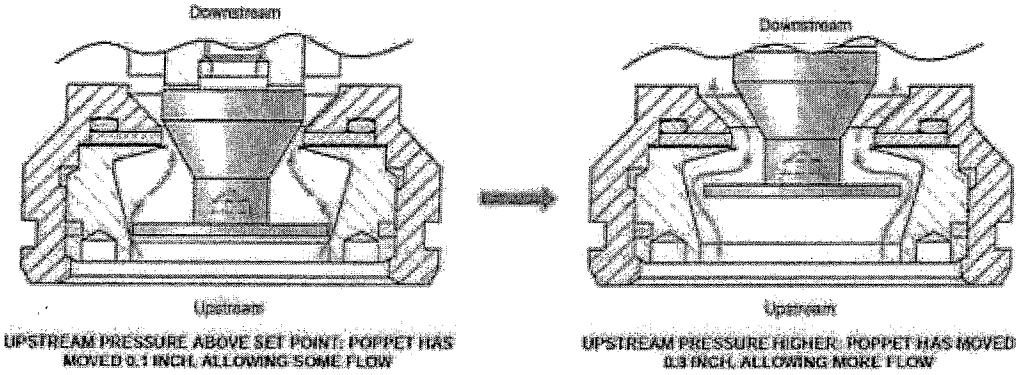
NASA Helps Industry Relieve Pressure Safely

In many industrial applications, pressure relief valves (PRV) perform the critical function of safely releasing pressure before potentially damaging build-ups occur. Conventional relief valves, however, have proven unstable; leading to premature wear and devastating consequences. A high-performance pressure relief valve, the PRV95, now being manufactured by Marotta Scientific Controls, Inc., of Montville, NJ, provides the answer to premature wear and instability. Using an improved valve design developed under a NASA Small Business Innovation Research Program (SBIR) contract from John C. Stennis Space Center (SSC), Marotta's PRV95 pressure relief valve provides stability over the entire operational range, from fully closed to fully open. The valve employs upstream control for valve positioning, that makes the valve more stable and affords excellent repeatability with minimal lag time. " It opens and closes softly, and does not oscillate or generate hard impacts; oscillation can result in a hard impact pressure release, which can lead to an explosion in the presence of oxygen," says Bill St. Cyr, Chief of Test Technology Branch at Stennis Space Center.

Marotta's PRV95 design is also unique in its ability to maintain a seal near the set point of the relief limit. Typically, relief valves seal tightly up to 90% of set point and then reseat when pressure is reduced to 85% of set point. The PRV95 technology maintains seal integrity until 98% of set point and will reseat a 95-97% of set point. This allows the operator to protect his system while not exceeding its limits.

HOW PRV95 WORKS

The key to stable, soft-opening/soft-closing operation is upstream control. A conventional "pop" type pressure relief valve is characterized as operating under downstream control. Once the valve has opened, the flow is controlled mainly by an effective cross-sectional area downstream of the valve seat. In the PRV95, the flow-limiting cross section remains upstream of the valve seat at all times, thereby, creating upstream control. The figure below illustrates the basic design and principle of operation of a controlled pressure relief valve.



UPSTREAM PRESSURE ABOVE SET POINT; POPPET HAS MOVED 0.1 INCH, ALLOWING SOME FLOW

UPSTREAM PRESSURE HIGHER; POPPET HAS MOVED 0.3 INCH, ALLOWING MORE FLOW

As in a conventional relief valve, excessive upstream pressure opens the valve by lifting a poppet from a seat in the valve body. However, the poppet in the PRV95 includes a conical portion and a paddle (essentially a disk) upstream of the conical portion. When the valve is closed and the upstream pressure is below the set point, the conical portion of the poppet engages about half the thickness of a main valve seat, forming a tight seal. In this condition, the paddle engages the wall of a cylindrical passage upstream of the main valve seat. When the upstream pressure rises to approximately the set point, the poppet moves downstream a little, but the valve is not yet open; the conical portion of the poppet remains partly engaged with the main valve seat, while the paddle remains in the cylindrical passage in the retainer. As pressure rises above the set point, the conical portion of the poppet moves out of the main valve seat and the paddle moves out of the cylindrical passage in the retainer.

BENEFITS TO INDUSTRY

Primarily designed to operate in systems that contain gases and liquids in a variety of pneumatic, hydraulic, and cryogenic applications, the PRV95 valve offers several advantages over valves with different operating characteristics. These advantages include: (1) a smooth transition from fully closed to fully open, (2) noise and wear reduction through elimination of chatter, (3) reduction in the risk of product fire and

explosion through elimination of hard impact, and (4) corresponding reductions in the uncontrolled venting of hazardous fluids and products. In summary, the increased stability of the valve operation results in better performance, with wider operating ranges and control. All of these attributes translate into the additional advantage of lower life-cycle costs.

WHAT IS THE FUTURE

To date, sales of the PRV95 total over $400,000.00 mostly to high-end customers, including the U.S. Navy, who has installed the valves on its DDG-51 Class Destroyers. The recently completed repairs to the USS Cole, the ship damaged by terrorists bombs in Yemen, included installation of the PRV95 relief valve. "Additional commercial sales are now required in order to be more than just a specialty player in the relief valve market. Our relief valve is not meant to be used everywhere, its features aren't always required. But where a traditional valve fails and the media is expensive or volatile our design is vastly superior," says Patrick Marotta, Commercial Products Manager at Marotta. To this end, Marotta is pursuing two avenues. First is a valve redesign effort to improve manufacturability to reduce the high price of the product. The second initiative is to obtain ASME Section VII certification. This certification is required for many industrial applications. To this end Marotta Scientific and the Office of Technology Transfer at John C. Stennis Space Center have entered into a Dual-Use Cooperative Agreement to develop an ASME Section VII certified PRV95 that meets the special pressure and compatibility requirements at SSC.

WHY SBIR WAS IMPORTANT

"The SBIR program enabled us to research, develop, and commercialize this technology through a combination of development funds and Marotta Scientific's own investment," said Marotta. "Right now, a follow-on dual-use agreement that will enhance our technology and address a government need is being completed. These partnerships have provided critically needed Federal resources to match our own capabilities to support innovation of this technology. Our company could provide the

talent but could not supply all of the other assets necessary for this technology to succeed."

The Small Business Innovation Research Program (SBIR) is a highly competitive multi-phase program that provides small U.S. businesses with federal funds reserved for conducting serious research and development. The SBIR Program at Stennis Space Center is managed through the Office of Technology Transfer; for more information regarding the NASA Small Business Innovation Research Program, contact the Office of Technology Transfer at Stennis Space Center at (228) 688-1929 or visit our website at http://technology.ssc.nasa.gov.

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