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LN Series Needle Valve

TECHNICAL REPORT

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SSP INTRODUCTION

Since its inception in 1926, SSP has exhibited an expertise in the precision machining of tight tolerance, high quality fitting components. In fact, SSP's historical reputation for product quality, service and performance is recognized across the country and around the world.

In 1986, SSP relocated to its 25-acre property in Twinsburg, Ohio Southeast of Cleveland in North America's manufacturing heartland. Within its modern 165,000 square foot manufacturing facility, SSP has developed the internal ability to control its manufacturing variables as much or more than any other fittings' manufacturer. SSP designs and produces its own specialty cutting tools to proprietary standards with a 5 axis CNC tool and cutter grinder, high speed 4 axis CNC machining centers and ultra precise EDM's to allow manufacturing to the most stringent dimensional tolerances and surface finishes. Additionally, SSP's tool making capability supports an internal hot, closed-die forging operation. SSP plans, controls and performs its own metal forging operations on all elbows, tees and crosses manufactured into SSP fittings, connectors and adapters. Indeed, SSP's production capacity is among the largest single-site facilities in the entire industry with the capability to allow one-of-a kind, "specials" machining on single spindle CNC's to high volume production on multi-spindle automatics.

Furthermore, SSP's ISO9001 Quality System Certification and Registration by DNV assures conformance to the highest levels of quality. The substantial investment of time and funds to obtain and maintain such status has paid dividends for SSP and its customers in efficiencies in process and supply.

1.0 INTRODUCTION

This document's purpose is to report, in a published format for public review, a representative sampling of the LN Series Needle Valves' actual performance results from the Design Plan's Validation Tests. The performance results are measured against the Design Team's Approved Acceptance Criteria, which are based on meeting or exceeding the published and/or test-based performance of equivalent products from other manufacturers. A positive testing performance of the products in the Validation Tests was required to complete the final element of the design cycle and provide for the Design Release of the LN Series Needle Valve product family.

1.1 SCOPE

Scope: Performance testing of the LN Series Needle Valve – This test report documents the results of the performance testing for the SSP LN Series Needle Valve. The samples were tested for hydrostatic proof and burst strength, pneumatic leakage test at ambient, pneumatic leakage test at low temperature, and a pneumatic leakage test at high temperature. The cold working pressure rating of this product is 6000 psig.

1.2 REFERENCES

- SSP No. QM06, "SSP Tech Center Laboratory Quality Manual"
- ISO 17025, "General Requirements for the Competence of Testing and Calibration Laboratories"
- ISO 9001:2008, "Quality Management Systems – Requirements"
- ANSI/NCSL Z540-1, "Calibration Laboratories and Measuring and Test Equipment, General Requirements"
- ASTM F1387-99, "Standard Specification for Performance of Piping and Tubing Mechanically Attached Fittings"
- ISO 10012-1, "Quality Assurance Requirements for Measuring Equipment"
- MIL-STD-45662A, "Calibration System Requirements"
- ISO 15500-4, "Compressed natural gas (CNG) fuel system components – Part 4: Manual valve"

1.3 TEST SPECIMEN DESCRIPTION

This test report will document all of the testing involved in the validation of the design for the LN Series Needle Valve. While many of the validation tests performed were conducted in a similar manner to the functional testing described in ISO 15500-4, this validation testing was not meant to be an exact duplicate of the type approval testing outlined in those documents and certain details of this validation testing program may vary from these testing standards. All test samples were built in accordance with the LN Series Needle Valve Assembly documents. Reference assembly document numbers EAS-031.

All body samples for this test were made from 316 grade stainless steel.

Sample#	Part#'s	End Type	Test Record
LN4-1 thru LN4-20	LN4V-4PF-316 LN4M-4PF-316 LN4R-4PF-316 LN4K-4PF-316	1/4" FNPT End	ITR-1388
LN6-1 thru LN6-20	LN6V-6PF-316 LN6M-6PF-316 LN6R-6PF-316 LN6K-6PF-316	3/8" FNPT End	ITR-1519
LN8-1 thru LN8-20	LN8V-D8-316 LN8M-D8-316 LN8K-D8-316 LN8R-D8-316	1/2" Tube End	ITR-1521

1.4 SUMMARY

Hydrostatic and burst test results were in excess of the minimum acceptable requirements. No detectable seat or shell leakage was observed from any of the needle valve test samples during the pneumatic leakage portions of the validation testing. No detectable seat or shell leakage was observed during the continued operation portion of the testing. The SSP LN Series Needle valve is now considered to be adequately validated for use.

2.0 TEST PROCEDURES AND RESULTS

2.1 HYDROSTATIC STRENGTH AND BURST TESTING

Purpose: Each sample was tested for hydrostatic proof and burst testing. Each test sample was individually plumbed into a hydrostatic burst test stand. The procedure for the hydrostatic proof and burst test is outlined below.

Test Procedure: Each test sample was prepared with the outlet connected to the pressure source. The handle was turned to the closed position for this test. This allowed for complete pressurization of the internal cavities. Hydrostatic (water) pressure was applied to the outlet port of each of the test samples at ambient temperature. The samples were pressurized and tested independently. The pressure was slowly increased until a minimum of 14,600 psig was reached and then held for three minutes. During this time, each sample was visually examined for leakage or deformation. The hydrostatic pressure was then increased to 4 times the cold working pressure of the valve for 1 minute. During this time, each sample was visually examined for leakage or deformation. The hydrostatic pressure was finally increased to the point where the integrity of the shell seal was lost. This pressure was then recorded as the “Burst Pressure” for the test sample.



Figure 2.1 Hydrostatic Proof and Burst Setup

Acceptance Criteria: All test results met or exceeded the established Design Team's Acceptance Criteria for this product. The primary acceptance criteria for this test is similar to those documented in ISO 15500-4, where applicable. The acceptance criterion for the hydrostatic strength portion of the validation testing is to withstand a minimum internal pressure of 14,600 psig (1,006 bar) for a three minute time period without any signs of leakage or deformation. The acceptance criterion for the hydrostatic burst test portion of the validation test is to withstand a minimum internal pressure of 4 times the full rated pressure of the valve (4 x 6000 psig = 24,000 psig minimum) without significant loss of containment.

SSP LN Series Needle Valve Validation Testing: Hydrostatic Proof and Burst			
Sample No.	Hydrostatic Burst Test @ 24,000 psig	Burst Pressure Actual, psig	Failure Mode
LN4V 1 2 3 4 5	Pass Pass Pass Pass Pass	28,200 psi 30,550 psi 28,150 psi 27,900 psi 31,200 psi	BODY/BONNET
LN4R 1 2 3 4 5	Pass Pass Pass Pass Pass	31,450 psi 30,300 psi 27,750 psi 28,450 psi 27,950 psi	BODY/BONNET
LN4M 1 2 3 4 5	Pass Pass Pass Pass Pass	30,350 psi 29,700 psi 29,600 psi 27,850 psi 30,350 psi	BODY/BONNET
LN4K 1 2 3 4 5	Pass Pass Pass Pass Pass	28,350 psi 27,800 psi 30,250 psi 30,450 psi 31,150 psi	BODY/BONNET
LN6V 1 2 3 4 5	Pass Pass Pass Pass Pass	32,350 psi 29,750 psi 32,850 psi 30,500 psi 29,950 psi	BODY/BONNET

LN6R 1 2 3 4 5	Pass Pass Pass Pass Pass	31,550 psi 32,400 psi 30,750 psi 33,150 psi 32,350 psi	BODY/BONNET
LN6M 1 2 3 4 5	Pass Pass Pass Pass Pass	33,300 psi 28,950 psi 29,850 psi 33,450 psi 34,500 psi	BODY/BONNET
LN6K 1 2 3 4 5	Pass Pass Pass Pass Pass	30,150 psi 32,500 psi 34,100 psi 31,650 psi 32,750 psi	BODY/BONNET
LN8V 1 2 3 4 5	Pass Pass Pass Pass Pass	35,250 psi 37,550 psi 35,750 psi 34,150 psi 35,150 psi	BODY/BONNET
LN8R 1 2 3 4 5	Pass Pass Pass Pass Pass	32,950 psi 37,250 psi 38,650 psi 31,900 psi 33,600 psi	BODY/BONNET
LN8M 1 2 3 4 5	Pass Pass Pass Pass Pass	34,700 psi 35,400 psi 36,950 psi 33,400 psi 35,550 psi	BODY/BONNET
LN8K 1 2 3 4 5	Pass Pass Pass Pass Pass	36,350 psi 33,850 psi 35,200 psi 34,750 psi 37,150 psi	BODY/BONNET

2.2 PNEUMATIC LEAKAGE TESTING (AMBIENT)

Purpose: Samples were tested for seat and shell leakage at ambient temperature. The procedure is outlined below.

Test Procedure: The valve was placed in the closed position for the duration of this test. The valve was prepared for testing by connecting the outlet port to the pressure source. The valve was submerged in water at ambient (room) temperature. The pressure was then increased to 6000 psig and the samples were visually examined for seat and shell leakage (bubble formation) for two minutes. Pressure was released from the valve.



Figure 2.2 Leakage Test (Ambient) Setup

Acceptance Criteria: All test results met or exceeded the established Design Team's Acceptance Criteria for these products. The primary acceptance criteria for all validation testing are similar to those documented in ISO 15500-4, where applicable. The acceptance criterion for all internal and external leakage tests is a maximum leakage rate of less than 20 cm³/hr.

SSP LN Series Needle Valve Leakage Testing - Seat and Shell Leakage at Ambient 75°F		
Sample No.	Seat Leakage @ Ambient (6000 psig)	Shell Leakage @ Ambient (6000 psig)
LN4V		
1	Pass	Pass
2	Pass	Pass
3	Pass	Pass
4	Pass	Pass
5	Pass	Pass
LN4R		
1	Pass	Pass
2	Pass	Pass
3	Pass	Pass
4	Pass	Pass
5	Pass	Pass
LN4M		
1	Pass	Pass
2	Pass	Pass
3	Pass	Pass
4	Pass	Pass
5	Pass	Pass
LN4K		
1	Pass	Pass
2	Pass	Pass
3	Pass	Pass
4	Pass	Pass
5	Pass	Pass
LN6V		
1	Pass	Pass
2	Pass	Pass
3	Pass	Pass
4	Pass	Pass
5	Pass	Pass
LN6R		
1	Pass	Pass
2	Pass	Pass
3	Pass	Pass
4	Pass	Pass
5	Pass	Pass
LN6M		
1	Pass	Pass
2	Pass	Pass
3	Pass	Pass
4	Pass	Pass
5	Pass	Pass

LN6K		
1	Pass	Pass
2	Pass	Pass
3	Pass	Pass
4	Pass	Pass
5	Pass	Pass
LN8V		
1	Pass	Pass
2	Pass	Pass
3	Pass	Pass
4	Pass	Pass
5	Pass	Pass
LN8R		
1	Pass	Pass
2	Pass	Pass
3	Pass	Pass
4	Pass	Pass
5	Pass	Pass
LN8M		
1	Pass	Pass
2	Pass	Pass
3	Pass	Pass
4	Pass	Pass
5	Pass	Pass
LN8K		
1	Pass	Pass
2	Pass	Pass
3	Pass	Pass
4	Pass	Pass
5	Pass	Pass

2.3 PNEUMATIC LEAKAGE TESTING (LOW TEMPERATURE)

Purpose: Samples were tested for seat and shell leakage at low temperature. The procedure is outlined below.

Test Procedure: The valve was placed in the closed position for the duration of this test. The LN Series Needle valves were soaked at -65°F for a minimum of four hours prior to leak testing. The valve was prepared for testing by connecting the outlet port to the pressure source. The valve was then submerged in denatured alcohol at -65°F . A pneumatic pressure (air) of 6,000 psig was applied to the valve. The sample was visually examined for seat and shell leakage (bubble formation) for two minutes. Pressure was released from the valve.



Figure 2.3 Leakage Test (Low Temperature) Setup

Acceptance Criteria: All test results met or exceeded the established Design Team's Acceptance Criteria for these products. The primary acceptance criteria for all validation testing is similar to those documented in ISO 15500-4, where applicable. The acceptance criterion for all internal and external leakage tests is a maximum leakage rate of less than $20\text{ cm}^3/\text{hr}$ under temperature conditions.

SSP LN Series Needle Valve Leakage Testing - Seat and Shell Leakage at -65°F		
Sample No.	Seat Leakage @ -65°F (6000 psig)	Shell Leakage @ -65°F (6000 psig)
LN4V		
1	Pass	Pass
2	Pass	Pass
3	Pass	Pass
4	Pass	Pass
5	Pass	Pass
LN4R		
1	Pass	Pass
2	Pass	Pass
3	Pass	Pass
4	Pass	Pass
5	Pass	Pass
LN4M		
1	Pass	Pass
2	Pass	Pass
3	Pass	Pass
4	Pass	Pass
5	Pass	Pass
LN4K		
1	Pass	Pass
2	Pass	Pass
3	Pass	Pass
4	Pass	Pass
5	Pass	Pass
LN6V		
1	Pass	Pass
2	Pass	Pass
3	Pass	Pass
4	Pass	Pass
5	Pass	Pass
LN6R		
1	Pass	Pass
2	Pass	Pass
3	Pass	Pass
4	Pass	Pass
5	Pass	Pass
LN6M		
1	Pass	Pass
2	Pass	Pass
3	Pass	Pass
4	Pass	Pass
5	Pass	Pass

LN6K		
1	Pass	Pass
2	Pass	Pass
3	Pass	Pass
4	Pass	Pass
5	Pass	Pass
LN8V		
1	Pass	Pass
2	Pass	Pass
3	Pass	Pass
4	Pass	Pass
5	Pass	Pass
LN8R		
1	Pass	Pass
2	Pass	Pass
3	Pass	Pass
4	Pass	Pass
5	Pass	Pass
LN8M		
1	Pass	Pass
2	Pass	Pass
3	Pass	Pass
4	Pass	Pass
5	Pass	Pass
LN8K		
1	Pass	Pass
2	Pass	Pass
3	Pass	Pass
4	Pass	Pass
5	Pass	Pass

2.4 PNEUMATIC LEAKAGE TESTING (HIGH TEMPERATURE)

Purpose: Samples were tested for seat and shell leakage at high temperature. The procedure is outlined below.

Test Procedure: The valve was placed in the closed position for the duration of this test. The valves were soaked at 200°F (Kel-f stems) and 450°F (metal stems) a minimum of four hours in an oven prior to leak testing. After soaking, the valve was prepared for testing by connecting the outlet port to the pressure source. A pneumatic pressure (air) of 6,000 psig was applied to the valve. The sample was visually examined for seat and shell leakage (bubble formation) for two minutes. Pressure was released from the valve.



**Figure 2.4.1 Leakage Test
High Temperature Setup (200°F - 450°F)**

Acceptance Criteria: All test results met or exceeded the established Design Team's Acceptance Criteria for these products. The primary acceptance criteria for all validation testing are similar to those documented in ISO 15500-4, where applicable. The acceptance criterion for all internal and external leakage tests is a maximum leakage rate of less than 20 cm³/hr under temperature conditions.

SSP LN Series Needle Valve Leakage Testing - Seat and Shell Leakage at 200°F - 450°F		
Sample No.	Seat Leakage @ 200°F - 450°F (6000 psig)	Shell Leakage @ 200°F - 450°F (6000 psig)
LN4V		
1	Pass	Pass
2	Pass	Pass
3	Pass	Pass
4	Pass	Pass
5	Pass	Pass
LN4R		
1	Pass	Pass
2	Pass	Pass
3	Pass	Pass
4	Pass	Pass
5	Pass	Pass
LN4M		
1	Pass	Pass
2	Pass	Pass
3	Pass	Pass
4	Pass	Pass
5	Pass	Pass
LN4K		
1	Pass	Pass
2	Pass	Pass
3	Pass	Pass
4	Pass	Pass
5	Pass	Pass
LN6V		
1	Pass	Pass
2	Pass	Pass
3	Pass	Pass
4	Pass	Pass
5	Pass	Pass
LN6R		
1	Pass	Pass
2	Pass	Pass
3	Pass	Pass
4	Pass	Pass
5	Pass	Pass
LN6M		
1	Pass	Pass
2	Pass	Pass
3	Pass	Pass
4	Pass	Pass
5	Pass	Pass

LN6K		
1	Pass	Pass
2	Pass	Pass
3	Pass	Pass
4	Pass	Pass
5	Pass	Pass
LN8V		
1	Pass	Pass
2	Pass	Pass
3	Pass	Pass
4	Pass	Pass
5	Pass	Pass
LN8R		
1	Pass	Pass
2	Pass	Pass
3	Pass	Pass
4	Pass	Pass
5	Pass	Pass
LN8M		
1	Pass	Pass
2	Pass	Pass
3	Pass	Pass
4	Pass	Pass
5	Pass	Pass
LN8K		
1	Pass	Pass
2	Pass	Pass
3	Pass	Pass
4	Pass	Pass
5	Pass	Pass

3.0 TEST EQUIPMENT AND INSTRUMENTATION

Calibration and Standardization:

1. Description: Gas Pressure Transducer
Range: 0 - 10,000 psig
ID#: 74466
Calibration Date: 10/13/14 Due: 10/13/15
2. Description: Gas Pressure Gage
Range: 0 - 10,000 psig
ID#: 67176
Calibration Date: 10/13/14 Due: 10/13/15
3. Description: Hydrostatic Pressure Transducer
Range: 0 - 72,000 psig
ID#: 096221
Calibration Date: 06/10/14 Due: 06/10/15
4. Description: Hydrostatic Pressure Gage
Range: 0 - 72,000 psig
ID#: 096221-1
Calibration Date: 06/10/14 Due: 06/10/15
5. Description: Microprocessor Thermometer
Range: -328°F to 752°F
ID#: 1016704
Calibration Date: 09/02/14 Due: 09/02/15
6. Description: Oven
Range: Ambient - 550°F
ID#: 33-1025193
Calibration Date: 09/03/14 Due: 09/03/15
7. Description: Pressure Standard
Range: 0 - 15,000 psig
ID#: A26156
Calibration Date: 09/04/14 Due: 09/04/15
8. Description: Gas Pressure Gage
Range: 0 - 5000 psig
ID#: LAB-13
Calibration Date: 08/14/14 Due: 08/14/15

4.0 QUALITY ASSURANCE PROGRAM

The preceding lists the major Validation Tests that were performed, and the sections which follow describe the tests and outline specific results. All products manufactured at SSP are to approved and controlled engineering documentation, to established process and quality procedures at every stage of manufacture, with fully calibrated quality and process instrumentation, using only certified and traceable materials. Tested products were selected randomly from documented normal production runs. Before and after test samples were retained for reference. All tubing used in testing meets applicable ASTM specifications, and has approved material and chemical certifications.

All SSP tests conducted on products are with laboratory equipment and instrumentation in current calibration in an ISO 17025 accredited laboratory. Trained personnel conducted tests by following approved, written test procedures. All test results were subjected to thorough engineering review and approval before internal publication.

ASTM Material Standards		
Standard	Material Shape	Description
A 182	Forged Fittings, Parts	Standard Specification for Forged or Rolled Alloy – Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
A 276	Bars	Standard Specification for Stainless Steel Bars and Shapes
A 479	Bar, Shapes	Standard Specification for Stainless Steel Bars and Shapes for use in Boilers and other Pressure Vessels
A 179	Tube	Standard Specification for Seamless Cold-Drawn Low-Carbon Steel Heat-Exchanger and Condenser Tubes
A 213	Tube	Standard Specification for Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater and Heat-Exchanger Tubes
A 269	Tubing	Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service

Table 4.0.0

Applicable Codes and Standards	
Section	Test Description
ANSI/ASME B 31.1	Power Piping Code
ANSI/ASME B 31.3	Process Piping Code
ANSI/ASME BPV Section VIII	Boiler & Pressure Vessel Code

Table 4.0.1

5.0 ATTACHMENTS

A. MATERIAL CERTS

B. EQUIPMENT

Validation Test Equipment		
Section	Test Description	Test Equipment Description
2.1	Hydrostatic Strength and Burst Test	High Pressure Transducer – Stellar Technologies GT3202-72000G-101
		High Pressure Liquid Pump – Maximator L-400
2.2	Pneumatic Leakage Test (Ambient)	Pressure Transducer – Precise Sensors 555-10000-G-36-4F-6P3
		Air Booster Pump - Maximator DLE 15-75
2.3	Pneumatic Leakage Test (Low Temperature)	Pressure Transducer – Precise Sensors 555-10000-G-36-4F-6P3
		Air Booster Pump - Maximator DLE 15-75
		Ultra Low Industrial Freezer - Cincinnati Sub-Zero
2.4	Pneumatic Leakage Test (High Temperature 200°F)	Pressure Transducer – Precise Sensors 555-10000-G-36-4F-6P3
		Air Booster Pump - Maximator DLE 15-75
		Immersion Heater - Ulanet 492-4
	Pneumatic Leakage Test (High Temperature Over 200°F)	Pressure Standard - Condec UPS3000AAA
		Air Booster Pump - Maximator DLE 15-75
	Bench Oven - Quincy 51-550ER	

C. REVISIONS

SSP Document Number: