



Seal-Lok Xtreme Metal Seal Connections

Catalog 4300-ETS December 2018

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Introduction

Seal-Lok Xtreme is a Parker patented solution which expands the O-ring face seal SAE J1453 (ISO 8434-3) connection to critical applications where elastomeric sealing is not an acceptable solution due to temperature or chemical compatibility concerns.

The traditional Seal-Lok connection relies on an elastomeric seal retained in a captive O-ring groove on the face of the fitting to create a seal. Seal-Lok Xtreme replaces the O-ring with a stainless steel metal face seal, shown in Figure 1, which allows for operating temperatures ranging from -328° up to 1200°F (-200° to 650°C) and pressures up to 6000 PSI.

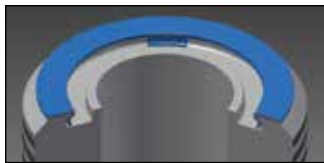


Figure 1 - Seal-Lok Xtreme Cutaway with Metal Seal

This larger range of operating temperatures makes Seal-Lok Xtreme well-suited for use in a wide array of harsh environments and applications such as combustion turbines for Power Gen applications, LNG storage and re-fueling systems, and cryogenic equipment. For other extreme high and low temperature applications, please contact the division.

In addition to the Seal-Lok Xtreme tube or hose connection, Parker also offers a patented metal port seal to replace the elastomeric seal on SAE J1926 O-ring boss fittings. The SAE Metal Port Seal, shown in Figure 2, provides similar temperature, pressure, and chemical compatibility as Seal-Lok Xtreme, providing a complete extreme solution.

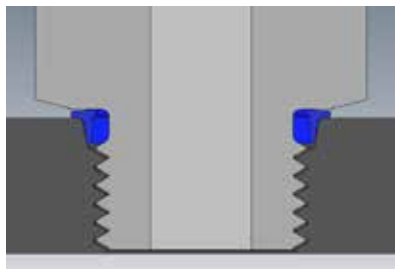


Figure 2 - SAE Metal Port Seal

How It Works

Seal-Lok Xtreme

Seal-Lok Xtreme connections consist of four main components: a fitting body, a nut, a sleeve, and the metal face seal. Like traditional Seal-Lok, the sleeve can be attached to the tube by either brazing or flanging using Parker's Parflange technology. Both configurations are shown in Figure 3. Seal-Lok Xtreme works with both inch and metric tube or hose.

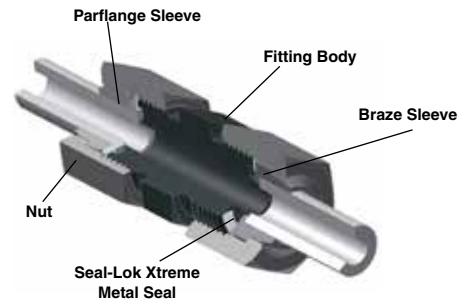


Figure 3a - Seal-Lok Xtreme union cutaway with flanged and brazed assemblies

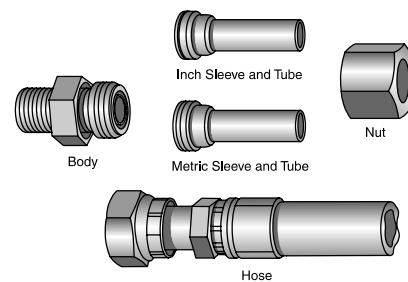


Figure 3b - Seal-Lok Xtreme works with inch or metric tube and hose

The Seal-Lok Xtreme metal face seal is retained in a captive (O-ring) groove by three formed tabs. The seals will not fall out during assembly and are factory pre-installed on the body.

During assembly the metal seal is compressed between the fitting body and flat face of the formed tube flange or braze sleeve as the nut is tightened. As the two faces come in contact with the seal, the silver plating on the seal will ensure small imperfections are filled and prevent galling damage sealing faces.

Seal-Lok Xtreme is a zero-clearance fitting, assembled by torque. Please refer to Table 4, page 7 for assembly torque values

SAE Metal Port Seal for O-Ring Boss Fittings

The SAE Metal Seal is designed for use with standard SAE J1926 O-ring boss fittings and ports. It replaces the O-ring by loosely threading onto the fitting where it is retained above the threads for assembly. Once tightened to the torque value given in Table 4, the seal is compressed against the port chamfer and positively energized by the internal pressure, creating a spring like reaction in the seal.

Recommended surface finish on port sealing surfaces is a Ra 32 micro inch or better. No chatter, spiral tool marks, scratches or dings should be present. The SAE Metal Seal is for straight connectors only and will not work correctly with adjustable fittings.

Construction

Parker's Seal-Lok Xtreme fittings are manufactured from SAE/AISI 316/316L stainless steel to meet extreme temperature requirements and provide superior corrosion resistance. Both the Seal-Lok Xtreme metal face seal and the SAE Metal Port Seal are also manufactured from SAE/AISI 316/316L stainless steel and plated with silver for improved sealing characteristics.

Note: Due to the material nature of the metal seals, some tarnish may appear. This does not affect the form, fit, or function.

Available Styles and Sizes

The Seal-Lok Xtreme product line includes a range of tube or hose connection styles to meet various system design needs in sizes 4 - 32. Standard configurations include straights, elbows, and tees, with port end styles NPT, BSPT, SAE J1926, BSPP ISO 1179, metric ISO 9974 and metric ISO 6149.

Extensively Tested

Extensive testing has been performed on Seal-Lok Xtreme and SAE Metal Port Seal. Both seals underwent the following tests:

- **Thermal Cycling** – Test assemblies pressurized with nitrogen gas were subjected to temperatures ranging from -328°F to 1200°F (-200°C to 650°C) using the temperature profile in Figure 4. The pressure was monitored at each change in temperature to ensure sealing was effective. No losses were allowed and all samples passed.

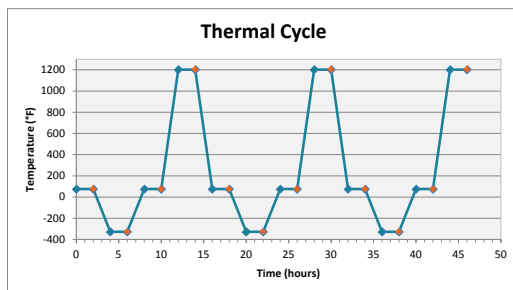


Figure 4 - Thermal Cycling Test Parameters

- **Thermal Shock** – Test assemblies pressurized with nitrogen gas were subjected to the temperature profile in Figure 5. Pressure was monitored continuously during testing. No losses were allowed and all samples passed.

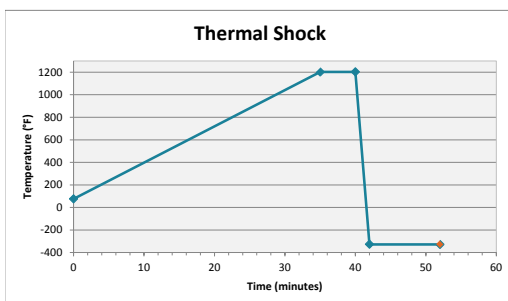


Figure 5 - Thermal Shock Test Parameters

- **Helium Mass Spectrometer Testing** – Using a vacuum helium mass spectrometer, test assemblies were leak tested and the target of 1×10^{-7} std atm-cc/sec for high purity applications was achieved.
- **Leak and Burst Pressure Testing** – Test assemblies were first leak tested by pressurizing them with nitrogen to 50 PSI and 1000 PSI and observing for visual signs of leakage when placed underwater. The same assemblies were then burst tested with water to ensure that a minimum 4:1 design factor was met before failure occurred. All samples passed.
- **Rotary Flex Testing** – Pressurized test assemblies completed a minimum of one million cycles at 30,000 psi of fiber stress level. No pressure losses were allowed and all samples passed.
- **Thread Galling** – Seal-Lok Xtreme fittings were tightened to 120% of recommended torque, heated to 510°C, and soaked for 60 minutes. After cooling for several hours, the fitting joint was broken and reassembled. This process was repeated 10 times or until threads were unusable or galled. All fittings passed at least ten cycles without threads or sealing surfaces galling.
- **Over Torque** – Test assemblies were tightened to 150% of recommended torque and inspected for damage. No damage to the threads or fitting sealing face allowed, included galling. All fittings passed with no damage or galling.
- **Thermal Shock FEA** – Simulated 70°F air flow at 75ft/s with fittings heated to 930°F. Thread and tailpiece displacement was kept fixed. Evaluated thermal distribution and mechanical stresses. The sealing faces did not lose contact pressure. No gap was observed.
- **Bonfire Testing** – Test assembly of Seal-Lok Xtreme with SAE Metal Port Seal were pressurized to 3,600 psig and exposed to a minimum of 1,094°F for 20 minutes. Tested in accordance with ANSI/CSA NGV 2.

The Seal-Lok Xtreme Advantage

- High temperature sealing capable up to 1200°F (650°C)
- Low temperature sealing capable to -328°F (-200°C)
- Zero clearance interface enables easier tube assembly and disassembly
- Extreme temperature seals incorporated into SAE J1453 (ISO 8434-3) O-ring face seal body design and SAE J1926 port design
- Excellent resistance to over tightening
- Resistant to loosening due to vibration
- Utilizes captive O-ring groove for seal retention to prevent seal fall out during shipment and assembly
- Can be used on tube assemblies with existing Parflange technology
- Field replaceable seal for easy maintenance
- Working pressures up to 6000 PSI
- Seals available in sizes 4 to 32.

Application

When using any fittings at operating temperatures above 300°F a pressure derating factor should be used that adjusts for material thermal effects. Derating factors are applied to the recommended working pressures for Seal-Lok Xtreme configurations. Refer to Table 1 for recommended derating factors by expected maximum working temperature.

Example: At 700°F the maximum recommended working pressure of 3000 psi would be derated to: $3000 \times 0.82 = 2460$ psi.

For applications with sustained temperatures between 850°F and 1200°F, fitting and tubing material should be reviewed for suitability, including strength and corrosion requirements.

Maximum Operating Temperature (°F)	Stainless Steel 316/316L
300	1.00
350	0.99
400	0.97
500	0.90
600	0.85
700	0.82
800	0.80
900	0.78
1000	0.77
1100	0.62
1200	0.37

Table 1 - Working Pressure Derating Factors

Seal-Lok Xtreme Assembly

The proper assembly of Seal-Lok Xtreme fittings requires several steps, each important in guaranteeing a leak free connection and long service life:

1. Tube selection and preparation
2. Sleeve attachment methods (flanging, brazing or welding)
3. Inspection and final installation

Tube Selection and Preparation

Seal-Lok Xtreme works with most tube materials that can be flanged, welded, or brazed. Standard stainless steel materials, such as 304 or 316, are widely available and a good solution for matching the temperature extremes and chemical compatibility of Seal-Lok Xtreme. Tubing should have a maximum hardness of HRB 90.

Seamless tube is recommended for ease in flanging and bending. For recommended minimum and maximum tube wall thickness requirements for Seal-Lok Xtreme, please refer to Tables 2 and 3 on page 7.

Tube prep is important to ensure robust connections. It is best to cut tubes with a cold saw to ensure a square, smooth cut, followed by deburring.

Sleeve Attachment Methods

Attaching the sleeve to the tube can be accomplished by several methods: flanging, brazing or welding. Flanging is the cleanest, fastest method and does not add an additional leak path since the formed tube is a single piece.

The flanging method requires the use of an appropriate machine to create the flat face on the tube end. Parker Parflange machines utilize an orbital cold forming process to produce a flat, smooth, rigidly supported 90° sealing surface on the tube end. Parker offers several models of Parflange machines such as the 1025 shown in Figure 6. For detailed instructions on the Parflange process, as well as brazing methods and weld spuds, please refer to Tube Fittings Catalog 4300.



Figure 6 - Parflange Machine

Inspection and Final Assembly

All sealing surfaces should be inspected prior to final assembly to ensure they are smooth, free of any nicks, scratches, spiral tool marks, splits, or weld beads.

For proper final assembly, the torque values provided in Table 4 should be used. A second wrench may be required to prevent the fitting from moving during assembly.

Seal-Lok Xtreme assemblies can tolerate several remakes prior to placing in service. However, it is always recommended that seals be replaced if the joint is disassembled for maintenance and repair.

Recommended Tube Wall Thickness

Fitting Dash Size	Product Type		
	Tube O.D. (inch)	Recommended Wall Thickness (Inch)	
		Seal-Lok Xtreme	
		Min.	Max.
-2	1/8	-	-
-3	3/16	-	-
-4	1/4	0.020	0.083
-5	5/16	-	-
-6	3/8	0.020	0.109
-8	1/2	0.028	0.148
-10	5/8	0.035	0.134
-12	3/4	0.035	0.148
-14	7/8	0.035	0.156
-16	1	0.035	0.188
-20	1 1/4	0.049	0.220
-24	1 1/2	0.049	0.250
-32	2	0.058	0.250

Table 2 — Recommended Inch Tube Wall Thickness

Tube O.D. (mm)	Metric Tube		
	Recommended Wall Thickness (mm)		
	Seal-Lok Xtreme		
	Fitting Size	Min.	Max.
6	-4	0.5	2.25
8	-6	1.0	2.5
10	-6	1.0	3.0
12	-8	1.0	3.5
14	-10	1.0	4.0
15	-10	1.0	3.0
16	-10	1.0	3.0
18	-12	1.0	3.0
20	-12	1.5	4.0
22	-16	1.0	3.0
25	-16	2.0	5.0
28	-20	1.5	5.0
30	-20	2.0	5.0
32	-20	2.0	2.5
35	-24	2.0	6.0
38	-24	2.5	7.0
50	-	-	-

Table 3 — Recommended Metric Tube Wall Thickness

Tube OD		SAE Dash Size	Seal-Lok Tube Side				SAE Port Side			
(in.)	(mm)		Thread Size (UN/UNF)	Assembly Torque (+10% / -0%)			Thread Size (UN/UNF)	Assembly Torque (+10% / -0%)		
				in.-lbs.	ft.-lbs.	N-m		in.-lbs.	ft.-lbs.	N-m
1/4	6	-4	9/16-18	240	20	28	7/16-20	340	28	38
3/8	8,10	-6	11/16-16	396	33	44	9/16-18	460	38	52
1/2	12	-8	13/16-16	528	44	60	3/4-16	790	66	89
5/8	14,15,16	-10	1-14	840	70	95	7/8-14	-	110	150
3/4	18,20	-12	1 3/16-12	-	90	122	1 1/16-12	-	150	205
1	22,25	-16	1 7/16-12	-	110	150	1 5/16-12	-	220	300
1 1/4	28,30,32	-20	1 11/16-12	-	200	270	1 5/8-12	-	275	375
1 1/2	35,38	-24	2-12	-	300	410	1 7/8-12	-	335	455
2	42,50	-32	2 1/2-12	-	500	685	2 1/2-12	-	415	565
2 3/8	60	-38	3 1/8-8	-	750	1015	-	-	-	-

Table 4 - Seal-Lok Xtreme Torque Values

Tube O.D.	304 or 316 Stainless Steel (seamless)															
	Wall Thickness															
	0.020	0.028	0.035	0.049	0.058	0.065	0.083	0.095	0.109	0.120	0.134	0.148	0.156	0.188	0.220	0.250
1/4	3000	3000	3000	3000	3000	3000	3000									
3/8	2000	2800	3000	3000	3000	3000	3000	3000	3000							
1/2		2100	2600	3000	3000	3000	3000	3000	3000	3000	3000					
5/8			2100	3000	3000	3000	3000	3000	3000	3000	3000	3000				
3/4			1750	2000	2000	2000	2000	2000	2000	2000	2000	2000				
1			1300	1850	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000		
1-1/4				1500	1750	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	
1-1/2				1250	1450	1650	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
2						1250	1550	1800	2000	2000	2000	2000	2000	2000	2000	2000
2-3/8						1050	1300	1500	1750	1900	2000	2000	2000	2000	2000	2000

Table 5 - Maximum Allowable Working Pressure^{1,2,3}

¹Maximum Allowable Working Pressure with 4:1 Design Factor

²Maximum Allowable Working Pressures for temperature range: -425°F to 300°F

³For Temperatures above 300°F, MAWP should be derated according to ASME recommendations

Face Seal Replacement Instructions

While Seal-Lok Xtreme metal face seals come fully assembled in the fitting body, field replacement of these seals can be performed using the following steps.

1. Remove the old seal using a plastic or soft metal pick that will not damage the sealing face of the fitting.
2. Install the metal seal by slightly angling it away from the fitting face and placing two tabs into the captive O-ring groove. See picture 1 in Figure 7.

Note: If connection is broken, a new seal is to be used.

3. Visually check that the third tab is not sitting on top of the fitting face but is starting to engage the captive groove lip.
4. If engaged, press the third tab into the captive groove, snapping it in place.

Note: Standard o-ring face seal o-rings and SAE port end o-rings cannot be used on Seal-Lok Xtreme fittings to achieve the same extreme temperatures detailed in catalog.

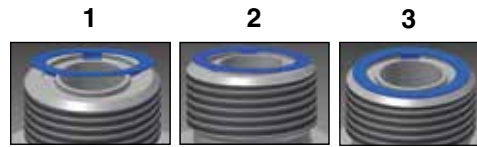


Figure 7 - Face Seal Replacement



Figure 7b - SAE Metal Seal Assembly

SAE Metal Seal Assembly Instruction

1. Check if SAE Metal Seal is assembled on fitting. If the seal is not on the fitting, orient the metal seal such that the flat end faces the shoulder of SAE ORB stud, as shown in the figure 7b.
2. Lightly screw the SAE Metal Seal through the SAE ORB threads until the flat end of the seal is in contact with the SAE ORB shoulder, as shown in figure 7b.
3. Apply system compatible lubricant to both the SAE Metal Seal and the fitting threads.
4. Screw the fitting into SAE port, carefully guide the SAE Metal Seal lip into the SAE port chamfer. Make sure that the SAE Metal Seal lip is not caught by the SAE port face, as shown in figure 7c.
5. Tighten the fitting to recommended torque.

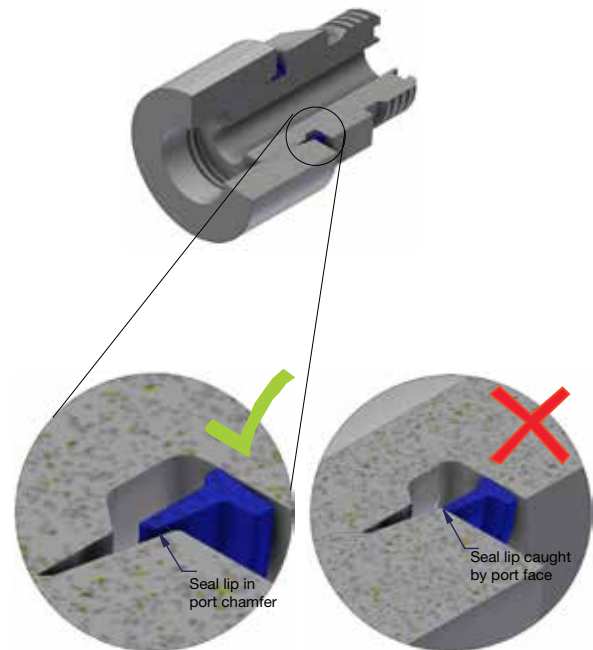


Figure 7c - SAE Metal Seal Assembly

How to Order













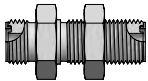
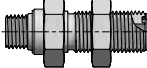
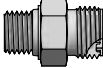





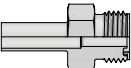
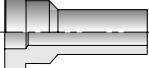
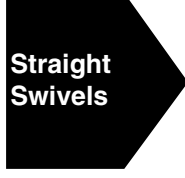
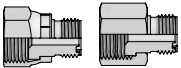


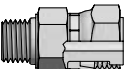
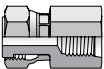

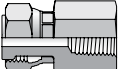

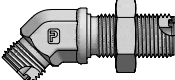



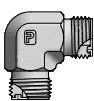
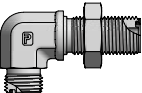
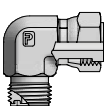


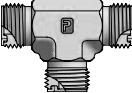
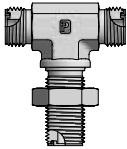
Seal-Lok Xtreme fittings nomenclature is similar to Seal-Lok, except with the following changes.

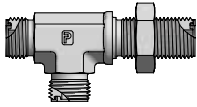
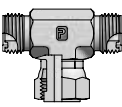
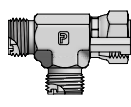
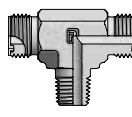
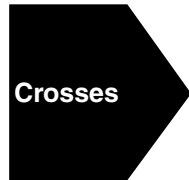
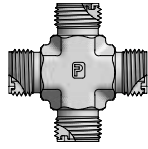



Add ETS suffix to indicate metal sealing compatible. Add 9 to indicate assembled with metal seals (instead of O for o-rings).

Example 1: 8 F59L9-SS ETS (metal seals installed on both port and face)

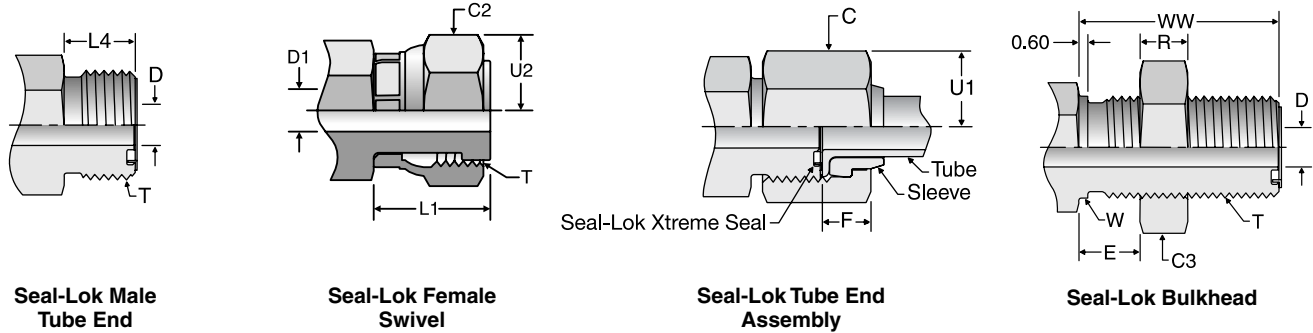
Example 2: 6 C6L9-SS ETS (metal seals installed on face)

Material Note: Seal-Lok Xtreme is available in 316 stainless steel. For other materials please contact the Tube Fittings Division.

 <p>Nuts, Sleeves, Locknuts</p>	<p>BL Tube Nut</p>  <p>12</p>	<p>BML Tube Nut - mm Hex</p>  <p>12</p>	<p>TPL (Inch) Parflange Sleeve</p>  <p>12</p>	<p>TPLS (Metric) Parflange Sleeve</p>  <p>13</p>	<p>TL (Inch) Braze Reducer Sleeve</p>  <p>13</p>
<p>TLS (Metric) Braze Reducer Sleeve</p>  <p>13</p>	<p>SBR (Inch and Metric) Braze Ring</p>  <p>14</p>	<p>WLNL Bulkhead Locknut</p>  <p>14</p>	<p>WLNML Bulkhead Locknut-mm Hex</p>  <p>14</p>	 <p>Straights</p>	<p>HL9 Union</p>  <p>15</p>
<p>WL9 Bulkhead Union</p>  <p>15</p>	<p>WF59L9 Metal Face Seal / SAE-Metal Face Seal</p>  <p>16</p>	<p>F59L9 Metal Face Seal / SAE-Metal Face Seal</p>  <p>17</p>	<p>FF59L9 Metal Face Seal / SAE-Metal Face Seal</p>  <p>18</p>	<p>FL9 Metal Face Seal / NPTF</p>  <p>18</p>	<p>GL9 Metal Face Seal / NPTF</p>  <p>19</p>
<p>L9HB3 Metal Face Seal / Braze Socket</p>  <p>20</p>	<p>MML9HB3 Metal Face Seal / Braze - mm Hex</p>  <p>21</p>	<p>L9HT3 Metal Face Seal / Tube Weld</p>  <p>21</p>	<p>TLW1 Butt Weld / Sleeve</p>  <p>22</p>	 <p>Straight Swivels</p>	<p>TRL9N Tube End Reducer</p>  <p>23</p>
<p>L9HL6 Extender and Expander</p>  <p>24</p>	<p>HL6 Metal Face Seal Swivel Union</p>  <p>24</p>	<p>F659L Metal Face Seal Swivel / SAE-Metal Seal</p>  <p>25</p>	<p>G65L Metal Face Seal Swivel / SAE-ORB</p>  <p>25</p>	<p>F6L Metal Face Seal Swivel / NPTF</p>  <p>26</p>	<p>G6L Metal Face Seal Swivel NPTF</p>  <p>26</p>
 <p>45° Elbows</p>	<p>WNL9 Bulkhead Union</p>  <p>27</p>	<p>V6L9 Metal Face Seal Swivel Elbow</p>  <p>27</p>	<p>VL9 Metal Face Seal / NPTF</p>  <p>28</p>	 <p>90° Elbows</p>	<p>EL9 Union Elbow</p>  <p>28</p>
<p>WEL9 Bulkhead Union</p>  <p>29</p>	<p>C6L9 Metal Face Seal Swivel Elbow</p>  <p>29</p>	<p>CL9 Metal Face Seal / NPTF</p>  <p>30</p>	 <p>Tees</p>	<p>JL9 Union Tee</p>  <p>31</p>	<p>WJL9 Bulkhead Branch</p>  <p>31</p>

<p>WJL9 Bulkhead Run</p>  <p>32</p>	<p>S6L9 Metal Face Seal Swivel Branch</p>  <p>32</p>	<p>R6L9 Metal Face Seal Swivel Run</p>  <p>33</p>	<p>SL9 NPTF Branch Tee</p>  <p>33</p>	<p>Crosses</p> 	<p>KL9 Union Cross</p>  <p>34</p>
<p>Plugs and Caps</p> 	<p>PNL9 Metal Face Seal Plug</p>  <p>35</p>	<p>FNL Metal Face Seal Cap</p>  <p>35</p>			

Seal-Lok Xtreme Metal Seal Tube Ends



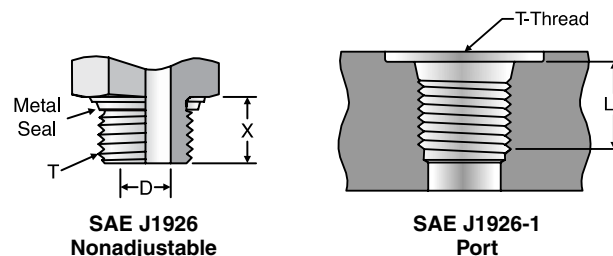
SAE Dash Size	Tube O.D.	T	Thread		Tube Nut Hex	Swivel Nut Hex	Bulkhead Locknut Hex		Nominal Drill Tube End	Nominal Drill Swivel End	Max Bulkhead Thickness	Tube Nut Assembled Allowance	Swivel Turn Back	Male Turn Back	Bulkhead			Across Corners		
			UN/UNF	C			C2	C3							Locknut Thickness	Pilot Dia	Length	Tube Nut Hex	Swivel Nut Hex	
			(in.) (mm)	(in.) (mm)			(in.) (mm)	(in.) (mm)							(in.)	(in.)	(in.)	(in.)	(in.)	
4	1/4	6	9/16-18	11/16	17	11/16	17	13/16	22	0.177	0.157	0.55	0.270	0.642	0.394	0.27	0.563	1.24	0.80	0.80
6	3/8	8 10	11/16-16	13/16	22	13/16	22	1	27	0.256	0.256	0.55	0.340	0.715	0.441	0.32	0.688	1.34	0.94	0.94
8	1/2	12	13/16-16	15/16	24	15/16	24	1 1/8	30	0.374	0.354	0.55	0.400	0.865	0.512	0.35	0.813	1.44	1.08	1.08
10	5/8	14 15 16	1-14	1 1/8	30	1 1/8	30	1 5/16	36	0.492	0.453	0.55	0.455	0.980	0.618	0.41	1.000	1.60	1.30	1.30
12	3/4	18 20	1 3/16-12	1 3/8	36	1 3/8	36	1 1/2	41	0.610	0.551	0.55	0.510	1.110	0.677	0.41	1.188	1.64	1.58	1.58
16	1	22 25	1 7/16-12	1 5/8	41	1 5/8	41	1 3/4	46	0.807	0.787	0.55	0.596	1.190	0.697	0.41	1.438	1.66	1.88	1.88
20	1 1/4	28 30 32	1 11/16-12	1 7/8	50	1 7/8	50	2	50	1.024	1.024	0.55	0.596	1.251	0.697	0.41	1.688	1.66	2.16	2.16
24	1 1/2	35 38	2-12	2 1/4	60	2 1/4	60	2 3/8	60	1.260	1.260	0.55	0.545	1.330	0.697	0.41	2.000	1.66	2.60	2.60
32	2	42 50	2 1/2-12	2 7/8		2 7/8		2 3/4		1.772	1.732	0.50	0.606	1.690	0.874	0.54	2.500	1.83	3.32	3.32

1) D and D1 nominal may vary from the values shown in the chart by 0.004 to 0.008. Also, D for -4 metric based Seal-Lok may be 0.197 (5 mm) to satisfy ISO 8434-3 (2005 edition). Contact the Tube Fittings Division if there are any questions.

2) Recommended clearance hole = W + 0.015.

Size	Thread T UN/UNF	Drill D (ref)	Minimum Thread L4 (inch)	Stud Length X (inch)
4	7/16-20	0.177	0.454	0.433
6	9/16-18	0.295	0.500	0.472
8	3/4-16	0.378	0.562	0.551
10	7/8-14	0.492	0.656	0.630
12	1 1/16-12	0.610	0.750	0.728
16	1 5/16-12	0.846	0.750	0.728
20	1 5/8-12	1.083	0.750	0.728
24	1 7/8-12	1.319	0.750	0.728
32	2 1/2-12	1.575	0.750	0.728

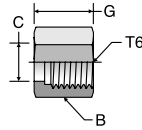
SAE Metal Seal Port Ends



Dimensions and pressures for reference only, subject to change.

BL

Tube Nut
Metal Face Seal



TUBE FITTING PART #	END SIZE (in.)	T6 UNF/UNF-2B	B HEX (in.)	C (in.)	G (in.)
6 BL-SS	3/8	11/16 - 16	13/16	0.530	0.67
8 BL-SS	1/2	13/16 - 16	15/16	0.650	0.79
10 BL-SS	5/8	1 - 14	1 1/8	0.830	0.94
12 BL-SS	3/4	1 3/16 - 12	1 3/8	0.950	1.04
16 BL-SS	1	1 7/16 - 12	1 5/8	1.150	1.08
20 BL-SS	1 1/4	1 11/16 - 12	1 7/8	1.420	1.08
24 BL-SS	1 1/2	2 - 12	2 1/4	1.730	1.08
32 BL-SS*	2	2 1/2 - 12	2 7/8	2.220	1.30

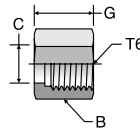
* Size 32 is not included in SAE J1453.

** These tube nuts should not be exposed to annealing temperatures, such as furnace brazing. Contact the Tube Fittings Division for information on special nuts.

• Stainless steel tube nuts are prelubricated for ease of assembly.

BL

Tube Nut with Molybdenum Di-Sulfide dry film lubricant
Metal Face Seal

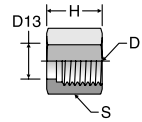


TUBE FITTING PART #	END SIZE (in.)	T6 UNF/UNF-2B	B HEX (in.)	C (in.)	G (in.)
6 BL-SS EL4	3/8	11/16 - 16	13/16	0.530	0.67
8 BL-SS EL4	1/2	13/16 - 16	15/16	0.650	0.79
10 BL-SS EL4	5/8	1 - 14	1 1/8	0.830	0.94
12 BL-SS EL4	3/4	1 3/16 - 12	1 3/8	0.950	1.04
12-14 BL-SS EL4	7/8	1 3/16 - 12	1 3/8	0.990	1.20
16 BL-SS EL4	1	1 7/16 - 12	1 5/8	1.150	1.08
20 BL-SS EL4	1 1/4	1 11/16 - 12	1 7/8	1.420	1.08
24 BL-SS EL4	1 1/2	2 - 12	2 1/4	1.730	1.08
32 BL-SS* EL4	2	2 1/2 - 12	2 7/8	2.220	1.30

Note: Tube nuts are coated with a Molybdenum Di-Sulfide dry-film lubricant. This lubricant provides excellent anti-galling characteristics and is suitable for all temperature extremes, it is reusable, and eliminates the need for additional set lubricants. It has a matte gray appearance.

BML

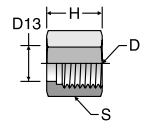
Tube Nut – mm Hex
Metal Face Seal



TUBE FITTING PART #	END SIZE		D THREAD UN/UNF-2B	D13 DRILL (mm)	H (mm)	S HEX (mm)
	(mm)	(in.)				
4BMLSS	6	1/4	9/16 - 18	10.50	15.0	17
6BMLSS	8,10	3/8	11/16 - 16	13.55	17.5	22
8BMLSS	12	1/2	13/16 - 16	16.60	20.0	24
10BMLSS	14,15,16	5/8	1 - 14	21.10	24.0	30
12BMLSS	18,20	3/4	1 3/16 - 12	24.15	26.5	36
16BMLSS	22,25	1	1 7/16 - 12	29.10	27.5	41
20BMLSS	28,30,32	1 1/4	1 11/16 - 12	36.00	27.5	50
24BMLSS	35,38	1 1/2	2 - 12	44.00	27.5	60

BML

Tube Nut – mm Hex with Molybdenum Di-Sulfide dry film lubricant
Metal Face Seal

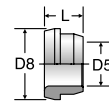


TUBE FITTING PART #	END SIZE		D THREAD UN/UNF-2B	D13 DRILL (mm)	H (mm)	S HEX (mm)
	(mm)	(in.)				
4BMLSS EL4	6	1/4	9/16 - 18	10.50	15.0	17
6BMLSS EL4	8,10	3/8	11/16 - 16	13.55	17.5	22
8BMLSS EL4	12	1/2	13/16 - 16	16.60	20.0	24
10BMLSS EL4	14,15,16	5/8	1 - 14	21.10	24.0	30
12BMLSS EL4	18,20	3/4	1 3/16 - 12	24.15	26.5	36
16BMLSS EL4	22,25	1	1 7/16 - 12	29.10	27.5	41
20BMLSS EL4	28,30,32	1 1/4	1 11/16 - 12	36.00	27.5	50
24BMLSS EL4	35,38	1 1/2	2 - 12	44.00	27.5	60

Note: Tube nuts are coated with a Molybdenum Di-Sulfide dry-film lubricant. This lubricant provides excellent anti-galling characteristics and is suitable for all temperature extremes, it is reusable, and eliminates the need for additional set lubricants. It has a matte gray appearance.

TPL (Inch)

Parflange Sleeve
for Inch Tubing
Metal Face Seal Mechanically Attachable Sleeve



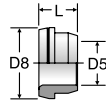
TUBE FITTING PART #	D5 END SIZE (in.)	D8 DIA (in.)	L (in.)
4 TPL-SS	1/4	0.50	0.30
6 TPL-SS	3/8	0.62	0.34
8 TPL-SS	1/2	0.74	0.42
10 TPL-SS	5/8	0.92	0.42
12 TPL-SS	3/4	1.09	0.47
16 TPL-SS	1	1.34	0.53
20 TPL-SS	1 1/4	1.59	0.51
24 TPL-SS	1 1/2	1.91	0.49
32 TPL-SS	2	2.39	0.54

• Must be mechanically attached using Parflange system.

Dimensions and pressures for reference only, subject to change.

TPLS (Metric)

Parflange Sleeve for
Metric Tubing
Metal Face Seal Mechanically
Attachable Sleeve

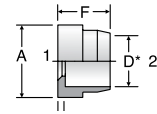


TUBE FITTING PART #	USED WITH FITTING SIZE	D5 END SIZE (mm)	D8 DIA (mm)	L (mm)
TPLSS6	-4	6	12.75	7.5
TPLSS8	-6	8	15.75	8.5
TPLSS10	-6	10	15.75	8.5
TPLSS12	-8	12	18.90	10.5
TPLSS15	-10	15	23.50	10.5
TPLSS16	-10	16	23.50	10.5
TPLSS18	-12	18	27.80	12.0
TPLSS20	-12	20	27.80	12.0
TPLSS25	-16	25	34.00	13.5
TPLSS30	-20	30	40.50	13.0
TPLSS32	-20	32	40.50	13.0
TPLSS35	-24	35	48.50	12.5
TPLSS38	-24	38	48.50	12.5

• Must be mechanically attached using Parflange system.

TL (Inch)

Braze Sleeve for Inch Tubing
Metal Face Seal
Silver Braze Sleeve Reducer



TUBE FITTING PART #	END SIZE		A (in.)	D* (in.)	E (in.)	F (in.)
	1 (in.)	2 (in.)				
4 TL-SS	1/4	1/4	0.50	0.26	0.04	0.37
6 TL-SS	3/8	3/8	0.62	0.38	0.04	0.37
6-4 TL-SS	3/8	1/4	0.62	0.26	0.08	0.41
8 TL-SS	1/2	1/2	0.75	0.51	0.04	0.37
8-4 TL-SS	1/2	1/4	0.75	0.26	0.14	0.47
8-6 TL-SS	1/2	3/8	0.75	0.38	0.14	0.47
10 TL-SS	5/8	5/8	0.92	0.63	0.06	0.41
10-4 TL-SS	5/8	1/4	0.92	0.26	0.20	0.53
10-6 TL-SS	5/8	3/8	0.92	0.38	0.20	0.53
10-8 TL-SS	5/8	1/2	0.92	0.51	0.20	0.53
12 TL-SS	3/4	3/4	1.10	0.76	0.06	0.55
12-4 TL-SS	3/4	1/4	1.10	0.26	0.24	0.57
12-6 TL-SS	3/4	3/8	1.10	0.38	0.24	0.57
12-8 TL-SS	3/4	1/2	1.10	0.51	0.24	0.57
12-10 TL-SS	3/4	5/8	1.10	0.63	0.22	0.57
16 TL-SS	1	1	1.35	1.01	0.06	0.61
16-8 TL-SS	1	1/2	1.35	0.51	0.28	0.61
16-10 TL-SS	1	5/8	1.35	0.63	0.26	0.61
16-12 TL-SS	1	3/4	1.35	0.76	0.18	0.67
20 TL-SS	1 1/4	1 1/4	1.60	1.26	0.06	0.61
20-12 TL-SS	1 1/4	3/4	1.60	0.76	0.28	0.77
20-16 TL-SS	1 1/4	1	1.60	1.01	0.28	0.83
24 TL-SS	1 1/2	1 1/2	1.91	1.51	0.06	0.61
24-16 TL-SS	1 1/2	1	1.91	1.01	0.28	0.83
24-20 TL-SS	1 1/2	1 1/4	1.91	1.26	0.28	0.83
32 TL***-SS	2	2	2.41	2.01	0.06	0.65

Unplated part, oil dipped for corrosion protection.

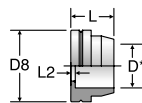
* D is for silver brazing.

** 12-14 TL must be assembled with 12-14 BL.

• Uses SBR silver braze rings

TLS (Metric)

Braze Sleeve for Metric Tubing
Metal Face Seal
Silver Braze Sleeve

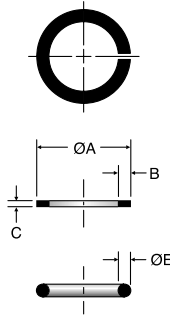


TUBE FITTING PART #	USED WITH FITTING SIZE	D* END SIZE (mm)	D8 DIA (mm)	L (mm)	L2 (mm)
TLSS6	-4	6	12.8	9.5	1.0
TLSS8	-6	8	15.8	9.5	1.0
TLSS10	-6	10	15.8	9.5	1.0
TLSS12	-8	12	18.9	9.5	1.0
TLSS16	-10	16	23.5	10.5	1.5
TLSS20	-12	20	27.9	14.0	1.5
TLSS25	-16	25	34.2	15.5	1.5
TLSS30	-20	30	40.6	15.5	1.5
TLSS38	-24	38	48.5	15.5	1.5

SBR (Inch)

Silver Braze Ring for Inch Tubing

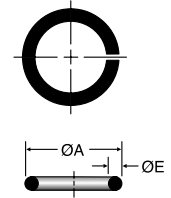
TUBE FITTING PART #	END SIZE (in.)	A DIA (in.)	B (in.)	C (in.)	E (in.)
4 SBR-SS	1/4	0.260	—	—	0.05
6 SBR-SS	3/8	0.390	0.07	0.03	—
8 SBR-SS	1/2	0.515	0.07	0.03	—
10 SBR-SS	5/8	0.640	0.07	0.03	—
12 SBR-SS	3/4	0.765	0.08	0.04	—
16 SBR-SS	1	1.015	0.08	0.04	—
20 SBR-SS	1 1/4	1.265	0.08	0.04	—
24 SBR-SS	1 1/2	1.515	0.08	0.04	—
32 SBR-SS	2	2.015	—	—	0.09



SBR (Metric)

Silver Braze Ring for Metric Tubing

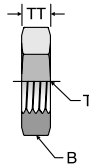
TUBE FITTING PART #	END SIZE (mm)	A DIA (mm)	E (mm)
SBR-SS 6mm	6	6.4	1.2
SBR-SS 8mm	8	8.4	1.2
SBR-SS 10mm	10	10.4	1.2
SBR-SS 12mm	12	12.4	1.2
SBR-SS 16mm	16	16.4	1.2
SBR-SS 20mm	20	20.4	1.6
SBR-SS 25mm	25	25.4	1.6
SBR-SS 30mm	30	30.4	1.6
SBR-SS 38mm	38	38.4	1.6



WLNL

Metal Face Seal Bulkhead Locknut

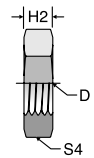
TUBE FITTING PART #	END SIZE (in.)	T TUBE END UN/UNF-2A	B HEX (in.)	TT (in.)
4 WLNL-SS	1/4	9/16 - 18	13/16	0.27
6 WLNL-SS	3/8	11/16 - 16	1	0.31
8 WLNL-SS	1/2	13/16 - 16	1 1/8	0.35
10 WLNL-SS	5/8	1 - 14	1 5/16	0.41
12 WLNL-SS	3/4	1 3/16 - 12	1 1/2	0.41
16 WLNL-SS	1	1 7/16 - 12	1 3/4	0.41
20 WLNL-SS	1 1/4	1 11/16 - 12	2	0.41
24 WLNL-SS	1 1/2	2 - 12	2 3/8	0.41
32 WLNL-SS	2	2 1/2 - 12	2 3/4	0.55



WLNML

Metal Face Seal Bulkhead Locknut – mm Hex

TUBE FITTING PART #	END SIZE		D TUBE END UN/UNF-2B	H2 (mm)	S4 HEX (mm)
	(mm)	(in.)			
4WLNMLSS	6	1/4	9/16 - 18	7.0	22
6WLNMLSS	8,10	3/8	11/16 - 16	8.0	27
8WLNMLSS	12	1/2	13/16 - 16	9.0	30
10WLNMLSS	14,15,16	5/8	1 - 14	10.5	36
12WLNMLSS	18,20	3/4	1 3/16 - 12	10.5	41
16WLNMLSS	22,25	1	1 7/16 - 12	10.5	46
20WLNMLSS	28,30,32	1 1/4	1 11/16 - 12	10.5	50
24WLNMLSS	35,38	1 1/2	2 - 12	10.5	60
32WLNMLSS	50	2	2 1/2 - 12	14.0	70

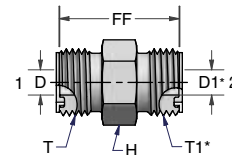


Dimensions and pressures for reference only, subject to change.

HL9

Union

Metal Face Seal / Metal Face Seal



* D1 and T1 are for jump sizes only. Otherwise D and T are typical.

TUBE FITTING PART #	END SIZE		T TUBE END UN/UNF-2A	T1 TUBE END UN/UNF-2A	D** DRILL (in.)	D1** DRILL (in.)	FF (in.)	H HEX (in.)
	1 (in.)	2 (in.)						
4 HL9-SS ETS	1/4	1/4	9/16 - 18	9/16 - 18	0.177	0.177	1.08	5/8
6 HL9-SS ETS	3/8	3/8	11/16 - 16	11/16 - 16	0.256	0.256	1.22	3/4
6-4 HL9-SS ETS	3/8	1/4	11/16 - 16	9/16 - 18	0.256	0.177	1.17	3/4
8 HL9-SS ETS	1/2	1/2	13/16 - 16	13/16 - 16	0.374	0.374	1.39	7/8
8-6 HL9-SS ETS	1/2	3/8	13/16 - 16	11/16 - 16	0.374	0.256	1.33	7/8
10 HL9-SS ETS	5/8	5/8	1 - 14	1 - 14	0.492	0.492	1.68	1 1/16
10-8 HL9-SS ETS	5/8	1/2	1 - 14	13/16 - 16	0.492	0.492	1.57	1 1/16
12 HL9-SS ETS	3/4	3/4	1 3/16 - 12	1 3/16 - 12	0.610	0.610	1.85	1 1/4
12-8 HL9-SS ETS	3/4	1/2	1 3/16 - 12	13/16 - 16	0.610	0.374	1.69	1 1/4
12-10 HL9-SS ETS	3/4	5/8	1 3/16 - 12	1 - 14	0.610	0.492	1.80	1 1/4
16 HL9-SS ETS	1	1	1 7/16 - 12	1 7/16 - 12	0.807	0.807	1.95	1 1/2
16-12 HL9-SS ETS	1	3/4	1 7/16 - 12	1 3/16 - 12	0.807	0.610	1.93	1 1/2
20 HL9-SS ETS	1 1/4	1 1/4	1 11/16 - 12	1 11/16 - 12	1.024	1.024	2.03	1 3/4
20-16 HL9-SS ETS	1 1/4	1	1 11/16 - 12	1 7/16 - 12	1.024	0.807	2.03	1 3/4
24 HL9-SS ETS	1 1/2	1 1/2	2 - 12	2 - 12	1.260	1.260	2.09	2 1/8
32 HL9-SS ETS	2	2	2 1/2 - 12	2 1/2 - 12	1.772	1.772	2.48	2 3/4

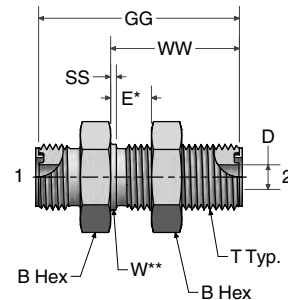
** Manufacturer's option permits a single drill through equal to the smaller of D and D1.

WL9

Bulkhead Union

Metal Face Seal / Metal Face Seal

WL9-WLNL Body with Locknut



*E – Maximum bulkhead thickness.

** W – Bulkhead pilot diameter. Recommended clearance hole is W + 0.015".

TUBE FITTING PART #	END SIZE (in.)	T TUBE END UN/UNF-2A	B HEX (in.)	D DRILL (in.)	E MAX (in.)	GG (in.)	SS	W DIA (in.)	WW (in.)
4 WL9-SS ETS	1/4	9/16 - 18	13/16	0.177	0.55	1.90	0.06	0.56	1.24
6 WL9-SS ETS	3/8	11/16 - 16	1	0.256	0.55	2.09	0.06	0.69	1.34
8 WL9-SS ETS	1/2	13/16 - 16	1 1/8	0.374	0.55	2.30	0.06	0.81	1.44
10 WL9-SS ETS	5/8	1 - 14	1 5/16	0.492	0.55	2.62	0.06	1.00	1.59
12 WL9-SS ETS	3/4	1 3/16 - 12	1 1/2	0.610	0.55	2.72	0.06	1.19	1.63
16 WL9-SS ETS	1	1 7/16 - 12	1 3/4	0.807	0.55	2.76	0.06	1.44	1.65
20 WL9-SS ETS	1 1/4	1 11/16 - 12	2	1.024	0.55	2.76	0.06	1.69	1.65
24 WL9-SS ETS	1 1/2	2 - 12	2 3/8	1.260	0.55	2.76	0.06	2.00	1.65
32 WL9-SS ETS	2	2 1/2 - 12	2 3/4	1.772	0.55	3.21	0.06	2.50	1.83

Dimensions and pressures for reference only, subject to change.

WARNING: This product can expose you to chemicals including Lead, which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.p65warnings.ca.gov.

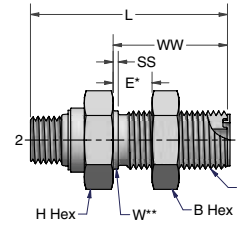


WF59L9

Straight Thread Bulkhead
Connector

Metal Face Seal / SAE-Metal Seal

WF59L9-WLNL - Body with Locknut
(See page 14 for WLNL)



TUBE FITTING PART #	END SIZE		T UN/UNF-2A	B HEX (in.)	E MAX (in.)	H HEX (in.)	L (in.)	SS (in.)	W DIA (in.)	WW (in.)
	1 (in.)	2 UN/UNF-2A								
4 WF59L9-SS ETS	1/4	7/16 - 20	9/16 - 18	13/16	0.55	13/16	2.14	0.06	0.56	1.24
6 WF59L9-SS ETS	3/8	9/16 - 18	11/16 - 18	1	0.55	1	2.31	0.06	0.69	1.34
8 WF59L9-SS ETS	1/2	3/4 - 16	13/16 - 16	1 1/8	0.55	1 1/8	2.60	0.06	0.81	1.44
10 WF59L9-SS ETS	5/8	7/8 - 14	1 - 14	1 5/16	0.55	1 5/16	2.69	0.06	1.00	1.60
12 WF59L9-SS ETS	3/4	1 1/16 - 12	1 3/16 - 12	1 1/2	0.55	1 1/2	2.89	0.06	1.19	1.64
16 WF59L9-SS ETS	1	1 5/16 - 12	1 7/16 - 12	1 3/4	0.55	1 3/4	2.95	0.20	1.44	1.66
20 WF59L9-SS ETS	1 1/4	1 5/8 - 12	1 11/16 - 12	2	0.55	2	3.03	0.20	1.69	1.66
24 WF59L9-SS ETS	1 1/2	1 7/8 - 12	2 - 12	2 3/8	0.55	2 1/8	3.10	0.20	2.00	1.66
32 WF59L9-SS ETS	2	2 1/2 - 12	2 1/2 - 12	2 3/4	0.55	2 3/4	3.28	0.20	2.50	1.83

* E – Maximum bulkhead thickness.

** W – Bulkhead pilot diameter. Recommended clearance hole is W + 0.015".

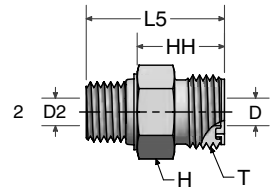
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F59L9

Straight Thread Connector
Metal Face Seal / SAE-Metal Seal



TUBE FITTING PART #	END SIZE		T TUBE END UN/UNF-2A	D** DRILL (in.)	D2** DRILL (in.)	H HEX (in.)	HH AFTER ASSY (in.)	L5 (in.)
	1 (in.)	2 UN/UNF-2A						
4 F59L9-SS ETS	1/4	7/16 - 20	9/16 - 18	0.177	0.177	5/8	0.71	1.13
4-6 F59L9-SS ETS	1/4	9/16 - 18	9/16 - 18	0.177	0.177	3/4	0.75	1.20
4-8 F59L9-SS ETS	1/4	3/4 - 16	9/16 - 18	0.177	0.394	7/8	0.77	1.32
6 F59L9-SS ETS	3/8	9/16 - 18	11/16 - 16	0.256	0.256	3/4	0.79	1.26
6-4 F59L9-SS ETS	3/8	7/16 - 20	11/16 - 16	0.177	0.177	3/4	0.91	1.34
6-8 F59L9-SS ETS	3/8	3/4 - 16	11/16 - 16	0.256	0.256	7/8	0.81	1.38
6-10 F59L9-SS ETS	3/8	7/8 - 14	11/16 - 16	0.256	0.492	1	0.89	1.52
6-12 F59L9-SS ETS	3/8	1 1/16 - 12	11/16 - 18	0.256	0.610	1 1/4	0.94	1.67
8 F59L9-SS ETS	1/2	3/4 - 16	13/16 - 16	0.374	0.374	7/8	0.89	1.44
8-4 F59L9-SS ETS	1/2	7/16 - 20	13/16 - 16	0.374	0.177	7/8	1.00	1.44
8-6 F59L9-SS ETS	1/2	9/16 - 18	13/16 - 16	0.374	0.295	7/8	1.00	1.48
8-10 F59L9-SS ETS	1/2	7/8 - 14	13/16 - 16	0.374	0.374	1	0.96	1.59
8-12 F59L9-SS ETS	1/2	1 1/16 - 12	13/16 - 16	0.374	0.374	1 1/4	1.02	1.75
8-16 F59L9-SS ETS	1/2	1 5/16 - 12	13/16 - 16	0.374	0.374	1 1/2	1.08	1.79
10 F59L9-SS ETS	5/8	7/8 - 14	1 - 14	0.492	0.492	1 1/16	1.06	1.69
10-6 F59L9-SS ETS	5/8	9/16 - 18	1 - 14	0.492	0.295	1 1/16	1.16	1.63
10-8 F59L9-SS ETS	5/8	3/4 - 16	1 - 14	0.492	0.394	1 1/16	1.22	1.77
10-12 F59L9-SS ETS	5/8	1 1/16 - 12	1 - 14	0.492	0.492	1 1/4	1.12	1.85
10-16 F59L9-SS ETS	5/8	1 5/16 - 12	1 - 14	0.492	0.492	1 1/2	1.18	1.89
12 F59L9-SS ETS	3/4	1 1/16 - 12	1 3/16 - 12	0.610	0.610	1 1/4	1.18	1.91
12-6 F59L9-SS ETS	3/4	9/16 - 18	1 3/16 - 12	0.610	0.264	1 1/4	1.30	1.77
12-8 F59L9-SS ETS	3/4	3/4 - 16	1 3/16 - 12	0.610	0.394	1 1/4	1.36	1.91
12-10 F59L9-SS ETS	3/4	7/8 - 14	1 3/16 - 12	0.610	0.492	1 1/4	1.36	1.99
12-16 F59L9-SS ETS	3/4	1 5/16 - 12	1 3/16 - 12	0.610	0.610	1 1/2	1.24	1.95
16 F59L9-SS ETS	1	1 5/16 - 12	1 7/16 - 12	0.807	0.807	1 1/2	1.26	1.97
16-8 F59L9-SS ETS	1	3/4 - 16	1 7/16 - 12	0.807	0.394	1 1/2	1.41	1.96
16-10 F59L9-SS ETS	1	7/8 - 14	1 7/16 - 12	0.807	0.492	1 1/2	1.42	2.05
16-12 F59L9-SS ETS	1	1 1/16 - 12	1 7/16 - 12	0.807	0.610	1 1/2	1.42	2.15
16-20 F59L9-SS ETS	1	1 5/8 - 12	1 7/16 - 12	0.807	1.083	1 7/8	1.34	2.07
16-24 F59L9-SS ETS	1	1 7/8 - 12	1 7/16 - 12	0.807	1.260	2 1/8	1.40	2.13
20 F59L9-SS ETS	1 1/4	1 5/8 - 12	1 11/16 - 12	1.024	1.024	1 7/8	1.34	2.07
20-16 F59L9-SS ETS	1 1/4	1 5/16 - 12	1 11/16 - 12	1.024	0.846	1 7/8	1.56	2.28
20-24 F59L9-SS ETS	1 1/4	1 7/8 - 12	1 11/16 - 12	1.024	1.024	2 1/8	1.40	2.13
24 F59L9-SS ETS	1 1/2	1 7/8 - 12	2 - 12	1.260	1.260	2 1/8	1.40	2.13
24-20 F59L9-SS ETS	1 1/2	1 5/8 - 12	2 - 12	1.260	1.083	2 1/8	1.61	2.34
32 F59L9-SS ETS	2	2 1/2 - 12	2 1/2 - 12	1.772	1.575	2 3/4	1.59	2.32

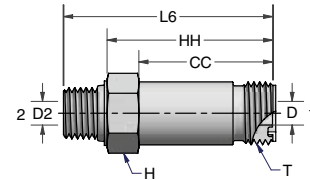
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FF59L9

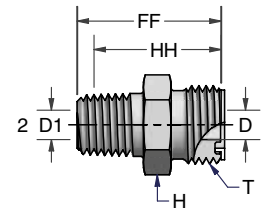
Long Straight Thread Connector
Metal Face Seal / SAE-Metal Seal



TUBE FITTING PART #	END SIZE		T TUBE END UN/UNF-2A	CC (in.)	D DRILL (in.)	D2 DRILL (in.)	H HEX (in.)	HH AFTER ASSY (in.)	L6 (in.)
	1 (in.)	2 UN/UNF-2A							
4 FF59L9-SS ETS	1/4	7/16 - 20	9/16 - 18	1.33	0.177	0.177	5/8	1.63	2.07
6 FF59L9-SS ETS	3/8	9/16 - 18	11/16 - 16	1.45	0.256	0.256	3/4	1.79	2.27
6-4 FF59L9-SS ETS	1/4	7/16 - 20	11/16 - 16	1.46	0.256	0.177	3/4	1.80	2.39
8 FF59L9-SS ETS	1/2	3/4 - 16	13/16 - 16	1.75	0.374	0.374	7/8	2.13	2.67
10 FF59L9-SS ETS	5/8	7/8 - 14	1 - 14	2.07	0.492	0.492	1 1/16	2.50	3.14
12 FF59L9-SS ETS	3/4	1 1/16 - 12	1 3/16 - 12	2.52	0.610	0.610	1 1/4	3.03	3.76
16 FF59L9-SS ETS	1	1 5/16 - 12	1 7/16 - 12	2.87	0.807	0.807	1 1/2	3.41	4.14
20 FF59L9-SS ETS	1 1/4	1 5/8 - 12	1 11/16 - 12	3.39	1.024	1.024	1 7/8	4.04	4.76
24 FF59L9-SS ETS	1 1/2	1 7/8 - 12	2 - 12	3.82	1.260	1.260	2 1/8	4.53	5.26
32 FF59L9-SS ETS	2	2 1/2 - 12	2 1/2 - 12	4.98	1.772	1.575	2 3/4	5.77	6.50

FL9

Male Pipe Connector
Metal Face Seal / NPTF



TUBE FITTING PART #	END SIZE		T TUBE END UN/UNF-2A	D* DRILL (in.)	D1* DRILL (in.)	FF (in.)	H HEX (in.)	HH AFTER ASSY (in.)
	1 (in.)	2 NPTF						
4 FL9-SS ETS	1/4	1/8 - 27	9/16 - 18	0.177	0.177	1.07	5/8	0.83
4-4 FL9-SS ETS	1/4	1/4 - 18	9/16 - 18	0.177	0.177	1.26	5/8	0.92
4-6 FL9-SS ETS	1/4	3/8 - 18	9/16 - 18	0.177	0.177	1.32	3/4	0.98
4-8 FL9-SS ETS	1/4	1/2 - 14	9/16 - 18	0.177	0.531	1.52	7/8	1.06
6 FL9-SS ETS	3/8	1/4 - 18	11/16 - 16	0.256	0.256	1.25	3/4	0.91
6-2 FL9-SS ETS	3/8	1/8 - 27	11/16 - 16	0.256	0.188	1.16	3/4	0.92
6-6 FL9-SS ETS	3/8	3/8 - 18	11/16 - 16	0.256	0.256	1.34	3/4	0.99
6-8 FL9-SS ETS	3/8	1/2 - 14	11/16 - 16	0.256	0.256	1.55	7/8	1.09
8 FL9-SS ETS	1/2	3/8 - 18	13/16 - 16	0.374	0.374	1.48	7/8	1.13
8-4 FL9-SS ETS	1/2	1/4 - 18	13/16 - 16	0.374	0.281	1.48	7/8	1.13
8-8 FL9-SS ETS	1/2	1/2 - 14	13/16 - 16	0.374	0.374	1.64	7/8	1.18
8-12 FL9-SS ETS	1/2	3/4 - 14	13/16 - 16	0.374	0.374	1.69	1 1/8	1.21
10 FL9-SS ETS	5/8	1/2 - 14	1 - 14	0.492	0.492	1.82	1 1/16	1.36
10-12 FL9-SS ETS	5/8	3/4 - 14	1 - 14	0.492	0.492	1.82	1 1/8	1.34
12 FL9-SS ETS	3/4	3/4 - 14	1 3/16 - 12	0.610	0.610	1.93	1 1/4	1.45
12-8 FL9-SS ETS	3/4	1/2 - 14	1 3/16 - 12	0.610	0.531	1.93	1 1/4	1.47
12-16 FL9-SS ETS	3/4	1 - 11 1/2	1 3/16 - 12	0.610	0.610	2.13	1 3/8	1.56
16 FL9-SS ETS	1	1 - 11 1/2	1 7/16 - 12	0.807	0.807	2.19	1 1/2	1.62
16-12 FL9-SS ETS	1	3/4 - 14	1 7/16 - 12	0.807	0.719	2.00	1 1/2	1.52
16-20 FL9-SS ETS	1	1 1/4 - 11 1/2	1 7/16 - 12	0.807	1.250	2.30	1 3/4	1.71
20 FL9-SS ETS	1 1/4	1 1/4 - 11 1/2	1 11/16 - 12	1.024	1.024	2.30	1 7/8	1.71
20-12 FL9-SS ETS	1 1/4	3/4 - 14	1 11/16 - 12	1.024	0.700	2.02	1 7/8	1.54
20-16 FL9-SS ETS	1 1/4	1 - 11 1/2	1 11/16 - 12	1.024	0.938	2.27	1 7/8	1.70
24 FL9-SS ETS	1 1/2	1 1/2 - 11 1/2	2 - 12	1.260	1.260	2.40	2 1/8	1.81
32 FL9-SS ETS	2	2 - 11 1/2	2 1/2 - 12	1.772	1.772	2.79	2 3/4	2.20

* Manufacturer's option permits a single drill through equal to the smaller of D and D1.

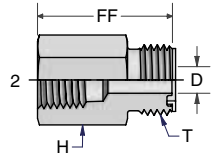
Dimensions and pressures for reference only, subject to change.

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GL9

Female Pipe Connector
Metal Face Seal / Female Pipe



TUBE FITTING PART #	END SIZE		T UN/UNF-2A	D (in.)	FF (in.)	H HEX (in.)
	1 (in.)	2 NPTF				
4 GL9-SS ETS	1/4	1/8 - 27	9/16 - 18	0.177	1.03	5/8
4-4 GL9-SS ETS	1/4	1/4 - 18	9/16 - 18	0.177	1.25	3/4
6 GL9-SS ETS	3/8	1/4 - 18	11/16 - 16	0.256	1.30	3/4
6-6 GL9-SS ETS	3/8	3/8 - 18	11/16 - 16	0.256	1.34	7/8
8 GL9-SS ETS	1/2	3/8 - 18	13/16 - 16	0.374	1.34	7/8
8-8 GL9-SS ETS	1/2	1/2 - 14	13/16 - 16	0.378	1.64	1 1/8
10 GL9-SS ETS	5/8	1/2 - 14	1 - 14	0.492	1.70	1 1/8
12 GL9-SS ETS	3/4	3/4 - 14	1 3/16 - 12	0.609	1.87	1 3/8
16 GL9-SS ETS	1	1 - 11 1/2	1 7/16 - 12	0.811	2.13	1 5/8
20 GL9-SS ETS	1 1/4	1 1/4 - 11 1/2	1 11/16 - 12	1.024	2.13	1 3/4
24 GL9-SS ETS	1 1/2	1 1/2 - 11 1/2	2 - 12	1.260	2.23	2 3/8
32 GL9-SS ETS	2	2 - 11 1/2	2 1/2 - 12	1.772	2.51	2 7/8

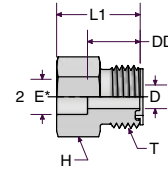
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L9HB3

Braze Connector
Metal Face Seal / Braze Socket



TUBE FITTING PART #	END SIZE		T TUBE END UN/UNF-2A	D DRILL (in.)	DD (in.)	E* DIA (in.)	H HEX (in.)	L1 (in.)
	1 (in.)	2 (in.)						
4 L9HB3-SS ETS	1/4	1/4	9/16 - 18	0.177	0.53	0.26	5/8	0.86
4-6 L9HB3-SS ETS	1/4	3/8	9/16 - 18	0.177	0.53	0.38	5/8	0.86
6 L9HB3-SS ETS	3/8	3/8	11/16 - 16	0.256	0.57	0.38	3/4	0.90
6-4 L9HB3-SS ETS	3/8	1/4	11/16 - 16	0.177	0.57	0.26	3/4	0.90
6-8 L9HB3-SS ETS	3/8	1/2	11/16 - 16	0.256	0.57	0.51	3/4	0.90
8 L9HB3-SS ETS	1/2	1/2	13/16 - 16	0.374	0.63	0.51	7/8	0.97
8-4 L9HB3-SS ETS	1/2	1/4	13/16 - 16	0.177	0.64	0.26	7/8	0.97
8-6 L9HB3-SS ETS	1/2	3/8	13/16 - 16	0.256	0.63	0.38	7/8	0.97
8-10 L9HB3-SS ETS	1/2	5/8	13/16 - 16	0.374	0.63	0.63	7/8	0.97
8-12 L9HB3-SS ETS	1/2	3/4	13/16 - 16	0.374	0.67	0.76	1 1/16	1.16
10 L9HB3-SS ETS	5/8	5/8	1 - 14	0.492	0.74	0.63	1 1/16	1.07
10-6 L9HB3-SS ETS	5/8	3/8	1 - 14	0.256	0.74	0.38	1 1/16	1.07
10-8 L9HB3-SS ETS	5/8	1/2	1 - 14	0.374	0.74	0.51	1 1/16	1.07
10-12 L9HB3-SS ETS	5/8	3/4	1 - 14	0.492	0.74	0.76	1 1/16	1.23
12 L9HB3-SS ETS	3/4	3/4	1 3/16 - 12	0.610	0.83	0.76	1 1/4	1.32
12-8 L9HB3-SS ETS	3/4	1/2	1 3/16 - 12	0.374	0.83	0.51	1 1/4	1.16
12-10 L9HB3-SS ETS	3/4	5/8	1 3/16 - 12	0.492	0.83	0.63	1 1/4	1.16
12-16 L9HB3-SS ETS	3/4	1	1 3/16 - 12	0.610	0.83	1.01	1 1/2	1.38
16 L9HB3-SS ETS	1	1	1 7/16 - 12	0.807	0.97	1.01	1 1/2	1.52
16-8 L9HB3-SS ETS	1	1/2	1 7/16 - 12	0.374	0.97	0.51	1 1/2	1.30
16-12 L9HB3-SS ETS	1	3/4	1 7/16 - 12	0.610	0.97	0.76	1 1/2	1.46
16-20 L9HB3-SS ETS	1	1 1/4	1 7/16 - 12	0.807	0.96	1.26	1 3/4	1.52
20 L9HB3-SS ETS	1 1/4	1 1/4	1 11/16 - 12	1.024	0.97	1.26	1 3/4	1.52
20-16 L9HB3-SS ETS	1 1/4	1	1 11/16 - 12	0.807	0.97	1.01	1 3/4	1.52
20-24 L9HB3-SS ETS	1 1/4	1 1/2	1 11/16 - 12	1.024	0.97	1.51	2 1/8	1.52
24 L9HB3-SS ETS	1 1/2	1 1/2	2 - 12	1.260	0.97	1.51	2 1/8	1.52
24-20 L9HB3-SS ETS	1 1/2	1 1/4	2 - 12	1.024	0.97	1.26	2 1/8	1.52
32 L9HB3-SS ETS	2	2	2 1/2 - 12	1.772	1.20	2.01	2 3/4	1.76

* E is for silver brazing. Standard steel parts are not recommended for welding.

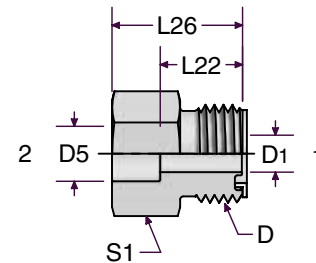
Dimensions and pressures for reference only, subject to change.

WARNING: This product can expose you to chemicals including Lead, which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.p65warnings.ca.gov.



MML9HB3

Braze Connector
Metal Face Seal / Braze Socket

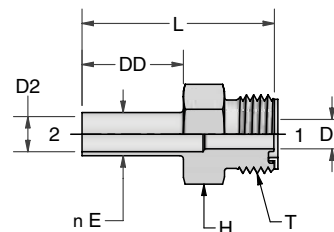


TUBE FITTING PART #	END SIZE		D UN/UNF-2A	D1 DRILL	D5* DIA TUBE SOCKET	L22 (mm)	L26 (mm)	S1 HEX	
	1	2							
	(mm)	(in.)							
4-6MML9HB3-SS ETS	6	1/4	6	9/16 - 18	4.500	6.15	13.5	22.0	17
4-8MML9HB3-SS ETS	6	1/4	8	9/16 - 18	4.500	8.15	13.5	22.0	17
6-10MML9HB3-SS ETS	8, 10	3/8	10	11/16 - 16	6.500	10.15	14.5	23.0	19
8-12MML9HB3-SS ETS	12	1/2	12	13/16 - 16	9.500	12.15	16.0	24.5	22
10-16MML9HB3-SS ETS	14, 15, 16	5/8	16	1 - 14	12.500	16.15	19.0	27.5	27
12-20MML9HB3-SS ETS	18, 20	3/4	20	1 3/16 - 12	15.500	20.18	21.0	33.5	32
16-25MML9HB3-SS ETS	22, 25	1	25	1 7/16 - 12	20.500	25.18	24.5	38.5	41
20-30MML9HB3-SS ETS	28, 30, 32	1 1/4	30	1 11/16 - 12	26.000	30.20	24.5	38.5	46
24-38MML9HB3-SS ETS	35, 38	1 1/2	38	2 - 12	32.000	38.20	24.5	38.5	55
32-50MML9HB3-SS ETS	50	2	50	2 1/2 - 12	1.772	50.20	30.5	45.0	70

* D5 is for silver brazing. Standard steel parts are not recommended for welding.

L9HT3

Tube Stub Connector
Metal Face Seal / Tube Weld



TUBE FITTING PART #	END SIZE	T TUBE END UN/UNF-2A	D1 DRILL (in.)	D2 DIA (in.)	DD (in.)	E DIA (in.)	H HEX (in.)	L (in.)
	1 & 2 (in.)							
4-4X035 L9HT3-SS ETS	1/4	9/16 - 18	0.177	0.18	0.88	0.25	5/8	1.58
6-6X035 L9HT3-SS ETS	3/8	11/16 - 16	0.256	0.31	0.88	0.38	3/4	1.67
8-8X065 L9HT3-SS ETS	1/2	13/16 - 16	0.374	0.37	1.00	0.50	7/8	1.89
12-12X065 L9HT3-SS ETS	3/4	1 3/16 - 12	0.610	0.62	1.16	0.75	1 1/4	2.35
12-16X065 L9HT3-SS ETS	1	1 3/16 - 12	0.610	0.87	1.13	1.00	1 1/4	2.32
16-16X065 L9HT3-SS ETS	1	1 7/16 - 12	0.807	0.87	1.13	1.00	1 1/2	2.40
20-20X083 L9HT3-SS ETS	1 1/4	1 11/16 - 12	1.024	1.08	1.16	1.25	1 7/8	2.54
24-24X120 L9HT3-SS ETS	1 1/2	2 - 12	1.260	1.26	1.24	1.50	2 1/4	2.64
32-32X120 L9HT3-SS ETS	2	2 1/2 - 12	1.772	1.76	1.34	2.00	2 3/4	2.95

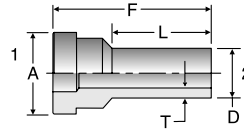
Dimensions and pressures for reference only, subject to change.

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TLW1

Butt Weld
Sleeve

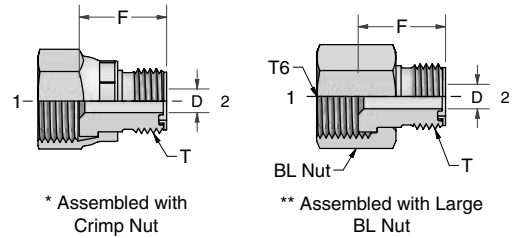


TUBE FITTING PART #	END SIZE		A (in.)	D (in.)	F (in.)	L (in.)	T Wall Thickness (in.)
	1 (in.)	2 (in.)					
4-4X035 TLW1-SS	1/4	1/4	0.50	0.250	1.20	0.75	0.035
6-6X035 TLW1-SS	3/8	1/4	0.62	0.250	1.26	0.75	0.035
6-4X049 TLW1-SS	3/8	1/4	0.62	0.250	1.26	0.75	0.049
6-6X035 TLW1-SS	3/8	3/8	0.62	0.375	1.20	0.75	0.035
6-6X049 TLW1-SS	3/8	3/8	0.62	0.375	1.20	0.75	0.049
6-6X065 TLW1-SS	3/8	3/8	0.62	0.375	1.20	0.75	0.065
8-8X049 TLW1-SS	1/2	1/2	0.75	0.500	1.20	0.75	0.049
8-8X065 TLW1-SS	1/2	1/2	0.75	0.500	1.20	0.75	0.065
12-12X065 TLW1-SS	3/4	3/4	1.10	0.750	1.39	0.75	0.065
12-12X083 TLW1-SS	3/4	3/4	1.10	0.750	1.39	0.75	0.083
12-12X095 TLW1-SS	3/4	3/4	1.10	0.750	1.39	0.75	0.095
12-8X049 TLW1-SS	3/4	1/2	1.10	0.500	1.52	0.75	0.049

Dimensions and pressures for reference only, subject to change.

TRL9N

Tube End Reducer
Metal Face Seal Swivel / Metal Face Seal Tube End



TUBE FITTING PART #			END SIZE		T TUBE END UN/UNF-2A	T6 TUBE END UN/UNF-2B	B HEX (in.)	D DRILL (in.)	F (in.)
TRL9N	TRL9N	TRL9	1 (in.)	2 (in.)					
*One Piece Design (With Crimp Nut)	**Two Piece Design (With Large Nut)	***Body Only (For Two-Piece Design Only)							
6-4 TRL9N-SS ETS	—	—	3/8	1/4	9/16 - 18	11/16 - 16	13/16	0.177	0.77
—	8-4 TRL9N-SS ETS	8-4 TRL9-SS ETS	1/2	1/4	9/16 - 18	13/16 - 16	15/16	0.177	0.87
8-6 TRL9N-SS ETS	—	—	1/2	3/8	11/16 - 16	13/16 - 16	15/16	0.256	0.89
—	10-4 TRL9N-SS ETS	10-4 TRL9-SS ETS	5/8	1/4	9/16 - 18	1 - 14	1 1/8	0.177	0.91
—	10-6 TRL9N-SS ETS	10-6 TRL9-SS ETS	5/8	3/8	11/16 - 16	1 - 14	1 1/8	0.256	0.94
—	10-8 TRL9N-SS ETS	10-8 TRL9-SS ETS	5/8	1/2	13/16 - 16	1 - 14	1 1/8	0.374	1.00
—	12-4 TRL9N-SS ETS	12-4 TRL9-SS ETS	3/4	1/4	9/16 - 18	1 3/16 - 12	1 3/8	0.177	0.98
—	12-6 TRL9N-SS ETS	12-6 TRL9-SS ETS	3/4	3/8	11/16 - 16	1 3/16 - 12	1 3/8	0.256	1.02
—	12-8 TRL9N-SS ETS	12-8 TRL9-SS ETS	3/4	1/2	13/16 - 16	1 3/16 - 12	1 3/8	0.374	1.08
12-10 TRL9N-SS ETS	—	—	3/4	5/8	1 - 14	1 3/16 - 12	1 3/8	0.492	1.16
—	16-8 TRL9N-SS ETS	16-8 TRL9-SS ETS	1	1/2	13/16 - 16	1 7/16 - 12	1 5/8	0.374	1.14
—	16-10 TRL9N-SS ETS	16-10 TRL9-SS ETS	1	5/8	1 - 14	1 7/16 - 12	1 5/8	0.492	1.26
16-12 TRL9N-SS ETS	—	—	1	3/4	1 3/16 - 12	1 7/16 - 12	1 5/8	0.610	1.30
—	20-12 TRL9N-SS ETS	20-12 TRL9-SS ETS	1 1/4	3/4	1 3/16 - 12	1 11/16 - 12	1 7/8	0.610	1.32
20-16 TRL9N-SS ETS	—	—	1 1/4	1	1 7/16 - 12	1 11/16 - 12	1 7/8	0.807	1.34
—	24-12 TRL9N-SS ETS	24-12 TRL9-SS ETS	1 1/2	3/4	1 3/16 - 12	2 - 12	2 1/4	0.610	1.32
—	24-16 TRL9N-SS ETS	24-16 TRL9-SS ETS	1 1/2	1	1 7/16 - 12	2 - 12	2 1/4	0.807	1.34
—	24-20 TRL9N-SS ETS	24-20 TRL9-SS ETS	1 1/2	1 1/4	1 11/16 - 12	2 - 12	2 1/4	1.024	1.34
—	32-20 TRL9N-SS ETS	32-20 TRL9-SS ETS	2	1 1/4	1 11/16 - 12	2 1/2 - 12	2 7/8	1.024	1.42
—	32-24 TRL9N-SS ETS	32-24 TRL9-SS ETS	2	1 1/2	2 - 12	2 1/2 - 12	2 7/8	1.260	1.42

* Assembled with crimp nut.

** Assembled with large BL nut.

***To order reducer without large nut (body only) remove the "N" from the part number (i.e., TRL9).

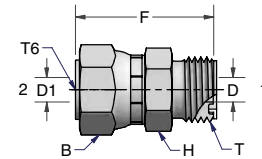
Dimensions and pressures for reference only, subject to change.

WARNING: This product can expose you to chemicals including Lead, which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.p65warnings.ca.gov.



L9HL6

Tube End Extender / Expander
Metal Face Seal / Metal Face Seal Swivel

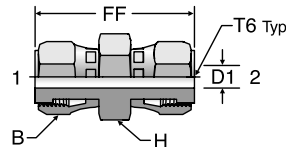


TUBE FITTING PART #	END SIZE		T TUBE END UN/UNF-2A	T6 SWIVEL UN/UNF-2B	B HEX (in.)	D* DRILL (in.)	D1* DRILL (in.)	F (in.)	H HEX (in.)
	1 (in.)	2 (in.)							
4 L9HL6-SS ETS	1/4	1/4	9/16 - 18	9/16 - 18	11/16	0.157	0.157	1.33	5/8
6 L9HL6-SS ETS	3/8	3/8	11/16 - 16	11/16 - 16	13/16	0.256	0.256	1.44	3/4
6-4 L9HL6-SS ETS	3/8	1/4	11/16 - 16	9/16 - 18	11/16	0.157	0.157	1.37	3/4
8 L9HL6-SS ETS	1/2	1/2	13/16 - 16	13/16 - 16	15/16	0.374	0.354	1.67	7/8
8-6 L9HL6-SS ETS	1/2	3/8	13/16 - 16	11/16 - 16	13/16	0.374	0.256	1.62	7/8
10 L9HL6-SS ETS	5/8	5/8	1 - 14	1 - 14	1 1/8	0.492	0.453	1.93	1 1/16
10-8 L9HL6-SS ETS	5/8	1/2	1 - 14	13/16 - 16	15/16	0.492	0.354	1.81	1 1/16
12 L9HL6-SS ETS	3/4	3/4	1 3/16 - 12	1 3/16 - 12	1 3/8	0.609	0.547	2.30	1 1/4
12-10 L9HL6-SS ETS	3/4	5/8	1 3/16 - 12	1 - 14	1 1/8	0.610	0.453	1.99	1 1/4
16 L9HL6-SS ETS	1	1	1 7/16 - 12	1 7/16 - 12	1 5/8	0.812	0.783	2.45	1 1/2
16-12 L9HL6-SS ETS	1	3/4	1 7/16 - 12	1 3/16 - 12	1 3/8	0.807	0.551	2.16	1 1/2
20 L9HL6-SS ETS	1 1/4	1 1/4	1 11/16 - 12	1 11/16 - 12	1 7/8	1.024	1.024	2.35	1 3/4
20-16 H9HL6-SS ETS	1 1/4	1	1 11/16 - 12	1 7/16 - 12	1 5/8	1.024	0.787	2.28	1 3/4
24 L9HL6-SS ETS	1 1/2	1 1/2	2 - 12	2 - 12	2 1/4	1.260	1.260	2.48	2 1/8
24-20 L9HL6-SS ETS	1 1/2	1 1/4	2 - 12	1 11/16 - 12	1 7/8	1.260	1.024	2.35	2 1/8
32 L9HL6-SS ETS	2	2	2 1/2 - 12	2 1/2 - 12	2 7/8	1.772	1.732	3.30	2 3/4
32-24 L9HL6-SS ETS	2	1 1/2	2 1/2 - 12	2 - 12	2 1/4	1.772	1.260	2.94	2 3/4

* Manufacturer's option permits a single drill through equal to the smaller of D and D1.
D1 nominal may vary from the values shown in the chart by 0.004 to 0.008.

HL6

Swivel Nut Union
Metal Face Seal Swivel / Metal Face Seal Swivel



TUBE FITTING PART #	END SIZE		T6 SWIVEL UN/UNF-2B	B HEX (in.)	D1 DRILL (in.)	FF (in.)	H HEX (in.)
	1 (in.)	2 (in.)					
4 HL6-SS	1/4	1/4	9/16 - 18	11/16	0.157	1.59	5/8
6 HL6-SS	3/8	3/8	11/16 - 16	13/16	0.256	1.77	3/4
8 HL6-SS	1/2	1/2	13/16 - 16	15/16	0.354	2.12	7/8
10 HL6-SS	5/8	5/8	1 - 14	1 1/8	0.453	2.42	1 1/16
12 HL6-SS	3/4	3/4	1 3/16 - 12	1 3/8	0.551	2.74	1 1/4
16 HL6-SS	1	1	1 7/16 - 12	1 5/8	0.787	2.95	1 7/16
20 HL6-SS	1 1/4	1 1/4	1 11/16 - 12	1 7/8	1.024	3.12	1 3/4
24 HL6-SS	1 1/2	1 1/2	2 - 12	2 1/4	1.260	3.33	2 1/8
32 HL6-SS	2	2	2 1/2 - 12	2 7/8	1.732	4.10	2 3/4

* D1 nominal may vary from the values shown in the chart by 0.004 to 0.008.

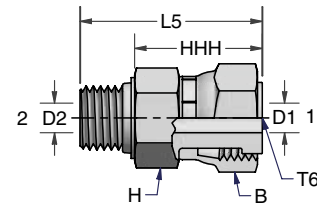
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F659L

Straight Thread Swivel Connector
Metal Face Seal Swivel / SAE-Metal Seal

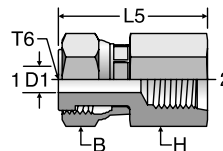


TUBE FITTING PART #	END SIZE		T6 SWIVEL UN/UNF-2B	B HEX (in.)	D1* DRILL (in.)	D2* DRILL (in.)	H HEX (in.)	HHH AFTER ASSY (in.)	L (in.)
	1 (in.)	2 UN/UNF-2A							
4 F659L-SS ETS	1/4	7/16 - 20	9/16 - 18	11/16	0.157	0.157	5/8	1.02	1.46
6 F659L-SS ETS	3/8	9/16 - 18	11/16 - 16	13/16	0.256	0.256	3/4	1.10	1.57
8 F659L-SS ETS	1/2	3/4 - 16	13/16 - 16	15/16	0.354	0.354	7/8	1.40	1.95
10 F659L-SS ETS	5/8	7/8 - 14	1 - 14	1 1/8	0.453	0.453	1 1/16	1.50	2.13
12 F659L-SS ETS	3/4	1 1/16 - 12	13/16 - 12	1 3/8	0.551	0.551	1 1/4	1.61	2.34
16 F659L-SS ETS	1	1 5/16 - 12	1 7/16 - 12	1 5/8	0.787	0.787	1 1/2	1.93	2.66
20 F659L-SS ETS	1 1/4	1 5/8 - 12	1 11/16 - 12	1 7/8	1.024	1.024	1 7/8	1.93	2.66
24 F659L-SS ETS	1 1/2	1 7/8 - 12	2 - 12	2 1/4	1.260	1.260	2 1/8	1.93	2.66
32 F659L-SS ETS	2	2 1/2 - 12	2 1/2 - 12	2 7/8	1.730	1.575	2 3/4	2.40	3.13

* D1, D2 nominal may vary from the values shown in the chart by 0.004 to 0.008.

G65L

Straight Thread Swivel
Female Connector
Metal Face Seal Swivel / SAE



TUBE FITTING PART #	END SIZE		T6 SWIVEL UN/UNF-2B	B HEX (in.)	D1* DRILL (in.)	L5 (in.)	H HEX (in.)
	1 (in.)	2 UN/UNF-2B					
4 G65L-SS	1/4	7/16 - 20	9/16 - 18	11/16	0.157	1.38	3/4
4-6 G65L-SS	1/4	9/16 - 18	9/16 - 18	11/16	0.157	1.45	13/16
6 G65L-SS	3/8	9/16 - 18	11/16 - 16	13/16	0.264	1.52	13/16
6-4 G65L-SS	3/8	7/16 - 20	11/16 - 16	13/16	0.256	1.51	3/4
8 G65L-SS	1/2	3/4 - 16	13/16 - 16	15/16	0.358	1.75	1 1/16
8-4 G65L-SS	1/2	7/16 - 20	13/16 - 16	15/16	0.354	1.57	7/8
8-6 G65L-SS	1/2	9/16 - 18	13/16 - 16	15/16	0.354	1.60	7/8
10 G65L-SS	5/8	7/8 - 14	1 - 14	1 1/8	0.453	1.96	1 1/8
12 G65L-SS	3/4	1 1/16 - 12	1 3/16 - 12	1 3/8	0.551	2.27	1 3/8
16 G65L-SS	1	1 5/16 - 12	1 7/16 - 12	1 5/8	0.787	2.38	1 5/8
20 G65L-SS	1 1/4	1 5/8 - 12	1 11/16 - 12	1 7/8	1.024	2.63	2
24 G65L-SS	1 1/2	1 7/8 - 12	2 - 12	2 1/4	1.260	3.00	2 1/4
32 G65L-SS	2	2 1/2 - 12	2 1/2 - 12	2 7/8	1.732	3.32	2 7/8

* D1 nominal may vary from the values shown in the chart by 0.004 to 0.008.

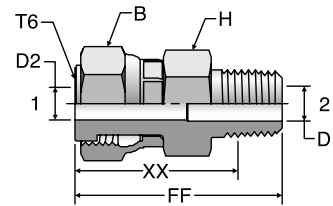
Dimensions and pressures for reference only, subject to change.

WARNING: This product can expose you to chemicals including Lead, which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.p65warnings.ca.gov.



F6L

Pipe Thread Swivel
Connector
Metal Face Seal Swivel / NPTF



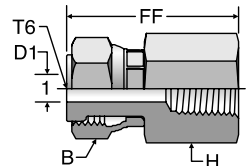
TUBE FITTING PART #	END SIZE		T6 SWIVEL UN/UNF-2B	B HEX (in.)	D1* DRILL (in.)	D2* DRILL (in.)	FF (in.)	H HEX (in.)	XX AFTER ASSY (in.)
	1 (in.)	2 NPTF							
4 F6L-SS	1/4	1/8 - 27	9/16 - 18	11/16	0.157	0.157	1.33	5/8	1.09
4-4 F6L-SS	1/4	1/4 - 18	9/16 - 18	11/16	0.157	0.157	1.52	5/8	1.18
6 F6L-SS	3/8	1/4 - 18	11/16 - 16	13/16	0.256	0.256	1.69	3/4	1.35
6-6 F6L-SS	3/8	3/8 - 18	11/16 - 16	13/16	0.256	0.256	1.67	3/4	1.32
8 F6L-SS	1/2	3/8 - 18	13/16 - 16	15/16	0.354	0.354	1.95	3/4	1.60
8-8 F6L-SS	1/2	1/2 - 14	13/16 - 16	15/16	0.354	0.354	2.14	7/8	1.68
10 F6L-SS	5/8	1/2 - 14	1 - 14	1 1/8	0.453	0.453	2.29	1 1/16	1.83
12 F6L-SS	3/4	3/4 - 14	1 3/16 - 12	1 3/8	0.551	0.551	2.37	1 1/4	1.89
16 F6L-SS	1	1 - 11 1/2	1 7/16 - 12	1 5/8	0.787	0.787	2.87	1 1/2	2.30
20 FL6-SS	1 1/4	1 1/4 - 11 1/2	1 11/16 - 12	1 7/8	1.024	1.024	2.90	1 3/4	2.31
24 FL6-SS	1 1/2	1 1/2 - 11 1/2	2 - 12	2 1/4	1.260	1.260	2.98	2 1/8	2.39
32 F6L-SS	2	2 - 11 1/2	2 1/2 - 12	2 7/8	1.730	1.938	3.45	2 3/4	2.86

* SAE standard permits a manufacturer's option of a single drill through equal to the smaller of D1 and D2 for up to two jump sizes.

* D2 nominal may vary from the values shown in the chart by 0.004 to 0.008.

G6L

Female Pipe Thread Swivel
Connector
Metal Face Seal Swivel / NPTF



TUBE FITTING PART #	END SIZE		T6 SWIVEL UN/UNF-2B	B HEX (in.)	D1* DRILL (in.)	FF (in.)	H (in.)
	1 (in.)	2 NPTF					
4 G6L-SS	1/4	1/4 - 18	9/16 - 18	11/16	0.165	1.29	9/16
4-4 G6L-SS	1/4	1/4 - 18	9/16 - 18	11/16	0.157	1.48	3/4
4-6 G6L-SS	1/4	3/8 - 18	9/16 - 18	11/16	0.157	1.55	7/8
6 G6L-SS	3/8	1/4 - 18	11/16 - 16	13/16	0.256	1.60	7/8
6-2 G6L-SS	3/8	1/8 - 18	11/16 - 16	13/16	0.264	1.41	11/16
6-6 G6L-SS	3/8	3/8 - 18	11/16 - 16	13/16	0.264	1.58	7/8
6-8 G6L-SS	3/8	1/2 - 14	11/16 - 16	13/16	0.256	1.78	1 1/8
8 G6L-SS	1/2	3/8 - 18	13/16 - 16	15/16	0.354	1.76	7/8
8-4 G6L-SS	1/2	1/4 - 18	13/16 - 16	15/16	0.354	1.75	7/8
8-8 G6L-SS	1/2	1/2 - 14	13/16 - 16	15/16	0.358	1.93	1 1/8
10-8 G6L-SS	5/8	1/2 - 14	1 - 14	1 1/8	0.453	2.08	1 1/8
10-12 G6L-SS	5/8	3/4 - 14	1 - 14	1 1/8	0.453	2.14	1 3/8
12 G6L-SS	3/4	3/4 - 14	1 3/16 - 12	1 3/8	0.547	2.27	1 3/8
12-4 G6L-SS	3/4	1/4 - 18	1 3/16 - 12	1 3/8	0.402	2.05	1 3/8
12-8 G6L-SS	3/4	1/2 - 14	1 3/16 - 12	1 3/8	0.547	2.21	1 3/8
16 G6L-SS	1	1 - 11 1/2	1 7/16 - 12	1 5/8	0.783	2.53	1 5/8
16-12 G6L-SS	1	3/4 - 14	1 7/16 - 12	1 5/8	0.783	2.35	1 3/8
20 G6L-SS	1 1/4	1 1/4 - 11 1/2	1 11/16 - 12	1 7/8	1.024	2.63	2
20-16 G6L-SS	1 1/4	1-11 1/2	1 11/16 - 12	1 7/8	1.024	2.59	1 7/8
24 G6L-SS	1 1/2	1 1/2 - 11 1/2	2 - 12	2 1/4	1.260	3.00	2 1/4
32 G6L-SS	2	2 - 11 1/2	2 1/2 - 12	2 7/8	1.732	3.32	2 7/8

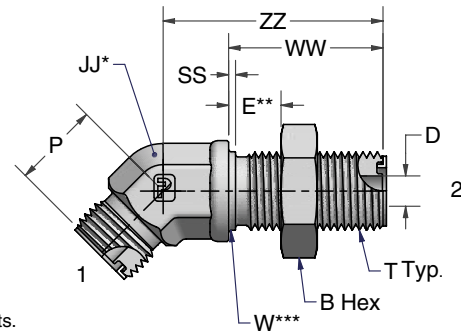
* D1 nominal may vary from the values shown in the chart by 0.004 to 0.008.

Dimensions and pressures for reference only, subject to change.

WNL9

45° Bulkhead Union Elbow
Metal Face Seal / Metal Face Seal

WNL9-WLNL - Body with Locknut

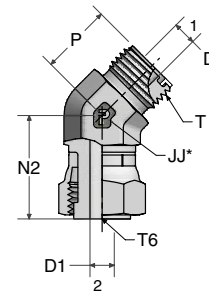


* JJ – Across wrench flats.
** E – Maximum bulkhead thickness.
*** W – Bulkhead pilot diameter. Recommended clearance hole is $W + 0.015''$.

TUBE FITTING PART #	END SIZE		T TUBE END UN/UNF-2A	B HEX (in.)	D DRILL (in.)	E MAX (in.)	JJ (in.)	P (in.)	SS (in.)	W DIA (in.)	WW (in.)	ZZ (in.)
	1 (in.)	2 (in.)										
4 WNL9-SS ETS	1/4	1/4	9/16 - 18	13/16	0.177	0.55	9/16	0.63	0.06	0.56	1.24	1.73
6 WNL9-SS ETS	3/8	3/8	11/16 - 16	1	0.256	0.55	3/4	0.75	0.06	0.69	1.34	1.91
8 WNL9-SS ETS	1/2	1/2	13/16 - 16	1 1/8	0.374	0.55	3/4	0.81	0.06	0.81	1.44	2.01
10 WNL9-SS ETS	5/8	5/8	1 - 14	1 5/16	0.492	0.55	1 1/16	0.93	0.06	1.00	1.59	2.22
12 WNL9-SS ETS	3/4	3/4	1 3/16 - 12	1 1/2	0.610	0.55	1 3/16	1.02	0.06	1.19	1.63	2.38
16 WNL9-SS ETS	1	1	1 7/16 - 12	1 3/4	0.807	0.55	1 7/16	1.18	0.06	1.44	1.65	2.56
20 WNL9-SS ETS	1 1/4	1 1/4	1 11/16 - 12	2	1.024	0.55	1 5/8	1.26	0.06	1.69	1.65	1.64
24 WNL9-SS ETS	1 1/2	1 1/2	2 - 12	2 3/8	1.260	0.55	1 7/8	1.46	0.06	2.00	1.65	2.64
32 WNL9-SS ETS	2	2	2 1/2 - 12	2 3/4	1.772	0.55	2 1/2	1.76	0.06	2.50	1.83	2.81

V6L9

45° Swivel Nut Elbow
Metal Face Seal / Metal Face Seal Swivel



* JJ – Across Wrench Flats

TUBE FITTING PART #	END SIZE	T TUBE END UN/UNF-2A	T6 SWIVEL UN/UNF-2B	B HEX (in.)	D DRILL (in.)	D1 DRILL (in.)	JJ (in.)	N2 (in.)	P (in.)
	1 & 2 (in.)								
4 V6L9-SS ETS	1/4	9/16 - 18	9/16 - 18	11/16	0.177	0.157	9/16	0.99	0.63
6 V6L9-SS ETS	3/8	11/16 - 16	11/16 - 16	13/16	0.256	0.256	3/4	1.12	0.74
8 V6L9-SS ETS	1/2	13/16 - 16	13/16 - 16	15/16	0.374	0.354	3/4	1.49	0.80
10 V6L9-SS ETS	5/8	1 - 14	1 - 14	1 1/8	0.492	0.453	1 1/16	1.53	0.92
12 V6L9-SS ETS	3/4	1 3/16 - 12	1 3/16 - 12	1 3/8	0.610	0.551	1 3/16	1.73	1.02
16 V6L9-SS ETS	1	1 7/16 - 12	1 7/16 - 12	1 5/8	0.807	0.787	1 7/16	1.63	1.18
20 V6L9-SS ETS	1 1/4	1 11/16 - 12	1 11/16 - 12	1 7/8	1.024	1.024	1 5/8	1.99	1.26
24 V6L9-SS ETS	1 1/2	2 - 12	2 - 12	2 1/4	1.260	1.260	1 7/8	2.07	1.46
32 V6L9-SS ETS	2	2 1/2 - 12	2 1/2 - 12	2 7/8	1.770	1.730	2 1/2	2.48	1.75

** D1 nominal may vary from the values shown in the chart by 0.004 to 0.008.

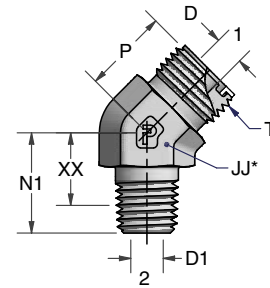
Dimensions and pressures for reference only, subject to change.

WARNING: This product can expose you to chemicals including Lead, which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.p65warnings.ca.gov.



VL9

45° Male Elbow
Metal Face Seal / NPTF

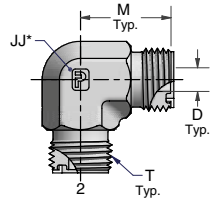


* JJ – Across Wrench Flats

TUBE FITTING PART #	END SIZE		T TUBE END UN/UNF-2A	D DRILL (in.)	D1 DRILL (in.)	JJ (in.)	N1 (in.)	P (in.)	XX AFTER ASSY (in.)
	1 (in.)	2 NPTF							
4 VL9-SS ETS	1/4	1/8 - 27	9/16 - 18	0.177	0.188	9/16	0.64	0.63	0.41
4-4 VL9-SS ETS	1/4	1/4 - 18	9/16 - 18	0.177	0.281	9/16	0.86	0.68	0.52
6 VL9-SS ETS	3/8	1/4 - 18	11/16 - 16	0.256	0.281	3/4	0.87	0.74	0.53
6-6 VL9-SS ETS	3/8	3/8 - 18	11/16 - 16	0.256	0.406	3/4	0.87	0.74	0.52
8 VL9-SS ETS	1/2	3/8 - 18	13/16 - 16	0.374	0.406	3/4	0.95	0.80	0.60
8-8 VL9-SS ETS	1/2	1/2 - 14	13/16 - 16	0.374	0.531	7/8	1.17	0.86	0.71
10 VL9-SS ETS	5/8	1/2 - 14	1 - 14	0.492	0.531	1 1/16	1.17	0.92	0.71
12 VL9-SS ETS	3/4	3/4 - 14	1 3/16 - 12	0.610	0.719	1 5/16	1.30	1.02	0.82
16 VL9-SS ETS	1	1 - 11 1/2	1 7/16 - 12	0.807	0.937	1 7/16	1.48	1.18	0.91
20 VL9-SS ETS	1 1/4	1 1/4 - 11 1/2	1 11/16 - 12	1.024	1.250	1 5/8	1.67	1.26	1.08
24 VL9-SS ETS	1 1/2	1 1/2 - 11 1/2	2 - 12	1.260	1.500	1 7/8	1.77	1.45	1.18
32 VL9-SS ETS	2	2 - 11 1/2	2 1/2 - 12	1.772	1.938	2 1/2	1.80	1.76	1.21

EL9

Union Elbow
Metal Face Seal / Metal Face Seal



* JJ – Across Wrench Flats

TUBE FITTING PART #	END SIZE		T TUBE END UN/UNF-2A	D DRILL (in.)	JJ (in.)	M (in.)
	1 (in.)	2 (in.)				
4 EL9-SS ETS	1/4	1/4	9/16 - 18	0.177	9/16	0.85
6 EL9-SS ETS	3/8	3/8	11/16 - 16	0.256	3/4	0.98
8 EL9-SS ETS	1/2	1/2	13/16 - 16	0.374	3/4	1.10
10 EL9-SS ETS	5/8	5/8	1 - 14	0.492	1 1/16	1.32
12 EL9-SS ETS	3/4	3/4	1 3/16 - 12	0.610	1 3/16	1.48
16 EL9-SS ETS	1	1	1 7/16 - 12	0.807	1 7/16	1.63
20 EL9-SS ETS	1 1/4	1 1/4	1 11/16 - 12	1.024	1 5/8	1.75
24 EL9-SS ETS	1 1/2	1 1/2	2 - 12	1.260	1 7/8	1.93
32 EL9-SS ETS	2	2	2 1/2 - 12	1.772	2 1/2	2.76

Dimensions and pressures for reference only, subject to change.

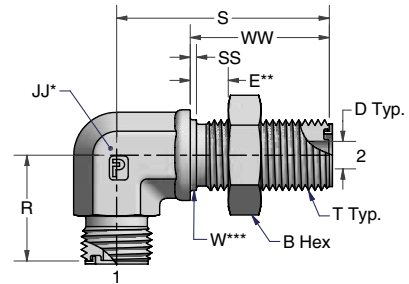
WARNING: This product can expose you to chemicals including Lead, which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.p65warnings.ca.gov.



WEL9

Bulkhead Union Elbow
Metal Face Seal / Metal Face Seal

WEL9-WLNL - Body with Locknut

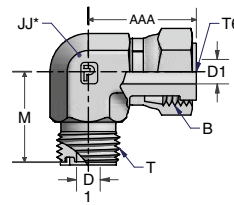


* JJ – Across wrench flats.
 ** E – Maximum bulkhead thickness.
 *** W – Bulkhead pilot diameter. Recommended clearance hole is $W + 0.015"$.

TUBE FITTING PART #	END SIZE		T TUBE END UN/UNF-2A	B HEX (in.)	D DRILL (in.)	E MAX (in.)	JJ (in.)	R (in.)	S (in.)	SS (in.)	W (in.)	WW (in.)
	1 (in.)	2 (in.)										
4 WEL9-SS ETS	1/4	1/4	9/16 - 18	13/16	0.177	0.55	9/16	0.89	1.85	0.06	0.56	1.24
6 WEL9-SS ETS	3/8	3/8	11/16 - 16	1	0.256	0.55	3/4	1.02	2.05	0.06	0.69	1.34
8 WEL9-SS ETS	1/2	1/2	13/16 - 16	1 1/8	0.374	0.55	3/4	1.14	2.19	0.06	0.81	1.44
10 WEL9-SS ETS	5/8	5/8	1 - 14	1 5/16	0.492	0.55	1 1/16	1.36	2.48	0.06	1.00	1.59
12 WEL9-SS ETS	3/4	3/4	1 3/16 - 12	1 1/2	0.610	0.55	1 3/16	1.52	2.64	0.06	1.19	1.63
20 WEL9-SS ETS	1 1/4	1 1/4	1 11/16 - 12	2	1.024	0.55	1 5/8	1.79	2.97	0.06	1.69	1.65
24 WEL9-SS ETS	1 1/2	1 1/2	2 - 12	2 3/8	1.260	0.55	1 7/8	1.95	3.13	0.06	2.00	1.65
32 WEL9-SS ETS	2	2	2 1/2 - 12	2 3/4	1.772	0.55	2 1/2	2.76	3.89	0.06	2.50	1.83

C6L9

Swivel Nut Elbow
Metal Face Seal / Metal Face Seal Swivel



* D1 nominal may vary from the values shown in the chart by 0.004 to 0.008.

* JJ – Across Wrench Flats

TUBE FITTING PART #	END SIZE		T TUBE END UN/UNF-2A	T6 SWIVEL UN/UNF-2B	AAA (in.)	B HEX (in.)	D DRILL (in.)	D1 DRILL (in.)	JJ (in.)	M (in.)
	1 (in.)	2 (in.)								
4 C6L9-SS ETS	1/4	1/4	9/16 - 18	9/16 - 18	1.07	11/16	0.177	0.157	9/16	0.85
6 C6L9-SS ETS	3/8	3/8	11/16 - 16	11/16 - 16	1.17	13/16	0.256	0.256	3/4	0.98
8 C6L9-SS ETS	1/2	1/2	13/16 - 16	13/16 - 16	1.50	15/16	0.374	0.354	3/4	1.10
10 C6L9-SS ETS	5/8	5/8	1 - 14	1 - 14	1.61	1 1/8	0.492	0.453	1 1/16	1.32
12 C6L9-SS ETS	3/4	3/4	1 3/16 - 12	1 3/16 - 12	1.83	1 3/8	0.610	0.551	1 3/16	1.48
16 C6L9-SS ETS	1	1	1 7/16 - 12	1 7/16 - 12	2.11	1 5/8	0.807	0.787	1 7/16	1.63
20 C6L9-SS ETS	1 1/4	1 1/4	1 11/16 - 12	1 11/16 - 12	2.28	1 7/8	1.024	1.024	1 5/8	1.75
24 C6L9-SS ETS	1 1/2	1 1/2	2 - 12	2 - 12	2.40	2 1/4	1.260	1.260	1 7/8	1.93
32 C6L9-SS ETS	2	2	2 1/2 - 12	2 1/2 - 12	3.23	2 7/8	1.770	1.730	2 1/2	2.75

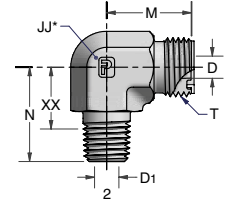
Dimensions and pressures for reference only, subject to change.

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CL9

Male Pipe Elbow
Metal Face Seal / NPTF



* JJ – Across Wrench Flats

TUBE FITTING PART #	END SIZE		T TUBE END UN/UNF-2A	D DRILL (in.)	D1 DRILL (in.)	JJ (in.)	M (in.)	N (in.)	XX AFTER ASSY (in.)
	1 (in.)	2 NPTF							
4 CL9-SS ETS	1/4	1/8 - 27	9/16 - 18	0.177	0.188	9/16	0.85	0.80	0.57
4-4 CL9-SS ETS	1/4	1/4 - 18	9/16 - 18	0.177	0.281	9/16	0.85	1.12	0.78
4-6 CL9-SS ETS	1/4	3/8 - 18	9/16 - 18	0.177	0.406	3/4	0.97	1.22	0.87
4-8 CL9-SS ETS	1/4	1/2 - 14	9/16 - 18	0.177	0.531	7/8	1.07	1.47	1.01
6 CL9-SS ETS	3/8	1/4 - 18	11/16 - 16	0.256	0.281	3/4	0.98	1.09	0.75
6-6 CL9-SS ETS	3/8	3/8 - 18	11/16 - 16	0.256	0.406	3/4	0.98	1.22	0.87
6-8 CL9-SS ETS	3/8	1/2 - 14	11/16 - 16	0.256	0.531	7/8	1.15	1.47	1.01
8 CL9-SS ETS	1/2	3/8 - 18	13/16 - 16	0.374	0.406	3/4	1.10	1.22	0.87
8-4 CL9-SS ETS	1/2	1/4 - 18	13/16 - 16	0.374	0.281	3/4	1.10	1.22	0.87
8-8 CL9-SS ETS	1/2	1/2 - 14	13/16 - 16	0.374	0.531	7/8	1.10	1.47	1.01
8-12 CL9-SS ETS	1/2	3/4 - 14	13/16 - 16	0.374	0.719	1 1/16	1.32	1.59	1.11
10 CL9-SS ETS	5/8	1/2 - 14	1 - 14	0.492	0.531	1 1/16	1.31	1.47	1.01
10-6 CL9-SS ETS	5/8	3/8 - 18	1 - 14	0.492	0.406	1 1/16	1.31	1.28	0.93
10-12 CL9-SS ETS	5/8	3/4 - 14	1 - 14	0.492	0.719	1 3/16	1.41	1.59	1.11
12 CL9-SS ETS	3/4	3/4 - 14	1 3/16 - 12	0.610	0.719	1 3/16	1.47	1.59	1.11
12-8 CL9-SS ETS	3/4	1/2 - 14	1 3/16 - 12	0.610	0.531	1 3/16	1.47	1.59	1.13
12-16 CL9-SS ETS	3/4	1 - 11 1/2	1 3/16 - 12	0.610	0.938	1 5/16	1.62	1.97	1.40
16 CL9-SS ETS	1	1 - 11 1/2	1 7/16 - 12	0.807	0.938	1 7/16	1.64	1.97	1.40
16-12 CL9-SS ETS	1	3/4 - 14	1 7/16 - 12	0.807	0.719	1 7/16	1.64	1.78	1.30
20 CL9-SS ETS	1 1/4	1 1/4 - 11 1/2	1 11/16 - 12	1.024	1.250	1 5/8	1.76	2.38	1.79
24 CL9-SS ETS	1 1/2	1 1/2 - 11 1/2	2 - 12	1.260	1.500	1 7/8	1.92	2.64	2.05
24-20 CL9-SS ETS	1 1/2	1 1/4 - 11 1/2	2 - 12	1.260	1.250	1 7/8	1.92	2.61	2.02
32 CL9-SS ETS	2	2 - 11 1/2	2 1/2 - 12	1.770	1.938	2 1/2	2.76	3.00	2.41

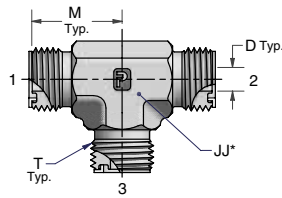
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JL9

Union Tee
Metal Face Seal (all three ends)



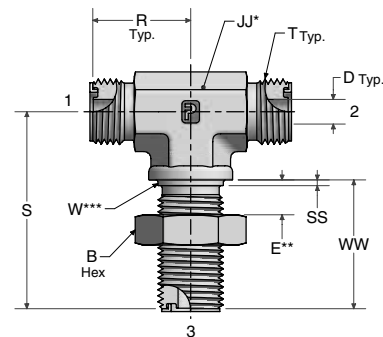
* JJ – Across Wrench Flats

TUBE FITTING PART #	END SIZE	T TUBE END UN/UNF-2A	D DRILL (in.)	JJ (in.)	M (in.)
	1-3 (in.)				
4 JL9-SS ETS	1/4	9/16 - 18	0.177	9/16	0.85
6 JL9-SS ETS	3/8	11/16 - 16	0.256	3/4	0.98
8 JL9-SS ETS	1/2	13/16 - 16	0.374	3/4	1.10
10 JL9-SS ETS	5/8	1 - 14	0.492	1 1/16	1.32
12 JL9-SS ETS	3/4	1 3/16 - 12	0.610	1 3/16	1.48
16 JL9-SS ETS	1	1 7/16 - 12	0.807	1 7/16	1.63
20 JL9-SS ETS	1 1/4	1 11/16 - 12	1.024	1 5/8	1.75
24 JL9-SS ETS	1 1/2	2 - 12	1.260	1 7/8	1.93
32 JL9-SS ETS	2	2 1/2 - 12	1.772	2 1/2	2.76

WJL9

Bulkhead Branch Tee
Metal Face Seal (all three ends)

WJL9-WLNL - Body with Locknut



* JJ – Across wrench flats.

** E – Maximum bulkhead thickness.

*** W – Bulkhead pilot diameter. Recommended clearance hole is W + 0.015".

TUBE FITTING PART #	END SIZE	T TUBE END UN/UNF-2A	B HEX (in.)	D DRILL (in.)	E MAX (in.)	JJ (in.)	R (in.)	S (in.)	SS (in.)	W DIA (in.)	WW (in.)
	1-3 (in.)										
4 WJL9-SS ETS	1/4	9/16 - 18	11/16	0.177	0.55	9/16	0.89	1.85	0.06	0.56	1.24
6 WJL9-SS ETS	3/8	11/16 - 18	13/16	0.256	0.55	3/4	1.02	2.05	0.06	0.69	1.34
8 WJL9-SS ETS	1/2	13/16 - 16	15/16	0.374	0.55	3/4	1.14	2.19	0.06	0.81	1.44
10 WJL9-SS ETS	5/8	1 - 14	1 1/8	0.492	0.55	1 1/16	1.36	2.48	0.06	1.00	1.59
12 WJL9-SS ETS	3/4	1 3/16 - 12	1 3/8	0.610	0.55	1 3/16	1.52	2.64	0.06	1.19	1.63
16 WJL9-SS ETS	1	1 7/16 - 12	1 3/4	0.807	0.55	1 7/16	1.67	2.80	0.06	1.44	1.65
20 WJL9-SS ETS	1 1/4	1 11/16 - 12	2	1.024	0.55	1 5/8	1.79	2.79	0.06	1.69	1.65
24 WJL9-SS ETS	1 1/2	2 - 12	2 3/8	1.260	0.55	1 7/8	1.95	3.13	0.06	2.00	1.65
32 WJL9-SS ETS	2	2 1/2 - 12	2 3/4	1.772	0.55	2 1/2	2.75	3.89	0.06	2.50	1.83

Dimensions and pressures for reference only, subject to change.

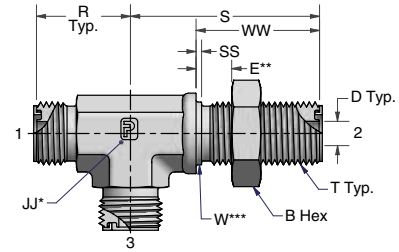
WARNING: This product can expose you to chemicals including Lead, which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.p65warnings.ca.gov.



WJL9

Bulkhead Run Tee
Metal Face Seal (all three ends)

WJL9WLNL - Body with Locknut

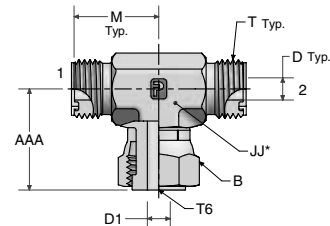


* JJ – Across wrench flats.
** E – Maximum bulkhead thickness.
*** W – Bulkhead pilot diameter. Recommended clearance hole is $W + 0.015"$.

TUBE FITTING PART #	END SIZE	T TUBE END UN/UNF-2A	B HEX (in.)	D DRILL (in.)	E MAX (in.)	JJ (in.)	R (in.)	S (in.)	SS (in.)	W DIA (in.)	WW (in.)
	1-3 (in.)										
4 WJL9-SS ETS	1/4	9/16 - 18	13/16	0.177	0.55	9/16	0.89	1.85	0.06	0.56	1.24
6 WJL9-SS ETS	3/8	11/16 - 16	1	0.256	0.55	3/4	1.02	2.05	0.06	0.69	1.34
8 WJL9-SS ETS	1/2	13/16 - 16	1 1/8	0.374	0.55	3/4	1.14	2.19	0.06	0.81	1.44
10 WJL9-SS ETS	5/8	1 - 14	1 5/16	0.492	0.55	1 1/16	1.36	2.48	0.06	1.00	1.59
12 WJL9-SS ETS	3/4	1 3/16 - 12	1 1/2	0.610	0.55	1 3/16	1.52	2.64	0.06	1.19	1.63
16 WJL9-SS ETS	1	1 7/16 - 12	1 3/4	0.807	0.55	1 7/16	1.67	2.80	0.06	1.44	1.65
20 WJL9-SS ETS	1 1/4	1 11/16 - 12	2	1.024	0.55	1 5/8	1.79	2.79	0.06	1.69	1.65
24 WJL9-SS ETS	1 1/2	2 - 12	2 3/8	1.260	0.55	1 7/8	1.95	3.13	0.06	2.00	1.65
32 WJL9-SS ETS	2	2 1/2 - 12	2 3/4	1.772	0.55	2 1/2	2.76	3.89	0.06	2.50	1.83

S6L9

Swivel Nut Branch Tee
Metal Face Seal / Metal Face Seal / Metal Face Seal Swivel



* JJ – Across Wrench Flats

TUBE FITTING PART #	END SIZE	T TUBE END UN/UNF-2A	T6 SWIVEL UN/UNF-2B	AAA (in.)	B HEX (in.)	D DRILL (in.)	D1 DRILL (in.)	JJ (in.)	M (in.)
	1-3 (in.)								
4 S6L9-SS ETS	1/4	9/16 - 18	9/16 - 18	1.07	11/16	0.177	0.157	9/16	0.85
6 S6L9-SS ETS	3/8	11/16 - 16	11/16 - 16	1.17	13/16	0.256	0.256	3/4	0.98
8 S6L9-SS ETS	1/2	13/16 - 16	13/16 - 16	1.50	15/16	0.374	0.354	3/4	1.10
10 S6L9-SS ETS	5/8	1 - 14	1 - 14	1.61	1 1/8	0.492	0.453	1 1/16	1.32
12 S6L9-SS ETS	3/4	1 3/16 - 12	1 3/16 - 12	1.83	1 3/8	0.610	0.551	1 3/16	1.48
16 S6L9-SS ETS	1	1 7/16 - 12	1 7/16 - 12	2.11	1 5/8	0.807	0.787	1 7/16	1.63
20 S6L9-SS ETS	1 1/4	1 11/16 - 12	1 11/16 - 12	2.28	1 7/8	1.024	1.024	1 5/8	1.75
24 S6L9-SS ETS	1 1/2	2 - 12	2 - 12	2.40	2 1/4	1.260	1.260	1 7/8	1.93
32 S6L9-SS ETS	2	2 1/2 - 12	2 1/2 - 12	3.23	2 7/8	1.770	1.730	2 1/2	2.75

*** D1 nominal may vary from the values shown in the chart by 0.004 to 0.008.

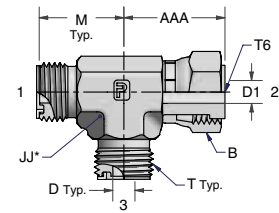
Dimensions and pressures for reference only, subject to change.

WARNING: This product can expose you to chemicals including Lead, which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.p65warnings.ca.gov.



R6L9

Swivel Nut Run Tee
Metal Face Seal / Metal Face Seal Swivel / Metal Face Seal



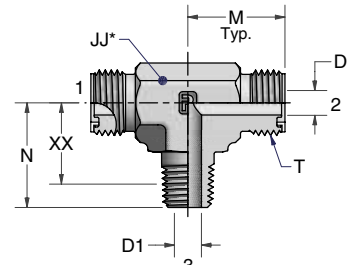
* JJ – Across Wrench Flats

TUBE FITTING PART #	END SIZE	T TUBE END UN/UNF-2A	T6 SWIVEL UN/UNF-2B	AAA (in.)	B HEX (in.)	D DRILL (in.)	D1** DRILL (in.)	JJ (in.)	M (in.)
	1-3 (in.)								
4 R6L9-SS ETS	1/4	9/16 - 18	9/16 - 18	1.07	11/16	0.177	0.157	9/16	0.85
6 R6L9-SS ETS	3/8	11/16 - 16	11/16 - 16	1.17	13/16	0.256	0.256	3/4	0.98
8 R6L9-SS ETS	1/2	13/16 - 16	13/16 - 16	1.50	15/16	0.374	0.354	3/4	1.10
10 R6L9-SS ETS	5/8	1 - 14	1 - 14	1.61	1 1/8	0.492	0.453	1 1/16	1.32
12 R6L9-SS ETS	3/4	1 3/16 - 12	1 3/16 - 12	1.83	1 3/8	0.610	0.551	1 3/16	1.48
16 R6L9-SS ETS	1	1 7/16 - 12	1 7/16 - 12	2.11	1 5/8	0.807	0.787	1 7/16	1.63
20 R6L9-SS ETS	1 1/4	1 11/16 - 12	1 11/16 - 12	2.28	1 7/8	1.024	1.024	1 5/8	1.75
24 R6L9-SS ETS	1 1/2	2 - 12	2 - 12	2.40	2 1/4	1.260	1.260	1 7/8	1.93
32 R6L9-SS ETS	2	2 1/2 - 12	2 1/2 - 12	3.23	2 7/8	1.770	1.730	2 1/2	2.75

** D1 nominal may vary from the values shown in the chart by 0.004 to 0.008.

SL9

Male Pipe Tee
Metal Face Seal / Metal Face Seal / NPTF



* JJ – Across Wrench Flats

TUBE FITTING PART #	END SIZE		T TUBE END UN/UNF-2A	D DRILL (in.)	D1 DRILL (in.)	JJ (in.)	M (in.)	N (in.)	XX AFTER ASSY (in.)
	1 & 2	3							
	(in.)	NPTF							
4-4-4 SL9-SS ETS	1/4	1/4 - 18	9/16 - 18	0.177	0.281	9/16	0.85	1.12	0.78
6 SL9-SS ETS	3/8	1/4 - 18	11/16 - 16	0.256	0.281	3/4	0.98	1.09	0.75
6-6-6 SL9-SS ETS	3/8	3/8 - 18	11/16 - 16	0.256	0.406	3/4	0.98	1.22	0.87
8 SL9-SS ETS	1/2	3/8 - 18	13/16 - 16	0.374	0.406	3/4	1.10	1.22	0.87
8-8-8 SL9-SS ETS	1/2	1/2 - 14	13/16 - 16	0.374	0.531	7/8	1.10	1.47	1.01
10 SL9-SS ETS	5/8	1/2 - 14	1 - 14	0.492	0.531	1 1/16	1.31	1.47	1.01
12 SL9-SS ETS	3/4	3/4 - 14	1 3/16 - 12	0.610	0.719	1 3/16	1.47	1.59	1.11
16 SL9-SS ETS	1	1-11 1/2	1 7/16 - 20	0.807	0.938	1 7/16	1.64	1.97	1.40
20 SL9-SS ETS	1 1/4	1 1/4 - 11 1/2	1 11/16 - 20	1.024	1.250	1 5/8	1.76	2.38	1.79
24 SL9-SS ETS	1 1/2	1 1/2 - 11 1/2	2 - 12	1.260	1.500	1 7/8	1.92	2.64	2.05
32 SL9-SS ETS	2	2 - 11 1/2	2 1/2 - 12	1.772	1.938	2 1/2	2.76	3.00	2.41

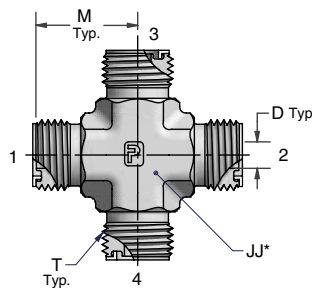
Dimensions and pressures for reference only, subject to change.

WARNING: This product can expose you to chemicals including Lead, which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.p65warnings.ca.gov.



KL9

Union Cross
Metal Face Seal (all four ends)

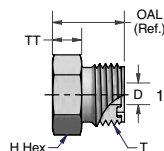


* JJ – Across Wrench Flats

TUBE FITTING PART #	END SIZE	T TUBE END UN/UNF-2A	D DRILL (in.)	JJ (in.)	M (in.)
	1-4 (in.)				
4 KL9-SS ETS	1/4	9/16 - 18	0.177	9/16	0.85
6 KL9-SS ETS	3/8	11/16 - 16	0.256	3/4	0.98
8 KL9-SS ETS	1/2	13/16 - 16	0.374	3/4	1.10
10 KL9-SS ETS	5/8	1 - 14	0.492	1 1/16	1.32
12 KL9-SS ETS	3/4	1 3/16 - 12	0.610	1 3/16	1.48
16 KL9-SS ETS	1	1 7/16 - 12	0.807	1 7/16	1.63
20 KL9-SS ETS	1 1/4	1 11/16 - 12	1.024	1 5/8	1.75
24 KL9-SS ETS	1 1/2	2 - 12	1.260	1 7/8	1.93
32 KL9-SS ETS	2	2 1/2 - 12	1.772	2 1/2	2.76

PNL9

Plug
Metal Face Seal



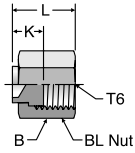
TUBE FITTING PART #	END SIZE	T TUBE END UN/UNF-2A	D DRILL (in.)	H HEX (in.)	OAL (REF) (in.)	TT (in.)
	1 (in.)					
4 PNL9-SS ETS	1/4	9/16 - 18	0.177	5/8	0.65	0.20
6 PNL9-SS ETS	3/8	11/16 - 16	0.256	3/4	0.75	0.32
8 PNL9-SS ETS	1/2	13/16 - 16	0.374	7/8	0.87	0.35
10 PNL9-SS ETS	5/8	1 - 14	0.492	1 1/16	1.02	0.41
12 PNL9-SS ETS	3/4	1 3/16 - 12	0.610	1 1/4	1.08	0.41
16 PNL9-SS ETS	1	1 7/16 - 12	0.807	1 1/2	1.10	0.41
20 PNL9-SS ETS	1 1/4	1 11/16 - 12	1.024	1 3/4	1.10	0.41
24 PNL9-SS ETS	1 1/2	2 - 12	1.260	2 1/8	1.10	0.41
32 PNL9-SS ETS	2	2 1/2 - 12	1.772	2 3/4	1.40	0.50

Dimensions and pressures for reference only, subject to change.

WARNING: This product can expose you to chemicals including Lead, which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.p65warnings.ca.gov.

FNL

Cap
Metal Face Seal



TUBE FITTING PART #	TUBE O.D. (in.)	T6 SWIVEL UN/UNF-2B	B HEX (in.)	K (in.)	L (in.)
4 FNL-SS	1/4	9/16 - 18	11/16	0.35	0.66
6 FNL-SS	3/8	11/16 - 16	13/16	0.41	0.74
8 FNL-SS	1/2	13/16 - 16	15/16	0.47	0.87
10 FNL-SS	5/8	1 - 14	1 1/8	0.53	1.02
12 FNL-SS	3/4	1 3/16 - 12	1 3/8	0.59	1.12
16 FNL-SS	1	1 7/16 - 12	1 5/8	0.63	1.16
20 FNL-SS	1 1/4	1 11/16 - 12	1 7/8	0.63	1.16
24 FNL-SS	1 1/2	2 - 12	2 1/4	0.63	1.16
32 FNL-SS	2	2 1/2 - 12	2 7/8	0.79	1.46

Dimensions and pressures for reference only, subject to change.

Parflange® 1025

Bench-Top 90° Flanging and 37° Flaring System

Tooling must be ordered separately

- Eliminates braze joint
- Compact, lightweight design
- Bench mountable
- Easy to operate
- Available in 110-volt single-phase or 440-volt 3-phase (please specify by ordering 1025/110 or 1025/440)
- Flanges or flares tube in less than 20 seconds
- For tube sizes 1/4" O.D. thru 1-1/2" O.D. (steel); and 1/4" O.D. thru 1" O.D. (stainless steel) – Flanging/flaring of tube sizes 1" & greater results in heavy machine vibration. Therefore, this machine is only recommended for occasional use for preparing tube ends 1" or larger.

Tooling is also available for comparable metric tube sizes.

Electrical Power: 110V/20A single-phase, or 440V/3-phase/2.1A

Power Cable Length: 8 feet long (2.5 meters)

Dimensions: Height: 18 1/8 inches (460mm)

Width: 15 3/8 inches (390mm)

Depth: 26 3/8 inches (670mm)

Weight: Basic Unit: 175 lbs. (80 kg.)

Each Die (typical): 4 lbs. (1.8 kg.)

Flanging Pin Lubrication Fluid: **LB2000**

See Bulletin 4390-1025A or 4390-1025 for more details.

A DVD is included to provide instructions for proper use.

COMPONENTS REQUIRED

Part Name	Part No.
Parflange 1025 (110 volt)	1025/110
Parflange 1025 (440 volt)	1025/440
Flanging Pin.....	See TFDToolSpec.com
Flanging Die Set.....	See TFDToolSpec.com
Lubrication Fluid.....	LB 2000
Die Adjustment Shims (Old Style Dies Only).....	Shim Kit

REPLACEMENT PART

Part Name	Part No.
Tube Stop	1025/0281014



Figure 8 — Parflange® 1025 Machine

CAUTION: Extension cords are *not* recommended and could cause damage to the machine due to a lack of power supply.



Figure 9 — Flanging Pin

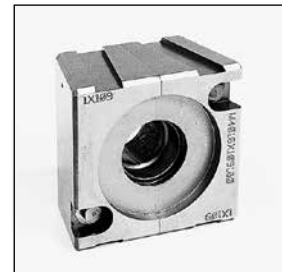


Figure 10 — Flanging Die Set



Figure 11 — LB 2000

Dimensions and pressures for reference only, subject to change.

Parflange® ECO 25

Bench-Top 90° Flanging and 37° Flaring System

Tooling and Hydraulic Pump must be ordered separately

- Eliminates braze joints
- More efficient than traditional flaring methods
- Only requires one die per tube size for both flanging and flaring
- For tube sizes 1/4" O.D. through 1-1/2" O.D. in both Steel and Stainless Steel
- Dies not dependent on wall thickness or tube material
- Uses same Parflange pins as 1025 and PRO 50 models
- Utilizes proven Parflange orbital process for consistent flanges and flares
- Burnishes flanges and flares for superior surface finish
- Compact, lightweight design
- Easy to operate
- Used with hand hydraulic pump
- 110-volt single-phase power
- Tooling also available in comparable metric sizes

Electrical Power: 110V/20A single-phase

Power Cable Length: 8 feet long (2.5 meters)

Dimensions: Height: 20.5 inches (520mm)

Width: 15 inches (381mm)

Depth: 20.5 (520mm)

Weight: 190 lbs. (86.4 kg.)

See Bulletin 4390-ECO 25 for more information and instructions for use.

COMPONENTS REQUIRED

Part Name	Part No.
*ECO 25 Basic Unit	ECO 25
*Hydraulic Hand Pump	900086
Flanging Pin.....	See TFDToolSpec.com
Flanging/Flaring Dual Function Die Set.....	See TFDToolSpec.com
*Lubrication Fluid.....	LB 2000
*Hose Assembly (for hand or electric pump)	910133
*Pressure gauge (0 - 10,000 psi).....	900044
*Hydraulic Pump Adapter	6-6 FLO-S
*Hydraulic Pump Tee	6 R6LO-S
*Pressure Gauge Adapter	6 G6L-S
*Hose Conversion Adapter (#1).....	6 G6L-S
*Hose Conversion Adapter (#2).....	6-6 G6L-S

*Included in ECO 25 kit (Part Number ECO 25 KIT)



Figure 12 — Parflange ECO 25, shown with hand pump

CAUTION: Extension cords are *not* recommended and could cause damage to the machine due to a lack of power supply.



Figure 13 — Hydraulic Hand Pump

ECO 25 Kit

Part Name	Part No.
ECO 25 Kit (includes hand pump)	ECO 25 KIT

(Kit includes basic unit, hand hydraulic pump, hose assembly, pressure gauge, hydraulic pump adapter, hydraulic pump tee, pressure gauge adapter, hose conversion adapters #1 & #2, Lubrication fluid, and operation manual.)

Dimensions and pressures for reference only, subject to change.

Parflange® Pro 50

Workstation 90° Flanging and 37° Flaring System

- Overall cycle time of 15 seconds
- 440V three-phase power
- Workstation setup with tooling cabinet below unit
- Improved tooling lubrication system
- Self-opening and closing dies
- Automatic cycle start triggered by tube insertion
- Sleeve loader machine available
- For tube sizes 1/4" O.D. thru 1 1/2" O.D. steel and stainless steel. Tooling is also available for comparable metric tube sizes.



Figure 14 — Parflange Pro 50

Electrical Power: 440V, 3-phase

Power Cable Length: 12 feet long

Dimensions: Height: 41 inches (1035 mm)

Width: 28 inches (700 mm)

Depth: 33 inches (840 mm)

Weight: 838 lbs. (380 kg.)

Hydraulic Fluid: mobile DTE light 5.28 gallons (20 liters)

Flanging Pin Lubrication Fluid: LB2000

CAUTION: Extension cords are *not* recommended and could cause damage to the machine due to a lack of power supply.

COMPONENTS REQUIRED

Part Name	Part No.
Parflange Pro 50.....	Pro 50
Parflange Pro 50 w/sleeve loader.....	Pro 50 w/feeder
Flanging Pins.....	See TFDToolSpec.com
Flanging Dies.....	See TFDToolSpec.com
Die Adjustment Shims (Old Style Dies Only).....	Shim Kit



Figure 15 — Parflange Pro 50 w/Feeder



Figure 16 — Flanging Pin



Figure 17 — Flanging Die Set



Figure 18 — LB 2000

Seal-Lok Xtreme Troubleshooting Guide

CONDITION	PROBABLE CAUSE(S)	RECOMMENDATION
Immediate leakage when system is pressurized	<ul style="list-style-type: none"> Improper tightening of joint 	<ul style="list-style-type: none"> Check for metal seal damage and re-tighten connection to the recommended torque value
Under-flanged assembly	<ul style="list-style-type: none"> Undersized tube diameter resulting in tube slippage during flanging Die gripping surface is worn or dirty 	<ul style="list-style-type: none"> Verify that the O.D. is correct; if undersized, replace tube. Inspect die gripping surface; if clogged or excessively worn, clean or replace.
Over-flanged assembly	<ul style="list-style-type: none"> Sleeve is positioned incorrectly in die 	<ul style="list-style-type: none"> Check for proper positioning of sleeve in die; if over-flanged, replace tubing
Flange out-of-round	<ul style="list-style-type: none"> Tubing was not cut properly Tube was not properly supported during flanging Tubing is eccentric 	<ul style="list-style-type: none"> Cut tubing within $90^{\circ} \pm 1^{\circ}$ Support tubing so that tube end is perpendicular to tube stop during flanging Replace with quality tubing Replace out-of-round flanges
Cracked flange	<ul style="list-style-type: none"> Tubing too hard 	<ul style="list-style-type: none"> Replace tubing using recommended quality tube
Scored, pitted flange	<ul style="list-style-type: none"> Improper deburring and cleaning of tube prior to flanging Flange pin not cleaned and lubricated properly 	<ul style="list-style-type: none"> Replace flange using proper deburring and cleaning recommendations Keep flanging pin clean and working surfaces well lubricated.
Leakage at braze joint	<ul style="list-style-type: none"> Poor braze joint/improper joint clearance Mixing of sleeve and tube material Improper/inadequate flux, braze alloy overrun, or buildup on face Improper/inadequate braze temperature 	<ul style="list-style-type: none"> Flux and reheat the joint, remove and replace with new sleeve Always use steel sleeves with steel tubing and stainless sleeves with stainless tubing Apply flux liberally to sleeve and tube end prior to brazing. Use recommended flux, braze alloy and brazing temperature.
Leakage at face-seal end	<ul style="list-style-type: none"> Misalignment or improper fit Damaged metal seal Braze overflow on sealing surface 	<ul style="list-style-type: none"> Align tube end and connecting fitting properly before tightening tube nut, holding the flat face of the mating fitting against metal seal while tightening Replace metal seal, properly installing it in the face seal groove Remove and replace sleeve which has braze overflow on its sealing surface.

Table 6 – Seal-Lok Xtreme Troubleshooting Guide

Dimensions and pressures for reference only, subject to change.

Troubleshooting Port End Connections

SAE Metal Seal

CONDITION	PROBABLE CAUSE(S)	RECOMMENDATIONS
Fitting threads are distorted	<ul style="list-style-type: none"> • Over-torqued • Mixed threads 	<ul style="list-style-type: none"> • Replace fitting and tighten to proper torque • Determine correct thread type
Severe scratches or nicks on the port face	<ul style="list-style-type: none"> • Port face contaminated (dirty) 	<ul style="list-style-type: none"> • Reface the port
Port threads are distorted (yielded)	<ul style="list-style-type: none"> • Fitting over-torqued 	<ul style="list-style-type: none"> • Replace component
Leakage persists after SAE port end has been torqued	<ul style="list-style-type: none"> • Damaged metal seal • Damaged port sealing surface • Improper assembly 	<ul style="list-style-type: none"> • Replace fitting • Replace or reface the port • Follow proper assembly procedure. Lubricate seals and threads.

Table 7 – Troubleshooting Port End Connections

Notes



Parker Safety Guide for Selecting and Using Hose, Tubing, Fittings, Connectors, Conductors, Valves and Related Accessories

Parker Publication No. 4400-B.1

WARNING: Failure or improper selection or improper use of hose, tubing, fittings, assemblies, valves, connectors, conductors or related accessories (“Products”) can cause death, personal injury and property damage. Possible consequences of failure or improper selection or improper use of these Products include but are not limited to:

- Fittings thrown off at high speed.
- High velocity fluid discharge.
- Explosion or burning of the conveyed fluid.
- Electrocution from high voltage electric powerlines.
- Contact with suddenly moving or falling objects that are controlled by the conveyed fluid.
- Injections by high-pressure fluid discharge.
- Dangerously whipping Hose.
- Tube or pipe burst.
- Weld joint fracture.
- Contact with conveyed fluids that may be hot, cold, toxic or otherwise injurious.
- Sparking or explosion caused by static electricity buildup or other sources of electricity.
- Sparking or explosion while spraying paint or flammable liquids.
- Injuries resulting from inhalation, ingestion or exposure to fluids.

Before selecting or using any of these Products, it is important that you read and follow the instructions below. No product from any division in Parker Fluid Connectors Group is approved for in-flight aerospace applications. For hoses and fittings used in in-flight aerospace applications, please contact Parker Aerospace Group.

1.0 GENERAL INSTRUCTIONS

- 1.1 Scope:** This safety guide provides instructions for selecting and using (including assembling, installing, and maintaining) these Products. For convenience, all rubber and/or thermoplastic products commonly called “hose” or “tubing” are called “Hose” in this safety guide. Metallic tube or pipe are called “tube”. All assemblies made with Hose are called “Hose Assemblies”. All assemblies made with Tube are called “Tube Assemblies”. All products commonly called “fittings”, “couplings” or “adapters” are called “Fittings”. Valves are fluid system components that control the passage of fluid. Related accessories are ancillary devices that enhance or monitor performance including crimping, flaring, flanging, presetting, bending, cutting, deburring, swaging machines, sensors, tags, lockout handles, spring guards and associated tooling. This safety guide is a supplement to and is to be used with the specific Parker publications for the specific Hose, Fittings and Related Accessories that are being considered for use. Parker publications are available at www.parker.com. SAE J1273 (www.sae.org) and ISO 17165-2 (www.ansi.org) also provide recommended practices for hydraulic Hose Assemblies, and should be followed.
- 1.2 Fail-Safe:** Hose, Hose Assemblies, Tube, Tube Assemblies and Fittings can and do fail without warning for many reasons. Design all systems and equipment in a fail-safe mode, so that failure of the Hose, Hose Assembly, Tube, Tube Assembly or Fitting will not endanger persons or property.
- 1.3 Distribution:** Provide a copy of this safety guide to each person responsible for selecting or using Hose, Tube and Fitting products. Do not select or use Parker Hose, Tube or Fittings without thoroughly reading and understanding this safety guide as well as the specific Parker publications for the Products.
- 1.4 User Responsibility:** Due to the wide variety of operating conditions and applications for Hose, Tube and Fittings. Parker does not represent or warrant that any particular Hose, Tube or Fitting is suitable for any specific end use system. This safety guide does not analyze all technical parameters that must be considered in selecting a product. The user, through its own analysis and testing, is solely responsible for:
- Making the final selection of the Products.
 - Assuring that the user’s requirements are met and that the application presents no health or safety hazards.
 - Following the safety guide for Related Accessories and being trained to operate Related Accessories.
 - Providing all appropriate health and safety warnings on the equipment on which the Products are used.
 - Assuring compliance with all applicable government and industry standards.
- 1.5 Additional Questions:** Call the appropriate Parker technical service department if you have any questions or require any additional information. See the Parker publication for the Products being considered or used, or call 1-800-CPARKER, or go to www.parker.com, for telephone numbers of the appropriate technical service department.

2.0 HOSE, TUBE AND FITTINGS SELECTION INSTRUCTIONS

- 2.1 Electrical Conductivity:** Certain applications require that the Hose be nonconductive to prevent electrical current flow. Other applications require the Hose and the Fittings and the Hose/Fitting interface to be sufficiently conductive to drain off static electricity. Extreme care must be exercised when selecting Hose, Tube and Fittings for these or any other applications in which electrical conductivity or nonconductivity is a factor.
- The electrical conductivity or nonconductivity of Hose, Tube and Fittings is dependent upon many factors and may be susceptible to change. These factors include but are not limited to the various materials used to make the Hose and the Fittings, Fitting finish (some Fitting finishes are electrically conductive while others are nonconductive), manufacturing methods (including moisture control), how the Fittings contact the Hose, age and amount of deterioration or damage or other changes, moisture content of the Hose at any particular time, and other factors.
- The following are considerations for electrically nonconductive and conductive Hose. For other applications consult the individual catalog pages and the appropriate industry or regulatory standards for proper selection.
- 2.1.1 Electrically Nonconductive Hose:** Certain applications require that the Hose be nonconductive to prevent electrical current flow or to maintain electrical isolation. For applications that require Hose to be electrically nonconductive, including but not limited to applications near high voltage electric lines, only special nonconductive Hose can be used. The manufacturer of the equipment in which the nonconductive Hose is to be used must be consulted to be certain that the Hose, Tube and Fittings that are selected are proper for the application. Do not use any Parker Hose or Fittings for any such application requiring nonconductive Hose, including but not limited to applications near high voltage electric lines or dense magnetic fields, unless (i) the application is expressly approved in the Parker technical publication for the product, (ii) the Hose is marked “nonconductive”, and (iii) the manufacturer of the equipment on which the Hose is to be used specifically approves the particular Parker Hose, Tube and Fittings for such use.
- 2.1.2 Electrically Conductive Hose:** Parker manufactures special Hose for certain applications that require electrically conductive Hose. Parker manufactures special Hose for conveying paint in airless paint spraying applications. This Hose is labeled “Electrically Conductive Airless Paint Spray Hose” on its lay-line and packaging. This Hose must be properly connected to the appropriate Parker Fittings and properly grounded in order to dissipate dangerous static charge buildup, which occurs in all airless paint spraying applications. Do not use any other Hose for airless paint spraying, even if electrically conductive. Use of any other Hose or failure to properly connect the Hose can cause a fire or an explosion resulting in death, personal injury, and property damage. All hoses that convey fuels must be grounded.
- Parker manufactures a special Hose for certain compressed natural gas (“CNG”) applications where static electricity buildup may occur. Parker CNG Hose assemblies comply with the requirements of ANSI/IAS NGV 4.2; CSA 12.52, “Hoses for Natural Gas Vehicles and Dispensing Systems” (www.ansi.org). This Hose is labeled “Electrically Conductive for CNG Use”

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on its layline and packaging. This Hose must be properly connected to the appropriate Parker Fittings and properly grounded in order to dissipate dangerous static charge buildup, which occurs in, for example, high velocity CNG dispensing or transfer. Do not use any other Hose for CNG applications where static charge buildup may occur, even if electrically conductive. Use of other Hoses in CNG applications or failure to properly connect or ground this Hose can cause a fire or an explosion resulting in death, personal injury, and property damage. Care must also be taken to protect against CNG permeation through the Hose wall. See section 2.6, Permeation, for more information. Parker CNG Hose is intended for dispenser and vehicle use within the specified temperature range. Parker CNG Hose should not be used in confined spaces or unventilated areas or areas exceeding the specified temperature range. Final assemblies must be tested for leaks. CNG Hose Assemblies should be tested on a monthly basis for conductivity per ANSI/IAS NGV 4.2; CSA 12.52.

Parker manufactures special Hose for aerospace in-flight applications. Aerospace in-flight applications employing Hose to transmit fuel, lubricating fluids and hydraulic fluids require a special Hose with a conductive inner tube. This Hose for in-flight applications is available only from Parker's Stratoflex Products Division. Do not use any other Parker Hose for in-flight applications, even if electrically conductive. Use of other Hoses for in-flight applications or failure to properly connect or ground this Hose can cause a fire or an explosion resulting in death, personal injury and property damage. These Hose assemblies for in-flight applications must meet all applicable aerospace industry, aircraft engine and aircraft requirements.

- 2.2 Pressure:** Hose, Tube and Fitting selection must be made so that the published maximum working pressure of the Hose, Tube and Fittings are equal to or greater than the maximum system pressure. The maximum working pressure of a Hose, or Tube Assembly is the lower of the respective published maximum working pressures of the Hose, Tube and the Fittings used. Surge pressures or peak transient pressures in the system must be below the published maximum working pressure for the Hose, Tube and Fitting. Surge pressures and peak pressures can usually only be determined by sensitive electrical instrumentation that measures and indicates pressures at millisecond intervals. Mechanical pressure gauges indicate only average pressures and cannot be used to determine surge pressures or peak transient pressures. Published burst pressure ratings for Hose is for manufacturing test purposes only and is no indication that the Product can be used in applications at the burst pressure or otherwise above the published maximum recommended working pressure.
- 2.3 Suction:** Hoses used for suction applications must be selected to insure that the Hose will withstand the vacuum and pressure of the system. Improperly selected Hose may collapse in suction application.
- 2.4 Temperature:** Be certain that fluid and ambient temperatures, both steady and transient, do not exceed the limitations of the Hose, Tube, Fitting and Seals. Temperatures below and above the recommended limit can degrade Hose, Tube, Fittings and Seals to a point where a failure may occur and release fluid. Tube and Fittings performances are normally degraded at elevated temperature. Material compatibility can also change at temperatures outside of the rated range. Properly insulate and protect the Hose Assembly when routing near hot objects (e.g. manifolds). Do not use any Hose in any application where failure of the Hose could result in the conveyed fluids (or vapors or mist from the conveyed fluids) contacting any open flame, molten metal, or other potential fire ignition source that could cause burning or explosion of the conveyed fluids or vapors.
- 2.5 Fluid Compatibility:** Hose, and Tube Assembly selection must assure compatibility of the Hose tube, cover, reinforcement, Tube, Plating and Seals with the fluid media used. See the fluid compatibility chart in the Parker publication for the product being considered or used. This information is offered only as a guide. Actual service life can only be determined by the end user by testing under all extreme conditions and other analysis.
- Hose, and Tube that is chemically compatible with a particular fluid must be assembled using Fittings and adapters containing likewise compatible seals. Flange or flare processes can change Tube material properties that may not be compatible with certain requirements such as NACE
- 2.6 Permeation:** Permeation (that is, seepage through the Hose or Seal) will occur from inside the Hose or Fitting to outside when Hose or Fitting is used with gases, liquid and gas fuels, and refrigerants (including but not limited to such materials as helium, diesel fuel, gasoline, natural gas, phosphate esters, Skydrol, or LPG). This permeation may result in high concentrations of vapors which are potentially flammable, explosive, or toxic, and in loss of fluid. Dangerous explosions, fires, and other hazards can result when using the wrong Hose for such applications. The system designer must take into account the fact that this permeation

will take place and must not use Hose or Fitting if this permeation could be hazardous. The system designer must take into account all legal, government, insurance, or any other special regulations which govern the use of fuels and refrigerants. Never use a Hose or Fitting even though the fluid compatibility is acceptable without considering the potential hazardous effects that can result from permeation through the Hose or Tube Assembly.

Permeation of moisture from outside the Hose or Fitting to inside the Hose or Fitting will also occur in Hose or Tube assemblies, regardless of internal pressure. If this moisture permeation would have detrimental effects (particularly, but not limited to refrigeration and air conditioning systems), incorporation of sufficient drying capacity in the system or other appropriate system safeguards should be selected and used. The sudden pressure release of highly pressurized gas could also result in Explosive Decompression failure of permeated Seals and Hoses.

- 2.7 Size:** Transmission of power by means of pressurized fluid varies with pressure and rate of flow. The size of the components must be adequate to keep pressure losses to a minimum and avoid damage due to heat generation or excessive fluid velocity.
- 2.8 Routing:** Attention must be given to optimum routing to minimize inherent problems (kinking or flow restriction due to Hose collapse, twisting of the Hose, proximity to hot objects or heat sources). For additional routing recommendations see SAE J1273 and ISO 17165-2. Hose Assemblies have a finite life and should be installed in a manner that allows for ease of inspection and future replacement. Hose because of its relative short life, should not be used in residential and commercial buildings inside of inaccessible walls or floors, unless specifically allowed in the product literature. Always review all product literature for proper installation and routing instructions.
- 2.9 Environment:** Care must be taken to insure that the Hose, Tube and Fittings are either compatible with or protected from the environment (that is, surrounding conditions) to which they are exposed. Environmental conditions including but not limited to ultraviolet radiation, sunlight, heat, ozone, moisture, water, salt water, chemicals and air pollutants can cause degradation and premature failure.
- 2.10 Mechanical Loads:** External forces can significantly reduce Hose, Tube and Fitting life or cause failure. Mechanical loads which must be considered include excessive flexing, twist, kinking, tensile or side loads, bend radius, and vibration. Use of swivel type Fittings or adapters may be required to insure no twist is put into the Hose. Use of proper Hose or Tube clamps may also be required to reduce external mechanical loads. Unusual applications may require special testing prior to Hose selection.
- 2.11 Physical Damage:** Care must be taken to protect Hose from wear, snagging, kinking, bending smaller than minimum bend radius and cutting, any of which can cause premature Hose failure. Any Hose that has been kinked or bent to a radius smaller than the minimum bend radius, and any Hose that has been cut or is cracked or is otherwise damaged should be removed and discarded. Fittings with damages such as scratches on sealing surfaces and deformation should be replaced.
- 2.12 Proper End Fitting:** See instructions 3.2 through 3.5. These recommendations may be substantiated by testing to industry standards such as SAE J517 for hydraulic applications, or MIL-A-5070, AS1339, or AS3517 for Hoses from Parker's Stratoflex Products Division for aerospace applications.
- 2.13 Length:** When determining the proper Hose or Tube length of an assembly, be aware of Hose length change due to pressure, Tube length change due to thermal expansion or contraction, and Hose or Tube and machine tolerances and movement must be considered. When routing short hose assemblies, it is recommended that the minimum free hose length is always used. Consult the hose manufacturer for their minimum free hose length recommendations. Hose assemblies should be installed in such a way that any motion or flexing occurs within the same plane.
- 2.14 Specifications and Standards:** When selecting Hose, Tube and Fittings, government, industry, and Parker specifications and recommendations must be reviewed and followed as applicable.
- 2.15 Hose Cleanliness:** Hose and Tube components may vary in cleanliness levels. Care must be taken to insure that the Hose and Tube Assembly selected has an adequate level of cleanliness for the application.
- 2.16 Fire Resistant Fluids:** Some fire resistant fluids that are to be conveyed by Hose or Tube require use of the same type of Hose or Tube as used with petroleum base fluids. Some such fluids require a special Hose, Tube, Fitting and Seal, while a few fluids will not work with any Hose at all. See instructions 2.5 and 1.5. The wrong Hose, Tube, Fitting or Seal may fail after a very short service. In addition, all liquids but pure water may burn fiercely under certain conditions, and even pure water leakage may be hazardous.

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- 2.17 Radiant Heat:** Hose and Seals can be heated to destruction without contact by such nearby items as hot manifolds or molten metal. The same heat source may then initiate a fire. This can occur despite the presence of cool air around the Hose or Seal. Performance of Tube and Fitting subjected to the heat could be degraded.
- 2.18 Welding or Brazing:** When using a torch or arc welder in close proximity to hydraulic lines, the hydraulic lines should be removed or shielded with appropriate fire resistant materials. Flame or weld spatter could burn through the Hose or Seal and possibly ignite escaping fluid resulting in a catastrophic failure. Heating of plated parts, including Hose Fittings and adapters, above 450°F (232°C) such as during welding, brazing or soldering may emit deadly gases. Any elastomer seal on fittings shall be removed prior to welding or brazing, any metallic surfaces shall be protected after brazing or welding when necessary. Welding and brazing filler material shall be compatible with the Tube and Fitting that are joined.
- 2.19 Atomic Radiation:** Atomic radiation affects all materials used in Hose and Tube assemblies. Since the long-term effects may be unknown, do not expose Hose or Tube assemblies to atomic radiation. Nuclear applications may require special Tube and Fittings.
- 2.20 Aerospace Applications:** The only Hose, Tube and Fittings that may be used for in-flight aerospace applications are those available from Parker's Stratoflex Products Division. Do not use any other Hose or Fittings for in-flight applications. Do not use any Hose or Fittings from Parker's Stratoflex Products Division with any other Hose or Fittings, unless expressly approved in writing by the engineering manager or chief engineer of Stratoflex Products Division and verified by the user's own testing and inspection to aerospace industry standards.
- 2.21 Unlocking Couplings:** Ball locking couplings or other Fittings with quick disconnect ability can unintentionally disconnect if they are dragged over obstructions, or if the sleeve or other disconnect member, is bumped or moved enough to cause disconnect. Threaded Fittings should be considered where there is a potential for accidental uncoupling.
- 3.0 HOSE AND FITTINGS ASSEMBLY AND INSTALLATION INSTRUCTIONS**
- 3.1 Component Inspection:** Prior to assembly, a careful examination of the Hose and Fittings must be performed. All components must be checked for correct style, size, catalog number, and length. The Hose must be examined for cleanliness, obstructions, blisters, cover looseness, kinks, cracks, cuts or any other visible defects. Inspect the Fitting and sealing surfaces for burrs, nicks, corrosion or other imperfections. Do NOT use any component that displays any signs of nonconformance.
- 3.2 Hose and Fitting Assembly:** Do not assemble a Parker Fitting on a Parker Hose that is not specifically listed by Parker for that Fitting, unless authorized in writing by the engineering manager or chief engineer of the appropriate Parker division. Do not assemble a Parker Fitting on another manufacturer's Hose or a Parker Hose on another manufacturer's Fitting unless (i) the engineering manager or chief engineer of the appropriate Parker division approves the Assembly in writing or that combination is expressly approved in the appropriate Parker literature for the specific Parker product, and (ii) the user verifies the Assembly and the application through analysis and testing. For Parker Hose that does not specify a Parker Fitting, the user is solely responsible for the selection of the proper Fitting and Hose Assembly procedures. See instruction 1.4.
- To prevent the possibility of problems such as leakage at the Fitting or system contamination, it is important to completely remove all debris from the cutting operation before installation of the Fittings. The Parker published instructions must be followed for assembling the Fittings on the Hose. These instructions are provided in the Parker Fitting catalog for the specific Parker Fitting being used, or by calling 1-800-CPARKER, or at www.parker.com.
- 3.3 Related Accessories:** Do not crimp or swage any Parker Hose or Fitting with anything but the listed swage or crimp machine and dies in accordance with Parker published instructions. Do not crimp or swage another manufacturer's Fitting with a Parker crimp or swage die unless authorized in writing by the engineering manager or chief engineer of the appropriate Parker division.
- 3.4 Parts:** Do not use any Parker Fitting part (including but not limited to socket, shell, nipple, or insert) except with the correct Parker mating parts, in accordance with Parker published instructions, unless authorized in writing by the engineering manager or chief engineer of the appropriate Parker division.
- 3.5 Field Attachable/Permanent:** Do not reuse any field attachable Hose Fitting that has blown or pulled off a Hose. Do not reuse a Parker permanent Hose Fitting (crimped or swaged) or any part thereof. Complete Hose Assemblies may only be reused after proper inspection under section 4.0. Do not assemble Fittings to any previously used hydraulic Hose that was in service, for use in a fluid power application.
- 3.6 Pre-Installation Inspection:** Prior to installation, a careful examination of the Hose Assembly must be performed. Inspect the Hose Assembly for any damage or defects. DO NOT use any Hose Assembly that displays any signs of nonconformance.
- 3.7 Minimum Bend Radius:** Installation of a Hose at less than the minimum listed bend radius may significantly reduce the Hose life. Particular attention must be given to preclude sharp bending at the Hose to Fitting juncture. Any bending during installation at less than the minimum bend radius must be avoided. If any Hose is kinked during installation, the Hose must be discarded.
- 3.8 Twist Angle and Orientation:** Hose Assembly installation must be such that relative motion of machine components does not produce twisting.
- 3.9 Securement:** In many applications, it may be necessary to restrain, protect, or guide the Hose to protect it from damage by unnecessary flexing, pressure surges, and contact with other mechanical components. Care must be taken to insure such restraints do not introduce additional stress or wear points.
- 3.10 Proper Connection of Ports:** Proper physical installation of the Hose Assembly requires a correctly installed port connection insuring that no twist or torque is transferred to the Hose when the Fittings are being tightened or otherwise during use.
- 3.11 External Damage:** Proper installation is not complete without insuring that tensile loads, side loads, kinking, flattening, potential abrasion, thread damage or damage to sealing surfaces are corrected or eliminated. See instruction 2.10.
- 3.12 System Checkout:** All air entrapment must be eliminated and the system pressurized to the maximum system pressure (at or below the Hose maximum working pressure) and checked for proper function and freedom from leaks. Personnel must stay out of potential hazardous areas while testing and using.
- 3.13 Routing:** The Hose Assembly should be routed in such a manner so if a failure does occur, the escaping media will not cause personal injury or property damage. In addition, if fluid media comes in contact with hot surfaces, open flame or sparks, a fire or explosion may occur. See section 2.4.
- 3.14 Ground Fault Equipment Protection Devices (GFEPDs): WARNING! Fire and Shock Hazard.** To minimize the danger of fire if the heating cable of a Multitube bundle is damaged or improperly installed, use a Ground Fault Equipment Protection Device. Electrical fault currents may be insufficient to trip a conventional circuit breaker.
- For ground fault protection, the IEEE 515:** (www.ansi.org) standard for heating cables recommends the use of GFEPDs with a nominal 30 milliampere trip level for "piping systems in classified areas, those areas requiring a high degree of maintenance, or which may be exposed to physical abuse or corrosive atmospheres".
- 4.0 TUBE AND FITTINGS ASSEMBLY AND INSTALLATION INSTRUCTIONS**
- 4.1 Component Inspection:** Prior to assembly, a careful examination of the Tube and Fittings must be performed. All components must be checked for correct style, size, material, seal, and length. Inspect the Fitting and sealing surfaces for burrs, nicks, corrosion, missing seal or other imperfections. Do NOT use any component that displays any signs of nonconformance.
- 4.2 Tube and Fitting Assembly:** Do not assemble a Parker Fitting with a Tube that is not specifically listed by Parker for that Fitting, unless authorized in writing by the engineering manager or chief engineer of the appropriate Parker division. The Tube must meet the requirements specified to the Fitting.
- The Parker published instructions must be followed for assembling the Fittings to a Tube. These instructions are provided in the Parker Fitting catalog for the specific Parker Fitting being used, or by calling 1-800-CPARKER, or at www.parker.com.
- 4.3 Related Accessories:** Do not preset or flange Parker Fitting components using another manufacturer's equipment or procedures unless authorized in writing by the engineering manager or chief engineer of the appropriate Parker division. Tube, Fitting component and tooling must be checked for correct style, size and material. Operation and maintenance of Related Accessories must be in accordance with the operation manual for the designated Accessory.
- 4.4 Securement:** In many applications, it may be necessary to restrain, protect, or guide the Tube to protect it from damage by unnecessary flexing, pressure surges, vibration, and contact with other mechanical components. Care must be taken to insure such restraints do not introduce additional stress or wear points.

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- 4.5 Proper Connection of Ports:** Proper physical installation of the Tube Assembly requires a correctly installed port connection insuring that no torque is transferred to the Tube when the Fittings are being tightened or otherwise during use.
- 4.6 External Damage:** Proper installation is not complete without insuring that tensile loads, side loads, flattening, potential abrasion, thread damage or damage to sealing surfaces are corrected or eliminated. See instruction 2.10.
- 4.7 System Checkout:** All air entrapment must be eliminated and the system pressurized to the maximum system pressure (at or below the Tube Assembly maximum working pressure) and checked for proper function and freedom from leaks. Personnel must stay out of potential hazardous areas while testing and using.
- 4.8 Routing:** The Tube Assembly should be routed in such a manner so if a failure does occur, the escaping media will not cause personal injury or property damage. In addition, if fluid media comes in contact with hot surfaces, open flame or sparks, a fire or explosion may occur. See section 2.4.
- 5.0 HOSE AND FITTING MAINTENANCE AND REPLACEMENT INSTRUCTIONS**
- 5.1** Even with proper selection and installation, Hose life may be significantly reduced without a continuing maintenance program. The severity of the application, risk potential from a possible Hose failure, and experience with any Hose failures in the application or in similar applications should determine the frequency of the inspection and the replacement for the Products so that Products are replaced before any failure occurs. Certain products require maintenance and inspection per industry requirements. Failure to adhere to these requirements may lead to premature failure. A maintenance program must be established and followed by the user and, at minimum, must include instructions 5.2 through 5.7
- 5.2 Visual Inspection Hose/Fitting:** Any of the following conditions require immediate shut down and replacement of the Hose Assembly:
 - Fitting slippage on Hose;
 - Damaged, cracked, cut or abraded cover (any reinforcement exposed);
 - Hard, stiff, heat cracked, or charred Hose;
 - Cracked, damaged, or badly corroded Fittings;
 - Leaks at Fitting or in Hose;
 - Kinked, crushed, flattened or twisted Hose; and
 - Blistered, soft, degraded, or loose cover.
- 5.3 Visual Inspection All Other:** The following items must be tightened, repaired, corrected or replaced as required:
 - Leaking port conditions;
 - Excess dirt buildup;/
 - Worn clamps, guards or shields; and
 - System fluid level, fluid type, and any air entrapment.
- 5.4 Functional Test:** Operate the system at maximum operating pressure and check for possible malfunctions and leaks. Personnel must avoid potential hazardous areas while testing and using the system. See section 2.2.
- 5.5 Replacement Intervals:** Hose assemblies and elastomeric seals used on Hose Fittings and adapters will eventually age, harden, wear and deteriorate under thermal cycling and compression set. Hose Assemblies and elastomeric seals should be inspected and replaced at specific replacement intervals, based on previous service life, government or industry recommendations, or when failures could result in unacceptable downtime, damage, or injury risk. See section 1.2. Hose and Fittings may be subjected to internal mechanical and/or chemical wear from the conveying fluid and may fail without warning. The user must determine the product life under such circumstances by testing. Also see section 2.5.
- 5.6 Hose Inspection and Failure:** Hydraulic power is accomplished by utilizing high pressure fluids to transfer energy and do work. Hoses, Fittings and Hose Assemblies all contribute to this by transmitting fluids at high pressures. Fluids under pressure can be dangerous and potentially lethal and, therefore, extreme caution must be exercised when working with fluids under pressure and handling the Hoses transporting the fluids. From time to time, Hose

Assemblies will fail if they are not replaced at proper time intervals. Usually these failures are the result of some form of misapplication, abuse, wear or failure to perform proper maintenance. When Hoses fail, generally the high pressure fluids inside escape in a stream which may or may not be visible to the user. Under no circumstances should the user attempt to locate the leak by "feeling" with their hands or any other part of their body. High pressure fluids can and will penetrate the skin and cause severe tissue damage and possibly loss of limb. Even seemingly minor hydraulic fluid injection injuries must be treated immediately by a physician with knowledge of the tissue damaging properties of hydraulic fluid.

If a Hose failure occurs, immediately shut down the equipment and leave the area until pressure has been completely released from the Hose Assembly. Simply shutting down the hydraulic pump may or may not eliminate the pressure in the Hose Assembly. Many times check valves, etc., are employed in a system and can cause pressure to remain in a Hose Assembly even when pumps or equipment are not operating. Tiny holes in the Hose, commonly known as pinholes, can eject small, dangerously powerful but hard to see streams of hydraulic fluid. It may take several minutes or even hours for the pressure to be relieved so that the Hose Assembly may be examined safely.

Once the pressure has been reduced to zero, the Hose Assembly may be taken off the equipment and examined. It must always be replaced if a failure has occurred. Never attempt to patch or repair a Hose Assembly that has failed. Consult the nearest Parker distributor or the appropriate Parker division for Hose Assembly replacement information.

Never touch or examine a failed Hose Assembly unless it is obvious that the Hose no longer contains fluid under pressure. The high pressure fluid is extremely dangerous and can cause serious and potentially fatal injury.

- 5.7 Elastomeric seals:** Elastomeric seals will eventually age, harden, wear and deteriorate under thermal cycling and compression set. Elastomeric seals should be inspected and replaced.
- 5.8 Refrigerant gases:** Special care should be taken when working with refrigeration systems. Sudden escape of refrigerant gases can cause blindness if the escaping gases contact the eye and can cause freezing or other severe injuries if it contacts any other portion of the body.
- 5.9 Compressed natural gas (CNG):** Parker CNG Hose Assemblies should be tested after installation and before use, and at least on a monthly basis per instructions provided on the Hose Assembly tag. The recommended procedure is to pressurize the Hose and check for leaks and to visually inspect the Hose for damage and to perform an electrical resistance test.
 - Caution:** Matches, candles, open flame or other sources of ignition shall not be used for Hose inspection. Leak check solutions should be rinsed off after use.
- 6.0 HOSE STORAGE**
- 6.1 Age Control:** Hose and Hose Assemblies must be stored in a manner that facilitates age control and first-in and first-out usage based on manufacturing date of the Hose and Hose Assemblies. Unless otherwise specified by the manufacturer or defined by local laws and regulations:
 - 6.1.1** The shelf life of rubber hose in bulk form or hose made from two or more materials is 28 quarters (7 years) from the date of manufacture, with an extension of 12 quarters (3 years), if stored in accordance with ISO 2230;
 - 6.1.2** The shelf life of thermoplastic and polytetrafluoroethylene hose is considered to be unlimited;
 - 6.1.3** Hose assemblies that pass visual inspection and proof test shall not be stored for longer than 2 years.
 - 6.1.4 Storage:** Stored Hose and Hose Assemblies must not be subjected to damage that could reduce their expected service life and must be placed in a cool, dark and dry area with the ends capped. Stored Hose and Hose Assemblies must not be exposed to temperature extremes, ozone, oils, corrosive liquids or fumes, solvents, high humidity, rodents, insects, ultraviolet light, electromagnetic fields or radioactive materials.

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Offer of Sale

- Definitions.** As used herein, the following terms have the meanings indicated.

Buyer: means any customer receiving a Quote for Products from Seller.

Goods: means any tangible part, system or component to be supplied by the Seller.

Products: means the Goods, Services and/or Software as described in a Quote provided by the Seller.

Quote: means the offer or proposal made by Seller to Buyer for the supply of Products.

Seller: means Parker-Hannifin Corporation, including all divisions and businesses thereof.

Services: means any services to be supplied by the Seller.

Software: means any software related to the Products, whether embedded or separately downloaded.

Terms: means the terms and conditions of this Offer of Sale or any newer version of the same as published by Seller electronically at www.parker.com/saleterms.
- Terms.** All sales of Products by Seller are contingent upon, and will be governed by, these Terms and, these Terms are incorporated into any Quote provided by Seller to any Buyer. Buyer's order for any Products whether communicated to Seller verbally, in writing, by electronic data interface or other electronic commerce, shall constitute acceptance of these Terms. Seller objects to any contrary or additional terms or conditions of Buyer. Reference in Seller's order acknowledgement to Buyer's purchase order or purchase order number shall in no way constitute an acceptance of any of Buyer's terms of purchase. No modification to these Terms will be binding on Seller unless agreed to in writing and signed by an authorized representative of Seller.
- Price; Payment.** The Products set forth in Seller's Quote are offered for sale at the prices indicated in Seller's Quote. Unless otherwise specifically stated in Seller's Quote, prices are valid for thirty (30) days and do not include any sales, use, or other taxes or duties. Seller reserves the right to modify prices at any time to adjust for any raw material price fluctuations. Unless otherwise specified by Seller, all prices are F.C.A. Seller's facility (INCOTERMS 2010). All sales are contingent upon credit approval and payment for all purchases is due thirty (30) days from the date of invoice (or such date as may be specified in the Quote). Unpaid invoices beyond the specified payment date incur interest at the rate of 1.5% per month or the maximum allowable rate under applicable law.
- Shipment; Delivery; Title and Risk of Loss.** All delivery dates are approximate. Seller is not responsible for damages resulting from any delay. Regardless of the manner of shipment, delivery occurs and title and risk of loss or damage pass to Buyer, upon placement of the Products with the shipment carrier at Seller's facility. Unless otherwise agreed, Seller may exercise its judgment in choosing the carrier and means of delivery. No deferment of shipment at Buyers' request beyond the respective indicated shipping date will be made except on terms that will indemnify, defend and hold Seller harmless against all loss and additional expense. Buyer shall be responsible for any additional shipping charges incurred by Seller due to Buyer's acts or omissions.
- Warranty.** The warranty related to the Products is as follows: (i) Goods are warranted against defects in material or workmanship for a period of twelve (12) months from the date of delivery or 2,000 hours of use, whichever occurs first; (ii) Services shall be performed in accordance with generally accepted practices and using the degree of care and skill that is ordinarily exercised and customary in the field to which the Services pertain and are warranted for a period of six (6) months from the completion of the Services by Seller; and (iii) Software is only warranted to perform in accordance with applicable specifications provided by Seller to Buyer for ninety (90) days from the date of delivery or, when downloaded by a Buyer or end-user, from the date of the initial download. All prices are based upon the exclusive limited warranty stated above, and upon the following disclaimer:
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- Security Interest.** To secure payment of all sums due, Seller retains a security interest in all Products delivered to Buyer and, Buyer's acceptance of these Terms is deemed to be a Security Agreement under the Uniform Commercial Code. Buyer authorizes Seller as its attorney to execute and file on Buyer's behalf all documents Seller deems necessary to perfect its security interest.
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- Use of Products. Indemnity by Buyer.** Buyer shall comply with all instructions, guides and specifications provided by Seller with the Products. **Unauthorized Uses.** If Buyer uses or resells the Products for any uses prohibited in Seller's instructions, guides or specifications, or Buyer otherwise fails to comply with Seller's instructions, guides and specifications, Buyer acknowledges that any such use, resale, or non-compliance is at Buyer's sole risk. Buyer shall indemnify, defend, and hold Seller harmless from any losses, claims, liabilities, damages, lawsuits, judgments and costs (including attorney fees and defense costs), whether for personal injury, property damage, intellectual property infringement or any other claim, brought by or incurred by Buyer, Buyer's employees, or any other person, arising out of: (a) improper selection, application, design, specification or other misuse of Products provided by Seller; (b) any act or omission, negligent or otherwise, of Buyer; (c) Seller's use of patterns, tooling, equipment, plans,

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13. **Cancellations and Changes.** Buyer may not cancel or modify any order for any reason, except with Seller's written consent and upon terms that will indemnify, defend and hold Seller harmless against all direct, incidental and consequential loss or damage. Seller, at any time, may change Product features, specifications, designs and availability.
14. **Limitation on Assignment.** Buyer may not assign its rights or obligations without the prior written consent of Seller.
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16. **Waiver and Severability.** Failure to enforce any provision of these Terms will not invalidate that provision; nor will any such failure prejudice Seller's right to enforce that provision in the future. Invalidation of any provision of these Terms by legislation or other rule of law shall not invalidate any other provision herein and, the remaining provisions will remain in full force and effect.
17. **Termination.** Seller may terminate any agreement governed by or arising from these Terms for any reason and at any time by giving Buyer thirty (30) days prior written notice. Seller may immediately terminate, in writing, if Buyer: (a) breaches any provision of these Terms (b) appoints a trustee, receiver or custodian for all or any part of Buyer's property (c) files a petition for relief in bankruptcy on its own behalf, or one if filed by a third party (d) makes an assignment for the benefit of creditors; or (e) dissolves its business or liquidates all or a majority of its assets.
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19. **Indemnity for Infringement of Intellectual Property Rights.** Seller is not liable for infringement of any patents, trademarks, copyrights, trade dress, trade secrets or similar rights ("Intellectual Property Rights") except as provided in this Section. Seller will defend at its expense and will pay the cost of any settlement or damages awarded in an action brought against Buyer based on a third party claim that one or more of the Products sold hereunder infringes the Intellectual Property Rights of a third party in the country of delivery of the Products by the Seller to the Buyer. Seller's obligation to defend and indemnify Buyer is contingent on Buyer notifying Seller within ten (10) days after Buyer becomes aware of any such claim, and Seller having sole control over the defense of the claim including all negotiations for settlement or compromise. If one or more Products sold hereunder is subject to such a claim, Seller may, at its sole expense and option, procure for Buyer the right to continue using the Products, replace or modify the Products so as to render them non-infringing, or offer to accept return of the Products and refund the purchase price less a reasonable allowance for depreciation. Seller has no obligation or liability for any claim of infringement: (i) arising from information provided by Buyer; or (ii) directed to any Products provided hereunder for which the designs are specified in whole or part by Buyer; or (iii) resulting from the modification, combination or use in a system of any Products provided hereunder. The foregoing provisions of this Section constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for such claims of infringement of Intellectual Property Rights.
20. **Governing Law.** These Terms and the sale and delivery of all Products are deemed to have taken place in, and shall be governed and construed in accordance with, the laws of the State of Ohio, as applicable to contracts executed and wholly performed therein and without regard to conflicts of laws principles. Buyer irrevocably agrees and consents to the exclusive jurisdiction and venue of the courts of Cuyahoga County, Ohio with respect to any dispute, controversy or claim arising out of or relating to the sale and delivery of the Products.
21. **Entire Agreement.** These Terms, along with the terms set forth in the main body of any Quote, forms the entire agreement between the Buyer and Seller and constitutes the final, complete and exclusive expression of the terms of sale. In the event of a conflict between any term set forth in the main body of a Quote and these Terms, the terms set forth in the main body of the Quote shall prevail. All prior or contemporaneous written or oral agreements or negotiations with respect to the subject matter shall have no effect. These Terms may not be modified unless in writing and signed by an authorized representative of Seller.
22. **Compliance with Laws.** Buyer agrees to comply with all applicable laws, regulations, and industry and professional standards, including those of the United States of America, and the country or countries in which Buyer may operate, including without limitation the U.S. Foreign Corrupt Practices Act ("FCPA"), the U.S. Anti-Kickback Act ("Anti-Kickback Act"), U.S. and E.U. export control and sanctions laws ("Export Laws"), the U.S. Food Drug and Cosmetic Act ("FDCA"), and the rules and regulations promulgated by the U.S. Food and Drug Administration ("FDA"), each as currently amended. Buyer agrees to indemnify, defend, and hold harmless Seller from the consequences of any violation of such laws, regulations and standards by Buyer, its employees or agents. Buyer acknowledges that it is familiar with all applicable provisions of the FCPA, the Anti-Kickback Act, Export Laws, the FDCA and the FDA and certifies that Buyer will adhere to the requirements thereof and not take any action that would make Seller violate such requirements. Buyer represents and agrees that Buyer will not make any payment or give anything of value, directly or indirectly, to any governmental official, foreign political party or official thereof, candidate for foreign political office, or commercial entity or person, for any improper purpose, including the purpose of influencing such person to purchase Products or otherwise benefit the business of Seller. Buyer further represents and agrees that it will not receive, use, service, transfer or ship any Product from Seller in a manner or for a purpose that violates Export Laws or would cause Seller to be in violation of Export Laws.

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