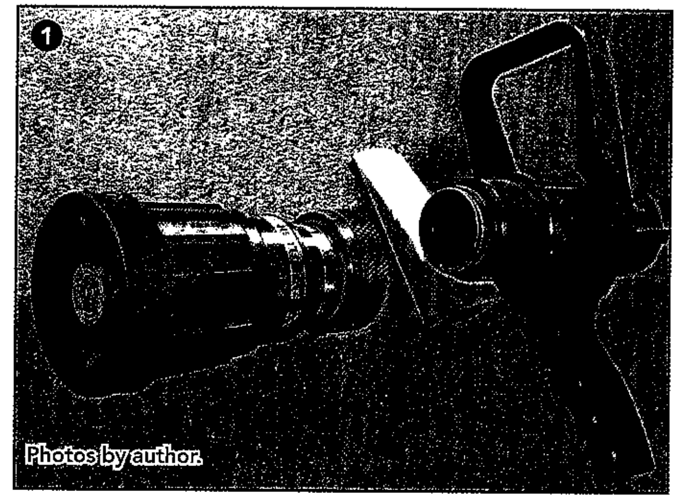
Improving Preconnect Function and Operation

BY BOB SHOVALD



Photos by author.

THE 1¾-INCH PRECONNECT IS THE MAINSTAY OF THE modern fire service. For most jurisdictions around the country, it is the initial attack line pulled for up to 80 to 90 percent of our fires. There are a multitude of hoselay configurations, such as preconnected lengths of 200, 150, and 100 feet, which can be combined with a large variety of accessories and nozzle styles. This allows the engine company more flexibility than ever before to fine-tune, customize, and make its 1¾-inch preconnects work harder and more efficiently.

At the Coeur d'Alene (ID) Fire Department, we use crosslay preconnects and have two 200-foot 1¾-inch crosslays and one 100-foot 1¾-inch line (configured as a crosslay on some engines, as a front bumper line on others). The 100-foot line is also called a "trashline"; it is used for nuisance fires, grass fires, and occasionally vehicle fires.

Our primary interior attack line is the 200-foot 1¾-inch line. We once had three 1¾-inch preconnects: 200, 150, and 100 feet. We changed this when we realized that a backup team using the 150-foot line could come up short when protecting the initial attack team using the 200-foot line—not a good plan when you are protecting your fellow firefighters.

The preconnects not equipped with solid stream nozzles had automatic combination nozzles. We used a flat load with pull loops on both sides with the nozzle on top of the stack, which allowed us to pull the lines from both sides of the apparatus. But this design often left a pile of hose at the side of the apparatus, which the pump operator had to help flake out. It did not allow for easy stretching around obstacles, and we depended on the pump operator to supply the correct pressure when it was unclear how many gallons per minute (gpm) the automatic nozzle was actually delivering.

Since we had a new engine on the way and we needed new nozzles, it was a good time to reexamine our crosslays and the equipment used with them.

1¾-INCH VS. 1½-INCH HOSE

Years ago, 1½-inch hose worked fine and is still a good choice for wildland fires. However, there are some key reasons to choose 1¾-inch over 1½-inch hose for interior attack preconnects. Primarily, it all comes down to one important factor, gallons per minute (gpm). Using 95- and 125-gpm attack lines is outdated and dangerous. Consider the following factors:

- Because of the huge increase in the use of synthetic materials in modern homes and businesses, including foams, plastics, vinyl, and volatile coatings, we are now experiencing fires with higher rates of release than ever before.
- Because of the high cost of energy, more homes and businesses have improved insulation. In a fire, this seals that increased heat inside the structure.
- As a result of more effective fire prevention programs, we arrive on-scene much sooner than in years past, in large part thanks to inexpensive smoke detectors.

What this all adds up to is that we are getting on-scene

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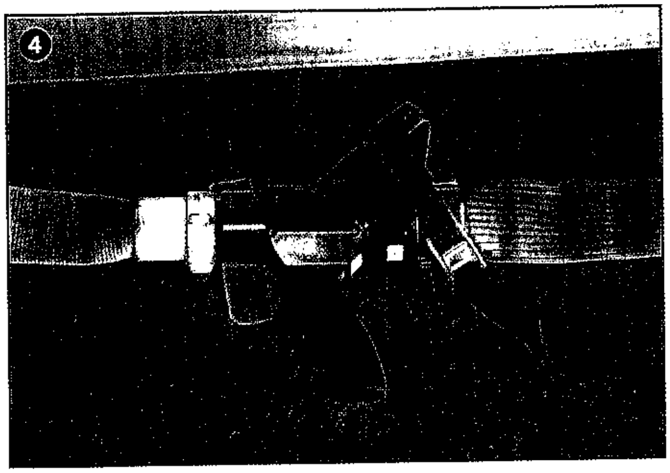

sooner to hotter, more aggressive fires, often just before flashover conditions or self-ventilation. To fight the beast, today we need a bigger gun with bigger bullets—i.e., providing greater gpm and thus more water faster at the start of our interior attacks. The gpm—not the pressure and not the steam—kill the beast.

In the case of 1¾-inch vs. 1½-inch hose, it all boils down to friction loss. Because of the hotter fires we experience today, the minimum flow for any interior attack line should be no less than 150 gpm. When comparing a 200-foot, 1½-inch attack line flowing 150 gpm, we have a friction loss of around 108 pounds per square inch (psi) in the line.[1] Add this to the 100 psi required for a standard combination/fog nozzle, and you have a pump panel pressure of 208 psi. The 1¾-inch attack line will have a 72-psi friction loss and a pump panel discharge of 172 psi with the same nozzle. With

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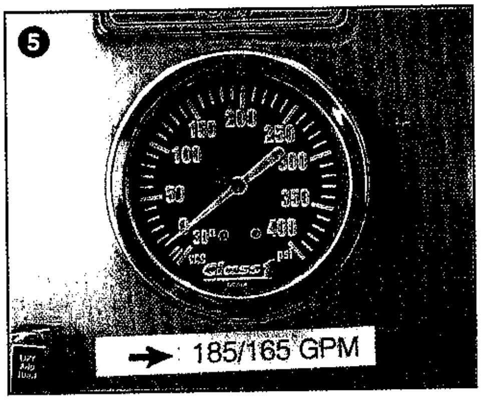
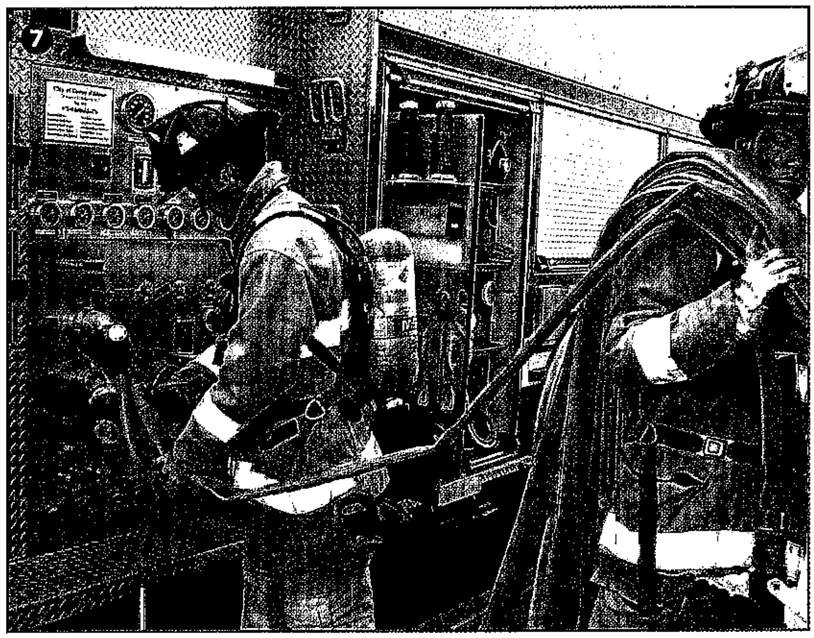


such high hoseline pressures, handling the attack line can feel like moving a 25-foot-long 2 × 4 around inside the structure.



NOZZLES

Our department had identified nozzles as one of our problem areas since we had two different operating pressures, solid stream nozzles operating at 50 psi nozzle pressure (NP) and the automatic combination nozzles operating at 100 psi NP. Additionally, flow tests of our automatic nozzles produced several failures because of insufficient flow. We found several of these nozzles flowed well below 100 gpm at 100 psi NP even though the reach and pattern looked fine. I highly recommend annual flow testing of combination nozzles, especially if you use an automatic design.

In our department, as well as in many other departments across the country, the Great Debate centers around solid stream vs. combination/fog nozzle. We have about a 50/50 split on this issue. If anyone wants to stir things up, introducing this topic will do the job! It was one of the issues we wanted to try to address if possible. Other goals were to reduce stress and fatigue on the nozzle team; to establish a minimum of at least 150 gpm for interior attack lines; and to select a lightweight, user-friendly nozzle package—no small task!

We started with research. We found that reaction force of a nozzle at 100 psi NP had a reaction force of roughly half of its gpm. Likewise, we found that a nozzle at 50 psi NP had a reaction force of one-third of its gpm. Example: A combination nozzle flowing 150 gpm at 100 psi NP has a reaction force of 76 pounds.[2] Compare this with a combination nozzle flowing 150 gpm but now at 50 psi NP; the reaction force drops to 53 pounds. This is a 30-percent decrease in reaction force, a big difference when operating the nozzle for any length of time. We felt that this was significant enough to test the new low-pressure/high-volume combination/fog nozzles.

One concern we had with low-pressure nozzles was line kinking. After extensive testing with several nozzle brands and different tips, we found that kinking of the attack line using a low-pressure/high-volume nozzle was negligible. For our testing, we considered 150 gpm and greater flows as high volume. We selected break-apart nozzles with a built-in 15⁄16-inch formed solid stream waterway or slug tip. The nozzle tip is threaded, allowing attachment of a combination/fog tip. The combination tip we use is a fixed-gallonage type rated at 150 gpm at 50 psi (photos 1, 2). This is a lightweight, simple, user-friendly nozzle designed to flow a specific rate at a specific pressure with no springs or dials. This is as simple as a combination/fog nozzle gets.

The 50-psi operating pressure also allows the pump operator to operate either the combination or solid stream at the same nozzle pressure. This went a long way in helping to at least quiet the Great Debate, since the combination/fog tip can be quickly removed from the nozzle, leaving the 15⁄16-inch solid stream.

We also found some other benefits of the break-apart nozzle design. With the combination tip removed, a medium foam expansion device can be quickly attached to the nozzle without shutting down the line (photo 3). A 1½-inch wildland hose can also be rapidly extended from a deployed preconnect without shutting down (photo 4). This can be beneficial on an initial attack of a fast-moving wildland fire.

With our nozzle style selected, we now needed to determine how best to pump the new style nozzles to take full advantage of their design.

Even though both solid stream and combination tips operate at 50 psi NP, they have different flow rates. The solid stream flows at 185 gpm, the combination tip at 150 gpm. Friction loss formulas are a good place to start in determining correct pump panel discharge pressure; however, they do not take into account the friction loss behind the pump panel caused by bends, turns, and swivels that add to the overall friction loss. To ensure that we would be delivering the desired gpm at the nozzle, we used a flowmeter to verify the flow. With the preconnects stretched to full length, we flowed the lines with the solid stream first. When 185 gpm was reached, we marked the discharge gauge with a reflective red arrow decal.

Next, we installed the combination tip and reflowed the line until we reached the same pressure as previously marked on the gauge. In our case, we found we were flowing 165 gpm with the combination tip, well above the 150 gpm we had set as a minimum. We also found that when operating an engine with a pressure governor, the revolutions per minute (rpm) automatically adjust to maintain the desired pressure when set in psi mode. On an apparatus equipped with a relief valve system, the pump operator needs to manually adjust the rpm to maintain the desired pressure. Marking the individual discharge gauges allows the pump operator to rapidly place lines in service and guarantees correct flow. Verifying our flow with a flowmeter also satisfied our concerns that the combination tip may not flow its rated flow when attached to a reduced orifice nozzle (slug tip). After flowing each preconnect, we labeled the discharge gauges with the flow ratings. The solid stream gpm is followed by that of the combination tip reading (photo 5).

HOSE AND HOSELAYS

In our flow tests, we found that the friction loss in our current hose was well below the standard formula established for 1¾-inch hose. We use an extruded nitrile rubber-coated hose on our preconnects. Since it has proved to be very durable and allows reloading without the hassle of hanging and drying, we decided to stay with it.

After testing several preconnect lay configurations, we decided on the minuteman load. It was a good choice, as we had already been using the minuteman load for our 2½-inch preconnect. Using the minuteman on the 1¾-inch preconnects simplified things and reduced the in-service training time. The beauty of the minuteman load is that the load is pulled from the bed directly onto the shoulder of the firefighter. Hose then plays off the top of the stack as the firefighter walks from the engine around any obstacles and to the attack position. Once at the door, the firefighter sets the remaining stack on the ground, then stretches back any remaining hose by grabbing the couplings.

One challenge with the minuteman load is that it is an unidirectional load—that is, it deploys from one side only. You must decide ahead of time ate at 50 psi NP, they have different flow rates. The solid stream flows at 185 gpm, the combination tip at 150 gpm. Friction loss formulas are a good place to start in determining correct pump panel discharge pressure; however, they do not take into account the friction loss behind the pump panel caused by bends, turns, and swivels that add to the overall friction loss. To ensure that we would be delivering the desired gpm at the nozzle, we used a flowmeter to verify the flow. With the preconnects stretched to full length, we flowed the lines with the solid stream first. When 185 gpm was reached, we marked the discharge gauge with a reflective red arrow decal.

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One challenge with the minuteman load is that it is an unidirectional load—that is, it deploys from one side only. You must decide ahead of time from which side you will deploy the load. We choose to deploy from the right side of the apparatus, since it would be away from the pump operator; we felt that the pump operator is busy enough at this point and shouldn't have to work around firefighters pulling lines. Deploying lines from the right side of the apparatus also allows the firefighter to pull lines to the curbside and out of the way of traffic most of the time.

One concern of deploying from the right side is loss of hose length as it goes around the apparatus to the left side. To address this, we attached a nine-foot extension hose (pup) at the beginning of the preconnect. The nine-foot pup makes up for any lost length going around the engine; but, more importantly, it provides a location at ground level for a quick disconnect of the hoselay (photo 6). The ability to quickly disconnect the load at ground level allows for the following:

- Quick deployment of a foam attack line when using a pump panel-mounted eductor (photo 7).
- Rapid line extension from a 2½-inch attack line.
- Deployment of an attack line to a remote site, a standpipe, or an auxiliary pump.

My engine crew has been using this configuration on our preconnects for more than a year now with very good results.

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Often, we tend to overlook those things that have worked well for us over the years. In this case, we found that we could improve the function and operation of our 1¾-inch preconnects. Sometimes you can't improve on a good thing, but you will never know until you look into it and check it out. ●

ENDNOTES

1. Formula for friction loss: $FL = C \times Q/100^2 \times L/100$.

FL = Friction loss; C = hose coefficient; Q = quantity of water (gpm); L = length of hose.

2. $NR = .0505 \times Q \times \sqrt{NP}$ (fog nozzle) or $1.57 \times d^2 \times NP$ (solid stream nozzles).

NR = nozzle reaction (psi), Q = total flow through the nozzle (gpm); NP = nozzle pressure (psi); d = nozzle diameter.

● **BOB SHOVALD** is a 14-year veteran of and a lieutenant with the Coeur d'Alene (ID) Fire Department, assigned to Station 3. He is certified in Idaho as an EMT; a hazmat technician; and an instructor for driver operator, rapid intervention teams, and hazmat response. Shovald also serves on Idaho's Task Force 1 as part of the state's All Hazards Rescue Team.