

# WATER PUMPING EQUIPMENT

## Water Tender Data Sheet No. 1

**Agency:** USDI Bureau of Land Mangement  
**Equipment Designator:** BLM 669 Water Tender  
**ICS Type:** 2

**Summary:** Tank Capacity—(gallons)— 3,500  
 Pump Rating—500 gal/min @ 150 psi  
 Pump Drive—PTO  
 Mobile Attack Capability?—Yes  
 Number Crew Personnel—3  
 Foam System Available?— Yes  
     Gallons—20  
 All-Wheel Drive? —No



**General Description:** This BLM water tender model is constructed to the NFPA 1906 Wildland Fire Engine Standard. This model was developed for off-road suppression activities in the Western States. The model is a 6 by 4, also available with all-wheel drive, FL112 Freightliner with various transmissions available. The truck is powered by a 415 horsepower, C12 Caterpillar turbo diesel. The tank is constructed of 304 stainless steel and is braced and baffled for hard use. The interior of the tank is coated with a two-part epoxy plastic coating to absorb stress and vibrations on wash board, secondary, and gravel roads. A wide variety of pumping capabilities and foam injection systems are available. The engine is equipped with live reels and discharge road sweeps which are air actuated; each can be operated independently from the cab. The unit has an option for a master stream appliance on the top or front bumper and controlled from the cab. Other sizes and pumping capacities and configurations are available.

**Pump:** Manufacturer: Waterous Model: CLVK  
 Type: Centrifugal  
 Performance: gal/min (max) at free flow; 500  
                   gal/min @ max psi = 250 @ 250  
 Primer Type: Electric

**Tank:** Material: 304 Stainless steel  
 Construction: Baffles? Yes  
 If steel, is the tank corrosion treated? Yes

**Controls and Gauges:** Hand Throttle? Yes      Pressure Gauge? Yes      Automatic shutdown? Yes

**Valves:** Tank-to-Pump? Yes      Pump-to-Tank? Yes

<b>Overboard Discharge:</b>	Quantity	2	2
	Size	2½ inch	1 inch
<b>Suction:</b>	Quantity	1	1
	Size	6 inch	2½ inch

**Priming Valve Handle:** Electric  
**Suction Valve Handle:** Electric  
**Tank-to-Plumbing Shut-Off?** Yes  
**Gravity Tank Drain/Dump?** Yes  
     Type—10-inch manual butterfly valve

**Manufacturer:** Freightliner  
**Manufacturer Model Year:** Current  
**Engine Fuel Type:** Diesel  
**Vehicle Operating Weight:** 59,000  
**Brake Type:** Air

**Discharge Valve Handle:** Manual  
**Adjustable Pressure Relief?** Yes  
**Pump and Plumbing Drain?** Yes  
**Rock Trap/Plumbing Strainer?** Yes  
     Type—Inlet screen

**Cab/Axle Distance:** 145½ inch  
**GVW Rating:** 64,000  
**Horsepower Rating:** 410  
**Transmission Type:** Various

**Written Materials:** Specifications and drawings are available from: National Interagency Fire Center  
 Bureau of Land Mangement  
 Fire Equipment Development Unit  
 3833 South Development Avenue  
 Boise, ID 83705

## WATER PUMPING EQUIPMENT Water Tender Data Sheet No. 2

**Agency:** Florida Division of Forestry

**Equipment Designator:** Water tender, semi

**ICS Type:** 2

**Summary:** Tank Capacity (gallons)— 6,000  
 Pump Rating—250 gal/min @ 150 psi  
 Pump Drive—Auxiliary engine  
 Mobile Attack Capability?—Yes  
 Number Crew Personnel—2  
 Foam System Available?— Yes  
     Gallons—100  
 All-Wheel Drive? —No



**General Description:** This is a stainless steel 6,000 gallon semitrailer with a truck tractor using an auxiliary pump and top mounted master stream appliance. Also used for potable water in disasters.

**Pump:** Manufacturer—Hale Model—HP 500  
 Type—Centrifugal  
 Performance: gal/min (max) at free flow—500  
                   gal/min @ max psi = 125 @ 225  
 Primer Type—Electric

**Tank:** Material— Stainless steel  
 Construction: Baffles?— Yes  
 If steel, is the tank corrosion treated?—N/A

**Controls and Gauges:** Hand Throttle?—Yes Pressure Gauge?—Yes Automatic shutdown?— No

**Valves:** Tank-to-Pump?—Yes Pump-to-Tank?—Yes

<b>Overboard Discharge:</b>	Quantity	2	2
	Size	2½ inch	1½ inch

<b>Suction:</b>	Quantity	1
	Size	4 inch

**Priming Valve Handle:** Electric  
**Suction Valve Handle:** Manual  
**Tank-to-Plumbing Shut-Off?** Yes  
**Gravity Tank Drain/Dump?** Yes  
 Type— ¼ turn 4-inch valve

**Manufacturer:** Brenner Trailers  
**Manufacturer Model Year:** 1986  
**Engine Fuel Type:** N/A  
**Vehicle Operating Weight:** 68,000  
**Brake Type:** Air

**Discharge Valve Handle:** Manual  
**Adjustable Pressure Relief?** No  
**Pump and Plumbing Drain?** Yes  
**Rock Trap/Plumbing Strainer?** No  
 Type—

**Cab/Axle Distance:** N/A  
**GVW Rating:** 68,000  
**Horsepower Rating:** N/A  
**Transmission Type:** N/A

**Written Materials:** Specifications and drawings are available from: Florida Division of Forestry  
 3125 Conner Boulevard  
 Tallahassee, FL 32399

# WATER PUMPING EQUIPMENT

## Water Tender Data Sheet No. 3

**Agency:** New Jersey Forest Fire Service

**Equipment Designator:** Tender

**ICS Type:** 3

**Summary:** Tank Capacity (gallons)— 1,200  
 Pump Rating—250 gal/min @ 150 psi  
 Pump Drive—PTO  
 Mobile Attack Capability?— No  
 Number Crew Personnel—3  
 Foam System Available?— No  
 Gallons—  
 All-Wheel Drive? —No



**General Description:** The tank and pump were commercially obtained and installed on this tender. The aluminum tank is oval in design to reduce stress points created by a rectangular shape. This tender is used to resupply engines when water sources are not close by.

**Pump:** Manufacturer—Hale Model—unknown  
 Type—Centrifugal  
 Performance: gal/min (max) at free flow—250  
 gal/min @ max psi = unknown  
 Primer Type— Electric

**Tank:** Material—Aluminum  
 Construction: Baffles?—Yes  
 If steel, is the tank corrosion treated?—N/A

**Controls and Gauges:** Hand Throttle?—Yes Pressure Gauge?—Yes Automatic shutdown?—No

**Valves:** Tank-to-Pump?— Yes Pump-to-Tank?—Yes

**Overboard Discharge:** Quantity 1 2  
 Size 2½ inch 1½ inch

**Suction:** Quantity 1  
 Size 2½ inch

**Priming Valve Handle:** Manual  
**Suction Valve Handle:** Manual  
**Tank-to-Plumbing Shut-Off?** Yes  
**Gravity Tank Drain/Dump?** Yes  
 Type— Manual ¼ turn valve

**Manufacturer:** Chevrolet  
**Manufacturer Model Year:** 1985  
**Engine Fuel Type:** Gasoline  
**Vehicle Operating Weight:** 24,500  
**Brake Type:** Air

**Discharge Valve Handle:** Manual  
**Adjustable Pressure Relief?** No  
**Pump and Plumbing Drain?** Yes  
**Rock Trap/Plumbing Strainer?** No  
 Type—

**Cab/Axle Distance:** 84 inch  
**GVW Rating:** 28,000  
**Horsepower Rating:** 210  
**Transmission Type:** Manual

**Written Materials:** Specifications and drawings are available from: New Jersey Forest Fire Service  
 P.O. Box 404, 4th Floor  
 Trenton, NJ 08625-0404



# WATER PUMPING EQUIPMENT

## Water Tender Data Sheet No. 5

**Agency:** New Jersey Forest Fire Service

**Equipment Designator:** Tender

**ICS Type:** 3

**Summary:** Tank Capacity (gallons)— 1,000  
 Pump Rating—N/A  
 Pump Drive—PTO  
 Mobile Attack Capability?— No  
 Number Crew Personnel—3  
 Foam System Available?— No  
 Gallons—  
 All-Wheel Drive? —No



**General Description:** This tender is used to resupply engines at the fire scene. It has minimal brush protection on the front of the vehicle.

**Pump:** Manufacturer—Hale Model—Unknown  
 Type—Centrifugal  
 Performance: gal/min (max) at free flow—500  
 gal/min @ max psi = Unknown  
 Primer Type— Other

**Tank:** Material— Aluminum  
 Construction: Baffles?—Yes  
 If steel, is the tank corrosion treated?—N/A

**Controls and Gauges:** Hand Throttle?— Yes Pressure Gauge?— Yes Automatic shutdown?— No

**Valves:** Tank-to-Pump?— Yes Pump-to-Tank?—Yes

**Overboard Discharge:** Quantity 1 2  
 Size 2½ inch 1½ inch

**Suction:** Quantity 1  
 Size 2½ inch

**Priming Valve Handle:** Manual  
**Suction Valve Handle:** Manual  
**Tank-to-Plumbing Shut-Off?** Yes  
**Gravity Tank Drain/Dump?** No  
 Type—

**Manufacturer:** Chevrolet  
**Manufacturer Model Year:** 1983  
**Engine Fuel Type:** Gasoline  
**Vehicle Operating Weight:** 26,000  
**Brake Type:** Air

**Discharge Valve Handle:** Manual  
**Adjustable Pressure Relief?** No  
**Pump and Plumbing Drain?** Yes  
**Rock Trap/Plumbing Strainer?** No  
 Type—

**Cab/Axle Distance:** 84 inch  
**GVW Rating:** 30,000  
**Horsepower Rating:** 210  
**Transmission Type:** Manual

**Written Materials:** Specifications and drawings are available from: New Jersey Forest Fire Service  
 P.O. Box 404, 4th Floor  
 Trenton, NJ 08625-0404

# WATER PUMPING EQUIPMENT

## Water Tender Data Sheet No. 6

**Agency:** New Jersey Forest Fire Service

**Equipment Designator:** 3,500 gallon off-road tender

**ICS Type:** 3

**Summary:** Tank Capacity (gallons)— 3,500  
 Pump Rating—N/A  
 Pump Drive—Auxiliary engine  
 Mobile Attack Capability?— Yes  
 Number Crew Personnel—2  
 Foam System Available?— No  
 Gallons—  
 All-Wheel Drive? —Yes



**General Description:** This unit is a converted military 5-ton transport obtained through the FEPP program. It is used in an area of the state with few paved roads and limited availability of water sources for resupplying engines.

**Pump:** Manufacturer—Hale Model—25FA  
 Type—Centrifugal  
 Performance: gal/min (max) at free flow—225  
 gal/min @ max psi = 25 @ 100  
 Primer Type— Other

**Tank:** Material— Aluminum  
 Construction: Baffles?—Yes  
 If steel, is the tank corrosion treated?—N/A

**Controls and Gauges:** Hand Throttle?— Yes Pressure Gauge?— Yes Automatic shutdown?— No

**Valves:** Tank-to-Pump?— Yes Pump-to-Tank?—Yes

<b>Overboard Discharge:</b>	Quantity	1	2
	Size	2½ inch	1½ inch

<b>Suction:</b>	Quantity	1
	Size	2½ inch

**Priming Valve Handle:** Manual  
**Suction Valve Handle:** Manual  
**Tank-to-Plumbing Shut-Off?** Yes  
**Gravity Tank Drain/Dump?** No  
 Type—

**Discharge Valve Handle:** Manual  
**Adjustable Pressure Relief?** No  
**Pump and Plumbing Drain?** Yes  
**Rock Trap/Plumbing Strainer?** No  
 Type—

**Manufacturer:** Mack  
**Manufacturer Model Year:** 1978  
**Engine Fuel Type:** Gasoline  
**Vehicle Operating Weight:** 44,000  
**Brake Type:** Air/hydraulic

**Cab/Axle Distance:** 128 inch  
**GVW Rating:** 55,000  
**Horsepower Rating:** 180  
**Transmission Type:** Manual

**Written Materials:** Specifications and drawings are available from: New Jersey Forest Fire Service  
 P.O. Box 404, 4th Floor  
 Trenton, NJ 08625-0404

# WATER PUMPING EQUIPMENT

## Water Tender Data Sheet No. 7

**Agency:** New Jersey Forest Fire Service

**Equipment Designator:** Tender

**ICS Type:** 3

**Summary:** Tank Capacity (gallons)— 1,400  
Pump Rating—N/A  
Pump Drive—Auxiliary engine  
Mobile Attack Capability?— Yes  
Number Crew Personnel—3  
Foam System Available?— No  
Gallons—  
All-Wheel Drive? —Yes



**General Description:** This unit is a converted military 5-ton vehicle obtained through the FEPP program and is used to resupply engines in unimproved roads. The tank was formerly used to transport gasoline and has been refitted and equipped to pump water.

**Pump:** Manufacturer—Hale Model—25FZZ  
Type—Centrifugal  
Performance: gal/min (max) at free flow—160  
gal/min @ max psi = 50@100  
Primer Type— Other

**Tank:** Material— Stainless steel  
Construction: Baffles?— Yes  
If steel, is the tank corrosion treated?— N/A

**Controls and Gauges:** Hand Throttle?— Yes Pressure Gauge?— Yes Automatic shutdown?— No

**Valves:** Tank-to-Pump?— Yes Pump-to-Tank?—Yes

**Overboard Discharge:** Quantity 3  
Size 1½ inch

**Suction:** Quantity 1  
Size 2½ inch

**Priming Valve Handle:** Manual  
**Suction Valve Handle:** Manual  
**Tank-to-Plumbing Shut-Off?** Yes  
**Gravity Tank Drain/Dump?** No  
Type—

**Manufacturer:** AM General  
**Manufacturer Model Year:** 1984  
**Engine Fuel Type:** Diesel  
**Vehicle Operating Weight:** 32,000  
**Brake Type:** Air

**Discharge Valve Handle:** Manual  
**Adjustable Pressure Relief?** No  
**Pump and Plumbing Drain?** Yes  
**Rock Trap/Plumbing Strainer?** No  
Type—

**Cab/Axle Distance:** 96 inch  
**GVW Rating:** 80,000  
**Horsepower Rating:** 240  
**Transmission Type:** Manual

**Written Materials:** Specifications and drawings are available from: New Jersey Forest Fire Service  
P.O. Box 404, 4th Floor  
Trenton, NJ 08625-0404

# WATER PUMPING EQUIPMENT

## Water Tender Data Sheet No. 8

**Agency:** USDA Forest Service (PSW Region, R5)

**Equipment Designator:** Wildland tender

**ICS Type:** 3

**Summary:** Tank Capacity (gallons)— 1,500  
 Pump Rating—350 gal/min @ 150 psi  
 Pump Drive—PTO  
 Mobile Attack Capability?—Yes  
 Number Crew Personnel—2  
 Foam System Available?—Yes  
     Gallons—20  
 All-Wheel Drive? —No



**General Description:** The 1,500-gallon Wildland tender is mounted on a two-wheel drive truck chassis with conventional cab. It is equipped with a single live reel, front and rear spray heads, a foam system, storage compartments, and equipment racks.

**Pump:** Manufacturer—Darley    Model—HM350  
 Type—Centrifugal  
 Performance: gal/min (max) at free flow—350  
                   gal/min @ max psi = 350 @ 150  
 Primer Type— Electric

**Tank:** Material— Stainless steel  
 Construction: Baffles?— Yes  
 If steel, is the tank corrosion treated?— N/A

**Controls and Gauges:** Hand Throttle?— Yes    Pressure Gauge?— Yes    Automatic shutdown?— Yes

**Valves:** Tank-to-Pump?—Yes    Pump-to-Tank?—Yes

**Overboard Discharge:**

Quantity	4	1
Size	2½ inch	1 inch

**Suction:**

Quantity	2
Size	3 inch

**Priming Valve Handle:** Electric  
**Suction Valve Handle:** Manual  
**Tank-to-Plumbing Shut-Off?** No  
**Gravity Tank Drain/Dump?** Yes  
     Type— 6-inch air dump

**Discharge Valve Handle:** Manual  
**Adjustable Pressure Relief?** No  
**Pump and Plumbing Drain?** Yes  
**Rock Trap/Plumbing Strainer?** No  
     Type—

**Manufacturer:** International  
**Manufacturer Model Year:** 2002  
**Engine Fuel Type:** Diesel  
**Vehicle Operating Weight:** 30,500  
**Brake Type:** Air

**Cab/Axle Distance:** 98 inch  
**GVW Rating:** 35,000  
**Horsepower Rating:** 310  
**Transmission Type:** Automatic

**Written Materials:** Specifications and drawings are available from: USDA Forest Service  
 San Dimas Technology  
     & Development Center  
 444 East Bonita Avenue  
 San Dimas, CA 91773

# WATER PUMPING EQUIPMENT

## Water Tender Data Sheet No. 9

**Agency:** New Jersey Forest Fire Service

**Equipment Designator:** Tender

**ICS Type:** N/A

**Summary:** Tank Capacity (gallons)— 500  
Pump Rating—N/A  
Pump Drive—Auxiliary engine  
Mobile Attack Capability?— Yes  
Number Crew Personnel—3  
Foam System Available?— No  
Gallons—  
All-Wheel Drive? —Yes



**General Description:** Acquired through the FEPP program, this truck is intended for off-road water supply, mop-up, and patrol on fire roads.

**Pump:** Manufacturer—Hale Model—30FB-B42  
Type—Centrifugal  
Performance: gal/min (max) at free flow—350  
gal/min @ max psi = 25@118  
Primer Type— Exhaust

**Tank:** Material— Aluminum  
Construction: Baffles?— Yes  
If steel, is the tank corrosion treated?—N/A

**Controls and Gauges:** Hand Throttle?— Yes Pressure Gauge?— Yes Automatic shutdown?— No

**Valves:** Tank-to-Pump?— Yes Pump-to-Tank?—Yes

**Overboard Discharge:** Quantity 2  
Size 1½ inch

**Suction:** Quantity 1  
Size 2½ inch

**Priming Valve Handle:** Manual  
**Suction Valve Handle:** Manual  
**Tank-to-Plumbing Shut-Off?** Yes  
**Gravity Tank Drain/Dump?** No  
Type—

**Manufacturer:** GMC  
**Manufacturer Model Year:** 1988  
**Engine Fuel Type:** Gasoline  
**Vehicle Operating Weight:** 18,000  
**Brake Type:** Hydraulic

**Discharge Valve Handle:** Manual  
**Adjustable Pressure Relief?** No  
**Pump and Plumbing Drain?** Yes  
**Rock Trap/Plumbing Strainer?** No  
Type—

**Cab/Axle Distance:** 107 inch  
**GVW Rating:** 21,200  
**Horsepower Rating:** 215  
**Transmission Type:** Manual

**Written Materials:** Specifications and drawings are available from: New Jersey Forest Fire Service  
P.O. Box 404, 4th Floor  
Trenton, NJ 08625-0404

## WATER PUMPING EQUIPMENT Nonhighway Equipment—

### D. Nonhighway Equipment

This section represents a variety of nonhighway mechanized water handling equipment. These have been fabricated to meet the specific needs of a geographic area.

Sheet No.	Tank Capacity (gallons)	Pump Rating (gal/min @ 150 psi)	Pump Drive	Equipment Designator	Agency
1	850	80	Auxiliary engine	Tracked water carrier M548	Florida Division of Forestry
2	800	65	Auxiliary engine	M548	Michigan DNR
3	300	65	Hydraulic	Skidder plow	Michigan DNR
4	120	N/A	Auxiliary engine	Tracked ATV	New Jersey Forest Fire Service
5	125	N/A	Auxiliary engine	Wheeled ATV	New Jersey Forest Fire Service
6	500	85	Auxiliary engine	Tracked water carrier M548	USDI Fish and Wildlife Service
7	15	N/A	Electric	Wheeled ATV	USDA Forest Service (R-9)
8	150	20	Hydraulic	Tractor plow unit	Wisconsin DNR
9	200	20	Auxiliary engine	Tracked unit	Wisconsin DNR

# WATER PUMPING EQUIPMENT

## Nonhighway Equipment Data Sheet No. 1

**Agency:** Florida Division of Forestry

**Equipment Designator:** Tracked water carrier, M548

**ICS Type:** N/A

**Summary:** Tank Capacity (gallons)— 850  
 Pump Rating—80 gal/min @ 150 psi  
 Pump Drive—Auxiliary engine  
 Mobile Attack Capability?—Yes  
 Number Crew Personnel—2  
 Foam System Available?—Yes  
     Gallons—20  
 All-Wheel Drive? —Tracked



**General Description:** Military M548 tracked cargo carrier with polypropylene tank, remote master stream appliance, rear view video camera, and fully caged. Good on initial attack, prescribed burns, patrolling fire lines, and as a water source.

**Pump:** Manufacturer—Robwen Model—180  
 Type—Centrifugal  
 Performance: gal/min (max) at free flow—110  
                   gal/min @ max psi = 10 @ 250  
 Primer Type—Exhaust

**Tank:** Material— Polypropylene  
 Construction: Baffles?—Yes  
 If steel, is the tank corrosion treated?—N/A

**Controls and Gauges:** Hand Throttle?—Yes    Pressure Gauge?—Yes    Automatic shutdown?—Yes

**Valves:** Tank-to-Pump?— Yes    Pump-to-Tank?—Yes

**Overboard Discharge:**

Quantity	1	1	2
Size	1 inch	1½ inch	1-inch booster

**Suction:**

Quantity	1	1
Size	2 inch	2½ inch

**Priming Valve Handle:** Manual  
**Suction Valve Handle:** Manual  
**Tank-to-Plumbing Shut-Off?** Yes  
**Gravity Tank Drain/Dump?** Yes  
     Type—Manual ¼ turn valve  
**Manufacturer:** U.S. Military  
**Manufacturer Model Year:** 1968  
**Engine Fuel Type:** Diesel  
**Vehicle Operating Weight:** 15,000  
**Brake Type:** Hydraulic

**Discharge Valve Handle:** Electric  
**Adjustable Pressure Relief?** No  
**Pump and Plumbing Drain?** Yes  
**Rock Trap/Plumbing Strainer?** Yes  
     Type— Inlet screen  
**Cab/Axle Distance:** N/A  
**GVW Rating:** 28,290  
**Horsepower Rating:** 225  
**Transmission Type:** Automatic

**Written Materials:** Specifications and drawings are available from: Florida Division of Forestry  
 3125 Conner Boulevard  
 Tallahassee, FL 32399

## WATER PUMPING EQUIPMENT

### Nonhighway Equipment Data Sheet No. 2

**Agency:** Michigan Dept. of Natural Resources

**Equipment Designator:** M548

**ICS Type:** N/A

**Summary:** Tank Capacity (gallons)— 800  
 Pump Rating—65 gal/min @ 150 psi  
 Pump Drive—Auxiliary engine  
 Mobile Attack Capability?— Yes  
 Number Crew Personnel—4  
 Foam System Available?— Yes  
     Gallons— 5  
 All-Wheel Drive? —Tracked



**General Description:** The M548 is the light armor version of the Bradley military family. The body is aluminum. The cab top, limb risers, and water tank are based on Roscommon Equipment Center design. It has rubber pads on the track and can travel up to 33 mph. At 105.75 inches wide, it must be transported as a wide load.

**Pump:** Manufacturer—Wildfire-Pacific Model—Mark 3  
 Type—Centrifugal  
 Performance: gal/min (max) at free flow—98  
                   gal/min @ max psi = 0 @380  
 Primer Type— Exhaust

**Tank:** Material— Steel  
 Construction: Baffles?— Yes  
 If steel, is the tank corrosion treated?— Yes

**Controls and Gauges:** Hand Throttle?— Yes Pressure Gauge?— Yes Automatic shutdown?— Yes

**Valves:** Tank-to-Pump?— Yes Pump-to-Tank?—Yes

**Overboard Discharge:**

Quantity	1	2
Size	1½ inch	1 inch

**Suction:**

Quantity	1
Size	2 inch

**Priming Valve Handle:** Manual  
**Suction Valve Handle:** Manual  
**Tank-to-Plumbing Shut-Off?** Yes  
**Gravity Tank Drain/Dump?** Yes  
     Type— Manual  
**Manufacturer:** Military  
**Manufacturer Model Year:** 1964 to 1984  
**Engine Fuel Type:** Diesel  
**Vehicle Operating Weight:** 23,700  
**Brake Type:** Hydraulic

**Discharge Valve Handle:** Manual  
**Adjustable Pressure Relief?** No  
**Pump and Plumbing Drain?** Yes  
**Rock Trap/Plumbing Strainer?** No  
     Type—  
**Cab/Axle Distance:** N/A  
**GVW Rating:** 28,500  
**Horsepower Rating:** 115  
**Transmission Type:** Automatic

**Written Materials:** Specifications and drawings are available from: Roscommon Equipment Center  
 c/o Forest Fire Experiment Station  
 P.O. Box 68  
 Roscommon, MI 48653-0068

# WATER PUMPING EQUIPMENT

## Nonhighway Equipment Data Sheet No. 3

**Agency:** Michigan Dept. of Natural Resources

**Equipment Designator:** Skidder plow

**ICS Type:** N/A

**Summary:** Tank Capacity (gallons)— 300  
 Pump Rating—65 gal/min @ 150 psi  
 Pump Drive—Hydraulic  
 Mobile Attack Capability?— Yes  
 Number Crew Personnel—1  
 Foam System Available?— Yes  
 Gallons— 5  
 All-Wheel Drive? —Yes



**General Description:** Based on a grapple skidder with grapple removed and wheelbase lengthened to 130 inches by stretching the rear frame. Includes integrated tank, fire plow, hydraulically operated Mark 3 pump head, foam proportioner, and a remote controlled master stream appliance. Rear live reel is available for mop-up work.

**Pump:** Manufacturer—Wildfire-Pacific Model—Mark 3  
 Type—Centrifugal  
 Performance: gal/min (max) at free flow—98  
 gal/min @ max psi = 0 @380  
 Primer Type— Other

**Tank:** Material— Steel  
 Construction: Baffles?— Yes  
 If steel, is the tank corrosion treated?— Yes

**Controls and Gauges:** Hand Throttle?— Yes Pressure Gauge?— Yes Automatic shutdown?— Yes

**Valves:** Tank-to-Pump?— Yes Pump-to-Tank?—Yes

<b>Overboard Discharge:</b>	Quantity	1	1
	Size	1½ inch	1 inch

<b>Suction:</b>	Quantity	1
	Size	2 inch

**Priming Valve Handle:** Manual  
**Suction Valve Handle:** Manual  
**Tank-to-Plumbing Shut-Off?** Yes  
**Gravity Tank Drain/Dump?** Yes  
 Type— Pipe plug

**Manufacturer:** John Deere  
**Manufacturer Model Year:** 1996  
**Engine Fuel Type:** Diesel  
**Vehicle Operating Weight:** 24,500  
**Brake Type:** Hydraulic

**Discharge Valve Handle:** Manual  
**Adjustable Pressure Relief?** No  
**Pump and Plumbing Drain?** Yes  
**Rock Trap/Plumbing Strainer?** No  
 Type—

**Cab/Axle Distance:** Unknown  
**GVW Rating:** 28,500  
**Horsepower Rating:** 115  
**Transmission Type:** Automatic

**Written Materials:** Specifications and drawings are available from: Roscommon Equipment Center  
 c/o Forest Fire Experiment Station  
 P.O. Box 68  
 Roscommon, MI 48653-0068

# WATER PUMPING EQUIPMENT

## Nonhighway Equipment Data Sheet No. 4

**Agency:** New Jersey Forest Fire Service

**Equipment Designator:** Tracked ATV

**ICS Type:** N/A

**Summary:** Tank Capacity (gallons)—120  
 Pump Rating—N/A  
 Pump Drive—Auxiliary engine  
 Mobile Attack Capability?— Yes  
 Number Crew Personnel—1  
 Foam System Available?— No  
 Gallons—  
 All-Wheel Drive? —Tracked



**General Description:** This is a highly maneuverable all-terrain tracked vehicle used for extensive mop-up work.

**Pump:** Manufacturer—Honda Model—Mini-Striker  
 Type—Centrifugal  
 Performance: gal/min (max) at free flow—56  
 gal/min @ max psi =0@85  
 Primer Type— Other

**Tank:** Material— Steel  
 Construction: Baffles?— Yes  
 If steel, is the tank corrosion treated?— Yes

**Controls and Gauges:** Hand Throttle?— Yes Pressure Gauge?— Yes Automatic shutdown?— No

**Valves:** Tank-to-Pump?— Yes Pump-to-Tank?—No

**Overboard Discharge:** Quantity 1  
 Size 1½ inch

**Suction:** Quantity 1  
 Size 1½ inch

**Priming Valve Handle:** Manual  
**Suction Valve Handle:** Manual  
**Tank-to-Plumbing Shut-Off?** Yes  
**Gravity Tank Drain/Dump?** Yes  
 Type— Manual gate valve  
**Manufacturer:** Bombardier  
**Manufacturer Model Year:** 1973  
**Engine Fuel Type:** Gasoline  
**Vehicle Operating Weight:** 4,000  
**Brake Type:** Manual

**Discharge Valve Handle:** Manual  
**Adjustable Pressure Relief?** No  
**Pump and Plumbing Drain?** Yes  
**Rock Trap/Plumbing Strainer?** No  
 Type—  
**Cab/Axle Distance:** N/A  
**GVW Rating:** 4,800  
**Horsepower Rating:** 113  
**Transmission Type:** Manual

**Written Materials:** Specifications and drawings are available from: New Jersey Forest Fire Service  
 P.O. Box 404, 4th Floor  
 Trenton, NJ 08625-0404

# WATER PUMPING EQUIPMENT

## Nonhighway Equipment Data Sheet No. 5

**Agency:** New Jersey Forest Fire Service

**Equipment Designer:** Wheeled ATV

**ICS Type:** N/A

**Summary:** Tank Capacity (gallons)—125  
 Pump Rating—N/A  
 Pump Drive—Auxiliary engine  
 Mobile Attack Capability?— Yes  
 Number Crew Personnel—2  
 Foam System Available?— No  
 Gallons—  
 All-Wheel Drive? —Yes



**General Description:** This Kawasaki Mule four-wheel drive is small and maneuverable in various terrain. Equipped with a slip-on unit that can be removed and placed as a pumping station at the fire scene.

**Pump:** Manufacturer—Honda Model—Mini-Striker  
 Type—Centrifugal  
 Performance: gal/min (max) at free flow—56  
 gal/min @ max psi =0@85  
 Primer Type— Manual

**Tank:** Material—Aluminum  
 Construction: Baffles?— Yes  
 If steel, is the tank corrosion treated?—N/A

**Controls and Gauges:** Hand Throttle?— Yes Pressure Gauge?— No Automatic shutdown?— No

**Valves:** Tank-to-Pump?— Yes Pump-to-Tank?—Yes

**Overboard Discharge:** Quantity 1  
 Size 1½ inch

**Suction:** Quantity 1  
 Size 1½ inch

**Priming Valve Handle:** Manual  
**Suction Valve Handle:** Manual  
**Tank-to-Plumbing Shut-Off?** Yes  
**Gravity Tank Drain/Dump?** Yes  
 Type— Manual ¼ turn valve  
**Manufacturer:** Kawasaki  
**Manufacturer Model Year:** 2001  
**Engine Fuel Type:** Diesel  
**Vehicle Operating Weight:** 1,600  
**Brake Type:** Hydraulic

**Discharge Valve Handle:** Manual  
**Adjustable Pressure Relief?** No  
**Pump and Plumbing Drain?** Yes  
**Rock Trap/Plumbing Strainer?** No  
 Type—  
**Cab/Axle Distance:** N/A  
**GVW Rating:** 1,630  
**Horsepower Rating:** Not listed  
**Transmission Type:** Automatic

**Written Materials:** Specifications and drawings are available from: New Jersey Forest Fire Service  
 P.O. Box 404, 4th Floor  
 Trenton, NJ 08625-0404

## WATER PUMPING EQUIPMENT Nonhighway Equipment Data Sheet No. 6

**Agency:** USDI Fish and Wildlife Service

**Equipment Designator:** Tracked water carrier, M548

**ICS Type:** N/A

**Summary:** Tank Capacity (gallons)—500  
 Pump Rating—85 gal/min @ 150 psi  
 Pump Drive—Auxiliary engine  
 Mobile Attack Capability?— Yes  
 Number Crew Personnel—2  
 Foam System Available?— Yes  
     Gallons— 5  
 All-Wheel Drive? —Tracked



**General Description:** Military M548 tracked cargo carrier with 500 gallon tank, fully caged, good on initial attack, prescribe burns, patrolling fire lines, and as a water source. Total length of the vehicle is 230.2 inches.

**Pump:** Manufacturer—Wajax Model—BB-4  
 Type—Centrifugal  
 Performance: gal/min (max) at free flow—110  
                     gal/min @ max psi = 14 @ 400  
 Primer Type— Exhaust

**Tank:** Material—Fiberglass  
 Construction: Baffles?— Yes  
 If steel, is the tank corrosion treated?—N/A

**Controls and Gauges:** Hand Throttle?— Yes Pressure Gauge?— Yes Automatic shutdown?— Yes

**Valves:** Tank-to-Pump?— Yes Pump-to-Tank?—Yes

<b>Overboard Discharge:</b>	Quantity	1	1
	Size	1 inch	1½ inch

<b>Suction:</b>	Quantity	1
	Size	2 inch

**Priming Valve Handle:** Manual  
**Suction Valve Handle:** Manual  
**Tank-to-Plumbing Shut-Off?** Yes  
**Gravity Tank Drain/Dump?** Yes  
     Type— Pipe plug  
**Manufacturer:** Military/FMC  
**Manufacturer Model Year:** 1986  
**Engine Fuel Type:** Diesel  
**Vehicle Operating Weight:** 28,000  
**Brake Type:** Hydraulic

**Discharge Valve Handle:** Electric  
**Adjustable Pressure Relief?** Yes  
**Pump and Plumbing Drain?** Yes  
**Rock Trap/Plumbing Strainer?** Yes  
     Type— Inlet screen  
**Cab/Axle Distance:** N/A  
**GVW Rating:** 28,290  
**Horsepower Rating:** 225  
**Transmission Type:** Manual

**Written Materials:** Specifications and drawings are available from: USDI Fish and Wildlife Service  
 Dismal Swamp National Wildlife Refuge  
 Suffolk, VA 23439

# WATER PUMPING EQUIPMENT

## Nonhighway Equipment Data Sheet No. 7

**Agency:** USDA Forest Service (Eastern Region, R9)

**Equipment Designator:** Wheeled ATV

**ICS Type:** N/A

**Summary:** Tank Capacity (gallons)— 15  
 Pump Rating—N/A  
 Pump Drive—Electric  
 Mobile Attack Capability?—Yes  
 Number Crew Personnel—1  
 Foam System Available?—No  
 Gallons—  
 All-Wheel Drive? —Yes



**General Description:** The 15-gallon tank with a 5-foot-long hose is mounted to a metal frame which is mounted on an ATV. The pump uses a 12-volt battery for operation.

**Pump:** Manufacturer—S&N Sprayer Model—2135-561  
 Type—Positive displacement  
 Performance: gal/min (max) at free flow—20  
 gal/min @ max psi = 2 @ 50  
 Primer Type—Manual

**Tank:** Material— Polyurethane  
 Construction: Baffles?— No  
 If steel, is the tank corrosion treated?— N/A

**Controls and Gauges:** Hand Throttle?— Yes Pressure Gauge?— No Automatic shutdown?— Yes

**Valves:** Tank-to-Pump?—No Pump-to-Tank?—No

**Overboard Discharge:** Quantity 1  
 Size ¾ inch

**Suction:** Quantity N/A  
 Size N/A

**Priming Valve Handle:** No  
**Suction Valve Handle:** No  
**Tank-to-Plumbing Shut-Off?** No  
**Gravity Tank Drain/Dump?** No  
 Type—

**Manufacturer:** User option  
**Manufacturer Model Year:** Varies  
**Engine Fuel Type:** Gasoline  
**Vehicle Operating Weight:** Varies  
**Brake Type:** Hydraulic

**Discharge Valve Handle:** No  
**Adjustable Pressure Relief?** No  
**Pump and Plumbing Drain?** No  
**Rock Trap/Plumbing Strainer?** No  
 Type—

**Cab/Axle Distance:** N/A  
**GVW Rating:** 1,050  
**Horsepower Rating:** 26  
**Transmission Type:** Manual

**Written Materials:** Specifications and drawings are available from: USDA Forest Service  
 Wayne National Forest  
 13700 U.S. Highway 33  
 Nelsonville, OH 45764

# WATER PUMPING EQUIPMENT

## Nonhighway Equipment Data Sheet No. 8

**Agency:** Wisconsin Dept. of Natural Resources

**Equipment Designator:** Tractor plow unit

**ICS Type:** T-P 5

**Summary:** Tank Capacity (gallons)— 150  
 Pump Rating—20 gal/min @ 150 psi  
 Pump Drive—Hydraulic  
 Mobile Attack Capability?—Yes  
 Number Crew Personnel—1  
 Foam System Available?—No  
 Gallons—  
 All-Wheel Drive? —Tracked



**General Description:** The Wisconsin dozer-plow unit is designed for fireline construction with its hydraulically operated middle buster fire plow and front mounted 6-way angling blade. A full canopy water shower system is incorporated in each unit for operator protection. The two side mounted 75-gallon water tanks and hydraulically driven Hypro model 7560XL water pump are mounted behind the operator and primarily used to support the shower system. They also prove useful in wetting down hot spots next to the fireline as well as during mop-up operations.

**Pump:** Manufacturer—Hypro Model—7560XL  
 Type—Positive displacement  
 Performance: gal/min (max) at free flow—20  
 gal/min @ max psi = 20 @ 185  
 Primer Type— Self-priming

**Tank:** Material— Steel  
 Construction: Baffles?— Yes  
 If steel, is the tank corrosion treated?— Yes

**Controls and Gauges:** Hand Throttle?— Yes Pressure Gauge?—Yes Automatic shutdown?— No

**Valves:** Tank-to-Pump?—Yes Pump-to-Tank?—Yes

**Overboard Discharge:** Quantity 1  
 Size 1 inch

**Suction:** Quantity 1  
 Size 1 inch

**Priming Valve Handle:** N/A  
**Suction Valve Handle:** Manual  
**Tank-to-Plumbing Shut-Off?** Yes  
**Gravity Tank Drain/Dump?** Yes  
 Type— Pipe plug  
**Manufacturer:** John Deere  
**Manufacturer Model Year:** Varies  
**Engine Fuel Type:** Diesel  
**Vehicle Operating Weight:** 21,725  
**Brake Type:** Hydraulic

**Discharge Valve Handle:** Manual  
**Adjustable Pressure Relief?** Yes  
**Pump and Plumbing Drain?** Yes  
**Rock Trap/Plumbing Strainer?** Yes  
 Type— Inlet screen  
**Cab/Axle Distance:** N/A  
**GVW Rating:** N/A  
**Horsepower Rating:** 75  
**Transmission Type:** Hydrostatic

**Written Materials:** Specifications and drawings are available from: Wisconsin Dept. of Natural Resources  
 Neil H. LeMay Forestry Center  
 518 West Somo Avenue  
 Tomahawk, WI 54487

# WATER PUMPING EQUIPMENT

## Nonhighway Equipment Data Sheet No. 9

**Agency:** Wisconsin Dept. of Natural Resources

**Equipment Designator:** Tracked unit

**ICS Type:** N/A

**Summary:** Tank Capacity (gallons)— 200  
 Pump Rating—20 gal/min @ 150 psi  
 Pump Drive—Auxiliary engine  
 Mobile Attack Capability?—Yes  
 Number Crew Personnel—2  
 Foam System Available?—Yes  
 Gallons— 5  
 All-Wheel Drive? —Tracked



**General Description:** The Bombardier Muskeg tracked unit is equipped with a 200-gallon stainless steel tank with mounted Darley/Davey water pump, live reel with 100 feet of 1-inch hose, and a Robwen foam proportioner. The unit is designed for wet ground/marsh fires that are inaccessible by more conventional equipment.

**Pump:** Manufacturer—Darley/Davey Model—AK282 **Tank:** Material— Stainless steel  
 Type—Centrifugal Construction: Baffles?— Yes  
 Performance: gal/min (max) at free flow—120 If steel, is the tank corrosion treated?— N/A  
 gal/min @ max psi = 20 @ 155  
 Primer Type— Self-priming

**Controls and Gauges:** Hand Throttle?— Yes Pressure Gauge?—No Automatic shutdown?— No

**Valves:** Tank-to-Pump?—Yes Pump-to-Tank?—Yes

**Overboard Discharge:** Quantity 2 1  
 Size 1 inch 1½ inch

**Suction:** Quantity 1  
 Size 1½ inch

**Priming Valve Handle:** N/A  
**Suction Valve Handle:** Manual  
**Tank-to-Plumbing Shut-Off?** Yes  
**Gravity Tank Drain/Dump?** Yes  
 Type— Pipe plug  
**Manufacturer:** Bombardier  
**Manufacturer Model Year:** 2000  
**Engine Fuel Type:** Diesel  
**Vehicle Operating Weight:** 14,760  
**Brake Type:** Hydraulic

**Discharge Valve Handle:** Manual  
**Adjustable Pressure Relief?** No  
**Pump and Plumbing Drain?** Yes  
**Rock Trap/Plumbing Strainer?** Yes  
 Type— Inlet screen  
**Cab/Axle Distance:** N/A  
**GVW Rating:** 19,000  
**Horsepower Rating:** 110  
**Transmission Type:** Automatic

**Written Materials:** Specifications and drawings are available from: Wisconsin Dept. of Natural Resources  
 Neil H. LeMay Forestry Center  
 518 West Somo Avenue  
 Tomahawk, WI 54487

## WATER PUMPING EQUIPMENT Trailer-Mounted Equipment

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### E. Trailer-Mounted Equipment

This section lists and describes specialized equipment that requires an accompanying power source for transporting, and is utilized by various fire management agencies to assist in the suppression of wildfires.

Sheet No.	Tank Capacity (gallons)	Pump Rating (gal/min @ 150 psi)	Pump Drive	Equipment Designator	Agency
1	2,500	80	Auxiliary engine	Water tender tracked trailer	Florida Division of Forestry
2	N/A	N/A	N/A	Water handling equipment cache	Georgia Forestry Commission

# WATER PUMPING EQUIPMENT

## Trailer-Mounted Equipment Data Sheet No. 1

**Agency:** Florida Division of Forestry

**Equipment Designator:** Water tender, tracked trailer

**ICS Type:** N/A

**Summary:** Tank Capacity (gallons)— 2,500  
 Pump Rating—80 gal/min @ 150 psi  
 Pump Drive—Auxiliary engine  
 Mobile Attack Capability?—No  
 Number Crew Personnel—2  
 Foam System Available?— Yes  
     Gallons—20  
 All-Wheel Drive? —N/A



**General Description:** A 2,500 gallon steel tank is mounted on a rubber-tracked trailer. Has diesel pump with master stream appliance, and one live reel; best pulled with a D-6/JD 750 size crawler. Very low ground pressure, good for mop-up, soggy areas, or as water supply.

**Pump:** Manufacturer—Berkeley Model—B1½ XQBS 26 **Tank:** Material— Steel  
 Type—Centrifugal Construction: Baffles?— Yes  
 Performance: gal/min (max) at free flow—100 If steel, is the tank corrosion treated?—Yes  
                   gal/min @ max psi = 40 @ 260  
 Primer Type—Exhaust

**Controls and Gauges:** Hand Throttle?— Yes    Pressure Gauge?— No    Automatic shutdown?— No

**Valves:** Tank-to-Pump?— Yes    Pump-to-Tank?—Yes

**Overboard Discharge:**

Quantity	1	2	1
Size	3 inch	1½ inch	1-inch booster

**Suction:**

Quantity	1
Size	2 inch

**Priming Valve Handle:** Manual  
**Suction Valve Handle:** Manual  
**Tank-to-Plumbing Shut-Off?** Yes  
**Gravity Tank Drain/Dump?** No  
 Type—

**Manufacturer:** Caterpillar  
**Manufacturer Model Year:** 2000  
**Engine Fuel Type:** N/A  
**Vehicle Operating Weight:** 30,000  
**Brake Type:** N/A

**Discharge Valve Handle:** Manual  
**Adjustable Pressure Relief?** Yes  
**Pump and Plumbing Drain?** Yes  
**Rock Trap/Plumbing Strainer?** Yes  
 Type— Inlet screen

**Cab/Axle Distance:** N/A  
**GVW Rating:** 35,000  
**Horsepower Rating:** N/A  
**Transmission Type:** N/A

**Written Materials:** Specifications and drawings are available from: Florida Division of Forestry  
 3125 Conner Boulevard  
 Tallahassee, FL 32399

# WATER PUMPING EQUIPMENT

## Trailer-Mounted Equipment Data Sheet No. 2

**Agency:** Georgia Forestry Commission

**Equipment Designator:** Water handling equipment cache

**ICS Type:** N/A

**Summary:** Tank Capacity (gallons)—N/A  
 Pump Rating—N/A  
 Pump Drive—N/A  
 Mobile Attack Capability?—  
 Number Crew Personnel—1  
 Foam System Available?—  
 Gallons—  
 All-Wheel Drive? —



**General Description:** FEPP trailer equipped with lift gate, carries a generous cache of portable pumps, hoses, adapters, fittings, nozzles, portable tanks, and tools for use in mopping up wildland fires. The cache is maintained at State headquarters by a water handling specialist who deploys with the cache on incidents.

**Pump:** Manufacturer—N/A Model—  
 Type—  
 Performance: gal/min (max) at free flow—  
 gal/min @ max psi =  
 Primer Type—

**Tank:** Material—  
 Construction: Baffles?—  
 If steel, is the tank corrosion treated?—

**Controls and Gauges:** Hand Throttle?— Pressure Gauge?— Automatic shutdown?—

**Valves:** Tank-to-Pump?— Pump-to-Tank?—

**Overboard Discharge:** Quantity  
 Size

**Suction:** Quantity  
 Size

**Priming Valve Handle:**  
**Suction Valve Handle:**  
**Tank-to-Plumbing Shut-Off?**  
**Gravity Tank Drain/Dump?**  
 Type—

**Manufacturer:**  
**Manufacturer Model Year:**  
**Engine Fuel Type:**  
**Vehicle Operating Weight:**  
**Brake Type:**

**Discharge Valve Handle:**  
**Adjustable Pressure Relief?**  
**Pump and Plumbing Drain?**  
**Rock Trap/Plumbing Strainer?**  
 Type—

**Cab/Axle Distance:**  
**GVW Rating:**  
**Horsepower Rating:**  
**Transmission Type:**

**Written Materials:** Specifications and drawings are available from: Georgia Forestry Commission  
 P.O. Box 819  
 Macon, GA 31202

# WATER PUMPING EQUIPMENT

## Water Tanks

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### F. Water Tanks

Water tank design should contribute to the safety and longevity of the fire vehicle. The vehicle's center of gravity should be as low as possible, and because a tank full of water is very heavy, the placement and size of tank is important. Low profile rectangular shaped tanks are preferred. They provide good stability on side slopes and driving. Tanks should be placed at a position on the vehicle frame that will correctly distribute the weight of water to both front and rear axles under loaded conditions. This position is normally found on, or just in front of the rear axle. If the payload is too far forward, the result is often overloading of the front axle. If it is too far to the rear, the steering of the vehicle will be affected.

Baffles in the tank are essential to prevent rapid movement of water on slopes, cornering, and stopping. Without baffles, inertia of the water in the tank, could cause vehicle rollover, contribute to tank failure, or braking difficulties. When installed, baffles should allow movement of water at the bottom of the tank and airflow at the top.

Tanks may be constructed of mild steel, stainless steel, fiberglass, polypropylene, aluminum, or polyurethane. Choice of material will be based on cost, ease of manufacture, tank weight, and resistance to corrosion. Steel tanks should be coated to protect from corrosion. Stainless steel may be more expensive, but the costs may be offset by factors such as warranties, longevity, ease of maintenance, and resistance to corrosion.

Fiberglass tanks are generally more costly than steel tanks, but are corrosion free.

High impact copolymer plastics (polypropylene) are becoming the material of choice for the construction of fire engine water tanks by a large number of municipalities, States, and Federal agencies. This material is extremely strong, durable, and is ultraviolet-light stabilized to prevent deterioration from exposure to sunlight. This material has a long service life, cannot be affected by fire fighting chemicals, and can be used in potable water applications. This material can be used in the construction of tanks in almost any size or shape.

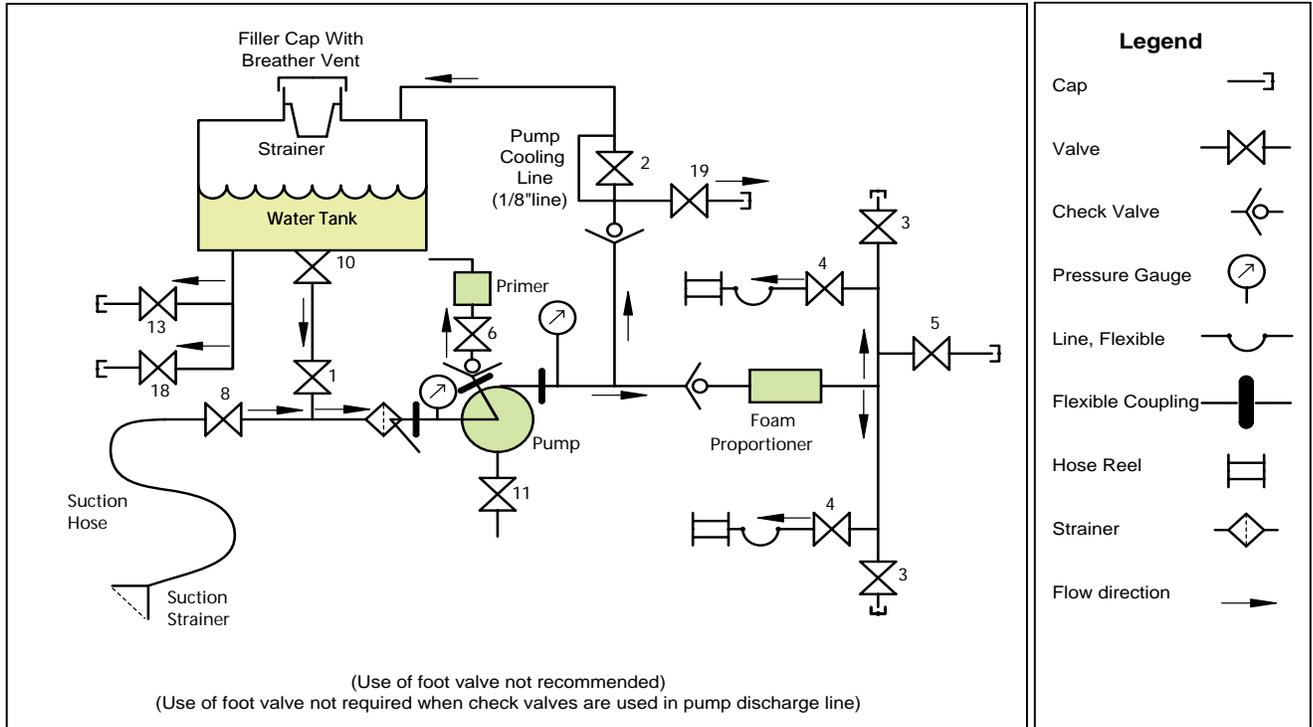
Polyurethane tanks should be avoided if at all possible. Plastics of this type are normally found in rotationally molded round tanks. These tanks tend to be brittle and subject to breakage from impact. They are normally not stabilized to resist deterioration due to sunlight (ultraviolet rays).

Due to the cleaning action of foam concentrate in solution, steel tanks in fire equipment with a foam system should be avoided if possible. Foam concentrates will reduce useful life of the steel tank several fold. Tank fabrication should be left to experienced manufacturers possessing the experience to properly design and engineer the tanks, baffles, inlets, outlets, and sumps. Tank manufacturers are listed in appendix G.

# WATER PUMPING EQUIPMENT Plumbing

## G. Plumbing

Figure 2—Typical engine plumbing diagram (centrifugal).



### Valve Numbering System

The numbering system below has been adopted by the USDA Forest Service (other systems may also be available).

- |  |   |
|--|---|
| No. 1 from tank to pump                              | No. 11 pump or piping drain valve                     |
| No. 2 from pump to tank                              | No. 12 pump coolant clean-out*                        |
| No. 3 from pump to overboard discharge               | No. 13 gravity tank drain                             |
| No. 4 from pump to hose reel or basket discharge     | No. 14 foam-differential-valve shunt*                 |
| No. 5 from pump to small auxiliary discharge(3/4 in) | No. 15 pump transfer valve*                           |
| No. 6 from pump to primer                            | No. 16 engine cooler line*                            |
| No. 7 adjustable pressure relief valve*              | No. 17 pump bypass*                                   |
| No. 8 from overboard suction intake to pump          | No. 18 low volume gravity (back pack fill)            |
| No. 9 reserve supply from tank to pump*              | No. 19 water only valve for eductor or water transfer |
| No. 10 tank to piping shut-off valve                 | No. 20 feed #2, #13 and/or #19*                       |

\* Valve not utilized in this diagram.

# FOAM GENERATING EQUIPMENT

## Foam Proportioners

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### II. FOAM GENERATING EQUIPMENT

#### A. Foam Proportioners

There are a number of systems used to proportion foam concentrate into water streams for use with standard nozzles, aspirating nozzles, or compressed air foam systems (CAFS). The two basic types of foam concentrate proportioning systems are manually regulated and automatic regulating. The system that gives the most consistent and desirable results is an automatic regulating proportioning system that injects directly into the discharge side of the water pump.

Manually regulated proportioning systems include:

- Batch mixing
- Suction-side proportioner
- In-line eductor
- Variable flow bypass eductor
- Around-the-pump proportioner
- Direct injection manually regulated proportioner

Automatic regulating proportioning systems include:

- Balanced pressure venturi proportioning systems
  - Bladder tank proportioner
  - Pump proportioner
- Water motor meter proportioner
- Direct injection automatic regulating proportioner

#### 1. Manually Regulated Proportioning Systems

Manual regulation systems, which must be monitored and changed manually, are frequently used. They have less precise regulation of concentrate addition and the resulting foam quality is highly variable.

##### a. Batch mixing

The simplest method of making a foam solution is to manually add foam concentrate to the water supply. This method, called batch mixing, is convenient for conventional water pumping systems. A measured volume of concentrate is poured into a measured volume of water to yield a foam solution of the recommended strength. Batching is potentially wasteful

because the required volumes of both water and concentrate must be estimated, especially when refilling a partially full tank. The concentrate should be added to water, because adding water to the foam concentrate causes excessive foaming in the tank as the water is added. Since the foam concentrate is heavier than water, mixing or recirculation of the concentrate/water mixture is required to obtain a homogeneous solution. The solution should be used as soon as possible for optimum performance. Despite a number of limitations, batch mixing is a common proportioning method for engines, portable tanks, bladders, and extinguishers, and is considered a backup method if the on-line proportioner fails to work.

##### b. Suction-side proportioner

The suction-side proportioner uses a water pump vacuum to add foam concentrate, via an in-line tee and regulating valve, to the water stream on the inlet side of the pump. At specific flow conditions the regulator is proportional. However, the in-line tee has no influence on vacuum, so the regulator cannot maintain a given mix ratio as waterflow changes without a manual adjustment. Because the regulator sends concentrate through the pump and the tank, when recirculating, its limitations are similar to those of batch mixing.

##### c. In-line eductor

The in-line eductor (or in-line proportioning system) drafts foam concentrate from a container to the pressure side of the water stream using venturi action. As pressurized water flows through the venturi, an area of negative pressure is created at the venturi throat. Atmospheric pressure forces the foam concentrate into the negative pressure area of the eductor.

Eductors work on any pump that can generate sufficient pressure and are compatible with pump capabilities. They are usually proportional at one waterflow rate. Because they are designed to operate within specific concentration ranges, a different eductor may be required to

## FOAM GENERATING EQUIPMENT

### Foam Proportioners

operate at a concentration outside that range. In some cases diluting the concentrate may allow use of the eductor at hand.

Eductors eliminate many of the problems associated with concentrate exposure to pump and tank. They also allow for proportioning while the tank is refilled or while the pump is fed from a hydrant. Eductors are most appropriate for applications of constant waterflow near the discharge nozzle. The in-line eductor system has a pressure loss in the 25 to 60 percent range.

The in-line eductor proportioning systems can be set up and adjusted to function properly and will continue to work well as long as no changes are made. If changes are made such as reducing the size of the nozzle (such as shutting down a nozzle when two are in use), adding hose, or adding elevation at the hose outlet, the proportion may change or the system may not work at all. This results in the in-line eductor proportioning system being very situation sensitive. Therefore, these systems should be avoided, or when used utilized with caution and concern in wildfire suppression conditions where low flows and long, small diameter hose lays are employed.

#### **d. Variable flow bypass eductor**

The variable flow bypass eductor proportioner is a modification of the in-line eductor proportioner. The bypass eductor proportioner is a manually regulated proportioning system and has the same large pressure loss (25 to 60 percent) associated with the in-line eductor. It is also situation sensitive like the in-line eductor. However, when a waterflow change occurs, it may be possible to adjust the system so it will continue to work.

#### **e. Around-the-pump proportioner**

The around-the-pump proportioner diverts a portion of the pump discharge through an in-line proportioner back to the suction side of the pump. This loop around the pump is used to draw concentrate up through the venturi and into the main water stream.

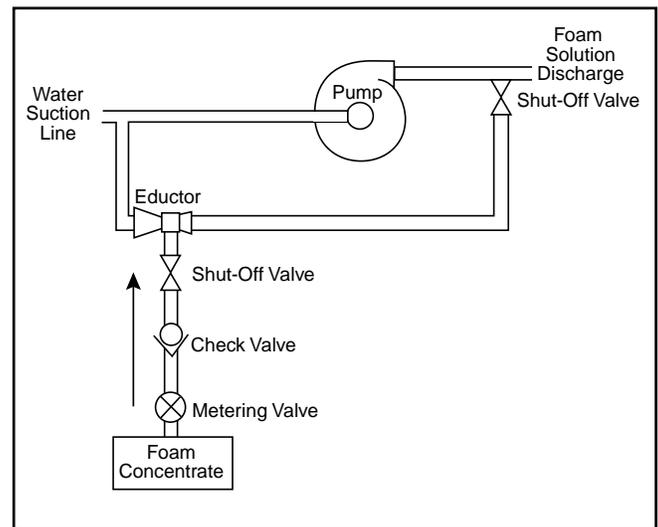


Figure 3—Around-the-pump proportioner schematic.

The around-the-pump system works on portable or built-in pumps of any size or output. Water tank refilling and pump nursing do not affect this system's performance. Around-the-pump devices are not automatic regulating. The venturi does not adjust the concentrate flow when the waterflow changes. The adjustment is done manually. When waterflow has stopped, the shutoff valve at the venturi MUST be turned off to prevent foam concentrate from being drawn into the discharge water line. The around-the-pump proportioner is more flexible than the eductor, but it introduces concentrate to the pump and tank in the same way as the suction-side regulator. Therefore, the same corrosion, cleansing, cavitation, and other related problems also limit the around-the-pump-proportioner.

#### **f. Direct injection manually regulated proportioner**

In a direct injection manually regulated proportioning system a small positive-displacement metering pump injects foam concentrate directly into the water stream on the discharge side or intake side of the pump. The rate of foam concentrate injection can be adjusted to give the desired foam solution. However, when the

# FOAM GENERATING EQUIPMENT

## Foam Proportioners

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waterflow rate changes, the foam concentrate injection rate must be manually changed in order to keep the foam solution at the same desired percentage. These units usually have a low water cut-off switch to stop foam concentrate flow when waterflow is stopped.

### 2. Automatic Regulating Proportioning Systems

Automatic regulating proportioning systems are designed to minimize the limitations of manually regulated proportioning systems. Specifically, they proportion accurately over wide ranges of water flow or pressure, adjusting automatically to changes in water flow and pressure to maintain the desired mix ratio. Foam concentrate is added on the discharge side of the pump to avoid tank and pump problems. The mix ratio can be quickly changed during operation. The proportioners place no restrictions on hose length, number of hoselays, or nozzles.

#### a. *Balanced pressure venturi proportioning systems*

The automatic regulating, balanced pressure venturi proportioning system is in wide use—both in the bladder tank system and the pump system.

*Bladder tank proportioner*—The balanced pressure bladder tank proportioner uses a small diversion of water to pressurize a tank with a bladder containing foam concentrate. The concentrate passes through a metering valve before it enters the water stream on the low pressure section of a pressure differential valve or venturi. Concentrate is added according to the difference in pressure at the differential valve or venturi. As waterflow increases, the difference in pressure increases and foam concentrate flow increases proportionately. The bladder tank proportioner has no moving parts and requires no external power. It can be portable for storage and dispensing. When the bladder is being filled on a single tank unit, concentrate flow is interrupted.

*Pump proportioner*—The balanced pressure pump proportioner senses water pressure with a pilot operated relief valve. The pilot operated relief valve makes foam concentrate pressure equal to water pressure. A pump delivers concentrate to a venturi in the water line according to the pressure at the relief valve. A metering valve allows for selection or change of the desired mix ratio. If the relief valve senses water pressure of 150 psi, then the foam concentrate pressure will be 150 psi. Concentrate enters the water stream in proportion to the pressure differential across the venturi. Excess foam concentrate is relieved to the concentrate tank. Refilling the concentrate tank does not interrupt concentrate flow. Foam concentrate flow and pressure are provided by an externally powered pump.

#### b. *Water motor meter proportioner*

In a water motor meter proportioning system a positive displacement water motor drives a positive displacement foam concentrate metering pump. The ratio of the water motor displacement to the displacement of the metering pump is the ratio of the desired foam solution.

The water motor meter proportioning system requires no external power. However, when operating near zero flow the system tends not to run. Also in the design of the system, the water motor must have an output shaft on each side to balance the side loading. If a water motor is used with only a shaft coming out one side, the unit will start and run well when there is no downstream pressure; however, when there is downstream pressure (as is generally the case when firefighting) the unit tends not to start.

#### c. *Direct injection automatic regulating proportioner*

The electronically controlled direct injection automatic regulating proportioner adds concentrate based on measured waterflow. An in-line flow sensor determines waterflow past the pump. A microprocessor receives electronic signals

# FOAM GENERATING EQUIPMENT

## Foam Proportioners

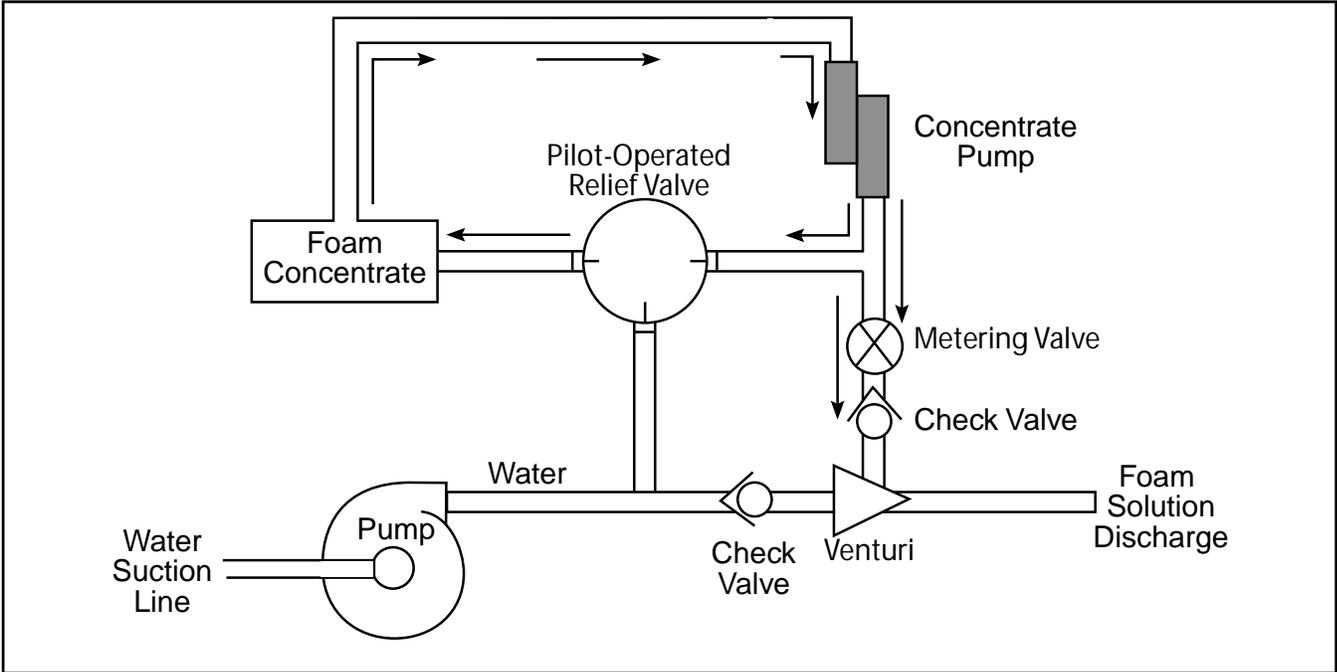


Figure 4—Balanced pressure pump proportioner schematic.

of mix ratio from the control panel and waterflow from the flow sensor. The processor then commands a pump to deliver concentrate at a proportional rate. This proportioner is capable of providing more than one foam concentrate type when more than one storage container is linked to the pump. The pump runs only on demand.

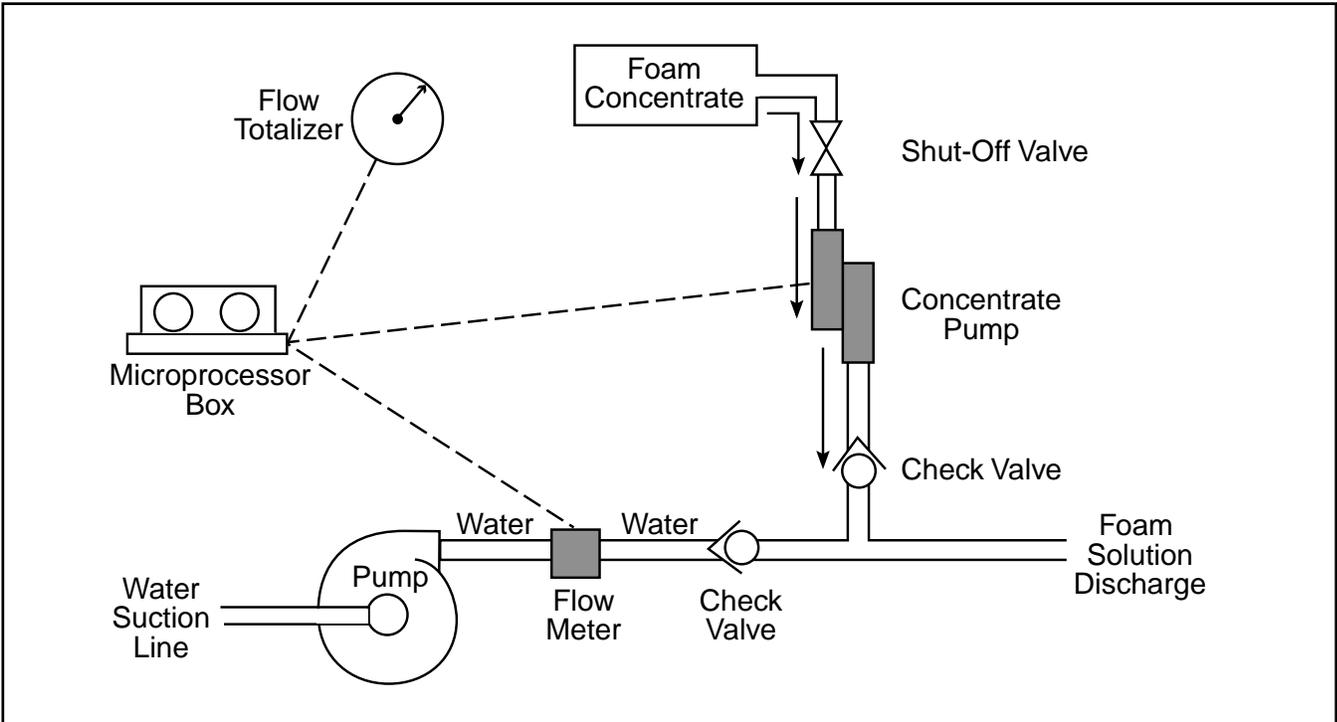


Figure 5—Direct injection proportioner schematic.

# FOAM GENERATING EQUIPMENT

## Foam Proportioners

Table 3—Advantages and disadvantages of proportioning devices.

Advantages	Proportioners*									
	Manually regulated						Automatic regulating			
	1	2	3	4	5	6	7a	7b	8	9
Maintain desired mix ratio with changes in waterflow & pressure	X				X	X	X	X	X	X
Unlimited hose length	X	X			X	X	X	X	X	X
Unlimited number of hose lines	X	X			X	X	X	X	X	X
Easily adjusted mix ratios		X	X	X	X	X	X	X		X
No moving parts	X	X	X	X	X		X			
No loss in water pressure		X	X			X	X			X
No loss or low loss in water pressure	X	X			X	X	X	X	X	X
Operate from pressure source	X		X	X	X	X	X	X	X	X
Requires no equipment investment	X									
Refill foam while operating		X	X	X	X	X		X	X	X
Can indicate foam concentrate remaining	X	X	X	X	X	X		X	X	X
No external power required	X	X	X	X	X		X		X	
<b>Disadvantages</b>										
Tank and pump corrosion	X	X			X					
Plumbing corrosion	X	X			X					
Pump cavitation	X	X			X					
Possible pump priming difficulties	X	X			X					
Foaming in tank	X	X			X					
Water tank refill fluid level obscured	X	X			X					
Clean water supply contamination	X	X			X					
Removes lubricants from pump	X	X			X					
Possible use of more concentrate than required		X	X	X	X	X				
Possible use of less concentrate than required		X	X	X	X	X				
Possible inconsistent dispersion of concentrate		X	X	X	X	X				
Foam solution degradation	X									
Cleaning required after every use	X	X	X	X	X					
Specific waterflow requirements			X							
Specific pressure requirements			X	X						
Limited nozzle elevation			X	X						
Must match hose length and nozzle			X	X						
Limited hose length and size			X	X						
High discharge pressure loss			X	X						
Cannot operate from water pressure source		X								
Dependent on pump vacuum		X								
Concentrate viscosity affected		X	X	X	X		X	X		
Concentrate resupply interrupts concentrate input							X			
Requires auxiliary power						X		X		X
<b>Accurate Water Flow Range</b>										
Any flow, single mix ratio	X								X	
Single flow, single mix ratio without adjustment		X	X	X	X	X				
Any flow, any mix ratio (between 0.1 and 1.0 percent for class A foam)							X	X		X
<b>Initial Equipment Investment</b>										
\$ 0 - \$ 500	X	X	X	X	X					
\$ 500 - \$1,000										
\$1,000 - \$2,000						X				
\$2,000 - \$4,000							X	X	X	
\$4,000 - \$6,000										X

# FOAM GENERATING EQUIPMENT

## Foam Proportioners

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### \*Key to Proportioning Systems

#### Manually regulated

- 1 = Batch mixing
- 2 = Suction-side proportioner
- 3 = In-line eductor
- 4 = Variable flow bypass eductor
- 5 = Around-the-pump proportioner
- 6 = Direct injection manually regulated proportioner

#### Automatic regulating

- 7 = Balanced pressure venturi proportioning systems
  - a = Venturi bladder tank proportioner
  - b = Venturi pressure pump proportioner
- 8 = Water motor meter proportioner
- 9 = Direct injection automatic regulating proportioner

### 3. Summary of Foam Proportioners

- Batch mixing should be considered as the backup proportioning system when another type of proportioning system fails or when no other proportioning system is available.
- While manually regulated foam concentrate proportioning systems are generally the lowest initial cost, they may be in fact the highest cost systems over the operating life of the system because they can proportion more foam concentrate than necessary or, worse yet, not proportion enough or any at all.
- Because of the many shortcomings of the manually regulated proportioning systems, automatic regulating proportioning systems have been developed to reduce these limitations found in the manually regulated proportioning systems. Specifically, the automatic regulating proportioning systems are designed to remain proportional over a wide range of flows and are not affected by changes in engine pressure, changes in hose length and size, or changes in nozzle adjustments, size, or elevation.
- The use of manually regulated proportioning systems should be avoided in wildfire suppression operations where low flows and long, small diameter hose lays are used and where frequent changes in waterflow are necessary.
- The use of automatic regulating proportioning systems injecting into the discharge side of the pump should be encouraged.

# FOAM GENERATING EQUIPMENT

## Foam Proportioners

### 4. Foam Accessories

#### a. Foam pickup tube

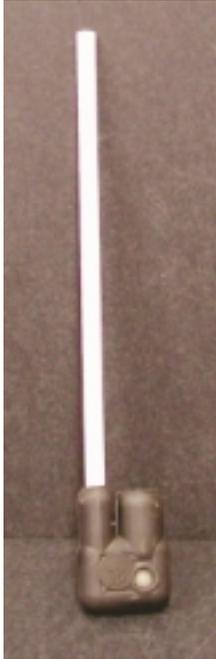


Figure 6 —Foam pickup tube.

When a foam proportional system intake to the water stream is on the suction side of the pump, the pump will lose prime when the foam concentrate is exhausted or the foam concentrate pickup line comes out of the supply container. A pickup tube attachment is available to prevent this. This attachment has a check valve that is seated when the foam concentrate is exhausted, preventing the pump from sucking air and losing prime. This pickup tube is available commercially and will work on the suction-side proportioning system and also on the around-the-pump proportioning system where this is a frequent occurrence.

#### b. Portable foam concentrate meter



Figure 7—Portable foam concentrate meter.

The Institute of Geological and Nuclear Sciences of New Zealand has developed and made available a direct reading portable foam concentrate percent meter that can be used to test a proportioner system in the field. This meter works by reading the conductivity of the water the foam solution is being made with. This direct reading foam concentrate percent meter is called a Digifoam™, and is available commercially.

# FOAM GENERATING EQUIPMENT

## Compressed Air Foam Systems (CAFS)

### B. Compressed Air Foam Systems

Compressed Air Foam Systems (CAFS) produce high-energy foam by injecting compressed air into the foam solution. This system includes a water pump, compressed air source, foam solution, pressure gauges, and assorted valves; it does not require an aspirated nozzle. Foam is produced differently with CAFS than aspirating systems. Air from the compressor is injected into the foam solution. This air represents stored energy for use in the discharge of foam. Once the air and foam solution are combined, they mix, agitate, and expand to produce foam. The mixing and agitation occurs in a hose line or a specialized mixing chamber. When hose is used to produce the foam, approximately 100 to 150 feet of hose is required. Mixing chambers are usually used when foam discharge must occur close to the pump, such as with a master stream appliance.

Air and water pressures from the compressor and pump should be matched. Because of the energy provided by the air compressor, gallon for gallon, compressed air foam is propelled farther than discharges from aspirating or standard water nozzles.

Almost any shutoff or nozzle, full flow or fog pattern, will work with CAFS. The nozzle type affects the type of foam that will be discharged. For example, a full-flow shutoff will provide the best foam, while a variable-pattern nozzle will break up the bubbles and create an air-charged foam solution. Each application has its place in fire suppression.

The advantages of CAFS are:

- The foam type can be easily changed by changing the ratio of water to air.
- Hose lines are considerably lighter than conventional water lines.
- Less foam concentrate is used.
- CAFS can be pumped higher and farther than plain water at the same pressure and reduces water consumption.
- Bubbles are more uniform, creating a more durable foam.
- CAFS increases the efficiencies of water use.
- The air compressor can be used separately to run pneumatic tools.

The limitations of CAFS are:

- The system is more complex than traditional pumping systems, and requires education and training.
- Maintenance requires more expertise and time.
- The large amount of energy stored in the hose can be difficult to control; thus, if an operator is not properly trained or prepared it can be unsafe.
- Purchase price.
- Weight and size of the module.

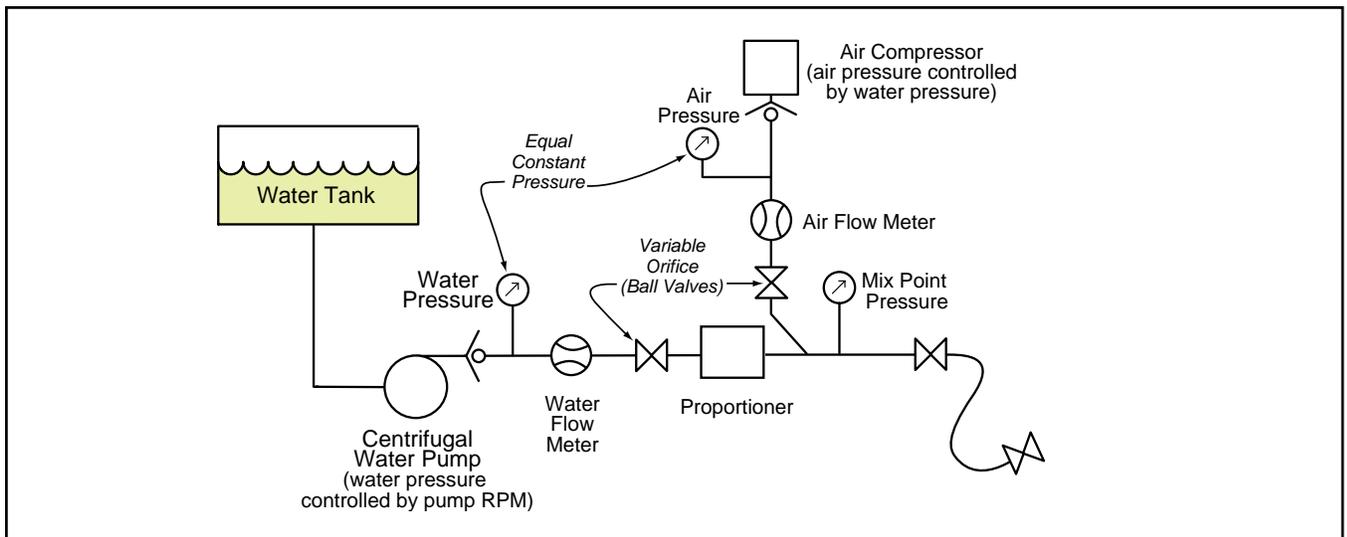


Figure 8—Compressed air foam system (CAFS) schematic.

# FOAM GENERATING EQUIPMENT

## Foam Nozzles

### C. Foam Nozzles

#### 1. Conventional Nozzles

Conventional nozzles, such as straight stream, spray, and combination, are a simple way to deliver foam solution with existing equipment when the objective is rapid wetting of the fuel and foam is not needed. The unstable foam applied in this manner is essentially wet water that enhances wetting of fuel, penetration, and spread of the water but does not give sufficient foam structure to provide insulation or heat reflection.

#### 2. Aspirating Nozzles

Aspirating nozzles use energy from the water pump to create foam. Energy, in the form of water pressure, is delivered by the pump to the aspirating nozzle. The nozzle restricts the flow of foam solution that causes air to be drawn into the foam solution stream. The air and foam solution mix in a chamber and are discharged as foam.

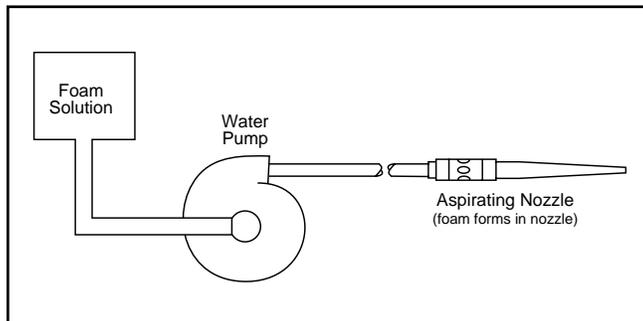


Figure 9—Nozzle aspirating foam systems.

#### a. Low-expansion nozzles

Low-expansion nozzles have small openings for air. They can produce a volume of foam up to 20 times the amount of foam solution used to make the foam, or a 20:1 expansion ratio. These nozzles focus pump energy into a narrow chamber that creates a limited airflow. Smaller volumes of foam are produced, but they are projected great distances.

There are two variations in nozzle design based on where the air is drawn into the nozzle. Air can be drawn into the back of the nozzle (figure 10) or into the front (figure 11).

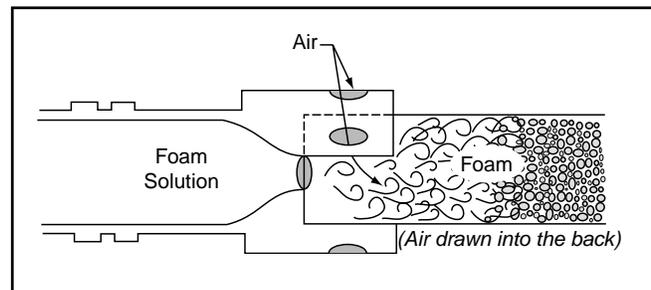


Figure 10—Low-expansion aspirating nozzle.

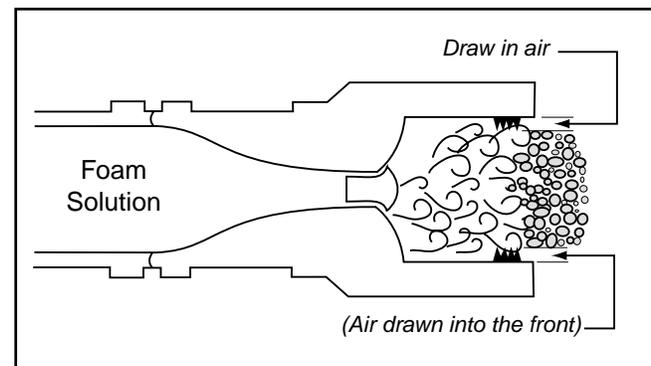


Figure 11—Low-expansion aspirating nozzle.

## FOAM GENERATING EQUIPMENT

### Foam Nozzles

#### b. Medium-expansion nozzles

Medium-expansion nozzles have much larger air openings than low-expansion nozzles. They can produce expansions from 20:1 up to 200:1, depending on the design of the nozzle. A medium-expansion nozzle has a wide chamber that draws in a large amount of air, which in turn slows down the stream velocity. There are screens located inside the chamber that are necessary for bubble formation.

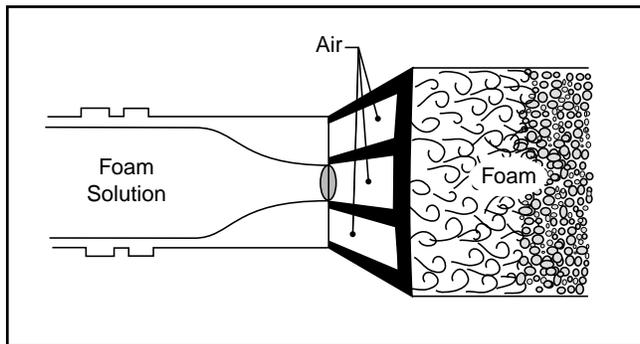


Figure 12—Medium-expansion aspirating nozzle.

#### c. High-expansion nozzles

High-expansion nozzles work along the same lines as the medium expansion ones, but put out a larger volume of foam. They can produce expansions in excess of 200:1. High-expansion nozzles are not commonly used in wildland fire applications, but can be effective in certain situations.

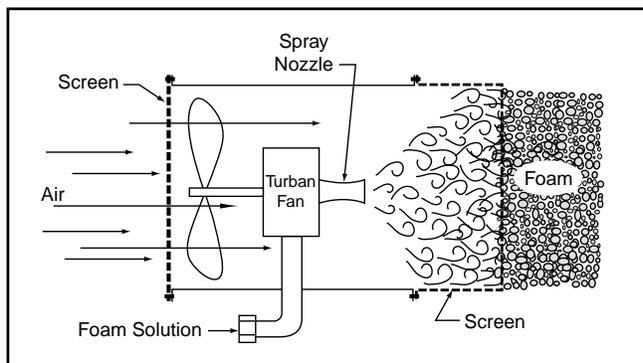


Figure 13—High-expansion aspirating nozzle.

### 3. Aspirating Nozzle Designs

Aspirating nozzles are designed for specific waterflows, water pressures, and mix ratios of foam solution. Nozzles may be single or variable flow by design. Water pressure is normally between 100 and 150 psi. Mix ratio is usually  $\frac{1}{2}$  of 1 percent. Changes in any of these variables affect foam production.

Single pattern, low-expansion nozzles are designed for only one discharge pattern. There are also low expansion nozzles that provide several discharge patterns. These nozzles offer a variety of patterns that may include long-range straight stream, fog, or spray, and foam patterns. Low expansion nozzles are commonly used for direct attack because of their extended discharge distances. They can also be used for pretreatment of aerial fuels and mopup.

Medium-expansion nozzles are generally designed for lower pressures than low expansion nozzles. Low pressures are required to build and maintain the larger bubbles of medium-expansion foam. Medium-expansion nozzles are best on surface applications at short distances. They can be used to create fire barriers during indirect attack or prescription burning, and are very useful for rapid mopup.

Advantages of aspirated nozzles are:

- Relatively inexpensive and simple.
- They do not require extensive training.
- Easy to maintain.
- Many are attachments to common water nozzles.

Limitations of aspirated nozzles are:

- Ability to change the foam type is limited.
- Foam will not cling to vertical surfaces as well as compressed air foam.
- Water pressure from the water stream is "robbed" to produce foam.
- More foam concentrate is used than compressed air foam systems.

# WATER DELIVERY COMPONENTS AND ACCESSORIES

## Hose

### III. WATER DELIVERY COMPONENTS AND ACCESSORIES

#### A. Hose

##### 1. General

Firehose provides the essential means of transporting water from a stream, lake, hydrant, or engine to the fire. The hose selected must withstand the necessary pressures involved, yet be flexible and lightweight enough to handle. Most hose in use is purchased by Federal Supply Services (GSA) under specifications developed by the USDA Forest Service. The wildland firefighting agencies purchase approximately 3 million feet of small diameter (1 and 1½ inch) firehose annually.

The care and maintenance of firehose is described in NFPA 1962, 2003 edition. Service test pressures and procedures are in Chapter 5 of this standard (see appendix D). A review of the appropriate acronyms and definitions will be helpful when using this section on firehose (see appendixes H and I).

##### 2. Design Criteria

The nominal outside diameters of all jacketed hose furnished under USDA Forest Service specifications are controlled. A saving thereby results, since coupling bowls for all jacketed hoses are identical and interchangeable. The outside diameter (OD) for 1-inch hose is 1¼ inches and for 1½-inch hose, it is 1¾ inches. In general fire department practice, the inside diameter (ID) is controlled and the OD varies with the jacket thickness, the type of liner, and other variables.

Jacketed fire hose elongates when pressurized. Most hose also twists under working pressure, and the direction of twist must be to tighten, not loosen, the couplings. Jacketed hose also tends to warp and rise. For example, a cotton synthetic jacket in a 50-foot length should not warp more than 25 inches from a straight line, nor rise more than 8 inches when pressurized to 450 psi. Fire hose is hydrostatically tested in accordance with the testing procedure as required by the procurement contract, if procured under USDA

Forest Service specifications. All USDA Forest Service hose specifications require qualification prior to procurement by GSA.

A list of qualified hose is available from:

USDA Forest Service  
Technology and Development Center  
444 East Bonita Avenue  
San Dimas, CA 91773  
Phone: 909-599-1267

##### 3. Hose Types

###### a. Cotton jacket rubber lined

Standard cotton jackets have a working pressure of 250 psi. Cotton is more resistant to heat and flame damage than synthetic fibers. Hot embers, however, may cause small pinholes. Cotton-jacketed hose in most agencies has been replaced with lightweight hoses (see b, c, and d).

**Type:** Single-jacket fabric, rubber lined.

**Construction and material:** The jacket consists of woven cotton yarn. The liner is petroleum-based thermoplastic polyester elastomer with a smooth inner surface. The jacket and liner are bonded together.

**Flow rate:** Friction loss relative to hose diameters is basically the same as the cotton-synthetic lined hose. Slight differences may be due to type of lining and roughness of inside surface of the lining.

**Weight:** 1-inch has maximum weight of 28 lb/100 ft; 1½ inch 33 lb/100 ft.

**Written material:** Federal specification A-A-59226 available from General Supply Administration (GSA).

###### b. Cotton-synthetic lined

This hose is used where higher working pressures are required. It has a working pressure of 450 psi. The cotton fibers run lengthwise (warp), and the synthetic fillers run crosswise, to form the weave. This combination makes a lighter, stronger jacket, but is subject to heat and flame damage. Grade A liners, capable of

# WATER DELIVERY COMPONENTS AND ACCESSORIES

## Hose

withstanding long periods of weather aging and high ozone conditions without checking or cracking are also available. Combination fabric jackets come in both 1- and 1½ inch diameters, and are usually furnished in 50- and 100-foot lengths.

**Type:** Single jacket fabric, rubber lined.

**Construction and materials:** The jacket consists of woven cotton and polyester filler yarn. The liner is a petroleum-based thermoplastic polyester elastomer with a smooth inner surface. The jacket and liner are bonded together.

**Available from GSA:**

100 foot  
1 inch (20.38 lb/100 feet)  
NSN 4210-00-777-1591

100 foot  
1½ inch (26.88 lb/100 feet)  
NSN 4210-00-777-1592

**Written material:** Specification 5100-186c is available from:

USDA Forest Service  
Technology and Development Center  
444 East Bonita Avenue  
San Dimas, CA 91773  
Phone: 909-599-1267

### **c. Synthetic lightweight lined type I hose**

**Type:** Single jacket fabric, lined, mildew resistant, with a working pressure of 45 psi.

**Construction and materials:** The jacket consists of interwoven synthetic warp and filler yarns. The liner consists of synthetic rubber or a combination of other synthetic material with a smooth inner surface. The lining is fully bonded to the jacket.

**Available from GSA:**

100 foot  
1 inch (9.38 lb/100 feet\*)  
NSN 4210-01-166-8122

100 foot  
1½ inch (15.88 lb/100 feet\*)  
NSN 4210-01-165-6597  
(\*Weight is after mildew treatment, with the couplings.)

**Written material:** Specification 5100-187b is available from:

USDA Forest Service  
Technology and Development Center  
444 East Bonita Avenue  
San Dimas, CA 91773  
Phone: 909-599-1267

### **d. Abrasion resistant synthetic lightweight lined type II hose**

**Type:** Lined, woven single-jacket, abrasion, and mildew resistant, with a working pressure of 450 psi.

**Construction and materials:** The jacket consists of synthetic filler yarn woven around the hose throughout its length with warp yarn interwoven to enhance abrasion resistance. The liner is composed of natural or synthetic rubber compound or thermoplastic. The hose is treated to be mildew resistant.

**Available from GSA:**

100 foot  
1 inch (9.00 lb/100 feet\*)  
NSN pending

100 foot  
1½ inch (14.00 lb/100 feet\*)  
NSN pending  
(\*Weight is after mildew treatment, with the couplings.)

# WATER DELIVERY COMPONENTS AND ACCESSORIES

## Hose

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**Written materials:** Specification 5100-187b.

USDA Forest Service  
Technology and Development Center  
444 East Bonita Avenue  
San Dimas, CA 91773  
Phone: 909-599-1267

### **e. Double-jacketed hose**

Double-jacketed hose is heavier and more costly than single-jacketed hose. In practice, some engines carry one or two lengths of double-jacketed hose for the first lengths in the lay to reduce excessive losses from bursts closer to the engine.

**Type:** Double-jacketed, rubber-lined, with a working pressure of 400 psi.

**Construction and materials:** There are two jackets constructed of 100 percent virgin spun polyester yarn. The liner is a petroleum-based thermoplastic polyester elastomer with a smooth inner surface. The inside jacket and liner are bonded together.

**Flow rate:** Friction loss relative to hose diameters is basically the same as the cotton-synthetic lined hose. Slight differences may be due to the type of lining and roughness of the inside surface of the lining.

**Weight:** Weights of hoses are as follows (weights may vary depending on tolerance):

1½ inch 38 lb/100 ft; 2½ inch 68 lb/100 ft.

**Written material:** Federal specification A-A-59226 is available from General Services Administration (GSA).

### **f. Rubber lined, braided high pressure hose**

Rubber-lined, rubber-covered, high-pressure hose is used as “hardline” on engine live reels. Forest Service specifications require a heavy-duty, noncollapsible water hose of braided and

molded construction. This hose is designed for use on hot fire lines with little possibility of damage. The hose can be wiped off with a dry rag after use. Abrasion resistance is high and the exterior covering is not readily damaged by the usual solvents. High-pressure hose (¾ inch ID) is available in 50-foot coupled lengths. This category also includes booster hose, which is not included in Specification 5100-185e.

**Type:** Compound rubber cover, multiple plies yarn reinforcement, and rubber-inner lining, with a working pressure of 600 psi. Booster hose has a working pressure of 800 psi.

**Construction and materials:** Multiple layers of braided or knit piles of cotton or synthetic yarn are embedded in rubber compound cover. The inner lining consists of a tube of rubber. The lining and cover are bonded together.

### **Available from GSA:**

50 foot  
¾ inch ID (28 lb/50 feet)  
NSN 4210-00-595-1838

**Written material:** Fire equipment suppliers (see appendix G). Specification 5100-185e is available from:

USDA Forest Service  
Technology and Development Center  
444 East Bonita Avenue  
San Dimas, CA 91773  
Phone: 909-599-1267

### **g. Woven fabric hardline hose.**

This hose is used as an initial attack hose and is available in ¾-inch and 1-inch diameter and in 50-, 100-, and 150-foot lengths. The lightweight construction includes a woven fabric jacket, a plastic helical reinforcement component, and a coating to improve abrasion resistance. It handles like a lay-flat hose yet performs like a rigid reel hose and provides water repellency, abrasion, oil and chemical resistance.

# WATER DELIVERY COMPONENTS AND ACCESSORIES

## Hose

**Type:** Semi-rigid hardline hose, with a working pressure of 300 psi.

**Construction and materials:** Lightweight woven fabric of spun polyester warp yarns with plastic helical reinforcement component and elastomer extruded tubing.

**Weight:** Uncoupled ¾-inch (lb/100 feet) = 16; 1-inch (lb/100 feet) = 21.

**Available:** Fire equipment suppliers (see appendix G).

50 foot  
1 inch  
10.5 lb/50 feet (uncoupled)  
Commercially available

100 foot  
1 inch  
21.0 lb/100 feet (uncoupled)  
Commercially available

**Written material:** *Hardline Hose Comparison Study*, Tech Tip 0251 1307—SDTDC, is available from:

USDA Forest Service  
Technology and Development Center  
444 East Bonita Avenue  
San Dimas, CA 91773  
Phone: 909-599-1267

### ***h. Relay-supply large diameter hose***

A single-jacket relay-supply hose has seen increasing use in the United States by fire departments. The single-jacket, made of all-synthetic fibers, is coated inside and out with a thin protective coating. The hose is available in 3½-, 4-, 4½-, 5-, and 6-inch diameters, and is often coupled with a lightweight aluminum alloy quick-connect coupling.

The hose is intended for supply line use only from a water source to the engine. It is **not** intended to move large volumes of water long distances, and **never** to a manifold or on the discharge side of an engine. Limited use has been made of this hose at airtanker bases for loading. Usually this hose performs poorly when subjected to a kink test.

### ***i. Garden hose***

Garden hose (pencil hose) is **not** recommended for general fire use, even though it has been used in some areas. Constructed of rubber or collapsible synthetic materials, difficulty in maintaining standard working pressures, and the uncertainty of buying premium products make this use hazardous. When garden hose is pressurized, a “scissor-like” condition occurs that increases the diameter and shortens the hose significantly. This can cause coupling failures and—when on hose reels—damage in and around the reel hub attachment and failure of some reel hubs.

**Available from GSA:** Synthetic garden hose NSN 4210-01-167-1061.

### ***j. Suction hose, heavy duty***

Hard-suction draft hose is used on all engines and with all portable pumps. Under Forest Service Specification 5100-184c, the hose is made of a natural or synthetic-rubber tube; a jacket consisting of cotton warp yarns or other suitable yarns interwoven with a helix or helixes of round spring-temper wire and fillers of yarn; and a synthetic-rubber outer covering. The coupled hose is designed for a hydrostatic-proof pressure test of 100 psi and a vacuum of 25 inches of mercury without internal blistering, undue distortion, or leakage. Suction hoses are usually furnished in 8- and 10-foot lengths. Soft suction is now widely accepted in fire department practice where engines connect directly to hydrants. The weight savings and flexibility of these 2½- to 6-inch diameters are significant factors.

## WATER DELIVERY COMPONENTS AND ACCESSORIES

### Hose

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**Available from GSA:**

8 foot  
1½ inch  
10.48 lb/8 foot  
NSN 4210-00-889-1774

10 foot  
1½ inch  
12.88 lb/10 foot  
NSN 4210-00-889-1775

8 foot  
2½ inch  
20.40 lb/8 foot  
only commercially available

10 foot  
2½ inch  
25.00 lb/10 foot  
only commercially available

**Written material:** Specification 5100-184c is available from:

USDA Forest Service  
Technology and Development Center  
444 East Bonita Avenue  
San Dimas, CA 91773  
Phone: 909-599-1267

**k. Suction hose, lightweight**

New technology presents a lighter construction with comparable performance, capable of holding a vacuum of 25 inches of mercury and a hydrostatic proof pressure higher than the rubber draft hose, at a proof of 600 psi. It has an encapsulation treatment for enhanced abrasion resistance and the manufacturer claims an increased resistance to acids, oils, chemicals, and salt water.

**Type:** Woven fabric jacket suction hose

**Construction and materials:** Woven fabric jacket and a plastic helical reinforcement component have an encapsulation treatment. The extruded tubing is an ozone resistant, and age resistant EPDM extruded elastomer.

**Weight:** 1½ inch 45 lb/100 foot; 2 inch 50 lb/100 foot.

**Available:** Fire equipment suppliers (see appendix G).

**Written materials:** *Draft Hose Comparison Study*, Tech Tip 0351 1309, March 2003 SDTDC, is available from:

USDA Forest Service  
Technology and Development Center  
444 East Bonita Avenue  
San Dimas, CA 91773  
Phone: 909-599-1267

**l. Cotton-synthetic self-protecting (weeping) hoses**

These hoses are used as replacement for linen (unlined) hose. Cotton-synthetic hoses are lightweight, treated to prevent mildew, and designed for uniform weeping, fast drying time, and high-heat resistance. Synthetic hoses are designed for high working pressures, high temperatures, and abrasion-resistance; they may be lined for antifriction and hose-weep control to protect the hose.

**Written material:** Fire equipment suppliers (see appendix G).

Note: Unlined (linen) hose is no longer available. Refer to USDA Forest Service *Wildland Fire Hose Guide*, February 1997, NFES 1308.

## WATER DELIVERY COMPONENTS AND ACCESSORIES

### Hose Dispensers and Storage

#### B. Hose Dispensers and Storage

There are several methods of storing fire hose and dispensing them for wildland firefighting. Many ingenious systems probably have been developed by fire crews to suit their own special needs. Fire equipment suppliers have some general-purpose equipment available, especially hose reels that are produced in manufacturing plants.

Rubber-lined, rubber-covered, high-pressure hose (also called booster hose) is normally stored and dispensed on live reels. Woven lined and unlined types of hose may be stored in baskets, as hose packs, on trays, or rolled and stored in compartments and are dispensed by hand. Hard suction draft hose is normally stored in a plastic or metal bin in a side compartment, or stored in tubes or trays.

#### 1. Reels

A hose reel basically consists of a drum, side rims, revolving joint on one end, self-aligning bearing on the other end, frame, inlet and outlet hose connections, electric or hand-crank rewind, and a brake. Various sizes are available. Rubber or fabric hoses in  $\frac{3}{4}$  or 1 inch sizes are used on the reels that are usually connected to the pump and kept filled with water ready for use; thus considering it as a "live reel."



**Construction and material:** Constructed of steel or aluminum. Drum and rims may be open or closed. Swivel joint connection may be capable of operating at hydrostatic pressures of at least 600 psi. Rewind by hand crank, electric motor, or by hand using side rims. Brakes maintain position of reel and hose. Hose reel information is available from equipment suppliers. Normal use is with 150 to 250 foot high-pressure rubber hose.

**Written material:** Hose reel manufacturers (see appendix G). Specification 5100-340 is available from:

USDA Forest Service  
Technology and Development Center  
444 East Bonita Avenue  
San Dimas, CA 91773

## WATER DELIVERY COMPONENTS AND ACCESSORIES

### Hose Dispensers and Storage

#### 2. Baskets

Hose baskets in this *Guide* are those that are normally used with fire engines for wildland firefighting. They consist of a rectangular-, circular-, or oval-shaped container. The wooden duckboard bottom keeps the hose off the metal floor and prevents mildew and abrasion damage. A water repellent fabric cover protects the hose from the elements. The hose may be connected to the pump, kept filled with water, and ready for immediate use; thus considering it as a “live hose basket.”



**Construction and material:** Constructed of steel sides, wooden duckboards on the bottom, and water repellent-type fabric cover. Fabric type  $\frac{3}{4}$ - or 1-inch fire hose connected to the engine through a hole in the side of the basket. Length of hose depends on size and type. Normal use is 200 foot 1-inch single cotton-synthetic jacket lined hose. Basic advantage is not to obstruct rear view of the driver and has no moving parts.

**Written material:** Drawing available from:

USDA Forest Service  
Technology and Development Center  
444 East Bonita Avenue  
San Dimas, CA 91773

#### 3. Packs

Hose packs in this *Guide* are portable types that a firefighter can carry, usually as a backpack. They may consist of a lightweight frame or board, or require no packboard or frame. Straps are used to contain the hose. Usually jigs are used to fold or wind the hose for proper fit. The hose is dispensed from the container as the loose end is pulled off, or the hose-carrying individual walks away with the loose end anchored, or—if the hose is in a roll—it is rolled out. Rapid deployment is the main objective.

##### a. Forester hose packsack



**Construction and material:** Dark green heavy-duty nylon duck cloth. Includes shoulder straps and a chest strap. The top closes with a drawstring and a zippered pocket flap.

**Written material:** GSA *Wildfire Protection Equipment and Supplies* catalog and fire equipment suppliers (see appendix G).

## WATER DELIVERY COMPONENTS AND ACCESSORIES

### Hose Dispensers and Storage

*b. Rhode Island hose pack*



**Construction and material:** Hose rolled on a Rhode Island hose roller is opened and connected in a hose bag. Hose will then lay precoupled without kinking.

**Written material:**

Dept. of Environmental Management  
Division of Forest Environment  
1037 Hartford Pike  
North Scituate, RI 02857

*c. Canadian style hose pack*



**Construction and material:** Cordura nylon outer pack with cardboard box inside to hold hose. The pack holds 400 feet of 1½-inch synthetic weeping hose. The hose is woven on a plywood jig and then inserted into a cardboard box. The cardboard box reduces the need to have every pack in the Cordura nylon outer pack. Once a box is used, it can be taken out of the pack and a full one put in. Approximate weight is 54 pounds.

**Written material:**

Northeast Interagency Fire Cache  
402 SE 11<sup>th</sup> Street  
Grand Rapids, MN 55744

## WATER DELIVERY COMPONENTS AND ACCESSORIES

### Hose Dispensers and Storage

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*d. Gansner hose pack*



**Construction and materials:** Progressive hose lay that requires no packboard; stiffness of the hose is used as support. Hose is bound with tie-cords and shoulder straps are loops of hose. Capacity is 100 feet each of 1- and 1½-inch fire hose.

**Written material:**

USDA Forest Service  
Pacific Southwest Region  
Plumas National Forest  
Mount Hough Ranger District  
39696 Highway 70  
Quincy, CA 95971

*e. Modified Gansner hose pack (Cleveland National Forest)*



**Construction and material:** Same materials as the Gansner hose pack, only a different configuration that does not deploy hose as the firefighter advances. The 1½-inch hose is used to suppress wildfire, and the 1-inch hose is used for laterals that are only charged when and if needed after the initial suppression action. Can be utilized in heavier fuels where more water volume is desired. Requires no packboard, stiffness of hose is used as support. Hose is bound with nylon shroud cord and 1½-inch hose is looped for shoulder straps. Contains a 1½-inch gated wye valve with reducer and adapter. Approximate weight with hose is 22 pounds. A training CD is also available.

## WATER DELIVERY COMPONENTS AND ACCESSORIES

### Hose Dispensers and Storage



There is also an additional variation to the Cleveland National Forest-modified Gansner hose pack. This variation requires that the hose be prepacked in two separate configurations. One hose pack contains two 100-foot lengths of 1½-inch hose, with a hose line tee fitting connecting them, which allows for the addition of a lateral hose when and if it is needed. The second hose pack contains three 100-foot lengths of 1-inch hose, each packed independently so they can be deployed as lateral hoses at existing hose line tee fitting locations as needed.

#### Written material:

USDA Forest Service  
Pacific Southwest Region  
Cleveland National Forest  
10845 Rancho Bernardo Road,  
Suite 200  
San Diego, CA 92127-2107

#### f. Travis hose pack



**Construction and materials:** Progressive hose lay that requires a heavy duty nylon duck packsack to harness 100 feet each of 1-inch and 1½-inch all-synthetic hose capacity. Total weight is 27 pounds. A training CD is also available.

#### Written material and training CD:

USDA Forest Service  
Prescott National Forest  
Henry Y.H. Kim Fire Center  
2400 Melville Drive  
Prescott, AZ 86301

# WATER DELIVERY COMPONENTS AND ACCESSORIES

## Hose Dispensers and Storage

### *g. Pondosa pack*



**Construction and materials:** Two 100 foot lengths of 1½-inch all-synthetic hose single donut roll with female coupling outside and one 100 foot length all-synthetic hose single donut roll with female coupling outside. A hose line tee and a 1½-inch NH by 1 inch NPSH reducer is included and an adjustable barrel combination nozzle is attached to the 1 inch hose. The pack is constructed of polypropylene webbing, 1,000 Denier Cordura, and acetyl buckles.

#### **Written material:**

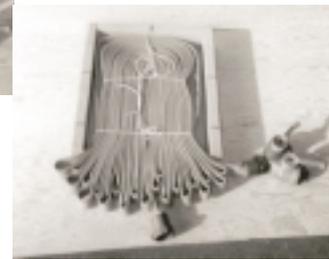
Corvallis Fire Department  
400 NW Harrison Boulevard  
Corvallis, OR 97330

There are numerous additional packs available that are not listed in this section. For additional information on commercial packs available see appendix G, Suppliers.

### **4. Hose packing boxes and devices**

#### **a. Gansner pack**

The boxes and devices seen here are used to produce the Gansner hose pack (see 3.d). Similar boxes are used to produce other types of hose packs. Step-by-step procedures for packing the Gansner hose pack are available.



#### **Written material:**

USDA Forest Service  
Pacific Southwest Region  
Plumas National Forest  
Mount Hough Ranger District  
39696 Highway 70  
Quincy, CA 95971

# WATER DELIVERY COMPONENTS AND ACCESSORIES

## Hose Dispensers and Storage

### **b. Travis pack**

The device shown here is used to assemble the Travis hose pack (see 3.e.). Step-by-step procedures for packing the Travis hose pack are available.



### **5. Trays**



Hose trays are used to contain and store fire hose neatly so that when needed the trays can be dispensed efficiently with a minimum of time. Capacity can be up to 2,000 feet of hose, depending on the type of hose and the engine size. The trays are custom made to suit the engine. The advantages of trays are that they can be assembled before loading on the engine and additional standby trays can be made ready. Trays are usually made of wood, aluminum, or expanded metal. Duckboard floors prevent mildew and reduce abrasion damage. In addition to hose trays on engines, hose trays can be used on specialized vehicles such as hose trucks and hose trailers. Many variations are in existence, and commercial sources are available.

### **Written material and training CD:**

USDA Forest Service  
Prescott National Forest  
Henry Y.H. Kim Fire Center  
2400 Melville Drive  
Prescott, AZ 86301

# WATER DELIVERY COMPONENTS AND ACCESSORIES

## Hose Dispensers and Storage

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### 6. Storage



Hard suction draft hose is normally used on engines. The hard suction draft hose used is usually in 8- or 10-foot lengths, and ranging in diameter from 1 to 6 inches. Exceptions in length and diameter can be found. Due to the inflexibility of the draft hose sections, storage methods vary. Draft hose normally is stored within a side compartment, or placed within external tubes or trays. A plastic or metal bin may be attached to the forward end of slip-on units for rolled suction hose storage.



**Indoor hose storage**—When fire hose (particularly fabric type) is properly maintained and stored, it will have an extended life and provide dependable service on the fireline. Storage racks can be constructed to provide a neat, well-ventilated hose storage area. There are other methods that can be “homemade” and just as practical.

**Written material:** Fire equipment suppliers (see appendix G).

# WATER DELIVERY COMPONENTS AND ACCESSORIES

## Hose Accessories

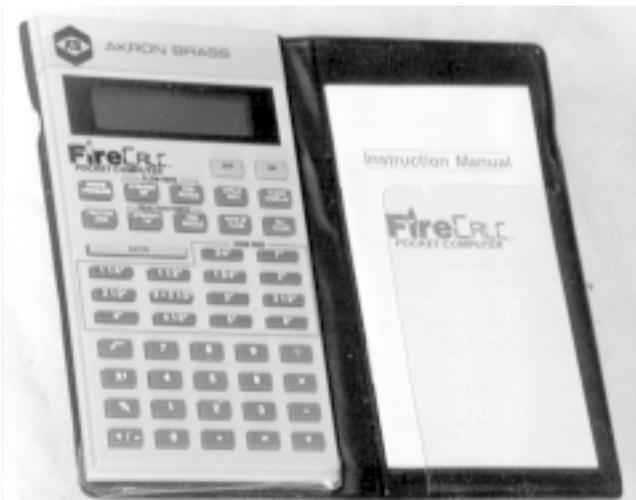
### C. Hose Accessories

Miscellaneous accessories that are useful in wildland firefighting support activities include such items as hose discharge and friction loss calculators, hose shutoff clamps, mop-up kits, hose rollers, water storage tanks, hydrant wrenches, and others.

**Purpose:** The slide rule is used to perform friction loss and nozzle discharge calculations.

**Available:** National Interagency Fire Cache NFES 0897, fire equipment suppliers (see appendix G).

#### 1. Discharge and friction loss calculators



**Type:** Hand-held calculator

**Construction and material:** Pocket size, plastic.

**Purpose:** This hand-held calculator is preprogrammed to solve water hydraulic problems common to firefighting.

**Available:** Fire equipment suppliers (see appendix G).

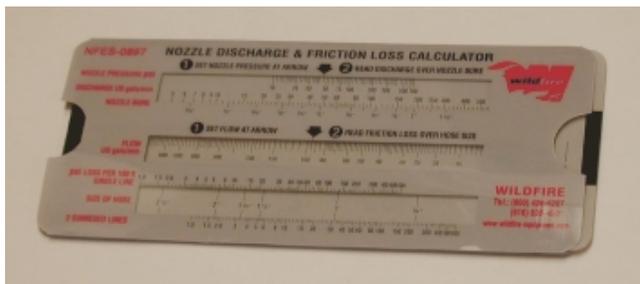


**Type:** Personal data assistant (PDA).

**Construction and material:** Pocket size, plastic.

**Purpose:** Hand-held organizer, fire hose software can be purchased to solve firefighting hydraulics problems. Several different models are available in various price ranges.

**Available:** Fire equipment suppliers (see appendix G).



**Type:** Hand-held slide rule

**Construction and material:** Pocket size, plastic.

## WATER DELIVERY COMPONENTS AND ACCESSORIES

### Hose Accessories

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#### 2. Hose shutoff clamps

##### a. Hose shutoff clamp



**Type:** Two-piece jaws with lever arm.

**Construction and material:** Pocket size, hand operated, light, corrosion-resistant alloy.

**Purpose:** Shutoff water in hose line to prevent loss of water when a fire hose bursts, or for other purposes—such as rapid changing of nozzles, hoses, and so on.

**Available from GSA:** NSN 4210-00-767-7123.

**Written material:** Fire equipment suppliers (see appendix G). For specification 5100-245c:

USDA Forest Service  
Technology and Development Center  
444 East Bonita Avenue  
San Dimas, CA 91773  
909-599-1267

##### b. Hose shutoff clamp inserts



**Type:** Inserts for two-piece jaws with lever arm.

**Construction and material:** Inserts are fabricated of various materials including cotton-synthetic or lightweight synthetic fire hose, bicycle inner tube, duct tape, rubber or plastic liners and rubber bands.

**Purpose:** Hose clamps without the inserts will slip out of position (when used with lightweight synthetic fire hose) thus not clamping effectively under normal working pressure.

**Written material:** Instructions for construction are detailed in the Tech Tip *Hose Clamp Inserts For Use On Lightweight Synthetic Fire Hose*, 5100 9651 1305-SDTDC, June 1996 which is available from:

USDA Forest Service  
Technology and Development Center  
444 East Bonita Avenue  
San Dimas, CA 91773  
909-599-1267

# WATER DELIVERY COMPONENTS AND ACCESSORIES

## Hose Accessories

### 3. Kits and accessories



#### **a. Mop-up accessories, three-person**

**Type:** Three-person, mop-up kit.

**Construction and material:** Kit consists of hose, hose line tees, reducers, wyes, applicators, nozzles, gaskets, shutoff valves, spanners, and more. Quantities sufficient for a three-person operation.

**Purpose:** Provide necessary mop-up tools in an identified, standardized kit.

**Available from GSA:** NSN 4210-01-321-4206.

#### **b. Helicopter slingable suppression water bag accessory kit**



**Type:** Accessory kit attachment for a 72 gallon helicopter slingable suppression water bag.

**Construction and materials:** Rugged nylon pack-cloth with snap hooks for attachment to water tank. A pre-attached rope is provided for tethering the suppression water bag on steep slopes. Also supplied are 10 rolls of synthetic garden hose, 5 each  $\frac{3}{4}$ -inch nozzles, wyes, ball valves, 1-inch to  $\frac{3}{4}$ -inch reducers, and 2 backpack pumps. All accessories are stored in special pockets of suppression water bag kit. Shoulder straps for carrying empty suppression water bag and accessories are included in kit.

#### **Availability and written materials:**

Missoula Smokejumper Unit  
Aerial Fire Depot  
Box 6, Airport Terminal  
Missoula, MT 59801