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**Electronic Propellant Feed System Centrifugal Pump Performance Test**

This description of procedure defines the conditions for the hydraulic testing of the electric feed system centrifugal pump.

# **Overview**

The objectives of testing the electric feed systems centrifugal pump are to:

* Document system pump performance.
* Establish the system curve for the pumping system.
* Determine the operating point of the pump; i.e. the point where the pump’s impeller curve crosses the system curve with the discharge valve throttled and with the discharge valve fully open.
* Assess the match between “full flow”—flow delivered by the EFS pump with the discharge valve fully open—and the actual design flow requirement.
* Assess the implications of modifying pump performance via trimming the impeller, adding a cutwater, and using impellers of differing solidity.
* Detect and diagnose other control or performance problems.

# **EFS Standard Operating Procedure**

1. Suction valve of the pump is opened which causes fluid flow to the impeller and fills the volute
2. Open the vent valve which is on the discharge line before the discharge valve of the pump which will cause all air to move out of the casing and flow loop.
3. When some quantity of the fluid exits from the vent valve close it.
4. Open the bypass valve of the discharge valve which is near or side of the discharge valve on discharge line.
5. Start the pump and let it attain its capacity read from the discharge line pressure gauge.
6. When the pressure gauge is stable it is time to open the discharge valve of the centrifugal pump.

## **EFS Pump Performance Testing**

1.1 **Verify all EFS prefunctional checklists are complete.** Prior to performing any functional tests, the commissioning pre-start, start-up, and verification checklists should be completed, Prefunctional checklist items include, but are not limited to, the following:

1.1.1 [**Insert a list of things that should occur during correct EFS operation in this step of the test.**] Control system point-to-point checkout is completed to ensure all EFS input/output points are wired correctly, and all actuators and relays or motor starters respond to control signals.

1.1.2 Power is provided to pump assembly at proper voltage and phase rotation. As an alternative to verifying phase rotation, pump rotation should be verified.

1.1.3 The electric feed system has been proportionally balanced with all control valves fully open.

1.1.4 All necessary sensors are calibrated.

1.1.5 Locations of EFS pump, valves, and other system components are clearly and correctly located on as-built drawings.

## *Main and operating characteristics*

In order to obtain the main characteristic curves of the EFS pump it is operated at different speeds (rpm). For each speed, rate of flow discharge is varied by means of a delivery valve and different values of monomeric head Hm, shaft power P and overall efficiency Eo, are measured or calculated. The same operation is repeated for different speeds of the pump. Then Hm Vs Q, P Vs Q and Eo Vs Q curves are plotted, so that three sets of curves are obtained, which represent main characteristics of the EFS pump.

The pump head (hp) which consists of the static (elevation) head, friction head, pressure head, and the velocity head measures the total resistance the pump must overcome in unit feet (meter for SI system). It is calculated using the conservation of energy equation for steady flow through a control volume which in this case is the pump. This equation contains both the pressure head and the elevation head since the pressure differential measured across the pump is the sum of the static and hydrostatic pressures. The power delivered to the water by the pump Wwhp, the power delivered to the pump by the motor Wbhp, and the pump efficiency ηp are then calculated at each flow capacity Q (gpm).

# **Test Precautions**

* Exercise care when changing operating RPM if the equipment served by the pump is in operation.
* Avoid sudden flow changes to minimize the potential for water hammer, especially when throttling the discharge valve for a shut-off test.
* Exercise proper caution when working around live wiring and terminals and taking voltage or amp readings.
* Exercise proper caution while working around the rotating parts of the pump.
* **DO NOT** let EFS centrifugal pump operate for long periods of time at zero flow.
* **DO NOT** operate pump in reverse direction, this could cause severe damage to the impeller shaft.
* **DO NOT** run EFS pump dry.

Troubleshooting

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For team to look out for. *(Remove after tests are performed)*

1. The shut-off head, this is the maximum head that the pump can achieve and occurs at zero flow. The pump will be noisy and vibrate excessively at this point. The pump will consume the least amount of power at this point.
2. The best efficiency point B.E.P. At this point, the impeller is subjected to minimum radial force promoting a smooth operation with low vibration and noise. The pump will consume the power corresponding to its B.E.P. rating at this point.
3. The maximum flow point, the pump may not operate past this point. The pump will be noisy and vibrate excessively at this point. The pump will consume the maximum amount of power at this point.

Characteristic noise of cavitation: [Characteristic noise of cavitation](http://www.pumpfundamentals.com/images/cavitation.wav)

