The Truth About Fire Pump Performance

Superior Performance. Reliability. Innovation.

EXECUTIVE SUMMARY

As with any purchase, there are critical factors that must be considered in order to determine which product best meets your needs and requirements. This is no different when selecting the pump used on your next fire apparatus. The purpose of this report was to determine which pumps in the North American market meet the critical requirements for a fire apparatus. In order to provide clarity to the important factors in making this decision, three different manufacturer's fully manifolded pumps were subjected to a rigorous testing protocol and ranked based on their respective performance results.

The complete performance of a fully manifolded midship pump can be tied to three important factors:

1) Maximum Vacuum
2) Horsepower Consumption of the Pump
3) Maximum Port Performance

The first of these factors is the maximum vacuum that can be attained. The maximum vacuum test determines what suction performance the pump can attain. The forces needed to be overcome include suction hose and strainer restrictions, lift and any other obstacles the water encounters before flowing into the pump. While many urban and suburban fire companies do not draft often, at those career fires when water from lakes, rivers, and other static sources are required, the pump with better maximum vacuum will provide higher water flow rates. The test is corrected for water temperature and environmental conditions so the results apply consistently for all pumps in all locations.

The second factor evaluated is the horsepower that is consumed by the pump to meet the standard NFPA test points. A pump that uses less horsepower with the same water flow performance as a competitive pump is the more efficient pump. The pump uses less fuel, has more reserve power on the same engine, and therefore has more power available for extra flow or pressure when required. Additionally with a more efficient pump the same engine has the opportunity to have spare power to drive additional accessories such as hydraulic generators or large foam systems. In most cases the pump is running slower, because it is more efficient, so engine noise is often decreased.

The last factor affecting pump performance is the maximum port performance of the pump. Maximum port performance measures the flow attainable at a single port as installed by an OEM. Whether supplying an LDH supply line over long distances or supplying an aerial the port performance determines how much water can be flowed from each point on the pump. This effectively determines the flows that are available from the pump for a single supply line or LDH at different pressures.

After all of the test data was compiled, there was clearly a single pump that outperformed the other manufacturers.

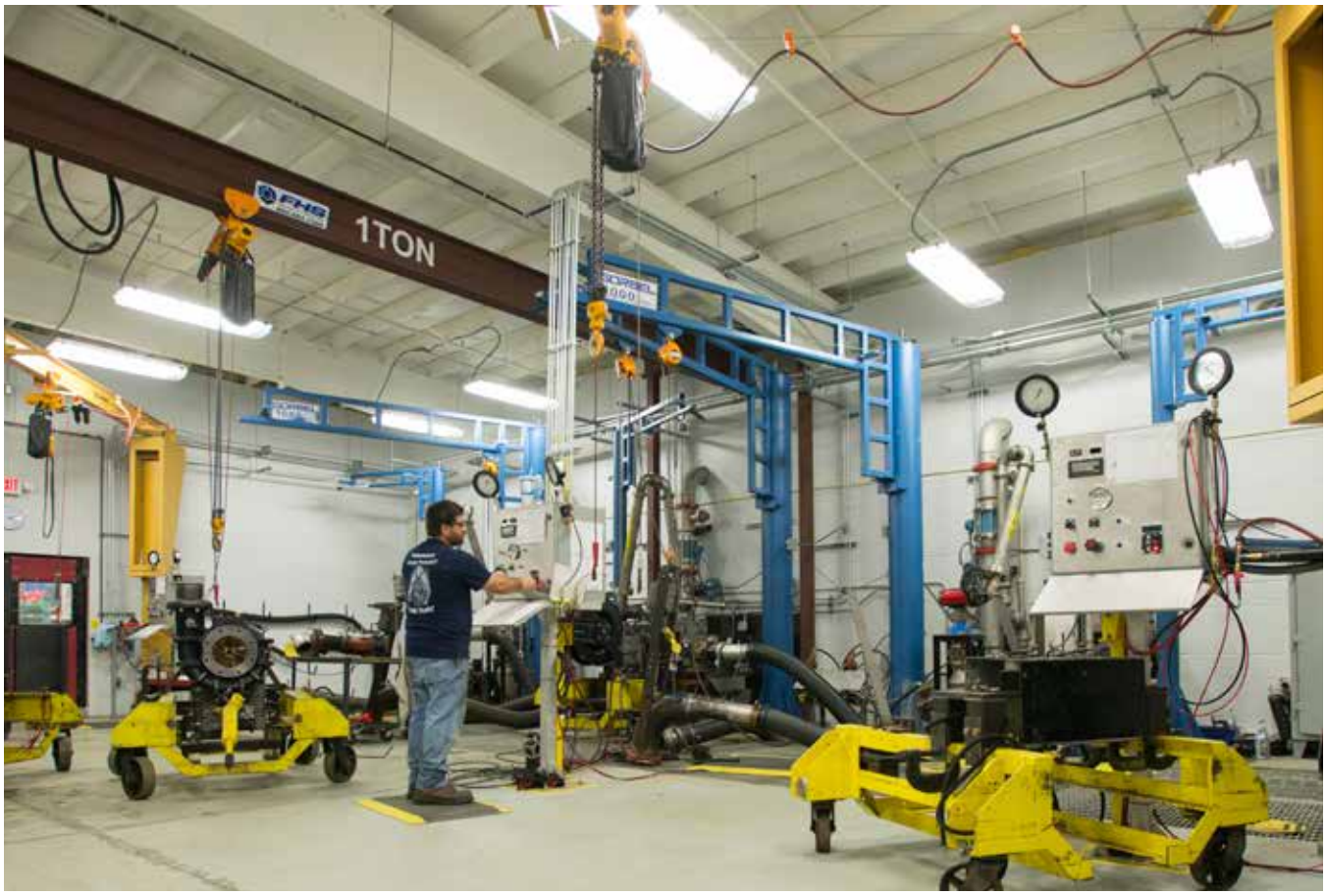
Total Pump Performance Testing Results

Factor	Qmax-XS	Pump A	Pump B
Maximum Vacuum Attained			
Minimum Horsepower Needed for Operation			
Maximum Port Performance			

Hale's Qmax-XS pump wins each category for the factors that impact pump performance.

TESTING CRITERIA

The pumps were tested in Hale's test facility in Ocala, FL and in order to maintain the validity of the test the following guidelines were met.



- The same pump tester was used for all testing conducted. Having one person complete the test took out the variability between different testing personnel.

- Hale has electric dynos that it uses to perform pump testing. In order to test pumps used on a wide variety of applications the test facilities can test pumps up to 700 horsepower. Each pump dyno is set up to measure the power and speed required by the pump to produce different flows and pressures. The same test station was used for all testing to remove any of the variations that might be present between the different testing stations.

- The pump was connected using a 10' piece of hard suction hose that is connected to the adjustable suction standpipes using the left and right suctions of the pump. The standpipes Hale use include a valve which controls a parabolic intake that can neck down the amount of water that is allowed into the suction which simulates lift requirements for NFPA testing. The special adjustable suction standpipes allow the lift to be varied and elevations to be tested, so a pump can be evaluated at high lift and high elevation where lifting the water to the pump is more difficult. While NFPA requires pump performance to 2000 feet elevation above sea level, these test facilities can test to the maximum capability of each pump. The standpipes are submerged inside the internal water tank located underneath the test house floor.

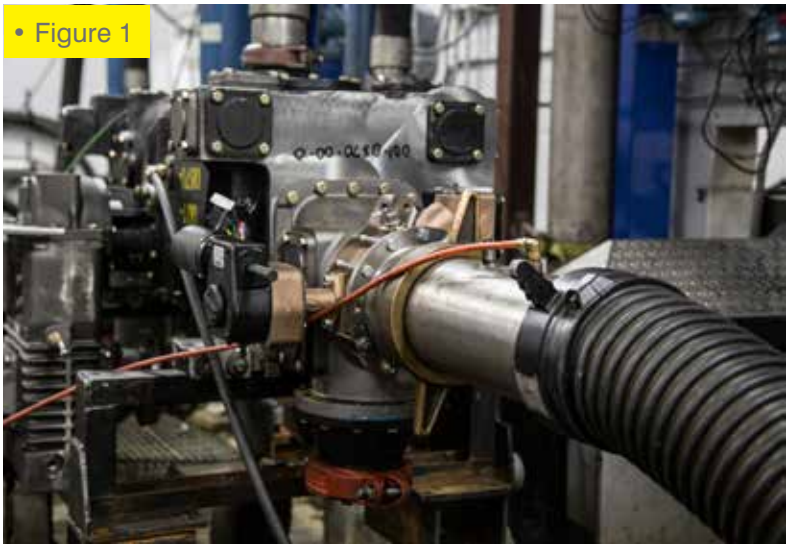
TESTING CRITERIA (Cont.)

- The discharge of the pump is connected to a 4” valve that is used to control the flow output of the pump. The valve is located between the pump connection and the plumbing that is used to discharge the water to the calibrated magnetic flow meter. For individual port testing the test discharge plumbing was connected to the individual port.

- Vacuum, or suction pressure readings are read from a port on the suction hose that is connected as close to the suction adapter as possible. The orange hose shown in Figure 1 is the connection used on the pump and leads to a calibrated test gauge.

- Discharge pressure readings are fed from a discharge port on the pump. Figure 2 shows the green hose that is used for connecting the pump to the calibrated discharge pressure test gauge.

• Figure 1



• Figure 2

All tests included the three fully manifolded midship pumps with mechanical seal.

- Competitor pump NFPA rated at 2000 GPM
- Competitor pump NFPA rated at 2250 GPM
- Hale’s Qmax-XS NFPA rated at 2250 GPM

The first test completed was the standard NFPA testing in accordance with NFPA 1901, Chapter 16. The pumps underwent five separate tests for the ratings 1000, 1250, 1500, 1750, and 2000. The test did not include the 2250 GPM point as one of the pumps was unable to perform to this rating. The pump rating test included the standard three points.

- 100% of the rating at 150 psi
- 70% of the rating at 200 psi
- 50% of the rating at 250 psi

The tests provided the pump RPM, horsepower and vacuum for each pump at each rating. From this information we were able to evaluate the maximum vacuum and the horsepower needed on each pump for all three test points.

TESTING RESULTS

The charts below show the results of each test. For each area where a pump won or tie it was awarded a point, and the pump with the highest point value is considered the winner for that section.

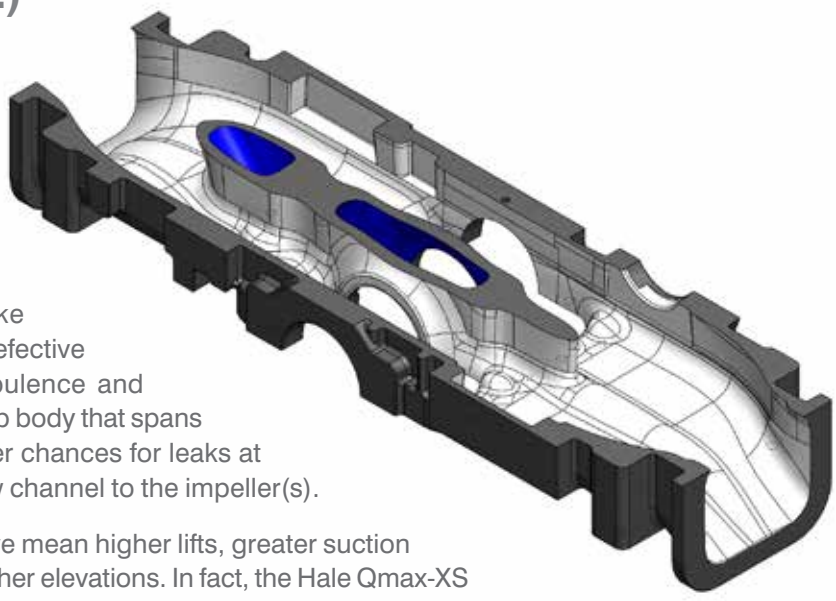
TEST 1: Maximum Vacuum

A point is awarded for the pump that makes the highest maximum vacuum at the test point indicating the pump has higher lift capabilities or in other words, the better ability to get water into the pump. For example an additional foot of lift corresponds to an additional 1,000 feet of elevation, or at 500 GPM an extra 20' section of 6" hose.

Maximum Vacuum Results				
Factor	Rated Flow	Hale Qmax-XS	Competitor Pump A	Competitor Pump B
Maximum Vacuum Performance at 100% of the rated flow at 150 psi	1000 GPM			
	1250 GPM			
	1500 GPM			
	1750 GPM			
	2000 GPM			
Maximum Vacuum Performance at 70% of the rated flow at 200 psi	1000 GPM			
	1250 GPM			
	1500 GPM			
	1750 GPM			
	2000 GPM			
Maximum Vacuum Performance at 50% of the rated flow at 250 psi	1000 GPM			
	1250 GPM			
	1500 GPM			
	1750 GPM			
	2000 GPM			
Selection Points (Out of a total of 15)		7	2	6

The results above demonstrate Hale's pumps ability to attain maximum vacuum better with more consistency than the competition. The reason for Hale's ability to attain maximum vacuum is the construction and design of the Hale fully manifolded midship pump. Each impeller installed in a Hale pump is ground, or fettled, to maximum performance characteristics before being dynamically balanced for smooth operation inside the pump body. The large suction inlets and one piece body efficiently direct the water to the double suction impeller that utilizes a wraparound clearance ring for maximum efficiency.

TESTING RESULTS (Cont.)



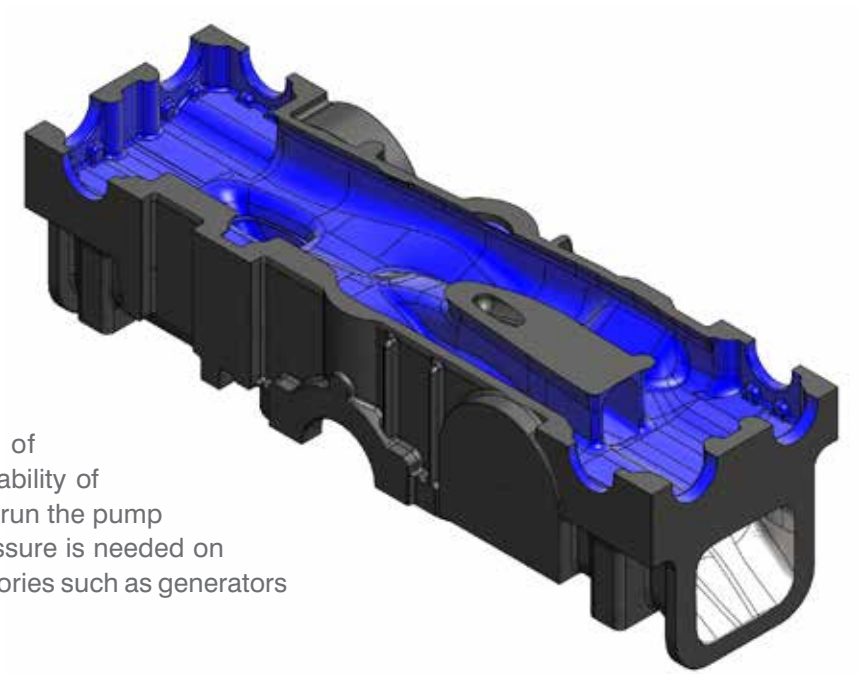
Hale used to build pumps built from multiple small sections but discontinued this practice as those connection points are not only opportunities for leakage, they are points where the pump body doesn't line up perfectly which might require inconsistent hand grinding to make the sections match. The opportunity for defective match between the housings creates turbulence and reduces performance. Hale's one piece pump body that spans the frame rails is not only stronger with fewer chances for leaks at gasketed joints; it also provides a better flow channel to the impeller(s).

The greater vacuum that Hale pumps achieve mean higher lifts, greater suction hose lengths, or attaining performance at higher elevations. In fact, the Hale Qmax-XS can attain lifts of over 25 feet while discharging up to 750 GPM. During testing the Hale pumps consistently were able to lift the water from a point greater than the competition.

If your department performs deep lifts, operates at higher elevations, or operates with longer suction hoses choose a pump with more vacuum than the competition. This extra capacity is demonstrated at draft conditions but it is also a measure of the pumps capacity from any water source.

TEST 2: Horsepower

Hale's Qmax-XS pump uses less horsepower than the competition to meet the standard three NFPA test points. The ground and balanced impeller and the wrap around clearance rings go a long way in helping Hale lower horsepower values. Hale incorporates double suction impellers with dual cut waters that not only help smooth water flow but also help minimize shaft deflection. The unique Autolube feature allows smooth water flow transition into the front eye of the impeller and Hale's one piece body ensures that horsepower robbing connections and elbows are minimized so the water entering and leaving the pump flow with minimal turbulence and pressure losses.



Lowering the horsepower requirements needed to run the pump allows Hale's pump to use less fuel than the competition. Additionally, the apparatus can operate from a lower RPM point which can help maintain clear communications near the apparatus since the engine does not have to work as hard and will generally run quieter. Finally the largest benefit of lowering horsepower requirements is the ability of the same engine to have reserve power to run the pump harder when more water flow or more pressure is needed on the fire ground or to drive additional accessories such as generators or large foam systems.

TESTING RESULTS (Cont.)

A point is awarded for the pump that uses the least amount of horsepower to achieve the test point.

Lowest Horsepower Consumption Results				
Factor	Rated Flow	Hale Qmax-XS	Competitor Pump A	Competitor Pump B
Lowest Horsepower needed at 100% of the rated flow at 150 psi	1000 GPM			
	1250 GPM			
	1500 GPM			
	1750 GPM			
	2000 GPM			
Lowest Horsepower needed at 70% of the rated flow at 200 psi	1000 GPM			
	1250 GPM			
	1500 GPM			
	1750 GPM			
	2000 GPM			
Lowest Horsepower needed at 50% of the rated flow at 250 psi	1000 GPM			
	1250 GPM			
	1500 GPM			
	1750 GPM			
	2000 GPM			
Selection Points		15	0	0

TEST 3: Maximum Port Pump Performance

The third test conducted was to determine the performance of the individual ports on each pump. The pump was connected identical to the first test for NFPA test points but for this test the discharge plumbing was connected to the specific port. For each port we tested the flow of the discharge when the pump was running at 100 and 150 psi.

Maximum Port Performance				
Factor	Pressure	Hale Qmax-XS	Competitor Pump A	Competitor Pump B
Large Diameter Discharge – Maximum Flow	100 PSI			
	150 PSI			
Deckgun Discharge – Maximum Flow	100 PSI			
	150 PSI			
Officer's Side Discharge – Maximum Flow	100 PSI			
	150 PSI			
Selection Points (Out of a total of 6)		6	0	0

The result of the test proves that Hale pumps have better single port flow performance than the competition. Superior flow was built into Hale's one piece bodies. The manifold is designed such that the water leaves the pump assembly at the closest point of distribution.

TESTING RESULTS (Cont.)

There are no flanged connections or abrupt plumbing turns to create turbulence and pressure drop that can minimize water flow. The internal passageways of Hale pumps are designed for maximum flows with minimal losses. Additionally only Hale offers the number of integral discharge parts. The competition uses flanges, adapters, and elbows to match the versatility of Hale pumps.

The inclusion of 15 ports on the Qmax and 19 ports on the Qmax-XS ensures that apparatus manufactures have the freedom of choice when plumbing discharges. Having more water available from all ports on Hale pumps offer fire departments superior water flow, as installed on a variety of fire apparatus.

Test Report Summary

In conclusion, when you are looking for a pump that checks all of the boxes, look no further than the most efficient, fully manifolded midship in the market. The Qmax-XS delivers unmatched:

1. **Superior Suction Performance** – the maximum vacuum determines what forces the pump can overcome before water flows through the pump.

2. **Low Horsepower** – A pump that uses less horsepower with the same water flow and pressure as a competitive pump, is a more efficient pump.

3. **Water Flow Performance** – More water can be flowed from each point on the pump to supply LDH, Aerial, and Master Stream Devices.

Total Pump Performance Testing Result			
Factor	Hale Qmax-XS	Competitor Pump A	Competitor Pump B
Maximum Vacuum Attained			
Minimum Horsepower Needed for Operation			
Maximum Port Performance			
Total Selection Points	**28**	**2**	**6**

Whether you are a fire department that relies on deep drafts for pumping operations or require long hose lays from water source to apparatus the superior vacuum capabilities of Hale's pumps will benefit your department. As departments are deciding to keep apparatus longer the maintenance costs to keep those apparatus have increased. An efficient pump does not need to be run as hard, as the same inefficient pump. This reduces the stress on the pump, reduces maintenance costs, and reduces the chance that the pump may have to be rebuilt during the department's apparatus life cycle. Finally if there is a chance you might fight a fire with a high fire load it is of utmost importance that you have a fire pump that has built in reserve capacity and the ability to flow large amounts of water out of any port, the only clear choice is Hale's line of reliable and durable pumps that deliver high performance. The results of the test clearly illustrate why the most demanding departments use Hale's Qmax-XS pumps

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