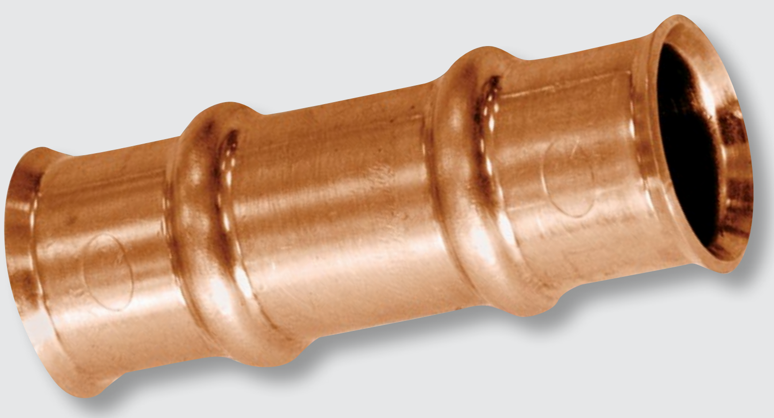
The Original Flame-Free
Refrigerant Press Fittings

Product Overview and Third Party Testing Summary



PROUDLY MADE
IN AMERICA

RLS Refrigerant Press Fittings Overview

Introduced in 2015 after many years of prior development and testing, the RLS Rapid Locking System is a proven method for quickly and reliably connecting copper tube in high-pressure HVAC/refrigeration applications. RLS refrigerant press fittings have gone through extensive independent testing (detailed on the following pages), and have received numerous agency approvals and certifications, including:

Agency Approvals and Certifications

- UL Listed: 207, SA#33958, SDTW (7) (Except where noted)
- UL Listed: Approved Use For Field & Factory Installations
- ISO 5149-2: Part 2 Compliant
- ASHRAE-15, ANSI 15, ASME B31.5 (504.7)
- ICC-ES, PMG-1296
- 2021, 2018, 2015, 2012, 2009, 2006 International Mechanical Code (IMC)
- 2021, 2018, 2015, 2012, 2009, 2006 International Residential Code (IRC)
- 2021, 2018, 2015, 2012, 2009, 2006 Uniform Mechanical Code (UMC)
- CRN Approved (#0A22551)

Third Party Testing

The following pages summarize the findings of five independent tests performed to verify the effectiveness, durability and installation time savings of RLS press fittings/connections in high-pressure refrigeration systems, including:

- ICC-ES Evaluation Report
- Time and Motion (compared to brazing)
- Helium Leak
- Accelerated Durability (frost/defrost, thermal cycling and vibration)
- Salt Spray Corrosion

RLS PATENTS

RLS Press Fitting Patents

- U.S. Patent No. 9,145,992
- U.S. Patent No. 9,638,361
- U.S. Patent No. D730,494
- Australian Patent No. 2012362443
- Canadian Patent No. 2,800,360
- Canadian Design Registration No. 149228
- EUIPO Registered Community Design No. 002218636-0001
- Japanese Patent No. 6051468
- Other Pending Patent Applications

RLS Press Tools and Jaws Patents

- Australian Design Registration No. 361533
- Canadian Design Registration No. 161804
- EUIPO Registered Community Design No. 002672667-0001
- Japanese Design Registration No. 1537545
- Other Pending Patent Applications

Effective Date: January 2021

PMG-1296

CSI: DIVISION: 23 00 00 – HEATING, VENTILATING AND AIR CONDITIONING (HVAC)

Section: 23 20 00 – HVAC Pipe and Fittings

Product certification system:
The ICC-ES product certification system includes testing samples taken from the market or supplier's stock, or a combination of both, to verify compliance with applicable codes and standards. The system also involves factory inspections, and assessment and surveillance of the supplier's quality system.

Products:
Refrigeration Tubing Connectors

Listee:
RLS LLC
101 S. Douglas Street
Shelbina, MO 63468
www.rlspressfittings.com

Compliance with the following codes:
2021, 2018, 2015, 2012, 2009 and 2006 International Mechanical Code (IMC)
2021, 2018, 2015, 2012, 2009 and 2006 International Residential Code (IRC)
2021, 2018, 2015, 2012, 2009 and 2006 Uniform Mechanical Code (UMC)*
*Copyrighted publication of the International Association of Plumbing and Mechanical Officials.

Compliance with the following standards:
UL 207 (Edition 8), Standard for Refrigerant-Containing Components and Accessories, Nonelectrical

Identification:
The refrigerant tubing connectors shall be legibly and permanently marked with the manufacturer's name, trade name, trademark, or identifying symbol or other descriptive marking by which the organization responsible for the product may be identified. The shipping carton, a separate instruction sheet included with the shipping carton or a tag attached to the component shall include a distinctive model, part number, or type designation for the connector and include information for each refrigerant type for which the connector is intended and the ICC-ES PMG listing mark.

Installation:
The refrigerant tubing connectors must be installed in accordance with the manufacturer's published installation instructions, the applicable codes and this listing. Mechanical joints shall not be used on annealed temper copper tube in sizes larger than 7/8-inch (22.2 mm) OD size per IMC and 3/4 of an inch nominal size per UMC.
Note: The 2018 IMC and IRC permit for press-connect joints listed for refrigeration piping.

Models:
The refrigerant tubing connectors are intended for connection of copper, aluminum, titanium and other types of tubing approved by the manufacturer. The connection is accomplished by compressing (solder-free) the fitting to a pipe. The refrigerant connectors are only suitable with the following refrigerants (R32, R134A, R143A, R290, R404A, R407, R410A, R417A, R421A, R422, R424A, R427A, R434A, R437A, R433A, R445A, R446A, R447A, R448A, R449, R450A, R451, R452, R453A, R454, R455A, R456A, R507, R513, R600, R600a, R718, R1234yf, R1234ze, Ethylene Gycol).

Series Model Name: RLS Cu

Type of Connector	Sizes (Inches)
Couplings	1/4, 5/16, 3/8, 1/2, 5/8, 3/4, 7/8, 1, 1-1/8, 1-1/4, 1-3/8
Slip Couplings	1/4, 5/16, 3/8, 1/2, 5/8, 3/4, 7/8, 1-1/8, 1-3/8
Long Radius 90°	1/4, 5/16, 3/8, 1/2, 5/8, 3/4, 7/8, 1, 1-1/8, 1-1/4, 1-3/8
Long Radius 45°	1/4, 5/16, 3/8, 1/2, 5/8, 3/4, 7/8, 1-1/8, 1-3/8
Street 90°	1/4, 3/8, 1/2, 5/8, 3/4, 7/8, 1-1/8, 1-3/8
Stubs	1/4, 5/16, 3/8, 1/2, 5/8, 3/4, 7/8, 1-1/8, 1-3/8
Reducers (F x F)	1-3/8 x 1-1/8, 1-3/8 x 7/8, 1-1/8 x 7/8, 1-1/8 x 3/4, 1-1/8 x 5/8, 1-1/8 x 1/2, 1 x 7/8, 7/8 x 3/4, 7/8 x 5/8, 7/8 x 1/2, 3/4 x 5/8, 3/4 x 1/2, 5/8 x 1/2, 5/8 x 3/8, 5/8 x 1/4, 1/2 x 3/8, 1/2 x 1/4, 3/8 x 1/4, 5/16 x 1/4, 11mm x 3/8
Tees	1/4, 5/16, 3/8, 1/2, 5/8, 3/4, 7/8, 1, 1-1/8, 1-1/14, 1-3/8
Bushing (B x F)	1-3/8 x 1-1/8, 1-1/8 x 7/8, 7/8 x 3/4, 3/4 x 5/8, 5/8 x 1/2, 1/2 x 3/8
Cap	1/4, 5/16, 3/8, 1/2, 5/8, 3/4, 7/8, 1, 1-1/8, 1-1/4, 1-3/8
E (Euro) Flare	1/4, 3/8, 1/2, 5/8, 3/4
Capillary Coupling	0.072 x 1/4, 0.109 x 1/4
Return Bend	1/4, 5/16, 3/8, 1/2, 5/8, 3/4, 7/8, 1-1/8

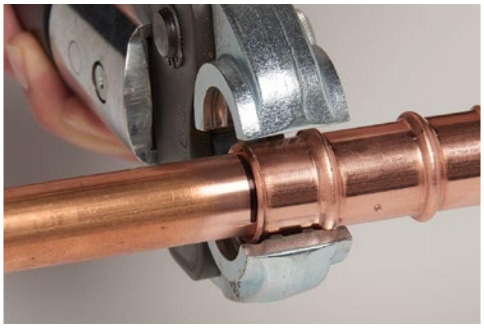
Ratings

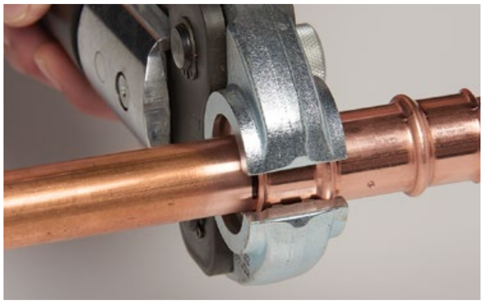
Sizes	Design Pressure, psig	Maximum Abnormal Pressure, psi	Continuous Operating Temperature
1/4" RLS	700	700	250°F (121°C)
5/16" RLS	700	700	250°F (121°C)
3/8" RLS	700	700	250°F (121°C)
1/2" RLS	700	700	250°F (121°C)
3/4" RLS	700	700	250°F (121°C)
5/8" RLS	700	700	250°F (121°C)
7/8" RLS	700	700	250°F (121°C)
1" RLS	700	700	250°F (121°C)
1-1/8" RLS	700	700	250°F (121°C)
1-1/4" RLS	700	700	250°F (121°C)
1-3/8" RLS	700	700	250°F (121°C)

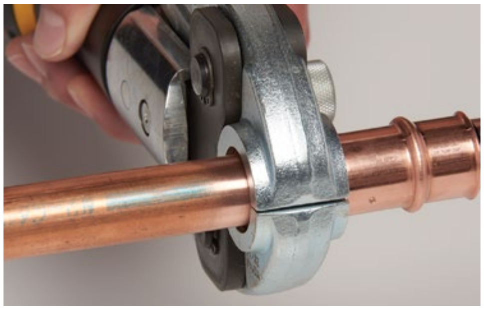
Conditions of Listing:

1. The refrigerant tubing connectors must be used with only the following refrigerants (R32, R134A, R143A, R290, R404A, R407, R410A, R417A, R421A, R422, R424A, R427A, R434A, R437A, R433A, R445A, R446A, R447A, R448A, R449, R450A, R451, R452, R453A, R454, R455A, R456A, R507, R513, R600, R600a, R718, R1234yf, R1234ze, Ethylene Gycol).
2. Mechanical joints shall not be used on annealed temper copper tube in sizes larger than 7/8 inch (22.2 mm) OD size per IMC and 3/4 of an inch nominal size per UMC.
3. The installation must be pressure-tested for leaks in the presence of the code official or the code official's designated representative.
4. When installation is in fire-resistance-rated assemblies, evidence must be provided to the code official of compliance with *International Building Code* (IBC) Section 713 (penetrations), *Uniform Building Code* (UBC) Section 709 (walls and partitions) or UBC Section 710 (floor/ceiling or roof/ceiling), as applicable.
5. The connectors must not be used as a source of electrical ground.
6. When the system is embedded in concrete, tubing must be covered a minumum of 3/4 inch (19.1 mm) and installation must comply with IBC Section 1906.3 or UBC Section 1906.3, as applicable.
7. The refrigerant tubing connectors are under a quality control program with surveillance inspectors annually by ICC-ES.

Time and Motion Study







Conducted by:
Jay Peters, Principal Advisor, Codes and Standards International

Methodology:

A time study was conducted in a controlled environment, with two stations set up for joining refrigeration tube: one by brazing and one by making RLS press connections. Two different installers were used, one very experienced in making brazed connections and one very experienced in using RLS approved press tools.

The two installers were timed independently making connections using various sized copper tube and fittings. Before timing began, tube was cut to length and the ends were prepared for connection (as these procedures are the same for both connection methods). Three connections were timed for each size of tube/fitting for each installer, and the three times were averaged. The results are shown in the table below.

LABOR TIME FOR INSTALLING A COPPER COUPLING

Fitting Size	1/4"	5/8"	1-1/8"
Brazed Connection	35 sec	42 sec	1:51 min
RLS Connection	24 sec	24 sec	25 sec
% Time Savings	31%	43%	77%

Key Findings and Conclusions:

The time savings achieved while joining tube using RLS press fittings, compared to brazed connections, ranged from 31% on the smallest fittings timed to 77% on the largest. The average time savings over the fitting sizes timed was approximately 50%. So, on average, RLS connections were made in roughly half the time of brazing — and in less than one-quarter the time on the largest fitting size.

Based on the study, brazed connections take longer to complete than RLS fitting connections. When analyzing the installation techniques for both connections, a brazed connection requires a period of time to raise the temperature of the fitting and tube to about 1000˚ F. As the tubing and fitting increases in diameter, the amount of time it takes to heat them also increases. The RLS fittings only require the connection of a press connect tool, which takes less than ten seconds to complete the actual pressing operation (two crimps) — and the time to connect does not increase significantly as the diameter of tubing and fittings increase in size.

In a controlled environment, such as the work station where the time study was conducted, the brazing operation takes less time than a similar joint made on a construction or repair project in the field. The controlled environment is already set up for brazing, with all necessary equipment and materials close at hand. However, using the RLS press tool and fittings requires approximately the same amount of time in any environment. Therefore, it can be assumed that the RLS time savings would be even greater outside of a controlled environment.

Helium Leak Test

Conducted by:
Jim Busch, Project Engineer, EWI

Methodology:

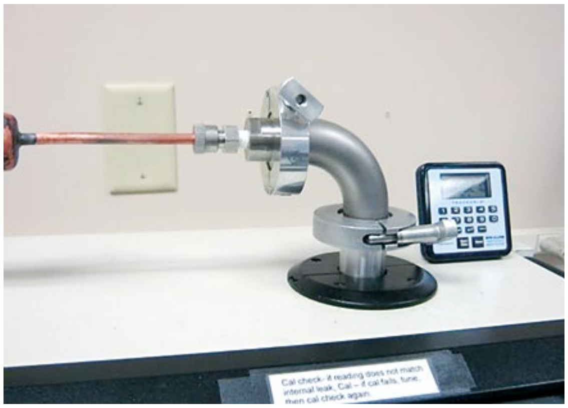
Six different RLS fitting sizes were connected to commercially available ACR tubing. Thirty union connections were chosen as a sample lot, with two connections per fitting. Each sample connected two pieces of tubing approximately nine inches long. One of the tubes was brazed shut at one end and the other tube was reduced to a 1/4" tube stub.

Prior to testing each lot of samples, the Veeco MS-40 helium leak tester was calibrated. After calibration, a solid 1/4" dowel was tested to verify the integrity of the seals on the helium leak test fixture. The 1/4" tube stub was wiped down with methanol and connected to the leak detector via a Swagelok 1/4" Ultra-Torr vacuum fitting. Each sample was pumped down to a level of approximately 500 millitorr prior to applying helium gas near the RLS crimp joint (at atmospheric pressure). The helium leak rate was measured and recorded for each of the 60 connections in a 30 piece sample lot.

Key Findings and Conclusions:

The maximum leak rate of all connections is summarized in the following table. The maximum leak rate detected was 5.40E-09 std.cc/sec.

Maximum Leak Rate per Lot						
Tube O.D. (inches)	0.250	0.313	0.375	.750	0.875	1.125
Maximum Helium Leak (std.cc/sec)	4.00E-10	6.10E-10	1.30E-09	5.20E-09	5.40E-09	3.00E-10




Test Set-up

Accelerated Durability Testing

Conducted by:
Chad Bowers, Creative Thermal Solutions, Inc.

Methodology:

Three tests were devised to accelerate mechanical fatigue on RLS refrigeration press fittings, to simulate real world extreme conditions and determine possible failure modes. A total of 6 different fitting sizes between 1/4" and 1 1/8" were subjected to the tests.

Accelerated Frost/Defrost Simulation
Field failures of brazed joints have been detected due to water being trapped in tight spaces and expanding during freezing, causing high stress on brazed joints and joining methods. To test RLS fittings in this environment, an accelerated freeze/thaw test was performed in a controlled laboratory environment. A total of 16 RLS fittings representing 6 different sizes were repeatedly cycled in a humid environment from 50°F down to -40°F to simulate the water freezing and thawing in the vicinity of a crimped RLS fitting.

Accelerated Thermal Cycling
Accelerated thermal and pressure cycling was performed in a controlled laboratory environment. A total of 16 RLS fittings representing 6 different sizes were repeatedly cycled from high temperature and pressure to low temperature and pressure in a working air conditioning system utilizing R410A.

Vibration Durability Testing
To ensure durability in the presence of vibration induced fatigue, a test was conceived to simulate mechanically induced field vibration in refrigerant carrying tubes. This vibration test procedure was performed in a controlled laboratory environment. A sample of pressurized RLS fittings were subjected to a series of 1 million cycles each.

Key Findings and Conclusions:

Accelerated Frost/Defrost Simulation
The freeze/thaw test loop was allowed to run for over 5,000 cycles (nearly 28 days), simulating approximately 10 years of field operation. During the testing, the facility was shut down once each week to check the fittings for leaks. A similar leak check was performed at the end of testing as well, to confirm that no failures were caused by the testing. All leak checks were passed, with no indications of any form of failure as a result of this accelerated test.

Accelerated Thermal Cycling
The thermal cycling test facility was allowed to run until a total of 85,000 thermal cycles were imposed on the set of 16 RLS fittings. Periodic leak checks were performed over the course of testing to ensure that the fittings' sealing capabilities were intact. Upon completion of thermal cycling, a final leak check was performed, using soap water, indicating that the thermal and mechanical fatigue imposed on the fittings was insufficient to cause a failure in any of the fittings.

Vibration Durability Testing
The accelerometer data showed the up and down motion from the oscillating support causes a very consistent acceleration of approximately +/- 1g on all fittings. The primary frequency occurs at the 28.5HZ provided by the motor, with a very small amount of power occurring in the second harmonic. All of the fittings tested were pressurized to 400 psi and cycled for 1 million times, as described above. All of the fittings maintained pressure over this test period, indicating resilience to vibrational loading.

Corrosion Test

Conducted by:
Jeremy L. Lewis, Touchstone Research Laboratory, Ltd.

Methodology:

A total of 41 RLS refrigeration press fittings were provided to Touchstone Research Laboratory for SWAAT corrosion testing according to instructions provided in ASTM G85, Standard Practice for Modified Salt Spray (Fog) Testing, Annex A3 Acidified Synthetic Sea Water Test.

Specimens were a mixture of copper and aluminum tubes with fittings and gauges. The tubes were pressurized to 400 psi using dry nitrogen and exposed for 1000 hours. After none of the samples had failed to lose pressure before the 1000-hour mark, the decision was made to continue the test to 2000 hours. Test interruptions consisted of 1-2 minute periods every day (excluding weekends) to collect fallout.

Key Findings and Conclusions:

All but one of the original 41 RLS fittings lasted the full exposure time of 2,000 hours. One specimen lasted approximately 1,915 hours and failed.

The RLS fittings did not corrode despite extended exposure to the harsh acidified salt solution. The specimens not only passed the 1,000-hour test, but also did not fail after 2,000 hours, except for the one sample that lasted approximately 1,915 hours.

Specimen placement in the test chamber at start of test.