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by

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Fluid Motion, Part 6

Investigating Intake Valves

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RURAL FIREFIGHTING INSTITUTE
Training America's Rural Fire & Emergency Responders

A Message the Author, Larry Davis

In October 2002, I started writing the monthly "Rural Fire Command" column for *FireRescue Magazine*. Since that time, the RFC column has been carried in just about every subsequent issue of the magazine.

As time has passed, several readers have contacted me about obtaining back issues of the column. Some expressed an interest in acquiring the articles in Powerpoint format for use in training programs.

This led to, my adaptation of the RFC columns to the PowerPoint format. These PowerPoint programs are being made available through the combined efforts of *FireRescue Magazine* and the Rural Firefighting Institute.

Fluid Motion — Part 6
Investigating Intake Valves

During the past couple of months, this sries of columns has ocused on drafting operations and as a result, I’ve received numerous emails from readers with questions regarding pump intake valves.

There are numerous issues with pump intake valves that affect both drafting and hydrant operations, most of which revolve around the type of intake valve used and the purpose for it. But, before we look at valves, we must review the factors that affect drafting operations.

Factors that Affect Drafting Ops — A Review

Thus far in this series on drafting, we have explored the following factors that affect the maximum delivery rate available from a given drafting operation:

- The rated capacity of the pump
- The altitude of the drat site in relation to sea level
- The temperature of the water to be drafted
- The static lift as measured from the surface of the water to the center of the pump intake
- The length and diameter of suction hose to be used and the resultant friction loss at specific flows within the suction hose
- The friction loss in the strainer used
- The friction loss in any front or rear suction piping
- The friction loss in the piping of any dry hydrant to be used

The Need for Intake Valves

Historically, pump intakes, other than 2-1/2” auxiliary intakes were not valved. Howeer as time went on, it became common practice for rural departments to valve the large diameter intakes on their pumps to facilitate operations that allowed water to be used from the on-board water tank while suction hose was connected to the intake to all the pumper to switch from a booster tank operation to a porta-tank drafting operation.

As the use of 4” and 5” large diameter hose (LDH) for supply lines caught on, the need for LDH intake valves that provided mechanisms to both bleed the air in the supply line as it was charged, and to provide pressure relief on the upstream side of the valve to prevent the supply hose from being over-pressured came about.

Problems with intake valves such as that shown in Figure 4 arise when it comes to drafting operations. Not all of these valves are air-tight for use with drafting. Secondly, most LDH intake valves do not have large enough openings to allow the pump to maximize its drafting capabilities.

Thirdly, unless the department uses 4” or 5” Storz connections on its suction hose, the intake valve must be removed to allow a drafting operation from a porta-tank to be set up.

Figure 1. Historically, the only intakes that were valved were the 2-1/2” (or 3”) auxiliary intake valves. This attack pumper is being supplied by a 3” line from a nurse tanker.

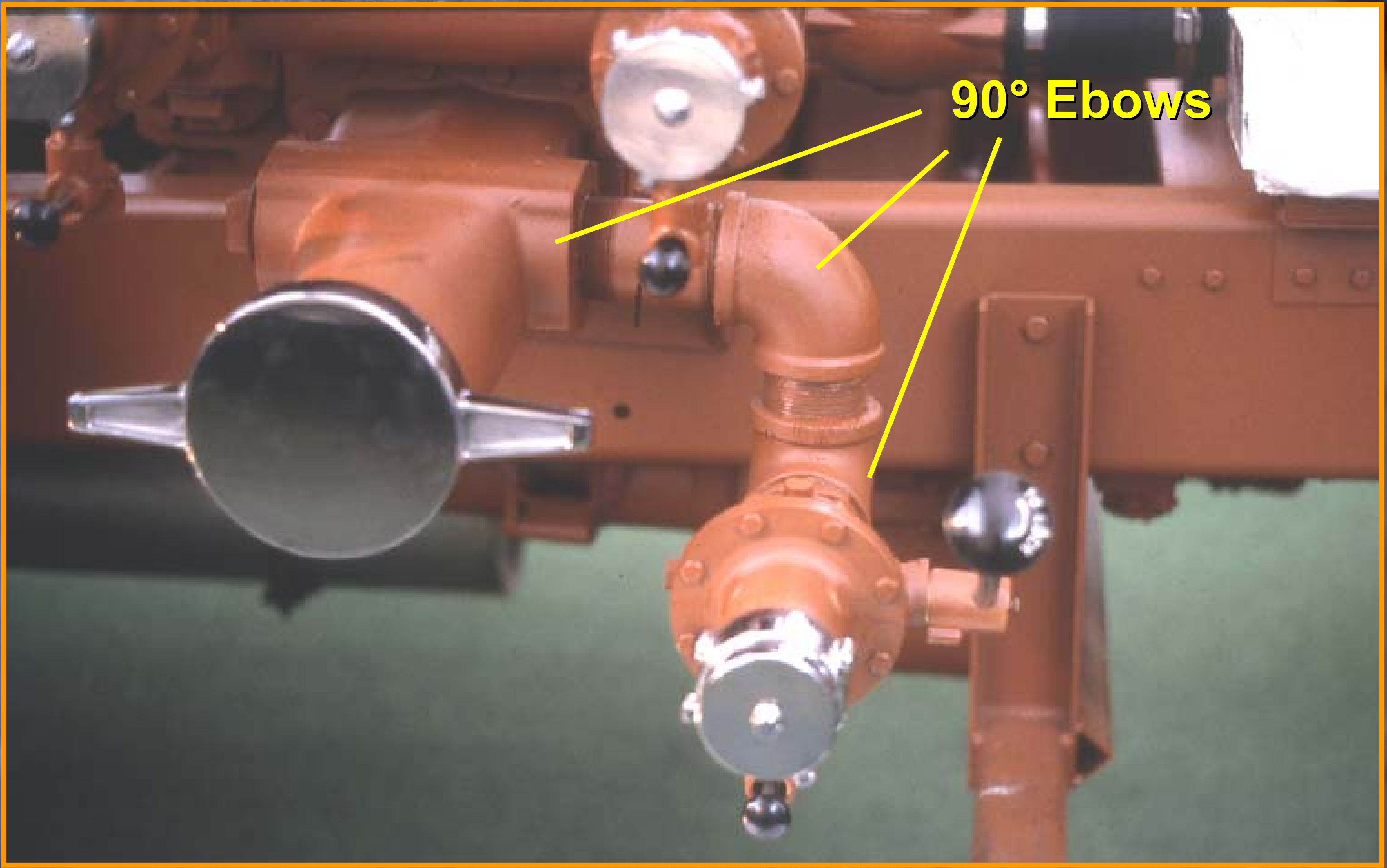

Figure 2. The typical 2-1/2” auxiliary intake has three 90° turns and equates to over 20 ft of 2-1/2” pipe. This creates significant loss at any flow above 200 gpm. Even with 3” piping, there is too much restriction to maximize pump performance.

Figure 3. If the purpose of having auxiliary intakes is to maximize pump output, a 2- or 3-inlet siamese into the large pump intake is much more efficient that auxiliary small intakes. In specifying apparatus, eliminate the auxiliary intakes required by NFPA 1901 and specify a siamese. This will maximize flow from the intake lines.

Figure 4. A piston intake valve connected to a 6” pump intake and equipped with a 4” Storz connection for connecting 4” LDH. The valve provides an air release valve and a pressure relief valve to protect the supply hose.

Intake Valves for Drafting

When pump intake valves are being selected, the department needs to decide whether they are setting up a pumper to be supplied by an LDH supply line from a hydrant or other pressurized source such as a relay pumper or a tanker being used in the nurse mode.

Historically, rural departments have used external 1/4-turn butterfly valves for drafting. These manually operated valves allow the pump operator to work from the booster tank and connect suction hose to the valve to allow water supply operations to make a smooth transition from the booster tank to a drafting operation.

Because of the concern with water hammer, many of the requirements mentioned in NFPA standards for apparatus require that any valve 3” or larger be slow-operating. This generally means that instead of a manual handle which allows the operator to quickly open a butterfly valve, the valves must be equipped with hand wheels that slow the opening process and prevent water hammer.

Butterfly valves are all 1/4-turn valves regardless of their operating mechanism. With a butterfly valve a disk in the in the valve only has to travel 90° from stop to stop.

While butterfly valves can be external — mounted on the outside of the pump panel as an add on to the pump intake, most pump manufacturers offer butterfly intake valves that are actually installed in the pump suction intake. Figure 9 shows one such valve.

Figure 5. To set up this porta-tank drafting operation using the pumper's 5" Storz-connected intake valve, a 5" Storz x 6" male NST adapter had to be used.

Figure 6. The simple addition of the 5" Storz x 6" NST adapter can reduce the delivery rate from draft by 200-300 gpm.

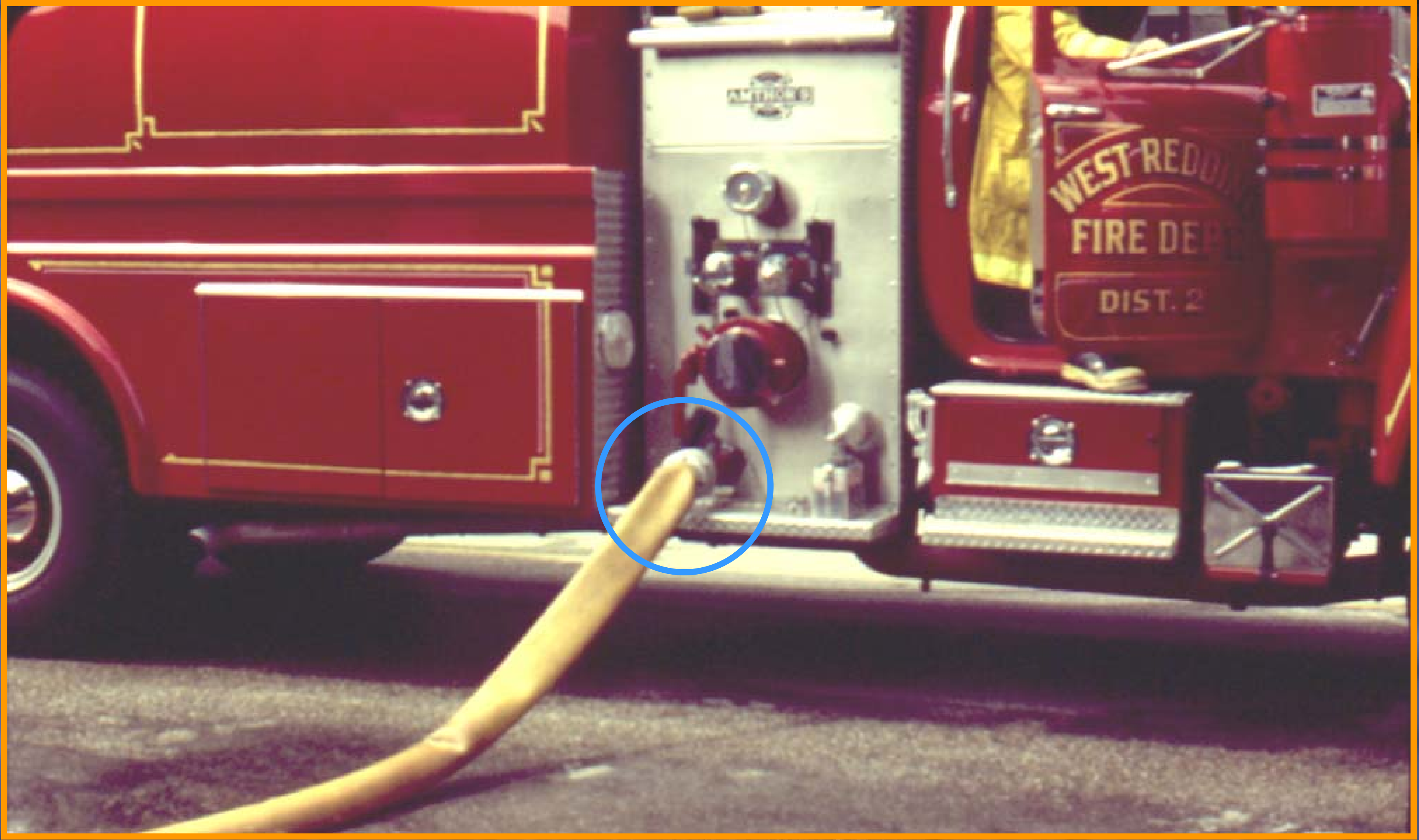

Figure 7. This pumper's 6" intake is equipped with a butterfly valve to facilitate drafting. However, due to the lack of an LDH Storz adapter for the butterfly valve, this LDH supply line had to be run into the 2-1/2" auxiliary intake. This significantly reduced the flow from the LDH into the pump.

Figure 8. This intake is primarily used for drafting from a porta-tank. It is equipped with a gear-operated slow-opening valve. Just in case the pumper must be supplied by a 5” LDH line, the department did a very smart thing. The valve has a 6” NST threaded connection on the outboard end. A 6” NST female x 5” Storz adapter with a 5” Storz blind cap finishes off the valve. When a 5” supply line is to be used, the Storz cap is removed. When the pumper must draft, the Storz adapter is removed. The cost of the 6” x 5” Storz adapter is small and provides versatility to this intake.

Figure 9. This intake is equipped with a Hale MIV (master intake valve). While the control can be remote or at the valve, the control for this valve is the black knob to the left of the valve.

Gate and Ball Intake Valves

Two other types of external valves can be used for pump intake connections. These are gate intake valves and ball intake valves. With both the gate and the ball valves, the opening through the valve is unrestricted when the gate or ball is fully open. With the gate valve, a sliding gate rises out of the waterway when fully opened. With the ball valve, when the opening in the ball is in the full open position, the opening in the ball lines up with the opening through the valve body.

Just as with the butterfly valve, either of these valves can be be finished with whatever connection is required (i.e. 4-1/2", 5", or 6" NST male thread, 4", 5", or 6" Storz, or any diameter of Camlok male connection) to connect suction hose or supply hose. The key is to be able to transfer from working off of tank water to a drafting or supply line without having to remove the valve. Another major factor is to be able to transfer from a booster tank operation to a drafting operation without losing water.

Figure 10. This department valved this engine’s front suction by using a Jaffrey gate valve.

Figure 11. This pumper is equipped with a Kochek gear-operated ball intake valve equipped with both an air release and pressure relief valve.

Pre-Priming

For rural departments that operate with any type of intake valve, one of the major problems is transferring from a booster tank operation to a porta-tank drafting operation without loosing water. While a good pump operator can generally do it, the problem is that the suction hose needs to be primed. If the intake valve is cracked open slowly and the primer operated a good operator can generally prime the suction.

To save time and a lot of aggravation, a pre-primer can be used. This is nothing more than installing a priming connection on the upstream side suction side of the valve. Once suction is connected, the pre-primer for the suction hose is opened and the suction hose primed up to the actual butterfly, gate or ball. This greatly reduces the possibility of losing the prime. It also helps Command from going into cardiac arrest.

Figure 12. This 1250-gpm front mount pump of Sister Bay (WI) is equipped with dual suctions equipped with gear-operated butterfly valves and pre-primers. The black hoses extending to the suction hose side of the valves are separate priming lines to allow the suction hose to be primed up to the pump. This allows the second suction to be connected and primed after the first suction and pump have been primed without losing water.

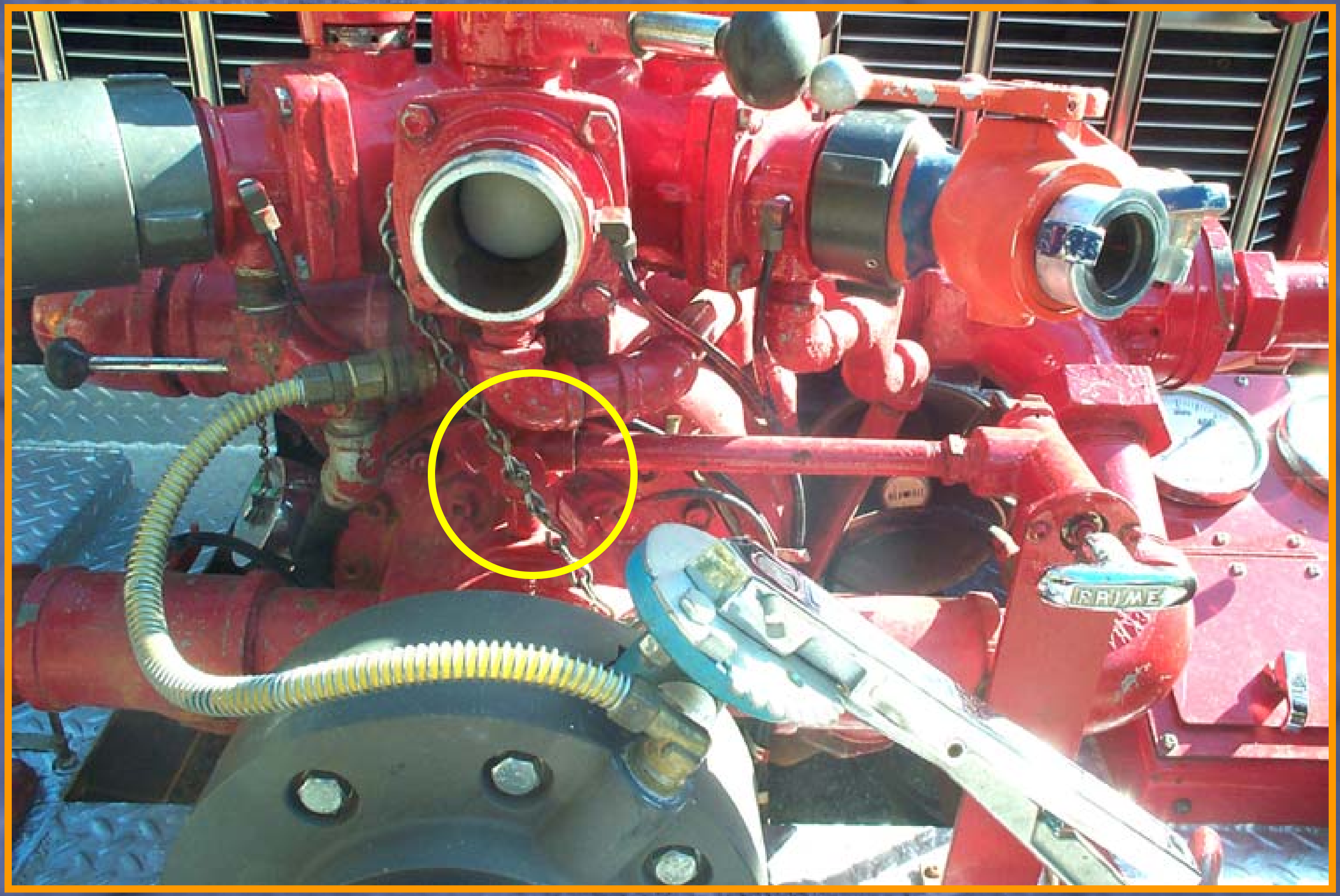

Figure 13. The West Greenwich(RI) FD installed a pre-primer on the front-mount pump of its tanker. The plastic tube connects from the suction side of the butterfly valve to the priming line. When the primer is pulled, a 3-way valve (yellow circle) installed in the priming line (the red horizontal pipe) can be positioned to prime the pump or positioned to prime the suction hose to the butterfly valve.

Next Month

In the next installment, we'll take a look at intake valve performance and how you can test their performance. Until then, stay safe.

For Questions or comments on this or any of the Rural Fire Command articles, contact the author at ldavis@RFI411.org

About the Author

Larry Davis is a full member of the Society of Fire Protection Engineers, a Certified Fire Protection Specialist, and a Certified Fire Service Instructor II with more than 30 years experience as a fire service instructor. He is Vice President of GBW Associates, and Chairman of the Rural Firefighting Institute.

Davis has conducted more than 400 Rural Firefighting Tactics and Rural Water Supply Operations seminars throughout the United States and Canada. In addition, he has written numerous fire service texts, including *Rural Firefighting Operations*, books I, II, and III. Most recently, Davis co-wrote the *Rural Firefighting Handbook* and *Foam Firefighting Operations*, book I with Dominic Colletti.

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To obtain any or all of the other PowerPoint versions of the Rural Fire Command column, contact Larry Davis at:

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