

NASA White Sands Test Facility Valve Repair Facility Helps Resolve Relief Valve Issues

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Disassembly, cleaning, maintenance, reassembly, and testing of pressure relief and pressure safety valves is performed at the NASA Johnson Space Center White Sands Test Facility (WSTF) in compliance with American National Standards Institute [ANSI] National Board Inspection Code (NBIC)/NB-23. The WSTF cleaning process is approved for oxygen service, International Space Station, and space shuttle support.

Background

WSTF, a human space flight test facility since the 1960s, has a requirement for items used in site test systems to be precision cleaned. Because of the possibility that contaminants could adversely affect the performance of test articles and test systems, components in hypergolic propellant, oxygen, and other fluid systems must be safely decontaminated and precision cleaned. After an “as-received” inspection, including review of the manufacturer drawings and specifications, the item is disassembled for cleaning. Precision cleaning combines chemical, mechanical, and ultrasonic cleaning. Procedures have been developed to safely clean various metals, elastomers, and composites. Item reassembly is performed in a clean room. Once the item has been reassembled, it is subjected to various checks and tests to ensure that it is operating as the manufacturer designed.

A component, to be properly cleaned, must be fully disassembled before each piece is partly cleaned, reassembled, and functionally tested. This became a problem when the standard for NASA ground-based pressure systems required that pressure systems be NBIC-compliant and all relief valves in a code application meet NBIC requirements. Not only do the valves have to be manufactured according to NBIC code, but the code must be maintained by an NBIC-approved valve repair facility. Code valves have a tamper-proof seal; if the seal is broken, the valve is no longer code compliant. WSTF faced conflicting requirements as there was no NBIC-approved valve repair (VR) facility that could maintain the required cleanliness level during testing. It was a vicious cycle because if WSTF cleaned a code valve, the valve would be out of compliance. To make the valve code compliant again, it would have to be sent to an NBIC-approved VR

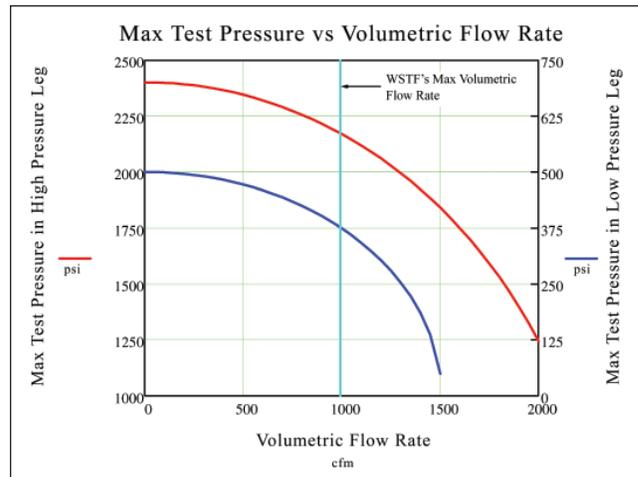


Fig. 1. Flow and pressure rating of the White Sands Test Facility flow facility.

facility, which would then contaminate the valve because cleanliness could not be maintained.

To solve this code-compliance problem, WSTF applied for and received the “VR” stamp from the National Board of Boiler and Pressure Vessel Inspectors in February 2010. Now, WSTF can repair relief valves in a Class 100 clean room that meets the requirements of the National Board. Only facilities certified by the NBIC can perform relief valve refurbishment and retain the valve code stamp. Unique to WSTF, and to NASA, is receiving “authorization of use” of the “VR” stamp from the National Board. In support of the VR capability, WSTF also built a relief valve flow facility in the Class 100 clean room to verify that the valve meets the flow requirements as approved by the National Board.

The VR facility ensures that relief valves are operating within manufacturer specifications and to customer expectations. The facility is capable of verifying flow capacities of pressure relief valves up to 1000 scfm, and pressures not to exceed 2800 psig, using clean gaseous nitrogen (figure 1). Because assembly and testing of the relief valves is performed in a Class 100 clean room environment, WSTF is the only known clean flow test facility in North America (figure 2).



Fig. 2. Relief valve to be tested is being connected to the GN2 exhaust system.



Fig. 3. Softgoods contamination.

Working with Manufacturers

Due to the hazardous fluids that flow through many of the valves at WSTF, even more stringent leak tests are needed than are required by NBIC. During routine leak tests, the VR facility found several valves that leaked prematurely at the crack pressure. Since these particular valves were low-pressure valves, it was initially thought the seating problems were caused by the design of the polytetrafluoroethylene (PTFE) seats. After inspection, however, embedded metal particles were found in the soft goods received from the manufacturer (figure 3), which caused the leakage and released loose particles of metal into the pressure system. WSTF began working with the manufacturer to remedy the problem of foreign particles embedded in the soft goods of the valve repair kit. To improve the leak tightness of the low-pressure valves, the manufacturer is working with WSTF in redesigning the shape of the soft goods to promote cold flow of the PTFE soft goods.

Another area in which WSTF has been working with manufacturers is in valve spring selection. Every valve received at WSTF is disassembled before cleaning, reassembly, and functional testing. Although not required by NBIC, WSTF flow tests each valve before returning it to the customer as part of WSTF quality control process to ensure the valve flow capacity is the same as stated in its specifications. During flow testing, some valves flowed significantly lower than the specified capacity. After investigating, it was discovered that the incorrect spring had been inserted at the manufacturing facility. In this case, the valve specifications called for a 60-psi-rated spring, while the actual spring in the valve was rated for 150 psi. Compression tests on the same valves using other springs determined that the springs were mislabeled. WSTF is working with the manufacturer to remedy this, and has added spring compression tests as well as flow testing to its processes.

Replacement Parts

The VR facility also provides replacement parts control. This ensures that parts being used for relief valve repair are replacement parts from the original manufacturer, or from a vendor approved by the National Board to make replacement parts that meet original manufacturer specifications. WSTF maintains traceability for parts and testing on code and non-code applications. All inspection measurement and test equipment used to support the VR facility is calibrated at WSTF and is traceable to National Institute of Standards and Technology or other internationally agreeable intrinsic standards.

By exceeding industry standards for superior precision cleaning and component refurbishment, the WSTF VR facility satisfies customer needs for the highest-quality products possible. With WSTF identifying issues with both code and non-code valves and working with various manufacturers to mitigate these problems, a better product is produced—not just for WSTF, but for all customers of the manufacturer.