Mounting the pipe on a forklift is a very convenient way of holding the pipe, since now the pipe can easily be adjusted either horizontally or vertically. (See figure C2.) If the test is conducted at a station or work center, a pipe can be mounted permanently on a stand or building and permanent marks can be placed on the ground. These marks can be in gal/min. This would permit flow tests to be conducted very quickly and easily.

Remember that a splash test only determines the flow rate in gal/min from the pump. To check pump performance, the pressure at which the water is flowing must also be known. The engine pressure gauge can be used to obtain this pressure by partially closing the overboard discharge valve to create a resistance for the pump.

Figure C2—Splash test with 1½ inch pipe at suggested height of 54¼ inches; the calculated flow rate is 84 gal/min.

There is a limited number of pipe sizes and practical heights for the water to fall from each of these pipes. Subsequently, the following table has been developed:

Table C1—Splash Test Table

Pipe size (inch)	Pipe ID (inch)	Pipe opening area (sq inch)	Flow range (gal/min)	Suggested height (inch)	Unit linear flow @ suggested height [(gal/min)/inch]
½	0.62	0.30	2 - 10	18 ¾	0.25
¾	0.82	0.53	5 - 20	29 ⅞	0.35
1	1.05	0.86	10 - 40	38 9/16	0.5
1¼	1.38	1.50	20 - 100	45 13/16	0.8
1½	1.61	2.04	40 - 150	54 ¼	1.0
2	2.07	3.36	60 - 250	65 ⅜	1.5
2½	2.47	4.79	100 - 400	74 ¾	2
3	3.07	7.39	150 - 600	79 ⅛	3
4	4.03	12.73	200 - 900	84 ½	5
5	5.05	20.01	300 - 1200	81 ½	8
6	6.07	28.89	400 - 1600	108 ¾	10

For pipe ID's or heights not listed in the table, the flow rate can be calculated using the following formula:

$$\text{Flow (gal/min)} = \frac{3.61 \times AD}{\sqrt{h}}$$

Where:

A = Area, in square inches, of the pipe opening = (3.14) x (r^2)
r = ½ of the pipe's ID in inches
D = Distance along ground, in inches, from the pipe exit to the midpoint of where the main body of water splashes.
h = Height above ground, in inches, of the midpoint of the pipe exit.
3.61 = Constant that adjusts the answer for measurement units used in formula.

Pump Testing by Using a Square-Edge Orifice
An inexpensive and reliable test method to ensure that pump engines meet flow and pressure requirements has been developed for field use. Pump testing using the square-edged orifice system requires a pressure gauge, hose line tee, and a hose cap machined (or drilled if machining equipment is not available) to the proper diameter (see figure C3). The advantages of using a square-edge orifice is the simplicity of the design which can be easily assembled in the field for all resource functions to test the gallons per minute (flow) and the pounds per square inch (pressure) of most pumps.

Figure C3 – Photo of square-edged orifice system.

By knowing the orifice diameter required for a certain flow and pressure, a hose cap can be drilled or machined to that diameter. Table C2 shows examples of orifice sizes that would be required to test flow and pressure rates of pumps on fire engines listed in the (NWCG engine resource types) Wildland Fire Engine Guide (SDTDC document 0051 1203). Also included in table C2 is the orifice size required for pumps that are used in most Forest Management contracts for fire protection.

Table C2—Example of orifice sizes

Resource Types	Orifice size (in)	Flow* (gal/min)	Pressure* (psi)	Line and Tee** size (in)
Type 1 Engine	2.102	1,000	150	4
Type 2 Engine	1.051	250	150	2½
Type 3 Engine	0.716	150	250	2½
Type 4 Engine	0.520	50	100	1½
Type 5 Engine	0.520	50	100	1½
Type 6 Engine	0.403	30	100	1½ or 1
Type 7 Engine	0.233	10	100	1½ or 1
Forest Mgmt	0.3125	23	175 at sea level	1 ½ or 1

**Flow (gal/min) and pressure (psi) listed for fire engines in the chart are National Wildfire Coordination Group (NWCG) type ratings for fire engines.*

***Line and tee size can be larger but not smaller.*

It is very important that the drilling of the hose cap be very accurate (see table C2) and the edge to the flow is sharp and square. Machining the orifice opening will provide the most accurate results; however, if the hose cap is drilled it should also be renamed to provide better accuracy. The reason for using a sharp square-edge orifice and not a smooth bore nozzle is that a sharp square-edge orifice can easily be described and made while smooth bore nozzles are much more difficult to describe and are made in many different variations having different flow rates.

Flow through a square-edge orifice can be found by the following formula:

$$Q = 29.81 * C_d * d^2 * \sqrt{P}$$

When:

- Q = flow in gallon per minute
- C_d = orifice discharge coefficient (NFPA recommends using .62)
- d = orifice diameter in inches
- P = pressure in psi

By knowing the flow in gallon per minute (Q) and the pressure in psi (P) the orifice diameter can be found by the following formula:

$$d = \sqrt{\frac{Q}{29.9*0.62*\sqrt{P}}}$$

The pressure gauge should be a Grade 1A or better, and be calibrated annually. A Grade 1A pressure gauge can have a permissible error of 1 percent of full scale (for example a 200 psi Grade 1A pressure gauge can have a permissible error of ±2 psi anywhere on the scale).

The recommended line and tee size should also be adhered to (see table C2). Smaller lines and tees should not be used, as the accuracy will not be maintained. The ratio of the orifice diameter to the diameter of the tee has an effect on the flow and pressure reading. Using a smaller line and tee than recommended could negatively affect the accuracy of the test.

Test Procedures

1. Select desired size square-edge orifice and attach to proper size in-line tee.
2. Attach the in-line tee to the overboard discharge or pump outlet.
3. Start pump, open desired overboard discharge or pump outlet valve, increase pump throttle to maximum.
4. If desired pressure is not reached, the pump does not pass.

Parts list

- One pressure gauge (grade 1A or better)
- One in-line tee (1 inch, 1½ inch, 2½ inch, or 4 inch)
- One appropriate size cap, with appropriate size orifice machined in center.
- One 4-foot length of 300-psi rubber line, with swivel and ¼ inch NPT (National Pipe Thread) fitting on each end.
- ⅜-inch straight-stream nozzle tip tapped with ¼-inch NPT threads.

Additional information about the square-edged orifice system can be obtained from:

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

Gauge Accuracy Information

When testing pumps as outlined in the previous section of this appendix, as well as for performing standard operations with fire apparatus, the use of quality gauges is necessary. To assist in meeting this requirement the following information is provided when selecting a gauge for pump testing and general fire apparatus needs.

Accuracy is defined as the difference (error) between the true value and the indication expressed as a percent of the span (span is the range of the gauge). It includes the combined effects of method, observer, apparatus, and environment. Accuracy error includes hysteresis and repeatability errors but not friction error. It is determined under specific conditions. Normally 73.4 °F (23 °C), and 29.92 inch Hg barometric pressure.

Accuracy of a pressure gauge may be expressed as percent of span or percent of indicated reading. Percent of span is the most common method. For example, the span of a 0-100 psi gauge is 100 psi. Percent of indicated reading is usually limited to precision test gauges.

The following are American Society of Mechanical Engineers (ASME) B40.1 accuracy grades.

Grade 4A. Gauges offer the highest accuracy and are calibrated to ±0.1 percent of span over the entire range of the gauge. The gauges are called laboratory precision test gauges and are generally 8½-, 12- or 16-inch dial sizes. These high-accuracy gauges may be temperature compensated. They must be handled carefully in order to retain accuracy.

Grade 3A. Gauges are calibrated to an accuracy of ±0.25 percent of span over the entire range of the gauge. The gauges are called test gauges and are

generally 4½-, 6-, or 8½-inch dial sizes. The gauges are generally not temperature compensated.

Grade 2A. Gauges are calibrated to an accuracy of ±0.5 percent of span over the entire range of the gauge. These gauges are generally used by the petrochemical industry for process measurement. They are often referred to as process gauges and are usually supplied as 4½- and 6-inch dial sizes and are not temperature compensated.

Grade 1A. Gauges are calibrated to an accuracy of ±1 percent over the entire range of the gauge. These gauges are high-quality industrial gauges and are supplied in 2½-, 3½-, and 4½-inch dial sizes.

Grade A. Gauges are calibrated to an accuracy of ±1 percent of span over the middle half of the scale and ±2 percent of span over the first and last quarters of the scale. These gauges are often referred to as industrial gauges and are usually supplied in 2½-, 3½-, and 4½-inch dial sizes.

Grade B. Gauges are calibrated to an accuracy of ±1 percent of span over the middle half of the scale and ±3 percent of span over first and last quarters of the scale. This accuracy of gauge represents the majority of those manufactured and used for pressure measurement on water pumps, swimming pool filters, air compressors, filter regulation, etc. These gauges are often referred to as commercial or utility gauges and are supplied in 1½-, 2-, 2½-, 3½-, and 4½-inch dial sizes.

Grade C. Gauges are calibrated to an accuracy of ±3 percent of span over the middle half of the scale and ±4 percent of span over the first and last quarters of the scale. These are used in similar applications as Grade B gauges except that they are less accurate.

Grade D. Gauges are calibrated to an accuracy of ±5 percent of span over the entire scale. These 5 percent gauges are used as indicators when minimal accuracy is required for application on water pumps and swimming pool filters.

Table C3—Accuracy Examples

Type of Gauge	Grade	Permissible Error % of Span			Max. Friction (% of span)
		Lower 25 %	Middle 50%	Upper 25%	
Precision 4A test	4A	0.1	0.1	0.1	See note below
Test	3A	0.25	0.25	0.25	0.25
Process	2A	0.5	0.5	0.5	0.5
Industrial/ Hydraulic	1A	1.0	1.0	1.0	1.0
Industrial/ Hydraulic	A	2.0	1.0	2.0	1.0
Commercial/ Utility	B	3.0	2.0	3.0	2.0

NFPA 1906 requires grade B or better gauges; however, lesser grade gauges are available but do not meet this requirement and are not satisfactorily accurate for use on fire apparatus. Grade 2A, 3A, and 4A gauges, although highly accurate, exceed the needs of fire apparatus and are extremely expensive.

APPENDIX D

Service Test Pressure Procedure
Long-term maintenance includes testing, repair or replacement of impaired hose, cleaning and drying, and proper long-term storage. Service testing is performed in order to determine if hose is suitable to continue in use.

Before subjecting any hose to a hydrostatic pressure test, it should be subjected to a close visual examination. Remove damaged hose from the test area.

Safety in testing
When conducting a hose test involving high pressures, there is a potential for serious accidents. Follow all recommended procedures. Be careful and use common sense.

General safety measures
Couplings mounted crooked on the hose are easier to find when the hose is charged. It is also more dangerous.

Fire hose should not be used to transport potable water. Never drink water from fire hose.

When testing, personnel should never stand: (1) in front of the free end of the hose, (2) on the right side of the hose, (3) closer than 15 feet on the left side of the hose, or (4) straddle a hose in the test layout during the test. Left is referenced when facing the free end of the hose, opposite the pressure source.

Air is a compressible substance
In performing Service Pressure Tests, be extra careful to remove all air from the hose before the nozzle or end cap is closed and the pressure is raised. Air is a compressible substance and when greatly compressed, the hose may burst at a pinpoint. In addition, the hose may whip around violently if the pressure is released suddenly, such as when a hose bursts. A blown-off coupling or an expansion ring can act as a missile or bullet, resulting in serious injury or damage to property.

Retesting recoupled hose
Retesting repaired or recoupled fire hose can be extremely dangerous. Hose that has been repaired or recoupled should be retested at a test pressure of at least 50 percent greater than the service test pressure.

Test setup
Provide a test area that will allow connection of the hydrostatic test equipment to an adequate water source. Only use water to pressure test fire hose. The surface of the test area should be level, smooth, and free of any materials that could damage the hose. The hose will be hydrostatic pressure tested at a minimum of 300 psi.

A hose testing machine, a stationary pump, or a fire engine can be used. The hose test layout should be connected to the pump source. If the pump source is a fire engine, it should not be attached to any discharge outlet at, or adjacent to, the pump operator's position. Shut-off nozzles or test caps should be attached to the far end of the line.

The gauge used to read the test pressure should be certified at least annually.

The water connection on the test valve outlet should be as close to the ground as possible. This will decrease the amount of pocketed air at the inlet end when filling the hose for pressure testing.

Hose test sample preparation
Each length of hose to be tested simultaneously should be of the same service test pressure and, collectively, should be considered the hose test layout. The total length of any hose line, in the hose test layout to be service tested, should not exceed 300 feet. The hose test layout should be straight without kinks or twists.

Hose that has just been repaired or recoupled must be tested at one length increments only for safety purposes, before being returned to

service. Each hose should be marked at the back of each coupling to assist in determining any coupling hose slippage during the test.

Test method

With the inlet valve open and the nozzle or test cap valve open, the pressure should be gradually raised to 45 psi (+ 5 psi tolerance). Fully charge the hose by exhausting all the air out of the hose line. This is done by raising the discharge end of each hose line above the highest point in the system. Close the nozzle or cap slowly, and then the inlet valve should be closed. It is very important that all safety requirements be observed. This includes being very careful to remove all air from the hose before the nozzle or end cap is closed and the pressure is raised.

After pressurizing the hose to 45 psi (+ 5 psi tolerance), check for leakage at the coupling. Tighten with a spanner wrench if necessary. If the coupling appears to be mounted crooked, remove the hose from service. Couplings mounted crooked are easier to find when the hose is charged.

All personnel, other than those required to perform the remainder of the procedure, should leave the area. The pressure will be raised slowly, over more than 15 seconds, to the service test pressure of a minimum 300 psi and held for 3 minutes.

When the service test pressure is achieved, inspect the hose for leaks along the hose length and at the couplings. Test personnel should maintain a distance of at least 15 feet to the left side of the nearest hose line. Left referenced when facing the free end, opposite the pressure source.

After maintaining the service test pressure of 300 psi for 3 minutes, drain the hose lay by shutting down the pump, closing the hose valve, and opening the nozzle or cap.

The marks placed on the hose at the back of the couplings should be observed for coupling slippage. If the coupling has slipped, the hose will have failed the test.

The hose has failed the service test if it did not pass the visual exam and the service pressure test. This includes hose that has burst, leaked, or couplings that have slipped or leaked.

Remove the hose from the test apparatus and allow hose that passed service pressure testing to drain.

Additional Test Requirements For Unlined, Hardline, and Suction Hose

Unlined, linen or weeping hose

Unlined weeping hose should have a 5-minute wet-soak at 50 psi to condition the linen yarn prior to applying the service test pressure. If the service test pressure cannot be obtained at a maximum flow rate of 20 gal/min, the unlined linen hose should be removed from service and condemned.

Hardline and suction hose

Hardline hose should be service tested annually to 150 percent of its rated working pressure. Hardline hose is rated for a working pressure up to 600 psi and should be service tested at 900 psi. Suction hose should be service tested annually at 50 percent of its proof pressure. Suction hose is rated for a proof pressure up to 100 psi and should be service tested at 50 psi.

In addition, suction hose should be dry vacuum tested annually to a vacuum of 25-inches mercury. Attach the hose to a suction source with the free end sealed and connected to an accurate vacuum-measuring instrument. Obtain a vacuum of 25-inches mercury and shut the vacuum pump off. The hose should maintain 25-inches mercury vacuum for 5 minutes, with no loss of vacuum, with the vacuum pump off. Disconnect the hose from the suction source and examine the lining for collapse or failure.

Cleaning and drying

After use, all hose should be thoroughly cleaned, including hose that has been tested or retested. Hose may be washed and drained outside when necessary, though hose should not be dried in intense direct sunlight. If dirt

and dust cannot be removed thoroughly by brushing, or if the hose has come in contact with harmful chemicals, it should be washed. If detergent is used, use a mild solution and rinse thoroughly with clean water.

Wet hose should be drained and completely dried before being placed in service or storage. Hose should not be dried on hot pavements or under intense sunlight. Wet hose, even the lightweight all-synthetic, should be thoroughly dried. Cotton-synthetic hose has been treated for mildew protection but will mildew under prolonged wet conditions. In addition, linen hose must be thoroughly dried immediately after testing to avoid mildew.

Allow the jacket to dry completely by hanging a 50-foot length of hose from the middle. Hang a 100-foot length of hose from the middle and allow to drain for a minimum of 4 hours. After 4 hours, double the hose and continue to dry for 2 to 3 days or longer as required. The couplings should be off the ground at all times.

Salvaging bad hose

All hose failing the visual exam and the pressure test should be tagged, repaired, or disposed of as per your agencies guidelines. In the field, tie a knot in failed hose to avoid reuse. If a 100-foot length of hose fails, it should be shortened to 50 feet. If a 50-foot length of hose fails, it should be shortened to no less than 45 feet. Good couplings should be salvaged from discarded hose.

Hose that has been repaired or recoupled should be retested at a test pressure of at least 50 percent greater than the service test pressure.

Place a readily visible, distinguishing mark noting the location of the hose defect, before sending it in. Good couplings should be salvaged from any hose not repairable. For defective couplings, the couplings should be cut from the hose and the hose sent in for re-coupling. When a length of hose is recoupled, the tailpiece gasket should be replaced. For additional information, consult the “Fire Equipment Storage and Refurbishing Standards,” National Wildfire Coordinating Group, NFES Number 2249, November 1994.

APPENDIX E

USDA FOREST SERVICE SPECIFICATIONS/ STANDARDS

5100-101c	Wrench, spanner, fire hose
5100-102d	Couplings, fire and suction hose
5100-105d	Strainer, suction hose
5100-107c	Fire hose connections and fittings
5100-108e	Couplings, lightweight, fire and suction hose
5100-183h	Hose, linen, 1-in and 1½-in
5100-184c	Hose suction
5100-185e	Hose, rubber, high-pressure ¾-in
5100-186c	Hose, cotton-synthetic jacketed, lined, 1-in and 1½-in
5100-187b	Hose, fire, lightweight synthetic, type 1 & type 2, lined, woven jacket, 1 in and 1½ in
5100-00192	Forged quarter turn couplings, new interim
5100-238c	Shut-off, valve, ball
5100-239c	Nozzle with shut-off, combination barrel
5100-240d	Nozzle, twin tip, shut-off, 1-in base
5100-241d	Nozzle, shut-off
5100-242d	Nozzle, screw-tip, 1½-in
5100-243c	Nozzle, garden hose
5100-244d	Nozzle tips, straight-stream and spray
5100-245c	Clamp, fire hose, shut-off
5100-256b	Pump, fire, backpack, hand-operated
5100-257c	Tank, fire, backpack
5100-273d	Pumper, engine-driven
5100-274c	Pumper, lightweight, portable
5100-275b	Pumper, portable, floating
5100-305b	Wetting agent
5100-340b	Reel, hose, booster
5100-341a	Tanker, slip-on, metal, end mounted, 125-, 200-gallon, Model 21
5100-343b	Tanker, slip-on, fiberglass-reinforced resin, capacity 75-, 125-, 200-gallon, Model 30
5100-344b	Pumper, belt-driven, vehicle engine
5100-346b	Tanker, slip-on, 50-gallon, Model 10
5100-347c	Tanker, slip-on, metal, end mounted, 75-, 125-, 200-gallon, Model 20
5100-349b	Tanker, slip-on, 300-gallon, Model 51
5100-380d	Valve, wye
5100-382c	Valve, check and bleeder
5100-383b	Valve, foot, with strainer
5100-01c	Spark arresters for internal combustion engines
5100-107c	Fire hose connections and fittings
5100-190b	Threads, gaskets, and rocker lugs, connections and fittings, fire hose
5100-500e	Accessories, external-loading, helicopter

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA), INC. STANDARDS

NFPA 1901	*Standards for Automotive Fire Apparatus*
NFPA 1906	*Standard for Wildland Fire Apparatus*
NFPA 1961	*Fire hose*
NFPA 1962	*Standard for the care, use, and service testing of fire hose, including connections and nozzles*
NFPA 1963	*Standard for fire hose connections*

CROSS REFERENCE OF FEDERAL NUMBERS

[***NOTE***: NFES = National Fire Equipment System of the National Wildfire Coordinating Group (NWCG)]

National Stock Number (NSN) (In ascending order)	NFES No.	Forest Service Number	Item
4210-00-126-5108	0259	5100-380d	Valve, wye, gated, 1 inch
		5100-184c	Hose, suction, 1 inch, 8-foot length
4210-00-177-6135	0737	5100-244d	Nozzle tips, straight-stream
		5100-105d	Strainer, suction hose, 2½ inch
		5100-241d	Nozzle, shut-off
4210-00-203-3845	0638	5100-244d	Nozzle tip, ⅜ inch
4210-00-203-3855	0637	5100-244d	Nozzle tip, 3⁄16 inch
4210-00-204-3358	0635	5100-244d	Nozzle tip, spray, No. 3, 2 to 4 gal/min, fog
4210-00-204-3386	0636	5100-244d	Nozzle tip, spray, No. 6, 5 to 7 gal/min, fog
4210-00-294-2648	0418	5100-107c	Reducer, 1½ to 1 inch
4210-00-595-1838	1220	5100-185e	Hose, rubber, high-pressure, ¾ inch
4210-00-889-1774	1808	5100-184c	Hose, suction, 1½ inch; 8-foot length
4210-00-640-1892	0024	5100-240d	Nozzle, twin tip, shut-off, 1 inch
4210-00-767-7123	0046	5100-245c	Clamp, fire hose, shut-off, 1 to 1½ inch hose
4210-00-777-1591	0966	5100-186c	Hose, rubber-lined, cotton-synthetic 1 inch, 100-foot length
4210-00-777-1592	0967	5100-186c	Hose, rubber-lined, cotton-synthetic, 1½ inch, 100-foot length
4210-00-889-1775	0115	5100-184c	Hose, suction, 1½ inch; 10-foot length
4210-00-975-2969	0010	5100-107c	Reducer, 1½ to 1 inch
		5100-105d	Strainer, suction hose, 1½ inch
4210-00-984-3475	0231	5100-380d	Valve, wye, gated, 1½ inch
4210-01-079-9283	0007	5100-107c	Thread adapter, 1½ inch NPSH to 1½ inch NH
4210-01-079-9284	0006	5100-107c	Thread adapter, 1½ inch NH to 1½ inch NPSH
4210-01-079-9285	0856	5100-107c	Double male coupling, 1½ inch
4210-01-079-9286	0733	5100-107c	Reducer 1 to ¾ inch
4210-01-080-1457	0710	5100-107c	Double female coupling, 1 inch NPSH
4210-01-080-1458	0916	5100-107c	Double male coupling, 1 inch NPSH
4210-01-080-1459	2240	5100-107c	Hose line tee, cap & chain, 1 inch
4210-01-080-1460	0731	5100-107c	Hose line tee, cap & chain, 1½ inch
4210-01-080-6531	2235	5100-107c	Increaser, ¾ to 1 inch
4210-01-080-6532	0416	5100-107c	Increaser, 1 to 1½ inch
4210-01-081-0417	0230	5100-107c	Hose line tee, valve, 1½ inch

National Stock Number (NSN) (in ascending order)	NFES No.	Forest Service Number	Item
4210-01-081-0418	1809	5100-107c	Hose line tee, 1 to ¾ inch
4210-01-081-0419	2229	5100-107c	Reducer, 2½ NPSH to 1½ inch NH
4210-01-081-8749	0857	5100-107c	Double female coupling, 1½ inch NH
4210-01-081-8751	2210	5100-107c	Cap, tee with chain, 1½ inch NH
4210-01-082-0575	0732	5100-107c	Cap, tee with chain, 1 inch NPSH
4210-01-165-6597	1239	5100-187b	Hose, synthetic, lined, 1½ inch, 100-foot length
4210-01-165-6599	1201	5100-238c	Shut off, valve, ball, 1 inch
4210-01-165-6600	1207	5100-238c	Shut-off, valve, ball, 1½ inch
4210-01-165-6603	1081	5100-239c	Nozzle, shut-off, comb. barrel, 1 inch
4210-01-166-8122	1238	5100-187b	Hose, synthetic, lined, 1 inch, 100-foot length
4210-01-167-1061	1016		Hose, synthetic, garden, ⅝ inch, 50-foot length
4210-01-167-1123	1082	5100-239c	Nozzle, shut-off, comb. barrel, 1½ inch
4320-00-289-8912	1149	5100-256b	Backpack pump, complete outfit
4320-00-595-0762	0151	5100-256b	Pump, single action, trombone
4320-00-890-5879	0601	5100-274c	Pump, lightweight, portable w/accessories
4320-01-495-3633	0148	5100-274c	Pump, lightweight, portable, backpack
4730-00-595-1103	0136	5100-243c	Nozzle, garden hose
4820-00-126-5114	0212	5100-383b	Valve, foot, with strainer, 1½ inch
5120-00-596-1426	0234	5100-101c	Wrench, spanner, 1 and 1½ inch
5120-00-596-1427	0235	5100-101c	Wrench, spanner, 1, 1½, and 2½ inch
5330-00-239-1873	0254	5100-190b	Gasket, fire hose, 1½ inch
5330-00-239-1875	0742	5100-190b	Gasket, fire hose, 2 inch
5330-00-239-1877	2326	5100-190b	Gasket, fire hose, 2½ inch
5330-00-720-2621	0743	5100-190b	Gasket, fire hose, 1 inch
6850-01-111-2200	1316	5100-305b	Wetting agent

APPENDIX F

The following metric system equivalents and approximate conversion factors are provided for common measurements encountered in the wildland fire agencies.

LINEAR MEASURE

1 centimeter=	10 millimeters=	0.394 inch
1 decimeters=	10 centimeters=	3.94 inches
1 meter=	10 decimeters=	39.37 inches
1 dekameter=	10 meters=	32.8 feet
1 hectometer=	10 dekameters=	328.08 feet
1 kilometer=	10 hectometers=	3,280.8 feet

LIQUID MEASURE

1 centiliter=	10 milliliters=	0.338 fl ounce
1 deciliter=	10 centiliters=	3.38 fl ounces
1 liter=	10 deciliters=	33.82 fl ounces
1 liter =		0.264 gallon
1 dekaliter=	10 liters=	2.64 gallons
1 hectoliter=	10 dekaliters=	26.42 gallons
1 kiloliter=	10 hectoliters=	264.18 gallons

WEIGHTS

1 centigram=	10 milligrams=	0.154 grain
1 decigram=	10 centigrams=	1.54 grains
1 gram=	10 decigrams=	0.035 ounce
1 dekagram=	10 grams=	0.35 ounces
1 hectogram=	10 dekagrams=	3.52 ounces
1 kilogram=	10 hectograms=	2.205 pounds
1 quintal=	100 kilograms=	220.46 pounds
1 metric ton=	10 quintals=	1.1 short tons

SQUARE MEASURE

1 sq centimeter=	100 sq millimeters=	0.155 sq in
1 sq decimeter=	100 sq centimeters=	15.5 sq in
1 sq meter (centare)=	100 sq decimeters=	10.76 sq ft
1 sq dekameter (are)=	100 sq meters=	1,076.4 sq ft
1 sq hectometer (hectare)=	100 sq dekameters=	2.47 acres
1 sq kilometer=	100 sq hectometers=	0.386 sq mi

CUBIC MEASURE

1 cu centimeter=	1000 cu millimeters=	0.0610 cu inch
1 cu meter=	1000 cu decimeters=	35.31 cu feet
1 cu decimeter=	1000 cu centimeters=	61.02 cu inches
1 gallon =	231.0 cu in =	0.134 cu ft= 3.79 liters

F—Metric System Equivalents/Conversion Factors

VOLUME (CAPACITY)	U.S. MEASURE	METRIC EQUIVALENT
One hose length = 100 feet		
⅝-inch ID =	1.59 gallons =	6.03 liters
¾-inch ID =	2.30 gallons =	4.69 liters
1-inch ID =	4.08 gallons =	15.4 liters
1½-inch ID =	9.18 gallons =	34.7 liters
1¾-inch ID =	12.5 gallons =	47.3 liters
Tank size (gallons)		
Rectangle =	Length x width x height (inches) x 0.00433	
Cylinder =	3.14 x diameter squared x height (or length) (inches) x 0.00108	

WEIGHT

1 gallon (3.79 L) of water at 20 °C (68 °F) =	8.33 pounds =	3.78 kilograms

PRESSURE

1 foot of water head (column of water)=	0.433 psi (approx. ½ psi)=	2.98 kPa
1 psi =	2.31 feet = (approx. 2 feet of water head)	6.89 kPa
1 psi =	2.04 inch Hg	
1 inch of Hg =	0.491 psi =	3.39 kPa
Atmospheric pressure =	14.696 psi @ sea level (or 29.92 inch Hg) =	101 kPa @ sea level
1,000 foot increase in elevation =	approx. ½ psi decrease in atmospheric pressure	

DRAFT

1 inch of mercury =	approx. 1 foot lift (1.135 ft) =	0.346 meter lift

DRAFTING GUIDELINES

Elevation	Suction Lift (feet) Theoretical	Suction Lift (feet) Practical	Vacuum (in. Hg*)
Sea level	34.0	22	19.5
2,640 feet (½ mile)	30.8	20	17.7
5,280 feet (1 mile)	27.8	17	15.0
7,920 feet (1½ mile)	25.1	15	13.3
10,560 feet (2 mile)	22.8	14	12.4

** At practical suction lift when water not flowing (no foot valve).*

To Change	To	Multiply By
inches	centimeters	2.54
feet	meters	0.305
yards	meters	0.914
miles	kilometers	1.60
sq. inches	sq. centimeters	6.451
sq. feet	sq. meters	0.0929
sq. yards	sq. meters	0.836
sq. miles	sq. kilometers	2.590
acres	sq. hectometers	0.405
cubic feet	cubic meters	0.0283
cubic yards	cubic meters	0.765
fluid ounces	milliliters	29.57
pints	liters	0.473
quarts	liters	0.946
gallons	liters	3.785
ounces	grams	28.349
pounds	kilograms	0.454
short tons	metric tons	0.907
pound-feet	newton-meters	1.355
pound-inches	newton-meters	0.113

To Change	To	Multiply By
ounce-inches	newton-meters	0.007062
centimeters	inches	0.394
meters	feet	3.281
meters	yards	1.094
kilometers	miles	0.621
sq. centimeters	sq. inches	0.155
sq. meters	square feet	10.764
sq. meters	sq. yards	1.196
sq. kilometers	sq. miles	0.386
sq. hectometer	acres	2.471
cubic meters	cubic feet	35.315
cubic meters	cubic yards	1.308
milliliters	fluid ounces	0.0338
liters	pints	2.113
liters	quarts	1.057
liters	gallons	0.264
grams	ounces	0.0353
kilograms	pounds	2.205
metric tons	short tons	1.102

Temperature (Exact)
°F = Fahrenheit °C = Celsius
°F=(°Cx9/5)+32 °C=5/9x(°F-32)

Fahrenheit	Celsius
-20	-28.9
-18	-27.8
-16	-26.7
-14	-25.6
-12	-24.4
-10	-23.3
-8	-22.2
-6	-21.1
-4	-20
-2	-18.9
0	-17.8
2	-16.7
4	-15.6
6	-14.4
8	-13.3
10	-12.2
12	-11.1
14	-10
16	-8.9
18	-7.8
20	-6.7
22	-5.6
24	-4.4
26	-3.3
28	-2.2
30	-1.1
32	0
34	1.1
36	2.2
38	3.3
40	4.4
42	5.6
44	6.7
46	7.8
48	8.9
50	10
52	11.1
54	12.2
56	13.3
58	14.4
60	15.6
62	16.7
64	17.8

Fahrenheit	Celsius
66	18.9
68	20
70	21.1
72	22.2
74	23.3
76	24.4
78	25.6
80	26.7
82	27.8
84	28.9
86	30
88	31.1
90	32.2
92	33.3
94	34.4
96	35.6
98	36.7
100	37.8
102	38.9
104	40
106	41.1
108	42.2
110	43.3
112	44.4
114	45.6
116	46.7
118	47.8
120	48.9
122	50
124	51.1
126	52.2
128	53.3
130	54.4
132	55.6
134	56.7
136	57.8
138	58.9
140	60
142	61.1
144	62.2
146	63.3
148	64.4
150	65.6

APPENDIX G

This section is not intended to be a complete listing, nor is it intended to imply any endorsement of any of the manufacturers or distributors. You are encouraged to research the best manufacturer or distributor for your situation. Please check with your department's policy for purchasing of equipment or supplies.

Fire Hose Couplings

Kochek Co. Inc.
271 Old Colony Rd.
Box 369
Eastford, CT 06242
www.kochek.com

Red Head Brass, Inc.
643 Legion Dr.
P.O. Box 566
Shreve, OH 44676
www.redheadbrass.com

Action Coupling and Equipment Inc.
8248 County Road 245
P.O. Box 99
Holmesville, OH 44633
www.actioncoupling.com

Fire Hose Manufacturers

Angus Fire
141 Junny Rd.
Angier, NC 27501
www.angusfire.com

Firequip
1026 N. Main St.
P. O. Drawer 2598
Burlington, NC 27216
www.Firequip.com

Heiman Fire Equipment, Inc.
248 Highway 60 Blvd.
Ashton, IA 51232
www.heimanfireequipment.com

Niedner Limited
675 Merril St.
Coaticook, Quebec
Canada J1A-2S8
www.niedner.com

Snap-Tite Hose, Inc.
Distributor: National Fire Hose Co.
217 Titusville Rd.
Union City, PA 16438
www.nationalfirehose.com

Nozzles/Valves

Akron Brass Co.
P.O. Box 86
Wooster, OH 44691
www.akronbrass.com

KCR Manufacturing, Inc.
2710 North Interstate Ave.
Portland, OR 97227–1608
503–281–8346
kcr@pacifier.com

Task Force Tips
2800 East Evans Ave.
Valparaiso, IN 46383–6940
www.tft.com

Teems, Inc.
1281 Logan Ave.
Costa Mesa, CA 92626
714–957–0465

United Fire Safety Co., Ltd.
3732 Bowen Rd.
P. O. Box 328
Lancaster, NY 14086
www.unitedfire.com

KK Products
2800 E. Evans Ave.
Valparaiso, IN 46383
www.tft.com

S & H Products, Inc.
5891 Nolan St.
Arvada, CO 80003
www.s-hproducts.com

Elkhart Brass Mfg. Co. Inc.
1302 West Beardsley Ave.
P.O. Box 1127
Elkhart, IN 46515
www.elkhartbrass.com

Cast Machined Products
6735 East 38th Ave.
Denver, CO 80207
303–377–1052

Pumps

CET Fire Pumps Mfg.
116 Consumer Sq.
Suite 358
Plattsburgh, NY 12901
www.fire-pump.com

Honda Power Equipment Group
4900 Marconi Dr.
Alpharetta, GA 30005–8847
www.hondapowerequipment.com

Sta-Rite Industries, Inc.
Berkeley Pump Co.
293 South Wright St.
Delavan, WI 53115
www.starite.com

Edwards Manufacturing Co.
2441 S.E. Stubbs St.
Milwaukie, OR 97222
www.edwardsmfg.com

Gorman-Rupp
305 Bowman St.
P. O. Box 1217
Mansfield, OH 44901
www.gormanrupp.com

H.D. Hudson Mfg. Co.
(Backpack pump & tank)
500 North Michigan Ave.
Chicago, IL 60611
www.hdhudson.com

Homelite Consumer Products, Inc.
1428 Pearman Dairy Rd.
Anderson, SC 29625
www.homelite.com

Hale Fire Pump Co.
700 Spring Mill Ave.
Conshohocken, PA 19428
www.haleproducts.com

Waterous Company
125 Hardman Avenue South
South St. Paul, MN 55075–2456
www.waterousco.com

W.S. Darley & Co.
(Digifoam)
2000 Anson Dr.
Melrose Park, IL 60160
www.wsdarley.com

Shindaiwa Inc.
11975 SW Herman Rd.
Tualatin, OR 97062
www.shindaiwa.com

Hose Reels

Aero-Motive Manufacturing Co.
P.O. Box 2678
Kalamazoo, MI 49003
www.aeromotive.com

American Reeling Devices, Inc.
15 Airpark Vista Blvd.
Dayton, NV 89403
www.americanreeling.com

Metal Masters
3862 Depot Rd.
Hayward, CA 94545
510–352–1230

CoxReels, Inc.
6720 S. Clementine Ct.
Tempe, AZ 85283
www.coxreels.com

Hannay Clifford B & Son, Inc.
533 State Route 143
Westerlo, NY 12193
www.hannayreels.com

General Suppliers

Cascade Fire Equipment Co.
(in-line gauge)
P.O. Box 4248
Medford, OR 97501
www.cascadefire.com

Cordova Fire Equipment Co.
(in-line gauge)
12355 Quicksilver Dr.
Rancho Cordova, CA 95742
www.cordovafire.com

Circul Air Corp.
(mechanical hose washer)
350 Pfingsten Rd.
Suite 105
Northbrook, IL 60062
www.circul-air-corp.com

Mulligan & Associates
P.O. Box 819
Canby, OR 97013
www.kcmull@web-ster.com

LN Curtis & Sons
1800 Peralta St.
Oakland, CA 94607
www.lncurtis.com

Valley Fire & Safety Company
115 B Commercial Blvd.
Martinez, GA 30907
www.valleyfireandsafety.com

Vico & Sons Mfg. & Supply
(gaskets)
P.O. Box 1977, Dept. T
Orange, CA 92862
714–997–4744

Wildfire Equipment Inc.
3951 Development Dr., Suite #4
Sacramento, CA 95838
www.wildfire-equipment.com

Mallory Company
1040 Industrial Way
P.O. Box 2068
Longview, WA 98632
www.malloryco.com

Mercedes Textiles Limited
16633 Hymus Blvd.
Kirkland, Quebec, Canada H9H 4R9
www.mercedestextiles.com

Vescio Threading Co., Inc.
14002 Anson Avenue
Santa Fe Springs, CA 90670
www.plantfloor.com

General Services Administration
501 W. Felix Street
Ft. Worth, TX 76115
www.gsaadvantage.gov

Tank Manufacturers

Custom Fiberglass Products
R.D. #1
Box 1227
Orwigsburg, PA 17961
www.cfpfiretanks.com

John Manion Associates
1052 Centre Turnpike
Orwigsburg, PA 17961
www.manionassociates.com

Fireflex Manufacturing, Ltd.
Distributor: Mulligan & Associates
www.sei-ind.com

FOL-DA-TANK Co.
1275 11th Street West
P.O. Box 110
Milan, IL 61264
www.foldatank.com

United Plastic Fabricating Inc.
165 Flagship Dr
North Andover, MA 01845
www.unitedplastic.com

Western Shelter Systems
830 Wilson St.
P.O. Box 2729
Eugene, OR 97402
www.westernshelter.com

Specialized Equipment Suppliers

Rice Hydro Equipment Mfg.
(hose tester)
3500 Arrowhead Dr.
Carson City, NV 89706
www.ricehydro.com

Hawthorne Screw Machine
(machining)
12355 Quicksilver Drive
Rancho Cordova, CA 95742
www.plantfloor.com

NoShok
(gauges)
110 West Bagley Rd
Berea. OH 44018
www.noshok.com

Ashcroft
(gauges)
250 East Main Street
Stratford, CT 06614–5145
www.ashcroft.com

Cole-Parmer Instrument Company
(gauges)
25 East Bunker Ct.
Vernon Hills, IL 60061
www.coleparmer.com

SEI Industries Ltd.
7400 Wilson Ave.
Delta, BC Canada V4G 1E5
www.sei-ind.com

Watts Industries, Inc.
(pressure regulator)
815 Chestnut St.
North Andover, MA 01845
www.wattsreg.com

Pocket Mobility Inc.
(friction loss calculator software)
2735-B Iris Ave.
Boulder, CO 80304
www.pocketmobility.com

MegaSecur Inc.
145 Jutras Blvd. East, Suite 3
Victoriaville, QC Canada G6P 4L8
www.megasecur.com

Fire Apparatus Manufacturers

American LaFrance
11710 Statesville Blvd.
Cleveland, NC 27013
www.americanlafrance.com

Becker Fire Equipment
1275 N. 6 Mile Rd.
Casper, WY 82604
www.beckerfire.com

Boise Mobile Equipment
900 W Boeing St.
Boise, ID 83705
www.bmefire.com

West-Mark
2704 Railroad Ave.
Ceres, CA 95307
www.west-mark.com

Danko Emergency Equipment
304 Range Line
Snyder, NE 68664
www.danko.net

Emergency One
1601 SW 37th Ave.
Ocala, FL 34474
www.emergencyone.com

FWD Corp. (Seagrave Fire Apparatus)
105 E. 12th St.
Clintonville, WI 54929
www.seagrave.com

HME, Inc.
1950 Byron Center Ave. SW
Grand Rapids, MI 49509
www.hmetruck.com

J&J Acquisition (S & S Fire Apparatus)
4353 W. 1900 N-48
Fairmont, IN 46928
www.ssfire.com

Kovatch Mobile Equipment
1 Industrial Complex
Nesquehoning, PA 18240
www.kovatch.com

Phenix Enterprises
1785 Mount Vernon Ave.
Pomona, CA 91768
www.phenixent.com

Pierce Manufacturing
2600 American Dr.
P.O. Box 2017
Appleton, WI 54913
www.piercemfg.com

Skaggs Company
3828 S. Main St.
Salt Lake City, UT 84115
www.skaggscompanies.com

Ochoco Manufacturing
2668 NE 3rd St.
Prineville, OR 97754
www.omco-mfg.com

Foam Systems and Accessories

Robwen, Inc.
1989-A Blake Ave.
Los Angeles, CA 90039
www.robwen.com

HyPro Corp.
375 5th Ave. NW
New Brighton, MN 55112
www.hypropumps.com

Machinery R & D
(foam pickup tube)
P.O. Box 1146
Twin Falls, ID 83301
www.idahofire.com

Ron Rochna—Foam Professionals
(high-expansion foam generators)
1004 Water St.
Cove, OR 97824
www.rochna.com

Compressed Air Foam Systems (CAFS)

Darley-Odin Foam Div
P.O. Box 327
Toledo, OR 07391
www.wsdarley.com

Waterous-Pneumax
125 Hardman Ave S.
South St. Paul, MN 55075-2426
www.waterousco.com

APPENDIX H

Acronyms and abbreviations used in this *Guide* are listed here, along with their meaning, to provide a ready reference for users of the *Guide*.

ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
ATV	All-terrain vehicle
BIA	Bureau of Indian Affairs, USDI
BLM	Bureau of Land Management, USDI
ºC	Degrees Celsius
CA	Cab to axle of motor-driven vehicle
CAFS	Compressed air foam system
CARB	California Air Resources Board
CJRL	Cotton-jacketed, rubber-lined (hose)
CSRL	Cotton-Synthetic jacketed, rubber-lined (hose)
CDF	California Department of Forestry and Fire Protection
CW	Curb weight of motor-driven vehicle
DJRL	Double-jacketed rubber-lined (hose)
DOI	Department of the Interior
EPA	Environmental Protection Agency
ºF	Degrees Fahrenheit
Fed	Federal
FEMA	Federal Emergency Management Agency
FEPP	Federal Excess Personal Property
FEWT	Fire Equipment Working Team
FS	Forest Service, USDA
ft	Feet (foot)
FWS	Fish and Wildlife Service, USDI
gal	Gallon(s)
GH	Garden hose
GHT	Garden hose thread
Gal/min	Gallons per minute
GSA	General Services Administration
GVW	Gross vehicle weight
GVWR	Gross vehicle weight rating
Hg	Mercury
HP	High pressure (hose)
hp	Horsepower
ICS	Incident Command System
ID	Inside diameter
in	Inch(es)
IPT	Iron pipe thread
lb	Pound(s)
LPG	Liquefied Petroleum Gas
LDH	Large diameter hose
mph	Miles per hour
MTDC	Missoula Technology & Development Center
NBFU	National Board of Fire Underwriters
NFES	National Fire Equipment System
NFPA	National Fire Protection Association
NH	National Hose
NIFC	National Interagency Fire Center, Boise, ID
NIIMS	National Interagency Incident Management Systems
NIST	National Institute of Standards and Technology
NPS	National Park Service
NPSH	National Pipe Straight Hose
NPT	National Pipe Thread
NSN	National Stock Number
NST	National Standard Thread
NWCG	National Wildfire Coordinating Group
OD	Outside diameter
OSHA	Occupational Safety and Health Administration
oz	ounce
PMS	Publication Management System (of NIIMS)
psi	Pounds per square inch

psig	Pounds per square inch gauge
pto	Power take off
QPL	Qualified Products List
QT	Quarter turn
R-1, etc.	Region 1 through Region 10, USDA Forest Service
rpm	Revolutions per minute
SIPT	Straight iron pipe thread
S-S	Straight-stream
SDTDC	San Dimas Technology and Development Center
spec	Specification
TPI	Threads per inch
UL	Underwriter's Laboratories
USDA	U.S. Department of Agriculture
USDI	U.S. Department of the Interior
WHEG	Water Handling Equipment Guide

APPENDIX I

These definitions are applicable to wildland firefighting activities. There may be other words, phrases, or terminology that are encountered, but those below are the less familiar or prone to be misunderstood.

Abrasion—Grinding or wearing away of a surface by rough materials.

Adhesion—Bonding or adherence between rubber lining and the jacket.

Alkali extract—A laboratory test procedure where alkali is extracted by boiling a sample hose jacket in a mixture of sodium carbonate and sodium hydroxide, and then determining the difference in weight of the sample.

Apparatus—A motor–driven vehicle, or group of vehicles, designed and constructed for the purpose of fighting fires. May be of different types such as engines, water tenders, and so on.

Aspirate (foam)—To draw in gases (or other substances) nozzle-aspirating systems draw air into the nozzle to mix with the foam solution.

Backing—A layer or rubber material used to provide adhesion between the inner tube and the outer jacket.

Baffle—Partitions in a tank that reduce shifting of water load.

Burst pressure— The ultimate breaking strength of the hose, generally specified to be two times the "rated pressure" for Forest Service-qualified hose.

Cavitation—Caused by reduced pressure and conversely increased vacuum on the water inside the suction of a pump, as a result of the following:

1. Excessive lift
2. Small or long suction hose
3. Blocked or small strainer
4. Warm water
5. High altitude
6. Combination of any

Coating—Protective material applied to a hose jacket to produce a smooth finish. Impregnate process in which a dye or chemical is forced into the yarns to mildew treat or coat the jacket for various reasons.

Construction—The type of fiber used, tensile strength of the fiber, number of ends, and number of picks per inch in a fire hose jacket.

Continuous performance (85 percent— pump test)—Eighty-five percent point established from a maximum. Performance test of a pump and corrected to sea level.

Cotton—Spun cotton fiber yarn woven into a hose.

Cotton-synthetic—Cotton yarn combined with polyester yarn filler for abrasion resistance.

Crimp—The waviness of the yarn in a woven jacket. The difference in distance between two points on a yarn as it lies in a fabric, and their same two points when the yarn has been removed and straightened.

Curb weight (vehicle)—Weight of a vehicle including full fuel tank, cooling system, crankcase, spare wheel, and other standard equipment.

Cure—The act of vulcanization. In fire hose, the vulcanization of the tube to the jacket.

Cycles (engine)—Complete power cycle of an engine—including intake, compression, power, and exhaust strokes.

Dacron—A synthetic polyester fiber. The first manmade fiber ever used in fire hoses. High-strength, low-stretch material ideally suited for fire hoses.

Denier—A unit of weight; used to express the yarn number of polyester and other continuous filament fibers.

Density altitude—Pressure altitude corrected for temperature.

Elastomer—An elastic substance similar to rubber.

Elongation—The increase in length caused by applied force or pressure. It may be measured at any specified load or pressure and is expressed as a percentage of the original length.

End—One thread of the warp, either before weaving or in the jacket.

Engine—Gasoline, or other fuel-powered machine that drives a pump, transmission, or other device.

Erosion—Act of eroding or wearing away of a surface by the impingement of abrasive materials.

Expansion ring—Thin brass or aluminum ring that is used to seat the hose jacket to the coupling and hose bowl gasket forming a secure, watertight seal.

Extrusion—The formation of a desired shape by ejecting through a shaped opening.

Flexibility—The amount of force required to compress a sample hose, or the amount of force to turn a sample hose around a roller drum.

Filament—A single continuous strand of indefinite length, such as manmade polyester. Compared to stable fibers such as cotton, a filament possesses extreme length and often may be measured in thousands of yards without a break.

Filler—The yarn that interlaces with the warp yarn to produce a woven jacket.

Foam—A fire extinguishing chemical that forms bubbles when mixed with water and reduces combustion by cooling, moistening, and excluding oxygen.

Foot valve—Spring action check valve usually used at the lower end of suction hose often incorporating a strainer.

Friction loss—The result of turbulence within the water (fluids) and the resistance along the inside wall of fire hose or pipe.

Fully backed—The process by which the tube is bonded 360 degrees around within the jacket.

Gear ratio—The ratio of the input driving element (shaft) to the output element (shaft).

Gross Vehicle Weight Rating—Maximum allowable vehicle weight.

Head—Pressure due to elevation of water. Equals 0.433 psi per foot of elevation. Back pressure.

Higbee cut—Removal of the end of the first thread to simplify and facilitate rapid coupling connections (also known as “blunt start”).

Horsepower—Engine work capacity. One horsepower (hp) equals 33,000-ft/lb work per minute. (Gross hp is directly off the engine drive shaft; net hp includes power remaining after power to accessories is subtracted.)

Hose bowl—Indentation on the inside of a hose coupling in which a rubber gasket is installed to provide the seal between the hose jacket, coupling, and expansion ring.

Hose lay—Arrangement of connected lengths of fire hose and accessories on the ground from the pump to the nozzle.

Hypalon—A synthetic rubber with excellent ozone, weathering, and acid resistance. Widely used in fire hose to retard abrasion.

Hysteresis—The under reading of an instrument (such as a pressure gauge) with increasing values (pressure is going up) and the over reading with decreasing values (pressure is going down).

Impeller—Rotating part, or blades, of a pump that transfers energy to movement of water.

Impinge—Projection of a substance into another; such as, projection of a stream of fluid or chemical product at high velocity.

Impregnate—To infuse a substance with particles of another substance. In fiber hose, a process in which a dye or chemical is forced into the yarns to mildew treat or coat the jacket for various reasons.

Jacket—A seamless, tubular, woven fabric used as the outer covering of a hose.

Kill switch—Automatic energy or engine shut-off feature resulting from pressure or vacuum loss.

Kink—The bursting of a sample hose when kinked (bent over itself) and tied, then hydrostatic pressure applied.

Kink pressure test—The testing of a sample hose when kinked (bent over itself), tied, and then pressurized.

Leakage rate—The amount of water seeping through a sample hose (unlined) in a special trough in a given time period.

Lined hose—A hose that is lined with a tube of petroleum-based thermoplastic or polyester elastomer.

Liner—The innermost continuous petroleum base, thermoplastic, polyester elastomer element of fire hose.

Live reel—Reel capable of supporting and operating a length of hose while under working pressure.

Loose-at-fold—The process by which a tube is not bonded 360 degrees around in the jacket.

Maximum hydraulic units—Unit of measure in testing of a pump. The highest value obtained when multiplying pressure by flow of a performance curve of a pump.

Maximum performance—The maximum flow at various pressures of a pump with peak revolutions per minute of the engine or motor.

Mildew—Growth of organic matter produced by fungi. It will discolor and cause deterioration of the woven fabric.

Mildew resistant—Designed to withstand the growth of mildew and mold without any deteriorating effect on the fabric.

Mildew treatment—The chemical treatment on a hose jacket to resist organic growth that would deteriorate the hose jacket fibers.

Neoprene—A synthetic rubber. Excellent resistance to many chemicals, weathering, ozone, heat, cold, and abrasion. Ideally suited for fire hose liners where prolonged storage is a factor.

Nylon—A synthetic fiber named by E.I. Dupont Co. used in wearing apparel and other commercial and industrial applications where elongation is not a factor.

One-hundred-hour endurance—Same value as the maximum hydraulic units, but at 85 percent of the maximum performance corrected to sea level (Forest Service-USDA specification).

Operating pressure—The pressure at which a system is operating.

Oven aging—The deterioration of a hose lining observed under a 7-power microscope after heating in an oven at a given temperature and time.

Ozone aging—The deterioration of a hose lining or jacket observed under a 7-power microscope after exposure to a given amount of ozone and time.

Pick—Circular yarn woven between longitudinal warp ends that form a pick on one turn of the finished jacket.

Polyester—A synthetic material either spun or filament. Can be used in both the warp and filler yarn in fire hose.

Polyethylene—Any of various partially crystalline lightweight thermoplastics that are resistant to chemicals and moisture, have good insulating properties, and are used especially in packaging, insulation and sometimes for wildland engine water tanks.

Polypropylene—A copolymer plastic, usually black, that is strong, ultraviolet resistant, not effected by chemicals and a good choice for wildland engine water tanks.

Polyurethane—This type plastic normally is used for round molded tanks, is not ultraviolet resistant, a poor choice for fire control use.

Power take-off—An output shaft on an engine, transmission, or transfer case of a motorized vehicle that delivers engine power to auxiliary equipment.

Priming—Filling pump with water when pump is taking water not under a pressure head. Necessary for centrifugal pumps.

Pump performance value—Same value as the maximum hydraulic units at 85 percent. (Also same as qualified rating. USDA Forest Service specification.)

Qualified rating—Same value as pump performance value (USDA Forest Service standard).

Rated Pressure—The maximum "operating pressure" of a component or system. Also known as "working pressure" in Forest Service specifications.

Retardant (fire)—A substance that reduces or inhibits flammability of combustible material by chemical or physical action.

Rise—The height hose lifts from its original flat position once hydrostatic pressure is applied.

Service test pressure—The pressure applied to a hose during periodic testing to determine if the hose can remain in service.

Slip-on unit—A self-contained unit including an auxiliary engine driven pump, piping, a tank, and hose storage that is designed to be placed on a truck chassis, utility bed, flat bed, or trailer. Such units can typically be attached and removed from the vehicle with a minimum amount of time and effort.

Spun yarn—A textile yarn spun and twisted from staple-length fiber, either natural or synthetic.

Sulfur content—The percent by weight of sulfur contained in a rubber hose lining as determined chemically in a laboratory test.

Suppressant—Agent that extinguishes the flaming and glowing phases of combustion by direct application to the burning fuel. (Water is a suppressant agent.)

Surge—Rapid increase in flow resulting in rise in pressure.

Tandem—One behind another. (In firefighting operation, a relay operation with short lines between pumps.)

Twist—The twisting of a hose when hydrostatic pressure is applied. The twisting is either left or right as observed in the direction of flow.

Uniform leakage—The wetting and close up period of a dry unlined hose.

Unlined hose—A woven hose that does not incorporate a tube. Designed to seep, and manufactured of linen yarn. Normally used as emergency hose, but used in wildland fires due to its resistance to hot spots that would burn through other types of hose.

USDA Qualification—The purpose of the qualification process is to determine if a manufacturer's product conforms to USDA Forest Service specifications. For example, the qualification of pumps includes a visual inspection, a priming test, a drafting test, an engine test, an endurance performance test, a spark arrester test, and a sound test. Testing and evaluation is conducted by the government at the expense of the contractor. Once a product is determined to meet the minimum specification requirements, the product is assigned a Qualified Products List (QPL) number and is added to the QPL. The QPL is a USDA Forest Service list of products that have been examined, tested, and have satisfied all applicable qualification requirements and may be used by any interested party.

Warp—The amount of deviation from a straight line when the hose is hydrostatically tested; usually expressed in inches.

Water extraction—The pH content of a hose jacket determined after boiling in distilled water in a laboratory test.

Water hammer—The series of shocks, sounding like hammer blows, produced by suddenly reducing the flow of a fluid in a pipe or hose such as when a valve is rapidly closed.

Wetting agent—Detergent type chemical that when added to water reduces surface tension and increases penetration into fuels.

Wet water—Water treated with wetting agent.

Wheel base —Distance from centerlines of front axle to rear axle of a motor-driven vehicle or center of tandem axles

Working pressure—The maximum "operating pressure" of a component or system. Identified as "WP" on Forest Service-qualified fire hose. Also known as "rated pressure."

Yarn number (cotton)—A conventional relative measure of fineness as applied to yarns. Coarse yarns have low numbers and fine yarns have high numbers.

APPENDIX J

Agency: _____

Equipment Designator: _____

ICS Type: _____

(Provide a useable picture/photograph for insertion here!)

Summary: Tank Capacity—gallons _____
Pump Rating— _____ gal/min @ 150 psi
Pump Drive— _____
Mobile Attack Capability?—Yes /No
Number Crew Personnel— _____
Foam System Available?— Yes/No Gallons—_____
All-Wheel Drive? —Yes/No

General Description: _____

_____

_____

_____

Pump: Manufacturer: _____ Model: _____
Type: Centrifugal/Positive displacement
Performance: gal/min (max) at free flow; _____
gal/min @ max psi = _____
Primer Type: Electric/Exhaust/Manual/Air/Self

Tank: Material: _____
Construction: Baffles? Yes/No
If steel, is the tank corrosion treated? Yes/No

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

Valves: Tank-to-Pump? Yes/No Pump-to-Tank? Yes/No

Overboard Discharge: Quantity _____ _____ _____
Size _____ _____ _____

Suction: Quantity _____ _____ _____
Size _____ _____ _____

Priming Valve Handle: _____
Suction Valve Handle: _____
Tank-to-Plumbing Shut-0ff? Yes/No
Gravity Tank Drain/Dump? Yes/No

Discharge Valve Handle: _____
Adjustable Pressure Relief? Yes/No
Pump and Plumbing Drain? Yes/No
Rock Trap/Plumbing Strainer? Yes/No

Chassis: Type _____
Manufacturer: _____
Manufacturer Model Year: _____
Engine Fuel Type: _____
GVW (Operating Weight): _____
Brake Type: _____

Type _____
Cab/Axle Distance: _____
GVWR: _____
Horsepower Rating: _____
Transmission Type: _____

Written Materials:
Specifications and drawings are available from: _____

_____

_____

J—Mobile Equipment Input Data Sheet

Agency: Name only

Equipment Designator: Agency and/or manufacturer's model name and number, i.e., Model 667, S&S Wildland, FS Model 60, brush patrol, initial attack, brush-buster, etc.

ICS Type: See the following NWCG resource-typing chart for Water Tenders and Engines.

Minimum Standards for Water Tender Type					
Resource	**Components**	**1**	**2**	**3**	**4**
Water Tender	Pump, gal/min	300	200	200	~
	Tank, Gallons	5,000	2,500	1,000	~

Minimum Standards For Engine Type							
Components	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Pump Capacity (GPM)	1,000	500	120	70	50	50	20
Tank capacity (Gallons)	400	400	300	750	500	200	125
Hose, 2½ inch (Feet)	1,200	1,000	~	~	~	~	~
Hose, 1½ inch (Feet)	400	500	1000	300	300	300	200
Hose, 1 inch (Feet)	200	300	800	300	300	300	200
Ladder (Feet)	20	20	~	~	~	~	~
Heavy Stream (gal/min)	500	~	~	~	~	~	~
Personnel (Minimum)	4	3	3	3	3	3	3

Summary: Pump Drive – i.e., PTO, auxiliary engine hydrostatic, V-belt, flywheel, or electric.

General Description: Describe any unique or special features not already included in this data sheet that may be of interest to others. An example is attached: *"This unit consists of a low-profile service body, 250-gallon steel tank, hose reel, and plumbing. The unit is intended for off-road use and is reinforced front, rear, and both sides for protection from trees and rocks."*

Tank: Material—i.e., mild steel, stainless steel, polypropylene, plastic, fiberglass, aluminum.

Controls and Gauges: Automatic shutdown—Does the unit have an automatic shutdown of the pumping system controlled by oil pressure, water temperature, or low water?

Valves: Priming valve handle, discharge valve handle, suction valve handle, gravity tank drain/dump—Are these valves controlled manually, electrically, or pneumatically?
Rock trap/plumbing strainer—Is apparatus equipped with a plumbed strainer/rock trap on the inlet side of the pump (excluding any devices on the suction hose)?

Chassis: Manufacturer—i.e., Dodge, Ford, Chevy, GMC, International, etc.
Model year—If several model years of this same type vehicle are used, this can be noted in the "General Description" section.
Gross Vehicle Weight Rating (GVWR)— The maximum allowable weight for the vehicle including fuel, water, operator, passengers, and payload. This is determined by the manufacturer of the vehicle and is identified on the door post of the vehicle as Vehicle GVWR.
Gross Vehicle Weight (GVW)—The total weight of the vehicle loaded with fuel, water, operator, passengers, and payloads, ready for response. This is sometimes referred to as the operating weight.
Note: On vehicles older than 1990, the GVWR is shown as the GVW for that vehicle. Care should be taken when determining the Gross Vehicle Weight of the loaded vehicle to insure that it does not exceed the Gross Vehicle Weight Rating.
Transmission Type—Standard or automatic.
Cab-to-Axle Distance—The distance from the rear of the cab to the center of the rear axle(s) recorded in inches.
Engine fuel type—Diesel, gasoline, etc.
Brake type—Hydraulic, air, etc.

Written Materials: Agency name, contact person, mailing address, telephone number, fax number, e-mail address.