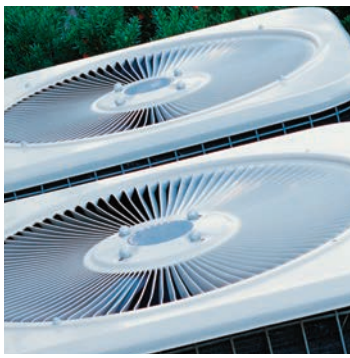
aerospace
climate control
electromechanical
filtration
fluid & gas handling
hydraulics
pneumatics
process control
sealing & shielding

HVAC & Refrigeration Tubing

Flexible Lines and Linesets

Catalog J, October 2015



Parker

ENGINEERING YOUR SUCCESS.

⚠ WARNING

FAILURE OR IMPROPER SELECTION USE OF TUBING, FITTINGS, ASSEMBLIES OR RELATED ACCESSORIES ("PRODUCTS") COULD CAUSE SERIOUS PERSONAL INJURY OR 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
- Accessibility: ZoomLine tubing must remain accessible for visual examination and replacement. Periodic examination is required to verify integrity and ensure proper performance and personnel and property safety.
- Electrocution from high voltage electric powerlines
- Injections by high-pressure liquid discharge
- Dangerously whipping hose
- 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 from flammable liquids

Before selecting or using any of these products, it is important that you read and follow the instructions below. Only hose from Parker's Stratoflex Products Division is approved for in-flight aerospace applications, and no other hose can be used for such in-flight applications.

⚠ WARNING

ACCESSIBILITY REQUIREMENTS: ZoomLine tubing, including end fittings, must remain accessible for visual examination or replacement. Periodic examination is required to verify integrity and ensure proper performance, personnel and property safety. Any visual indications of the following requires replacement:

- Fitting slippage at the tubing ends
- Damaged, cracked, cut or abraded cover (including exposed reinforcement layer)
- Hard, stiff, heat cracked or charred tubing
- Cracked, damaged or badly corroded fittings
- Leaks at fitting or in tubing
- Kinked, crushed, flattened or twisted tubing
- Blistered, soft, degraded or loose cover

Failure to replace ZoomLine could result in serious personal injury or property damage.

⚠WARNING – USER RESPONSIBILITY

Failure or improper selection or improper use of the products described herein or related items could cause serious personal injury or property damage.

This document and other information from Parker Hannifin Corporation, its subsidiaries and authorized distributors provide product or system options for further investigation by users having technical expertise.

The user, through its own analysis and testing, is solely responsible for making the final selection of the system and components and assuring that all performance, endurance, maintenance, safety and warning requirements of the application are met. The user must analyze all aspects of the application, follow applicable industry standards, and follow the information concerning the product in the current product catalog and in any other materials provided from Parker or its subsidiaries or authorized distributors.

To the extent that Parker or its subsidiaries or authorized distributors provide component or system options based upon data or specifications provided by the user, the user is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the components or systems.

Table of Contents

HVAC & Refrigeration Tubing

Flexible Lines and Linesets

Applications

Parker's ZoomLine lineset assemblies are engineered and tested for the following exacting requirements:

- Air Conditioning
- Heat Pump
- Low and Medium Temperature Refrigerating System

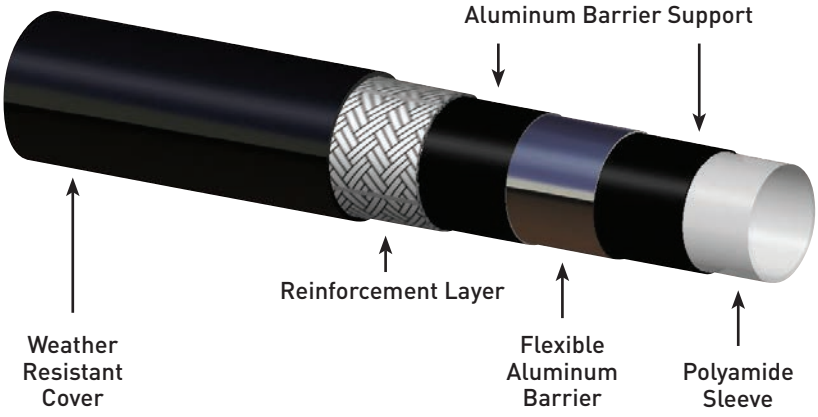
ZoomLine is available in multiple sizes ranging from 3/8" up to 7/8" and at lengths up to 50 ft. with the option of pre-installed foam insulation. Individual or linesets are available in pre-made assemblies in heat sealed bags.

Features and Benefits

The flexible ZoomLine assemblies offer many advantages over rigid tubing including time and cost savings due to:

- Ease of routing and maintenance
- Reduced copper content eliminating expensive metals and theft concerns
- Reduced brazing and rework due to leakage at braze joints
- Reduced tube bending, rework, and scrap
- Reduced parts and inventory by eliminating elbows and couplings. This tubing is designed for permanent installation.

ZoomLine Construction



System benefits include enhanced insulating effect compared to bare copper and reduced vibration transmission which decreases potential tube breakage, making the system more efficient and reliable. For OEM system designers, ZoomLine assemblies are custom configurable with many connection styles, lengths and diameters available for system optimization. Single lines and line-sets are also available in heat-sealed bags with lengths between 5 and 50 ft. along with optional foam insulation.

ZoomLine has been designed to eliminate refrigerant leakage while maintaining flexibility not available with copper tubing. The 6 layer hose is designed to withstand environmental, temperature and pressure extremes while providing excellent installation flexibility and long life.

- **Polyamide Sleeve** is a time tested material that provides compatibility and durability with system fluids.
- The state of the art, patent pending **Flexible Aluminum Barrier** provides the same metal-based worry-free leakage performance as copper tubing.
- **Aluminum Barrier Supports** also act as refrigerant barriers and support the Aluminum Barrier during installation and use.
- **Reinforcement Layer** provides high strength with lower weight than copper tubing.
- **Weather Resistant Cover** ensures long life regardless if installed indoors or outdoors.

The unique couplings connecting ZoomLine assemblies to the system have multiple barriers. Entire assemblies have been rigidly tested using the latest leak detection technologies to ensure no leakage.

ZoomLine is the first flexible line designed to protect the environment and the customer's investment while eliminating the need for expensive and hard to work with copper tubing.

ZoomLine Specifications & Performance

- **Estimated Tonnage Range:** <2 to 10 tons
- **Refrigerants:** R-134a, R-404A, R-407A/C/F, R-410A, R-448A, R-449A, R-450A, R-507 & R-513A
- **Lubricant / Oil:** Polyolester Oil (POE), Mineral Oil (MO), Alkylbenzene (AB), Polyvinyl Ether (PVE) & Polyalkyl Glycol (PAG)
- **Minimum Burst Pressure:** 2100 psi (145 bar) all sizes
- **Maximum Operating Pressure:** 700 psi (48.3 bar)
- **Operating Gas and Ambient Temperature Range:** -25°F to +200°F (-32°C to +93°C)
- **ROHS Compliant**
- **Meets or Exceeds UL and ASTM Specifications:**

  Thermal Cycle: *UL 1963 Section 58.8*

  Refrigerant Exposure: UL 1963-2011 Section 58.3, 58.11

  Fatigue Test: *UL 207 2009 Section 14*

  Crush & Ultraviolet Exposure: *UL 746*

  Flame test: ASTM D635

  Vibration Test: *UL 1963 Section 58.10*

- **Refrigerant Wetted Materials:** Copper, brass, polyamide, HNBR elastomer
- **Environmental / UV Protection:** Optimized outer sleeve; Tubing tested using SAE and ASTM Test Conditions

- **Permeation:** Permeation is the "seepage" of refrigerant molecules through the tubing and is expressed as an annual rate per year per unit length of tubing. ZoomLine is designed with a welded aluminum barrier sleeve that eliminates most refrigerant permeation. Permeation is affected by numerous factors such as refrigerant type, as well as fluid and tubing temperatures and pressures during operation.

  No standard testing method has been developed to rate permeation in HVAC&R systems or components so Parker looked at system and compressor operating envelopes and developed test methods that looked at worst case conditions as well as typical operating conditions. Additionally, a method was developed to estimate the "real" leak rates based on actual system operating cycles (which affects temperature and pressures) in various geographical regions from which a North American average was determined. The table below provides these values by the largest and smallest line sizes:

	OUNCES/YEAR/FOOT OF LENGTH*			
	R-404A		R-410A	
Line Size	Typical	Worst Case	Typical	Worst Case
3/8"	0.001	0.002	0.007	0.03
7/8"	0.003	0.006	0.01	0.04

ZoomLine Tubing Dimensions

Nominal Size	I.D.	Tubing O.D.	Maximum O.D.	Minimal Bend Radius
3/8" (10 mm)	0.33" (8 mm)	0.68" (17 mm)	0.83" (21 mm)	2.72" (69 mm)
1/2" (13 mm)	0.43" (11 mm)	0.81" (21 mm)	0.96" (24 mm)	3.25" (83 mm)
5/8" (16 mm)	0.95" (24 mm)	0.95" (24 mm)	1.10" (28 mm)	3.88" (98 mm)
3/4" (19 mm)	0.69" (18 mm)	1.05" (27 mm)	1.20" (30 mm)	4.20" (107 mm)
7/8" (22 mm)	0.82" (21 mm)	1.25" (32 mm)	1.44" (36 mm)	5.00" (127 mm)

*While the permeation is actually quite small it may be trapped by system cabinetry or tubing installation. This should not show up in standard sensitivity settings.

ZoomLine Pressure Drop

Typical ZoomLine pressure drop is similar to copper tubing pressure drop per unit length. Comparison to published copper line pressure drop indicates that ZoomLine is within 0.5 psi (0.04 bar) for the same length of straight tubing and it is slightly less than copper tubing for lengths longer than 35 feet (10.7 m). ZoomLine actually has a larger tubing ID than standard refrigeration copper grades L and K which is counterbalanced by the termination support tubing restrictions at each end of ZoomLine. It is possible to use established copper tubing information with no change when substituting ZoomLine. It is recommended to follow system manufacturer's guidelines and recommendations for line sizing and configuration.

It is possible to use the information in the Sporlan Product Selection software to estimate ZoomLine pressure drop for specific system conditions. This software is available at www.sporlanonline.com. Alternately, Sporlan Form 5-162 provides standard condition information. Or consult with Sporlan Technical Service at 636-239-1111.

Suction Line Pressure Drop

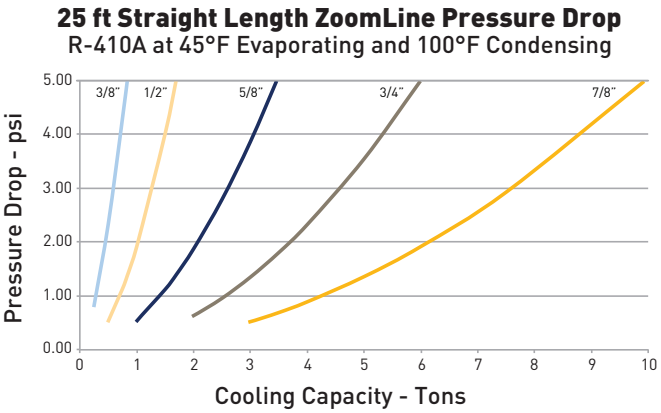


Figure 1, Example Suction Line Pressure Drop - IP Units

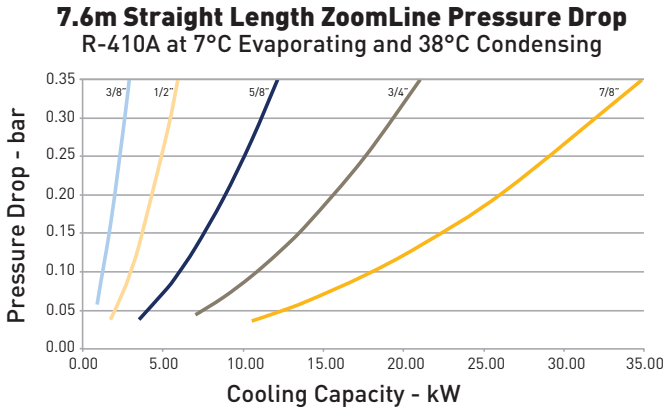


Figure 2, Example Suction Line Pressure Drop - SI Units

Hot Gas Pressure Drop

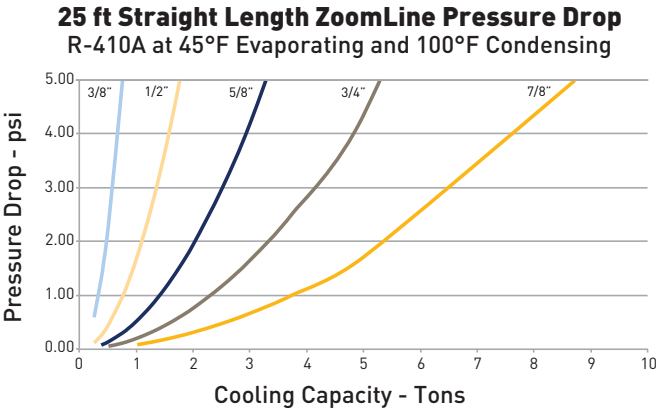


Figure 3, Example Hot Gas Pressure Drop - IP Units

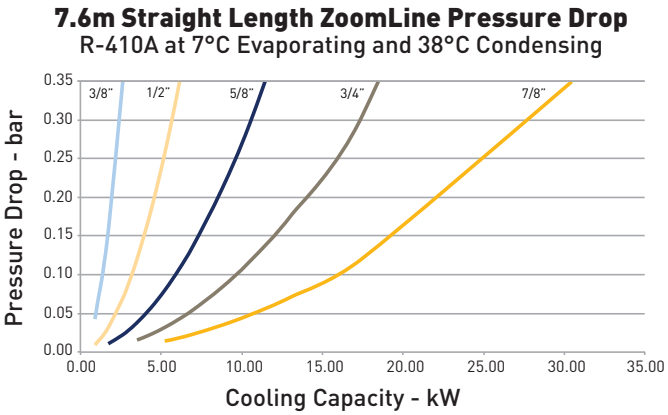


Figure 4, Example Hot Gas Pressure Drop - SI Units

Note: Straight line data provided with no bends which add pressure drop.

Liquid Line Pressure Drop

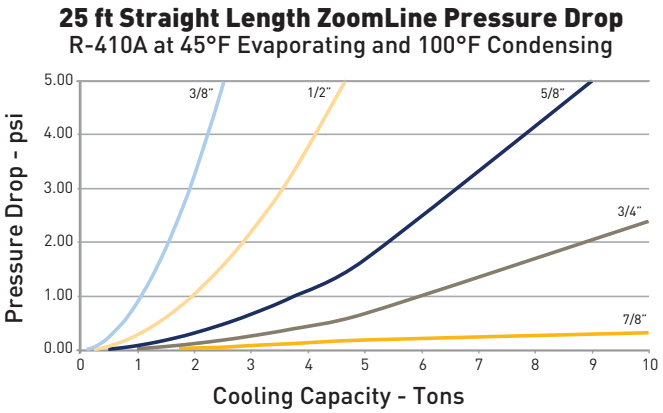


Figure 5, Example Liquid Line Pressure Drop - IP Units

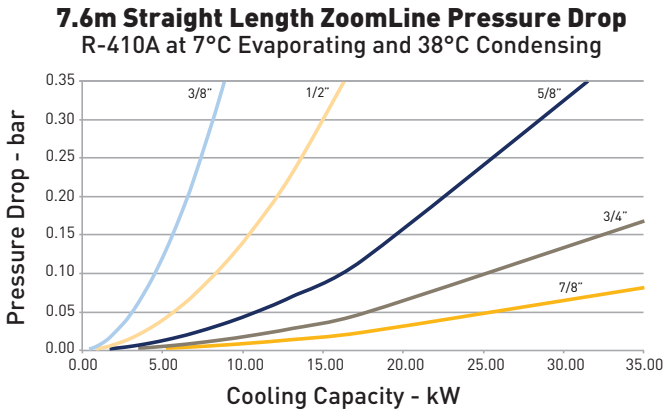


Figure 6, Example Liquid Line Pressure Drop - SI Units

Custom OEM Assemblies

Available using a variety of terminations including copper and quick couplings.

ODF Copper
Sweat connection to copper tubing
Size Range: 1/4" to 7/8"

5500 Series Brass Couplings
Pre-chargeable self-sealing and resealing connector
Size Range: 3/8" to 1-1/8"

5400 Series Steel Couplings
Self-sealing and resealing connector
Size Range: 1/4" to 1-3/8"

5700 Series Brass Couplings
One Shot™ pre-chargeable connector
Size Range: 3/8" to 1-1/8"

For more information on Parker's Series Couplings refer to Catalog OEM-1.
*Custom bent copper connectors and mechanical connections available upon request.

Note: Straight line data provided with no bends which add pressure drop.

ZoomLine Standard ODM Individual Tubing Models

Parker Model Description	Line Size ft (mm)	Length ft (m)	Insulation Thickness	Weight (lbs)
ZL-L-6-3-00-01	3/8" (10mm)	3 (0.9)	None	0.7
ZL-L-6-5-00-01	3/8" (10mm)	5 (1.5)	None	1.0
ZL-L-6-15-00-01	3/8" (10mm)	15 (4.6)	None	2.4
ZL-L-6-25-00-01	3/8" (10mm)	25 (7.6)	None	3.7
ZL-L-6-35-00-01	3/8" (10mm)	35 (10.7)	None	5.1
ZL-L-6-40-00-01	3/8" (10mm)	40 (12.2)	None	5.8
ZL-L-6-50-00-01	3/8" (10mm)	50 (15.2)	None	7.2
ZL-L-8-3-00-01	1/2" (13mm)	3 (0.9)	None	1.0
ZL-L-8-5-00-01	1/2" (13mm)	5 (1.5)	None	1.3
ZL-L-8-15-00-01	1/2" (13mm)	15 (4.6)	None	3.1
ZL-L-8-25-00-01	1/2" (13mm)	25 (7.6)	None	4.9
ZL-L-8-35-00-01	1/2" (13mm)	35 (10.7)	None	6.7
ZL-L-8-40-00-01	1/2" (13mm)	40 (12.2)	None	7.6
ZL-L-8-50-00-01	1/2" (13mm)	50 (15.2)	None	9.4
ZL-L-10-3-00-01	5/8" (16mm)	3 (0.9)	None	1.3
ZL-L-10-5-00-01	5/8" (16mm)	5 (1.5)	None	1.8
ZL-L-10-15-00-01	5/8" (16mm)	15 (4.6)	None	4.1
ZL-L-10-25-00-01	5/8" (16mm)	25 (7.6)	None	6.4
ZL-L-10-35-00-01	5/8" (16mm)	35 (10.7)	None	8.7
ZL-L-10-40-00-01	5/8" (16mm)	40 (12.2)	None	9.9
ZL-L-10-50-00-01	5/8" (16mm)	50 (15.2)	None	12.2
ZL-L-12-3-00-01	3/4" (19mm)	3 (0.9)	None	1.8
ZL-L-12-5-00-01	3/4" (19mm)	5 (1.5)	None	2.4
ZL-L-12-15-00-01	3/4" (19mm)	15 (4.6)	None	5.4
ZL-L-12-25-00-01	3/4" (19mm)	25 (7.6)	None	8.4
ZL-L-12-35-00-01	3/4" (19mm)	35 (10.7)	None	11.4
ZL-L-12-40-00-01	3/4" (19mm)	40 (12.2)	None	12.9
ZL-L-12-50-00-01	3/4" (19mm)	50 (15.2)	None	15.9
ZL-L-14-3-00-01	7/8" (22mm)	3 (0.9)	None	2.5
ZL-L-14-5-00-01	7/8" (22mm)	5 (1.5)	None	3.2
ZL-L-14-15-00-01	7/8" (22mm)	15 (4.6)	None	6.5
ZL-L-14-25-00-01	7/8" (22mm)	25 (7.6)	None	9.8
ZL-L-14-35-00-01	7/8" (22mm)	35 (10.7)	None	13.2
ZL-L-14-40-00-01	7/8" (22mm)	40 (12.2)	None	14.8
ZL-L-14-50-00-01	7/8" (22mm)	50 (15.2)	None	18.2

ZoomLine General Installation Instructions

1.0 GENERAL INSTRUCTIONS

1.1 **Scope:** This safety guide provides instructions for selecting and using (including assembling, installing and maintaining) the ZoomLine product.

1.2 **Fail-Safe:** ZoomLine can fail without warning for many reasons. Design all systems and equipment in a manner so that failure of the ZoomLine assembly will not endanger persons or property.

1.3 **User Responsibility:** Due to the wide variety of operating conditions and applications Parker does not represent or warrant that any particular ZoomLine assembly is suitable for any specific end use system. This 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 the user requirements are met and the application presents no health or safety hazards
- Assuring compliance with all applicable government and industry standards

2.0 ZOOMLINE SELECTION & INSTALLATION INSTRUCTIONS

2.1 **Accessibility Requirements:** ZoomLine tubing, including end fittings must remain accessible for visual examination or replacement. Periodic examination is required to verify integrity and ensure proper performance, personnel and property safety. Any visual indications of the following requires replacement:

- Fitting slippage at the tubing ends
- Damaged, cracked, cut or abraded cover (including exposed reinforcement layer)
- Hard, stiff, heat cracked or charred tubing
- Cracked, damaged or badly corroded fittings
- Leaks at fitting or in tubing
- Kinked, crushed, flattened or twisted tubing
- Blistered, soft, degraded or loose cover

2.2 **Sizing:** Size ZoomLine in accordance with system manufacturer's guidelines. For field designed/built systems follow existing copper line sizing guidelines.

2.3 **Minimum Bend Radius:** Installation of ZoomLine at less than the minimum listed bend radius may significantly reduce the product life and restrict flow. Particular attention must be given to avoid sharp bending at the coupling / connection ends.

2.4 **Copper Stub Ends: Do not cut the copper stub ends shorter.** These were selected to be the proper length to prevent overheating of the ZoomLine end couplings during wet-rag brazing.

2.5 **Brazing Copper Stubs: When using a torch, wet ragging must be used.** Improper wet ragging could result in overheating the ZoomLine end fittings above 450°F (232°C) causing damage and emission of deadly gases.

ZoomLine Tubing Dimensions

Nominal Size	I.D.	Tubing O.D.	Maximum O.D.	Minimal Bend Radius
3/8" (10 mm)	0.33" (8 mm)	0.68" (17 mm)	0.83" (21 mm)	2.72" (69 mm)
1/2" (13 mm)	0.43" (11 mm)	0.81" (21 mm)	0.96" (24 mm)	3.25" (83 mm)
5/8" (16 mm)	0.95" (24 mm)	0.95" (24 mm)	1.10" (28 mm)	3.88" (98 mm)
3/4" (19 mm)	0.69" (18 mm)	1.05" (27 mm)	1.20" (30 mm)	4.20" (107 mm)
7/8" (22 mm)	0.82" (21 mm)	1.25" (32 mm)	1.44" (36 mm)	5.00" (127 mm)

2.6 **Brazing Technique:**

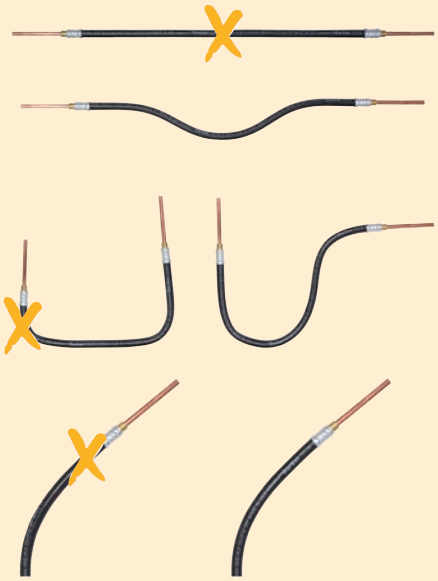
1. Fittings are clean and ready to braze as received. Avoid excessive polishing with steel wool since this may rub off the copper plating on models with plated steel fittings, making brazing more difficult.
2. Nitrogen flow should direct heat away from ZoomLine flexible tubing.
3. Use a torch that is large enough to rapidly heat the line size being used.
4. Direct the flame away from the ZoomLine tubing.
5. Perform the brazing as rapidly as possible.

2.7 **Electrical Conductivity:** ZoomLine is not conductive. Ensure no electricity is applied to the product to avoid potential electrical sparking or arcing and product, property, or personnel damage or injury.

2.8 **Pressure:** After determining the system pressure, ZoomLine selection must be made so the recommended maximum operating pressure on the label is equal or greater than the maximum system pressure. Surge pressures or peak transient pressures in the system must be below the published maximum working pressure for the tubing. Surge pressures and peak pressures can usually only be determined by sensitive electrical instrumentation that measures and indicates pressures at millisecond time intervals. Mechanical pressure gauges indicate only average pressures. Published burst pressure ratings for ZoomLine are for manufacturing test purposes only and are no indication that the product can be used in applications at the burst pressure or otherwise above the maximum recommended working pressure. Continuous use at maximum temperatures together with maximum pressures should always be avoided.

2.9 **Suction and Liquid Line Use:** ZoomLine is approved for all HVAC suction line and liquid line use as long as the system working pressures and temperatures are equal or less than the ZoomLine working pressure and temperature.

Figure 7



Provide sufficient slack for expansion and contraction, since ZoomLine may change in length under the surge of high pressure.

ZoomLine should not be bent close to the fitting. Approximately 2 in. (51 mm) of straight tubing is necessary to prevent damage. The minimum bend radius must not be exceeded to avoid kinking of the tubing and flow restriction.

Install ZoomLine without twist. ZoomLine is weakened when installed twisted. Pressure pulses in twisted tubing may cause abnormal fatigue and loosen fitting connections.

2.10 **Discharge Line Limitation:** ZoomLine is approved for use on heat pump gas lines (i.e. suction in cooling mode/discharge in heating mode). **ZoomLine cannot be attached to the compressor discharge.** A high risk exists for exceeding the ZoomLine maximum temperature rating if a compressor fails or has abnormal operation.

2.11 **Temperature:** Be certain that fluid and ambient temperatures, both steady and transient, do not exceed the limitations found on page 5. Temperatures below and above the recommended limits can degrade the product to a point where a failure may occur and release refrigerant. Special care must be taken when routing near hot manifolds or other hot surfaces. Continuous use at or near the maximum temperature rating will cause deterioration of physical properties of ZoomLine and reduce the service life.

2.12 **Insulation:** Although ZoomLine has natural insulating advantages to copper, it is still recommended to use ZoomLine with insulation.

2.13 **Refrigerant and Oil Compatibility:** ZoomLine is designed to be used with the refrigerant/oil combinations defined in the specifications.

2.14 **Permeation:** Permeation (that is, seepage through the tubing material) will occur from the inside to the outside. ZoomLine has been designed such that permeation is negligible and cannot be reliably measured even using Helium mass spectrometry methods.

2.15 **Moisture Ingression:** All ZoomLine products are dehydrated before shipping, capped and placed in a heat-sealed bag to prevent moisture absorption. Take care to keep the shipping caps on the copper stubs when not in use.

2.16 **Routing and Support:** Attention must be given to optimum routing to minimize inherent problems (kinking, twisting or flow restrictions due to tubing collapse, proximity to hot objects or heat sources). Satisfactory performance and appearance depend upon proper tubing installation. Excessive length between supports, exceeding minimum bend radius or allowing inadequate room for flexing will shorten the life of the line. Supports should be places within 6 in. (152.4 mm) of the metal terminations to ensure no side loading occurs. Supports should be placed as required to facilitate and hold bends. Support ZoomLine every 10 ft. (3 m) as a minimum or more frequently if building code requires it. ZoomLine should not be pulled tight as this may cause an undue stress at the terminations. Allow a slight sag between support clamps to enable expansion and contraction. See Figure 7 for diagrams offering suggestions for proper tubing installations. There are many available support methods and parts available commercially or can be created at the job site. It is recommended to use a support that is at least 1 in. (25.4 mm) wide and without sharp edges.

2.17 **Length:** When establishing proper length, motion absorption, line length changes due to pressure, as well as tubing and machine tolerances must be considered. Determine ZoomLine lengths and configurations that will result in the proper routing and protection from abrasion, snagging or kinking. In many applications, it may be necessary to restrain, protect or guide ZoomLine to protect it from damage by unnecessary flexing, pressure surges or contact with other mechanical components.

2.18 **Restraints:** Care must be taken to ensure restraints do

not introduce additional stress or wear points. Straps with widths of at least 1 inch (25 mm) is recommend ed to provide adequate support. Follow system manufacturer's recommendations.

2.18 **Environment:** ZoomLine has been designed to be resistant to typical materials and environmental conditions for indoor and outdoor use. This includes traditional cleaning products, ozone, UV, rain, etc.

2.19 **Mechanical Loads:** External forces can significantly reduce ZoomLine life or cause failure. Mechanical loads which must be considered include flexing, twist, kinking, tensile or side loads, bend radius, and vibration. Unusual applications may require special testing prior to ZoomLine product selection.

2.20 **Physical Damage:** Care must be taken to protect ZoomLine from wear, snagging, kinking, bending smaller than the minimum bend radius and cutting, any of which can cause premature failure. Any ZoomLine that has been kinked or bent to a radius smaller than the minimum bend radius should be removed and discarded.

2.21 **ZoomLine Cleanliness:** Components may vary in cleanliness levels. Care must be taken to ensure the ZoomLine product has an adequate level of cleanliness for the application.

2.22 **Radiant Heat:** The ZoomLine product 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 product.

2.23 **Visual Inspection of Tubing/Fitting:** As good practice, check before and after installation and periodically for external damage such as severe abrasion, holes, tensile loads, side loads, kinking, and flattening. Periodic examination is required to verify integrity and ensure proper performance and personnel and property safety. Any of the following conditions require immediate shut down and replacement of ZoomLine:

- Fitting slippage at the tubing ends;
- Damaged, cracked, cut or abraded cover (any reinforcement exposed);
- Hard, stiff, heat cracked, or charred tubing;
- Cracked, damaged, or badly corroded fittings;
- Leaks at fitting or in tubing;
- Kinked, crushed, flattened or twisted tubing; and
- Blistered, soft, degraded, or loose cover.

2.24 **Repair:** ZoomLine is currently not repairable and the entire line will need to be replaced. It is not approved for any field crimp repair or patching.

2.24 **Storage:** Parker recommends keeping the ZoomLine product contained in its heatsealed bag with the caps on the ends of the copper stubs. It is recommended that all ZoomLine assemblies at a minimum be inspected and retested before use after 2 years. Stored ZoomLine 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 product must not be exposed to temperature extremes, ozone, oils, corrosive liquids or fumes, solvents or high humidity.

2.25 **Cold Temperature Flexibility:** ZoomLine becomes less flexible at colder temperatures. It is recommended to maintain ZoomLine warm prior to installation to maximize ease of installation. Do not warm ZoomLine by exposing it to open flames or by direct contact with heat sources above specification temperature. See note 2.11.

OFFER OF SALE

The items described in this document and other documents and descriptions provided by Parker Hannifin Corporation, its subsidiaries and its authorized distributors ("Seller") are hereby offered for sale at prices to be established by Seller. This offer and its acceptance by any customer ("Buyer") shall be governed by all of the following Terms and Conditions. Buyer's order for any item described in its document, when communicated to Seller verbally, or in writing, shall constitute acceptance of this offer. All goods, services or work described will be referred to as "Products".

1. Terms and Conditions. Seller's willingness to offer Products, or accept an order for Products, to or from Buyer is subject to these Terms and Conditions or any newer version of the terms and conditions found on-line at www.parker.com/saleterms/. Seller objects to any contrary or additional terms or conditions of Buyer's order or any other document issued by Buyer.

2. Price Adjustments; Payments. Prices stated on Seller's quote or other documentation offered by Seller are valid for 30 days, and do not include any sales, use, or other taxes unless specifically stated. Unless otherwise specified by Seller, all prices are F.C.A. Seller's facility (INCOTERMS 2010). Payment is subject to credit approval and is due 30 days from the date of invoice or such other term as required by Seller's Credit Department, after which Buyer shall pay interest on any unpaid invoices at the rate of 1.5% per month or the maximum allowable rate under applicable law.

3. Delivery Dates; Title and Risk; Shipment. All delivery dates are approximate and Seller shall not be responsible for any damages resulting from any delay. Regardless of the manner of shipment, title to any products and risk of loss or damage shall pass to Buyer upon placement of the products with the shipment carrier at Seller's facility. Unless otherwise stated, Seller may exercise its judgment in choosing the carrier and means of delivery. No deferment of shipment at Buyers' request beyond the respective dates indicated 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.

4. Warranty. Seller warrants that the Products sold hereunder shall be free from defects in material or workmanship for a period of twelve months from the date of delivery to Buyer or 2,000 hours of normal use, whichever occurs first. The prices charged for Seller's products are based upon the exclusive limited warranty stated above, and upon the following disclaimer: **DISCLAIMER OF WARRANTY: THIS WARRANTY COMPRISES THE SOLE AND ENTIRE WARRANTY PERTAINING TO PRODUCTS PROVIDED HEREUNDER. SELLER DISCLAIMS ALL OTHER WARRANTIES, EXPRESS AND IMPLIED, INCLUDING DESIGN, MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.**

5. Claims; Commencement of Actions. Buyer shall promptly inspect all Products upon delivery. No claims for shortages will be allowed unless reported to the Seller within 10 days of delivery. No other claims against Seller will be allowed unless asserted in writing within 30 days after delivery. Buyer shall notify Seller of any alleged breach of warranty within 30 days after the date the defect is or should have been discovered by Buyer. Any action based upon breach of this agreement or upon any other claim arising out of this sale (other than an action by Seller for an amount due on any invoice) must be commenced within 12 months from the date of the breach without regard to the date breach is discovered.

6. LIMITATION OF LIABILITY. UPON NOTIFICATION, SELLER WILL, AT ITS OPTION, REPAIR OR REPLACE A DEFECTIVE PRODUCT, OR REFUND THE PURCHASE PRICE. **IN NO EVENT SHALL SELLER BE LIABLE TO BUYER FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF, OR AS THE RESULT OF, THE SALE, DELIVERY, NON-DELIVERY, SERVICING, USE OR LOSS OF USE OF THE PRODUCTS OR ANY PART THEREOF, OR FOR ANY CHARGES OR EXPENSES OF ANY NATURE INCURRED WITHOUT SELLER'S WRITTEN CONSENT, EVEN IF SELLER HAS BEEN NEGLIGENT, WHETHER IN CONTRACT, TORT OR OTHER LEGAL THEORY. IN NO EVENT SHALL SELLER'S LIABILITY UNDER ANY CLAIM MADE BY BUYER EXCEED THE PURCHASE PRICE OF THE PRODUCTS.**

7. User Responsibility. The user, through its own analysis and testing, is solely responsible for making the final selection of the system and Product and assuring that all performance, endurance, maintenance, safety and warning requirements of the application are met. The user must analyze all aspects of the application and follow applicable industry standards and Product information. If Seller provides Product or system options, the user is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the Products or systems.

8. Loss to Buyer's Property. Any designs, tools, patterns, materials, drawings, confidential information or equipment furnished by Buyer or any other items which become Buyer's property, will be considered obsolete and may be destroyed by Seller after two consecutive years have elapsed without Buyer ordering the items manufactured using such property. Seller shall not be responsible for any loss or damage to such property while it is in Seller's possession or control.

9. Special Tooling. A tooling charge may be imposed for any special tooling, including without limitation, dies, fixtures, molds and patterns, acquired to manufacture Products. Such special tooling shall be and remain Seller's property notwithstanding payment of any charges by Buyer. In no event will Buyer acquire any interest in apparatus belonging to Seller which is utilized in the manufacture of the Products, even if such apparatus has been specially converted or adapted for such manufacture and notwithstanding any charges paid by Buyer. Unless otherwise agreed, Seller shall have the right to alter, discard or otherwise dispose of any special tooling or other property in its sole discretion at any time.

10. Buyer's Obligation; Rights of Seller. To secure payment of all sums due or otherwise, Seller shall retain a security interest in the goods delivered and this agreement shall be deemed 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.

11. Improper use and Indemnity. Buyer shall indemnify, defend, and hold Seller harmless from any claim, liability, damages, lawsuits, and costs (including attorney fees), whether for personal injury, property damage, patent, trademark or copyright infringement or any other claim, brought by or incurred by Buyer, Buyer's employees, or any other person, arising out of: (a) improper selection, improper application or other misuse of Products purchased by Buyer from Seller; (b) any act or omission, negligent or otherwise, of Buyer; (c) Seller's use of patterns, plans, drawings, or specifications furnished by Buyer to manufacture Product; or (d) Buyer's failure to comply with these terms and conditions. Seller shall not indemnify Buyer under any circumstance except as otherwise provided.

12. Cancellations and Changes. Orders shall not be subject to cancellation or change by Buyer 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 may change product features, specifications, designs and availability with notice to Buyer.

13. Limitation on Assignment. Buyer may not assign its rights or obligations under this agreement without the prior written consent of Seller.

14. Force Majeure. Seller does not assume the risk and shall not be liable for delay or failure to perform any of Seller's obligations by reason of circumstances beyond the reasonable control of Seller (hereinafter "Events of Force Majeure"). Events of Force Majeure shall include without limitation: accidents, strikes or labor disputes, acts of any government or government agency, acts of nature, delays or failures in delivery from carriers or suppliers, shortages of materials, or any other cause beyond Seller's reasonable control.

15. Waiver and Severability. Failure to enforce any provision of this agreement will not waive that provision nor will any such failure prejudice Seller's right to enforce that provision in the future. Invalidation of any provision of this agreement by legislation or other rule of law shall not invalidate any other provision herein. The remaining provisions of this agreement will remain in full force and effect.

16. Termination. Seller may terminate this agreement for any reason and at any time by giving Buyer thirty (30) days written notice of termination. Seller may immediately terminate this agreement, in writing, if Buyer: (a) commits a breach of any provision of this agreement (b) appointments 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 by a third party (d) makes an assignment for the benefit of creditors, or (e) dissolves or liquidates all or a majority of its assets.

17. Governing Law. This agreement and the sale and delivery of all Products hereunder shall be 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 this agreement.

18. Indemnity for Infringement of Intellectual Property Rights. Seller shall have no liability for infringement of any patents, trademarks, copyrights, trade dress, trade secrets or similar rights except as provided in this Section. Seller will defend and indemnify Buyer against allegations of infringement of U.S. patents, U.S. trademarks, copyrights, trade dress and trade secrets ("Intellectual Property Rights"). 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 an allegation that a Product sold pursuant to this Agreement infringes the Intellectual Property Rights of a third party. Seller's obligation to defend and indemnify Buyer is contingent on Buyer notifying Seller within ten (10) days after Buyer becomes aware of such allegations of infringement, and Seller having sole control over the defense of any allegations or actions including all negotiations for settlement or compromise. If a Product is subject to a claim that it infringes the Intellectual Property Rights of a third party, Seller may, at its sole expense and option, procure for Buyer the right to continue using the Product, replace or modify the Product so as to make it noninfringing, or offer to accept return of the Product and return the purchase price less a reasonable allowance for depreciation. Notwithstanding the foregoing, Seller shall have no liability for claims of infringement based on information provided by Buyer, or directed to Products delivered hereunder for which the designs are specified in whole or part by Buyer, or infringements resulting from the modification, combination or use in a system of any Product sold hereunder. The foregoing provisions of this Section shall constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for infringement of Intellectual Property Rights.

19. Entire Agreement. This agreement contains the entire agreement between the Buyer and Seller and constitutes the final, complete and exclusive expression of the terms of sale. All prior or contemporaneous written or oral agreements or negotiations with respect to the subject matter are herein merged.

20. Compliance with Law, U. K. Bribery Act and U.S. Foreign Corrupt Practices Act. Buyer agrees to comply with all applicable laws and regulations, including both those of the United Kingdom and the United States of America, and of the country or countries of the Territory in which Buyer may operate, including without limitation the U. K. Bribery Act, the U.S. Foreign Corrupt Practices Act ("FCPA") and the U.S. Anti-Kickback Act (the "Anti-Kickback Act"), and agrees to indemnify and hold harmless Seller from the consequences of any violation of such provisions by Buyer, its employees or agents. Buyer acknowledges that they are familiar with the provisions of the U. K. Bribery Act, the FCPA and the Anti-Kickback Act, and certifies that Buyer will adhere to the requirements thereof. In particular, Buyer represents and agrees that Buyer shall not make any payment or give anything of value, directly or indirectly to any governmental official, any foreign political party or official thereof, any candidate for foreign political office, or any commercial entity or person, for the purpose of influencing such person to purchase products or otherwise benefit the business of Seller.

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