



Rigorous Testing Proves Ruggedness, Durability of Norgren® Posi-Clik™ Fittings

Since 1980, Norgren Global Vehicle Technologies has supplied vehicle push-in fittings to commercial vehicle manufacturers around the world. New Norgren® Posi-Clik™ fittings meet or exceed industry standard specifications when subjected to a wide range of rigorous tests. Test results show that Posi-Clik fittings outperform the industry standard for pneumatic fittings set for by the Society of Automotive Engineers (SAE). The J2494 specification covers performance and dimensional specifications for brass-bodied, reusable Push-to-Connect tube fittings, for use in the piping of vehicular air brake systems.

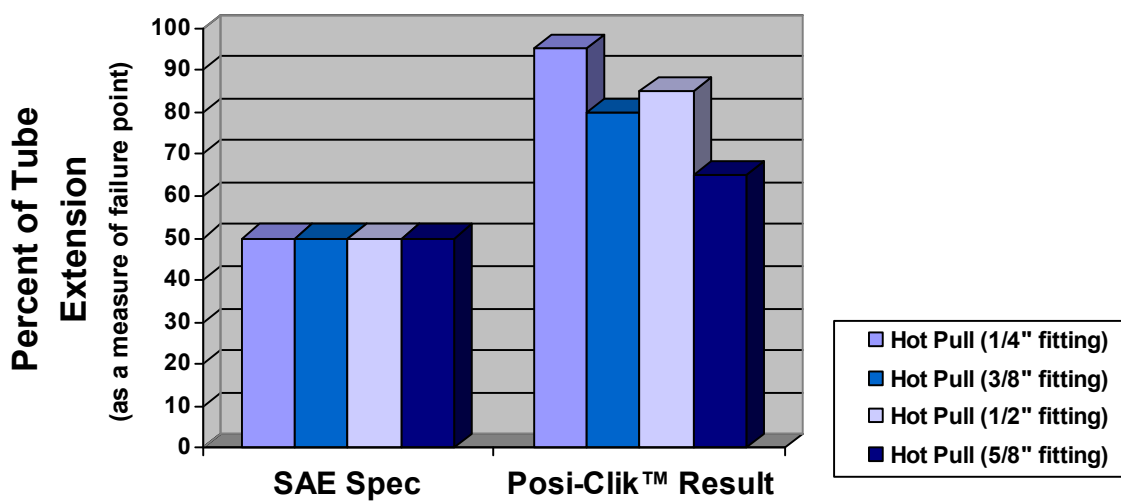
This document presents results from the following tests:

- Hot Pull test
- Cold Impact test
- Burst Pressure tests
- Leakage tests (conducted over a wide range of operational temperatures)

Hot Pull Test Methodology

Hot pull testing is a tension test, used as a benchmark to determine the heat tolerance of fittings. This test was conducted in compliance with SAE J2494 specifications. Test specimens were placed in a tensile machine with the lower fitting and 102 mm (+/- 6 mm) of tubing submerged below the surface of boiling, distilled water, such that the outside diameter is exposed to the water. The test specimens were boiled for five minutes (+/- .5 minute). Tension load was applied equivalent to 25 mm per minute.

Hot Pull Test Results





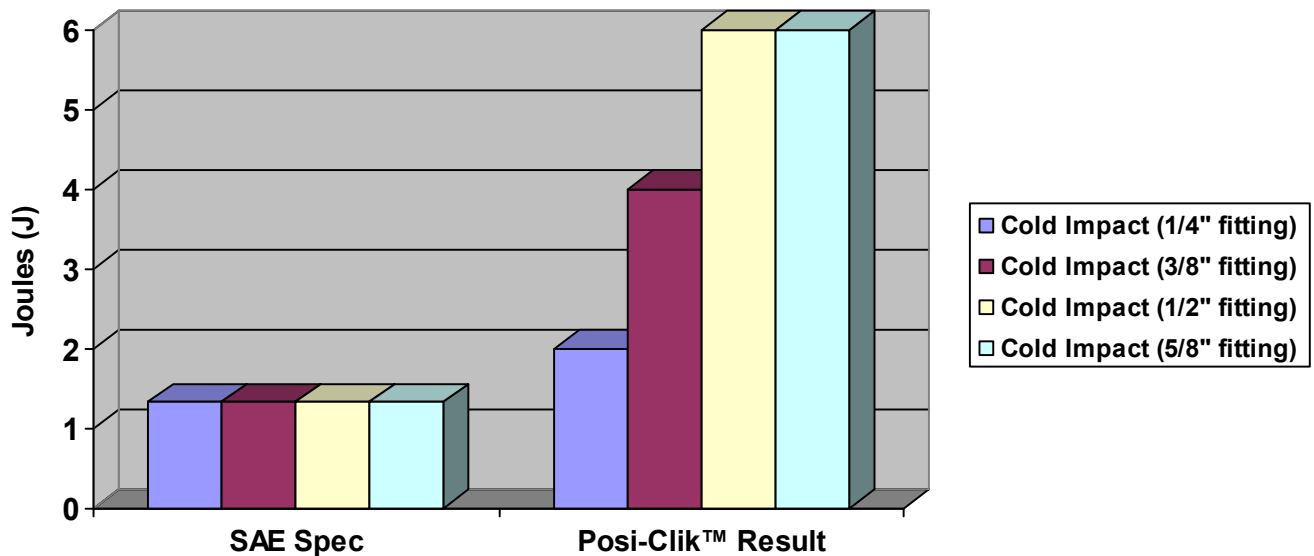
Hot Pull Test Results

On average, the failure point of Posi-Clik fittings was 81.25 percent tube extension. The SAE J2494 specification requires at least 50 percent tube extension prior to failure. Thus, Posi-Clik fittings exceed the SAE specification by **an average of 31.25 percent**.

Cold Impact Test Methodology

Tubes were cut to 300 mm, and assembled to the fittings, with the free end of the tubing fixed. The Posi-Clik fittings were mounted so that the 2.27 Kg weight at height (H) hits within 5mm from the end of the fitting. Test samples were conditioned in a cold chamber to -40°C ($\pm 2^{\circ}\text{C}$) for two hours. The fittings were then subjected to impact while in the chamber, still chilled to -40°C ($\pm 2^{\circ}\text{C}$). After impact, the samples were examined for visible cracks.

Cold Impact Test Results



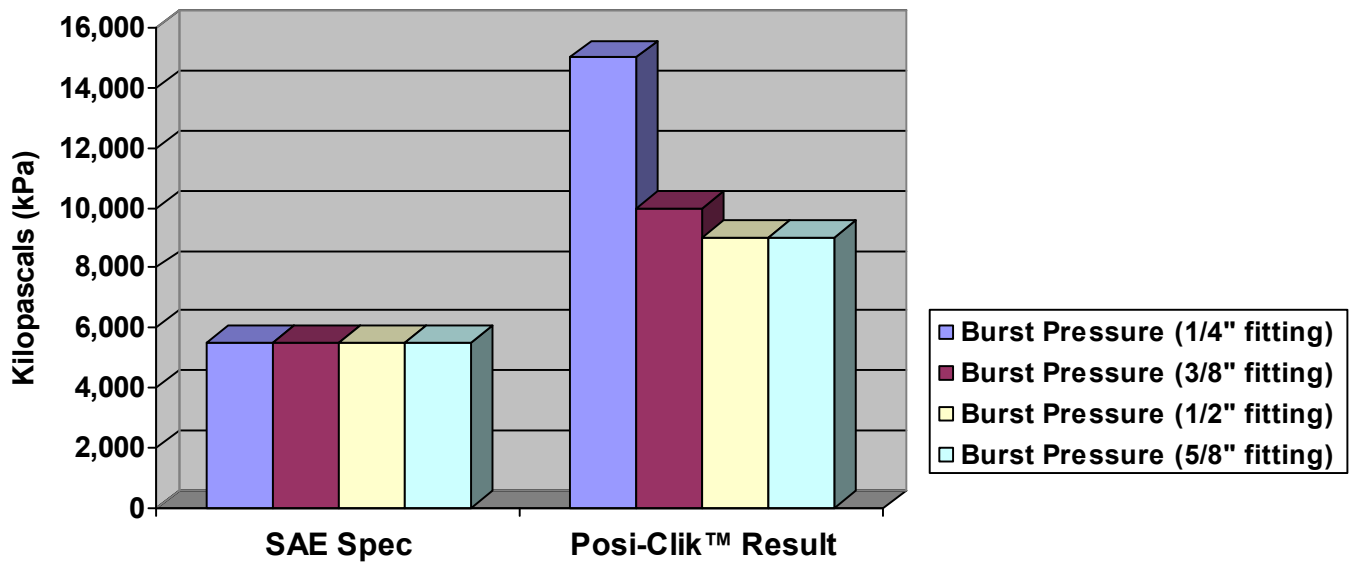
Cold Impact Test Results

The results show that the amount of energy (measured in joules (J)) required to destroy a Posi-Clik fitting far exceeds SAE specifications for impact endurance. SAE specifications state that fittings must be able to endure minimum impact energy of 1.33 joules. On average, Posi-Clik fittings endured impact energy levels of 4.5 joules, **more than 338 percent more durable** than standard industry specifications require.

Ambient Burst Test Methodology

Posi-Clik test samples consisted of two fittings, connected by 150 mm of tubing. One fitting was plugged, the other left open so as to be capable of being pressurized by hydraulic pressure or other suitable media. The test samples were pressurized until they burst. The pressure increase rate was gauged to ensure failure within 15 to 60 seconds. The maximum achieved pressure is the failure pressure.

Burst Pressure Test Results (in kPa)



Ambient Burst Test Results

The average failure pressure for a Posi-Clik fitting was 10,750 kilopascals (kPa). This exceeds SAE J2494 specifications (5,500 kPa) by **an average of 195 percent**. The failure pressure for Posi-Clik 1/4" fittings **exceeded industry standard specifications by 272 percent** (failure pressure for the Posi-Clik 1/4" fitting was 15,000 kPa versus a 5,500 kPa SAE J2494 specification).

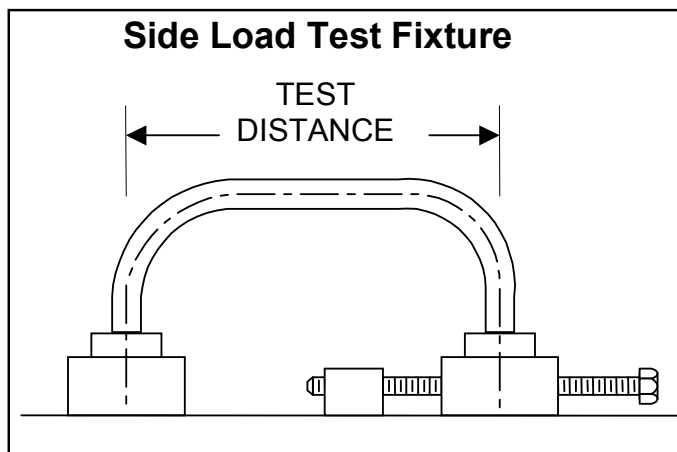
Side Load Leakage Test Methodology

Test samples were mounted as shown in Figure 1 (see below), and according to the test dimensions shown in the following table, in the environmental chamber:

Posi-Clik test results fact sheet
Page four

Tube OD mm (in)	Min. Bend Radius (mm)	Test Distance (mm)	Insertion Depth (mm)	Tube Length (mm)
4 (5/32)	13	30		
5 (3/16)	20	50		
6 (1/4)	25	65	20	180
8 (5/16)	38	80	22	245
10 (3/8)	38	95	24	270
12 (1/2)	64	130	27	375
16 (5/8)	76	160	30	460
19 (3/4)	90	180	30	535

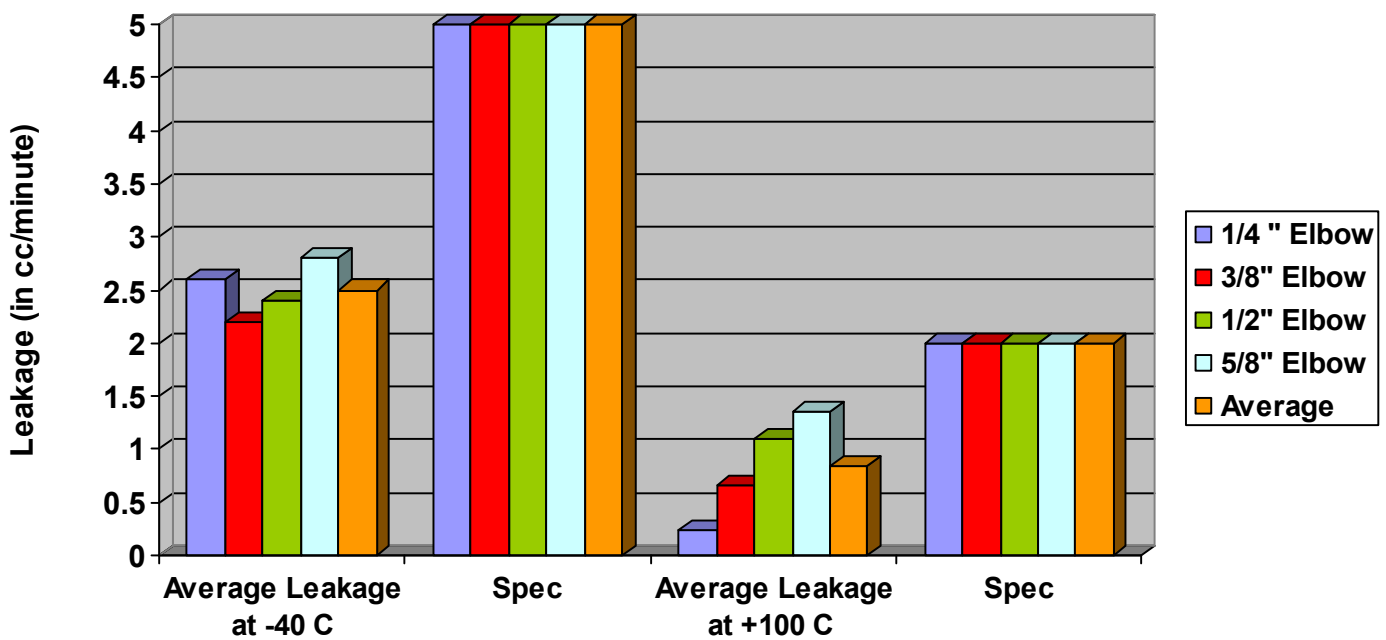
Figure 1: Side Load Mounting Configuration



Note: Tube Length = 3.14.(min. bend radius) + 2.(fitting tube insertion depth) + 10.(tube O.D)

Pressure was cycled every 15 minutes, alternating between 0 bar and 10 bar, +/- 0.7 bar. While the pressure was cycling, the test samples were subjected to - 40 C for 7.5 hours. After this period, the temperature was raised to 100 C for an additional 15.5 hours. During the test, 0.5 hours was allowed between each temperature change, thus creating a 24-hour temperature cycle. This 24-hour cycle was repeated 10 times. At each temperature during the final (ie., the tenth) temperature cycle, 10 bar of air pressure was applied, and any leakage recorded.

Side Load Leakage Test Results



Side Load Leakage Test Results

As this figure shows, Posi-Clik fittings far exceeded industry standards for minimizing leaks, even at temperature extremes, and under rigorous testing conditions. Some key statistics:

- At -40° C, Posi-Clik fittings averaged a leak rate of only 2.5 cc/minute, **minimizing leaks twice as effectively as industry standards demand.**
- At +100° C, Posi-Clik fittings had an average leak rate of only 0.8375 cc/minute – **58 percent less leakage than industry standards demand.**

As these test results demonstrate, only Posi-Clik fittings give manufacturers a robust, virtually leak-free connection, improving process efficiency, lowering maintenance and improving truck and trailer longevity.