.

If the system operates for a period of 30 seconds without a feedback signal the system switches to the STANDBY mode and the display flashes **no Pr** (no prime) indicating there is no foam concentrate flow. (See Figure 39: “Display - Priming Error.”)

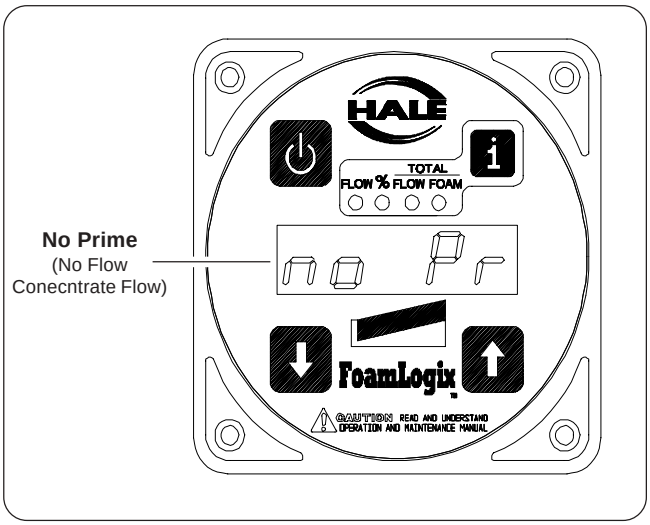


Figure 39: Display - Priming Error

High Ambient Temperature

If the Hale FoamLogix system is operating in an environment of excessive ambient temperatures, the display shows **HIGH**.

If the circuitry in the Hale FoamLogix system is being affected by a drop in power supply voltage the display shows **Lo SP**.

See Figure 40: “Display - High Temperature and Low Battery” on page 61.

Note: This is not necessarily an indication of apparatus battery level or condition. It is only an indication of adverse operating conditions. For instance a bad battery cable can cause the system to see low power even though the batteries are fully charged.

In either case the system continues to run. If conditions deteriorate to the point of potential system damage, due to heat or low power, the system returns to the STANDBY mode and the error message remains until **ON** is pushed again.

PRIMING THE FOAM PUMP

(When the Foam Tank Runs Dry.)

In some instances, the foam tank may run dry while operating the Hale FoamLogix system. The foam pump is designed to pump liquid. When the fire pump is running the foam pump may not pump efficiently against 100 to 150 PSI (7 to 10 BAR) back pressure. To re-establish foam concentrate flow quickly the following procedure is used.

1. Turn the bypass valve to the **BYPASS** position.

2. With the fire pump flowing water from foam discharge and the Hale FoamLogix ON, observe the hose from the bypass valve.

3. When foam concentrate flows from the hose turn the bypass valve back to the **INJECT** position.

   The pump is now primed and ready for normal operation.

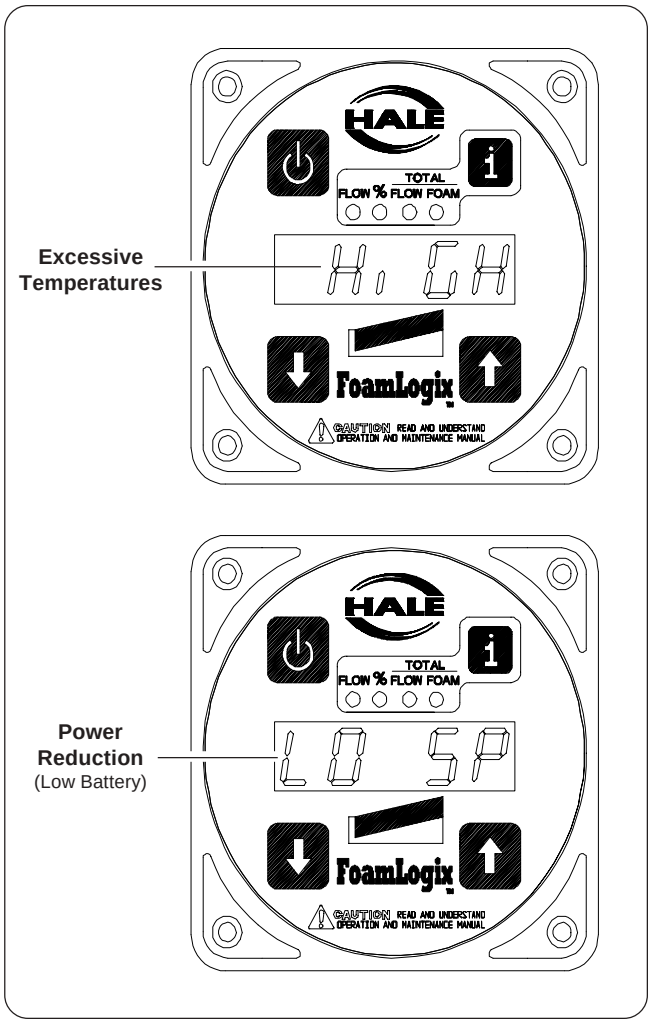
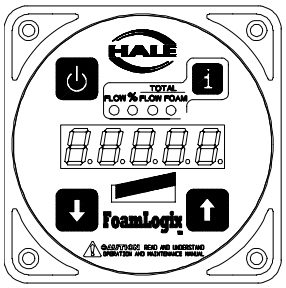
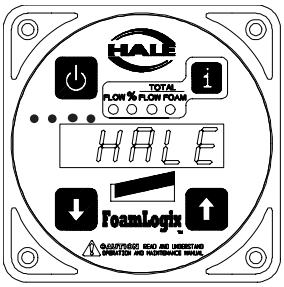
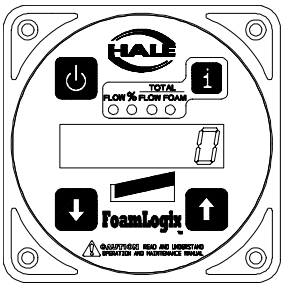
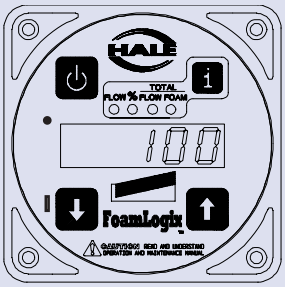
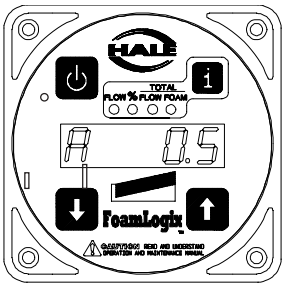
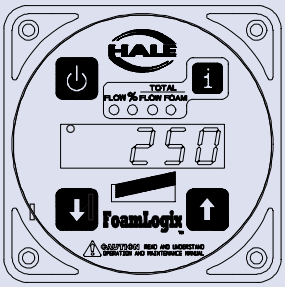
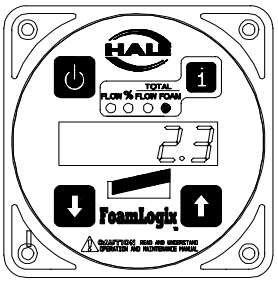
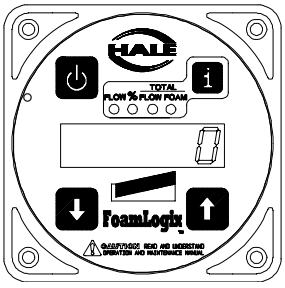


Figure 40: Display - High Temperature and Low Battery

NORMAL OPERATION SUMMARY

OPERATION	ACTION	DISPLAY
Energize the system	Energize apparatus and turn FoamLogix power switch to **ON.**	**Initial StarUp**  **Self Diagonstics**  
Select foam tank	If System equipped with dual foam tanks place selector to proper tank.	**STANDBY Display** (Single Flow Sensor: FLOW MULTIPLE Flow Sensor: % FOAM)
Begin foam injection	Establish water flow and press **ON** button.	**Water Flow Established** (ON Button Pressed) 

OPERATION	ACTION	DISPLAY
Change injection rate **Read injection rate**	Press ↑ or ↓ and hold for 2 seconds. Release once rate is set. Press and release ↑ or ↓. Display shows injection rate and returns to selected function after 2 seconds.	**Foam Concentrate Injecion Rate** 
Read total water or foam solution	Press **i** until LED below TOTAL FLOW turns ON.	**Total Flow** 
Read total foam concentrate	Press **i** until concentrate LED below TOTAL FOAM turns ON.	**Total Foam** 
Reset totalized values	While in TOTAL FLOW or TOTAL FOAM press and release ↑ or and ↓.	
End foam injection	Press **ON** button.	 **STANDBY MODE** (Single flowsensor: Flow multiple Flow sensors: % FOAM)

SIMULATED FLOW OPERATION

The Simulated Flow mode of the Hale FoamLogix system allows operation of the foam pump without discharging water through a foam capable discharge or when the flow sensor is not functioning.

The simulated flow mode is used for draining the foam tank for:

- ❑ Cleaning
- ❑ Checking calibration of the feedback sensor
- ❑ Verifying foam pump operation
- ❑ Manually controlling foam injection if the flow sensor malfunctions.

The factory default simulated flow rate is 150 GPM (568 LPM). The simulated flow rate and the concentrate injection percentage rate are set by the rate adjustment buttons on the control unit display, while in simulated flow mode.

The simulated flow function provides manual operation of the foam injection system required by NFPA standards.

CAUTION!

WHEN OPERATING THE HALE FOAMLOGIX IN SIMULATED FLOW MODE AN OUTLET FOR THE FOAM CONCENTRATE MUST BE PROVIDED TO PREVENT EXCESSIVE PRESSURE BUILDUP IN DISCHARGE PIPING OR HOSES.

Simulated flow sequence

1. Uncoil and place the end of the bypass hose into a suitable container to collect the foam concentrate.

2. Place the BYPASS valve in the **BYPASS** position.

3. Energize the apparatus electrical system and press Hale FoamLogix power button (**i**) to turn ON the system.

4. The Hale FoamLogix enters the STANDBY mode. (See Figure 41: “Display - Simulated Flow Operation.”)

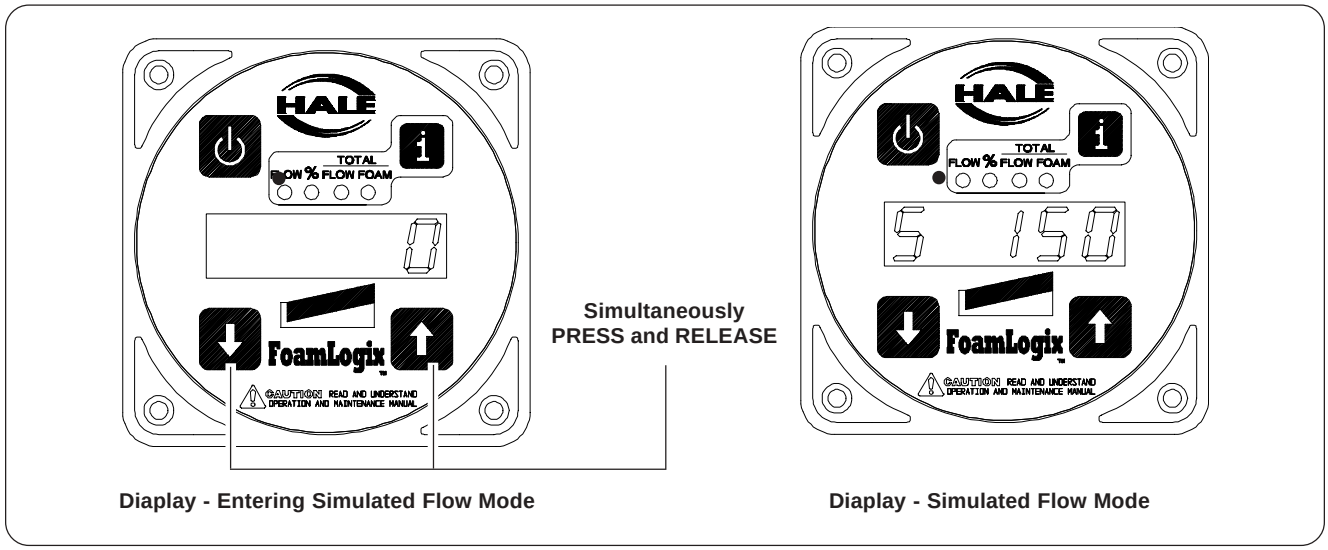


Figure 41: Display - Simulated Flow Operation

5. When the **FLOW** LED lights, press and release the ↑ and ↓ buttons at the same time.

6. The display shows **S 150** (or other preset default value) and the **FLOW** LED lights. (See Figure 41: “Display - Simulated Flow Operation” on page 64.)

7. Press the **ON** button. The left-most LED on the bar graph lights and the foam pump begins running.

   Foam concentrate flows out of the end of the bypass hose.

To End Simulated Flow

1. First press the **ON** button to STOP the foam pump.

2. Press the **i** button until the FLOW LED lights.

3. Press and release the ↑ and ↓ buttons at the same time. The display shows the current water flow value and the FLOW LED lights.

4. De-energize the apparatus electrical system.

5. Place the bypass valve to the INJECT position.

6. Secure bypass hose in the appropriate compartment.

7. Return apparatus to normal ready condition.

NOTES

SECTION 5 MAINTENANCE

MAINTENANCE PROCEDURES

1. **After each use**

   Inspect wiring, hoses, flow sensors and connections for tightness, corrosion, leaks and/or damage. Refer to Figures 3 and 3a, beginning on page 20.

   Flush foam pump if a non-approved foam concentrate is used. Also see Appendix A, "Hale Foam Concentrate Compatibility," beginning on page 79 for recommended foam concentrates.

2. **Monthly**

   Remove and clean the foam strainer screen. Flush as required.

3. **Monthly**

   Verify water flow calibration.

4. **Annually**

   Verify Foam feedback calibration.

5. **Every Two (2) Months**

   If an approved foam concentrate has been left in the system, operate foam system to remove the foam concentrate and prevent jelling.

NOTES

SECTION 6 TROUBLESHOOTING

USER DIAGNOSTICS

Power indicator lamps are provided on the distribution box and on the feedback sensor. The LED on the feedback sensor flashes when the sensor is receiving pulses from the flow sensor rotor targets. These LEDs help to ease tracing of power supply faults and eliminates some of the guesswork in troubleshooting. (See Figure 42: "Distribution Box Overview.")

If the system malfunctions make sure the following conditions are checked:

- ❑ All hose connections correct and tight (Refer to appropriate system plumbing diagram in Section 3 "Installation.")
- ❑ All electrical connections correct and tight (Refer to appropriate system electrical diagram in Section 3 "Installation.")
- ❑ Apparatus electrical system energized with power supplied to pump panel and Hale FoamLogix.

Once the above conditions are met, proceed to the system troubleshooting section to determine the cause of the malfunction.

Hale FoamLogix systems consist of individual subsystems working together to provide finished foam solution at the proper percentage. Also see heading "System Overview" on page 70.

The system is designed using modular components making troubleshooting and repair easier. Each subsystem has its own set of troubleshooting procedures. The procedures that follow provide a logical flow path to isolate and correct a system failure.

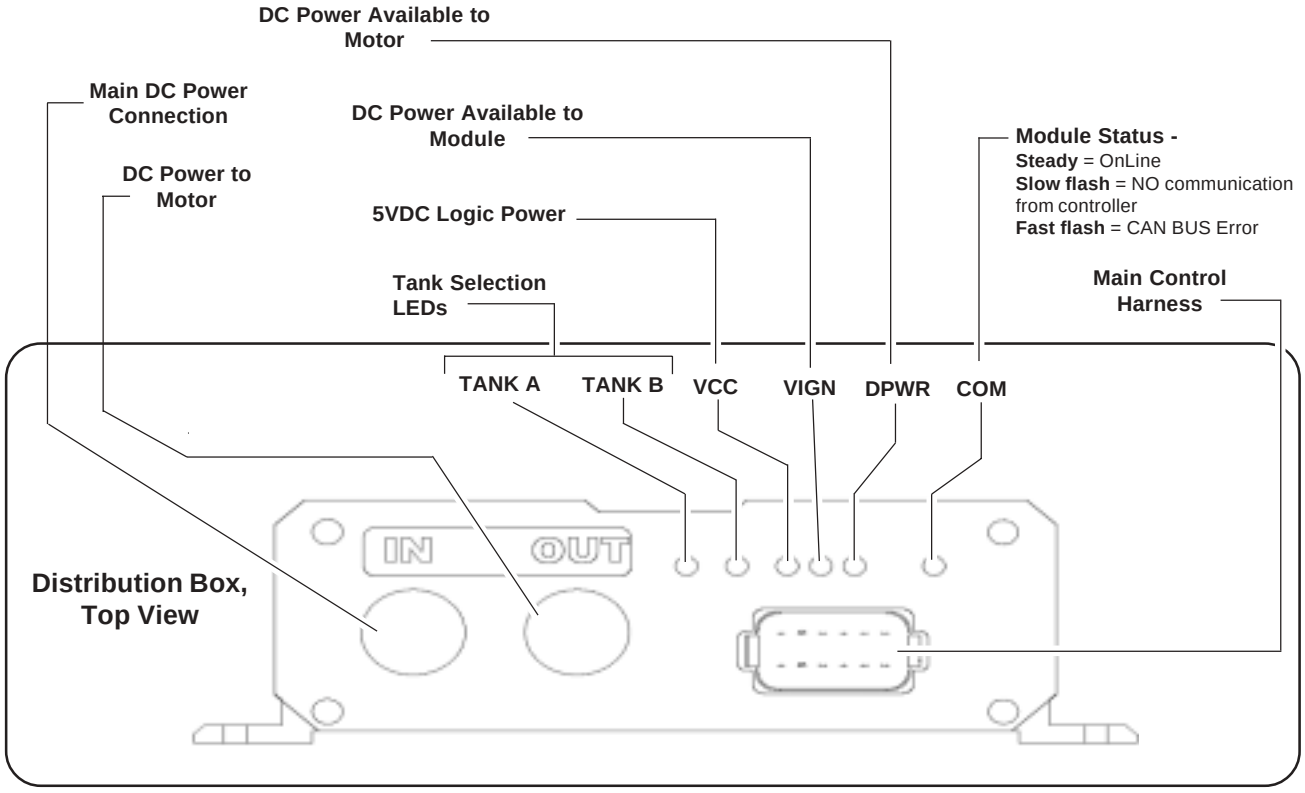


Figure 42: Distribution Box Overview

Note: Hale FoamLogix system electronic components have no user serviceable components inside and are replaced as a unit. **Opening of Hale FoamLogix electronic components voids the manufacturer warranty.**

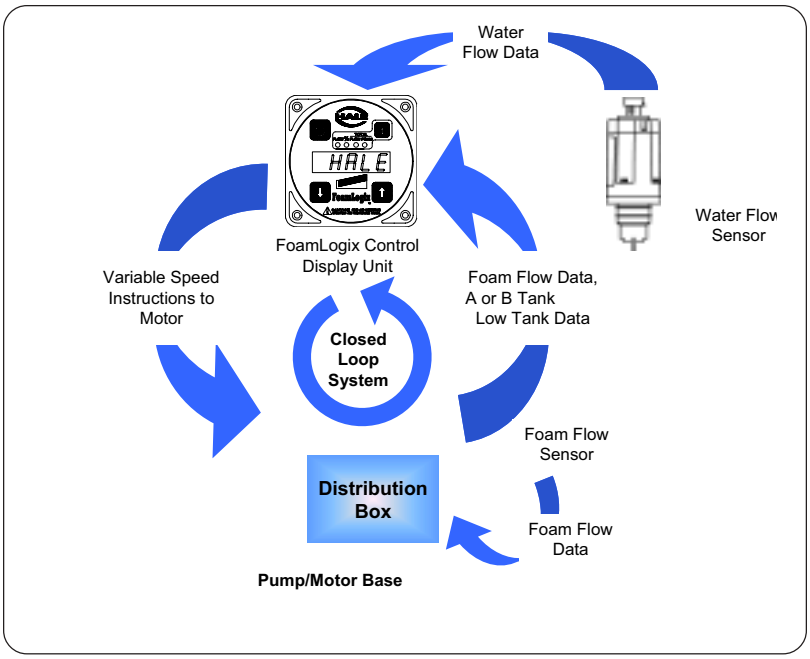


Figure 43: FoamLogix 2.1A System Closed-Loop Flow Diagram

System Overview

See Figure 43: "FoamLogix 2.1A System Closed-Loop Flow Diagram."

The FoamLogix 2.1A is a "closed-loop" system. The brains behind the system is the computer-controlled FoamLogix Control Display Unit. As an electronic system, the flow of data "runs" the system. A basic understanding of how the system functions makes troubleshooting easier.

Water flow data is fed to the control unit computer. Since the injection rate (%) is preset, the control unit calculates the required motor speed of the foam pump and sends this data to the motor. The output of the pump is measured by a foam flow feedback sensor.

The foam flow feedback sensor tells the control unit how much foam is actually pumped so the display can make the required motor speed adjustments. This closed-loop runs several times per second and is what makes the system so accurate.

Note: The FoamLogix unit has a "simulated flow" function, described in Section 4: "Operation," heading "Simulated Flow Operation" beginning on page 64. This allows troubleshooting without flowing water, yet *simulates* an actual water flow.

Distribution Box

The Distribution Box, part of the pump/motor assembly, sends data on LOW tank warnings tank selection status, as well as foam concentrate flow feedback to the display.

LOW tank and Tank selection status are also determined within the distribution box. A connector attaches to selector valves. This connection signals the control unit if the unit is in tank selected or flush mode.

If no accessory is used, a connector plug is installed to lock the system in the Tank A mode. (See Figure 20: "Control Harness Connections" on page 43.) Removing this plug or disconnecting the MST accessory cable places the system in the "flush" mode.

Pump/Motor

The discharge of the foam pump directs foam to the rotary lobe flow meter.

The rotors are a composite material containing small stainless steel targets. As the foam is being pumped, a target lines up with the sensor in the pump head.

The sensor “sees” the target and sends this signal to the control display, through the distribution box. An indicator lamp on the sensor “flashes” as the target passes the sensor. Depending on how much foam is being pump determines the flashing speed, which could be so fast that the indicator light actually appears to be constant.

Bar Graph

The bar graph, on the control display unit, indicates the system capacity and is a good troubleshooting tool.

If the display does not see foam feedback data, indicating foam is being pumped, the bar graph lights all segments and “flashes.” The display runs the pump fast attempting to prime it and achieve the proper foam concentrate flow.

If the display does not receive data that foam concentrate is flowing, it displays the “**No Pri**” error message, indicating no prime, and turns the system OFF. Pressing ON starts the cycle again. There must be water flow or the unit must be in the simulated flow mode. Operation of the bar graph and no prime warnings are discussed in Section 4, “Operation” beginning on page 57.

Summary

Starting with the troubleshooting charts (see Chart 44: “Hale FoamLogix System Troubleshooting Flow Diagram,” beginning on page 72) and using Figure 43, on page 70 to show the flow data, a field problem can be traced to a particular component for replacement.

FoamLogix replacement parts are “plug-and-play” type devices that do not require specialized equipment to service. Normal water flow and foam calibration is usually necessary after a major component service.

PROBLEM ISOLATION

The first step in troubleshooting is to determine which subsystem caused the system failure. To make this determination operate the apparatus and Hale FoamLogix system in accordance with standard operating procedures and isolate where the problem occurs.

See Chart 44: “Hale FoamLogix System Troubleshooting Flow Diagram,” beginning on page 73, to assist in isolating the cause. Also review the following steps.

1. Setup the apparatus for normal operation.

2. Power-up the apparatus and energize the pump operator panel.

   Take notice of the Hale FoamLogix control unit. If the display is NOT illuminated proceed to Chart 44: “Hale FoamLogix System Troubleshooting Flow Diagram,” beginning on page 73.

3. If the Hale FoamLogix control unit is illuminated, engage the apparatus water pump and establish discharge.

   If water flow CANNOT be established, troubleshoot the water pump system.

4. If there is no indication of water flow on the control unit display troubleshoot the flow sensor.

5. If water flow is established, turn the Hale FoamLogix system ON to flow foam.

6. Observe foam pump discharge. If foam is NOT flowing troubleshoot the foam pump.

7. Check accuracy of system using calibration procedures in Section 4 “Operation” of this manual, making adjustments as required.

TROUBLESHOOTING CHARTS

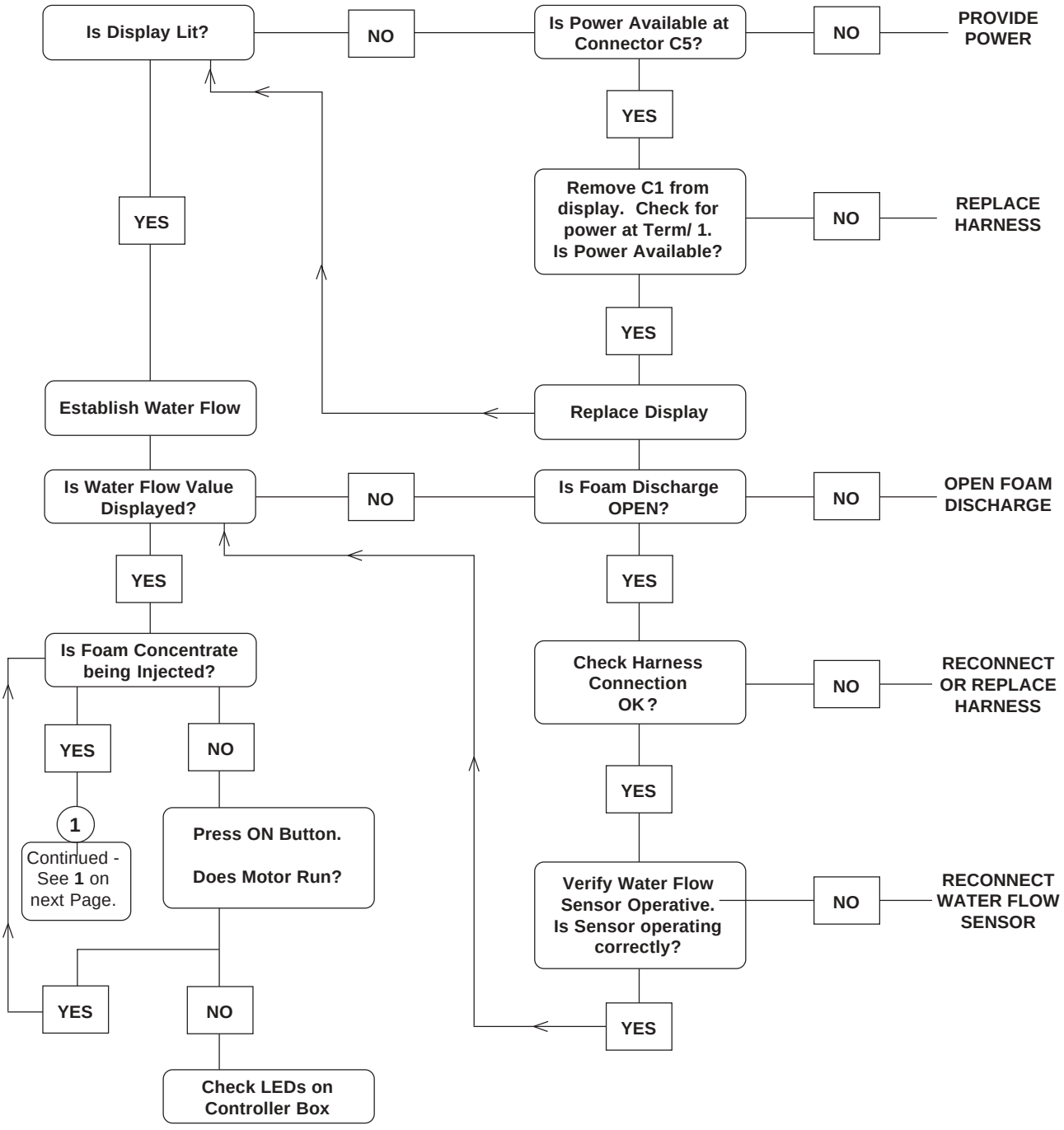


Chart 44: Hale FoamLogix System Troubleshooting Flow Diagram

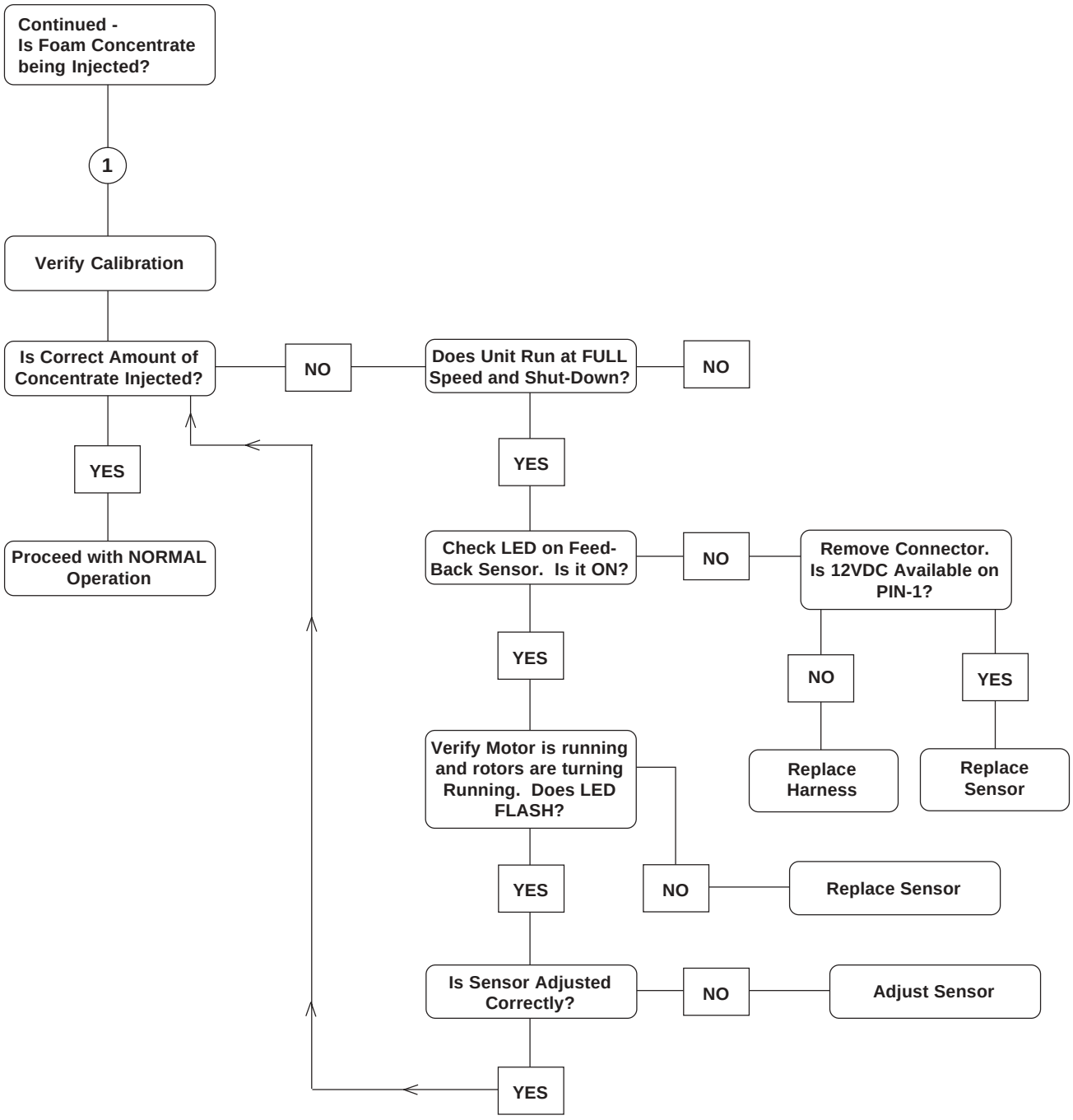


Chart 44: Hale FoamLogix System Troubleshooting Flow Diagram - continued

NOTES

SECTION 7 ILLUSTRATED PARTS BREAKDOWN

GENERAL

This section contains drawings and the parts breakdown for the serviceable assemblies, components and most commonly used options for the FoamLogix, Model 2.1A Class "A" Electronic Foam Proportioning System..

ABBREVIATIONS

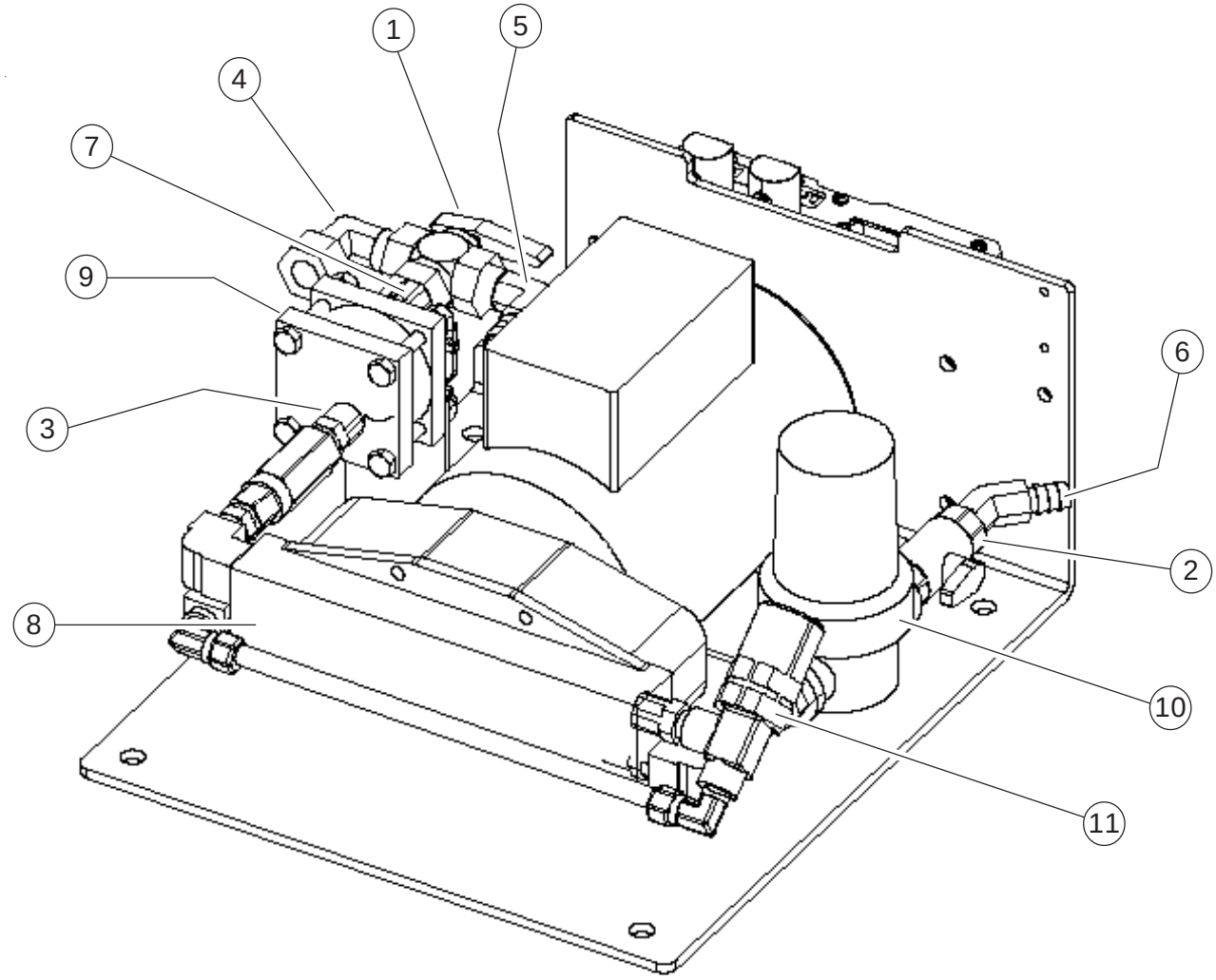
The following abbreviations may be used in this IPB:

A/R ..... As required
Cm ..... Centimeters
Ext. ..... Exrternal
Fwd ..... Forward
Ga ..... Gauge
Grd, Gr .... Grade – when hardware lists a grade rating, it is imperative to maintain that rating when replacing parts.
HS ..... Hardened Steel
Hex ..... Hexagonal
Id, ID ..... Inner diameter
IPB ..... Illustrated Parts Breakwown
JIC ..... Joint Industry Conference – an industry standard used to describe a fitting.
Lh, LH ..... Left Hand
MM ..... Millimeters
Mtg ..... Mounting
n/s ..... Not Shown – parts that are not shown but are servicable.
No ..... Number
NPT ..... National Pipe thread
NPTF ..... National Pipe Thread, Fine
OD ..... Outer diameter
p/n ..... Part number
Ref ..... Reference
Rev ..... Reverse
Rh, RH .... Right hand
Str ..... Straight – usually ti describe a hydraulic or pneumatic fitting (vs. elbow)

FOAM PUMP ASSEMBLY

Item #	Part Number	Qty.	Description
1	038-2220-00-0	1	Valve, 3/8" NPT, 3-Way BYPASS A
2	038-2230-00-0	1	Valve, Shut-Off, 3/8" NPT Male/Female
3	082-0301-02-0	1	Nipple, 3/8" NPT, Brass, CLOSE
4	082-0317-02-0	1	Elbow, 3/8" NPT x 1/2" Compression
5	082-0327-02-0	1	Elbow, 3/8" NPT x 1/2" Hose, Brass
6	082-0328-02-0	1	Elbow, 3/8" NPT x 1/2" Hose, 45°
7	082-0364-02-0	1	Nipple, 3/8" NPT Hex, Brass
8	501-3420-08-0	1	Transfer Pump Assembly, 2.1A-12
9	168-0420-00-0	1	Foam Flow Meter, 2.1A-12, includes: (See IPB on page 76)
10	510-0200-02-0	1	Filter Assembly
11	538-1750-01-0	1	Relief Valve
n/s	538-1750-02-0	1	Relief Valve Repair Kit

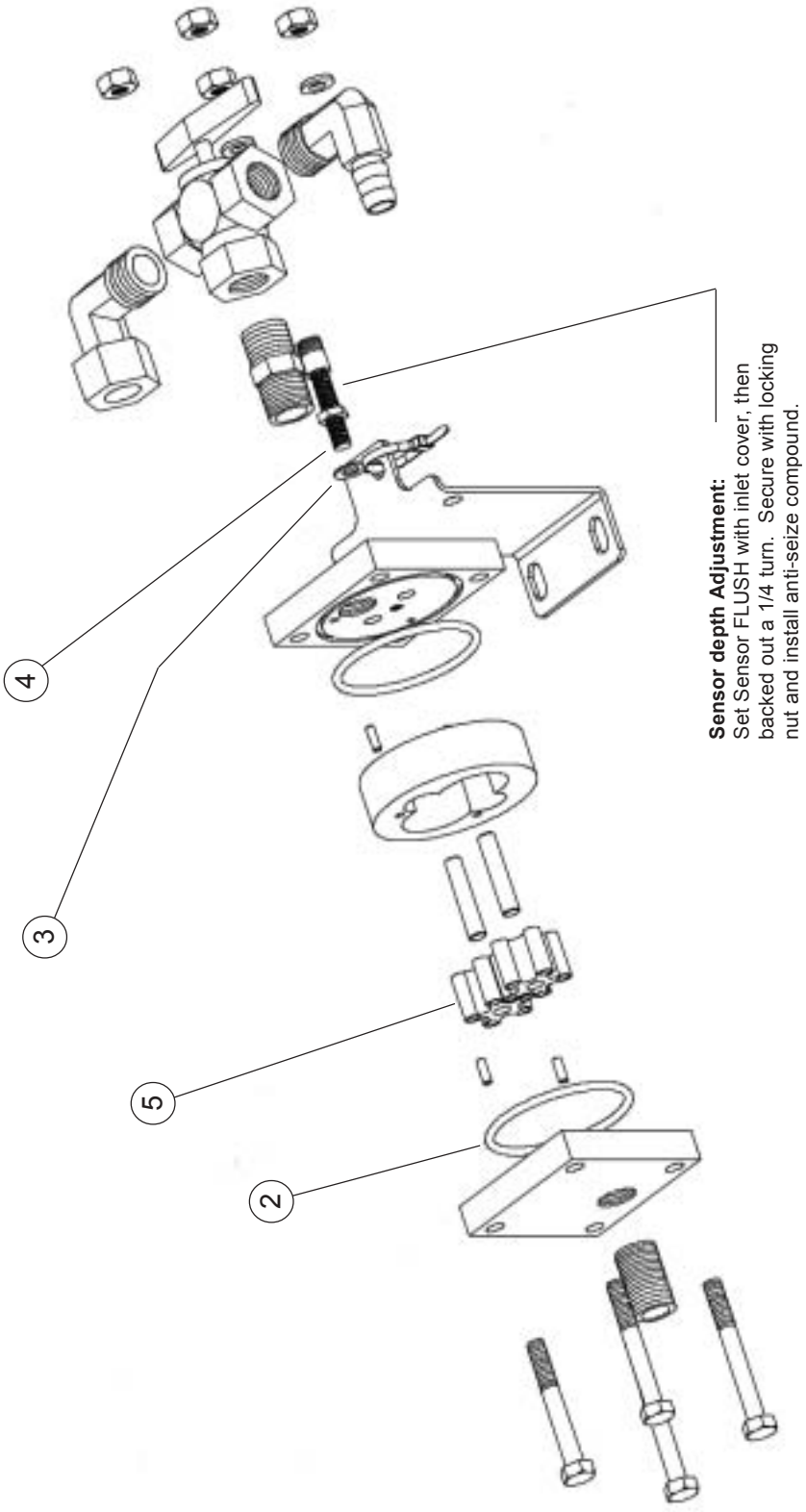
Figure 7-1: Foam Pump Assembly



FOAM FLOW METER ASSEMBLY

Item #	Part Number	Qty.	Description
1	168-0420-00-0	1	Foam Flow Meter, 2.1A-12, includes: Item 2 through Item 5 below
2	040-0340-00-0	2	Seal Ring, 2-034
3	097-1971-00-0	1	Washer, Sealing, 5mm
4	200-2481-00-0	1	Foam Feedback Sensor Assembly
5	516-0670-00-0	2	Flow Meter Rotor Assembly

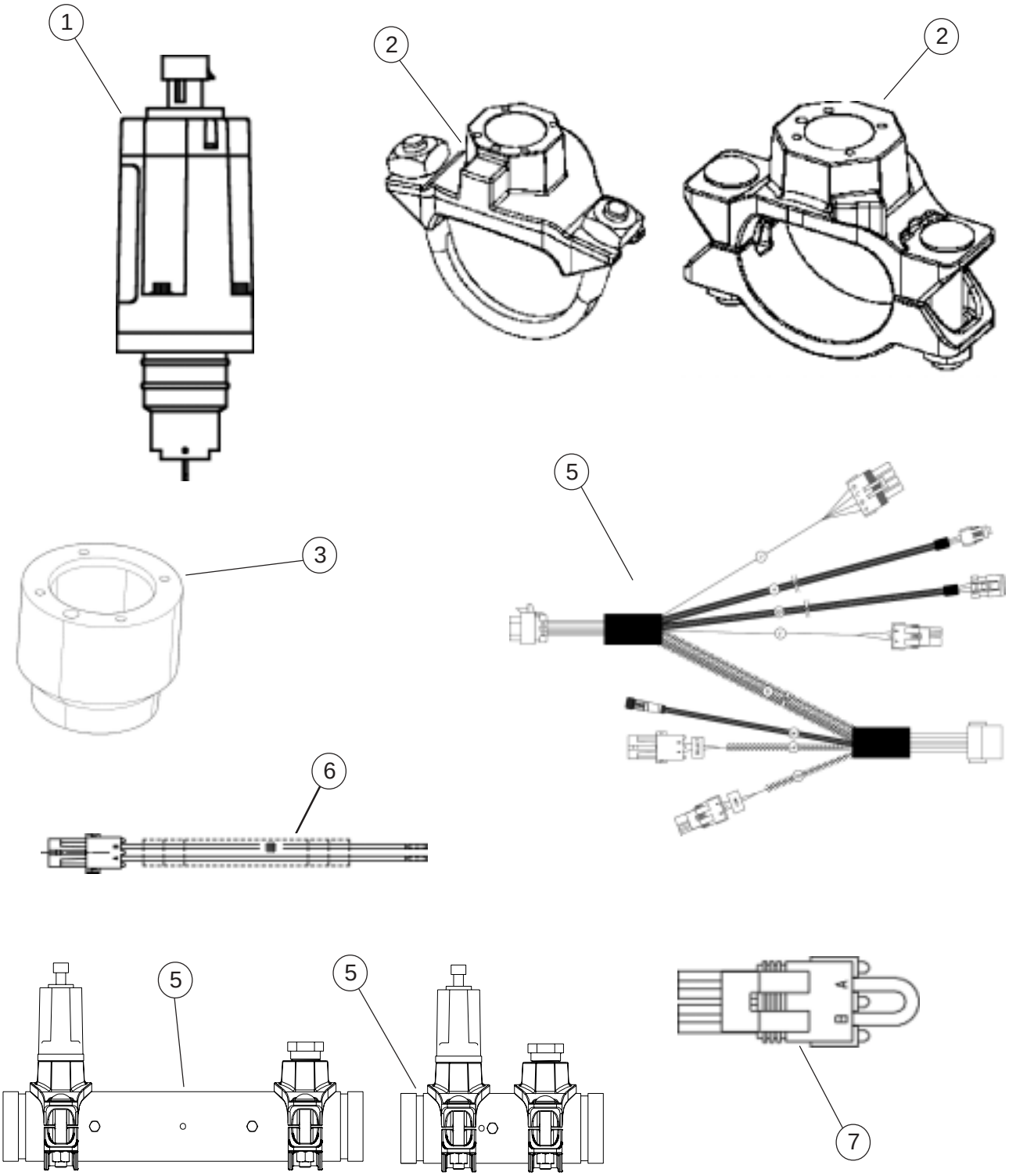
Figure 7-2: Foam Flow Meter Assembly



FLOW SENSOR COMPONENTS

Item #	Part Number	Qty.	Description
1	102714		Paddle Wheel
2	4842010		Saddle Clamp, 2"
	4843010		Saddle Clamp, 2-1/2"
	4844010		Saddle Clamp, 3"
	4846010		Saddle Clamp, 4"
	4845010		Saddle Clamp, 5"
3	082-3060-00-0		Weld Fitting, Stainless Steel
	309020		Weld Fitting, Steel
	309010		Weld Fitting, Aluminum
4	111331	1	Cable, FoamLogix Flow Sensor, 10' x 15'
	111332	1	Cable, FoamLogix Flow Sensor, 15' x 20'
5	108751	1	Dual Check Valve Manifold Assembly
	108893	1	Single Check Valve Manifold Assembly
6	513-0270-04-0	1	Wire Harness
7	513-0320-23-0	1	Tank Select Plug

Figure 7-3: Flow Sensor Components



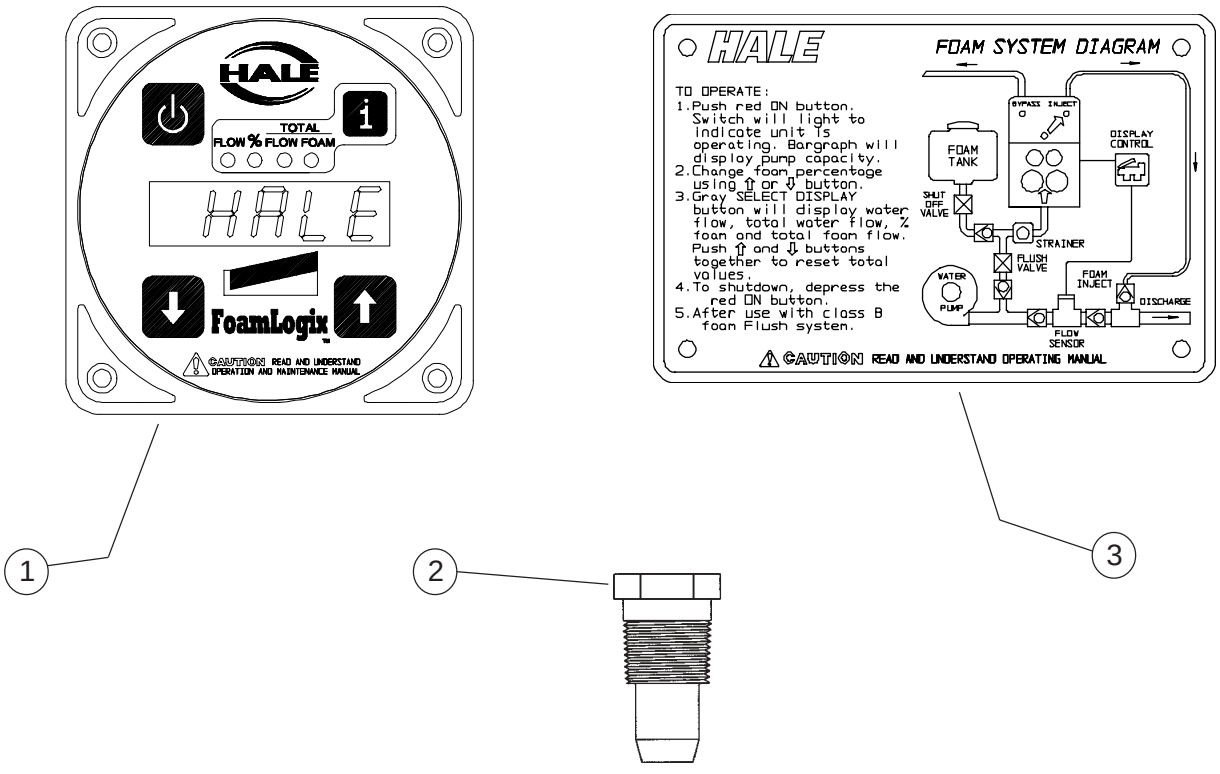
Dual Check Valve Manifold

Single Check Valve Manifold

ADDITIONAL FOAMLOGIX COMPONENTS

Item #	Part Number	Qty.	Description
1	111530	1	Control Unit
2	038-1790-00-0	1	Check Valve Injector
3	101-1630-12-0	1	Nameplate, Foam System Diagram, Single Tank

Figure 7-4: Additional FoamLogix Components



APPENDIX A:

HALE FOAM CONCENTRATE COMPATIBILITY

The following foam concentrates are approved for use in Hale Foam Proportioning Systems. The Class “A” foam concentrates are approved for use in all Hale Foam Proportioning Systems (Hale FoamLogix 5.0, 3.3, 2.1A and Hale V-Series).

Type of Foam Concentrate	Manufacturer	Brand Name
CLASS "A" FOAM		
US Forestry Service Approved **Reference * and ****	Ansul	Silvex Class "A" Foam Concentrate
	Kidde Fire Fighting / National Foam	Forexpan S (0.1% - 1.0%)
	Kidde Fire Fighting / National Foam	Hi Combat Class "A" (1st Defense Class "A" Cold Water Foam)
	Kidde Fire Fighting / National Foam	Knock-Down
	Monsanto	PhosCheck WD881
	Chemonics	Fire-Trol Fire Foam 103
	Chemonics	Fire-Trol Fire Foam 104
	3M	Light Water FT-1150
* For use in FoamLogix Models 5.0, 3.3, 2.1 and Hale V-Series. ** USFS approved foams have been tested for corrosion and biodegradability toxicity by the US Forest Service in addition to the Hale testing described on page A-3.		
Non US Forestry Service Approved **Reference ***	Chemguard	Class "A" Plus
	Unifoam Co. Ltd.	UniA 1%
	3M	Light Water SFFF
	Kidde Fire Fighting / National Foam	Responder
	Kidde Fire Fighting / Angus Foam	FirePower Class "A"

Table A-1: Hale Foam Concentrate Compatibility

Type of Foam Concentrate	Manufacturer	Brand Name
CLASS "B" FOAM		
* The Class "B" Foam, Specialty Foam and Fire Fighting Water Additive Concentrates are approved for use in FoamLogix Models 5.0 and 3.3 Foam Proportioning Systems only.		
AFFF - Alcohol Resistant Concentrates **Reference ***	3M	3% Alcohol Type AFFF Concentrate (p/n: 98-0211-6573-7)
	Ansul	3 x 3 Low Viscosity Alcohol Resistant Concentrate
	ChemGuard	AR 3% - 6% (p/n: CAR36P)
	ChemGuard	Ultraguard 1% - 3% (p/n: C-133)
	ChemGuard	AR-AFFF 3% x 3% (p/n: C-333)
	Kidde Fire Fighting / Angus Foam	ALCOHOSEAL 3 x 3
	Kidde Fire Fighting / Angus Foam	Universal Gold 3% AR-AFFF
	Kidde Fire Fighting / Angus Foam	Universal Gold 1% - 3% AR-AFFF
	US Foam	1% - 3% Alcohol Resistant AFFF (p/n: US-AR13)
	US Foam	1% - 3% Alcohol Resistant AFFF (p/n: US-FCAR36)
AFFF	Kidde Fire Fighting / National Foam	1% Aero-Water
SPECIALTY FOAM CONCENTRATES		
Protein	Kidde Fire Fighting / National Foam	Terra Foam 3% CF
	Chemonics	Durra Foam 3%
FIRE FIGHTING WATER ADDITIVE		
	Hazard Control Technologies Inc.	F-500 (1%, 3%, 6%)
	SPL Control LLC	Pyrosolv (FF Agent - 6% Solution) (p/n: 72038, MSDS#)

Table A-1: Hale Foam Concentrate Compatibility

REFERENCE

The preceding foam concentrates have been tested by Hale Products to ensure compatibility with Hale FoamLogix models 5.0 and 3.3 Foam Proportioning Systems. These chemicals were run for several hundred hours over several months to make sure they do not harm the Foam System. This list is solely intended to assist the end user in selection of foam concentrate(s) compatible with a Hale FoamLogix Model 5.0 and 3.3 and is not a determination of the fire fighting effectiveness of one product over another.

Always consult with NFPA standards, U.L. Listings, Federal, State, and local regulations pertaining to application and environmental regulations before selecting a foam concentrate. (Refer to FoamLogix User Manual for additional information.)

Many fire fighting foam chemical manufacturers have specific instructions on handling and use of their products including, but not limited to, shelf life, tank life, and intervals between use. Always follow manufacturer's instructions for use.

This Appendix applies to Hale FoamLogix foam pumps built after April 17, 1997. For Hale FoamMaster foam pumps built prior to April 17, 1997, refer to Bulletin 650, Rev-2.

If a particular foam concentrate you wish to use does not appear on this list, please contact your Hale representative for information concerning compatibility with Hale FoamLogix Model 5.0 or 3.3 Foam Proportioning Systems. As further testing is completed, Hale Products Inc. updates this list and expands capabilities and features to keep the Hale Foam-Logix the best system available for all fire fighting.

Revised 7-6-04

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EXPRESS WARRANTY

EXPRESS WARRANTY: Hale Products Inc. ("Hale") hereby warrants to the original Buyer that products manufactured by Hale are free of defects in material and workmanship for one (1) year. The "Warranty Period" commences on the date the original Buyer takes delivery of the product from the manufacturer.

LIMITATIONS: HALE's obligation is expressly conditioned on the Product being:

- Subjected to normal use and service.
- Properly maintained in accordance with HALE's Instruction Manual as to recommended services and procedures.
- Not damaged due to abuse, misuse, negligence, or accidental causes.
- Not altered, modified, serviced (non-routine) or repaired other than by an Authorized Service Facility.
- Manufactured per design and specifications submitted by the original Buyer.

THE ABOVE EXPRESS LIMITED WARRANTY IS EXCLUSIVE. NO OTHER EXPRESS WARRANTIES ARE MADE. SPECIFICALLY EXCLUDED ARE ANY IMPLIED WARRANTIES INCLUDING, WITHOUT LIMITATIONS, THE IMPLIED WARRANTIES OF MERCHANTABILITY OF FITNESS FOR A PARTICULAR PURPOSE OR USE; QUALITY; COURSE OF DEALING; USAGE OF TRADE; OR PATENT INFRINGEMENT FOR A PRODUCT MANUFACTURED TO ORIGINAL BUYER'S DESIGN AND SPECIFICATIONS.

EXCLUSIVE REMEDIES: If Buyer promptly notifies HALE upon discovery of any such defect (within the Warranty Period), the following terms shall apply:

- Any notice to HALE must be in writing, identifying the Product (or component) claimed defected and circumstances surrounding its failure.
- HALE reserves the right to physically inspect the Product and require Buyer to return same to HALE's plant or other Authorized Service Facility.
- In such event, Buyer must notify HALE for a Returned Goods Authorization Number and Buyer must return the product F.O.B. within thirty (30) days thereof.
- If determined defective, HALE shall, at its option, repair or replace the Product, or refund the purchase price (less allowance for depreciation).
- Absent proper notice *within* the Warranty Period, HALE shall have no further liability or obligation to Buyer therefore.

THE REMEDIES PROVIDED ARE THE SOLE AND EXCLUSIVE REMEDIES AVAILABLE. IN NO EVENT SHALL HALE BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGE INCLUDING, WITHOUT LIMITATION, LOSS OF LIFE; PERSONAL INJURY; DAMAGE TO REAL OR PERSONAL PROPERTY DUE TO WATER OR FIRE; TRADE OR OTHER COMMERCIAL LOSSES ARISING, DIRECTLY OR INDIRECTLY, OUT OF PRODUCT FAILURE.

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