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WHA Test Report
on
Tekno Key Operated Pin Index Valve

For
BOC India Limited

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WHA Test Report on Tekno Key Operated Pin Index Valve

Introduction

BOC India Limited requested that Wendell Hull & Associates Inc. (WHA) conduct pneumatic impact testing in gaseous oxygen to evaluate the ignition propensity of the test articles indicated below:

Test Article:	Tekno Key Operated Pin Index Valve
Test Articles Supplied by:	BOC India Limited
Test Article Working Pressure:	177 Kg/cm^3

Test Documents

EN 849: "*Transportable gas cylinders – Cylinder valves – Specification and type testing*"; Section 5.48 – Oxygen Pressure Surge Test

Typical test conditions applied to the valves based on the requirements of the test document listed above or special instructions from the customer were as follows:

Test Pressure (1.2 times the MAWP):	3020 psig (212.4 kg/cm^3)
Test Gas:	Oxygen – 99.5% (minimum)
Pressurization Rate:	20 ms (+0, -5 ms)
Test Cycle Period:	30 sec
Minimum Pressure Hold Period:	10 sec (minimum)
Minimum Vent Period Between Cycles:	3 sec
Test Gas Temperature:	60 ^{o}C (+/- 3 ^{o}C)
Pressure Surge Application Point:	Outlet port
Pressure Surge Cycles:	50 cycles in two configurations (see below)

Test Article Description

The test articles consisted of brass bodied cylinder valves equipped with a rotating seat, "plug-style", operating mechanism. A typical valve in its "as received" condition is attached as Photo 1. Three (3) test articles (TA-1A, TA-2A, and TA-3A) were tested according to the test standard indicated above.

Test Setup:

The test system consisted of an accumulator to supply heated (~ 60 ^{o}C), high-pressure oxygen to a rapid opening or "impact valve". Prior to testing, calibration cycles were performed on the WHA test system to ensure that the required pressure rise time of 15 to 20

milliseconds was achieved at the end of a capped, 1-meter long, 5 mm inside-diameter tube. A test article was affixed to the WHA test system at an interface located a distance of one meter from the impact valve. A vent valve to relieve pressure in the test system was located between the WHA impact valve and the test article. A high frequency response pressure transducer was provided to ensure that the required test article pressurization rate was achieved for each cycle. Pressurization rates were monitored and recorded during each pressure shock. An oxygen supply was provided to replenish the test system accumulator between test cycles. The test was performed under computer control and data was recorded digitally. Figure 1 depicts a schematic representation of the WHA pneumatic impact test system.

Test Conditions

Each valve was tested in two configurations within the standard WHA pneumatic impact test system[1]. Photo 2 shows a typical test article as installed on the WHA test system.

The two test configurations per EN 849 were as follows:

Configuration 1: The valves were subjected to rapid pneumatic impact pressurizations with the valve closed and the pneumatic impact applied to the valve outlet.

Configuration 2: The valves were subjected to rapid pneumatic impact pressurizations with the valve open and the pneumatic impact applied to the valve outlet. The normal valve inlet was plugged for this configuration.

Test Results

Pressure surge cycles were conducted on each of three test articles (TA-1A, TA-2A and TA-3A) according to the configurations listed above. Fifty (50) pneumatic impact cycles were performed in each configuration. No evidence of combustion was observed visually or audibly during the test. Post-test disassembly of each test article did not reveal evidence of ignition, scorching, melting, or deterioration of the valve seat or seals. Photographs of the post-test disassembled test articles and main seats for the three cylinder valves tested are attached as Photos 3 – 8.

Based on the results observed during this testing, all three pin index valves were judged by WHA personnel to have successfully PASSED the pressure surge requirements of EN 849, Section 5.48.

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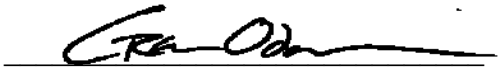
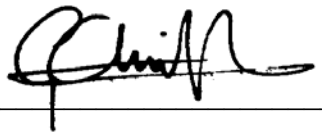
[1] Newton, B., Porter, A., Hull, W.C., Stradling, J., and Miller, R., **"A 6000 psig Gaseous Oxygen Impact Test System for Materials and Components Compatibility Evaluations,"** *Flammability and Sensitivity of Materials in Oxygen-Enriched Atmospheres: Eighth Volume, ASTM STP 1319,* W.T. Royals, T.C. Chou, and T.A. Steinberg, Eds., American Society for Testing and Materials, 1997.

Test Conducted By:



Greg Odom, BSME
Wendell Hull & Associates, Inc.

Test Results Reviewed by:



Gwenael Chiffoleau, BEng, PhD
Wendell Hull & Associates, Inc.

Test Results Approved By:

Barry Newton, BSME, PE
Wendell Hull & Associates, Inc.

DISCLAIMER:

WHA does not endorse or warrant any component or item tested by WHA personnel as being suitable for any design function or service application what-so-ever. Wendell Hull & Associates, Inc. has not performed any evaluation or testing beyond that stated herein, and expressly denies any responsibility for having evaluated the test article for function or safety. WHA disavows any responsibility for the function or safety of test articles.

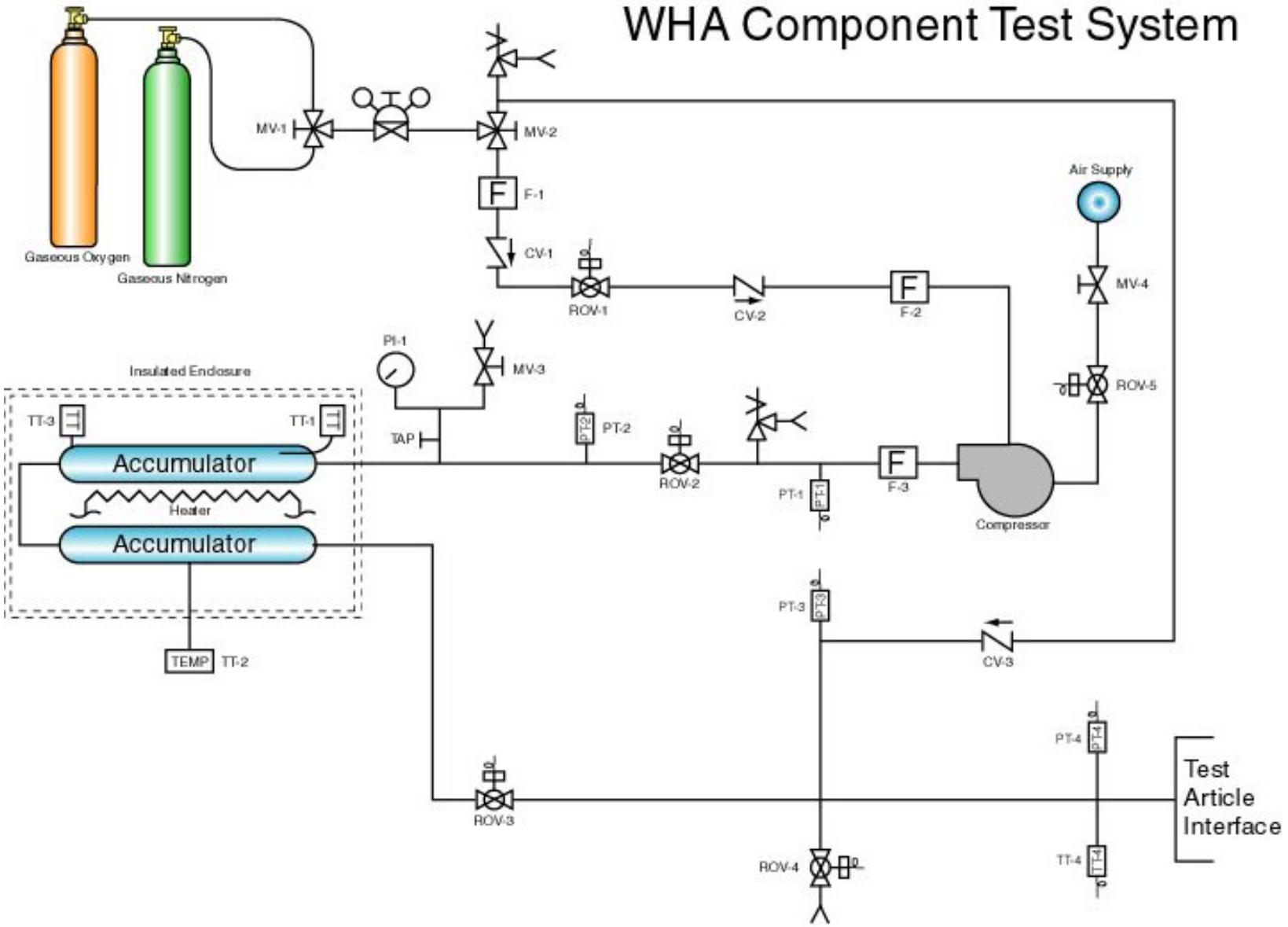


Figure 1: WHA Test System Schematic.

Photo 1: Typical test article in its "as received" condition.

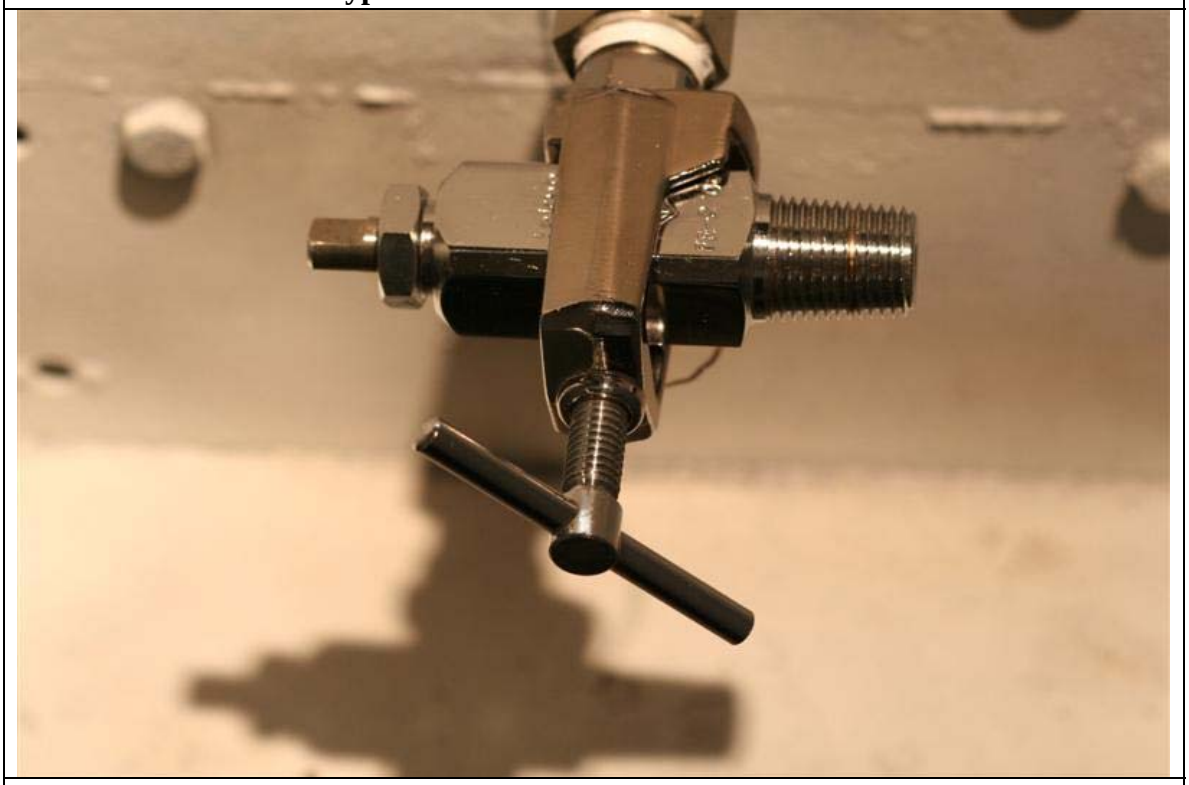


Photo 2: Typical test article as installed on the WHA test system.

Photo 3: Post-test view of test article TA-1A after disassembly.

Photo 4: Condition of the main seat after testing on test article TA-1A.

Photo 5: Post-test view of test article TA-2A after disassembly.

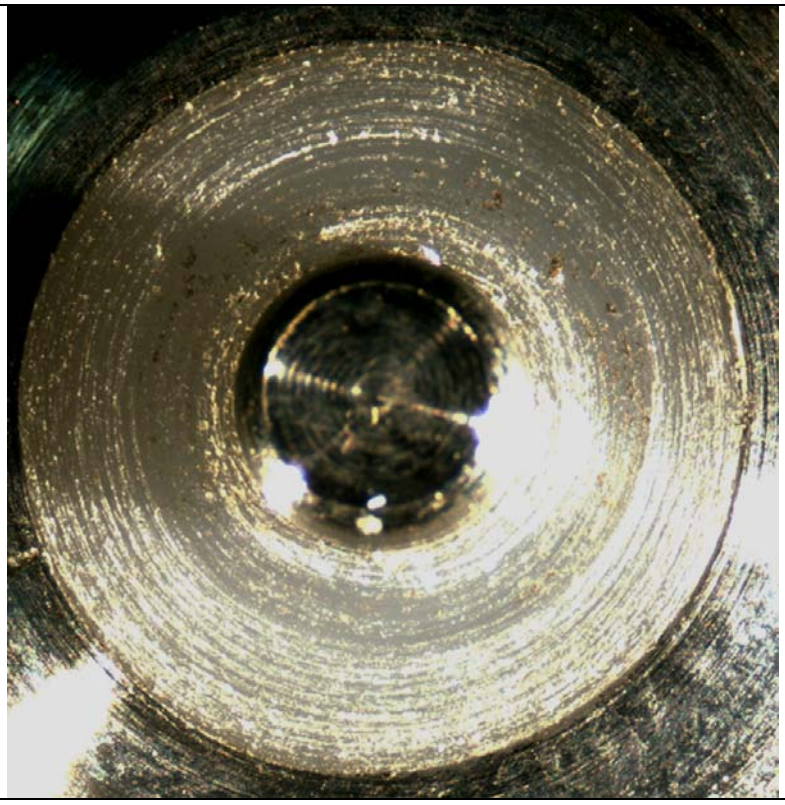


Photo 6: Condition of the main seat after testing on test article TA-2A.

Photo 7: Post-test view of test article TA-3A after disassembly.

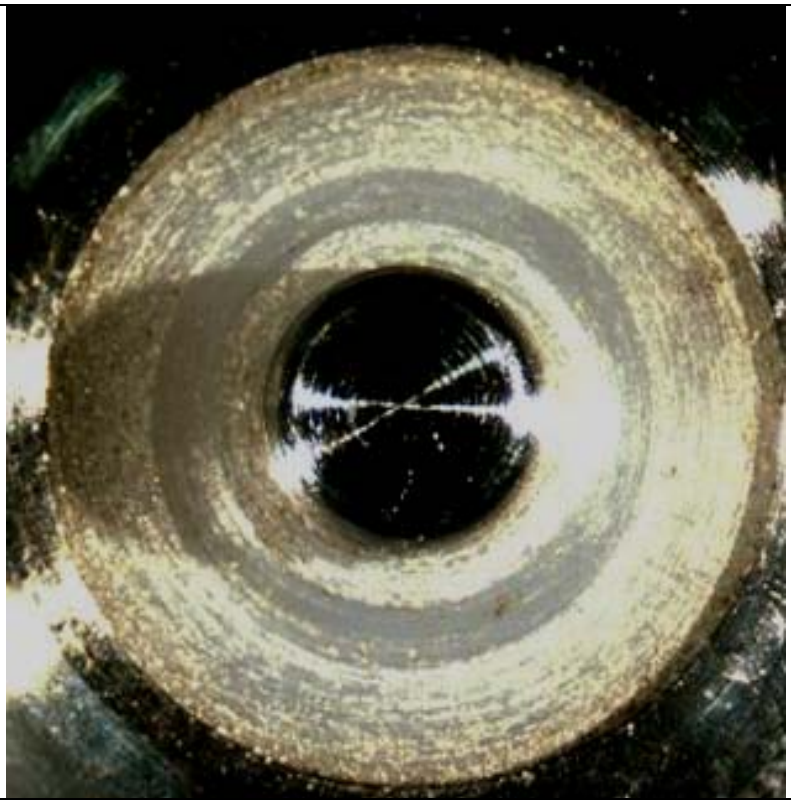


Photo 8: Condition of the main seat after testing on test article TA-3A.