

## Revolutionary changes in fire pump priming technology are driving the market forward

Alan Salusbury tells International Fire Buyer about the evolution of the fire-fighting pump in the past 100 years, and looks ahead to future developments in the market



Over the last 100 years, fire-fighting pump designs have certainly changed! The positive displacement pumps have been replaced with centrifugal pumps. Likewise, priming of centrifugal fire pumps has also evolved. In the late 1800s and early 1900s, fire pumps were either hand-operated or steam-operated 'positive displacement piston pumps'. Such fire pumps did not require a supplementary priming devices; since the piston or rotary gear fire pumps drafted both air and water through the hard suction hose. Now, centrifugal fire pumps are the 'world standard' for fire-fighting; in addition, we have seen various primers and their drive systems engineered and produced primarily by fire pump manufacturers.

### Overview of primers

The purpose of this article is to provide both fire truck manufacturers and fire department apparatus specification writers an 'update' on past, present, and new primers on the market. With the evolution of the global centrifugal type fire pump, engineers have come up with a variety of priming systems as follows:

**a) Intake manifold primer system:** With early gasoline engines, the chassis engine 'intake manifold' was used as a suction device. It was piped to the fire pump intake manifold, with a 'float system' that would stop water flow from engine the engine carburettor. These were popular on Darley Fire Pumps for over 50 years, but have virtually disappeared from the fire service.

**b) Exhaust primers:** Using the exhaust system from a small gasoline engine used a portion of the exhaust discharge, piped through a small venturi device that was connected to the intake side of the pump. The system created a 'vacuum', thus water was lifted into the eye of the impeller. Around the world, these economical units are still used today on mainly small gasoline portable pumps.

**c) Piston type or rotary gear positive displacement priming systems:** A miniature version of a positive displacement fire pump was designed for only priming purposes. These priming systems are typically higher priced and complicated in nature. These primers normally have an excellent add feature: 'Automatic' start and stop priming feature. For the most part these are driven by the fire pump gear box or drive system from the chassis power train as follows:

**1) Clutch and belt assembly driven:** Similar to a modern air conditioning system on an automobile and powered by the fire pump drive system. Such eccentric vane, piston, or rotary gear primers require a rubber belt and pulley drive system, electric clutch, and various electrical components. Normally found in the higher price range.

**2) Direct gear driven:** Integrated fire pump and primer system, using fire pump input drive shaft or gear box; piston type primer. These primers are commonly found in the higher price range for centrifugal pumps as Zeigler, Rosenbauer, Godiva, and others in Europe, Asia, and Far East.



**d) Electric driven:** Low voltage (12 or 24 volt) DC electric motor driven rotary gear or eccentric vane primers are available in several compact versions. For the last 60 years, these were the most popular in North America. These primers are normally found in the middle price range.

**e) Hand-operated vacuum pumps:** Small manual 'hand operated' diaphragm primer pumps; these are used on both small portable pumps and smaller vehicle mounted engine-driven fire pumps. A typical unit is marketed with Guzzler brand name with very low price level, but these are not suited for fire pumps rated for over 1000 LPM.

**f) Air Powered Priming System:** Are designed for fire apparatus with an 'air brake' compressor system, available in both manual and automatic versions, with and without a 'vertical lift' gauge and multi-location gated-intake priming. These units were developed in North America by TRIDENT EMERGENCY PRODUCTS (AirPrime) and has become the standard for many larger OEM manufacturers. Air primers are normally found in the lower price range.

### Typical fire pump operations

Most Fire Departments operate in 'initial attack mode', operating from the on-board fire apparatus water tank and with a 'wet' fire pump (in warm climates). Therefore, priming of the fire pump has become a 'quick five-to-ten-second operation' to speed-up the pumping process. However, in rural areas, drafting from a secondary source is quite common when the initial water tank source is depleted. In North America, tanker 'shuttle operations' or use of large diameter hose (LDH) for relaying of water are quite common. Consequently, drafting from an external water source requires frequent use of the priming system.

### Pump operator training aspects

Typically, during fire pump training and instructions, we have encountered that fire pump engagement, pump drafting, priming, and pressure relief valve/pressure governor operations are the most difficult educational training tasks. Electronic chassis engines and chassis components have certainly changed pump engagement steps; thus the NFPA #1901 Standard has carefully addressed pump engagement procedures and required safety interlock system for fire pump and transmission shifting. Pressure governor systems are simple in nature and more popular than relief valves for pressure control on larger centrifugal fire pumps. These versatile systems now incorporate both RPM and PRESSURE mode controls, and engine monitoring devices and safe guards. This leaves the 'drafting and priming system' as a difficult combination for the average pump operator to understand.

### Automatic priming

The European fire pump manufacturers developed one of the best features in priming of fire pumps with automatic priming; which is the ideal 'operational solution'. This system requires very little operator control and education; since the primer automatically 'engages' without pump pressure and 'disengages' when discharge pump pressure is achieved.

European companies all have fire pumps available with standard 'automatic priming'. As the world grows smaller, many of these very practical ideas from both European & US engineering are crossing the oceans. The 'automatic priming' is one of these great ideas, which makes 'perfect sense' on any fire truck for several reasons:

**Priming From Water Tank:** Is simple and makes the pump operator's job easier, allowing time for other tasks;

**Priming with Hard Suction Drafting Hose:** It automatically removes any slugs of air that find their way to the pump during drafting operations;

**Priming During Normal Operations:** Will immediately and automatically engage, if discharge pressure is lost.

Prior to 1998, such an 'automatic system' was missing from North American electric primer systems. The pump operator was required to activate an electric primer manually, which has led to the following problems:

- 1) If the operator was not highly trained in its use or if the primer was shut-off too soon, the prime could be lost.
- 2) If the electric primer was operated for over one minute, the electric primer would be severely damaged or destroyed.
- 3) Electric primers create a considerable drain on the chassis

electrical system (alternator & batteries).

4) Annually, most electric eccentric vane primers must be removed from the apparatus, cleaned, rebuilt, tested, and re-installed.

**Challenges & solutions**

Both North American electric primers and European primer systems have inherent challenges and problems. Primers are very complicated in design and operational components, difficult and costly to repair, and Euro-primers sometimes require the entire fire pump assembly to be removed from the apparatus for access and rebuilding of the primer. In addition, most primer assemblies are of aluminium construction and subject to corrosion.

The revolutionary Trident 'AirPrime' primer system employs the 'automatic' feature of a Euro-priming system; while using the available chassis air brake compressor, which proved to be a sufficient and reliable air power supply. The all brass and stainless steel construction of the Trident primer is NOT integral to the fire pump assembly and is remote-mounted for quick installation or removal. (it is not part of the fire pump, thus it can be used on any fire pump)

The Trident 'AirPrime' system is the perfect answer for fire pump manufacturers around the world to reduce cost! The system uses pressurised air piped through a series of nozzles creating vacuum and lift. The reliability of a product is the key ... that has no moving gears or shafts, and is powered by air pressure!

**User benefits**

The 'AirPrime' can be used on any new fire pump or in-service vehicle with air brakes. The unit requires no electric motor, clutch, direct gears, eccentric vanes or primer pistons. The 'AirPrime' system includes the following standard features:

- Fully complies to NFPA #1901 and other global standards for lift height
- Drafting capability to nearly eight metres (25 feet) or more
- Integral strainer on intake line from the fire pump
- Air filter on intake line from air compressor
- Automatic draining (no freezing in cold temperature)
- No large amp draw on the vehicle's alternator and battery system
- All brass and stainless steel construction – corrosion free in salt water
- Five-year warranty
- Environmentally safe and low noise level
- Air operated 'manual' push button operation (no electrical components required)

The Trident 'AirPrime' is available with the numerous options:

- Automatic operation: With a three-way rocker switch control
- Lift gauge: To denote lift in meters/feet for either manual or automatic models
- Multi-location Priming System: Up to four separate pre-priming intakes for either manual or automatic models

**Automatic primer installation**

The Trident 'AirPrime' can be installed in less than two hours in

five easy steps!

- The primer inlet is plumbed to the suction of the fire pump.
- Air pressure from the air-brake system is connected to the solenoid on top of the primer.
- The pressure sensor is connected to the discharge of the fire pump.
- The 'AirPrime' rocker switch and placard are mounted on the pump panel.
- The wiring harness: Connecting a wire to the pump engaged light acts as an interlock to ensure that the automatic primer will only run when the pump is engaged or the primer can be manually operated (with the fire pump not engaged) for daily primer testing.

**Operational components**

Operation of the Trident automatic priming system is controlled with a simple three-way rocker switch:

- Centre Position: "OFF"
- Lower Position: "PRIME" a momentary position requires the operator to depress rocker switch to operate the primer in an override manual mode
- Upper Position: "AUTO Prime" places the system in automatic priming and which will illuminate an integral green LED light

**Multi-location priming**

In many water supply situations, the ability to prime from multiple suction locations on the vehicle has become important. For these applications, the Trident multi-location automatic primer can pick up a prime from a number of locations: Main pump suction plumbing, front suction inlet, side suction inlet, rear suction inlet, or any gated intake valve.

Installation and operation of the optional multi-location automatic primer has several advantages:

- 1) The ability to have only one primer that can prime either the fire pump or a gated suction intake when the fire pump panel push-button is depressed.
- 2) The ability to 'pre-prime' an intake while operating from another water source.
- 3) When switching between water sources, with the automatic primer set in the "AUTO" position, the primer will automatically operate to remove any air that finds its way to the pump impeller during the switch-over.

**Summary**

Certainly times are changing! Now a fire department can secure an independent priming system totally separate from the fire pump. No other automatic priming system has the unique combination of 'lift gauge', multi-location priming, and brass construction. The Trident air priming system is no doubt the simplest primer in the world to use.

The Trident automatic 'AirPrime' system has grown quickly in popularity, especially among progressive fire departments, fire pump manufacturers, and fire apparatus manufacturers that want to simplify fire ground operations, reduce purchase and installation cost, and reduce potential maintenance costs.

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