

Module 8: Water Use

Topic 1: Introduction

Module introduction

Narration Script: Water can be a good friend on the fireline, and you'll want to take care of that precious commodity and use it wisely. You may have to bring the water to the scene of the fire yourself using a backpack pump. Or, water or agents may be available from an engine or from another water source by way of a portable pump. In that case, you'll be using hoses and nozzles to attack the flames.

Hoses can make fire fighting easier, but you'll need to be proficient at simple and progressive hose lays. And your choice of nozzle to put on the end of that hose will vary according to the fire environment you're facing. If you're thinking there's a lot to learn about spraying water or foam on a fire, you're right. That's why it calls for an entire water delivery system.

Module overview

Spraying water or *foam* on a fire may seem like one of the more fun parts of wildland fire fighting.

However, before the water comes out of the hose, there are some basics you'll need to be familiar with, including the:

- **“Ins” and “outs” of backpack pumps**
- **Tools of the trade—hose, nozzles, and hose-related equipment**
- **Types of *hose lays*—simple and *progressive***
- **Hand signals specific to water use**
- **Types of *fire streams*—fog and straight**
- **Hose and equipment maintenance**

Narration Script: Water, water everywhere—well, that's not exactly true on the fireline. During a wildland fire incident, you won't have tons of water to spread around. The smart firefighter knows where and how to use each component of the water delivery system.

Topic 2: Backpack Pump

Backpack pumps introduction

Backpack pumps are a form of portable fire extinguisher. They can carry plain water or a foam and water solution. You'll use backpack pumps to attack small fires and *hot spots*, perform *mop-up*, and to *overhaul* areas that are beyond reach of hoselines. Though not as common, some areas may use manually pressurized backpack pumps that permit pressurization of the tank vessel.

In this topic, we'll cover backpack pump basics, including:

- Components
- Use
- Safety
- Field maintenance

Narration Script: Backpack pumps are a common piece of suppression equipment you will see on wildland rigs and assigned to wildland crews. For increased effectiveness, use them in conjunction with other firefighters using hand tools.

Backpack tanks

Most collapsible backpack tanks carry 5 gal. (20 l) of water and consist of a rubber or neoprene bladder.

One slightly different design is a collapsible bladder-type unit you wear as a vest rather than on your back. Because the weight is more evenly distributed with the vest design than with the backpack design, the vest type units may carry up to 8 gal. (32 l) of water.

Collapsible backpacks are usually stored empty.

Backpack tank parts

In addition to the collapsible tank, backpack tanks are made up of the following parts:

- Shoulder straps with clips
- Filler cap
- Flexible hose
- Suction check valve
- Trombone pump—includes combination nozzle with washer, handle, adjusting nut, and barrel
- Trombone clip
- Ball-in-check valve

Narration Script: Knowing the right names for the parts on your backpack tank will keep you talking the same language as your fellow firefighters. Calling your trombone pump anything else just sends a sour note.

Backpack tank use

Now that you are familiar with the parts and pieces of the backpack pump, turn your attention to how to use it.

When you are ready to use the pump, start by working the trombone in and out to prime the pump. Then with good footing and stance, continue to slide the piston pump in the nozzle to discharge water. A stream of water will discharge each time you move the pump handle out and then back in.

You can change the nozzle tip to produce a fog or a straight *stream*. Direct your stream in a swinging motion parallel to the fire's *perimeter* and at the base of the flame.

Narration Script: Backpack pumps discharge water when you operate a sliding piston pump in the nozzle. A stream of water will discharge each time you move the pump handle out and then back in.

Backpack tank safety

The water inside a full 5-gal. (20-L) backpack pump weighs about 45 lb. (20 kg)—if you don't handle it safely, you could end up with a back injury. Therefore, when using your backpack pump, follow these safety steps:

- Lift with your legs and keep your back straight
- Adjust the carrying straps to your body frame
- Do not climb over obstacles or run

Also, to keep the unit working properly, fill the tank with clean water only. Muddy water will plug the water passages.

Narration Script: You know the old saying, "Put your back into it"? Well, that's exactly what you DON'T want to do when lifting your backpack pump. Avoid pain at the pump by learning to lift and use the backpack pump correctly.

Lubrication and field maintenance

Keep the trombone pump lubricated with powdered graphite or non-oil-based lubricant. Never use oil or grease for this purpose as it will collect dirt and grime.

Also, if your backpack pump stops working properly, on-site repairs may be necessary, including:

- Checking for adequate water in the tank
- Removing any blockages at the bottom outlet and the nozzle tip

- **Disconnecting the hose from the tank and pump assembly and removing any blockages inside the hose**
- **Making sure the ball-in-check valve is not stuck in the open or closed position**

Knowledge Check 1

Multiple choice—check the box of the answer(s) you choose.

Can you carry that backpack tank load?

Identify THREE steps to follow when putting on or using a backpack pump.

**Lift with your legs and keep your back straight
Conserve water by spraying at a specific spot
Adjust the carrying straps to your body frame
Do not climb over obstacles or run
Fill the tank with water from any available source**

The correct answers are lift with your legs and keep your back straight, adjust the carrying straps to your body frame, and do not climb over obstacles or run.

Topic conclusion

Your backpack pump is one handy tool. This portable extinguisher can tackle small fires and hot spots, perform mop-up, and overhaul areas beyond the reach of hoselines. It can even carry a foam and water solution in addition to plain water.

Like all tools, it helps to know the basics, including:

- **Components**
- **Use**
- **Safety**
- **Field maintenance**

Pack up this knowledge, and get ready for the next topic.

Topic 3: Water Delivery Systems

Fire hose, nozzles, and related equipment

As a wildland firefighter, you may have to work with various types of water delivery systems. These systems may use engines or draw water from other water sources, such as ponds or streams.

Here are the types of equipment you will get familiar with in this topic:

- Fire hose
- Nozzles
- Hose-related equipment

Narration Script: If you've gone through the modules of this course in order, you've learned about everything from preparedness to hand tools. But by now you may be asking when *do we get to spray water?* The answer is now. As you know, wildland response calls for a variety of fire hoses, nozzles, and hose-related equipment. We'll introduce you to some of the most common types, but be sure to get familiar with the hose, nozzles, and equipment your agency uses.

Fire hose

Depending on your region or area, the term *forestry hose* may describe various types of lined and unlined fire hose. You will use hose to deliver water from a water source to the fire.

Four main categories of fire hose used for wildland fire fighting operations are:

- Noncollapsible rubber hose
- Jacketed, lined fire hose
- Unlined fire hose
- Hard suction hose

You will investigate each of the fire hoses and their uses in turn.

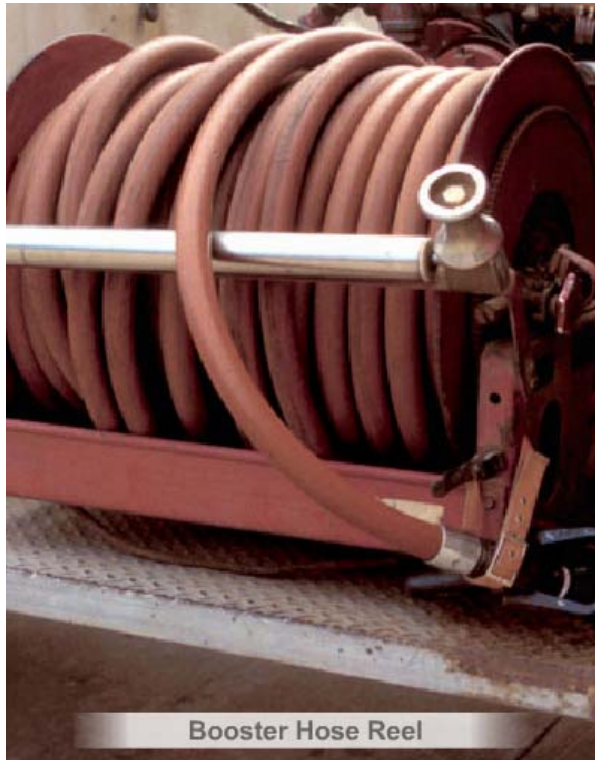
Narration Script: You may use numerous sizes and types of fire hose during the course of a wildland fire. The size and type of fire hose used by your department depends on the types of fires experienced most often and the tactics used by the department.

Noncollapsible rubber hose

Noncollapsible rubber hose is more commonly referred to as *booster hose*, *hard line*, or *high-pressure hose*. You'll use this rubber-covered hose for *mobile attack* on very low-intensity fires and for *mop-up*.

Of course, fires of greater intensity require larger hoselines. Make sure there is adequate water flow to match the intensity and size of the fire.

Narration Script: Booster line is useful for mobile attacks on very low-intensity fires and for mop-up. You'll need better and larger hose for heavy fire fighting. Think, "go big or go home."



Caption: Typical example of noncollapsible rubber hose, also known as booster hose.

Noncollapsible rubber hose characteristics

Let's look at the long and short of noncollapsible rubber hose. The characteristics of this hose type are:

Length

Sections of booster hose are coupled in 100- to 200-ft. (30- to 60-m) lengths wound on a reel mounted somewhere on your apparatus. Your wildland fire apparatus may have a 6- to 20-ft. (2- to 6-m) section attached directly to a discharge for pump-and-roll (mobile attack) operations and for use as a protection line.

Diameter

You most commonly find booster hose in 3/4- and 1-in. (19- and 25-mm) diameters.

Water Delivery

Because of its relatively small diameter and high friction loss, booster hose can only deliver a limited quantity of water. Generally, expect flows of less than 30 gpm (120 l/min) from booster lines.

Jacketed, lined fire hose

Cotton-synthetic jacketed rubber lined (CSJRL) hose, also known as jacketed, lined fire hose, is intended for heavy fire fighting. It consists of an internal rubber waterway protected on the outside by a single or double layer of a woven fabric or an external rubber covering.

The most common diameters of this type of hose used for wildland applications are:

- 1 in. (25 mm)
- 1 1/2 in. (38 mm)
- 1 3/4 in. (45 mm)
- 2 in. (50 mm)
- 2 1/2 in. (65 mm)

The vast majority of wildland hose in the United States are lightweight versions of jacketed, rubber-lined fire hose designed specifically for wildland fire fighting. Lightweight single-jacketed hose and lined wildland fire hose are available in 1- and 1 1/2-in. (25- and 38-mm) sizes.

Narration Script: Intended for heavy fire fighting, the jacketed, lined fire hose is the same as that used for structural fire fighting operations. However, in wildland fire fighting, you will probably use a lightweight version.



Caption: A cross section of a jacketed, lined rubber hose.

Unlined fire hose

Use linen or unlined fire hose for fires in very *light fuels*. Unlined hose, also referred to as *weeping hose*, is made of a woven linen fabric. The weave allows some of the water to weep

through to the outside to seal and protect the hose against heat and flames during fire attack.

Some departments prefer unlined hose because it is less expensive than lined hose as well as very lightweight and compact. However, because this hose *is* unlined, it is less durable than lined hose and is more vulnerable to puncture.

Here are some characteristics of unlined hoses:

Length

Unlined hose is most often available in 50- to 100-ft. (15- to 30-m) lengths.

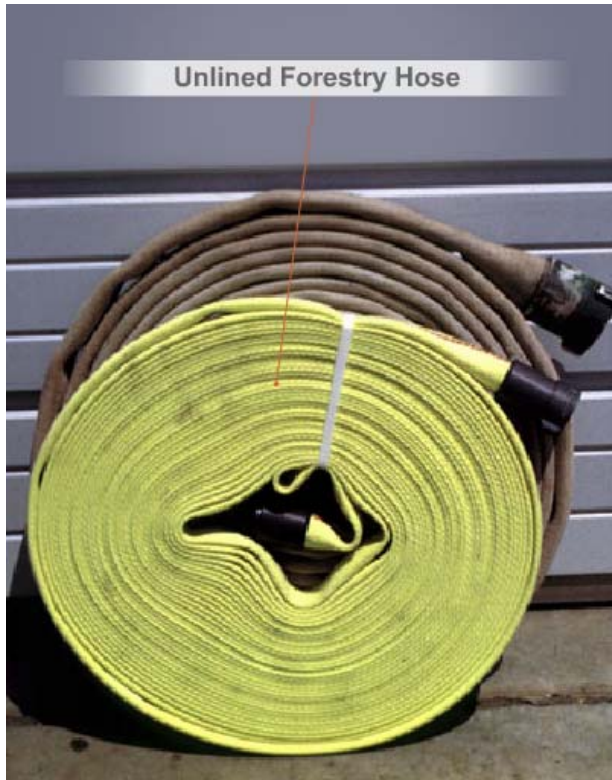
Diameter

Unlined hose is available in these diameters:

- 3/4 in. (19 mm)
- 1 in. (25 mm)
- 1 1/2 in. (38 mm)

Weight

A single firefighter can carry 300 to 400 ft. (90 to 120 m) of unlined hose in a relatively small package. This is especially important when you must hike long distances carrying hose *and* pumps to reach fires in remote locations.



Caption: An example of a reel of unlined fire hose.

Hard suction hose

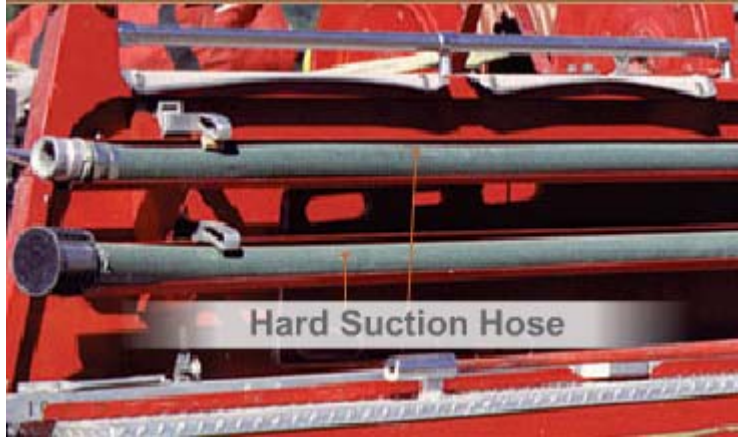
Use hard suction hose (standard or lightweight) for *drafting* water from an auxiliary water source such as a pond, stream, lake, or swimming pool. You may use hard suction hose with a *portable fire pump* or a fire engine.

This hose is designed to be rigid and noncollapsible because it must withstand a partial vacuum during drafting operations.

Hard suction hose used on portable fire pumps is usually in these diameters:

- 1 in. (25 mm)
- 1 1/2 in. (38 mm)
- 2 in. (50 mm)
- 2 1/2 in. (65 mm)

Narration Script: If you have a pond, stream, lake, or swimming pool nearby, hard suction hose is the tool of choice for drafting. Its rigidity allows it to withstand the partial vacuum needed to lift water from a source below the pump.



Caption: An example of hard suction hose stored on the side of an engine.

Garden hose

Although your agency may also carry garden hose (pencil hose) and appropriate adapters on the wildland *apparatus*, they are rarely used for general fire use. Garden hose is most commonly either 1/2 or 5/8 in. (13 or 16 mm) in diameter, and you can expect flows of less than 10 gpm (40 l/min). If necessary, garden hose should be reserved for very sparse fuels or for mop-up.

Garden hoses are less than ideal choices for most wildland *incidents* because:

- They have difficulty maintaining standard working pressure.
- The quality of garden hoses varies widely.
- When a garden hose is pressurized, a “scissor-like” condition occurs increasing the diameter, shortening the hose significantly, and potentially causing coupling failure.
- The shortening effect on the pressurized hose can also damage hose reels.

Narration Script: Before you became a wildland firefighter, the only hose you probably knew of was a garden-variety garden hose. But garden hoses rarely perform well as standard fire fighting equipment. You have better options. Still, garden hoses can be used by residents to put out any embers that land on roofs or wooden decks.



Caption: A fire fighter mopping up using a garden hose.

Knowledge Check 2

Matching—select the match you choose from the pull down list.

Let's see if your hose knowledge is better than garden variety.

Match each hose type with its function.

Noncollapsible rubber hose

Jacketed, lined fire hose

Garden hose

Unlined fire hose

Hard suction hose

The correct matches are as follows:

Noncollapsible rubber hose: For mobile attack on very low-intensity fires and for mop-up

Jacketed, lined fire hose: For use in heavy fire fighting

Garden hose: For sparse fuels and mop-up

Unlined fire hose: For use in very light fuel fires

Hard suction hose: For drafting water from an auxiliary water source

Nozzles

Of course, a hose is just a hose without a nozzle. You may use a variety of nozzles to control water distribution during a wildland incident. These include nozzles specifically designed for:

- **Standard structural fire fighting**

- *Wildland fire suppression*

Any nozzle used for attacking an active wildland fire should be able to produce a protective fog pattern for protecting the firefighters involved in the attack.

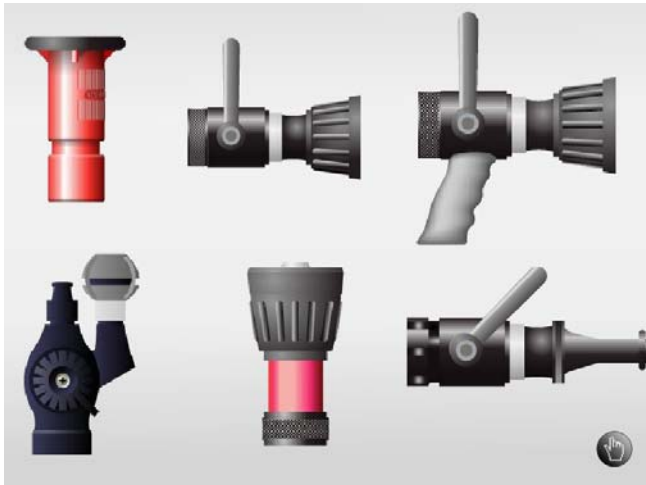
Safety Equipment Warning! Whenever operating pumps or nozzles, you must wear the following safety equipment in addition to your normal wildland personal protective equipment (PPE):

- Ear plugs—when operating pumps
- Eye protection—when operating nozzles

Narration Script: You commonly use structural fire nozzles when you bring your structural fire apparatus to a wildland fire attack. However, some wildland fire apparatus are equipped with structural-type nozzles, and structural engines are often equipped with wildland-type nozzles.

Nozzle types

Like a street-side watch salesman with a slew of watches inside of his jacket, we too can uncover some wildland nozzles and related gadgets. Our figurative hose salesman will tell you all about them.



Caption: An example of six nozzles that will be discussed in turn.

Examples of nozzles with application to wildland fire fighting include:

- Plastic forestry nozzle
- Adjustable fog nozzle with bale shutoff
- Adjustable fog nozzle with pistol grip
- Combination forester nozzle
- Dual gallonage combo nozzle
- Solid-stream nozzle

Read along as the nozzle salesman gives a rundown of his nozzles.

Plastic Forestry Nozzle

This is my most inexpensive nozzle in the wildland. It has a simple barrel design where you turn the nozzle on or off and select the discharge pattern by twisting the barrel. However, you have to readjust the nozzle each time you open it.

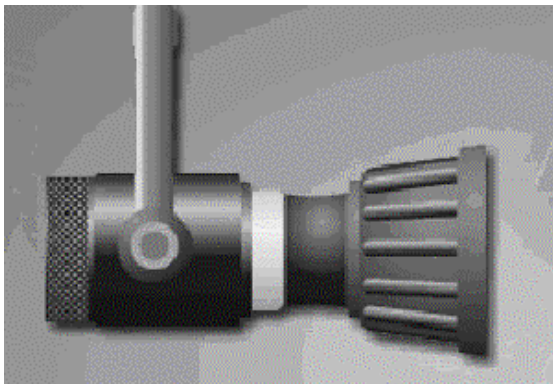


Caption: A typical plastic forestry nozzle.

Adjustable Fog Nozzle with Bale Shutoff

This is my structural fire fighting standby. With the bale shutoff, you can open and close it more quickly than those with twist-type shutoffs, increasing your safety and saving water. With this nozzle, you can adjust both the rate of flow and the discharge pattern as you need. It's good for applying water, wet water, or foam solution.

As an added bonus, once you select a discharge pattern and flow rate, this nozzle will produce the same flow rate and pattern automatically each time you open it. So, you don't have to readjust it as you would with twist-type nozzles.

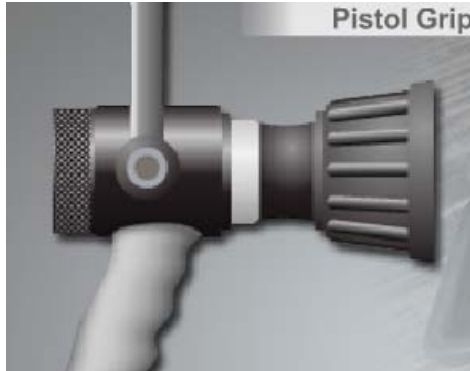


Caption: An example of an adjustable fog nozzle with bale shutoff.

Adjustable Fog Nozzle with Pistol Grip

Now this baby has the same advantages as the nozzle with the bale shutoff, but it's my deluxe version with a pistol grip. Pistol grips give you better control of the nozzle and more leverage when you're pulling hose. Better control and greater leverage are especially useful when you're developing a progressive hose lay and a mobile attack isn't possible.

Back at the shop, I have some other pistol grips that are designed for you to place between the nozzle and the hose. The downside to those pistol grips is that they may not be practical for all types of hose packs.



Caption: A typical adjustable fog nozzle with pistol grip.

Combination Forester Nozzle

This is my combination forester nozzle—or twin tip as I often call it. It comes with different tips for both orifices for changing the flow rates to fit the needs of the situation. It has two separate discharge orifices—one is a solid stream, and the other produces a spray pattern. Depending on how you position the shutoff control handle:

- The nozzle directs water through the solid-stream orifice.
- The nozzle directs water through the spray-stream orifice.
- No water flows at all.

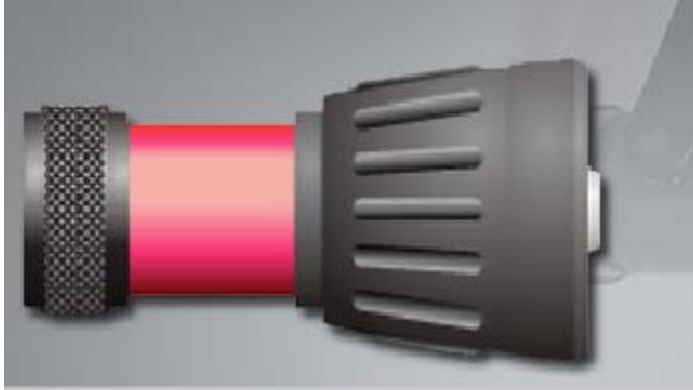
The downside of the twin tip is that it provides very low flow, and the spray orifice doesn't produce an effective water screen to protect you in case of a blowup. So here's my advice—because of its limited output, use this nozzle for mop-up only, *not* for wildland fire attack.



Caption: A typical combination forester nozzle.

Dual Gallonage Combo Nozzle

Oh here's a good one. It's called a dual gallonage combo nozzle. I carry this one specifically for wildland use. You can get it in 1-in. (25-mm) and 1 1/2-in. (38-mm) sizes. With this nozzle, you can produce anywhere from a straight stream to a wide-angle fog pattern, and it delivers a wide range of gallons per minute. It's great for attacking wildland fires.



Caption: A typical dual gallonage combo nozzle.

Solid-Stream Nozzle

And this is my solid-stream nozzle, the one to choose when you are using a compressed air foam system (CAFS). You're a smart firefighter, and you know you can apply compressed air foam with an adjustable fog nozzle. But with that solid-stream nozzle you've got there, you'll get the greatest amount of reach and accuracy with a CAFS.



Caption: A typical solid-stream nozzle.

Special Narration Script (Watch Salesman): Psst. Hey! Buddy! Over here! You wanna buy a nozzle? I got some quality merchandise here. They'll help you put the wet stuff on the red stuff. And today only, have I got a deal for you!

Regular Narration Script: Different nozzles perform different functions. Some are best at delivering foam. Others are better at protecting you in case of a flare-up. Take a peek at all the nozzles this "watch salesman" is trying to get you interested in! I think you'll find that even though he sounds a little shady, he really has your best interests at heart!

Knowledge Check 3

Multiple choice—check the box of the answer(s) you choose.

Each nozzle has a primary purpose or specialty.

Identify a nozzle to reserve for mop-up only and *not* for wildland fire attack.

- Plastic forestry nozzle
- Adjustable fog nozzle
- Combination forester nozzle
- Dual gallonage combo nozzle
- Solid-stream nozzle

The correct answer is combination forester nozzle.

Hose-related equipment

Ah, so now our nozzle salesman has dragged you back to his shop. You are about to be reminded that in addition to fire hoses and nozzles, you need a variety of other types of equipment to place *fire streams* in service at a wildland fire.

Some of these are very similar to the hose equipment you'll find on structural fire engines. Sometimes you'll carry this equipment in what some call a *brass bag*.

Read the following to get adapted to each piece of hose-related equipment.

Double-Male Adapters

Here's something every firefighter worth his, or her, weight has got to have. Use double-male adapters (connectors) to join two female ends.



Caption: An example of a double-male adapter.

Double-Female Adapters

Use double-female adapters (connectors) to join a couple of male ends.



Caption: An example of a double-female adapter.

Reducers/Inceasers

This here is your typical reducer. Use reducers and increasers to join different sized hoses.



Caption: An example of a reducer/increaser.

Different Thread Adapters

This is an adapter for connecting hose with different threads. The three most common threads used for wildland fire purposes are:

- **National hose (NH)—a coarser thread than National pipe straight hose (NPSH), commonly found in 1 1/2- to 3-in. (38- to 75-mm) hose**
- **NPSH—a finer thread than NH, commonly found in 1-in. (25-mm) forestry hose**
- **Garden hose (GHT)**



Caption: An example of a different thread adapter.

Quarter-Turn to Threads Adapters

A smart firefighter like you would use this very useful adapter for connecting quarter-turn couplings to those with threads.



Caption: An example of a quarter-turn to threads adapter.

Typical Forestry Hose Clamps

When you have to stop the flow of water through a hose, hose clamps are what you need. Be aware that hose clamps for wildland applications are a lot smaller than those typically used in structure fire fighting.



Caption: An example of a typical forestry hose clamp.

Gated Wyes

For those times when you need to divide one hoseline into two hoselines of equal or smaller diameter, you better get yourself one of these gated wyes.



Caption: An example of a gated wye.

Siamese

Some people might think a Siamese is a kind of cat, but a sharp firefighter like you knows it is used to merge two hoselines into one hoseline of equal or larger diameter. You better take one of these with you today.



Caption: An example of a Siamese connector.

Narration Script: No two hoses are alike, so you may need additional equipment to join unlike hose together, split one hoseline into two, or even stop the flow of water through a hose. Let the friend you met previously give you a tour of items in his shop.

Wildland-specific hose-related equipment

Besides the common types of hose equipment you just saw, there are other types peculiar to wildland fire fighting operations, including:

- **Hoseline tee**
- **Hoseline pressure relief valve**
- **Check and bleeder valve**
- **Water ejector**
- **Foot valve**

You will learn about each piece of the hose-related equipment in turn.

Narration Script: You've just learned about a lot of hose equipment; but wait, there's more. Continue your tour of the nozzle and gizmo shop by looking at several types peculiar to wildland fire fighting operations.

Hoseline tee

The *hoseline tee* is a device placed between sections of a main 1 1/2-in. (38-mm) hose to extend a 1-in. (25-mm) hoseline laterally off the main. The tee may be equipped with a shutoff valve to control the flow of water into the lateral discharge. There are also smaller tees allowing you to extend a garden hose laterally from a 1-in. (25-mm) supply hose.



Caption: A hoseline tee.

Hoseline pressure relief valves

A hoseline pressure relief valve is a spring-loaded, adjustable valve placed between the pump and the discharge hose. It bypasses water and relieves sudden line surges automatically to permit use of shutoff nozzles.

They are used on 1 1/2-in. (38-mm) hoselines being supplied by *positive-displacement pumps*, but you may also use them with *centrifugal pumps*.

If you have a kinked hose, or you abruptly close the shutoff valve, a hoseline pressure relief valve relieves the resulting line surges and excessive pressure on the pump. The pressure at which the relief valve functions can vary from 50 to 200 psi (350 to 1,400 kPa), and you manually adjust it at the valve.



Caption: A hoseline pressure relief valve.

Check and bleeder valve

You will find check and bleeder valves useful for controlling water flow on portable pumps. Attach this combination valve to the discharge on a portable pump supplying 1 1/2-in. (38-mm) hoselines.

A spring check valve serves two purposes:

- **Primarily, it prevents back pressure created when you have a long upslope *hose lay*. Such back pressure could prevent you from restarting the pump after shutting down for refueling.**
- **It keeps water from flowing *out* of the pump before you get the pump motor started. Once the motor is running, open the bleeder valve until the pump develops normal operating pressure.**

The check and bleeder valve also contains a 1-in. (25-mm) discharge similar to what you use on a tee.



Caption: A typical check and bleeder valve.

Water ejector

If you cannot use a water source to draft from because it is too far below the level of the pump, such as on lifts of greater than 18 to 20 ft. (5.5 to 6 m), or if the distance between the water source and the pump is too great, you may use a water ejector.

Use a water ejector:

- **When drafting from deep cisterns or from comparatively high bridges**
- **When you cannot place the engine close enough to the water to be within reach of the hard suction**

In such cases, the ejector can operate several hose lengths away from the engine. However, you need sufficient water in the tank to start the process, as you'll find in the next section.

Narration Script: A water ejector is a clever device that allows you to pump water from your tank through a static water source and then refill the tank at twice your pumping rate. Sound too good to be true? Well, we'll talk about when and why you might use it before we get into the magic of how it works.



Caption: A water ejector.

Water ejector operation

Here's how a water ejector works:

- The ejector is placed in the *static water source* with one end connected to a pump discharge and the other to a tank fill or pump intake.
- Water pumped from the engine to the ejector passes through a restriction (*venturi*) that increases the velocity of the stream.
- The partial vacuum created within the device draws some of the surrounding water into the ejector.
- The combined flow, which is greater than that being pumped by the engine, is discharged under low pressure back into the tank.
- A water ejector's low-pressure stream allows your water tank to be filled at twice the rate of output from the engine.

Foot valve

The foot valve is a spring-loaded clapper valve that prevents water from running out the end of the suction hose as you are *priming* the pump or when the pump is temporarily turned off.

Place foot valves on the end of a hard suction hose you are using to draft from a static water source. Most foot valves are equipped with a strainer that prevents large pieces of debris from being drawn into the pump.



Caption: A typical foot valve.

Other hose accessories

Hold on—we’re not quite done with accessories yet. Here are a few more you should know about:

- Washers and gaskets
- Spanner wrenches
- Hose clamps

Read the following to learn more about each accessory.

Washers and Gaskets

If you’ve ever had a dripping faucet, you probably already know what a washer is. That slim bit of soft rubber fits into the female end of the hose and keeps water or foam from leaking out.

For wildland purposes, gaskets are used in the female ends of adapters, reducers, increasers, connectors, caps, or other pieces of equipment to provide a tighter, more complete seal. The tricky part is that the outside diameter (OD) of gaskets has never been standardized and depends entirely on the width of the gasket seat in the hose bowl. Check with your agency or organization about the right gaskets for your equipment.



Caption: Examples of washers and gaskets.

Spanner Wrenches

Spanner wrenches are used to loosen or tighten hose connections. They come in a variety of sizes and shapes and are often designed to fit several hose connection combinations—rocker, slotted, or pin lugs. Combination wrenches are available to handle both hydrant stems and spanner lugs.



Caption: Examples of spanner wrenches.

Hose Clamps

As the name implies, a hose clamp abruptly stops the flow of water through the hose. The hose clamp allows you to shut off the water—even if that water is under hydrostatic pressure—and all without damaging the hose. Hose clamps are lightweight so you can carry them in your hip pocket or attached to a belt loop.



Caption: A typical hose clamp.

Knowledge Check 4

Matching—select the match you choose from the pull down list.

Will you be able to match these correctly, or will you get hosed?

Match each piece of equipment with the correct description.

Noncollapsible rubber hose

Weeping hose

Forester nozzle

Gated wye

Siamese

The correct matches are as follows:

Noncollapsible rubber hose: Commonly referred to as booster hose

Weeping hose: An unlined fire hose

Forester nozzle: Has two separate discharge orifices

Gated wye: Divides one hoseline into two hoselines

Siamese: Merges two hoselines into one hoseline

Water delivery summary

In this topic, you gained a familiarity with the water delivery system components you will use in wildland fire fighting, including:

- **Fire hose—there are weeping hoses, hoses connecting to other hoses to grow in size to meet the demands of a growing fire, and hoses allowing you to draft water from a pond or lake**
- **Nozzles—the nozzle you put on the end of your hose may be able to spray foam as well as water and shift from a straight stream to a fog pattern**
- **Hose-related equipment—the equipment in your brass bag will help you make the proper connection**

Your water delivery system is just that—a system, with each part and accessory having an important role.

Narration Script: A water delivery system knits together hoses, nozzles, and their accessories. Every device—even down to a washer—serves a purpose of fire management and crew protection.

Topic 4: Water Delivery and Hose Maintenance

Topic introduction

When you roll out a hose to put a damper on a fire, you also have to roll out an array of knowledge about hoses and water use, and that's what we're going to cover in this topic.

We'll take a closer look at:

- **Principles of water use**
- **Types of *hose lays***
- **Hand signals**
- **Types of *fire streams***
- **Hose care and maintenance**

Get started unrolling some hose and rolling up some knowledge.

Narration Script: Are you champing at the bit to start spraying water? Yes, applying water to a fire can be one of the more exciting parts of wildland fire fighting. But before plunging ahead, let's cover some basics so you won't be all wet on the fireline.

Principles of water use

Before we get into specific hose lay techniques, investigate these "golden rules" of wildland water use. Keep these in mind and you won't go far wrong:

- **Planning and safety**
- **Water conservation**
- **Spray technique**

Read the following for a bunch of good details about each golden rule.

Planning and Safety

Make sure your attack teams are safe and well supplied including normal personal protective equipment (PPE). Do:

- **Provide eye protection for nozzle operators**
- **Provide ear plugs for pump operators**
- **Maintain good communications between nozzle personnel and water-source personnel**
- **Coordinate so that all units do not run out of water at the same time during critical periods**
- **Plan for ample water supply in advance, including possible use of water tenders**
- **Reserve the last 100 gal. (400 l) of water for firefighter and engine protection**

Water Conservation

Water is often like gold on the fireline. Do:

- Use water sparingly, especially when it is in short supply
- Shut off nozzles while traveling between hot spots
- Use hand tools in conjunction with water application methods to ensure effective water use, especially during mop-up operations
- Use foam or other wetting agents whenever possible
- Shorten discharge times when using Class A foam

Spray Technique

Beyond putting out the fire, good technique will also conserve water and increase firefighter safety. Do:

- Spray at the base of the flame (at what is burning)
- Avoid scattering burning fuel with the hose stream
- Apply water as close to the burning fuel as possible to reduce wasteful overspray, but use the stream reach when needed to reduce the threat from radiant heat
- Saturate down to mineral soil by proper stream selection and flow setting
- Maintain correct pressure for the nozzle being used

Hose lay introduction

Now we'll talk specifics about creating hose lays in the wildland environment. You might use these lays for *direct attack*, *indirect attack*, or *structure protection*. Each incident dictates its own unique response.

Look at the types of hose you might use in these lays, including their pluses and minuses:

- Booster line
- Small diameter
- Large diameter

Read the following to learn more about each type of hose.

Booster Line

Use a booster line (hard line) to attack small, very low-intensity fires or for mop-up. Because friction loss in a booster line is high, it delivers a relatively limited volume of water. Do not use booster line for hose lays of more than a few hundred feet long.

Small Diameter Hose

To provide adequate personnel protection, larger attack lines may incorporate valved tees to facilitate lateral extension with smaller hose such as 3/4-in. or 1-inch (19 or 25 mm) forestry hose. These smaller hoselines are fine for mop-up within the black. Small hoselines

create too much friction loss and may not deliver enough water to be safe and effective for fire attack. However, 1-in. (25-mm) hose *is* often used in long wildland hose lays because it is relatively light, compact, and easy to carry.

Large Diameter Hose

On actively burning wildland fires or where long hose lays are needed, use at least 1 1/2-in. (38-mm) attack hose to minimize friction loss and deliver maximum volume. Hoselines must deliver enough water (in gallons per minute or liters per minute) to absorb the heat generated by the fire and protect you in case of a flare-up.

Narration Script: With the background we've given you, you can now look at hose lay issues particular to wildland fire fighting. As we get into specific hose lay techniques, here's a tip for you: it's a good idea to put a few sticks of larger diameter hose at the beginning of the lay to reduce your friction loss. Drop back to smaller hose only when you really need to.

Unrolling hose

The first step in a hose lay is to unroll the hose in an organized way with the right end of the hose pointing toward the fire.

Follow these tips and you'll stay organized:

- **Remove and store any ties securing the hose. The ties can be string, rubber bands, or some other material. Keep these ties handy so you can use them again after re-rolling the hose**
- **Unroll the hose so that the female end always points toward the water source and the male end points toward the fire**

Narration Script: One of the most common duties you'll perform is rolling and unrolling a fire hose. Once at the scene of a wildland fire, deploy the hose quickly without getting all tangled up.

Restricting water flow

From time to time during hose lays, you will restrict water flow through the line. Water is a precious commodity on the fireline, and conservation is key. To restrict water flow, use a hose clamp or turn off the nozzle or use a gated wye.

When using a hose clamp, place it on the hose at least 18 in. (46 cm) from any coupling and crimp down on the hose. Open the nozzle after the hose is clamped off to relieve any pressure.

Hose lay types

In case you don't already know, hose lays are lengths of hose and accessories laid from a pump and extending to a point of delivery.

There are two types of hose lays:

- Simple
- Progressive

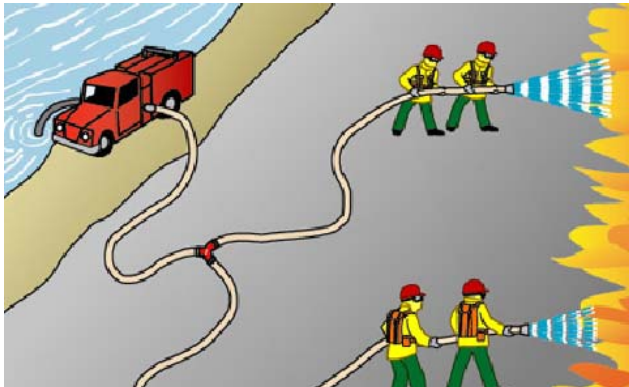
You will learn more about both of the hose lays in turn.

Narration Script: Hose lays are made up of connected lengths of fire hose and accessories. The lays come in two flavors: simple and progressive. Be sure you have all the necessary equipment on hand or on order before you start either of these lays.

Simple hose lay

A simple hose lay comprises lengths of hose connected together to reach the fire. The nozzle at the end of the hose regulates water flow and application.

Study the graphic to find some of the significant components of a simple hose lay.



Caption: An example of a simple hose lay.

Progressive hose lays

A *progressive hose lay* is primarily used for a quick attack on the fire and always starts from a secure anchor point. Progressive hose lays have some big advantages:

- Fast, aggressive attack
- Your engine stays on the road

To maintain a continuous water supply for progressive hose lays, consider having additional *water tenders*. A progressive hose lay normally requires you to run along and attach hose from a pack carried on your back or slung over a shoulder.

Hose Packs

While hose packs vary from department to department, most contain:

- Two 100-ft. (30-m) lengths of 1 1/2-in. (38-mm) hose
- Lightweight couplings
- One hoseline tee with a 1 1/2- by 1-in. (38- by 25-mm) valved male branch

Typical hose packs include a 100-ft. (30 m) length of 1-in. (25-mm) forestry hose; others keep the 1-in. (25-mm) hose on their engines until needed for mop-up.

Narration Script: In the backcountry, you'll see progressive hose lays all the time. We'll describe a lay in action in a moment, but first you should know where you're getting your hose. In this case, you're schlepping it yourself!

Making a progressive hose lay

To make a progressive hose lay:

- 1—Fully extend the *preconnect* (original length of hose)
- 2—Shut the nozzle
- 3—Clamp the hose
- 4—Remove the nozzle
- 5—Attach an additional length of hose (install a *hoseline tee*, if needed)
- 6—Attach a nozzle to the new length of hose
- 7—Release the hose clamp
- 8—Repeat!

If you want to prepare for the real deal, train with a group of three. You should be able to extend 600 ft. (180 m) of 1 1/2 in. (3.8 cm) hose in about eight minutes while wetting down the fire edge or creating a *wet line*.

Narration Script: Progressive hose lays require coordination and teamwork. Let's assume you are part of the attack team working the nozzle on the original length of hose. While you are doing that, another firefighter prepares the next stick for the lay.

Once you fully extend the original length of hose and use the stream to your maximum advantage to reach as far ahead as you can, then the steps for a progressive hose lay begin. Start by shutting the nozzle. Next, clamp the hose using a lightweight wildland clamp, and bleed any residual pressure before removing the nozzle. Attach an additional length of hose. Throw in a valved water thief if you're going to be performing mop-up or might need to protect the lay. Attach the nozzle to the new length of hose, release the hose clamp, and you're good to go for another hundred feet or so of attack.

All this while, you may need additional personnel to pull hose, extinguish hot spots, and to help with mop up. Repeat the process until the fire is contained, you run out of hose, or you reach the limits of your pump.

Progressive hose lay considerations

Some key points to remember about progressive hose lays are described as follows.

Tactics and Personnel

- **Deploy from the green to avoid hose damage**
- **Normally, start the hose lay at the heel of the fire, attacking the most active flank**
- **Under fire conditions, assume two to five minutes per 100 ft. (30 m) of 1 1/2-in. (38-mm) line for deployment depending on fuel and terrain**
- **Use a minimum of nine personnel for progressive hose lays more than 1,000 ft. (300 m) in length**

Water Supply and Equipment

- **Make sure you have sufficient hose and appliances *before* you begin the lay**
- **When pumping uphill, choose the engine with the greatest pressure pumping capability**
- **Use pumping engines with the largest booster tanks, when possible**
- **Consider the availability of additional engines or tenders to maintain continuous water supply**

Laterals

As you extend attack lines around the perimeter of a fire, you may connect 1-in. (25-mm) lateral lines to the hoseline tees. Working in the black, you will use laterals primarily for mop-up, but you can also use them to protect the attack line from minor flare-ups.

Laterals can be as long as 300 ft. (90 m), but 200 ft. (60 m) is recommended. Especially when working in the black, do not allow the forestry hose to contact flames or glowing embers because this hose will quickly burn through and fail.

Knowledge Check 5

Sequencing—select the number from the pull down list to put the items in the correct sequence.

You've got a 600-ft. (183-m) fire perimeter resulting from a dropped cigarette butt next to the highway. You need to do a progressive hose lay and begin a flank attack.

Place the steps to complete a progressive hose lay in the correct order.

Attach nozzle
Attach additional hose
Clamp hose
Remove nozzle
Attack with preconnect
Release hose clamp
Shut nozzle

The correct order is as follows:

Attack with preconnect
Shut nozzle
Clamp hose
Remove nozzle
Attach additional hose
Attach nozzle
Release hose clamp

Hand signals

For safety reasons, hose line *crews* and nozzle operators must be able to communicate with the pump operator. Usually this is done by using portable radios.

If you cannot maintain radio communication with the pump operator, be aware of the hand signals to use:

- **Four hand signals indicate how much water is in a tank.**
- **Three signals tell the pump operator to start the water flowing to the nozzle, or to change the water pressure.**
- **Three signals indicate more hose is needed, the hose is broken, or the hose can be rolled up.**
- **One signal indicates the operation can be shut down.**

You can view the hand signals in the Incident Response Pocket Guide (IRPG) available in the resources accompanying this course.

Narration Script: When radio communication with the pump operator isn't possible, use these hand signals. You can refer to these hand signals in the field by looking in the IRPG.

Fire stream patterns

You have to be flexible on the fireline, and that goes for how you spray water, too. By switching nozzles or nozzle settings, you can shift from one stream pattern to the other to fit a changing wildfire incident.

The two main patterns you will use during a wildland incident are:

- Straight streams
- Fog streams

You will read about each different stream in turn.

Narration Script: You have extended the hose line to the fire's edge, and now it is time to use your nozzle properly. Do you know how? We'll describe the basics of using straight streams and fog streams here.

Straight stream

Straight stream can effectively knock down flames so you can get closer to the fire edge.

A straight stream uses a lot of water, but it is the best spray method when:

- You need better reach, especially in high winds.
- The fire is too hot to get close.
- The fire is confined to a small area.
- A lot of pressure is needed to reach some distance.
- Burning materials cannot be reached with fog or spray.
- Hand crews are digging out hot roots or beds during *mop-up*.

Narration Script: You'll use more water with a straight stream than with a fog stream. Keep that point in mind when conserving water is a must. Still, a straight stream can effectively knock down flames so you can get closer to the fire edge.



Caption: An example of straight stream use.

Fog streams

The water-conserving fog or spray is a good choice when you can work close to the fire or when the fire covers a large area.

Use fog streams for these fire situations:

- *Hotspotting*
- **Building a wet line**
- **Direct attack**
- **Mop-up**

Narration Script: The fog spray pattern does a good job of protecting you while putting a damper on a fire, and it conserves precious water supplies, too.



Caption: An example of fog stream use.

Applying water

Using both straight and fog streams, there's a logical approach to spraying water.

Follow these steps, and you'll keep your cool on the fireline:

- **Start with a straight stream to knock down flames if you can't get close to the fire**
- **Turn and direct the fog spray parallel to the edge at the base of the flames**
- **Knock down the fire before proceeding**
- **Keep an eye out for *flare-ups* along the extinguished edge**
- **Follow up water with a mechanized or hand line as soon as possible, especially in *heavy fuels***
- **Aim accurately and use a sweeping motion**
- **Apply water intermittently to conserve water**
- **Watch the pressure—besides wasting water, high-pressure streams deliver air as well as water, and the air could fan the flame**

Narration Script: You have two weapons in your arsenal—straight streams and fog streams. However, applying water on a fire requires more than a “point and shoot” approach. Take aim

and follow the solid tactics listed here for delivering water. But know this—if you knock down the fire edge with water only, the fire may come back to life if not completely extinguished. For this reason, accompany your water use with assistance from heavy equipment or from other firefighters with hand tools.

Knowledge Check 6

Multiple choice—check the box of the answer(s) you choose.

Identify **THREE** fire situations when fog streams are a good choice.

- The fire is hot and you're having trouble getting near the fire edge.**
- You've been assigned to mop-up duties.**
- A lot of pressure is needed to reach any distance.**
- You're in the middle of a direct attack.**
- Hot roots or beds must be dug out during mop-up.**
- Water conservation is a must.**

The correct answers are you've been assigned to mop-up duties, you're in the middle of a direct attack, and water conservation is a must.

Hose hazards

Just like you, hoses also face hazards on the fireline. Protect your hose from all of these potential hazards:

- **Burn damage**
- **Cuts from sharp rocks**
- **Damage from vehicle roll-overs in traffic areas**
- **Tool damage from inadvertent tool strikes or by placing hose on sharp tools**
- **Damage near the hose attachment to the reel hub due to improper rolling**

But by using proper retrieval and cleaning methods—and a good measure of common sense—you can protect fire hoses so they can protect you. This is where we are heading in this discussion.

Narration Script: You've seen how to deploy hoses and use your nozzles effectively. You also need to be aware of how to prevent hose damage. Hoses may be indispensable, but they're not indestructible—neither are they cheap! Your hose requires some care and feeding to keep it in good working order. Know the hazards to protect your hose from.

Retrieving hoses

What you unroll, eventually you must re-roll. Rolling the hose properly will protect exposed threads. Use your agency's method for rolling hose—the watermelon, firefighters' carry, or figure eight method.

Follow these steps, and you'll bring it on home—the hose, that is:

- **Replace protective caps on accessories and male hose ends**
- **Be sure female ends have the correct gasket size**
- **Drain water from hose as you roll**

Narration Script: After taming the fire, it's time to retrieve hose, and the hose line may be hundreds of feet long. You may be fatigued, but it's no time to drop form. Carefully retrieving the hose will protect fittings and other accessories and ensure lines are ready for the next incident. Get the hands-on training you need for rolling up hose according to your agency's standard practice.

Defective hoses

While you are rolling up your hose, take time to look for these or any other defects established in your agency's standards:

- **Damaged threads**
- **Inoperative valves**
- **Holes in hose**

Mark each defective item for easy identification and replacement.

Narration Script: When rolling up the hose, take a few moments to look for defects. If you spot damage, remove the hose or accessory from use, and alert your supervisor so the equipment can be quickly repaired or replaced.

Knowledge Check 7

Multiple choice—check the box of the answer(s) you choose.

Identify THREE hazards to protect your hose from.

- Progressive hose lays**
- Sharp rocks and tools**
- Fire streams**
- Vehicles**
- Foam**
- Burns**

The correct answers are burns, sharp rocks and tools, and vehicles.

Summary

Spraying water may be one of the more exciting parts of wildland fire fighting, but it's a learned skill.

Before you aim and shoot, make sure you have these knowledge areas and skills at the ready:

- **Principles of water use**
- **Steps for unrolling and rolling hose**
- **Steps for restricting water flow**
- **Types of hose lays**
- **Hand signals to communicate effectively**
- **Straight streams and fog streams**
- **Protecting your hose lines**
- **Signs of hose wear and tear**

Narration Script: Knowledge is power, and on the fireline your knowledge of hoses and water use will preserve your hose and vital equipment and fight the fire. That's pretty powerful stuff.