Hy-Lok

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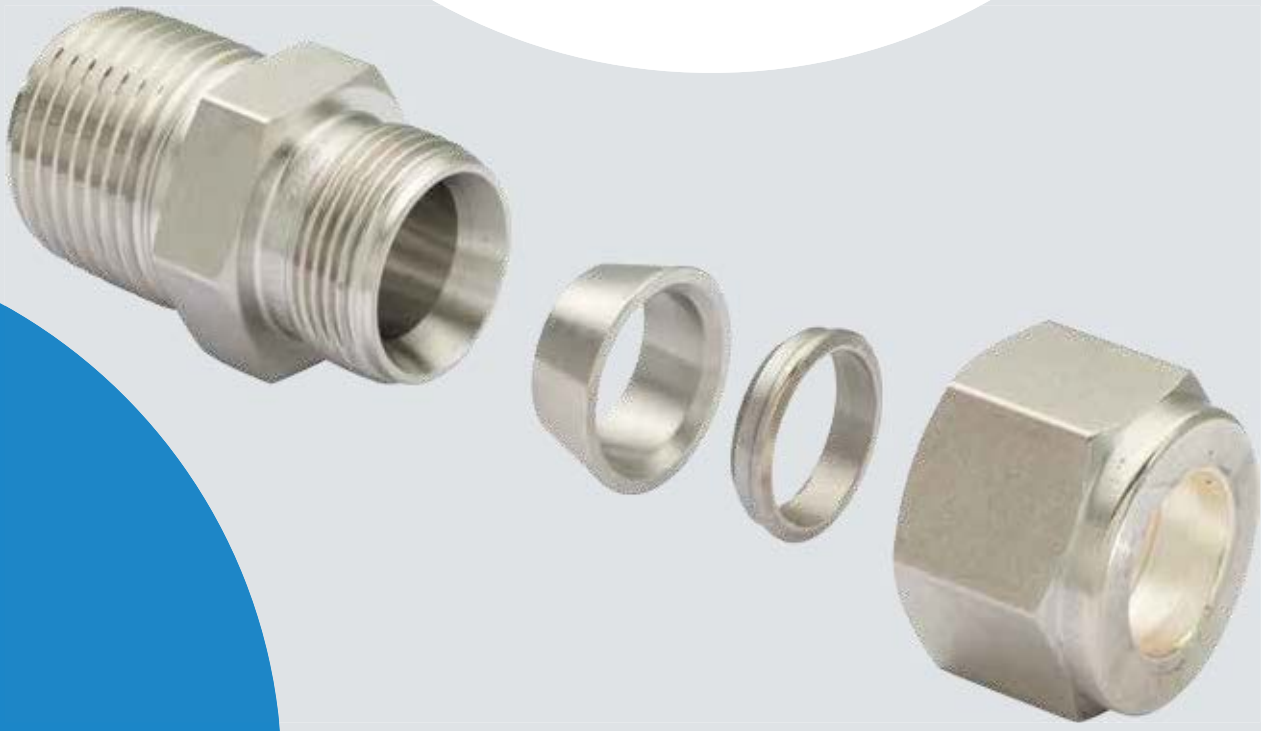
ASTM F-1387 ENGINEERING TEST SUMMARY ETR 1028-15



ENGINEERING TEST SUMMARY ETR 1028-15

Hy-Lok Tube Fittings
ASTM F1387 Test Summary
Standard Specification for Performance of Mechanically Attached Fittings

Purpose
This study was conducted to test the performance of stainless steel Hy-Lok tube fittings, following the guidelines of ASTM F1387 (2012) standard.

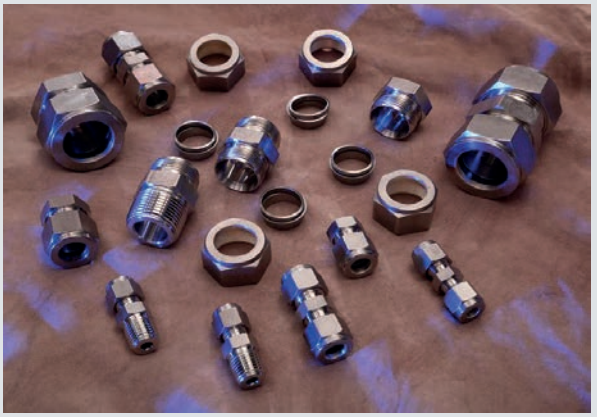
Test Conditions
All tests, except for the shock test, were performed at the test facilities of Southwest Research Institute, San Antonio, Texas. The shock test was performed at the Dayton T. Brown, Inc. test facility in Bohemia, New York.

Test Method
All fittings were assembled in accordance with Hy-Lok's published instruction. All tests were performed in accordance with ASTM F 1387 standard, including the Supplementary Requirements as applicable.

Test Results
See enclosed overview of individual tests. Hy-Lok Data Sheets are maintained on file at Hy-Lok Corporation.

Conclusion
Hy-Lok Tube Fittings meet the requirements of ASTM F1387-12 and SAE MA2003.

Referenced and Related Documents
SAE MA2003, Rotary Flexure Testing of Hydraulic Tubing Joints and Fittings.



ETR 1028-15
Testing Overview

The rated pressures for the 316 stainless steel tubing or MAFs are:

0.25-in outer diameter x 0.049-in wall thickness = 7,500 psig
0.375-in outer diameter x 0.049-in wall thickness = 4,800 psig
0.50-in outer diameter x 0.065-in wall thickness = 5,100 psig
0.75-in outer diameter x 0.095-in wall thickness = 4,900 psig
1.0-in outer diameter x 0.095-in wall thickness = 3,600 psig

The tests described below were conducted per ASTM F1387 standard procedure (Standard Specification for Performance of Piping and Tubing Mechanically Attached Fittings).

Pneumatic Proof Test

Each of the fitting sizes were assembled into manifolds with each size consisting of 32 connections. Each manifold was submerged in water and pressurized with nitrogen to 100 psig for 5 minutes. Pressure was then gradually increased to 500 psig and maintained at that pressure for 5 minutes. No leakage was noted and all of the Hy-Lok MAFs met the acceptance criteria stated in ASTM F1387.

Hydrostatic Proof Test

The same manifolds were subjected to the hydrostatic proof test with each being filled with water and pressurized to 100 psig for 5 minutes. Pressure was then gradually increased to 150% of the rated pressure (.25 in = 11,250 psig, .375 in = 7,200 psig, .5 in = 7,650 psig, .75 in = 7,350 psig, and 1 in = 5,400 psig). No detectable leakage of any kind was observed.

Impulse Test

For this test, six MAFs of each size were used and subjected to at least one million pressure cycles. Three of the six were disassembled and reassembled after every 25% of the cycles (250,000 cycles). Pressures were cycled from 133% to 20% of the rated pressure – 9936 to 1487 for 1/4", 6425 to 987 for 3/8", 6813 to 1124 for 1/2", 6602 to 405 for 3/4", and 4683 to 782 for 1" with a cycle occurring approximately every second. All of the MAFs met the acceptance criteria stated in ASTM F1387.

Flexure Fatigue Test

Six MAFs of each size were subjected to this test, which consists of a bidirectional pressure applied to the MAF while also subjected to the internal hydrostatic pressure. These tests were conducted at 30,000 cycles. Three out of six MAFs were subjected to the repeated assembly test every 7,500 cycles. At the end of the 30,000 cycles each specimen was then retested to the Hydrostatic Proof Test. All of the MAFs met the acceptance criteria stated in ASTM F1387.

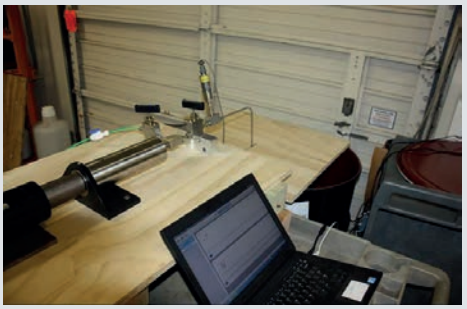
ETR 1028-15
Testing Overview

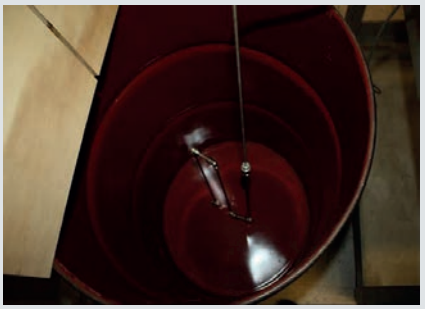
Tensile Test

After passing the pneumatic and hydrostatic proof tests, six of the MAFs were tested. The objective of this test is to achieve the calculated tensile load without separation of the tube fitting joint. All of the MAFs met the acceptance criteria stated in ASTM F1387.

Hydrostatic Burst Test

This test demonstrates the reliability of the MAFs when exposed to hydrostatic over-pressure. This test was conducted on four of the MAFs of each size that passed the shock and elevated temperature soak tests. The pressure was gradually increased to four times the rated pressure of the tube (30,000 psig for the 1/4 inch, 19,200 psig for the 3/8 inch, 20,400 psig for the 1/2 inch, 19,600 psig for the 3/4 inch, and 14,400 psig for the 1 inch). The test objective was for each of the MAFs to reach the rated pressure without leaks or bursts. All of the MAFs met the acceptance criteria stated in ASTM F1387.





Repeated Assembly

As mentioned earlier, three (3) MAFs subjected to the impulse test and three (3) MAFs subjected to the flexure fatigue were used for the repeated assembly test. Prior to the initiation of the impulse and flexure fatigue tests, the MAFs were disassembled and reassembled. Every 25% of the test cycles for the impulse and flexure fatigue, the tests were briefly interrupted, and the MAFs were disassembled and reassembled following the guidelines provided by Hy-Lok. The torque required for complete MAF reassembly was recorded.

Rotary Flex Test

Pressurized and fully cantilevered, MAFs were subjected to a bending deflection which was then rotated 360 degrees to expose all sides of the fitting grip to a predetermined bending stress level. This test demonstrates that the fitting can retain the tubing or minimize the effects of stress at the gripping point over a sustained period of time. A bending moment equivalent to a minimum of 35% of the ultimate tensile strength of the tube was initially applied to unpressurized MAFs. This bending moment was maintained for the rest of the test as the hydrostatic pressure was increased to 500 psig. Then, the MAFs were flexed in a rotary motion at 1,750 rpm for 106 cycles maintaining the specified bending stress level and pressure throughout the test. Test pressure was monitored throughout the test. At the completion of the rotary flex test, the MAFs were hydrostatically pressure tested. The MAFs passed the rotary flex test if there were no detectable leaks during the rotary flex and after the subsequent hydrostatic proof test.

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MECHANICAL ENGINEERING DIVISION

Mechanical Engineering Division
October 28, 2015

To whom it may concern,

This letter documents that "Hy-Lok separable mechanically attached fittings" made of stainless steel type 316 for the diameters ¼", 3/8", ½", ¾", and 1", tested in accordance with the ASTM F1387-12 (Performance of Piping and Tubing Mechanically Attached Fittings, 2012) standard and the SAE MA 2003 standard (Rotary Flexure Testing of Hydraulic Tubing Joints and Fittings, 2003), successfully passed the following tests:

Standard Qualification Tests:
1. Examination of Specimen
2. Pneumatic Proof
3. Hydrostatic Proof
4. Impulse
5. Flexure Fatigue
6. Tensile
7. Hydrostatic Burst
8. Repeated Assembly
9. Rotary Flex

Supplementary Tests:
1. Thermal Cycling
2. Elevated Temperature Soak
3. Stress-Corrosion
4. Torsion
5. Fire
6. Vibration
7. Shock

All the testing, except for the shock test, was conducted at the test facilities of Southwest Research Institute, San Antonio, Texas. The shock test was performed at the Dayton T. Brown, Inc. test facility in Bohemia, New York.

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ETR 1028-15

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