Swagelok Company
29500 Solon Road
Solon, Ohio 44139 U.S.A.

TITLE

Hydraulic Impulse Test and Hydrostatic Proof Test of Stainless Steel Tubing with Stainless Steel Swagelok® Tube Fittings

PRODUCT TESTED

Fitting Ends Tested	Tubing Size OD × Wall in.	Tubing Hardness HRB	Working Pressure psig (bar)	Part Description Ordering Number	Part Description Ordering Number
6	1/4 × 0.028	76	4000 (275)	Union Straight SS-400-6	Union Elbow SS-400-9
6	1/4 × 0.065	79	10 200 (702)	Union Straight SS-400-6	Union Elbow SS-400-9
6	3/8 × 0.035	70	3300 (227)	Union Straight SS-600-6	Union Elbow SS-6400-9
6	3/8 × 0.083	88	7500 (517)	Union Straight SS-600-6	Union Elbow SS-600-9
6	1/2 × 0.035	75	2600 (179)	Union Straight SS-810-6	Union Elbow SS-810-9
6	1/2 × 0.083	80	6700 (461)	Union Straight SS-810-6	Union Elbow SS-810-9
6	3/4 × 0.049	75	2400 (165)	Union Straight SS-1210-6	Union Elbow SS-1210-9
6	3/4 × 0.109	79	5800 (399)	Union Straight SS-1210-6	Union Elbow SS-1210-9
6	1 × 0.065	75	2400 (165)	Union Straight SS-1610-6	Union Elbow SS-1610-9
6	1 × 0.120	78	4700 (323)	Union Straight SS-1610-6	Union Elbow SS-1610-9

PURPOSE

These assemblies were tested under laboratory test conditions to observe the hydraulic performance (during and after impulse testing) of stainless steel Swagelok tube fittings when installed on stainless steel tubing.

TEST CONDITIONS

Original test date: October 2015

Laboratory environment

TEST METHOD

Hardness Measurements of Tubing:

1. Performed five measurements equally spaced apart on each tube OD with the United Hardness Tester using the 15-T scale with the 1/16-inch diameter ball penetrator.
2. Reported the average of the five measurements.
3. Added the tubing cylindrical values taken from the Wilson Chart #53 Cylindrical Conversion Table.

Impulse Test with Repeat Assembly (Reference ASTM F1387):

1. Assembled one tube length with one union straight and one union elbow according to the Swagelok tube fitting installation instructions.
2. Prior to impulse testing, some of the samples were identified for repeat assembly according to ASTM F1387 Annex A9. These samples were disassembled and reassembled once according to Swagelok procedures. In order to reseat the ferrules at a different location, the disassembled samples were rotated approximately 90° between each disassembly / reassembly cycle.
3. Impulse testing was then performed according to ASTM F1387 Annex A5. The samples were attached to an impulse stand, pressurized with hydraulic oil to 133 +/- 5% of the working pressure, and then depressurized to 20 +/- 5% of the working pressure. This constituted one impulse cycle.
4. Impulse cycles were modeled with a square waveform, and cycling continued for 1 000 000 cycles at a rate of one Hz (one cycle per second) with the rate not exceeding 75 cycles per minute.
5. At the conclusion of 250 000 impulse cycles, the samples identified for repeat assembly were disassembled and reassembled twice as described in step 2.
6. This cycling and reassembly process was repeated with two remakes of the identified samples at the conclusion of 500 000, 750 000, and 1 000 000 of the impulse cycles. There were 9 total reassemblies for the repeat assembly samples.
7. Monitored the samples for leakage during the test; the pass criterion was no visible leakage.

Hydrostatic Proof Test Procedure (Reference ASTM F1387 Annex A4):

1. Upon completion of the Impulse Test with Repeat Assembly, the samples were subjected to a hydrostatic proof test at ambient laboratory temperature.
2. Samples were pressurized to 100 psig (6.8 bar) with hydraulic oil and held for a period of five minutes.
3. After 5 minutes at 100 psig (6.8 bar), the samples were pressurized to 150% (+/- 5%) of the working pressure with hydraulic oil and held for an additional period of 5 minutes.
4. Monitored the samples for leakage throughout the test; the pass criterion was no visible leakage.

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TEST RESULTS

Impulse Test with Repeat Assembly

Tubing Size OD × Wall in.	Impulse Test Pressure Cycle psig (bar)	Ends Tested	Number of Reassemblies at % of 1 000 000 Total Cycles					Results
			0% (Prior to Impulse)	25%	50%	75%	100%	
1/4 × 0.028	800 to 5 320 (55.1 to 366)	3	Reassembly not required					Pass
		3	1	2	2	2	2	Pass
1/4 × 0.065	2040 to 13 560 (140 to 934)	3	Reassembly not required					Pass
		3	1	2	2	2	2	Pass
3/8 × 0.035	660 to 4390 (45.4 to 302)	3	Reassembly not required					Pass
		3	1	2	2	2	2	Pass
3/8 × 0.083	1500 to 9975 (103 to 688)	3	Reassembly not required					Pass
		3	1	2	2	2	2	Pass
1/2 × 0.035	520 to 3460 (35.8 to 238)	3	Reassembly not required					Pass
		3	1	2	2	2	2	Pass
1/2 × 0.083	1340 to 8910 (92.3 to 613)	3	Reassembly not required					Pass
		3	1	2	2	2	2	Pass
3/4 × 0.049	480 to 3190 (33.0 to 219)	3	Reassembly not required					Pass
		3	1	2	2	2	2	Pass
3/4 × 0.109	1160 to 7710 (79.9 to 531)	3	Reassembly not required					Pass
		3	1	2	2	2	2	Pass
1 × 0.065	480 to 3190 (45.4 to 303)	3	Reassembly not required					Pass
		3	1	2	2	2	2	Pass
1 × 0.120	940 to 6 250 (64.7 to 430)	3	Reassembly not required					Pass
		3	1	2	2	2	2	Pass

Hydrostatic Proof Test

Tubing Size OD × Wall in.	Ends Tested	150% Proof Test Pressure psig (bar)	Test Results
1/4 × 0.028	6	6000 (413)	Pass
1/4 × 0.065	6	15 300 (1054)	Pass
3/8 × 0.035	6	4950 (340)	Pass
3/8 × 0.083	6	9750 (670)	Pass
1/2 × 0.035	6	3900 (268)	Pass
1/2 × 0.083	6	10 050 (692)	Pass
3/4 × 0.049	6	3600 (248)	Pass
3/4 × 0.109	6	8700 (599)	Pass
1 × 0.065	6	6300 (434)	Pass
1 × 0.120	6	7050 (485)	Pass

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The tests were conducted beyond the product's recommended operating parameters and do not modify the published product ratings.

These tests were performed to consider a specific set of conditions and should not be considered valid outside those conditions. Swagelok Company makes no representation or warranties regarding these selected conditions or the results attained. Laboratory tests cannot duplicate the variety of actual operating conditions. Test results are not offered as statistically significant. See the product catalog for technical data.

SAFE PRODUCT SELECTION

When selecting a product, the total system design must be considered to ensure safe, trouble-free performance. Function, material compatibility, adequate ratings, proper installation, operation, and maintenance are the responsibilities of the system designer and user.

Referenced Documents

Wilson Cylindrical Correction Chart # 53, Wilson Instrument Division, 929 Connecticut Avenue, Bridgeport, CT 06602

ASTM F1387-99, *Standard Specification for Performance of Piping and Tubing Mechanically Attached Fittings*, American Society of Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428