Hale CAFSPro MidshipCompressed Air Foam System Detailed Specifications:

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WHEN PREPARING SPECIFICATIONS FOR YOUR COMPRESSED AIR FOAM EQUIPPED PUMPER, ASSURE THE USE OF A HALE CAFSPRO BY INCORPORATING THE FOLLOWING SPECIFICATIONS. NO COMPETITIVE CAF SYSTEM CAN MATCH HALE CAFSPRO FEATURES, CONSTRUCTION, SAFETY, PERFORMANCE, AND OVERALL BENEFITS.

SYSTEM DESIGN
The apparatus drive engine output, fire pump output, and air compressor output shall be designed to meet the criteria of CAFS performance required by applicable NFPA standards and the end user. The apparatus manufacturer shall specify these requirements before the installation of system components. Final performance of this requirement is to be verified by the end user.

The following specification defines a fully integrated Compressed Air Foam System (CAFS) to be installed on the mid-ship fire pump within the fire apparatus. Discharges to be piped as CAF discharge and/or foam solution discharge capable include the following:

(3) 1-¾ inch (44.5 mm) Pre-connected Hoses.
(1) 2-½ inch (63.5 mm) Rear Discharge..
(1) 1-3/4 inch (44.5 mm) Foam Solution "only line".

COMPONENTS
The major CAFS components shall include:

A) Rotary Air Compressor (assembled to fire pump transmission)
B) Electronically controlled Rotary Gear Pump, Discharge-Side Foam-Concentrate Proportioning System
C) Foam Injection Check Valves (installed in stainless manifold)
D) Foam Concentrate and Water Reservoirs (supplied by installer)
E) Stainless Steel discharge manifold for water, foam solution, and CAFS.
F) X-Type Motionless Mixing Chambers
G) Stainless Steel Discharge Piping Check valves (installed)
H) SCFM Air Flowmeter with integrated hourmeter & temperature warnings.
I) Push-button, automatic CAFS Operating Controls
J) Apparatus Fire Pump split-shaft gearbox with PTO to include a clutch disengagement mechanism for the rotary air compressor.

A. AIR COMPRESSOR
1. The air compressor shall be of the rotary type rated at producing a minimum flow of 210 standard cubic feet per minute (322 normal cubic meters per hour) of compressed air at 125 PSIG (8.5 BAR).
2. The air compressor shall have a continuous duty rating of 150 PSIG (10 BAR). Rotary Compressors with a continuous

duty rating under 150 PSIG (10 BAR) are not acceptable.

3. Components to be included with the air compressor and to be factory installed and tested include: 1) An oil reservoir separator, 2) an air filter, 3) an oil filter and 4) a water to oil heat exchanger.
4. An oil temperature read-out to show the temperature in the oil reservoir separator shall be integrated with the display on the apparatus pump panel.
5. A built-in electronic alarm shall warn of excessive operation temperatures.
6. An automatic air system "blow down" valve will be installed in the system to relieve pressure in the oil reservoir separator and air compressor when the unit is shut down.
7. A manual over-ride control shall provide for fixed pressure operation to run rescue tools (without CAFS) from an auxillary port, or to over-ride electrical controls in event of a mal-function.
8. The heat exchanger shall be capable of cooling the compressor oil at all expected operating conditions and temperatures. The heat exchanger shall be capable of 500 psig (34.5 BAR) test pressures on the water side to comply with NFPA standards, and 250 psig (17.2 BAR) on the air side. The oil cooler assembly shall be mounted on the pump and tested at the manufacturer's facility.

B. FOAM CONCENTRATE PROPORTIONING SYSTEM

1. A 12 Volt DC Powered Variable Speed Rotary Gear Pump Direct Injection Foam Concentrate Proportioning System shall be integrated into the CAF System to provide foam concentrate proportioning. The system shall operate via a paddlewheel flow transducer in the discharge manifold, providing a signal to a Control Unit.
2. The Control Unit Microprocessor shall monitor total water flow and foam concentrate pump output providing the operator the set proportional amount of foam concentrate injection into the foam manifold.
3. Total foam pump concentrate output shall be 5.0 gallons per minute (19 liters per minute) minimum.
4. The control unit display shall provide concentrate injection readout in tenths of percentage while also being able to read water flow, total water flowed and total amount of foam concentrate used. The control shall flash a warning indicating low concentrate in the reservoir to the operator, and shall be able to shut off the concentrate pump to prevent damage to the pump.
5. A bar graph on the control unit will provide visual indication of system operating capacity and will indicate when capacity is exceeded.
6. Micro Processor shall automatically change concentrate injection percentage when operators switch tanks.
7. In-line, field serviceable foam concentrate strainer(s) shall be installed in the foam concentrate suction line(s).
8. Full flow ball valves will be installed in an accessible location to permit foam tank shutdown and service of this strainer.
9. The strainer screen shall be of reusable stainless steel mesh.
10. Foam concentrate Proportioning Systems that use a Venturi (either directly or indirectly) to measure water flow, and therefore, cause a

restriction to that flow, will not be accepted.

C. FOAM INJECTION CHECK VALVE
   1. The foam concentrate pump discharge line shall be equipped with a bubble tight check valve, rated at 500 PSIG (34 BAR) and 10 GPM (38 LPM), to prevent water flow into the concentrate pump from the apparatus fire pump. This valve shall have a cracking pressure of 4- 6 PSIG (0.3- 0.4 BAR) to prevent flowing concentrate through the pump due to head pressure from the concentrate reservoir.
   2. The foam injection check valve shall have an integral injection fitting.
   3. Valve shall be brass or 300 Series stainless steel with an elastomeric seat compatible with fire fighting foam chemicals (No exceptions).

D. RESERVOIRS
   1. FOAM RESERVOIR
      a. An installer supplied foam reservoir conforming to NFPA standards shall be incorporated into the apparatus water tank with a separate fill tower and with 1-inch NPT minimum size bottom outlet(s). The reservoir shall hold a volume of concentrate that ensures compliance with NFPA requirements.
      b. A cover with vacuum breaker will be provided on top of the fill tower.
      c. A ¼ inch (6.4 mm) mesh screen shall be incorporated into the fill tower to prevent debris from entering the tank.
      d. A low-level sensor switch will be mounted in the tank to provide a feedback signal to the foam proportioner system electronic control. The sensor signal will indicate when the foam tank is running low and will shut down the foam concentrate pump if the tank is not refilled. The switch shall be located so that false alarms do not occur and there is (1) minute reserve capacity when switch trips.
   2. WATER RESERVOIR
      a. An installer supplied water reservoir (booster tank) will be provided on the apparatus and will be constructed in accordance with the requirements of NFPA.
      b. The water reservoir will have a fill connection provided as described in paragraph 6 regarding valves.

E. CAFS PIPING
   1. All water, air and foam concentrate piping and hoses within the CAF System shall meet NFPA standards.
   2. Hoses shall be compatible with oil, air and water at all maximum working pressures and maximum expected temperatures.
   3. Air piping and valves shall be adequate to carry air at the rated SCFM (SLPM) capacities.
   4. Foam solution and CAFS pipe work shall be 300 series stainless steel or brass construction.

F. MIXING CHAMBERS
   1. Four stage stainless steel static mixing chambers shall be installed on the discharge of CAFS System. These mixing chambers will consist of modular stainless steel cast sections utilizing integrally cast “fins” for semi-directional motionless agitation of the foam solution and air flow, creating a CAFS discharge. Additional four stage static mixers are required on the 3" deck gun after the discharge valve.

G. DISCHARGE PIPING CHECK VALVES
   1. Check valves shall be installed on all foam equipped discharge manifolds to prevent foam solution from entering the fire pump.
   2. Check valves shall also be installed upstream of any compressed air injection device. These check valves shall be of compact double door design and shall be constructed of stainless steel.
   3. The check valve doors shall be spring loaded, normally closed, by means of one or more heavy-duty stainless steel torsional springs.
   4. Flow from the fire pump shall cause the doors to open and upon pump or discharge line shutdown, the torsion spring will shut the doors.
   5. Seating shall be resilient and water tight.
   6. Under no circumstances will center guide, tilting disc, swing or globe check valves be accepted.

H. FOAM SOLUTION TO AIR RATIO CONTROL
   1. Changing the foam consistency from wet to dry on the air flow display shall automatically increase the % foam when running below 1%. This will allow one button switching from Wet to Dry foam types.
   2. Foam Injection % may also be adjusted independently of Air Injection. Foam solution to Air Ratio Control shall be incorporated in the CAFS discharge plumbing. This control shall be automatically regulated by the panel digital control to maintain air/foam solution ratios, and allow the pump operators to select foam consistencies from “wet” to “dry”.
   3. No single or multiple manual lever actuators will be accepted.
   4. The foam solution to air ratio control shall also be the compressed air injection point common for all the compressed air foam discharges.
   5. One panel-mounted operator control shall be provided for foam consistency control of all the CAFS discharges.
   6. The foam solution to Air Ratio Controls shall be designed to not shut the water flow off even under an error or failure condition.
   7. The entire CAFS manifold system shall flow 750 gpm of water or foam solution.
   8. A digital readout flow meter showing standard cubic feet per minute (SCFM) or normal cubic meters per hour (NCMH) will be installed to read gross CAF System air output (actual flow) of the rotary air compressor.
   9. The display shall be mounted on the pump operator’s panel. The air flow meter sensor shall automatically compensate for temperature and pressure and read directly in SCFM (NCMH).
   10. Flow meters that do not automatically compensate for temperature and pressure will not be accepted.

I. CAFS OPERATING CONTROLS
   1. All CAFS operating controls (foam concentrate proportioning system control, digital water and air flow meters) shall be mounted and integrated as part of the main apparatus pump panel. Under no circumstances will auxiliary control panels be permitted. Under no circumstances will an “auxiliary” module type CAFS package be installed on the apparatus.
   2. No auxiliary drive engines will be permitted for the CAFS installation.

3. Compressor, Foam Proportioner and CAFS controls shall be engaged and enabled when pump is placed in “pumping gear”.
4. CAFS shall be available by opening the discharge valve for the specific CAFS equipped discharge.
5. CAFS and or Foam solution may be turned off independently at the control panel. Compressor can be disengaged at the control panel.
6. A liquid filled Duplex Master Gauge shall be installed on the pump panel showing fire pump discharge and CAF System air discharge pressures.
7. A red needle for air and a black needle for water pressure shall operate on a common gauge face.
8. Safety enhancement features incorporated into the CAF System shall include a control valve in the outlet of the CAF System. This valve shall close and prevent air flow when a transducer monitoring the output of the foam concentrate pump reads no foam pump output, or if no water is flowing, or if the foam tank is empty. This feature shall prevent the injection of air when foam concentrate is not being injected, thus preventing “slug-flow” conditions.
9. Safety placards shall be installed upon the apparatus providing warnings against the use of the compressed air source for SCBA or any other breathing apparatus.
10. Warning placard should also warn against using hose caps because of the possibility of residual compressed air in hose lines and within the apparatus piping, that potentially could propel caps and other objects causing personal injury.

J. PUMP CONSTRUCTION
1. The pump shall be of a size and design to mount on the chassis rails of commercial and custom truck chassis, and have the capacity of 1000 or more gallons per minute (U.S. GPM) (3785 LPM), NFPA-1901 rated performance.
2. The entire pump, both suction and discharge passage, shall be hydrostatically tested to a pressure of 600 PSI (41 BAR). The pump shall be fully tested at the pump manufacturer’s factory to the performance spots as outlined by the latest NFPA Pamphlet No. 1901. Pump shall be free from objectionable pulsation and vibration.
3. The pump body and related parts shall be of fine grain alloy cast iron, with a minimum tensile strength of 30,000 PSI (207 N/mm^2). All moving parts in contact with water shall be of high quality bronze or stainless steel. Pumps utilizing castings made of lower tensile strength cast iron are not acceptable.
4. Pump shaft to be rigidly supported by at least two bearings for minimum deflection. On pumps with a double suction impeller, one high lead bronze sleeve bearing to be located immediately adjacent to the impeller (on side opposite the drive unit). The sleeve bearing is to be lubricated by a force fed automatic oil lubricated design, pressure balanced to exclude foreign material (No exceptions). The remaining bearings shall be heavy duty, deep groove ball bearings in the gearbox and they shall be splash lubricated by the gearbox oil.
5. Pump impeller shall be hard, fine grain bronze of the mixed flow design accurately machined, hand-ground and individually balanced. The vanes of the impeller intake eyes shall be

hand-ground and polished to a sharp edge and be of sufficient size and design to provide ample reserve capacity utilizing minimum horsepower.

6. Impeller clearance rings shall be bronze, easily renewable without replacing impeller or pump volute (No exceptions.)
7. The pump shaft is heat-treated, corrosion resistant stainless steel. Pump shaft must be sealed with double lip oil seal to keep road dirt and water out of drive unit.

K. GEAR BOX

1. Pump gearbox driveline shall be of sufficient size to withstand up to 16,000 ft-lbs (21,693 N-m) of torque of the engine in road operating condition. The gearbox shall be designed of ample capacity for lubrication reserve and to maintain the proper operating temperature.
2. The gearbox drive shafts shall be of heat-treated chrome nickel steel and at least 2-¾ inches (70 mm) in diameter on both the input and output drive shafts. They shall withstand the full torque of the engine in both road and pump operating conditions.
3. All gears, both drive and pump, shall be of highest quality chrome nickel steel. Bores shall be ground to size and teeth integrated, and hardened to give an extremely accurate gear for long life, smooth quiet running and high load carrying capability. An accurate spur design shall be provided to eliminate all possible end thrust (No exceptions).
4. Gearbox shall be equipped with a power shift. The shifting mechanism shall be a heat-treated, hard-anodized aluminum power cylinder, with stainless steel shaft. An incab control for rapid shift shall be provided that locks in road or pump position.

L. PRIMING PUMP

1. The priming pump shall be a positive displacement vane type, electrically driven, conform to standards outlined in NFPA Pamphlet No. 1901 and manufactured by the apparatus pump manufacturer.
2. One priming control shall both open the priming valve and start the priming motor.
3. No oil or lubricants shall be discharged from the priming pump to the ground.

M. WATER PRESSURE CONTROL MECHANISM

1. The pump shall be equipped with an automatic pressure control device.
2. A variable Total Pressure Master (TPM) Relief Valve System, as required by NFPA 1901 Standards, shall be provided to prevent undue pressure rise. This system monitors discharge and suction pressures through single panel mounted control valve.
3. An automatic pressure governor may be used with this relief valve device.

N. THERMAL PROTECTION DEVICE

1. The pump shall be equipped with a thermal protection device, which monitors the pump water temperature, and relieves water when the temperature exceeds 120° F (49° C). This device shall have an indicator lamp on the pump operator panel to show when the device is open.
2. There must also be a test button located on the panel adjacent to the lamp.

O. VALVES

1. All valves shall be manufactured by the pump manufacturer with stainless steel bodies and valve balls.

2. All valves shall have a dual seat that can be lubricated without dismantling valves or piping.
3. Discharge and suction valves shall be of the quarter turn, ball type design, with a locking handle.
4. All “in-line” valves on the apparatus shall be of the quarter turn, ball type design.
5. The tank to pump valve shall be a 4-inch full flow ball valve. A built in non-corrosive check valve(s) to be furnished in the pump body. A 4-inch full flow ball valve with 4 inch NPT or 5 inch flexible connection shall be provided for flows up to 1000 GPM (3785 LPM)
6. A direct tank fill valve with 2-½ inch NST (or equal) connection and associated piping shall be provided for filling the water tank. This valve will be used during CAFS operations to maintain the water supply on the truck and maintain the engine speed within the optimum range for compressor operation regardless of the inlet pressure. An automatic level control for the tank linked to the direct fill valve is optional.
7. Check valves designed specifically for CAFS use shall be used. The check valves shall be made of a corrosion resistant material, shall be spring loaded, equipped with soft seats compatible with the foam concentrates being used and have a bubble tight rating. Double check valves shall be used in main water/foam solution piping feeding the CAFS to prevent foam solution backflow into water pump piping.

P. POWERTRANSMISSION

1. The pump and compressor shall be driven by a common split shaft gearbox in the driveline from the truck transmission. The air compressor engagement shall be by a clutch with an interlock that prevents engagement at high input speeds. The torque rating of the vehicle transmission shall exceed the limit of the requirement of the pump and compressor.
2. The pump ratio shall be selected to provide sufficient horsepower and RPM to enable the pump and compressor to meet and exceed their rated performance.
3. The compressor speed shall be monitored and if the unit max speed is exceeded a warning shall be indicated. Further increases in speed will disengage the compressor drive.

Q. AUTO-FILL

The apparatus shall be equipped with a 2.5” “AutoFill” automatic tank fill valve. The AutoFill valve shall automatically fill the booster tank without pump operator intervention, when supplied with an adequate water supply source. The system shall include a “Auto / Manual” switch on the pump panel and be integrated with the Class 1 booster tank water level gauge also located on the pump panel.