Hose, Nozzles & Fittings

12

Section II - Engine Company Operations

Fire Hose

Nozzles

Hose Appliances

Master Stream Appliances

Hose Fittings

Hose Tools

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Chapter 12 Table of Contents

Objectives

- Identify the three components of hose construction
- Describe the components of the hose jacket, hose liner and couplings
- List the markings found on fire hose and couplings
- Identify the hose sizes, lengths and Engine Company compliment
- Identify the different types of hose packs used and describe the components of each type of hose pack
- Identify the three types of damage fire hose can be subjected to
- Understand how to care for fire hose on the fire ground and in the station
- Identify who repairs and tests fire hose and the processes involved
- Identify the acceptance and service test pressure for fire hose
- Describe high-pressure hose and its usage
- Identify the two most common types of nozzles found in the fire service
- Explain the versatility of the fog nozzle
- Identify the parts of the fog nozzle
- Describe the benefits of a straight stream nozzle
- Identify the parts of the straight stream nozzle
- Identify the different types of fittings
- Describe the maintenance of nozzles and fittings

Introduction

Fire hose, nozzles and fittings are the key tools available to the firefighter for successful operations on the fire ground. Fire hose provides an avenue to get water from a source to the fire pump and from the fire pump to the seat of a fire itself. Early firefighters used bucket brigades to supply the water to the engines while top-mounted nozzles sprayed the water on the fire. This method came to pass with the invention of leather fire hose which allowed firefighters to make better access and attack the fire directly. Today many different materials have replaced the leather fire hose, but similar hose deployment tactics still remain.

Nozzles, fittings and appliances provide the means to control and deliver the water in a variety of ways, from creating different fire streams, to starting and stopping the flow of water. Nozzles, fittings and appliances have evolved in their material and design over the past century, but their function and purpose has remained the same. A good understanding of these tools is essential in order for firefighters to deliver an effective fire stream with sufficient pressure, volume and pattern.

Fire Hose

Hose Construction

With the invention of new technologies and materials, fire hose construction techniques have improved significantly. Fire hose is composed of three basic components; the hose jacket, hose liner and the couplings.

The Hose Jacket

The fire hose jacket is the woven material that forms the outer barriers of the hose. The purpose of the hose jacket is to protect the inner hose liner from heat and mechanical damage as well as to provide strength for high water pressures. The woven hose jacket consists of filler strands and warp strands. Filler strands are the fibers which are woven around the hose. As the hose expands with water, the filler strands absorb 75% of the internal pressure created by water in the line. Filler strands are the key component that give the hose its structural integrity to withstand the high pressures used in fire suppression operations.

The warp strands run the length of the hose and hold the filler strands in place. Warp strands absorb 25% of the internal pressure created by water in the line. While they do not absorb a very large percentage of the internal pressure, warp strands are key in maintaining the structural integrity of the fire hose. Another function of the warp strand is to provide protection to the filler strands from the wear and abrasions fire hose is exposed to in fire ground operations and training. One way to remember what purpose the warp strands serve is the phrase, "Warp doesn't wrap."

All hose is designed to twist to the right and elongate as it is filled with water. The reason that fire hose has this design is to tighten the coupling, ensuring firefighter safety and to prevent the loss of pressure. The amount of filler strands and how tight they are held in place by the warp strands determines the number of rotations made to the right as the fire hose is filled.

Cotton Hose Jacket

Cotton jacketed hose is not commonly found on the fire ground any longer because it is heavier when wet and more susceptible to damage. Because cotton is an organic material, cotton hose is required to be hung and dried after every use in order to prevent mold, mildew and deterioration.

Rubber Hose Jacket

Rubber has also been used for the purposes of hose jackets. The SDFD primarily uses rubber jacketed hose for the hose reel or "booster line." Several mutual aid departments do, however, use rubber jacketed hose for attack line and large diameter supply hose.

Synthetic Hose Jacket

While hose jackets can be constructed out of materials like cotton and rubber, the synthetic jacketed hose is the most common type used by fire departments today. Dacron, polyester and nylon are the most popular of synthetic materials used for modern day fire hose because of their ability to resist heat, abrasion, chemicals and oil, as well as repel water. The fire hose used by the SDFD is predominantly constructed from synthetic materials and can have a single jacket or a double jacket depending on its intended usage.

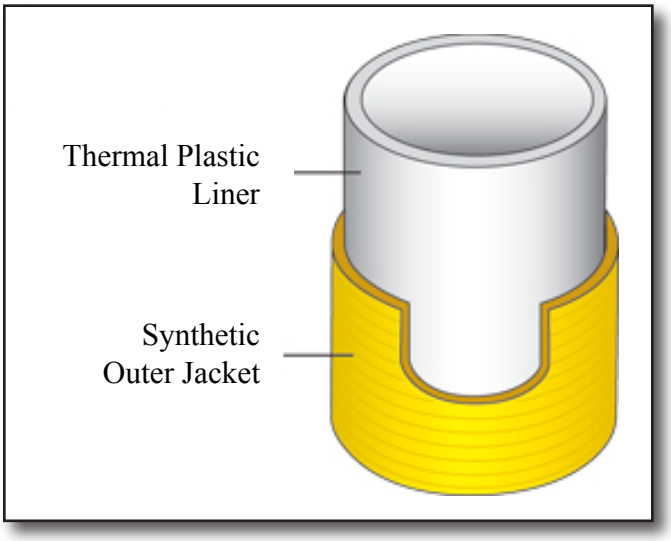


Figure 12-1 Single Jacket Hose Construction with a Thermal Plastic Liner

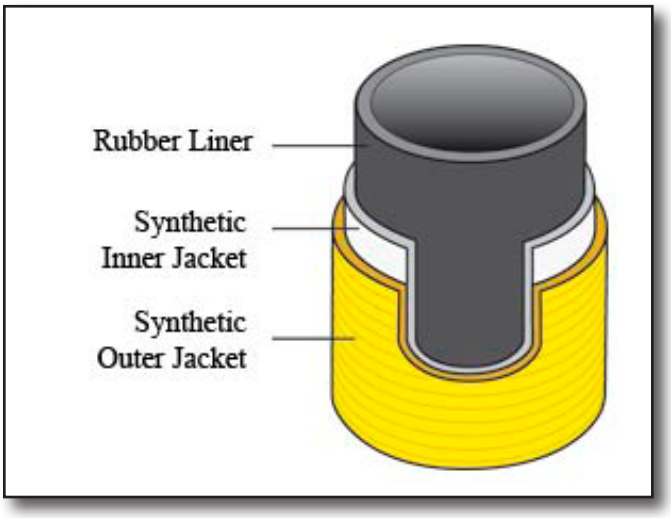


Figure 12-2 Double Jacket Hose Construction with a Rubber Liner

Single Jacket Synthetic Hose

Single jacketed hose has one layer of woven synthetic material that encompasses the hose liner. The single jacket synthetic hose is lightweight and mobile, making it the preferred hose for use in wildland firefighting. The drawback to single jacket hose is that it only has a single thin layer of protection which causes it to be more prone to failure caused by abrasion, heat, and excessive pressures. Additionally, single jacket hose is more prone to kinks. Because the single jacket synthetic hose is more susceptible to heat damage, care must be taken to wet down and cool the ground the hose comes in contact with as the hose is advanced during a wildland fire.

Double Jacket Synthetic Hose

Double jacketed hose has two independent layers of woven synthetic material that encompasses the hose liner. The double jacket synthetic hose is more durable than the single jacket synthetic hose and can withstand higher pump pressures. Double jacket hose also has a greater life expectancy and is more reliable in the extreme environments of firefighting. The double jacket synthetic hose is heavier in weight than the single jacket and can be more cumbersome to maneuver.

Hose Markings

The following hose markings should be found on SDFD fire hose and should be located within 10' of the hose coupling.

- Manufacturer's Name
- Manufacture Date
- Service Test Pressure
- San Diego Fire Department (or agency name)

Dry Fire Hose Weights

Diameter and Type	*Jacket*	*Length*	*Weight*
1” Synthetic	Single	100’	9 lbs.
1 ½” Synthetic (wildland)	Single	100’	15 lbs.
1 ¾” Synthetic	Double	50’ / 100’	23 lbs./ 37 lbs.
2 ½” Synthetic	Double	50’	32 lbs.
3” Synthetic	Triple	50’	36 lbs.
4” Synthetic	Double	100’	86 lbs.

- Unit Number
- “Meets NFPA 1962”

Hose Liner

The hose liner is the inner lining of the fire hose. There are two materials commonly used to line the inside of the hose, rubber and thermal plastic. The hose liners are used in the hose to prevent leakage and act as an efficient waterway. They also increase the hose’s tensile strength. There are advantages and disadvantages to both types of hose liners. The advantage to a rubber lined hose is that it creates a smoother waterway. The disadvantage is that the rubber used is heavier than the thermal plastic. The advantages to the thermal plastic liner are that it is lighter weight and more puncture resistant. The disadvantage is that the laminate plastic used in the liner forms a rougher waterway creating an increase in friction and pressure loss.

Figure 12-3 Brass Coupling

To prevent the twisting or movement of hose liners within the hose jacket, liners are joined to the inner-most jacket by a process called vulcanization. Vulcanization utilizes heat, steam and pressure to permanently bond the rubber or thermal plastic liner to the hose jacket.

Hose Couplings

Couplings are used to connect sections of hose together and are found on the ends of fire hose. One end of the hose has a male coupling with external threads, while the other end of the hose has a female coupling with internal threads and a swivel. Hose couplings are constructed out of either malleable brass, Figure 12-3, or aluminum alloy, Figure 12-4. Like the cotton jacketed hose, malleable brass couplings are now less common in the fire service because of

Figure 12-4 Alluminum Alloy Coupling

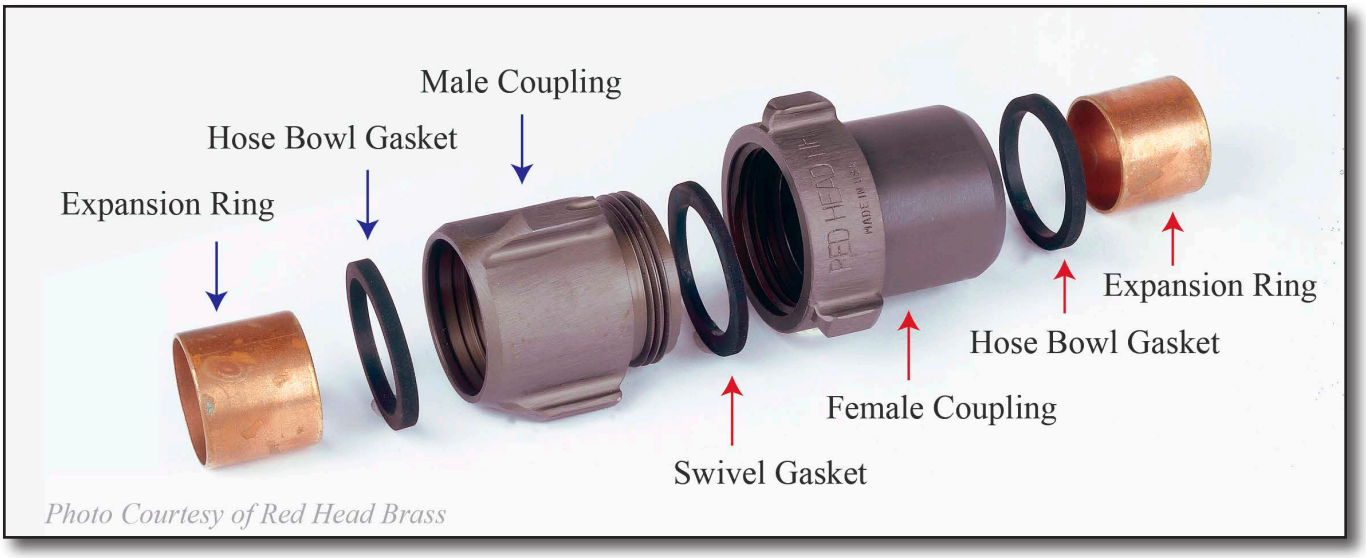


Photo Courtesy of Red Head Brass

their heavy weight and soft material. Malleable brass has since been replaced by the aluminum alloy coupling which is lighter in weight and a stronger material.

The expansion ring, swivel, thread, gaskets and lugs are the main components that comprise a hose coupling.

Expansion Ring

The expansion ring is a brass ring used to attach both the male and female coupling onto the fire hose itself. The ring is slipped inside the hose liner and then the coupling is placed over the hose jacket. An expansion machine is inserted inside the hose. When activated, the machine presses the brass ring outward to fasten the hose between the brass ring and the coupling. This process can only be done by trained personnel at Station 20.

Swivel

In order for two couplings to attach, one coupling must rotate freely or swivel, otherwise you would have to twist the hose itself. The female coupling allows for this movement by providing an internally threaded end which rotates about a fixed metal coupling using ball bearings.

Thread Type

The most common type of thread found in the fire service, and the one used by the San Diego Fire-Rescue Department, is the National Standard Thread (NST). It is important to be aware that other thread types can be encountered. On multi-agency responses, other agencies, such as the U.S. Forest Service who uses Pipe Thread, may use different thread types that will not be compatible with NST. Location of the incident may also determine thread compatibility; pipe thread may be encountered during shipboard firefighting incidents as well. Units that may encounter incompatible threads are often equipped with adaptors to overcome this obstacle. This reinforces the need to know and understand the equipment on your rig.

Knowing Hose Couplings Can Save Your Life!

Let's say you are lost in a fire. There is heavy smoke with no visibility, your vibralert is going off because you are low on air and you are disorientated. If you have the fortune of coming into contact with a hose line, knowledge of the hose couplings and lugs can help lead you back to the point of entry and safety.

When coming into contact with a hose line, the first thing to do is to follow it until you find couplings. When you reach the couplings, feel the lugs to determine which is the male and which is the female coupling. Remember that the male coupling has the long rocker type lugs and the female coupling has the short rocker type lugs.

With firefighting attack hose lines, water flows out the male coupling. By orienting yourself to the couplings on the hose, you can determine which way water is flowing and in which direction the fire is.

To remove yourself from the IDLH environment, remain in constant contact with the hose line and move in the opposite direction of the water flow. Eventually your hose will lead you to an exit, window or stairwell.

Remember to stay in contact with the hose at all times and never take a short cut when using this emergency exit method.

Gaskets

A swivel gasket is placed in the female coupling to make connections water tight. Before every connection, the gasket should be checked visually or with a finger to ensure that it is in place. If the gasket is worn or cracked, it should be replaced with a new gasket. If the gasket protrudes into the waterway, a thinner gasket should be found or the inside of the existing gasket should be cut down so it no longer impedes the flow of water.

The hose bowl gasket (also known as the tail gasket), is located on the inside of the hose behind the female coupling. It acts as a buffer between the fire hose and the female coupling and helps seal the hose to the coupling. The purpose of the hose bowl gasket is to prevent leakage.

Coupling Lugs

The lug is used on a coupling to tighten the male and female couplings together with the use of a spanner. The type of lug found on the coupling will

Figure 12-5 Rocker Lug & Spanner

Figure 12-6 Pin Lug & Spanner

determine the type of spanner that needs to be used to tighten or un-tighten the couplings.

The most common type of coupling lug used by the SDFD is the rocker type lug. The hydrant or pocket spanner can be used to tighten a rocker type lug, Figure 12-5.

Another type of lug found on a coupling is the pin type. To tighten a pin type lug, a spanner with a circular groove is required, Figure 12-6.

The type of lug found on the red line, also known as the booster line, is called a recessed eye. This type of lug requires a spanner with a pin to insert into the recessed eye lug, Figure 12-7.

Markings on Couplings

There are several markings that are found on the couplings:

- Manufacturer's Name or Trademark
- Fire Department Inventory Number (found on female)
- SDFD Bar-Code (found on male)
- Higby Indicator Notch

Figure 12-7 Recessed Eye Lug & Spanner

The Higby Indicator Notch is a notch on one of the three coupling lugs that is used to indicate the start of the threads. Lining up the Higby Notch on the male and female couplings will ensure a quick connection and minimize the chances of cross threading, Figure 12-8.

Non-Threaded Couplings

Another type of hose coupling that may be encountered on the fire ground, and is increasing in popularity, is the non-threaded coupling. These couplings use locks or cams to secure their connection instead of the standard thread system. Both couplings are identical and either end can be used to connect to another coupling. The couplings are simply aligned and twisted one-quarter turn, which locks them together. "Storz" couplings are the most popular of the non-threaded coupling but many different kinds exist, Figure 12-9. Currently, the SDFD does not use non-threaded couplings.

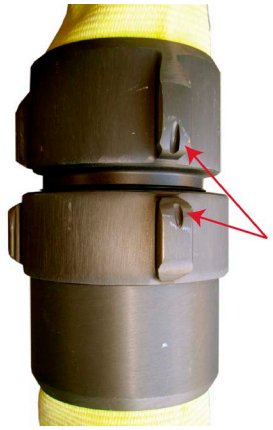


Figure 12-8 Higby Indicator Notch

Size & Lengths of Fire Hose

Fire hose comes in various sizes (diameters) and lengths. Depending on the intended purpose or use of the hose will determine which size hose line is the most appropriate to pull. A small diameter hose line is easier to maneuver and operate than a large diameter hose line, however it delivers less gallons per minute (GPM's). Conversely, a large diameter hose line can deliver large volumes of water, but is difficult to move when charged and may require special appliances to operate safely. As a general rule, fire hose with a diameter of 2 ½" or less is used for hand held attack lines. Fire hose with a diameter of 2 ½" or greater is used as a water supply line for apparatus, ladder pipes, FDC's and other appliances.

Size of Hose

Diameter	*Hose Usage*
¾" - 1"	Redline (Booster Line)
1" - 1 ½"	Wildland Firefighting
1 ¾"	Cross bed Pre-connects (Mattydale), High-rise Hose Pack, Firefighting Hose
2 ½"	Back-Up Line, Exposure Line, Supply Line
2 ½" - 3"	High Pressure Hose for High-rise
3" - 3 ½"	Ladder Pipe
4"	Supply Line

Lengths of Hose

Hose Length	*Hose Usage*
6'	2 ½" Hose Section on the Hose Pack "A"
10' – 12'	Whip on Cross-bed Pre-connect (Mattydale)
15'	2 ½" Fill Hose
25'	Short Length of 4" Supply Line (bypass)
50'	1 ¾", 2 ½" and 3" Hose. Short Length of 4" Supply Line (suction)
100'	Redline Hose, 4" Supply Line, 1 ½" Wildland Hose

Fire hose most commonly comes in 50' or 100' sections, however, other sizes are found on SDFD apparatus.

When a coupling is damaged and needs replacement, or the end of a hose has a defect, a repair will be made which can often result in the shortening of the hose. Fire hose can be shortened by as much as 10' because of a previous hose repair and still remain in service. Any hose repair requiring more than 10' of hose to be removed will result in the hose being placed out of service. It is important to keep this in mind when selecting which hose to pull for a fire.

For example, if you were to pull the 200' pre-connect, and each of the four sections of 1 ¾" have had repairs done to them, your hose could be as much as 40' shorter than the expected 200' Be aware of this possibility when determining the amount of hose to pull at an incident or training exercise. Determining the amount of hose to pull is an art form; too little hose and you might as well still be on the rig; too much hose and you have a nest of kinks, trip hazards, etc. PRACTICE!

Figure 12-9 Storz, Non-Threaded Coupling

SDFD Standard Hose Compliments

The following is a breakdown of the minimum standard hose compliments that are found on all SDFD Type I Engine Companies. It is important to note that you will encounter Engine Companies with additional sections of hose, such as hose found stored in the running board or in rolls stored on top of the apparatus. Completing a thorough check of the rig you are assigned to prior to each shift is imperative in order to be prepared.

4" Hose - 900 feet

Four inch diameter, double jacket hose, is used to supply water from a water source to a fire pump, an aerial ladder pipe, deck gun, ground monitor or other master stream device. Because of its large size and weight, 4" hose is never used as a handheld firefighting line.

Nine hundred feet of 4" hose is the minimum standard carried on SDFD Type I Engine Companies and is found in 100' sections.

4" Hose - 50' & 25' Rolled Section

Figure 12-10 Four Inch Rolled Hose, 50' & 25' Lengths

Two rolled sections of 4" hose, 50' and 25' in length, are kept in a compartment on the apparatus and used to complete a 4" hose lay, Figure 12-10 A situation may call for ten more feet of 4" hose to complete your hose lay; instead of pulling another 100' section of 4" hose, you have the option of utilizing the 25' rolled section. You also may hear the terms "50' Suction" and "25' Bypass" used to describe these two hose rolls. This is because of a previous hose evolution involving a 4-way hydrant valve that is no longer utilized by the SDFD.

2 1/2" Hose - 800 feet

The 2 1/2", double jacket hose, is the most versatile fire hose used by the SDFD. This hose can be utilized for just about any purpose; supplying fire pumps, ladder pipes, deck guns, ground monitors, fire department connections and hand held attack lines.

Eight hundred feet of 2 1/2" hose is the minimum standard carried on SDFD Type I Engine Companies and is found in 50' sections. Most engine companies also carry one short 10' to 15' section of rolled 2 1/2" hose that can be utilized to fill the apparatus water tank in non-emergency situations.

1 3/4" Hose - 450 feet

The 1 3/4", double jacket hose, is the primary hose of choice for most fires requiring a hand held attack line. It is small enough to advance and operate with one firefighter, yet still deliver an effective fire stream. SDFD Engine Companies utilize this hose by pre-connecting it to the fire pump and loading it into the "Mattydale" or "Cross-Lay" bed of the engine in 100', 150' and 200' lengths.

Four-hundred and fifty feet of 1 3/4" hose is the minimum standard carried on SDFD Type I Engine Companies and comes in 50' sections. It is also important to note that 1 3/4" hose uses 1 1/2" diameter hose couplings and can be connected to 1 1/2" hose as long as the thread types on the coupling are compatible.

1" Hose - 200 feet

Two-hundred feet of 1", double jacket, hose is also carried on SDFD Type I Engine Companies. This hose is used for small fires and other applications where minimal water is needed. This hose may be found rolled in a compartment or stored in a bumper well depending on the crews preference and apparatus configuration.

The High Rise Hose Pack

The High-Rise Hose Pack is a valuable tool found on all SDFD Type I Engines. It is composed of two packs: Hose Pack "A" and Hose Pack "B". The common components of each hose pack are: one hundred feet of 1 ¾" hose, an Elkhart Phantom high-rise nozzle and a nylon harness.

*High-Rise Hose Pack "A" (*Figure 12-11*)*

- 100' of 1 ¾" Hi-Rise Hose
- Elkhart Phantom Hi-Rise Fog Nozzle
  - Fog Nozzle
  - 7/8" Slug Tip
  - 1 ½" Shut-off Butt
- 2 ½" to 1 ½" Gated Wye
- 6' Section of 2 ½" hose
- Pressure Regulating Valve Adjustment Tool/Bar
- Nylon Hose Straps

Figure 12-11 Highrise Hose Pack "A"

*High-Rise Hose Pack "B" (*Figure 12-12*)*

- 100' (two 50' sections) of 1 ¾" Hi-Rise Hose
- Elkhart Phantom Hi-Rise Fog Nozzle
  - Fog Nozzle
  - 7/8" Slug Tip
  - 1 ½" Shut-off Butt
- 2 ½" to 1 ½" Reducer

Figure 12-12 Highrise Hose Pack "B"

- Nylon Hose Straps

The high-rise hose packs give the firefighter several options for deploying hose. For example, both hose packs can be combined to provide one, 200' length of firefighting line. If the gated wye is utilized, the two hose packs can be used as two, 100' firefighting lines from the same standpipe connection. The 6' section of 2 ½" hose attached to hose pack "A" allows the firefighter to connect the 1 ¾" hose to the gated wye on the floor of a stairwell. This allows for the hose line to be maneuvered out of the way of firefighters using the stairwells as well as provide an easier method of connecting if the outlet is in a corner.

Figure 12-13 Elkhart Phantom 200gpm Fog Nozzle

The 2 ½" to 1 ¾" reducer on Hose Pack "B" allows the firefighter to connect the 1 ¾" hose to a separate standpipe connection than the one being used by Hose Pack "A". The reducer makes Hose Pack "B" independent of Hose Pack "A" and provides greater fire operation versatility.

Elkhart Phantom Nozzle & Slug Tip

Pressure on higher levels of a high-rise can become an issue. The Elkhart Phantom Fog Nozzle provides an effective fire stream at lower pressures than the standard fog nozzle (75 psi as opposed to 100 psi), Figure 12-13. The nozzle of the Elkhart Phantom can be removed to expose a 7/8" slug tip, Figure 12-14. The 7/8" slug tip can maintain an effective fire stream at even lower pressures than with the nozzle on, requiring only 50 psi as opposed to 75 psi.

Figure 12-14 1 1/2" Shut-Off Butt w/ 7/8" Slug Tip

Pressure Regulator Adjustment Bar

Newer standpipe systems in high-rise buildings are equipped with pressure regulators on each floor (covered in more detail in the Hi-Rise Firefighting Chapter). The Pressure Regulator Adjustment Bar is found on hose pack "A" and allows a firefighter to adjust the pressure at the current floor they are on to increase the efficiency of their fire stream.

Figure 12-15 Fifty foot sections of 2 1/2" hose can be made into hose packs with duct tape. Once at the fire floor they can be connected easily, the tape can be removed, then quickly flaked out and deployed

Hose Harness

The nylon hose harness holds the hose pack together. After it is removed, the straps can be clipped around a shut-off butt or a valve on the gated wye to keep them from accidently being shut during firefighting operations.

2 1/2" Hose Packs

During large, uncompartmentalized high-rise fires, 2½" hose shall be used with an 1 1/8" smooth bore tip because they can produce a higher GPM at lower pressures. The 2½" hose is not in pre-made packs and will have to be made into packs prior to ascent. This can be done quickly and the only thing needed is some white EMS duct tape, Figure 12-15. Refer to Chapter 31, High-Rise Firefighting, for additional information.

Building a 2 1/2” Hose Pack - Shoulder Load Method

Remove any nozzles or gated wyes and shoulder load 50’ of 2 1/2” Hose

Break the coupling and have a partner duct tape the hose together

Once duct taped on both ends, secure a smooth bore nozzle with a shut off butt

Building a 2 1/2” Hose Pack - Ground Method

Remove any nozzles or gated wyes and lay out 50’ of 2 1/2” hose on the ground

Continue to pull out hose as you make folds approximately every 6’ to 8’

Break the hose and duct tape the bundle together on both ends

Wildland I-Zone Hose Pack

The Wildland I-Zone hose packs are located on all SDFD Type I and Type III Engine Companies, Figure 12-16. A minimum of one I-Zone hose pack is assigned to Type I Engine Companies, while Type III Engine Companies may have up to eight I-Zone hose packs. The I-Zone pack, short for interface zone, provides a rapid and efficient means to conduct a progressive hose lay. The I-zone pack weighs 47 pounds and has several components.

300' of Hot Line 1 ½" Lightweight Hose

The wildland hose pack carries three, 100' sections of single jacket, synthetic 1 ½" lightweight hose, also known as "Hot Line." Each 100' hose bundle is rolled in a specific manner so that it can be placed on the ground, spread open, and charged in place without having to unroll or flake any hose. This operation greatly reduces the amount of time it takes to connect a new section of hose to the progressive hose lay, thereby, protecting the crew operating the line and decreasing the amount of time it takes to knock down the fire.

3/8" Straight Tip Nozzle

The first length of hose removed from the wildland pack should have a 3/8" straight tip nozzle attached with a quarter turn shut-off butt. When you are out of hose, the hose is clamped, the nozzle and shut-off but should be removed, and another length of hose should be added. Re-attach the nozzle and continue the progressive lay.

(2) Water Thiefs

The wildland hose pack has two water thiefs. The water thiefs are attached to the male couplings of the first and third length of hose in the wildland hose pack. The water thief is set every 200' of a progressive lay so a section of 1" hose can be attached if necessary. The theory is that a 100' section of 1" hose could reach any spot if the water thiefs are spaced apart every 200'. If there is a flare up down the line and moving the main line would be difficult or if there is a hot patch of ground that threatens to burn the main line, the 1" hose could be attached to the water thief quickly to handle the issue.

Figure 12-16 Wildland I-Zone Hose Pack

Hose Clamp

The wildland hose pack comes with a hose clamp. It is used to clamp shut the water flow through the hose to allow the nozzle to be removed from the current line and attached to the next line.

1” Wildland Hose Pack

The 1” Wildland Hose Pack is used for extending lateral hoselines off of the main progressive hoselay for knocking down small spot fires and used during mop-up operations. The 1” hoseline is connected to the in-line water thief found in the “I-Zone” hose packs. Due to thread compatability issues, an NH (national standard) to NPHS (pipe) thread adapter must be used for this connection.

Figure 12-17 1” Wildland Hose Pack

The 1” Wildland Hose Pack consist of the following items, Figure 12-17:

- (2) 100’ lengths of 1” NPHS (pipe) thread wildland hose
- (2) 1” NPHS (pipe) thread USFS style nozzle
- (2) 1” NH Female x NPHS Male adapter
- (1) Green Bag to hold hose and equipment

The 1”Wildland Hose Pack can be found on Type I Engines and Type III Brush Units. It should be noted that the inventory of the 1” wildland hose pack on Type III apparatus may have additional fittings included in its inventory.

SDFD Non-Standard Hose Compliments

The following is a break down of hose compliments that are found on select Type I and Type III SDFD Engine Companies.

Hi-Pressure Hose - 400 feet

Due to the unique challenges that hi-rise fires pose for firefighting, special hose is required to supply the FDC in order to deliver the necessary nozzle pressures on upper floors. Select engine companies in the Downtown and UTC area have been outfitted with 400’ of triple jacket synthetic hose, Engine 1, 201, 3 and 4 carry green 3” diameter, triple jacket, high-pressure standpipe hose. This 3” hose comes in 50’ lengths and uses 2 1/2” hose couplings. Engine 35 carries the older blue 2 ½”, triple jacket, high pressure stand pipe hose.

These engine companies 2 1/2” double jacket hose compliments have been modified from the standard Type I SDFD engine company to accommodate this high pressure hose; instead of 800’ of double jacket 2 1/2” hose, they only have 400’.

The triple jacket synthetic fire hose has a maximum service pressure of 600 psi compared to 300 psi for the double jacket hose. The high pressure capability of these hoses allow units to safely deliver 750 GPM at 100 psi at the roof outlet of buildings greater than 400’ feet as required by the Uniform Building Code (UBC). Because of the high pressures these hose lines are subjected to, their unique construction and high cost, proper maintenance is imperative with both the green 3” and blue 2 ½” high pressure hose.

There are several guidelines that apply to use and care of the 2 ½" and 3"high pressure hose:

- When possible, restrict use of this hose to high-rise buildings 20 stories or greater in height.
- When practicing high-pressure hose evolutions do not use the high-pressure hose. Simulate the high-pressure hose procedures by using the red or yellow synthetic 2 ½", double jacket hose.
- Because 2 1/2" shut-off butts have a smaller waterway than the actual diameter of the hose, the use of shut-off buts when connecting high pressure hose to the FDC should be avoided.

Figure 12-18 Booster Hose

Booster Hose or "Red Line"

Booster hose is smaller diameter, rigid, rubber-coated hose of 3/4" or 1" diameter size, Figure 12-18. Booster hose, or "red line" as it is commonly referred, is mounted on a reel and can be used for small exterior fires or overhaul operations after the fire is extinguished. Booster hose is not designed to flow high quantities of water, and although it is easy to control and maneuver, it should never be used as a structural firefighting hand line.

Newer generation SDFD Type I Engine Companies, and most all Type III Engine Companies have booster hose reels with varying locations, diameters and lengths.

Hard Suction Fire Hose

Hard suction fire hose is used to draft water from a static source. Hard suction is rigid in construction and consists of a hardened rubber jacket reinforced with a wire helix to prevent hose collapse, Figure 12-19. This hose is less flexible than typical fire hose which allows for a negative pressure, or vacuum, to be created inside the hose. Hard suction hose comes in sizes from 2 1/2" to 6" in diameter and ten feet in length. Although hard suction hose is not a standard hose compliment for Type I SDFD Engine Companies, it is carried on some Type III Engine Companies and can be found stored at the Repair Facility for emergency situations.

Figure 12-19 Hard Suction Hose

Hose Rolls

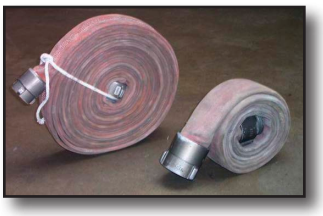


Figure 12-20 Straight Roll

Fire hose is typically stored in a rolled position. Rolled hose protects the jacket from dirt, debris and damaging UV rays. It also protects the hose from unnecessary kinks or creases as well as allowing the hose to be deployed quickly for use. There are several methods used by the SDFD for rolling and storing fire hose.

Straight Roll

In a straight roll, the entire length of hose is laid out flat on the ground. The hose is then rolled tightly beginning with the male coupling and working towards the female coupling. By rolling the hose in this manner, the male threads of the coupling will end up in the center of the roll and be protected from possible damage, Figure 12-20.

Figure 12-21 Donut Roll

Single Donut Roll

A single donut roll is used to roll hose when access to both couplings may be necessary, Figure 12-21.

- A single donut roll begins with the hose laying out flat in a straight line.
- The hose is then folded back upon itself with the male coupling placed on top about 18” to 24” short of the female coupling (this distance varies depending on the length of hose).
- Begin rolling from the fold of the hose towards the couplings. A partner is recommended to assist in taking up slack in the hose as you begin rolling.

The 25’ and 50’ sections of 4” hose are rolled using this method.

Figure 12-22 Double Donut Roll

Double Donut Roll

The double donut roll is used for rolling smaller diameter or single jacket hose with lengths in excess of 50’. For example, a 100’ section of 1 1/2” hose rolled in a straight roll tends to fall apart because it is too tall, so a double donut roll may be preferred, Figure 12-22.

- A double donut roll begins with the hose laid out flat with both couplings at one end and each half lying parallel to the other.
- At the center of the hose, the loop is folded over the top of both halves.
- Begin rolling towards the couplings.
- To prevent the two halves from falling apart from each other, the hose lines may be crossed over each other at several points along the roll.
- The hose is then secured with sash cord or a rubber band.

High-Rise Hose Pack

The high-rise hose pack is formed by creating a loose oval roll with an inside diameter of roughly 3 feet, commonly referred to as a “Cleveland Roll.” The male coupling and nozzle are rolled to the inside and then the entire hose

bundle is strapped together to make a hose pack that can easily be carried on the shoulder.

Wildland I-Zone Pack

The Wildland I-Zone hose pack is formed similar to the high rise hose pack. The difference with the I-Zone pack is the "Cleveland Roll" that was created is now folded in half to allow it to fit into a back pack, Media 12-1.

Media 12-1 Rolling a I-Zone Hose Pack

Hose Loads

There are several different ways that hose can be loaded onto apparatus for quick deployment. Although some fire companies have tailored or modified their hose beds to meet the specific needs for their district, all SDFD Type I engine companies utilize the following three standard hose loads.

Figure 12-23 Flat Load (L) & Accordian Load (R)

Flat Load

The 4" hose bed is loaded using the "Flat" or "Bacon" load, Figure 12-23. Because 4" hose is primarily used to supply water from a water source to the pump, the hose is loaded with the female coupling pointing toward the tail board so that it will be the first coupling to leave the hose bed when deployed.

Accordion Load

The accordion load calls for the hose to be laid on its folded edge and layered back and forth as the hose bed is loaded, Figure 12-23. The advantage to the accordion load over the flat load is that the firefighter can accurately and quickly select multiple hose folds to pull in one motion. The "Accordion" method is used to load the 2½" hose bed. Because 2 1/2" hose is primarily used for delivering water from the pump to the fire (nozzle, FDC, master stream etc.) The male coupling will always point toward the tail board and will be the first coupling coming out of the hose bed.

Pre-Connect or "Mattydale"

1¾" hose is loaded into a hose bed that crosses the apparatus from side to side. This hose bed is located forward of the rear hose bed adjacent to where the firefighters are seated, and is called the "Mattydale" or "Cross lay" hose bed, Figure 12-24. The hose bed is split to accommodate three separate hose lines. Each are pre-connected to the pump to aid in quick deployment with a shutoff butt and nozzle already attached. These hose beds are also referred to as "Pre-connects" for that reason. The hose is loaded in the "Flat" configuration with the female coupling going into the hose bed first.

Figure 12-24 Pre-Connect Hose Load

The 1¾" hose beds are loaded in the following manner:

- The #1 cross lay hose bed closest to where the firefighters sit consists of one hundred feet of 1¾" hose with a 30 to 125 GPM s.o.f. (select-o-flow) nozzle already attached. In operations a red foam nozzle may be attached to the pre-existing s.o.f. nozzle.
- The #2 , or middle cross lay, consists of one hundred and fifty feet of 1¾" hose with a 95 to 200 GPM fog nozzle.
- The #3, or rear cross lay (furthest away from where the firefighters sit), consists of two hundred feet of 1¾" hose and a 95 to 200 GPM fog nozzle.

Fire Hose Care & Maintenance

Hose Dependability

The life expectancy for fire hose is 12-15 years. The average life for fire hose is 7 years. There are several factors that affect the actual service life of fire hose:

Figure 12-25 Abrasion

- The quality of hose purchased.
- The pressure that the hose is subjected to while it is in service.
- The care and handling of the hose at the fire scene and during training.
- The care and maintenance of the hose at the station.

Types of Hose Damage

There is three types of damage fire hose can receive: Mechanical, Chemical and Heat.

Mechanical hose damage includes:

- Tears
- Abrasions (Figure 12-25)
- Excessive pressure
- Water hammer
- Driving over hose or couplings

Figure 12-26 Mold

Chemical hose damage includes:

- Mildew/Mold from improper drying and storage (Figure 12-26)
- Petroleum products.
- Solvents.
- Exposure to acid.
- Vehicle exhaust

Heat hose damage includes:

- Prolonged exposure to the sun
- Improper storage near a heat source.
- Exposure to fire and its by-products.

Hose Care on the Fire Ground

It is critical to have functional hose during operations on the fire ground. Care should be provided during and after its use on an incident and during training. When a supply line is laid at a fire, the hose should be laid on the same side of the street as the hydrant. When the supply line is laid out, it should be kept 6'-8' from the curb. However, keeping the hose on the same side of the street as the hydrant is not always possible. If the supply line must cross the street, it should be done as close to the fire scene as possible. Crossing the street close to the scene minimizes the amount of traffic that may need to drive over the hose.

Driving Over Fire Hose

It is prohibited, and illegal, for smaller vehicles to drive over fire hose. The smaller vehicles have low clearance which can cause abrasion to the hose or expose the hose to the heat from the exhaust and the catalytic converter.

Driving over the fire hose with a fire engine or truck should only be done as a last resort. If you must drive over fire hose, avoid crossing the hose line within 3' of the coupling. The hose should only be crossed one wheel at a time on a 45-degree angle if the hose line is charged. Driving over fire hose can cause liner separation, a hose crease, abrasions and most notably, it creates severe pressure fluctuations. If a supply line is compromised because a line was driven over, it will eliminate the current water source and will cause a delay until a new water source is established. If a handheld attack or exposure line is driven over, it will cause severe pressure fluctuations at the nozzle, known as water hammer. Driving over a handheld attack line is very dangerous for the firefighter on the nozzle and should be avoided except in extreme emergencies.

Water Hammer

Water hammer is a surge of pressure caused when a high velocity flow of water is abruptly shut down or opened up. Water hammer is seven times the static pressure. In addition to driving over fire hose, water hammer can occur when the shut off butt is open or closed too quickly. Care should be taken by the firefighter operating the shut off butt to make slow controlled movements..

Kinks

Kinks in fire hose are a common occurrence and are usually the result of poor hose deployment. Every attempt should be made to remove kinks from hose lines. Not only will kinks restrict the flow of water and the nozzle pressure, but they can also damage the hose line. The pressure of water at the kink transfers from the filler strands to the weaker warp strands thereby making the hose line more susceptible to failure. Kinks may also create excessive friction to the rubber liner as the turbulent water and air pass over them, known as air burns.

The fire hose should be washed at the fire scene before being loaded back onto the apparatus to remove any materials that may damage the hose. Keep the hose covered when it is stored on the apparatus after use on the fire ground. Covering the fire hose prevents exposure to sunlight and the elements.

Hose Care at the Station

After hose has been used, the wet hose should be washed free of foreign materials and hung in the hose tower or on a hose rack to dry the wet lengths. Drying helps prevent the formation of mold on the hose. If hose is dried with the use of a hose rack, remember that direct sunlight can cause deterioration. Hose that is not placed back on the apparatus after drying should be rolled and stored in a dry area out of sunlight and away from hydrocarbons and other chemicals.

To prevent the swivels on couplings from binding, graphite powder should be inserted in the moving components and ball bearings. Graphite powder lubricates the moving components of the female coupling and makes both connecting and disconnecting sections of hose easier.

Hose Rotations & Inspections

Hose is rotated quarterly to increase its longevity. Quarterly hose rotations are an operational requirement. They help prevent the lengths of hose from becoming covered with mold and other foreign substances. Quarterly hose changes not only preserve construction integrity and enhance hose service life, but also ensure the safety of the personnel handling and working with each hose length.

Each quarter all hose, including 4", 3", 2 ½", 1 ¾", 1 ½" and 1", are to be removed, cleaned, inspected and reloaded on each engine, truck, or quint. Foreign debris, including mold, should be lightly scrubbed with a soft to medium bristled brush, and a mild liquid soap solution, such as dish soap. Minimize contaminated water run-off by following department guidelines for storm water containment.

To ensure even usage and wear, when reloading hose, reverse the order; the first length removed will be the first length loaded. Try to fold the hose in different positions to reduce the tube cracking and the chance of a permanent crease being created which cause stress points. When reloading hose it is recommended to roll the hose on the established crease into a donut roll and elevate it off the ground. This procedure helps prevent abrasions.

NFPA 1965 defines a master stream as a device used to deliver 350 gpm or greater

Hose Repair

Hose repair is done at Fire Station 20. The regular duty personnel at Station 20 handle all defective or questionable hose. If a length of hose is to be sent to Station 20, clean and drain the length. Mark where the defect is with chalk and wrap a rag around the damage. Roll the hose with the male coupling first to protect the threads. When the length of hose is tagged to be sent to Station 20, include a detailed description of the damage to the hose. Fire Station 20

Fire Hose Test Pressures

Type	*Size*	*Color*	*Acceptance Pressure*	*Service Pressure*
Booster	3/4" & 1"	Red	800 psi	400 psi
Single Jacket	1" & 1 1/2"	Yellow	600 psi	300 psi
Double Jacket	1 3/4", 2 1/2" or 4"	Yellow	600 psi	300 psi
Triple Jacket	2 1/2" or 3"	Blue or Green	1200 psi	600 psi
Hard Suction	4"	Black	300 psi	150 psi

personnel can shorten the length of hose by up to 10'; the minimum acceptable length would be 40' out of a 50' or 90' out of a 100' section of hose.

Hose Testing

The personnel from Station 20 conduct hose testing at Fire Station 19. They perform either the acceptance pressure test or the annual service test. The acceptance pressure test and inspection is done on all new hose to ensure compliance with specifications. Each length is tested individually. The acceptance test pressure is always double the annual service test pressure. The acceptance pressure test is performed for five minutes.

The annual service test is conducted on all hose following an annual schedule or after a length of hose is repaired. The purpose of the annual service test is to determine the serviceability of the hose. It subjects the hose to a predetermined pressure that is well above the normal working pressures experienced on the fire ground. All is hose is tested annually. The annual pressure test also lasts five minutes.

Nozzles

Figure 12-27 Combination or "Fog Nozzle"

A nozzle is defined as, a constricting appliance attached to the end of a fire hose or monitor to increase the water velocity and form a stream. (NFPA 1965) Nozzles come in many different sizes, shapes and have different applications based on the design. The two most common types of nozzles found in the fire service are the fog nozzle and the smooth bore nozzle.

Important factors in nozzle selection are nozzle pressure, flow, reach, stream shape and nozzle reaction.

Nozzle Pressure

Nozzle Pressure is the pressure required for effective nozzle operation and relates to flow and reach. Nozzles are designed to operate at a specific pressure, usually 50, 75, 80 or 100 psi. Nozzle pressure is measured in pounds per square inch or PSI.

Nozzle Flow

Nozzle flow is the amount of volume of water that a nozzle will provide at a given pressure. Flow is critical because the amount of water provided determines the amount of heat absorbed or cooled. Some nozzles only flow a set volume at a set pressure, while others can be adjusted manually or automatically. Flow is measured in gallons per minute or GPM.

Nozzle Reach

Nozzle reach is the distance the water will travel after leaving the nozzle. Greater reach is important in large rooms or during exterior fire operations. Reach is a function of the pressure, which is converted to velocity or speed, of the water leaving the nozzle. Reach is measured in feet. Reach can be affected by such factors as stream shape, water pressure, gravity and wind direction.

Maximum horizontal reach occurs at the nozzle being placed at 32 degrees, while maximum vertical reach is obtained at 65 to 70 degrees.

Stream Shape

Stream shape, also called stream pattern, is the arrangement or configuration of the droplets of water as they leave the nozzle. The shape of the water pattern helps determine the reach of the fire stream

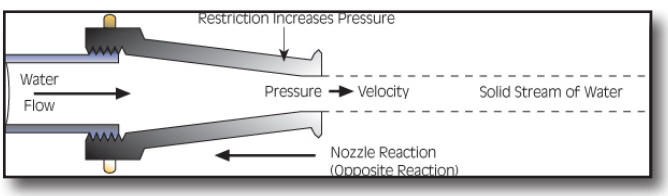


Figure 12-28 Nozzle Reaction

Nozzle Reaction

Nozzle reaction is the force of nature that makes the nozzle move in the opposite direction of the water flow. The nozzle operator must counteract

or fight the backward thrust exerted by the nozzle to maintain control of the nozzle and to direct it to the correct location. The nozzle pressure and stream shape affect nozzle reaction.

Combination Nozzle aka "Fog Nozzle"

A combination nozzle allows the firefighter to change the spray of the water from a wide cone pattern to a straight stream flow based on the needs of the incident. A combination nozzle, most commonly referred to as a fog nozzle by the SDFD, can be used for fighting structural, vehicle and wildland fires. Fog nozzles also have a feature which allows the firefighter to adjust the amount of water being discharged from the nozzle. In order to function properly, fog nozzles require a nozzle pressure of 100 psi.

Fog nozzles are also commonly referred to as "Select-O-Flow" & "Select-O-Stream" nozzles, referring to their ability to change stream pattern and nozzle flow.

Components of a Fog Nozzle

Stream bumper

The stream bumper is the rubber adjustable tip of the fog nozzle. By turning the stream bumper to the left, you will create and increase your fog pattern. By turning the stream bumper to the right, you will create a straight stream pattern. It is imperative that the firefighter understands this principal and knows at all times the position that their nozzle is in. Opening a nozzle in the incorrect stream pattern can cause serious burns and injury to firefighers.

Figure 12-29 Fog Nozzle

WARNING: On certain fog nozzles used by the SDFD, if the stream bumper is turned all the way to right past the point of straight stream, it will actually shut-off the stream flow. There have been several instances where firefighters have thought they had a water supply issue or kink, only to find the nozzle was in the incorrect position.

GPM bumper

The GPM bumper is the adjustable collar of the nozzle that is located just behind the stream bumper. The GPM bumper allows the user to select the amount of water flow coming from the nozzle in gallons per minute. In situations where not a lot of water is required to extinguish the fire or a water source is not available, a firefighter may lower the GPM setting on the nozzle to conserve water. Conversely, when making an interior attack on a fire or when large amounts of water is necessary, a firefighter may increase the GPM setting to the appropriate rate.

Figure 12-30 Shut-off Butt

Shut-off butt

The shutt-off butt is actually a separate component that attaches to the fog nozzle assembly. Since these two components are always used in conjunction with each other, we commonly refer to them both as a fog nozzle. The shut-off butt consists of a metal or plastic handle that attaches to a ball valve located

inside the waterway of the shut-off butt. By pushing the handle forward, the ball valve closes, stopping the flow of water. To open the nozzle, you simply pull back towards you on the handle. All opening and closing of nozzles should be done slowly and carefully to prevent water hammer and dangerous nozzle reaction.

Fog Stream Pattern

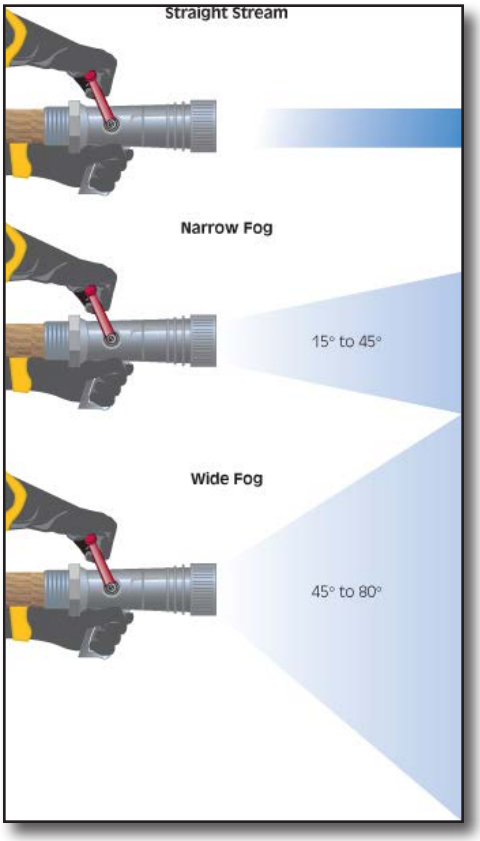


Figure 12-31 Nozzle Patterns

The main advantage to using a fog stream is that it provides immediate protection to firefighters from radiant and convective heat. Because the fog stream breaks the water into tiny droplets, it increases the ability for the water to absorb heat, thereby creating a protective heat shield. Fog streams are ideal for protecting exposures and people from heat.

The slogan, "Left for Life," is used to help firefighters remember that by turning the stream bumper to the left, you will create a fog pattern.

There are, however, several disadvantages of using fog streams. Fog streams do not have as much reach, or penetrating power, and are more affected by wind when compared to those of straight streams. This shorter reach makes fog streams less useful for outside, defensive fire fighting operations. When used to extinguish a fire inside a structure, the fog stream may disturb thermal layering, causing steam burns to firefighters, if applied incorrectly. Fog streams have also been know to intensify a fire by pushing air into an oxygen deficient atmosphere.

Straight Stream Pattern

A straight stream is a pattern of the adjustable fog nozzle (not to be confused with a solid stream which is discharged from a smoothebore nozzle) which combines the flow of water into one steady stream.

There are several advantages to using a straight stream pattern. In a straight stream, the water travels much farther, faster and has better penetration into the seat of the fire than that of a fog pattern. Wind also has less of an effect on a straight stream pattern when compared to a fog pattern. When fighting an interior fire, a straight stream pattern will reduce the amount of thermal layer disruption and minimize steam burns to firefighters.

The slogan "Right to Fight," is used to help firefighters remember that by turning the stream bumper to the right, you will create a straight stream which is most commonly used during a direct attack on a fire.

A disadvantage of the straight stream pattern compared to that of a fog pattern is that the firefighter will receive a more aggressive nozzle reaction, requiring a solid stance and firm grip. Additionally, a straight stream pattern creates less of a heat shield which can be used for protecting the firefighter. When com-

pared to a solid stream (covered in the next section) the straight stream is actually broken up as it goes through the fog nozzle then joined back together again as it discharges, Figure 12-32. This increase in turbulence and friction does not give you as effective of a straight stream as can be achieved with a solid stream through a smooth bore nozzle.

Solid Stream aka "Smooth Bore" Nozzles

Solid stream, or smooth bore nozzles, are used for structural and wildland firefighting. They deliver an unbroken or solid stream of water when exiting the hose line, allowing water to travel over a greater distance and deliver larger amounts of water with less water pressure than that of a fog nozzle. Smooth bore nozzles allow for lower resistance and turbulence, creating an effective stream. These nozzles are identified by the diameter of their discharge.

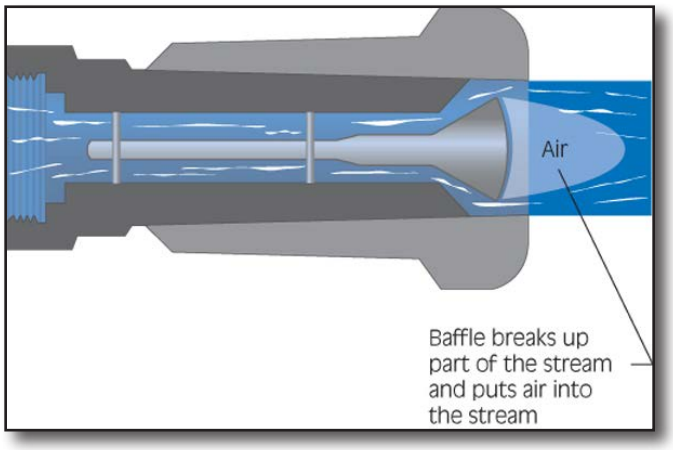


Figure 12-32 Straight Stream through a Fog Nozzle

A solid stream provides good penetration into burning or smoldering piles of materials. Smooth bore nozzles are more durable and easier to maintain than a fog nozzles and they contain less parts. Another significant advantage of a smooth bore nozzle is that they require a lower nozzle pressure to operate than a fog nozzle. Smooth bore nozzles that are 1 1/8" in diameter or less can be used as a hand line and only require 50 psi of nozzle pressure to deliver an effective stream. Nozzles 1 1/8" or larger in diameter can be used as a master stream and require 80 psi of nozzle pressure. A master stream requires the use of an appliance or other hose control device or method be utilized due to the high volume of water delivered (greater than 350 GPM). An 1 1/8" smooth bore nozzle can be utilized for either a hand line or a master stream.

The disadvantage to a smooth bore nozzle is that it lacks the option of quickly switching to a fog stream pattern for firefighter protection.

Parts of Straight Stream Nozzles

- Shutoff Butt
- Stream Straightener
- Tips

FOG Nozzles

1 1/2” Fog Nozzle

There are several types of 1 1/2” Adjustable Fog Nozzles used by the SDFD. The most common have the following GPM options with a 100 psi nozzle pressure:

30, 60, 95, 125 GPM

95, 125, 150, 200 GPM

150, 175, 200, 250 GPM

1 1/2” Phantom Hi-Rise Fog Nozzle

Elkhart Phantom Hi--Rise Fog Nozzle is found on both Hi-Rise Hose Packs and has been painted orange for easy identification. This nozzle only requires a 75 psi nozzle pressure and has the following GPM options:

30, 95, 125, 150, 200 GPM

Monitor Mounted Fog Nozzle

This nozzle is used on the Deck Gun, Portable Monitor, or Ladder Pipe for master stream operations. It is designed to be pumped at a nozzle pressure of 100 psi and has the following GPM options:

500, 750, 1000, 1250 GPM

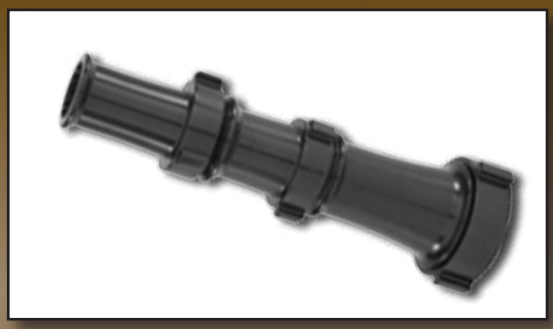
1” Pistol Grip Fog Nozzle

This lower flow GPM nozzle is commonly found on small diameter hose such as the booster reel. It is designed to be pumped at a nozzle pressure of 100 psi and typically has the following GPM options:

20, 40, 60 GPM

Smooth Bore Nozzles

Stacked Tips



Stacked tips are smooth bore nozzles that can be unscrewed to reveal a larger diameter nozzle. Stacked tips used for SDFD start at 1 3/8", however, other agencies may utilize stack tips starting at 1 1/4" in size.

Tip Size	*GPM*	*Nozzle Pressure*
1"	210	50 psi
1 1/8"	270	50 psi
1 1/4"	330/400	50/80 psi
1 3/8"	500	80 psi
1 1/2"	600	80 psi
1 3/4"	800	80 psi
2"	1100	80 psi

Wildland Tips

Tip Size	*GPM*	*Nozzle Pressure*
3/16"	7	50 psi
1/4"	13	50 psi
3/8"	30	50 psi
1/2"	50	50 psi

7/8" Slug Tip

The Elkhart 7/8" slug tip nozzle is used in conjunction with the Phantom Fog Nozzle on both Hi-Rise Hose Packs. It gives firefigthers a back up option for situations where low nozzle pressure is an issue. The Slug Tip will flow 160 GPM @ 50psi

Smooth Bore Nozzle - Highrise Standpipe Kit

A smooth bore nozzle with stacked tips and a pistol grip shut off butt can be found inside the highrise standpipe kit. The sizes of the smooth bore stacked tips are: 1" , 1 1/8" , 1 1/4".

More information on the Highrise Standpipe Kit found in Chapter 31 - Highrise Firefighting

Special Purpose Nozzles

Special purpose nozzles have been developed for use in limited types of situations and are not commonly used. However, firefighters should know when and how to use them when called upon.

Foam Nozzle

Foam nozzles are designed to fit over the rubber stream bumper of a combination nozzle. The foam nozzle has an opening in itself to allow for the induction of air to aerate the foam.

Compressed Air Foam Nozzle

The compressed air foam nozzle is simply a 7/8" or 1 1/8" smooth bore nozzle.

Cellar Nozzle

Cellar nozzles are used to fight localized fires in basements, cellars, or other confined spaces where firefighters are unable to make a direct attack on the fire. The cellar nozzle has four spray nozzles that are designed to rotate in a circular spray pattern when discharging water.

Piercing Nozzle

Piercing nozzles were originally designed to penetrate the skin of aircraft but have most recently been modified to pierce through the buildings walls, floors and roof. Some have striking points that allow them to be driven through the material.

Nozzle Care & Maintenance

Fog nozzles have many moving parts made with both plastic and metal components that can be easily damaged if care is not taken. There are several things a firefighter can do to ensure that the nozzles remain in good working condition and will extend their service life.

- Do not drop, throw or drive over any nozzle or shut-off butt.
- Do not place the nozzle in dirt or other debris.
- Open/close the nozzles slowly. Some nozzles bails have developed stress cracks and broken from rigorous use.
- Nozzles and fittings should be washed with a brush, mild soap and water periodically and after each use to keep the moving components free of debris.
- Inspect the fins of the fog nozzle to ensure that they spin freely and are not broken.
- Lubricate the swivels with graphite powder and moving parts with silicone

Hose Appliances

NFPA 1965 defines a hose appliances as a piece of hardware (excluding nozzles) generally intended for the connection to fire hose to control or convey water.

Wye

A wye allows for one hoseline to split into two hoselines. It consists of one female coupling and two male outlets and is most commonly found in the 2 1/2" size.

Gated Wye

A gated wye allows for one hoseline to split into two hoselines with the added ability to close or open the male discharges. A typical gated wye will split one 2 1/2" hoseline into two 1 1/2" outlets.

Siamese

A siamese allows for two hoselines to combine into one hoseline. It consists of two female couplings and one male outlet. Siamese' are most commonly found in the 2 1/2" size and used to increase supply line pressure.

Triamese

Similar to a siamese, a triamese allows for three hoselines to combine into one hoseline. It consists of three female couplings and one male outlet. Triamese' are typically 2 1/2" in size and used to increase supply line pressure. Triamese have become less common since the introduction of 4 inch hose.

Hose Appliances Cont.

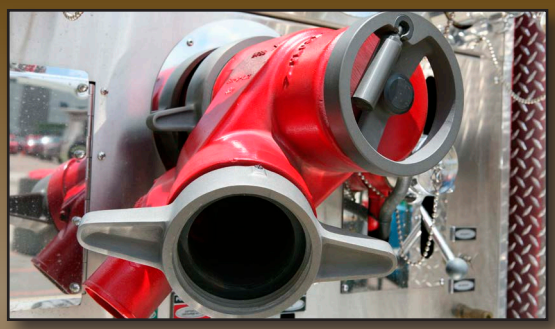
Shut Off Butts

Shut off butts allow users to quickly open and close the water flow from their hose line A ball valve joint connected to the bail (handle) on the shutoff butt allows the water to flow. Come in the following sizes: 1", 1 1/2" and 2 1/2".

Gate Valves

A gate valves is essentially a shut-off butt used on large diameter hose. Because of the increased water flow in large hose, a handle must be rotated which slowly lowers a gate to stop and start the flow of water. Typically used to supply water to a ladder pipe using 4" hose.

Intake Relief Valves



A 4" intake valve that is attached to the fire pump. The valve is opened by rotating a wheeled handle. The intake valve has an air bleeder and an adjustable spring loaded relief valve which will discharge excessive water pressures, protecting the pump from damage.

Foam Eductor & Proportioner

Designed to draw up foam concentrate and mix it with water to the desired proportions. The Venturi Effect causes foam concentrate to automatically draw up the down tube and mix with water as it passes through the proportioner.

Hose Appliances Cont.

Play Pipe

The play pipe is an appliance used to assist the firefighter with handling the 2 1/2" hoseline with a smooth bore nozzle. Some playpipes come with a shut-off butt built in, such as in this picture, and others require a shut-off butt to be attached.

Elbow

These 30 degree elbows are used for larger diamter hose and help prevent kinks as well as ease the pressure on the fittings where the hose attaches to the apparatus. They are commonly found pre-attached on truck companies for ladder pipe evolutions.

In-Line Pressure Gauge

The inline pressure gauge is becoming more common as a front line firefighting tool. It is most useful during highrise firefighitng operations when the connection to an FDC has been made. This guage informs the firefighter of the disharge pressure on their floor level and will assist them if adjustments to the PRV need to be made.

Hose Strainer

Hose strainers are used on hard suction hose during drafting operations. The strainer prevents damage to the pump by keeping out foreign debris that may inadvertantly be drawn in from the water source.

Master Stream Appliances

NFPA 1965 defines a master stream appliance as a non-handheld water applicator capable of flowing over 350 gallons of water per minute.

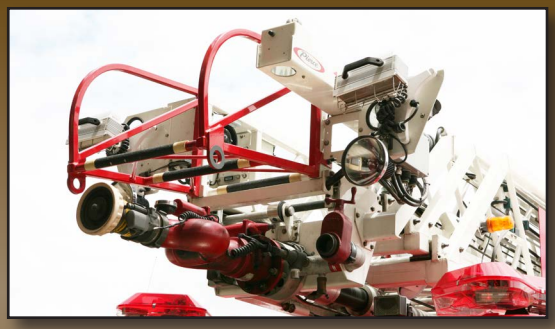
Deck Gun

A permanently mounted master stream device that is pre-plumbed directly to the fire pump. Located on the top of engine companies, it can accomodate a fog or smooth bore nozzle tip.

Ground Monitor & Stand

A portable master stream device that requires large diameter supply lines. Typically, the deck gun is removed from the engine company and placed onto a portable monitor stand. Can accomodate a fog or smooth bore nozzle tip.

Ladder Pipe



A permanently attached master stream device with a pre-plumbed waterway on an aerial device. Can accomodate a fog or smooth bore nozzle tip and can be controlled remotely from the ladder turntable. Newer ladder pipe appliances have an additional 2 1/2" gated outlet that can be utilized as an external standpipe.

Stream Straightener

Because water has a tendancy to rotate or spin when it flows through certain appliances under pressure, the stream straightener is used to decresase this. It's purpose is to keep the nozzle stream intact on master stream appliances and is placed just behind the nozzle onto the appliance itself.

Hose Fittings

A hose fitting is a simplified appliance that is primarily used for connecting different size hose diameters and thread types.

Double Male

A hose fitting with two male ends. Used for connecting two female couplings together.

Double Female

A hose fitting with two female couplings. Used for connecting two male ends together.

Increaser

A fitting which has a female end that is smaller than the male end. Used to connect hoselines of different diameters. Since water typically flows in through a female coupling and out of a male coupling, it is said to increase the hose diameter for water flow.

Reducer

A fitting which has a male end that is smaller than the female end. Used to connect hoselines of different diameters. Since water typically flows in through a female coupling and out of a male coupling, it is said to decrease the hose diameter for water flow.

Hose Fittings (Continuued)

A hose fitting is a simplified appliance that is primarily used for connecting different size hose diameters and thread types.

Hose Cap

These caps are typically found on the plumbing of the pump panel or standpipe outlets and used to protect against potential damage to the threads.

Hose Plug

These plugs are typically found on the plumbing of the pump panel or standpipe inlets and used to protect the plumbing from damage and foreign debris entering the system.

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spray or a light weight oil.

- Ensure that the nozzle gaskets are present and not dried out or cracked
- Ensure that the stream bumper and GPM bumper moves freely

Hose Tools

Hydrant Spanner

This hydrant spanner is adjustable and used to open and shut the stem valve on a fire hydrant as well as to tighten the large diameter hose coupling to the hydrant.

Large Spanner

This spanner wrench is used for large diameter hose couplings and applianes.

Pocket Spanner

The pocket spanner is required to be carried by all firefighters. This simple tool has several uses: It can tighten & loosen couplings, pry, open a hydrant cap or valve, shut-off utilities and even be used as a hammer and door chock.

Rocker, Pin, & Recessed Eye Spanner

These specialized spanners are used for the different types of lugs that may be encountered on fire hose.

Hose Tools (Continuued)

Hose Clamp

Hose clamps come in many sizes. However, the SDFD only uses the wildland hose clamp, which works for single jacket hose up to 1 1/2” in diameter.

Rubber Mallet

Rubber mallets are typically used for tightening or loosening large fittings and couplings.

Foam Wrench

This specially designed wrench is used to open the large plastic cap on 5 gallon class “A’ foam buckets. Because the cap is held to the container by plastic tabs, the wrench is required to initially break the seal to the foam.

Hose Strap

Hose straps can be used as an alternative to the utility webbing that is carried by all firefighters. This is typically used to pull and secure hose for when a hose line is up a ladder or a stairwell. The hook on the handle can then be secured to the ladder rung or stairwell railing.

Hose Tools (Continuued)

Wire Brush

The wire brush is used with water for cleaning couplings, threads, fittings, and appliances .

Graphite Powder

Graphite powder is a dry lubricating powder that can be applied to fittings, couplings, swivels and nozzles. The dry powder is preferred over the lubricating sprays because it does not attract dust or debris.

Hose Roller

Hose rollers can be attached to railings, roof lines or other obstacles where a sharp bend in the hose may occur. The hose roller prevents kinking, hose damage, and allows the hose to be pulled around the obstacle with less effort.

Wildland Hose Roller

Wildland Hose Rollers allow for the quick rolling and assembly of 1 1/2” single jacket hose for the I-Zone Hose Pack. These hose rollers are carried on all brush apparatus.

Appliance and Fitting Maintenance

Appliances & fittings, like all fire ground equipment, should be treated with care and be well maintained. Although appliances and fittings are quite durable and made from metal, if mistreated or not maintained, failure can occur with devastating results. The following is a list of things a firefighter should do to extend the life of this equipment and keep it in safe working order.

- Appliances and fittings should be washed with a brush, mild soap and water periodically, and after each use, to keep the moving components free of debris.
- Avoid placing appliances and fittings in dirt, mud or other areas of loose debris.
- Graphite powder should be used to lubricate the female coupling swivels.
- Light weight oil or silicone lubricant should be used to lubricate ball valves and bail joints.
- For ladder pipes, deck guns and ground monitors, apply lubricating grease to appropriate zuric fittings.
- Lubricate the fixed waterway of a ladder pipe with ATF monthly, and after each use where water was flowing.
- Protect the threads of the male couplings when not connected.
- Periodically, and after each use, inspect the fittings and appliances for thread damage, cracks, missing gaskets, broken handles and functionability.

Summary

A good working knowledge of firefighting equipment is essential for all firefighters. This holds especially true for fire hose, nozzles and fittings. Understanding how fire hose, nozzles and fittings work allows a firefighter to diagnose any problems encountered and better care for and maintain the equipment. Most importantly, a solid working knowledge of fire hose, nozzles and fittings allows the firefighter to know what options are available to them to quickly knock down a fire or troubleshoot how to overcome any situation that may be placed in front of them on the fire ground. In addition to understanding the verbiage, usage and components of fire hose, nozzles and fittings, it is critical to actually use them. Get out there and put your hands on them!

Media & Link Index

 I Zone Hose Pack Deployment and Assembly

 I Zone Hose Pack Hose Roller

 Bulletin 09-081, May 18, 2009, Wildland Hose Packs

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NOTE: If you have any additional information or content that you feel would be appropriate to contribute to this Chapter or would like to report any errors or misrepresentations, please contact the SDFD Training Division or email the Drill Manual Revision Staff at

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Revisions/Updates

Date	*Revision/Update Description*
May 2020	Added images and info regarding smooth bore stacked tip hand held nozzle found in highrise standpipe kit
May 2020	Revised hydraulics/nozzle pressures for 1 1/8’ and 1 1/4” smooth bore stacked tips per SDFD Training Bulletin 20-01