



## Tired of Doing the Exhaust Primer Tango?

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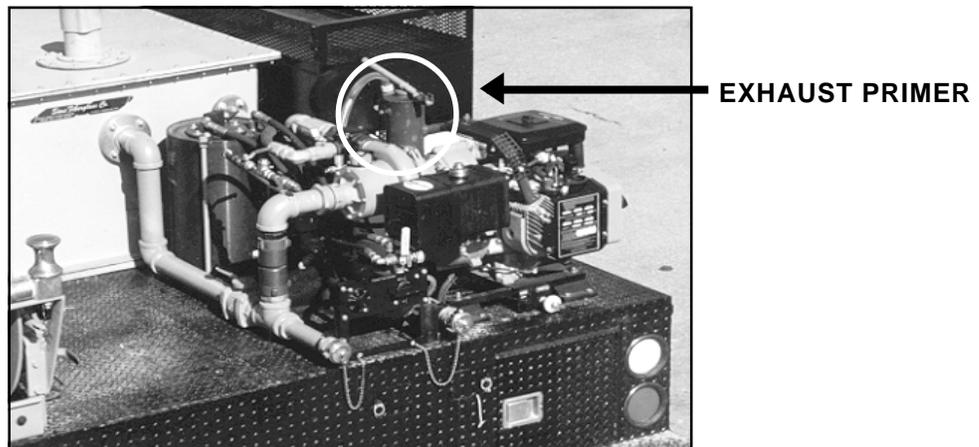
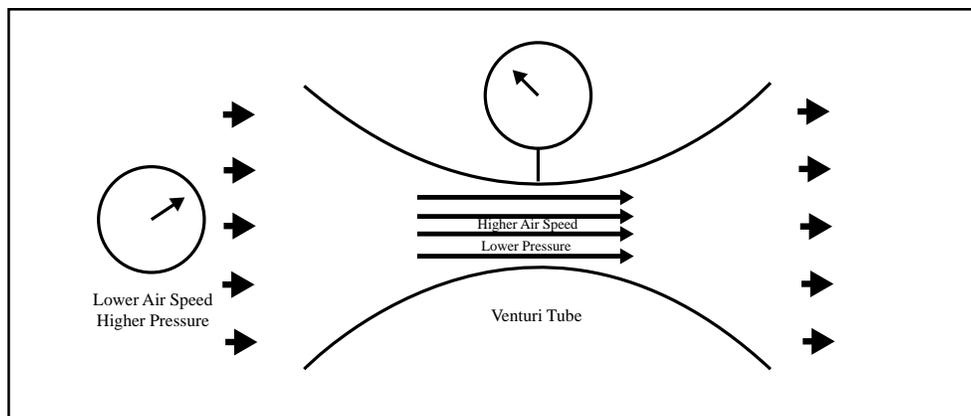


Figure 1.—Engine With Exhaust Primer.

Exhaust primers represent about 25 percent of the priming systems used on wildland fire apparatus. Firefighters who have worked with them to prime for a drafting operation know of the Exhaust Primer Tango. The time required to open the discharge valve and release the primer as the pump motor loads up is exacting and touchy. Success in establishing a prime rarely occurs on the first try. However, the simple fix of adding a check valve will eliminate the frustration and increase the reliability of establishing a prime with this system.

First let's examine the physics of what is happening with an exhaust primer, with the illustration below. The primer uses a venturi tube to generate the vacuum that excavates the air from the pump and fills it with water. A venturi is based on the physics principle that as a gas speeds up, the static pressure drops.



By placing a priming tube in the center of the throat of the venturi, a partial vacuum is produced while the engine is running. Figure 2 depicts the location of the venturi in the exhaust primer pump installation.

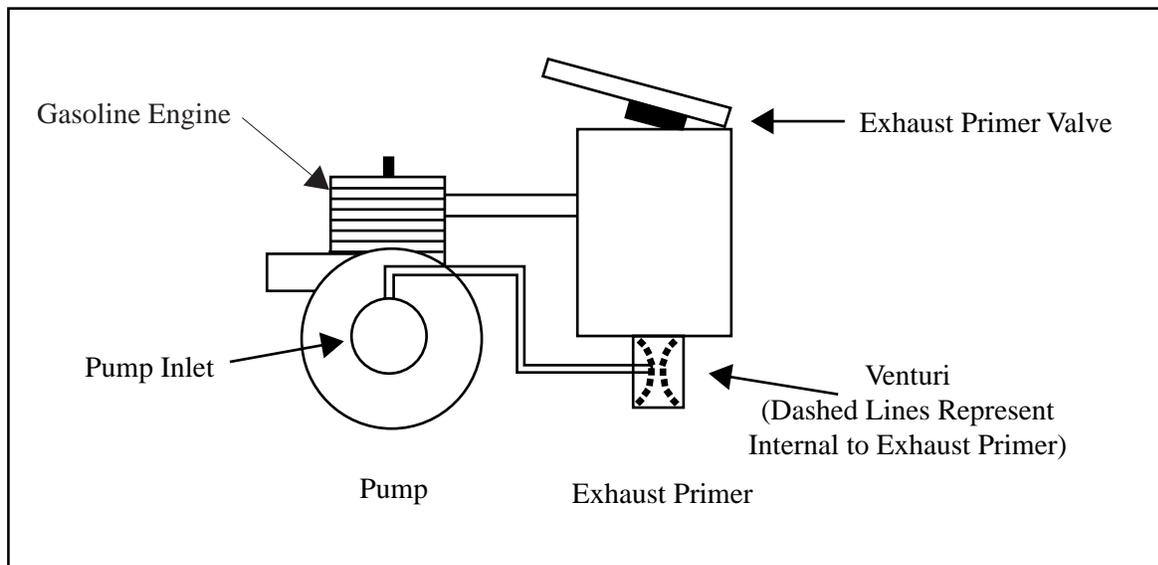


Figure 2.—Exhaust Primer Connections.

In the exhaust primer, the speed of the air (exhaust) is dependent on the speed of the engine. The higher the engine speed, the faster the exhaust is produced. The speed of the air (exhaust) entering the inlet of the exhaust primer also determines the amount of vacuum that will be generated. The higher the inlet air speed to the venturi, the higher the speed of the air in the throat of the venturi, the lower the pressure, and hence the greater the vacuum generated.

To operate the exhaust primer, the pump engine throttle is set to full open, the priming valve (No. 6 valve) is opened, the exhaust primer valve handle is placed over the exhaust exit, and the venturi generates a significant vacuum. Since the vacuum in the venturi is based on the engine speed (rpm), as the last of the air is pulled out of the pump and replaced by water, the engine loads up, the speed (rpm) drops off, and the vacuum in the venturi also drops off. The result is air reentering the pump head through the venturi in the primer and water leaving the pump head. This causes a loss of prime. To prime the pump, the operator typically makes several tries at the precise timing required to close the exhaust primer valve, prior to losing prime, while allowing for sufficient water in the pump head to complete the priming operation. This is the basis of the Exhaust Primer Tango. However, this dance probably relies more on luck than skill.

### Proposed Solution

What is needed is something to stop the vacuum in the pump head from falling when the pump motor becomes under load, which causes the engine rpm to slow down. The answer is a check valve. A check valve placed between the priming port on the pump and the priming valve (No. 6) solves the problem. The closer the valve is to the priming port on the pump, the better. A schematic of the solution is provided in Figure 3. Note that all other valves have been eliminated for simplicity.

The steps to operate the exhaust primer with the check valve installed do not change. The operator sets the engine throttle to full open, the priming valve (No. 6) is opened, and the exhaust handle on the primer is held in the closed position. When the air is evacuated from the pump head and replaced by water, the engine will become under load; but because of the check valve, air cannot reenter the pump head and cause a loss of prime. The operator need only continue to hold the exhaust primer handle in place until an indication that water is flowing through the pump is observed—thus eliminating the Tango. Tests at SDTDC indicate that the time to prime with the check valve installed was reduced from 7.5 minutes to approximately 8 or 9 seconds.

In Figure 3, it is also important to note that the primer port to the plumbing must be taken on the suction side of the pump. This port must be on the top of the inlet pipe to the pump, unless there is a hump in the plumbing leading to the pump inlet. In that case, the primer port should be on both the top of the inlet to the pump and the top of the highest point of the hump.

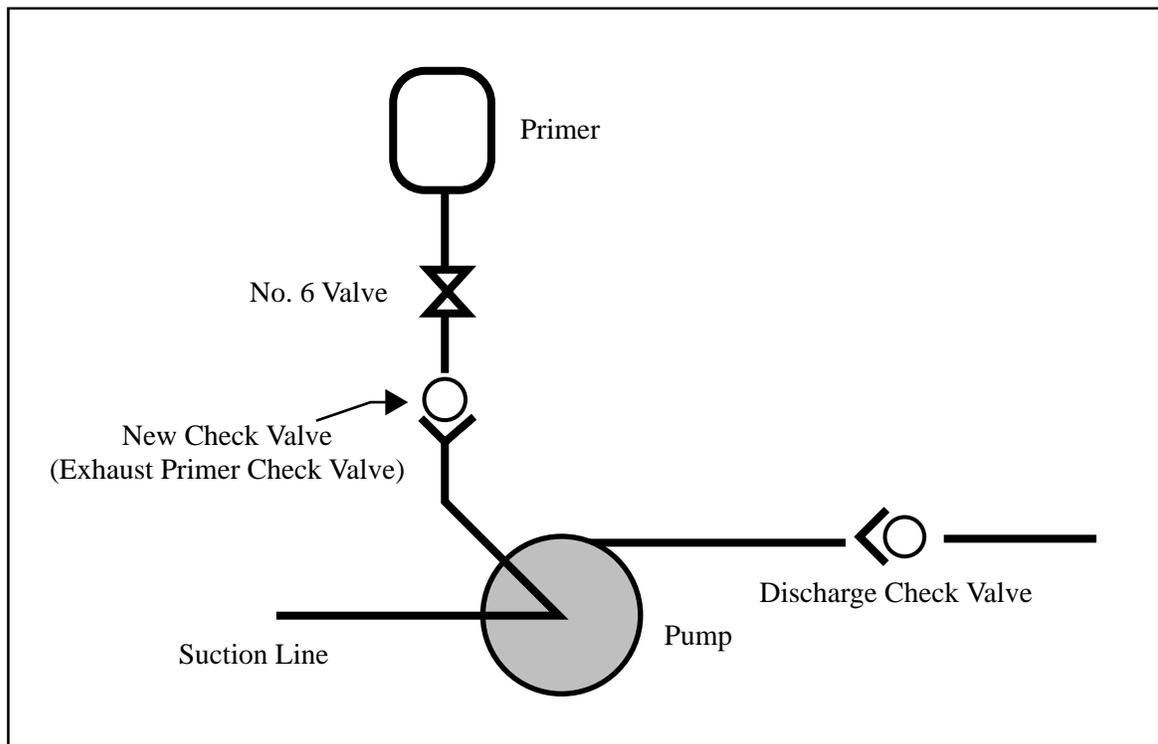


Figure 3.—Exhaust Primer Check Valve Schematic.