PREFERRED RELIABILITY PRACTICES

FLOW FUSES FOR ELIMINATION OF HAZARDS IN PNEUMATIC AND HYDRAULIC SYSTEMS

Practice:

To maximize system reliability (fail safe) through use of Flow Fuses when designing pneumatic or hydraulic systems for either facilities or ground support applications

Benefits:

The Flow Fuse, otherwise known as an Excess Flow Check Valve, inhibits media flow as a result of sensing a pressure differential which exceeds preset limits. Pressure differentials would be a result of downstream component failure, line rupture a downstream component failure, line rupture or catastrophic human error.

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The Flow Fuse is essentially a Check Valve installed in the system such that flow is attempting to travel in the normally blocked direction. A mechanism enabled by pressure equilibrium causes the normal :q.check":eq. function to revert to a “bypass” function. Upon sensing a shift in pressure differential which exceeds some calibrated setpoint (user defined), the “bypass” function is disabled and the valve immediately inhibits flow.

The Flow Fuse has extremely rapid response characteristics (tests have proven 10-100 msec), can handle a wide range of applications (50-14000 psi), and has a long proven test and application history. The unique qualities of the Flow Fuse including multiple reset options (manual, automatic or remote), remote position indication and time delayed opening/closing features make the device adaptable to almost all applications where inadvertent expulsion of media could result in personal injury, loss of production or other catastrophic occurrences.

Installation of Flow Fuses will provide extended downstream protection to personnel, equipment and/or facilities. The prime benefit provided by Flow Fuses will be the ability to produce near ideal “failsafe”. designs. Flow Fuses, if used to their potential, will minimize the effects of hardware failure through systematic abatement of physical hazards. Additionally, inclusion of these devices will substantially
lower failure recovery costs.

Programs Which Certify Use:

These devices are utilized at the Operations & Checkout Facility (O&C) at Kennedy Space Center, Florida. Their prime function is to prevent atmospheric oxygen depletion from occurring in underground tunnels should high pressure lines rupture expelling inert gases.

KENNEDY SPACE CENTER

FLOW FUSES FOR ELIMINATION OF HAZARDS IN PNEUMATIC AND HYDRAULIC SYSTEMS

Center to Contact for More Information:

Kennedy Space Center (KSC)

Implementation Method:

Flow Fuses should be installed in Pneumatic and Hydraulic systems for the prevention of loss of life, injury, or flight hardware damage due to expulsion of high pressure gaseous or liquid media. The designer should only implement these devices after a careful review of good safety review considerations. System analysis and subsequent modeling will reveal strategic points for the inclusion of Flow Fuses to maximize protection and provide system fault isolation. As an analogy, these devices will be installed much like circuit breakers used in electrical circuit design. In those applications, main breakers provide global overcurrent protection and branch circuit breakers provide secondary fault isolation (See Figure 1 "Flo- Fuse Implementation Diagram").

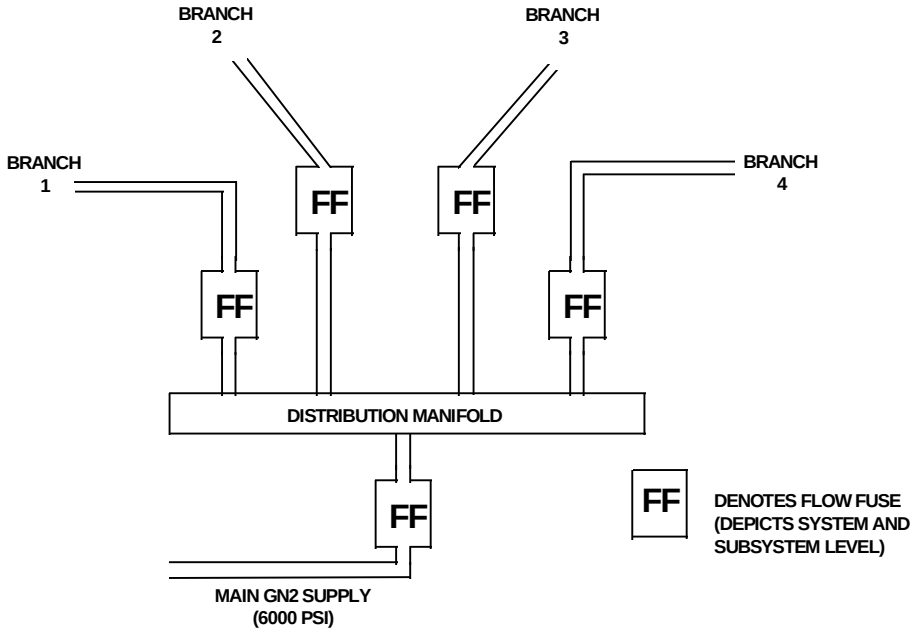

Figure 1. Flo-Fuse Implementation Diagram

Technical Rationale:

Flow Fuses should be installed in Pneumatic and Hydraulic systems for the prevention of loss of life, injury or flight hardware due to catastrophic hardware failure or human error. These devices are appropriately selected through system modeling to match system operating parameters and

installed within flexible or hard-lines as necessary. Flow Fuses should be utilized at both the system and subsystem level where they can serve as narrow field fault isolation devices. In contrast to manual hand valves or other manually actuated shut-off devices, Flow Fuses are automatically tripped and offer multiple reset options and monitor/control functions. Figure 2 depicts generic fluid distribution system uses and implementation methodologies.

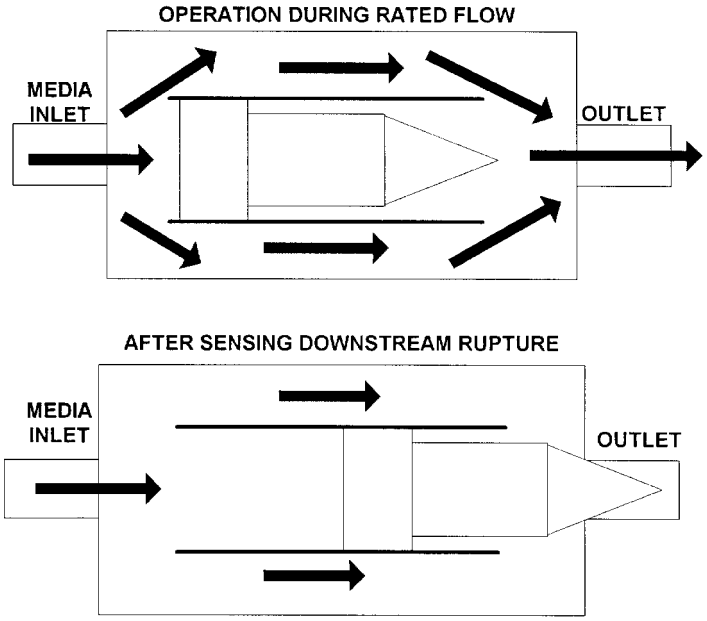

Figure 2. Flo-Fuse Typical Diagram

Impact of Nonpractice:

Increased risk of loss of life or damage to hardware.

References:

1. NCSL 174-73, Naval Coastal Systems Laboratory "Test and Evaluation of Flow Fuses for Use In Manned Pressure Chambers"; by Clifford R. Holland, NCSL dated August 1973
2. Marotta Scientific Controls, Inc.; Product Correlation Sheet
3. Marotta Scientific Controls, Inc.; "FLOW FUSES" dated 23 November 1970 (White Paper)