Hydraulic Fuse Tutorial

By Gordon Yowell
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What is a Hydraulic Fuse?

A Hydraulic Fuse is similar to an electrical fuse or circuit breaker found in our homes. You may have had to find the fuse box and reset or replace a blown fuse. This happened because the electrical circuit was overloaded and the capacity for carrying electrical current was exceeded. This condition can cause overheating of the circuitry or wiring, the fuse senses the overload and disconnects the electrical circuit effectively shutting it off. In this way, further equipment damage is eliminated and a potential safety hazard is avoided.

The Hydraulic Fuse provides similar protection to a hydraulic circuit. A Hydraulic Fuse is used to detect a leakage condition (such as a broken line or a disconnected hose) and shut off the circuit reducing the loss of fluid. A good definition of a Hydraulic Fuse is:

"A device used as a safety measure in hydraulic systems to prevent fluid loss."

A Hydraulic Fuse is a shut-off valve that actuates (closes) when a predetermined condition has occurred. Depending on the type of hydraulic fuse specified, this condition may be a sudden change in pressure or flow. The fuse shut-off may also be triggered when a specific quantity of fluid has been sensed.

History has shown that if hydraulic fuses had been used, lives and equipment could have been saved. In addition, expensive environmental clean-up could have been avoided.

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Why haven't hydraulic fuses been used?

Cost seems to be the main objection, even when the price of a fuse is less than $100.00. It is the same reason seat belts were not voluntarily installed in automobiles, it cost too much. It was not until the Government made it mandatory that seat belts were installed in every automobile. The same may be needed to mandate hydraulic fuses, especially in lifesaving applications, i.e. airplanes, cranes, lifts, elevators, etc. Again, just like wearing a seat belt doesn't guarantee to save your life in an accident, the odds of surviving the accident are much better when this safety device is securely in place.

In addition to the cost impact, there are other reasons for the reluctance of adding fuses to hydraulic circuits:

1.) Nuisance trips may occur (the fuse closes when it is not supposed to). These can be overcome by selecting the proper type of fuse for the application and choosing the correct size that matches the characteristics of the hydraulic circuit being protected.

2.) Not stopping a slow leak. Generally, hydraulic fuses guard against catastrophic failures. Again, selecting a quantity fuse may work in a slow leak application.

In summary, when selecting a hydraulic fuse it is important to have a clear understanding of the operation of the hydraulic system. Select and apply the proper type of hydraulic fuse with the correct rating for maximum protection.

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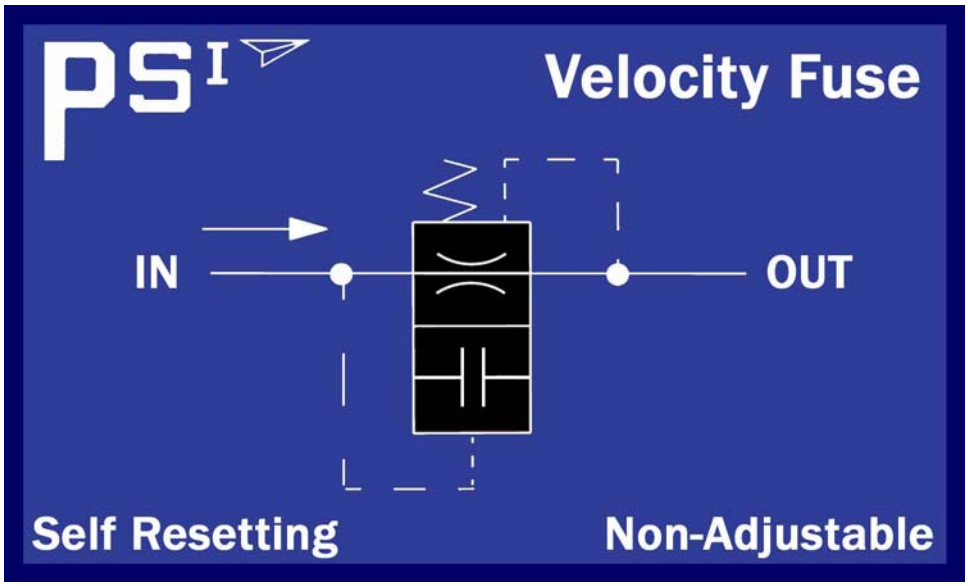
The Velocity Fuse

Our Velocity Fuse works by sensing flow across a control orifice. When the pressure differential exceeds the predetermined amount (approximately 50 psid), a spring biased poppet will close, shutting flow to the damaged hydraulic circuit.

NOTE: A velocity fuse requires a flow potential large enough to meet the differential pressure setting. Normally, the flow required to trip the fuse is 30% above the rated flow. This is typically done to allow small flow surges just above the fuse rating without tripping the fuse. Flow surges can be caused by sudden start/stops, valve actuations, motor reversals, etc. The fuse allows reverse free flow. Depending on the system requirements, hydraulic fuses may reset automatically when the pressure is removed or with reverse flow. Refer to Schematic 1 below.



Schematic 1

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Time Delay

To overcome nuisance trips, the patented PSI velocity fuse incorporates a time delay feature that allows an overshoot above rated flow for up to 0.2 seconds before closing. This prevents nuisance trips caused by sudden flow surges.

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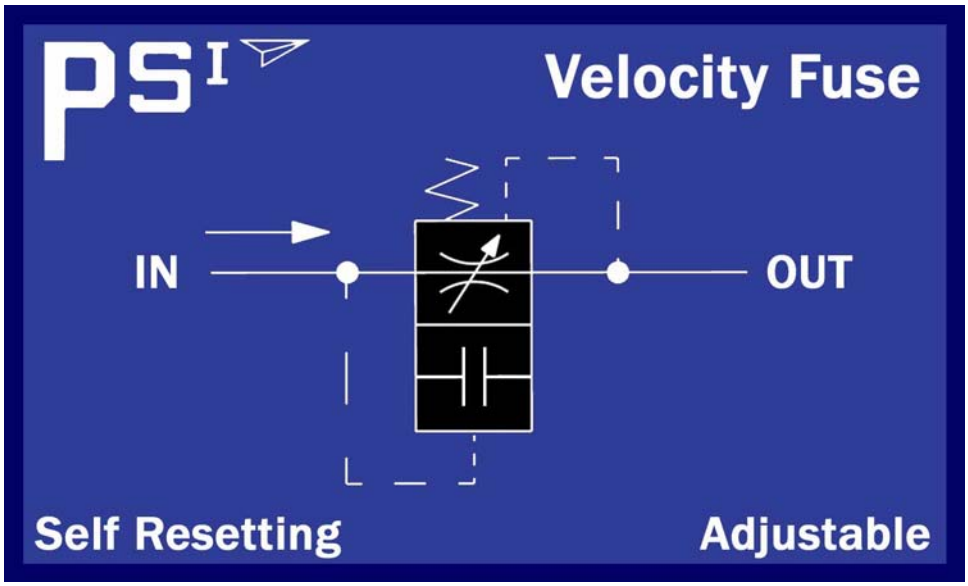
Adjustable Fuse

To optimize the fuse trip setting, our patented velocity fuse can be installed in a hydraulic line and externally adjusted to provide a flow trip setting without having to disconnect the hydraulic lines. Once the fusing flow is set the housing can be locked for repetitive operation. Refer to Schematic 2 below.



Schematic 2

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Soft Stop

Elevator/lift fuse applications may require a maximum "G" loading for stopping. Other requirements include safety pressure rating (7-8 times normal operating pressure) maximum speed and performance requirements. To meet these requirements we have incorporated a variable orifice in our velocity fuse. The variable orifice feature limits the shock load to less than 0.3 G's and the closing time to less than 0.2 seconds.

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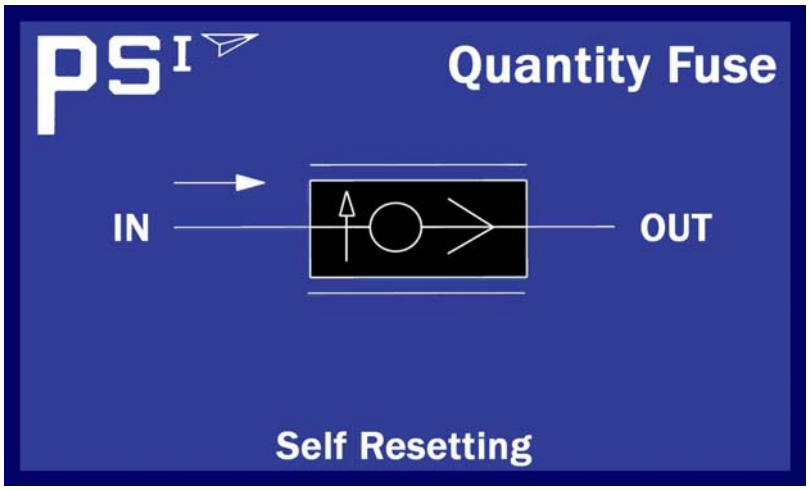
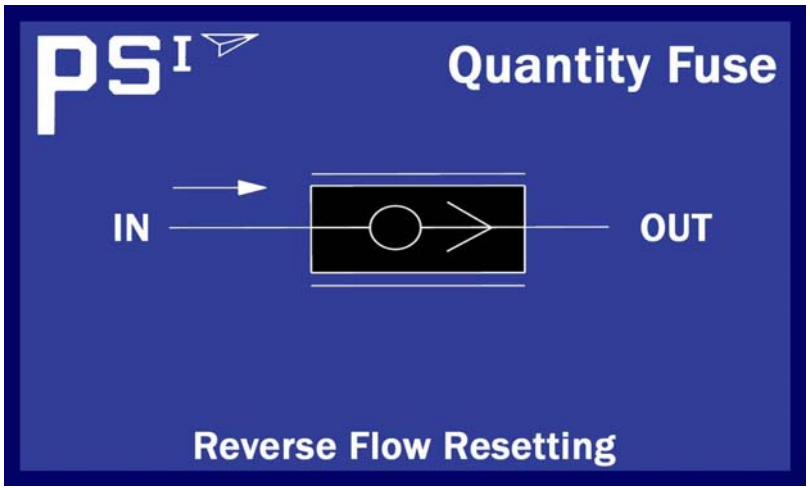
Quantity Fuse

Quantity Fuses are generally used in hydraulic circuits that have a limited fixed volume, for example a clutch or locking circuit. Our quantity fuse works by sensing flow across two (2) orifices sized to provide a specific volume. Generally quantity fuse volume is sized to be less than one half gallon. Refer to Schematic 3 and Schematic 4 below.



Schematic 3



Schematic 4

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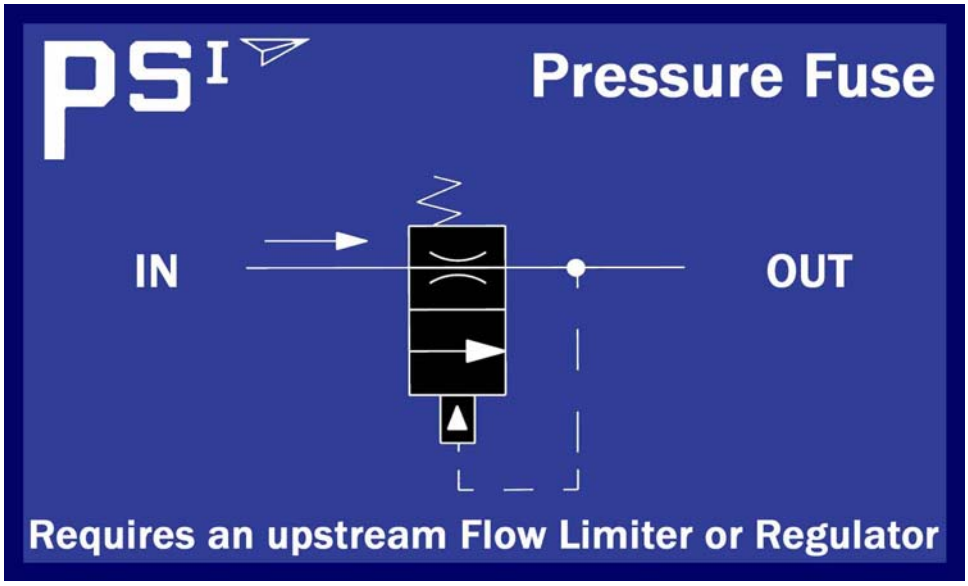
Pressure Sensing Fuse

Pressure Sensing Fuses operate by sensing low pressure (low load) for valve actuation. NOTE: Flow potential must be limited such that the outlet pressure does not exceed the fuse actuation pressure. Refer to Schematic 5 below.



Schematic 5

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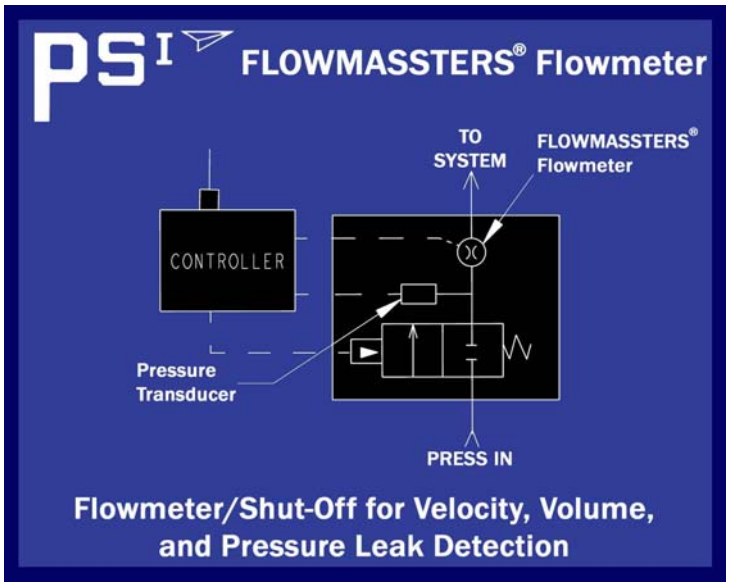
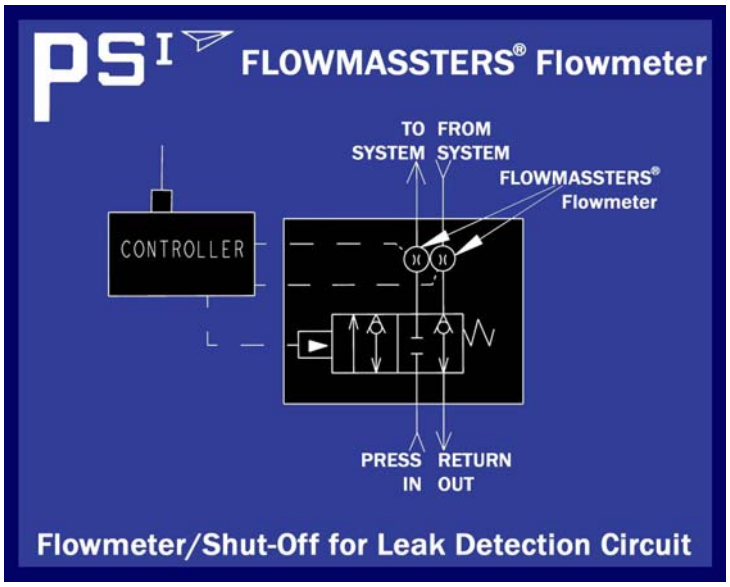
Smart Hydraulic Fuse

In addition to hydraulic fuses we have developed a leak detection method that utilizes a flowmeter (Flowmassters®) with a microcontroller to monitor flow conditions and send a shut-off signal to (an) electronically controlled valve(s). Any hydraulic circuit can be disabled when the predetermined flow conditions are not met. For example, a circuit can be turned off when a flow leak is detected or can be switched to a back-up system. This method can also monitor the circuit volume and can shut off the circuit if the total volume has been exceeded. Refer to Schematic 6 and Schematic 7 below.

NOTE: The Flowmassters® flowmeter is patented and manufactured by Predator Systems Incorporated (PSI). It has instantaneous response (reads at a 1 millisecond interval) when sensing the flow rate. Flow loss may be detected before the system pressure decays or before there is any noticeable loss in performance.



Schematic 6



Schematic 7