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## From Experience

### Minimum Flow in Centrifugal Pumps: Flow Protection

The March 2022 issue of From Experience described some of the causes and consequences of operating a centrifugal pump below its Minimum Continuous Safe Flow (MCSF). The MCSF is the flow at which a pump can operate continuously without excessive wear from hydraulic anomalies and temperature rise associated with low flow conditions. In this issue, we explore three of the main methods of flow protection: continuous bypass, automated flow-controlled recirculation, and self-contained automatic recirculation valves.

#### Continuous Bypass

A continuous bypass involves a fixed restriction orifice leading back to the fluid source. The orifice should be sized to allow the MCSF when the main process path has been blocked. This solution has a low installation cost, is virtually maintenance free, and provides reliable pump protection. However, the pump and driver must be sized to allow for the recirculation flow as recirculation will take place even when process demands exceed the minimum flow requirement.

#### Automated Flow-Controlled Recirculation

An automated flow-controlled recirculation loop consists of a bypass that opens at low flows and closes when process demand exceeds the MCSF. This system typically

consists of a flow meter, a bypass control valve, and its related automation. The flow rate through the bypass is adjusted to maintain the minimum flow requirements as downstream demand fluctuates. Because flow only occurs when demand falls below the recommended minimum flow, this is an energy efficient option. However, it is the most complex and costly protection system in terms of materials and installation. Note that this option can also be configured with a sanitary valve for Clean-in-Place (CIP) conditions.

#### Automatic Recirculation Valves

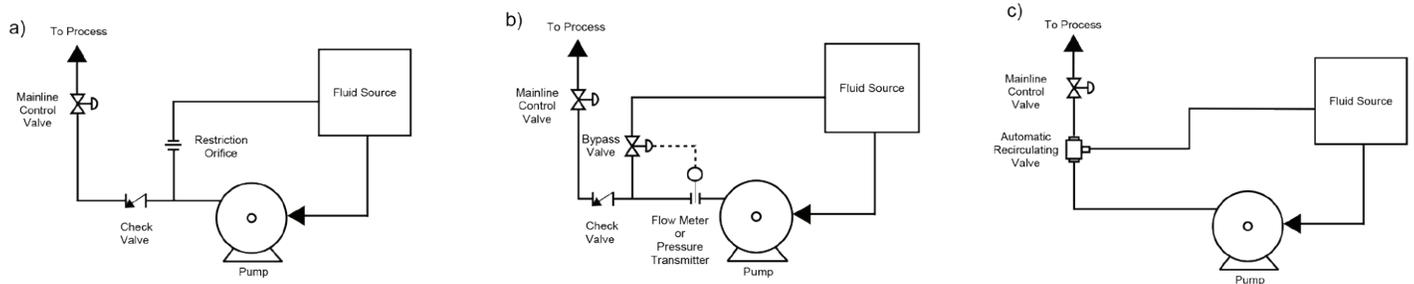
Automatic Recirculation Valves (ARVs) are multifunctional valves whose primary purpose is to ensure that a minimum flow passes through the pump at all times. These valves combine the check valve, the bypass valve, and the control valve into an interconnected unit. When flow through the pump begins to fall below the minimum

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#### EXPERIENCE IN BRIEF

Restriction orifices can come in a variety of types, e.g., Single-Stage, Multi-hole, Multi-Stage. Once the required pressure drop and flow are identified, it is important to work with a vendor to identify the correct orifice type and size for the application.

requirement, the ARV automatically opens to allow flow through the bypass. ARVs have the same energy savings as the automated flow control system and are cheaper to install. However, care needs to be taken to ensure that the valves are installed correctly and are properly maintained per the manufacturer's recommendation. Improper maintenance could cause the bypass to fail to open under low flow conditions.



- a) Continuous Bypass
- b) Automated Flow Controlled Recirculation
- c) Automatic Recirculation Valves

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