VOMO Pre-Assembly Bodies

For EO and EO-2 Flareless Metric Tube Fittings

VOMO tools are made of hardened tool-steel, for standard assembly of steel fittings, stainless steel fittings and hose standpipes (BE).

Refer to the EO/EO2 Assembly and Installation section for use information (page R35).

NOTE: It is strongly recommended that a hydraulic tool be used to preset EO and EO-2 fittings in sizes 30S, 35L, 38S and 42L.

Fig. Q93 — VOMO Pre-Assembly Tool

Series	Tube O.D. (mm)	Part No.
LL	4	**VOMO04LLX**
LL	6	**VOMO06LLX**
LL	8	**VOMO08LLX**
LL	10	**VOMO10LLX**
LL	12	**VOMO12LLX**
L	6	**VOMO06LX**
L	8	**VOMO08LX**
L	10	**VOMO10LX**
L	12	**VOMO12LX**
L	15	**VOMO15LX**
L	18	**VOMO18LX**
L	22	**VOMO22LX**
L	28	**VOMO28LX**
L	35	**VOMO35LX**
L	42	**VOMO42LX**
S	6	**VOMO06SX**
S	8	**VOMO08SX**
S	10	**VOMO10SX**
S	12	**VOMO12SX**
S	14	**VOMO14SX**
S	16	**VOMO16SX**
S	20	**VOMO20SX**
S	25	**VOMO25SX**
S	30	**VOMO30SX**
S	38	**VOMO38SX**

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Hyferset

Parker Hydraulic Ferrule Pre-Setting Tool for Ferulok® Fittings and EO/EO-2 Metric Fittings

PORTABLE...EFFICIENT...EASY TO USE

The Hyferset is an efficient, dependable device for pre-setting Parker ferrules on tube of steel and stainless steel. This task is made easy through hydraulic power provided by a hand or electric pump. The equipment is portable, and has an optional sturdy wood carrying case.

In hydraulic pre-setting, little physical strength is required by the operator to set ferrules properly. Although the amount of force needed increases as the ferrule size increases, the pressure can be easily achieved.

This tool accommodates pre-setting dies for tubes ranging in size from 4 through 32 (1/4" through 2" outside diameter) and 6mm to 28mm O.D. metric sizes. The tube, with tube nut and ferrule, is positioned in the die. The hydraulic "push" of the Hyferset pre-sets the ferrule onto the tube — producing a visible ridge of metal, in front of the sleeve bite edge, that can be easily inspected.

Positive Stop Body Dies (For Ferulok Fittings Only)

The positive stop body die design eliminates the need for predetermined relief valve settings, pressure gauges or chart reading. Positive stop feature allows for uniform assemblies to be made on tube from 1/4" thru 2". One set of dies can be used on both steel and stainless steel tube. When used in conjunction with the Ferulok visible bite ferrules, the entire system is the most reliable method available for assembling a fitting to a piece of tube.

See Assembly for pre-setting pressures for EO and EO-2 steel fittings.

You will find instructions for proper use in the 4393-B1 user manual.

Instructional video is available at discover.parker.com/TFDTubeFabEquipment.

Fig. Q94 — Hyferset

Fig. Q95 — Electric Pump

Fig. Q96 — Hand Pump

COMPONENTS REQUIRED

Part Name	Part No.
*Hyferset (basic unit, no accessories)	**611011A**
*Hyferset Adapter	**6 FLO-S**
Gauge "T" Adapter	**6 R6LO-S**
*Hose Assembly	**910004**
Gauge Swivel Adapter	**6 G6L-S**
Pressure Gauge (0 - 10,000 psi)	**900044**
*Hand pump (10,000 psi, 2 speed)	**900086**
Electric pump (10,000 psi, 1/2 HP, 40-125 volt)	**900085**
Nut die set (1/4" to 2" O.D.)	See page Q46
Positive Stop body die (1/4" to 2" O.D.)	See page Q46
Nut Die Set (6mm to 28mm)	See page Q47
Body Die (6mm to 28mm)	See page Q47

* Included in Hyferset Kit

Part Name	Part No.
Hyferset Kit Includes basic unit, hand hydraulic pump, hose assembly, 1 adapter (6 FLO-S), wooden carrying case, and operation manual.	**611049C**

WARNING: This product can expose you to chemicals including Lead and Lead Compounds 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.

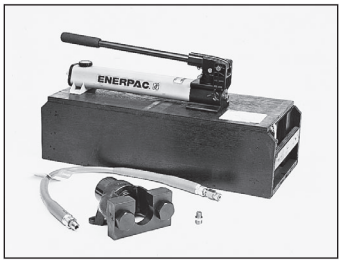

Fig. Q97 — Hyferset Kit

Dimensions and pressures for reference only, subject to change.

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OPTIONAL ACCESSORIES

Part Name	Part No.
Wooden carrying case	651085

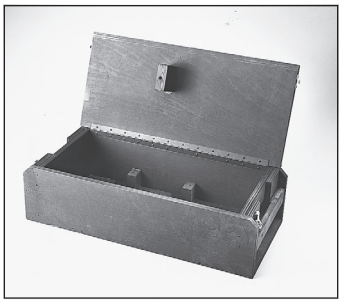

Fig. Q98 — Hyferset Wood Carrying Case

Hyferset Body Dies for Ferulok Fittings

Size	Tube O.D. (in.)	Part No.
4	1/4	720105-4
6	3/8	720105-6
8	1/2	720105-8
10	5/8	720105-10
12	3/4	720105-12
14	7/8	720105-14
16	1	720105-16
20	1 1/4	720105-20
24	1 1/2	720105-24
32	2	720105-32

Fig. Q99 — Body Die

Hyferset Nut Dies for Ferulok Fittings

Size	Tube O.D. (in.)	Part No.
4	1/4	680370-4
6	3/8	680370-6
8	1/2	680370-8
10	5/8	680370-10
12	3/4	680370-12
14	7/8	680370-14
16	1	680370-16
20	1 1/4	680370-20
24	1 1/2	680370-24
32	2	680370-32

Fig. Q100 — Nut Die

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Hyferset Body Dies for EO / EO-2 Fittings

Series	Tube O.D. Size (mm)	Part No.
L	6	910290-6L
L	8	910290-8L
L	10	910290-10L
L	12	910290-12L
L	15	910290-15L
L	18	910290-18L
L	22	910290-22L
L	28	910290-28L
S	6	910289-6S
S	8	910289-8S
S	10	910289-10S
S	12	910289-12S
S	14	910289-14S
S	16	910289-16S
S	20	910289-20S
S	25	910289-25S

Fig. Q101 — Body Die

Hyferset Nut Dies for EO / EO-2 Fittings

Tube O.D. Size (mm)	Part No.
6	910291-6 mm
8	910291-8 mm
10	910291-10 mm
12	910291-12 mm
14	910291-14 mm
15	910291-15 mm
16	910291-16 mm
18	910291-18 mm
20	910291-20 mm
22	910291-22 mm
25	910291-25 mm
28	910291-28 mm

Fig. Q102 — Nut Die

Q

Hydra-Tool

Pre-Setting Components

COMPONENTS REQUIRED

Part Name	Part No.
*Hydra-Tool (basic unit) (Fig. Q102)	**710400B**
Hand pump (10,000 psi, 2 speed)	**900086**
Electric pump (10,000 PSI, 1/2 HP, 40-125 volt)	**900085**
*Hose Assembly	**910004**
Back-up Plate (sizes -4 to -32 and 6mm to 28mm)	**770102**
Back-up Plate (sizes 30 to 42mm)	See page Q49
Ram Insert (sizes -4 to -32)	**770101**
Small Ram Insert (EO & EO-2 only)	**971108**
Large Piston Stop Adapter (EO & EO-2 only)	**971107**
Nut die set (1/4" to 2" O.D.)	See below
Positive Stop body die (1/4" to 2" O.D.)	See below
Nut Die Set (6mm to 42mm)	See page Q49
Body Die (6mm to 42mm)	See page Q49
*Pressure Gauge (0 - 10,000 psi)	**900044****
*Male Adapter	**6-8 F5OLO-S**
*Adapter	**6 G6L-S**
*Hydra-Tool Gauge Adapter	**6 R6LO-S**

* Included in Kit

STP lubricant is the only lubricant recommended for use with the Hydra-Tool.

See Assembly for pre-setting pressures.

Instructional video is available at discover.parker.com/TFDTubeFabEquipment.

See the Hydra-Tool 4392-B10 manual.

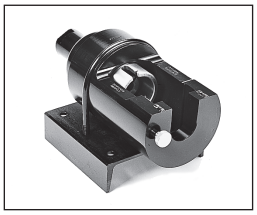

Fig. Q103 — Hydra Tool

Fig. Q104 — Ram Insert (Ferulok Only)

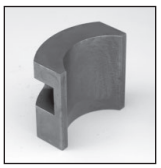

Fig. Q105 — Small Ram Insert and Stop Adapter (EO and EO-2 only)

Hydra-Tool Kit

Part Name	Part No.
Hydra-Tool Kit (for use with electric or hand pump)	**720370B-3**

Includes basic unit, gauge adapter, Hydra-Tool connector, lubricant, "T" adapter, carrying case, hose assembly, pressure gauge, p/n 900044, and operation manual.

Fig. Q106 — Hydra-Tool Kit

Hydra-Tool Body Dies for Ferulok Fittings

Size	Tube O.D. (in.)	Part No.
4	1/4	**720105-4**
6	3/8	**720105-6**
8	1/2	**720105-8**
10	5/8	**720105-10**
12	3/4	**720105-12**
14	7/8	**720105-14**
16	1	**720105-16**
20	1 1/4	**720105-20**
24	1 1/2	**720105-24**
32	2	**720105-32**

Fig. Q107 — Body Die

Hydra-Tool Nut Dies for Ferulok Fittings

Size	Tube O.D. (in.)	Part No.
4	1/4	**680370-4**
6	3/8	**680370-6**
8	1/2	**680370-8**
10	5/8	**680370-10**
12	3/4	**680370-12**
14	7/8	**680370-14**
16	1	**680370-16**
20	1 1/4	**680370-20**
24	1 1/2	**680370-24**
32	2	**680370-32**

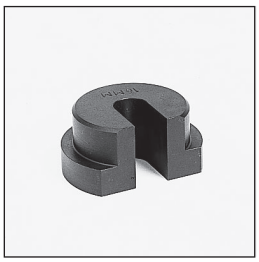

Fig. Q108 — Nut Die

WARNING: This product can expose you to chemicals including Lead and Lead Compounds 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.

Dimensions and pressures for reference only, subject to change.

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Hydra-Tool Body Dies for EO / EO-2 Fittings

Series	Tube O.D. Size (mm)	Part No.
L	6	910290-6L
L	8	910290-8L
L	10	910290-10L
L	12	910290-12L
L	15	910290-15L
L	18	910290-18L
L	22	910290-22L
L	28	910290-28L
L	35	910290-35L
L	42	910290-42L
S	6	910289-6S
S	8	910289-8S
S	10	910289-10S
S	12	910289-12S
S	14	910289-14S
S	16	910289-16S
S	20	910289-20S
S	25	910289-25S
S	30	910289-30S
S	38	910289-38S

Fig. Q109 — Body Die

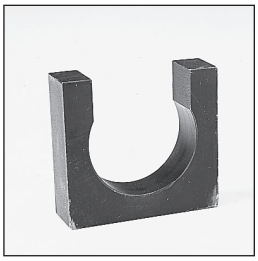

Fig. Q110 — Back up Plate

Hydra-Tool Nut Die / Split Back-up Plate Sets for EO / EO-2 Fittings

Tube O.D. Size (mm)	Part No.
6	910291-6 mm
8	910291-8 mm
10	910291-10 mm
12	910291-12 mm
14	910291-14 mm
15	910291-15 mm
16	910291-16 mm
18	910291-18 mm
20	910291-20 mm
22	910291-22 mm
25	910291-25 mm
28	910291-28 mm
30	970135-30 mm
35	970135-35 mm
38	970135-38 mm
42	970135-42 mm

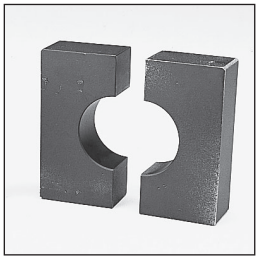

Fig. Q111 — Split Nut Dies

Fig. Q112 — Nut Die

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EO-Karrymat

The EO-Karrymat is a dependable device for safe and efficient bite-type pre-setting. It allows pre-assembly of all sizes of EO, EO-2 and Ferulok fittings without the need for electric power.

The EO-Karrymat consists of a hydraulic drive, Handpump and pressure gauge, all firmly attached to a carrying case.

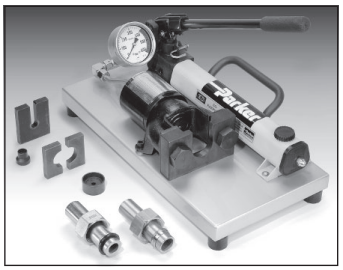

Fig. Q113 — EO-Karrymat

Part Name	Part No.
EO-Karrymat	**EOKarrymat**

EO-Karrymat Body Dies for EO / EO-2 Fittings

Series	Tube O.D. (mm)	Part No.
LL	4	**MOK04LLX**
LL	6	**MOK06LLX**
LL	8	**MOK08LLX**
LL	10	**MOK10LLX**
LL	12	**MOK12LLX**
L	6	**MOK06LX**
L	8	**MOK08LX**
L	10	**MOK10LX**
L	12	**MOK12LX**
L	15	**MOK15LX**
L	18	**MOK18LX**
L	22	**MOK22LX**
L	28	**MOK28LX**
L	35	**MOK35LX**
L	42	**MOK42LX**
S	6	**MOK06SX**
S	8	**MOK08SX**
S	10	**MOK10SX**
S	12	**MOK12SX**
S	14	**MOK14SX**
S	16	**MOK16SX**
S	20	**MOK20SX**
S	25	**MOK25SX**
S	30	**MOK30SX**
S	38	**MOK38SX**

Fig. Q114 — MOK Body Die

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EO-Karrymat Nut Dies for EO / EO-2 Fittings

Series	Tube O.D. (mm)	Part No.
LL	4	GHP04X
LL	6	GHP06X*
LL	8	GHP08X*
LL	10	GHP10X*
LL	12	GHP12X*
L	6	GHP06X*
L	8	GHP08X*
L	10	GHP10X*
L	12	GHP12X*
L	15	GHP15X
L	18	GHP18X
L	22	GHP22X
L	28	GHP28X
L	35	GHP35X
L	42	GHP42X
S	6	GHP06X*
S	8	GHP08X*
S	10	GHP10X*
S	12	GHP12X*
S	14	GHP14X
S	16	GHP16X
S	20	GHP20X
S	25	GHP25X
S	30	GHP30X
S	38	GHP38X

* Nut Dies for 6-12mm are identical in LL, L and S series.

Fig. Q115 — GHP Nut Die

EO-Karrymat Body Dies for Ferulok Fittings

Tube Size (in.)	Part No.
1/4	976521-4
3/8	976521-6
1/2	976521-8
5/8	976521-10
3/4	976521-12
7/8	976521-14
1	976521-16
1 1/4	976521-20
1 1/2	976521-24
2	976521-32

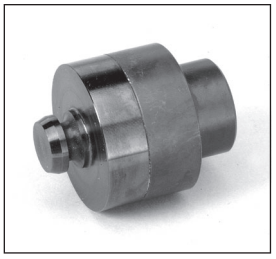

Fig. Q116 — EO-Karrymat Body Die for Ferulok

EO-Karrymat Back-up Plates for Ferulok Fittings

Tube Size (in.)	Part No.
1/4	975867-4
3/8	975867-6
1/2	975867-8
5/8	975867-10
3/4	975867-12
7/8	975867-14
1	975867-16
1 1/4	975867-20
1 1/2	975867-24
2	975867-32

Fig. Q117 — EO-Karrymat Back-up Plates for Ferulok

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O-Ring Pick

Plastic O-ring pick allows for easy removal of O-rings without causing damage to the fitting.

Part Name	Part No.
O-Ring Pick	**O-Ring Pick**

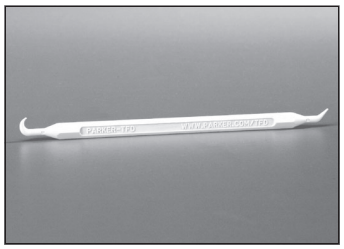

Fig. Q118— O-Ring Pick

Captive O-Ring Assembly Tool

The captive O-ring (CORG) assembly tool utilizes a Parker patented method for inserting O-rings in ORFS fittings, such as Seal-Lok, without causing O-ring damage. These tools can be used both as a hand tool and a bench-mounted tool. All CORG tools have a #8-32 tapped hole to allow easy mounting.

Fitting Size	L (in.)	D1 (in.)	D2 (in.)	O-Ring Size	Part No.
-4	1.4	0.8	0.6	2-011	**CORG-4**
-6	1.5	0.9	0.6	2-012	**CORG-6**
-8	1.5	1.1	0.8	2-014	**CORG-8**
-10	1.6	1.3	0.9	2-016	**CORG-10**
-12	1.9	1.4	1.1	2-018	**CORG-12**
-16	1.9	1.7	1.3	2-021	**CORG-16**
-20	2.1	1.9	1.6	2-025	**CORG-20**
-24	2.1	2.3	1.9	2-029	**CORG-24**
-32	2.2	2.8	2.4	2-135	**CORG-32**

WARNING: This product can expose you to chemicals including Lead and Lead Compounds 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.

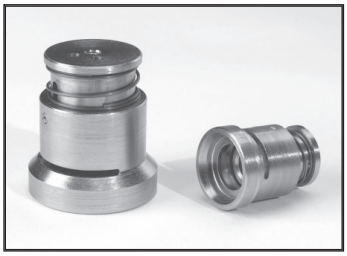

Fig. Q119 — Captive O-Ring Assembly Tool

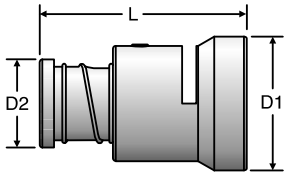

Fig. Q120 — Captive O-Ring Assembly Tool dimensions

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Braze Flux

Black braze flux can be used for brazing either steel or stainless steel components. When applied liberally this flux helps the flow of the silver braze alloy and prevents oxidation.

Part Name	Part No.
Black Flux	**Black Flux 1/2 lb**
Black Flux	**Black Flux 1 lb**

Fig. Q121 — Braze Flux

Post Braze Cleaner

This cleaner is used to clean the assembly after brazing. Once the silver braze alloy has solidified, immediately immerse the joint into the braze cleaner solution. The cleaner combined with the sudden change in temperature removes the flux from the assembly. Braze cleaner does not provide corrosion protection. See "Corrosion Protection After Brazing" in the Assembly / Installation section, page R17.

Available in sizes 2 1/2 lb. and 5 lb. jars. When ordering simply denote quantity after Braze Cleaner.

Part Name	Part No.
Braze Cleaner	**Braze Cleaner 2 1/2 lb**
Braze Cleaner	**Braze Cleaner 5 lb**

Fig. Q122 — Post Braze Cleaner

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Lubricants

Lubricants act as friction reducers to ease forming processes, fitting assembly and prevent galling, corrosion and seizing of components. The use of the correct lubricant for various purposes is critical to achieve maximum tool life during forming processes and performance of threaded connections.

Parflange® Lubricants

Lubricants are used to maximize tool life during the flanging process. Selection of the appropriate lubricant for the type of Parflange machine is critical to its proper operation.

Part Description	Part No.
Recommended for use with steel or stainless steel	**LB 2000** (8 oz.)

Fig. Q123 — Parflange Lubricant, LB 2000

EO / EO-2 Fitting Lubricants

EO Niromont lubricants are specifically developed for lubrication of threads prior to assembly of EO and EO-2 fittings.

Part Description	Part No.
EO Niromont – Liquid 250cc bottle	**Niromont Liquid**
EO Niromont – Paste 130 g. tin	**Niromont Paste**

Fig. Q124 — EO Niromont

O-Ring Lubricants

Parker O-Lube

O-Lube is an outstanding general-purpose grease intended for use with O-rings and other seals in hydraulic and pneumatic systems. The temperature range is from -29°C to +82°C (-20°F to +180°F).

Part Description	Part No.
O-ring Lubricant 2 oz.	**OLUBE-884-2-TFD**

Fig. Q125 — Parker O-Lube

Parker Super O-Lube

Super O-Lube is an all-purpose O-ring lubricant. It is not a grease, but rather a high-viscosity silicone oil. The temperature range is -54°C to +204°C (-65°F to +400°F).

Part Description	Part No.
O-ring Lubricant	**SLUBE-884-2-TFD**

Fig. Q126 — Parker Super O-Lube

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Thread Sealants

Thread sealants seal and secure metal pipes and fittings by filling the space between the threaded metal parts. Thread sealants harden to prevent leakage caused by vibration loosening, solvent evaporation, damaged threads and temperature cycling. Designed for low and high pressure applications, thread sealants seal quickly for on-line low pressure testing. When fully cured, they seal to the burst strength of most systems. Thread sealants are easily remove with basic hand tools. Thread sealants can be used on pipe thread fittings.

Threadmate™ Sealant/Lubricant

Threadmate™ is an extreme-duty lubricant developed to reduce galling during the assembly of pipe thread fittings. Threadmate™ promotes reliable sealing of pipe threads, even at high pressure. Recommended for use on stainless steel pipe threads.

Size available	**Part No.**
4 oz. tube	**MTM04T-TFD**

Fig. Q127 — Threadmate Sealant/Lubricant

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Click here for Support Resources or to Configure Parts Online

Tube Preparation Centers

Parker offers five different styles of tube preparation centers to meet various user's needs, from the basic TP-1 unit which includes a cabinet and deburr unit, to the TP1025 which offers the ability to cut, deburr, Parflange and flare tube.

Utilizing a sturdy steel cabinet with bins for fitting storage, tooling shelves and heavy duty casters to ease mobility, Parker Tube Preparation Centers cover almost every tube preparation need. All machines require 110V, 20A power supply.

Fig. Q128 — Tube Preparation Center TP1025

Part Description	Part No.
Tube Prep Center with Deburr Unit	**TP-1**
Tube Prep Center with Deburr and Saw	**TP-974250**
Tube Prep Center with Deburr, Saw and Hydratool	**TP432**
Tube Prep Center with Deburr, Saw and Hyferset	**TP-611011A**
Tube Prep Center with Deburr, Saw and Karryflare Tool	**TP-Karryflare**
Tube Prep Center with Deburr, Saw and 1025 Parflange	**TP1025**

Replacement Parts	Part No.
I.D. Deburr Cone	**971816**
O.D. Deburr Blades (set of 6)	**910485**
Cutting Lubricant	**Saw Lube**
Saw Blade – 250 mm x 2.0 mm thick (all purpose)	**987036**
Saw Blade – 200 mm x 2.0 mm thick (all purpose)	**987037**
Flaring tooling for TP432	See page Q33 – Q35
Presetting tooling for TP432 and TP-611011A	See page Q45 – Q47
Karryflare Flaring tooling	See page Q36
Flanging tooling for TP1025	See page Q24
Flaring tooling for TP1025	See page Q37
Lubricant for TP1025	**LB 2000**

WARNING: This product can expose you to chemicals including Lead and Lead Compounds 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.

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Thread Identification Kit

The Thread Identification Kit can be used to identify metric, BSP, SAE and NPT threads, as well as SAE flanges. It con-tains thread gauges, calipers, thread profiles, and an instruction booklet that details most thread forms and connection styles found in fluidpower systems worldwide.

Part Name	Part No.
Thread Identification Kit	**MIK-1**

⚠ **WARNING:** This product can expose you to chemicals including Diisononyl Phthalate which is known to the State of California to cause cancer. For more information go to www.p65warnings.ca.gov.

Need help identifying threads?
See our article: Four Easy Steps to Identify Hydraulic Threads.
http://blog.parker.com/four-easy-steps-to-identify-hydraulic-threads

Fig. Q129 — Thread Identification Kit

Portboards

The Portboards can be used for identification of ISO, SAE, BSP and NPT ports and port threads. They are machined with female threads for quick and easy identification by screwing in the male port end.

Portboard A (SAE Straight Thread -2 through -32 and NPT 1/8 through 1 1/2).

Part Name	Part No.
Portboard A	**Portboard A**

Portboard B (Metric 8mm through 48mm and BSP 1/8 through 1 1/2).

Part Name	Part No.
Portboard B	**Portboard B**

⚠ **WARNING:** This product can expose you to chemicals including Lead and Lead Compounds 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.

Fig. Q130 — Portboard A

Fig. Q131 — Portboard B

International Thread Kit

Parker's International Thread Kit offers the necessary tools to identify almost any thread you may encounter. The new ITK has LL, L and S series plugs to identify female DIN threads such as EO style hose ends. It also includes the MIK-1 and BSPP plugs in order to identify BSPP hose ends from 1/8" to 2".

Part Name	Part No.
International Thread Kit	**ITK**

⚠ **WARNING:** This product can expose you to chemicals including Lead and Lead Compounds 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.

Fig. Q132 — International Thread Kit (ITK)

Dimensions and pressures for reference only, subject to change.

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Tube Fabricating Equipment Weights	
Part No.	**Approx. Ship Weight (lbs.)**
Rolo-Flare Tool	
945 TH	4.00
212FB	4.00
Hydra-Tool	
710400B	62.00
720370B-3	85.00
Accessories (Hydra-Tool)	
900044*	1.00
910004	1.50
720377	16.00
710416	4.00
710412	3.00
710419	2.00
710411	2.00
710424-1	4.00
710424-2	4.00
710417-4	2.00
710417-5	2.00
710417-6	2.00
710417-8	2.00
710417-10	2.00
710417-12	2.00
710417-14	2.00
710417-16	2.00
710417-20	2.00
710415-24	2.00
710415-32	2.00
Power Source (Pumps)	
900085	30.00
900086	10.00
Flaring Dies - Metric (Hydra-Tool)	
770106-6	2.00
770106-8	2.00
770106-10	2.00
770106-12	2.00
770106-16	2.00
770106-18	2.00
770106-20	2.00
770106-25	2.00
770106-30	2.00
770106-32	2.00
Hydra-Tool Ferulok Pre-Set Tooling	
770101	5.00
770102	3.00

Tube Fabricating Equipment Weights	
Part No.	**Approx. Ship Weight (lbs.)**
Ferulset Tools (Ferulok Pre-Set Tool)	
560576	0.50
560577	0.50
560578	0.50
560579	0.50
560580	0.50
560581	0.50
560582	0.50
560583	0.50
560584	0.50
560585	0.50
560586	0.50
560587	1.00
560589	1.00
Hyferset (Ferulok Pre-Set Tool)	
611011A	35.00
Hyferset Accessories	
900086	10.00
910004	2.00
651085	15.00
Hyferset and Tooling	
611049C	53.00
680370-4	3.50
720105-4	0.50
680370-6	3.00
720105-6	0.50
680370-8	3.00
720105-8	0.50
680370-10	2.50
720105-10	0.50
680370-12	2.50
720105-12	0.50
680370-14	2.50
720105-14	0.50
680370-16	1.50
720105-16	1.00
680370-20	2.00
720105-20	1.00
680370-24	1.50
720105-24	1.00
680370-32	1.50
720105-32	1.00
Straight Thread Taps and Counterbores	
7/16-20 UNF-2B	1.00
9/16-18 UNF-2B	1.00
3/4-16 UNF-2B	1.00
7/8-14 UNF-2B	1.50
1 1/16-12 UN-2B	1.75
1 3/16-12 UN-2B	2.00
1 5/16-12 UN-2B	2.00
1 5/8-12 UN-2B	2.50
1 7/8-12 UN-2B	2.50
2 1/2-12 UN-2B	3.00

Tube Fabricating Equipment Weights	
Part No.	**Approx. Ship Weight (lbs.)**
Straight Thread Taps and Counterbores (Cont'd)	
Y-34730	0.50
Y-34731	0.50
Y-34732	0.50
Y-34733	0.75
Y-34734	1.00
Y-34735	1.00
Y-34736	1.50
Y-34737	1.50
Y-34738	1.75
Y-34739	2.00
Y-34740	2.00
Y-34741	2.50
Y-34743	2.50
Tube Cutters	
218B	1.00
1232	3.00
Parker Tru-Kut Sawing Vise	
710439	9.00
974250	198.00
Deburring Tools	
226A	1.00
972125	90.00
Hand Tube Benders	
2-2829	2.00
3-2829	2.00
4-2829	2.50
5-2829	2.50
6-2829	3.00
8-2829	3.00
10-2829	8.00
12-2829	15.00
14-2829	15.00
Exactol Tube Benders (412 & 424)	
560569	18.50
550570	5.00
550572	25.50
621044	38.00
631156	10.00
412 Kit	42.00
424 Kit	—
Slide Blocks (412 & 424)	
550585	3.50
621045	5.00
870150	5.00

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(Continued on next page)

Table Q16 — Tube Fabricating Equipment Weight Chart

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Tube Fabricating Equipment Weights	
Part No.	**Approx. Ship Weight (lbs.)**
Radius Blocks (412 & 424)	
550579	1.00
550580	1.00
550581	2.50
550582	3.00
550583	4.00
550584	5.00
621046	7.00
621047	9.00
621048	9.50
621049	10.00
870149	11.00
Small Radius Blocks (412 & 424)	
550573	2.00
550574	2.00
550575	2.50
550576	2.50
550577	3.00
550578	4.00
Close Bend Radius Blocks	
590533	2.00
590535	3.00
590537	3.00
Metric Slide Blocks (412 & 424)	
820091	3.00
820092	5.00
820093	5.00
Metric Radius Blocks (412 & 424)	
820090-6mm	1.00
820090-8mm	2.00
820090-10mm	2.00
820090-12mm	3.00
820090-14mm	3.00
820090-15mm	4.00
820090-16mm	4.50
820090-18mm	6.50
820090-20mm	7.00
820090-22mm	9.00
820090-25mm	9.50
820090-28mm	10.00
820090-30mm	10.50
820090-32mm	11.00
Tube Preparation Centers	
TP432	560.00
TP1025	880.00
EO Presetting Tooling	
Nut Die	1.75
Body Die	.75
EO-Karrymat	55.00

Tube Fabricating Equipment Weights	
Part No.	**Approx. Ship Weight (lbs.)**
HB632 Hydraulic Tube Bender	
631050 (632)	245.00
660221	8.00
900085	30.00
Radius Blocks (HB632)	
540502	3.00
530763	3.50
530764	4.00
530765	6.00
530766	10.00
530768	14.00
530770	54.00
590512-18	35.00
590515-24	4.00
590518-30	6.00
590521-36	7.00
590523-42	8.00
590524-48	10.00
590526-54	12.00
590630-72	16.00
631060-128	50.00
Close Bend Radius Blocks for HB632	
530597	3.50
530601	5.00
530605	6.00
530609	8.00
530613	10.50
530621	12.00
530625	13.00
Metric Radius Blocks for HB632	
810023	3.00
780175	3.50
780176	4.00
780177	4.00
780178	5.00
780179	6.00
780180	8.00
780181	9.00
780182	10.50
780183	12.00
780184	13.00
CP432 Parflange Machines	225.00
1025	175.00
Metric Close Bend Radius Blocks for HB632	
780185	3.50
780186	3.50
780187	4.00
780188	5.00
780189	6.00
780190	6.50

Tube Fabricating Equipment Weights	
Part No.	**Approx. Ship Weight (lbs.)**
Clamp Blocks for HB632	
864266	4.00
631092	3.00
631093	3.00
027418-28	5.00
027418-32	5.00
Metric Clamp Blocks for HB632	
790017	3.00
780194	4.00
780195	3.00
780186	4.00
Metric Slide Blocks for HB632	
790016	8.00
780191	11.00
780192	9.00
780193	8.00
Bender Table	
520515	470.00
Mandrel Rod Stop Assemblies	
550571	5.00
631141	20.00
Universal Side Angle Indicator	
520520	25.00
Karryflare	116.00
Inch Flaring Dies for Karryflare	
M 047415-1	4.00
M 157408-1	4.00
M 067415-1	4.00
M 087415	4.00
M 107415	3.50
M 127415	3.50
M 167415	3.50
M 207415	3.00
M 157438	3.00
Parflange Tooling	
Pin and Die Set (1025)	4.50
Pin (1025)	.75
Die (1025)	3.75
Parflange Pro 50	
Pro 50	838.00

WARNING: This product can expose you to chemicals including Lead and Lead Compounds 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

Table Q16 — Tube Fabricating Equipment Weight Chart (continued from previous page)

Dimensions and pressures for reference only, subject to change.

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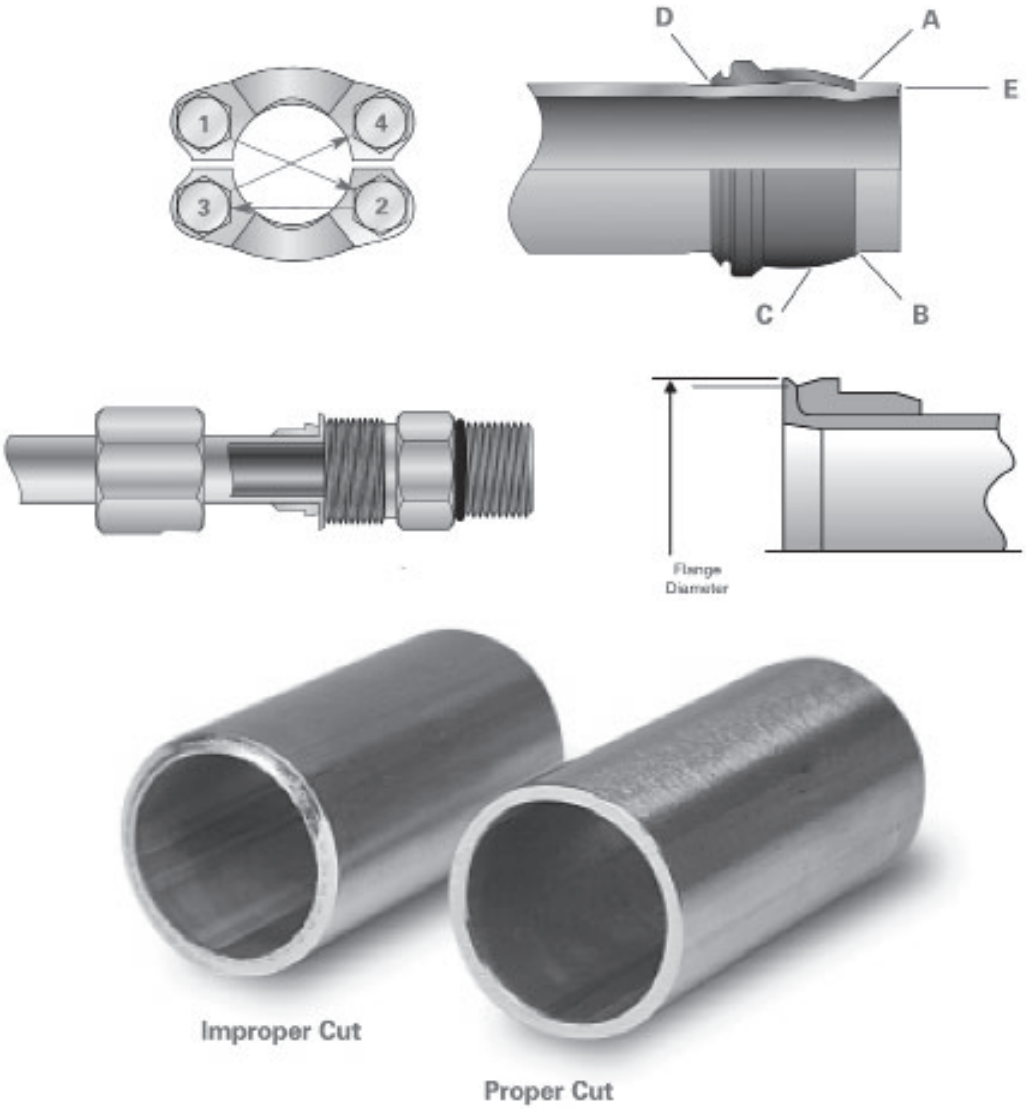
R ASSEMBLY/INSTALLATION



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Port End Assembly

The three common types of port ends used in the United States with tube fittings, pipe fittings and hose fittings are:

1. Parallel thread
2. Tapered Thread
3. Flanges

1. Parallel Thread Ports

Unlike tapered threads, parallel thread ports do not require sealing by the threads. The seal is obtained by other means, typically an elastomeric seal. When assembled properly, parallel thread ports provide the best leak-free port connection available.

Parker tube fittings are available with several types of parallel thread port studs (ends):

- SAE straight threads (SAE J1926 / ISO 11926)
- ISO (ISO 6149)
- JIS (JIS B2351)
- BSPP flat face (ISO 1179)
- DIN Metric flat face (ISO 9974).

The SAE straight thread, ISO 6149 and JIS B2351 ports are all of similar design. The male end is fitted with an O-ring. On assembly, the O-ring is firmly sandwiched between the angular sealing surface of the female port, the male end undercut, and the shoulder or back-up washer of the male end. Sealing is thus made possible and maintained by the O-ring compression, as shown in Fig. R1. The straight threads do not offer sealing action; they provide the resistance (holding power) for service pressure. Port dimensions for SAE and ISO 6149 ports are given on pages S31 and S32 respectively. For JIS B2351 dimensions, please contact the Tube Fittings Division.

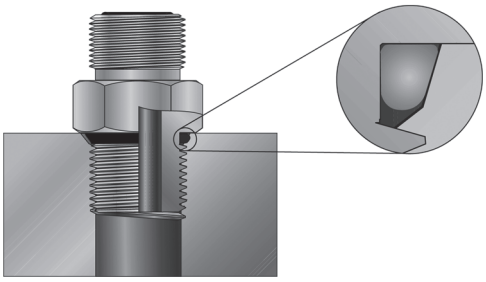

Fig. R1 – SAE / ISO / JIS B2351 Straight Thread Port O-Ring Upon Assembly

With the BSPP and metric flat face port ends, the sealing actually takes place on the top surface (spot face) of the port. Port dimensions can be found on pages S34 and S35 respectively. There are several sealing methods available for these ports. Port studs with type “E” sealing utilize Parker’s EOlastic seal (ED) (see Fig. R2) and are recommended for higher pressures than the other types. Types “G” and “H” use an O-ring that is supported on the outside by a removable retaining ring (see Fig. R3). Type B (cutting face) is designed with a relatively sharp ridge of material that seals by coining the flat face of the female port (see Fig. R4). A fourth sealing method uses a bonded seal which consists of a metal ring with an elastomer bonded to the inside surface (often referred to as Dowty® seal) (see Fig. R5).

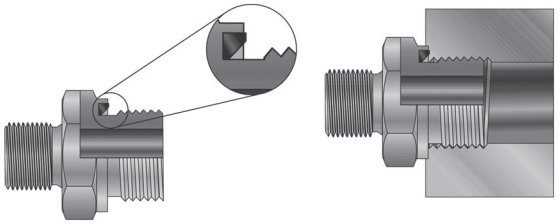

Fig. R2 – EOlastic Seal, Type E

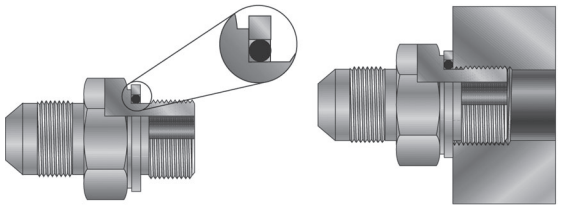

Fig. R3 – O-Ring with Retaining Ring, Types G & H

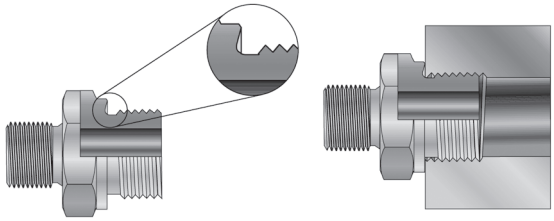

Fig. R4 – Cutting Face, Type B

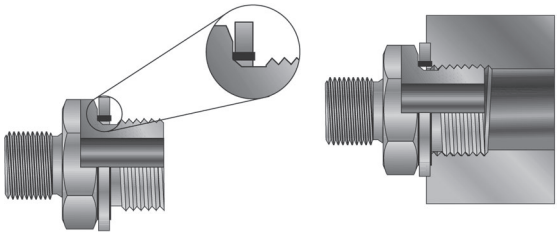

Fig. R5 – Bonded Seal

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For assembly purposes, there are two main categories of parallel port ends: adjustable and non-adjustable. Adjustable port ends are commonly found on shaped fittings to allow for proper orientation of the fitting. Besides the elastomeric seal, adjustable port ends are assembled with a locknut and a back-up washer as shown in Fig. R6. Non-adjustable port ends are found on straight fittings.

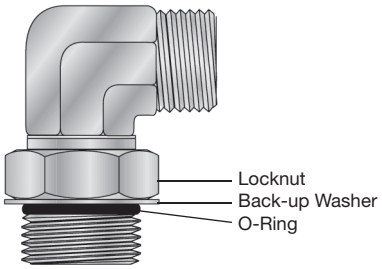
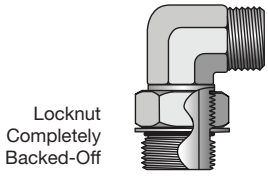


Fig. R6 – Adjustable Port End Assembly

The general assembly procedure for all adjustable parallel thread port ends is the same. Likewise, the assembly procedure is the same for all non-adjustable parallel thread port ends.

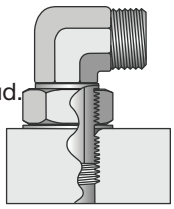
Adjustable Port End Assembly

1. Inspect components to ensure that male and female port threads and sealing surfaces are free of burrs, nicks and scratches, or any foreign material.
2. If O-ring or seal is not pre-installed to fitting male port end, install proper size O-ring or seal, taking care not to damage it.
3. Lubricate O-ring with light coat of system fluid or a compatible lubricant to help the O-ring slide smoothly into the port and avoid damage.
4. Back off lock nut as far as possible. Make sure back-up washer is not loose Parker Robust Port Stud and is pushed up as far as possible.



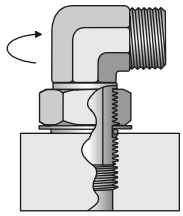
Step 4

5. Screw fitting into port until the back-up washer or the retaining ring contacts face of the port. Light wrenching may be necessary. **Over tightening may damage washer.** This potential damage is eliminated with Parker's Robust Port Stud.



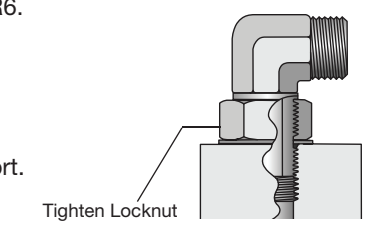
Step 5

6. To align the tube end of the fitting to accept incoming tube or hose assembly, unscrew the fitting by the required amount, but not more than one full turn.



Step 6

7. Using two wrenches, hold fitting in desired position and tighten locknut to the proper torque value from the appropriate table located on pages R5 - R6.
8. Inspect to ensure that O-ring is not pinched and that washer is seated flat on face of port.



Steps 7 and 8

Non-adjustable Port End Assembly

1. Inspect components to ensure that male and female port threads and sealing surfaces are free of burrs, nicks, and scratches, or any foreign material.
2. If O-ring or seal is not pre-installed to fitting male port end, install proper size O-ring or seal, taking care not to damage it.
3. Lubricate O-ring with light coating of system fluid or a compatible lubricant to help the O-ring slide past the port entrance corner and avoid damaging it.
4. Screw fitting into port and tighten to proper torque from the appropriate table located on pages R5 - R6.

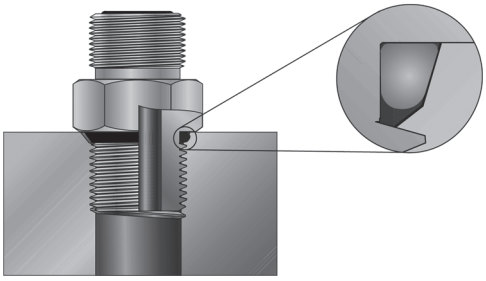


Fig. R7 — Non-Adjustable Port End Assembly

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SAE Straight Thread Port Assembly (SAE J1926)

SAE Dash Size	Thread Size UN/UNF	Assembly Torque (+10% -0)											
		Non-Adjustables				Adjustables				Plugs			
		Seal-Lok (Heavy Duty SAE J1926-2)		Triple-Lok Ferulok Adapters (Light Duty SAE J1926-3)		Seal-Lok (Heavy Duty SAE J1926-2)		Triple-Lok Ferulok Adapters (Light Duty SAE J1926-3)		Hollow Hex HP5ON-S (Light Duty SAE J1926-3)		Hex Head P5ON-S (Light Duty SAE J1926-3)	
		ft.lbs. (in. lbs)	N-m	ft.lbs. (in. lbs)	N-m	ft.lbs. (in. lbs)	N-m	ft.lbs. (in. lbs)	N-m	ft.lbs. (in. lbs)	N-m	ft.lbs. (in. lbs)	N-m
2	5/16-24	—	—	(85)	10	—	—	(60)	7	(60)	7	(85)	10
3	3/8-24	—	—	(155)	18	—	—	(100)	11	(100)	11	(155)	18
4	7/16-20	(310)	35	(260)	29	(180)	20	(180)	20	(180)	20	(260)	29
5	1/2-20	(360)	41	(280)	32	(360)	41	(250)	28	(250)	28	(280)	32
6	9/16-18	(420)	47	(350)	40	(420)	47	(350)	40	(350)	40	(350)	40
8	3/4-16	(720)	81	(620)	70	(720)	81	(620)	70	(620)	70	(620)	70
10	7/8-14	100	136	85	115	100	136	85	115	85	115	85	115
12	1 1/16-12	135	183	135	183	135	183	135	183	135	183	135	183
14	1 3/16-12	175	237	175	237	175	237	175	237	175	237	175	237
16	1 5/16-12	200	271	200	271	200	271	200	271	200	271	200	271
20	1 5/8-12	250	339	250	339	250	339	250	339	250	339	250	339
24	1 7/8-12	305	414	305	414	305	414	305	414	305	414	305	414
32	2 1/2-12	375	508	375	508	375	508	375	508	375	508	375	508

Table R1 – SAE J1926 Straight Thread Port Assembly Torques

Notes: Lubricate threads before assembly. Values in chart are for plated steel fittings in steel ports. For stainless steel fittings, use the upper limit of torque range. For brass and aluminum decrease torque value by 35%.

BSPP (Thread G) Port Assembly (ISO 1179 / DIN 3852-2)

Series	Tube O.D.	BSPP Thread G Size	Assembly Torque Nm +10% -0							
			Straight Male Stud Fittings			Non-Return Valves RHV / RHZ	Banjo Fittings		Plugs VSTI-ED	Straight and Adjustable Fittings
			Form A for Sealing Washer	Form B with Cutting Face	Form E with ED-Sealing	Form E with ED-Sealing	WH / TH	SWVE	Form E with ED-Sealing	O-Ring with Retaining Ring and Bonded Washer
	6	1/8 - 28	9	18	18	18	18	18	13	18
	8	1/4 - 19	35	35	35	35	45	40	30	35
	10	1/4 - 19	35	35	35	35	45	40	30	35
	12	3/8 - 19	45	70	70	50	70	65	60	70
L	15	1/2 - 14	65	140	90	85	120	90	80	90
	18	1/2 - 14	65	100	90	85	120	90	80	90
	22	3/4 - 14	90	180	180	140	230	125	140	180
	28	1 - 11	150	330	310	190	320	—	200	310
	35	1 1/4 - 11	240	540	450	360	540	—	400	450
	42	1 1/2 - 11	290	630	540	540	700	—	450	540
	6	1/4 - 19	35	55	40	45	45	40	—	40
	8	1/4 - 19	35	55	40	45	45	40	—	40
	10	3/8 - 19	45	90	80	60	70	65	—	60
	12	3/8 - 19	45	90	80	60	70	65	—	60
S	14	1/2 - 14	65	150	115	145	120	90	—	90
	16	1/2 - 14	65	130	115	100	120	90	—	90
	20	3/4 - 14	90	270	180	145	230	125	—	180
	25	1 - 11	150	340	310	260	320	—	—	310
	30	1 1/4 - 11	240	540	450	360	540	—	—	450
	38	1 1/2 - 11	290	700	540	540	700	—	—	540

Table R2 – Assembly Torques for ISO 1179-1 / DIN 3852-2 Port

Note: Lubricate threads before assembly! Tightening torques are for steel fittings assembled in steel components. Values in chart are for steel fittings in steel ports. For stainless steel fittings, use the upper limit of torque range. For brass and aluminum decrease torque value by 35%.

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Metric (ISO Thread M) Port Assembly (ISO 9974-1 / DIN 3852-1)

Series	Tube O.D.	Metric Thread M Size	Assembly Torque Nm +10% -0							
			Straight Male Stud Fittings			Non-Return Valves RHV / RHZ	Banjo Fittings		Plugs VSTI-ED	Straight and Adjustable Fittings
			Form A for Sealing Washer	Form B with Cutting Face	Form E with ED-Sealing	Form E with ED-Sealing	WH / TH	SWVE	Form E with ED-Sealing	O-Ring with Retaining Ring
	6	M 10 x 1	9	18	18	18	18	18	12	18
	8	M 12 x 1.5	20	30	25	25	45	35	25	25
	10	M 14 x 1.5	35	45	45	35	55	50	35	40
	12	M 16 x 1.5	45	65	55	50	80	60	50	55
L	15	M 18 x 1.5	55	80	70	70	100	80	65	70
	18	M 22 x 1.5	65	140	125	125	140	120	90	90
	22	M 27 x 2	90	190	180	145	320	130	135	180
	28	M 33 x 2	150	340	310	210	360	—	225	310
	35	M 42 x 2	240	500	450	360	540	—	360	450
	42	M 48 x 2	290	630	540	540	700	—	360	540
	6	M 12 x 1.5	20	35	35	35	45	35	—	35
	8	M 14 x 1.5	35	55	45	45	55	50	—	55
	10	M 16 x 1.5	45	70	70	55	80	60	—	70
	12	M 18 x 1.5	55	110	90	70	100	80	—	90
S	14	M 20 x 1.5	55	150	125	100	125	110	80	125
	16	M 22 x 1.5	65	170	135	125	135	120	—	135
	20	M 27 x 2	90	270	180	135	320	135	—	190
	25	M 33 x 2	150	410	310	210	360	—	—	310
	30	M 42 x 2	240	540	450	360	540	—	—	450
	38	M 48 x 2	290	700	540	540	700	—	—	540

Table R3 – Assembly Torques for ISO 9974-1 / DIN 3852-1 Port

Note: Lubricate threads before assembly. Values in chart are for steel fittings in steel ports. For stainless steel fittings, use the upper limit of torque range. For brass and aluminum decrease torque value by 35%.

Metric ISO Port Assembly (ISO 6149/DIN 3852-3)

Metric Thread M Size	Assembly Torque (+10% -0)[2]			
	ISO 6149-2 Stud Ends (S-Series) (Seal-Lok, EO & VSTI-OR Plugs)		ISO 6149-3 Stud Ends (L-Series) (Triple-Lok, EO, Ferulok & Pipe Adapters)	
	N.m.	ft. lbs.	N.m.	ft. lbs.
M8x1	10	7.5	8	6
M10x1	20	15	15	11
M12x1.5	35	26	25	18
M14x1.5	45	33	35	26
M16x1.5	55	41	40	30
M18x1.5	70	52	45	33
M20x1.5[3]	80	59	—	—
M22x1.5	100	74	60	44
M27x2	170	125	100	74
M30x2	235	175	130	95
M33x2	310	230	160	120
M38x2[1]	320	235	185	135
M42x2	330	245	210	155
M48x2	420	310	260	190
M60x2	500	370	315	230

Table R4 – ISO 6149 / DIN 3852-3 Port Assembly Torques

1) M38X2 is not covered in ISO 6149 standards.
2) These torques are for steel fittings, assembled lubricated, for brass and aluminum decrease torque value by 35%.
3) For cartridge valves only.

2. Tapered Thread Ports

Tapered thread ports include NPT/NPTF, BSPT and metric taper. The tapered threads in these ports serve two functions: 1) to hold the fitting in place while under pressure, and 2) to serve as the primary seal. The seal for NPTF threads is created by the metal-to-metal contact between the mating roots and crests of the male and female threads. With tapered threads, there is not always contact at the roots and crests. There can be a spiral gap which is small enough for a sealant to fill and provide an effective seal.

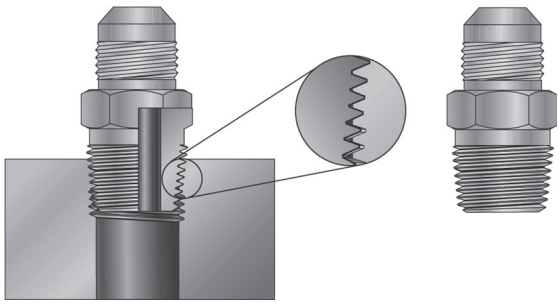

Fig. R8 – Tapered Thread Port

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The variety of thread forms available under taper threads include:

NPT – American Standard Taper Pipe Thread (ANSI B1.20.1).

NPTF – Dryseal American Standard Taper Pipe Thread (SAE J476, ANSI B1.20.3).

BSPT or JIS "PT" – British Standard Pipe, Tapered (BS21, JIS B 0203, ISO 7), also known as "R" for male and "Rc" for female.

M-Keg – Metric taper threads (DIN 158).

The vast majority of Parker Tube Fittings Division's standard pipe thread fittings are machined with the NPTF thread form. NPTF thread is also referred to as Dryseal Pipe Thread.

The full thread profile contact of NPTF threads is designed to give the tapered threads self-sealing ability without thread sealant. **However, variations in condition of mating threads, fitting and port materials, assembly procedures and operating conditions make self-sealing highly improbable. Therefore, some type of thread sealant is required to achieve proper seal and, in some cases, additional lubricity to prevent galling.**

Types of Sealant/Lubricant

Sealant/Lubricants assist in sealing and provide lubrication during assembly, reducing the potential for galling. Pipe thread sealants are available in various forms such as dry pre-applied, tape, paste and anaerobic liquid.

Pre-applied sealants, such as Vibraseal® and powdered PTFE are usually applied to connectors by the manufacturer. Connectors with some of these sealants may be remade a few times without needing additional sealant. Vibraseal may also help reduce loosening due to vibration.

PTFE tape, if not applied properly, can contribute to system contamination during assembly and installation. In addition, because of PTFE's high lubricity, fittings can be more easily over tightened; and it does not offer much resistance to loosening due to vibration.

Paste sealants, if not applied properly, can also contribute to system contamination. Generally they can be messy to work with and some types require a cure period after component installation prior to system start up.

Anaerobic liquids are available from several manufacturers and perform sealing as well as thread locking functions. They are applied to the connectors by the user and require a cure period prior to system start up. Some are soluble in common hydraulic fluids and will not contaminate the system. For proper performance they need to be applied to clean and dry components, carefully following the manufacturer's directions.

How many times can you reassemble a tapered thread pipe fitting? Read our article for what you need to know.

Tapered Thread Port Assembly

The proper method of assembling tapered threaded connectors is to assemble them finger tight and then wrench tighten further to the specified number of turns from finger tight (T.F.F.T.) given in Table R5. The following assembly procedure is recommended to minimize the risk of leakage and/or damage to components.

1. Inspect components to ensure that male and female port threads and sealing surfaces are free of burrs, nicks, scratches, or any foreign material.
2. Apply sealant/lubricant to male pipe threads if not pre-applied. For stainless steel fittings, the use of Parker Threadmate sealant/lubricant is strongly recommended. (Pre-applied dry sealants are preferred over other sealants). With any sealant, the first one to two threads should be left uncovered to avoid system contamination. If PTFE tape is used it should be wrapped 1-1/2 to 2 turns in clockwise direction when viewed from the pipe thread end.

   Caution: More than two turns of tape may cause distortion or cracking of the port.
3. Screw the connector into the port to the finger tight position.
4. Wrench tighten the connector to the appropriate T.F.F.T. values shown in Table R5, making sure that the tube end of a shaped connector is aligned to receive the incoming tube or hose assembly. **Never back off (loosen) pipe threaded connectors to achieve alignment.**
5. If leakage persists after following the above steps, check for damaged threads and total number of threads engaged.

If threads on the fitting are badly nicked or galled, replace the fitting. If port threads are damaged, re-tap, if possible, or replace the component. If the port is cracked, replace the component.

Normally, the total number of tapered threads engaged should be between 3-1/2 and 6. Any number outside of this range may indicate either under or over tightening of the joint or out of tolerance threads. If the joint is under tightened, tighten it further but no more than one full turn. If it is over tightened, check both threads, and replace the part which has out-of-tolerance threads.

As a general rule, pipe fittings with tapered threads should not be assembled to a specific torque because the torque required for a reliable joint varies with thread quality, port and fitting materials, sealant used, and other factors. Where many of these factors are well-controlled, such as particular jobs on an assembly floor, a torque range that produces the desired results may be determined by test and used in lieu of turns count for proper joint assembly.

Tapered Pipe Thread Size		T.F.F.T.
BSPT	NPTF	
1/8-28	1/8-27	2 - 3
1/4-19	1/4-18	2 - 3
3/8-19	3/8-18	2 - 3
1/2-14	1/2-14	2 - 3
3/4-14	3/4-14	2 - 3
1-11	1-11 1/2	1.5 - 2.5
1 1/4-11	1 1/4-11 1/2	1.5 - 2.5
1 1/2-11	1 1/2-11 1/2	1.5 - 2.5
2-11	2-11 1/2	1.5 - 2.5

Table R5 – Assembly Turns From Finger Tight (T.F.F.T) Values For Steel, Stainless Steel and Brass Pipe Fittings

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3. Flange Ports

Large threaded port connections, such as SAE straight thread, require very high torque to assemble. This makes assembly very difficult, especially where wrench clearance is limited. Split flange connections solve this problem by dividing the hydraulic load among four bolts each requiring much less torque, smaller wrenches and smaller wrench clearance.

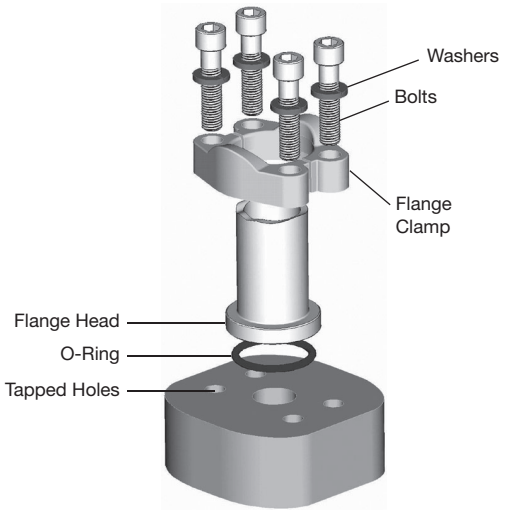

Fig. R9 – 4-Bolt Split Flange Components

There are two types of flange port connections:

1. ISO 6162
   - SAE Code 61 4-bolt split flange
   - SAE Code 62 4-bolt split flange
2. ISO 6164

The 4-Bolt Split Flange consists of four main components:

1. A body (flange head)
2. An O-ring
3. One captive or two split flange clamps
4. Four bolts and washer

The four-bolt port is simply a circular opening (flow passage) surrounded by four tapped holes in a certain pattern for acceptance of the flange clamping bolts. The flat surface of the port compresses the O-ring contained in the groove in the flange head when the clamp bolts are torqued. In some instances, the groove is in the port and not in the flange head. The bolts clamp down the flange head onto the flat surface of the port compressing and trapping the O-ring in the groove and leaving no gap for it to extrude under pressure. The hydraulic pressure is thus sealed by the compressed O-ring as long as the bolts are tightened enough to maintain solid metal to metal contact between the flange head at the outside diameter of the O-ring and the top of the port.

Flange Port Assembly

The steps to properly assemble the flange port clamping bolts are:

1. Inspect components to ensure that male and female port threads and sealing surfaces are free of burrs, nicks and scratches, or any foreign material.
2. Lubricate the O-ring.
3. Position flange and clamp halves.
4. Place lock washers on bolts and insert through clamp halves.
5. Hand tighten bolts.
6. Torque bolts in diagonal sequence (see Fig. R10) in small increments to the appropriate torque level listed in Table R6 or R7 below.

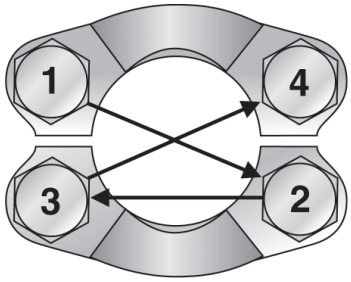

Fig. R10 – Flange Bolt Tightening Sequence

Dash Size	Flange Size	Inch Bolt (J518)	+10% -0 Torque ft. lbs.	Metric Bolt (ISO 6162)	+10% -0 Torque N-m
8	1/2	5/16-18	17	M8	24
12	3/4	3/8-16	31	M10	50
16	1	3/8-16	31	M10	50
20	1-1/4	7/16-14	52	M10	50
24	1-1/2	1/2-13	77	M12	92
32	2	1/2-13	77	M12*	92
40	2-1/2	1/2-13	77	M12	92
48	3	5/8-11	155	M16	210
56	3-1/2	5/8-11	155	M16	210
64	4	5/8-11	155	M16	210
80	5	5/8-11	155	M16	210

* Does not meet ISO 6162 specification.

Table R6 – Code 61 Flange Recommended Bolt Torque

Dash Size	Flange Size	Inch Bolt (J518)	+10% -0 Torque ft. lbs.	Metric Bolt (ISO 6162)	+10% -0 Torque N-m
8	1/2	5/16-18	17	M8	24
12	3/4	3/8-16	31	M10	50
16	1	7/16-14	52	M12	92
20	1-1/4	1/2-13	77	M14*	130
24	1-1/2	5/8-11	155	M16	210
32	2	3/4-10	265	M20	400

Table R7 – Code 62 Flange Recommended Bolt Torque

Socket Screw Bolt Circle (LK)	Socket Head Cap Screws	Tightening Torques N-m
LK35	M6	10
LK40	M6	10
LK55	M8	25

Table R8 – Hydraulic Flange Recommended Bolt Torque

* In general, variances of torque for soft metal ports/manifolds (ie: aluminum block - 66% of specified torque)

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Troubleshooting Port End Connections

60° Cone (Metric, BSPP and NPSM)

Read our blog post "Troubleshooting Leaks: Fixing a Port End Connection Issue"

CONDITION	PROBABLE CAUSE(S)	RECOMMENDATION
End of swivel nut contacts hex shoulder of adapter before cone and ball nose tightens	• Wrong combination of swivel nut and adapter	• Ensure that components are to the same specification (even with the same type, there are different designs for 60° cone fittings)
Thread engagement seems adequate and swivel nut is tight but leakage still occurs	• Scratches or nicks on sealing surface • Chatter marks on sealing surface	• Replace components. These fittings depend on metal-to-metal seal and require smooth mating surfaces to seal
There is leakage from the joint and the swivel nut is loose	• Inadequate make-up torque	• Use proper torque to create a seal as well as prevent vibration loosening
Swivel nut tightens, cone is tight but connection still leaks	• Inadequate or no chamfer in adapter	• Use components with proper chamfer (very common occurrence with NPTF/ NPSM 60° cone fittings). Male pipe end must have chamfer for proper sealing. Not all male pipe ends have chamfer as standard

Tapered Thread (including BSPT, NPT and metric taper)

CONDITION	PROBABLE CAUSE(S)	RECOMMENDATION
Thread galling	• Most common in stainless steel, caused by friction and lack of lubricant	• Replace fitting and apply proper thread sealant/lubricant to replacement fitting and tighten to appropriate TFFT
Fitting leaks, even after proper tightening	• Sealant omitted or inadequately applied • Damaged or cracked threads • Cracked port • Thread mixing of BSPT and NPT threads	• Re-apply sealant to appropriate TFFT and re-tighten • Replace fitting • Replace component • Determine port thread type and replace fitting with matching thread type
Insufficient thread engagement (3 to 6 threads of engagement required)	• Quality problem with port or adapter • Too much thread sealant (tape)	• Have port and adapter thread inspected; replace faulty parts • Remove all thread sealant and re-apply 1 to 2 layers of tape
Too much thread engagement (more than recommended 3 to 6 threads)	• Typically port or adapter machining or wear problem, or port could be cracked due to excessive torque	• Inspect port and adapter for proper tolerance or wear, replace faulty parts, retighten to appropriate TFFT
Poor-quality threads or damaged/nicked threads	• Larger sizes are more prone to having nicked threads due to handling damage	• Replace fitting with threads that are free of scratches and nicks

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Troubleshooting Port End Connections

Parallel (SAE, BSPP and metric)

CONDITION	PROBABLE CAUSE(S)	RECOMMENDATION
Washer is too loose (moves by its own weight or rocks too much on the undercut)	• Washer damaged	• Replace fitting
Fitting threads are distorted	• Over-torqued • Mixed threads	• Replace fitting and tighten to proper torque • Determine correct thread type
Several scratches or nicks on the port face	• Port face contaminated (dirty)	• Reface the port
Spot face of port is smaller than washer diameter	• Improper port tool was used • Wrong fitting selected for port	• Reface the port • Select a proper fitting
Port threads are distorted (yielded)	• Fitting over-torqued	• Replace component
Leakage persists after locknut has been torqued	• Damaged O-ring • Damaged washer • Improper assembly	• Replace O-ring with new quality O-ring (90 durometer) and reconnect fitting to proper torque • Replace fitting • Follow proper assembly procedure
Washer distorted, allowing opportunity for O-ring to extrude	• Exposed upper thread forced washer into port during assembly (over-torquing makes this more prevalent)	• Replace fitting, using proper installation techniques for adjustable port ends

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Troubleshooting Port End Connections

Flange (i.e., ISO 6162 4-Bolt)

CONDITION	PROBABLE CAUSE(S)	RECOMMENDATION
Missing or improper O-ring	• Assembly/re-assembly oversight	• Replace with proper O-ring and re-tighten connection using incremental alternating tightening procedure
O-ring pinched or extruded	• Improper tightening procedure	• Replace O-ring and re-tighten connection using incremental alternating tightening procedure
Evidence of yielded or cracked flange head, tube or hose end	• Misaligned tube or hose connection	• Re-bend or re-route hose/tube lines to eliminate misalignment
Components do not mate or gap is too large	• Proprietary flange or pressure series matching problem	• Properly identify all components—most proprietary flanges use standard Code 61/62 bolt patterns and threads but are not usually interchangeable
Port has severe scratches or nicks in seal area	• Mishandling or abuse	• Resurface the port to remove scratches and nicks
Clamp halves are bent	• Over-pressurization or over-torque	• Replace clamp halves and tighten to proper torque
Bolts are bent	• Bolts are too weak or over-torqued	• Replace bolts with grade 8 or better; retighten to proper torque

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Tube End Assembly

The assembly of the tube end consists of the following two steps:

1. Tube end preparation (cutting, deburring and cleaning)
2. Assembly and installation

Tube End Preparation

Tube end preparation is a very critical step to assure the integrity of a tube assembly. Failure to properly perform this function can result in leakage. The three steps in proper tube end preparation are: cutting, deburring and cleaning.

Cutting

Cut tube square (within +/- 1°) using a circular toothed cut-off saw (see Fig. R11), or a hacksaw with a fine tooth blade guided by a Tru-Cut Saw Guide (Fig. R12) or other mitre-type saw guide.

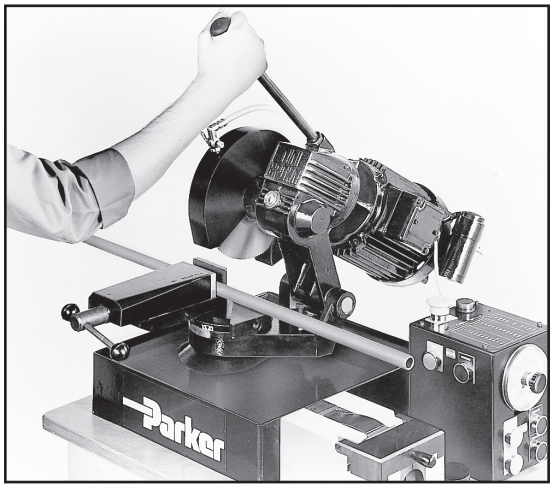

Fig. R11 – Cut-off Saw on Parker's TP432 or TP1025 Tube Preparation Center

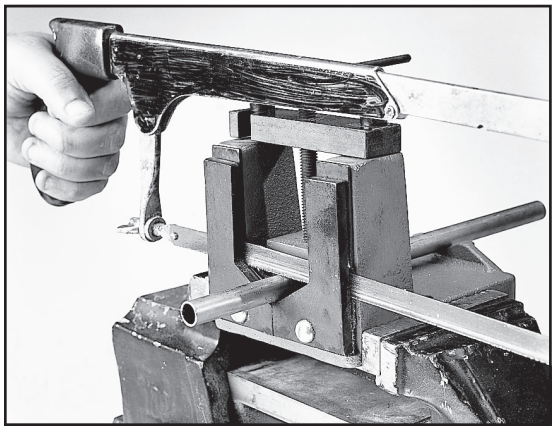

Fig. R12– Parker's Tru-Kut Sawing Vise used with hacksaw

A tube cutter may be used with soft tube such as copper and aluminum. It is not recommended for steel and stainless steel tube because it creates a large burr on the I.D., which is difficult to remove and creates flow restriction. Furthermore, if the tube needs to be flared or flanged, the build up on the ID can compromise the sealing surface. For a steel or stainless steel tube application, Fig. R13 illustrates a proper cut and an improper cut (with the improper cut performed by a tube cutter).

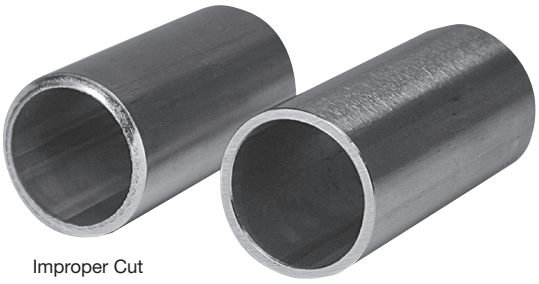

Fig. R13 – Samples of improper and proper cuts on steel tube

A square cut is essential to assure a leak-free connection. The following illustrations depict what will result from an uneven cut.

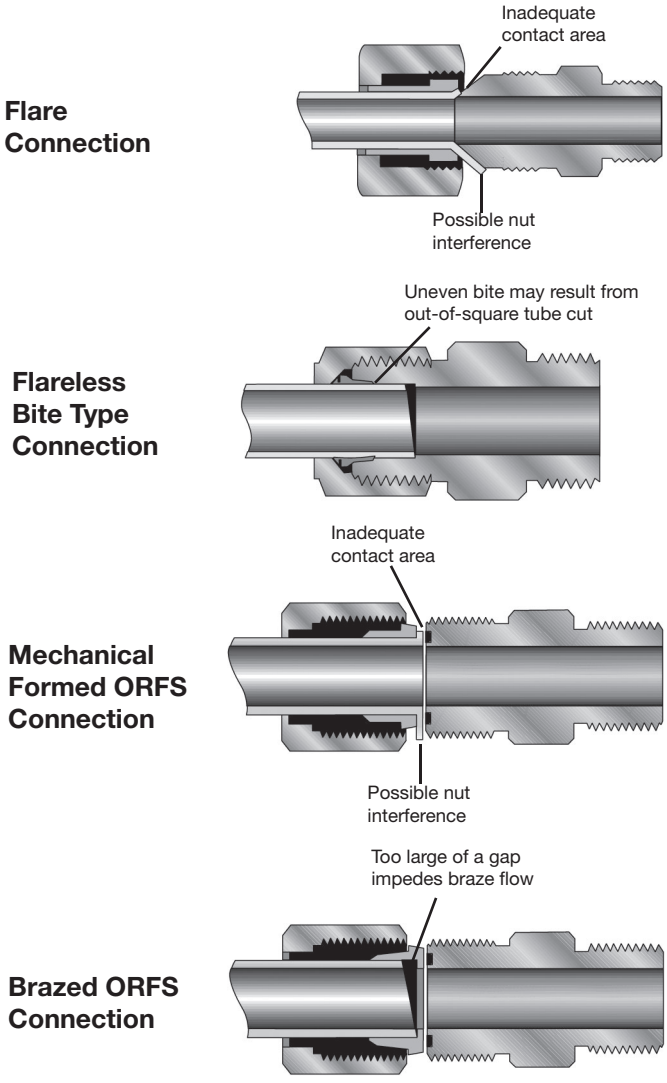

Fig. R14– Results of Uneven Tube Cuts

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Deburring

Lightly deburr the I.D. and O.D. of the tube end to remove burrs and sharp edges. Use a hand deburring tool or power deburring tool (shown on page Q22), or emery paper if using tube cutter (for soft tube). Use front mounted deburring tools if using TP432 or TP1025 tube preparation center found on page Q56.

Note: Point tube end downward during deburring to keep chips from entering the tube.

Cleaning

Remove metal chips from I.D. with a brush or compressed air. Wipe the I.D. and the O.D. of the deburred tube end with a clean rag. Debris present in the tube end can result in system contamination or can get embedded into the flange or flare, causing imperfections that are potential leak paths.

Seal-Lok O-Ring Face Seal Fittings

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

1. Cutting, deburring and cleaning the tube
2. Sleeve Attachment
3. Inspection of sleeve attachment
4. Final installation

For cutting, deburring and cleaning see pages R12-R13, or refer to the detailed blog post and video on www.TFDtechconnect.com.

For recommended minimum and maximum tube wall thickness for Seal-Lok fittings, please refer to Table R9 and R10 on page R14.

Sleeve Attachment

Attaching the sleeve to the tube end is the next critical assembly step. This can be accomplished by two methods: flanging or brazing.

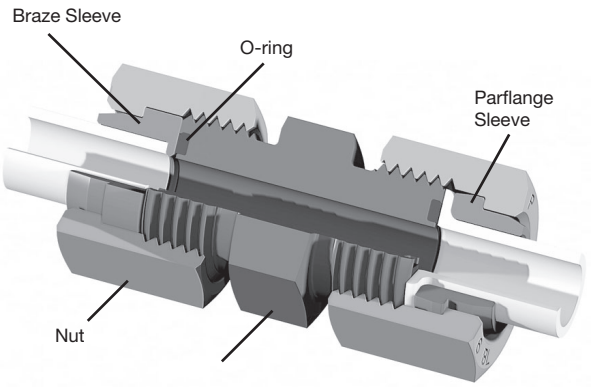

Fig. R15 – Seal-Lok Union cutaway with flanged and brazed assemblies

Flanging

The flanging method requires the use of an appropriate forming machine to create the flange or flat face on the tube end. Since the flat face of the flanged tube seals against the O-ring within the fitting groove, it is important that this surface be relatively smooth. Proper tube end preparation (cutting, deburring and cleaning) will help accomplish this goal.

The Parker Parflange® machines utilize an orbital cold forming process to produce a flat, smooth, rigidly supported 90° sealing surface on the tube end.

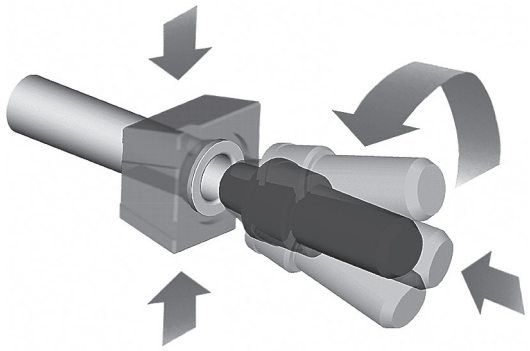

Fig. R16 – Parker's exclusive orbital spindle motion produces a perfect flange every time

Parker offers three Parflange machine options: ECO 25, 1025, and Pro 50. These models range in portability, cycle times, and tube size capability. For additional information on the Parflange machines and tooling, refer to section R of this catalog or see www.TFDToolSpec.com.

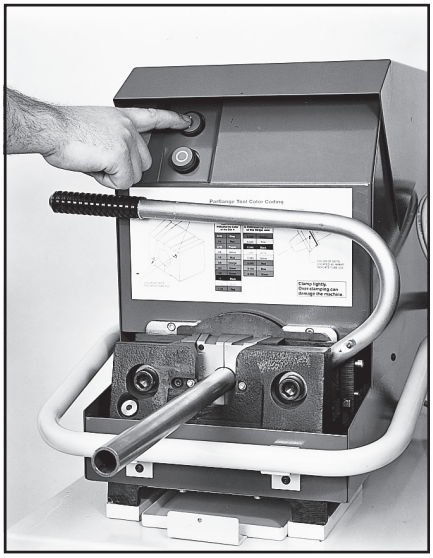

Fig. R17 – Parflange 1025 machine

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Flanging Steps:

1. Determine the extra cut-off length required for the Parflange process by referring to Tables R9 and R10. (Each table is only a guide. Variations in tube wall thickness and inconsistency in quality of tube cut-off may affect actual dimensions. User should verify actual extra tube cut-off length with one or two flanges prior to large scale flanging.)
2. Select the proper tooling for the tube size. The tube OD, wall thickness and material must be known for proper selection. Refer to Table R11 on page R15 for flanging capability by Parflange machine and availability of tooling
3. With the sleeve properly positioned within the die set, place the die set into the die holder of the machine.
4. Insert the tube through the die opening until it comes in contact with the tube stop. Do not forget to position the tube nut over the tube in the proper orientation, especially if the other tube end has already been flanged, or the tube has sharp bends.
5. Flange the tube as shown in Figure R17.

Note: For more information on Parflange procedures, machines, required tooling, etc., see www.TFDToolSpec.com.

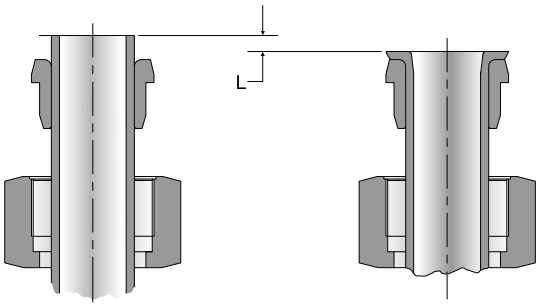

Fig. R18 – Extra cut-off length

Tube O.D. (in.)	Tube Wall Thickness – Inch										
	.028	.035	.049	.065	.083	.095	.109	.120	.134	.156	.188
1/4	3/16	13/64	7/32								
3/8		5/32	3/16	13/64	15/64	1/4					
1/2		9/64	9/64	3/16	13/64	9/32	19/64	19/64			
5/8			11/64	3/16	13/64	1/4	17/64	17/64			
3/4			11/64	3/16	7/32	7/32	1/4	17/64	9/32		
1				3/16	3/16	13/64	15/64	1/4	19/64		
1 1/4				11/64	3/16	13/64	15/64	1/4	19/64	19/64	21/64
1 1/2				13/64	15/64	15/64	1/4	17/64	19/64	23/64	3/8

Table R9 – Extra tube cut-off length guide for inch tube

Tube O.D. (in.)	Metric Tube Outside Diameter – (mm)								
	6	8	10	12	16	20	25	30	38
1.0	3/16 5.2	7/32 5.7	1/8 3.1	5/32 4.1	9/64 3.6				
1.5	17/64 6.7	15/64 5.9	13/64 5.1	7/32 5.4	11/64 4.2				
2.0			13/64 5.3	15/64 6.1	3/16 4.9	7/32 5.4	15/64 6.1	17/64 6.6	9/32 7.2
2.5				17/64 6.7	7/32 5.5	15/64 6.1	1/4 6.4	19/64 7.6	
3.0					15/64 5.8	17/64 6.7	9/32 7.2	5/16 7.9	19/64 7.7
3.5						17/64 6.9	19/64 7.5	21/64 8.5	
4.0						9/32 7.2	5/16 8.0	11/32 8.6	11/32 8.7
5.0							11/32 8.8		3/8 9.4

Table R10 – Extra tube cut-off length guide for metric tube

Dimensions and pressures for reference only, subject to change.

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Another consideration prior to flanging is the minimum straight length to the start of a 90° bend. Table R11 provides this information.

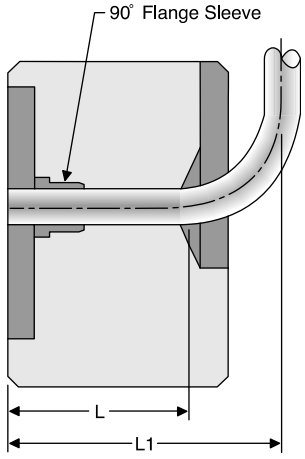

Fig. R19 – Minimum straight length to start of bend for 90° flanging

Tube O.D. Inch Sizes	Tube O.D. Metric Sizes	L* (in.)	L* (mm)	L1** (in.)	L1** (mm)
1/4”	6	1 5/16	35	3 1/8	79
5/16”	8	1 5/16	35	3 5/32	80
3/8”	10	1 5/16	40	3 3/16	81
1/2”	12	1 3/8	40	3 1/4	82
	15	1 3/8	40	3 5/16	84
5/8”	16	1 1/2	41	3 5/16	84
	18	1 5/8	42	3 11/32	85
3/4”	20	1 3/4	50	3 3/8	86
	22	1 7/8	50	3 7/16	87
	25	1 7/8	50	3 1/2	89
1”	28	1 7/8	50	3 9/16	90
	30	1 7/8	50	3 19/32	91
1 1/4”	32	1 7/8	50	3 5/8	92
	35	2	50	3 11/16	94
1 1/2”	38	2	50	3 3/4	95

Table R11 – Minimum straight length to start of bend for 90° Parker Parflange

Notes:

* L is the minimum straight length to the start of tube bend.

** L1 is the minimum centerline dimension necessary for 90° bent tube to clear the frame of the Parflange machine. In bending of the tubes, use radius blocks which will ensure that L1 dimensions are met or exceeded.

Flange Inspection

The flange should be inspected for proper diameter and sealing surface quality. Table R12 provides the flange diameters for the different sizes. The sleeve can also be used as a quick gauge of the flange diameter. Visually compare the flange diameter to the tapered surface located at the front end of the sleeve (right behind the flange). The large diameter and small diameters at each end of this surface serve as the maximum and minimum flange diameter limits, respectively.

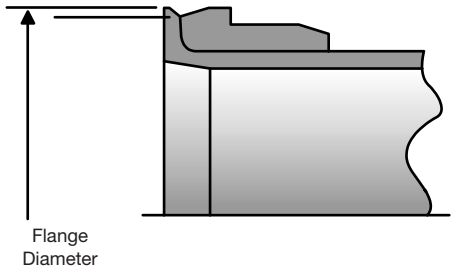

Fig. R20 — Flange diameter

Inch Tube O.D. (in.)	Metric Tube O.D. (mm)	Flange Diameter (in.)
1/4	6	.478 / .502
3/8	10	.594 / .620
1/2	12	.719 / .744
5/8	14, 15, 16	.875 / .923
3/4	18, 20	1.048 / 1.096
1	22, 25	1.298 / 1.346
1-1/4	28, 30, 32	1.549 / 1.597
1-1/2	38	1.861 / 1.909

Table R12 – Flange dimensions

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Over-flanging will result in tube nut interference, as well as thinning of the flange tube end. Under-flanging reduces the contact area for sealing against the O-ring in the fitting.

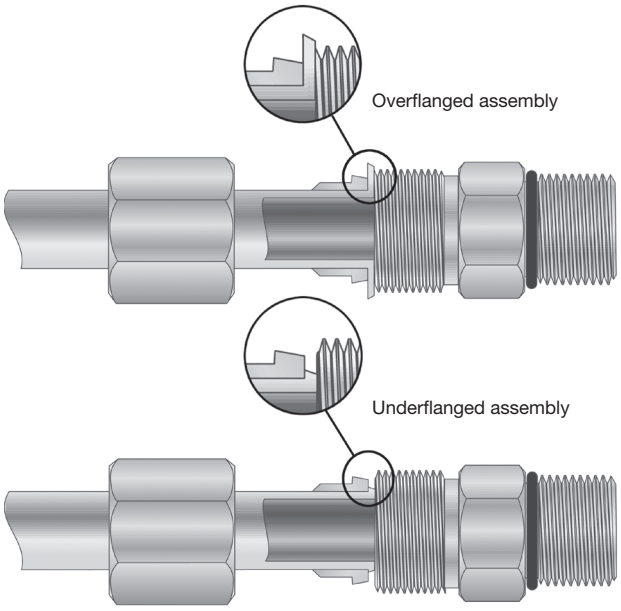

Fig. R21 – Overflanging and Underflanging

Advantages of Parflange process

There are numerous advantages to using the Parflange process over the braze or weld process:

- The Parflange process is several times faster than the brazing or welding methods. For instance, the 1025 model can produce flanges at a rate of 9 to 12 times the speed of comparable induction brazing.
- The Parflange process does not require any special pre- or post-flange cleaning of the tube and sleeve.
- Unlike brazing, the Parflange process does not require any flux, braze alloy, post braze cleaner or rust inhibitor. An environmentally safe lubricant applied to the flanging pin is the only additive associated with the Parflange.
- The Parflange process is inherently safe. It does not require open flame or any form of heating. Additionally, there is no emission of hazardous fumes, as is typical with welding and brazing.
- The Parflange process uses only a fraction of the energy needed for welding or brazing.
- The Parflange process accommodates the use of plated components (i.e., tube and sleeve), thus eliminating the need to electroplate assemblies after fabrication.
- The Parflange process eliminates the potential for leaks at the braze or weld joint.
- The Parflange process produces a burnished sealing surface, typically much smoother than the 125 micro-inch requirement of SAE J1453.

Brazing

Brazing is the other method of attaching the sleeve to the tube end. This process can be accomplished by using a multi-flame torch, as shown in Fig. R22, or an induction brazing unit. (Note: multi-flame torches and induction brazing units are not available through Tube Fittings Division). During the heating process, the pre-formed braze ring or wire-fed filler material is melted between the tube O.D. and the sleeve I.D., creating a strong bond between the two.

Fig. R22 – Multi-flame torch brazing

Brazing Steps:

1. Determine the tube length allowance using Table S13.

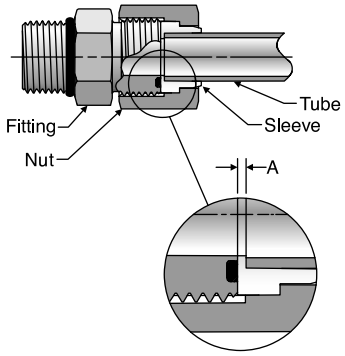

Fig. R23 – Tube length allowance

Nominal Tube O.D.		A
Inch	Metric	(in.)
1/4	6	0.04
3/8	8, 10	0.04
1/2	12	0.04
5/8	14, 15, 16	0.06
3/4	18, 20	0.06
1	22, 25	0.06
1 1/4	28, 30, 32	0.06
1 1/2	35, 38	0.06

Table R13 – Tube length allowance for brazing

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2. **Cleaning the tube end:** All oil and oxide build-up must be removed from the tube end for at least the length of the braze joint. Oil may be removed by using an oil-free solvent. Oxide build-up may be removed by pickling or by lightly sanding with an aluminum-free emery paper.
3. **Fixturing the parts for brazing:** Care should be taken so the braze fixture allows the sleeve to settle and bottom on the tube completely during heating. Since the Seal-Lok fitting sleeve is designed for a slip fit, this should happen easily. Short tubes can be brazed in the vertical position. On longer tubes, the joint may need to be in the horizontal position, requiring a slight nudge to seat the sleeve on the tube.
4. **Applying flux:** Apply proper flux to tube end (about 1½ sleeve lengths) and sleeve's face and outside surface. Insert appropriate braze ring in the sleeve and place the sleeve on end of the tube. The flux helps protect the parts from oxidizing and promotes braze flow.
5. **Heating the part:** Apply heat uniformly to the joint by using a multi-flame torch as shown in Fig. R22 or with an induction braze unit. Proper brazing involves heating the assembly to brazing temperature and flowing the filler metal through the joint. Heat should be applied broadly and uniformly to the tube as well as the Seal-Lok sleeve. Keep in mind that thicker fitting and tubing sections take longer to heat. The entire assembly should heat to brazing temperature at about the same time. The braze alloy will always flow towards the area of higher temperature. The pre-formed braze ring has been placed inside the joint area—the last area to reach melting temperature. Therefore, when you see the braze material flow to the outside of the joint, you know the joint is complete. If the sleeve does not settle, a slight pressure will cause the sleeve to settle, completing the braze joint.
6. **Cleaning the brazed joint:** After stopping heat application, allow about 10 seconds for the braze alloy to solidify. Then, immerse the joint in hot water (approx. 140°F.). To make cleaning easier, add braze cleaner to the hot water. This sudden cooling cracks the braze flux residue, making it easier to remove. Any remaining residue can be removed by careful wire brushing, making sure not to scratch the sealing surface of the sleeve.
7. **Corrosion protection after brazing:** This is an extremely important step following brazing and even more so following the use of a braze cleaner. Braze cleaners available from Parker are used to facilitate the removal of residual flux after brazing, however are generally corrosive. The residue left on the surface by the cleaner, especially on the I.D. of the tube, can cause rusting in carbon steel tubes rather quickly, if it is not neutralized. Therefore, it is important to neutralize the cleaner residue after cleaning with a solution such as Bernite 136[2] (mix 4 ounces of Bernite 136 with one gallon of water). If the brazed parts are not to be used soon after brazing, a coating of rust inhibitors such as WD-40[3] or SP-350[4] is recommended for the braze and heat affected area.

2) Products of Bernite Products, Inc. 84 New York, Westbury, NY 11500 (516) 338-4646.
3) A product of WD-40 Company, San Diego, CA 92220.
4) A product of CRC Chemicals, USA, Warminister, PA 18974 (215) 674-4300

Inspection of Brazing

Inspect the braze for a fillet all the way around the tube at the far end (small diameter) of the sleeve.

Caution: If there are gaps in the fillet, the joint may not be sound. In this case, rebrazing is recommended. Remove the sleeve and rebraze a new one in its place.

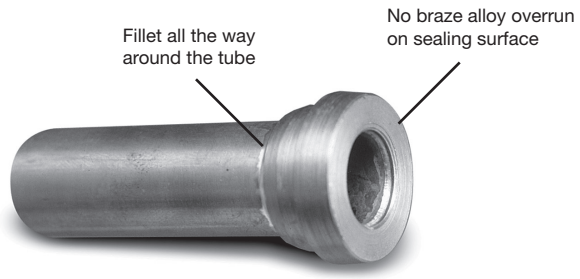

Fig. R24 – Brazed fitting

Inspect the sealing surface. There should be no braze alloy overrun or build-up on this surface. If there is build-up, remove it with emery paper, being careful not to scratch the seal surface. If this is not possible, remove the old sleeve and rebraze a new one in its place.

Final Installation

The following steps are required for final installation of the Seal-Lok fitting:

1. Ensure that the seal is properly installed in the groove of the face seal. Parker provides Seal-Lok fittings with pre-installed trap seals on the grove of the face seal. However, if the seal is being replaced, standard round O-Ring face seal O-rings can be found on page M4, in section M. Since Seal-Lok is machined with the Captive O-ring Groove (CORG), it is recommended that a CORG assembly tool be utilized, as shown in Fig. R25. To properly use the assembly tool, follow these steps

- Position the O-ring inside the CORG assembly tool against the pusher.
- Position the tool over the Seal-Lok tube end until the end is bottomed in the tool.
- Push the plunger of the tool until the O-ring is inserted and seated into the groove.

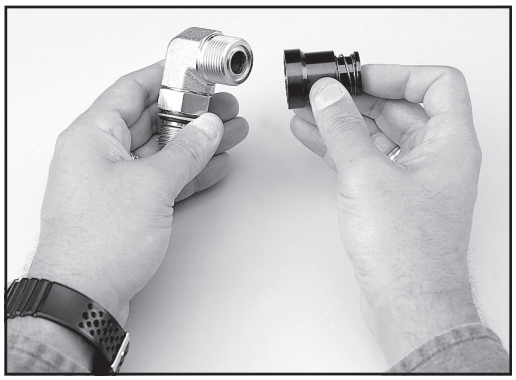

Fig. R25 – O-Ring installation using the CORG assembly tool

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2. Place the tube assembly against the fitting body so that the flat face of the flange tube (or braze sleeve) comes in full contact with the O-ring. Thread the nut onto the fitting body by hand and tighten it to the recommended torque represented in Table R14. If torque wrenches are not available, an alternate method of assembly is the Flats From Wrench Resistance (F.F.W.R.) method. Wrench tighten the nut onto the fitting body until light wrench resistance is reached. Tighten further to the appropriate F.F.W.R. value.

   Note: A second wrench may be required to prevent the fitting from moving during assembly.

Caution: The torque method of assembly is the preferred method of assembly for Seal-Lok fittings. It reduces the risk of human error during assembly that is more prevalent in the Flats From Wrench Resistance (F.F.W.R.) method. To ensure the most accurate assembly of the Seal-Lok fitting, it is strongly recommended that the torque method be utilized.

O.D.		SAE Dash Size	Tube Side Thread Size (UN/UNF)	Tube Side Assembly Torque (+10% -0%)			Flats from Wrench Resistance (F.F.W.R.)	
(in.)	(mm)			in.-lb.	ft.-lb.	N-m	Tube Nuts	Swivel & Hose Ends
1/4	6	-4	9/16-18	220	18	25	1/4 to 1/2	1/2 to 3/4
3/8	8, 10	-6	11/16-16	360	30	40	1/4 to 1/2	1/2 to 3/4
1/2	12	-8	13/16-16	480	40	55	1/4 to 1/2	1/2 to 3/4
5/8	14, 15, 16	-10	1-14	—	60	80	1/4 to 1/2	1/2 to 3/4
3/4	18, 20	-12	1 3/16-12	—	85	115	1/4 to 1/2	1/3 to 1/2
1	22, 25	-16	1 7/16-12	—	110	150	1/4 to 1/2	1/3 to 1/2
1 1/4	28, 30, 32	-20	1 11/16-12	—	150	205	1/4 to 1/2	1/3 to 1/2
1 1/2	35, 38	-24	2-12	—	230	315	1/4 to 1/2	1/3 to 1/2
2	50	-32	2 1/2-12	—	375	510	1/4 to 1/2	1/3 to 1/2

Table R14 – Seal-Lok assembly torque and F.F.W.R. For brass, aluminum (and other soft metals) decrease torque value by 35%, however F.F.W.R. is the same.

Note: Assembly torque values are for unlubricated carbon steel components and properly lubricated stainless steel components. All stainless steel Seal-Lok tube nuts have an anti-seize lubricant to prevent galling during assembly. No additional lubricant is needed unless the tube nuts are washed or heated above 150ºF.

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FastSeal Assembly Instructions and Troubleshooting

FastSeal assembly consists of the following steps:

1. Prep - cutting, deburring and cleaning of the tube
2. Pre-setting of the bite ring
3. Pre-set inspection
4. Final installation

1. Prep

To start, please select tubing material, OD, wall thickness and pressure using Table R15.

Part Number	TUBE O.D.	Low Carbon Steel Tube Walls (in)[1]								
		0.028	0.035	0.049	0.058	0.065	0.083	0.095	0.109	0.120
Carbon steel fittings used with low-carbon steel tube walls (in)										
4 TLFA-S	1/4	2,750	3,350	5,150	6,200	7,000	-	-	-	-
6 TLFA-S	3/8	-	2,250	3,300	3,950	4,500	5,900	6,800	7,850	-
8 TLFA-S	1/2	-	-	2,400	2,900	3,250	4,300	4,950	7,750	-
12 TLFA-S	3/4	-	-	-	-	2,100	2,750	3,150	3,700	4,100
Part Number	**TUBE O.D.**	**304/316 Stainless Steel Tube Walls (in)[1]**								
		0.028	**0.035**	**0.049**	**0.058**	**0.065**	**0.083**	**0.095**	**0.109**	**0.120**
4 TLFA-SS	1/4	4,650	5,900	8,600	10,350	11,700	-	-	-	-
6 TLFA-SS	3/8	-	3,800	5,500	6,500	7,500	9,850	11,400	11,400	-
8 TLFA-SS	1/2	-	-	4,000	4,800	5,450	7,150	7,400	7,400	7,400

Tube walls shown are recommended for Fastseal. Pressure rating shown MAY be de-rated, verify application with listed tube wall pressure in table before use.

For proper tube end preparation see the Assembly and Installation section or ***watch our techConnect Tube End Preparation Video.***

⚠ CRITICAL STEP:

A heavy deburr, per Figure 1 of at least 1 mm on the tube is recommended to prevent damage to the internal O-ring. Ensure tube is clean and all chips and debris have been removed from the tube. The deburr dimension can be checked visually (roughly the thickness of a coin) or with the depth gauge on the back end of the marking tool.

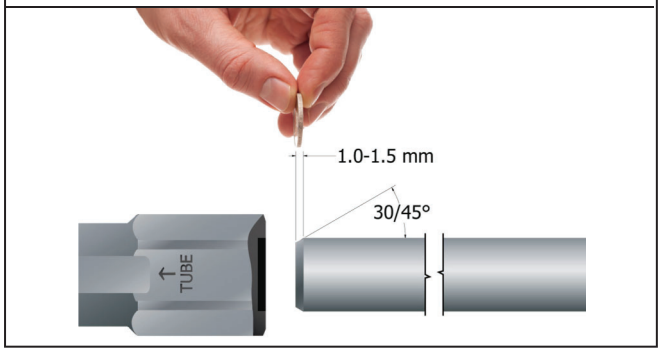
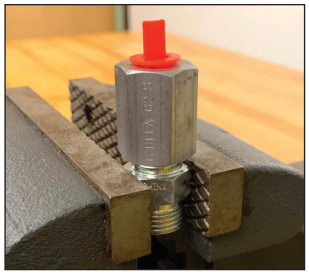


Fig. R26 – Recommended deburr

2. Pre-Set

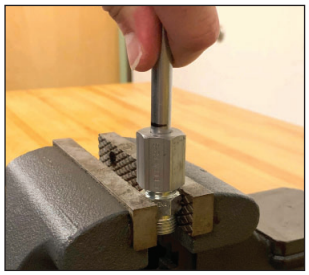
FastSeal connections require pre-setting the bite ring that can be accomplished by hand with a wrench and is best done with the assistance of a fixed vice and assembly mandrel.

Step 1 – Place marking tool on tube until it bottoms out. Mark around OD as shown. If marking tool is not available, use insertion depths shown in **Table R16.**



Step 2 – Lightly thread FastSeal nut onto fitting body or mandrel hand tight. This is best completed with the assistance of a fixed vice if available.

Step 3 – Lubricate the end of the tube with hydraulic oil to help with insertion in the next step.



Step 4 – Insert the tube into the **FastSeal** nut to the tube depth mark. Twist and push tube to aid the insertion. You will feel the tube pop past the O-ring and bottom out.

Step 5 – Now tighten the nut finger tight and then mark the nut and body as shown to assist with the FFFT preset.

Step 6 – Tighten the nut to specified FFFT of 7-8 flats. You should feel a perceptible torque rise around 7 flats.
For SS nuts, if torque rise is too high before reaching 7 flats, loosen the nut, lubricate threads with anti-seize and retighten until reaching the 7-8 FFFT.

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Tube OD	Depth - in (mm)
1/4”	0.62 (16)
3/8”	0.66 (17)
1/2”	0.71 (18)
3/4”	0.79 (20)

Table R16 – Tube insertion depths when not using the marking tool

3. Pre-set Inspection

The gap closure is an important visual inspection to make after presetting the **FastSeal** nut. A “closed gap” can vary from 0-0.01” (0-0.25mm). This small gap may appear due to spring back of the material and will close when the parts are tightened at final assembly.

Loosen and back off nut to inspect the sleeve gap to ensure it has closed. (see Fig. R27).

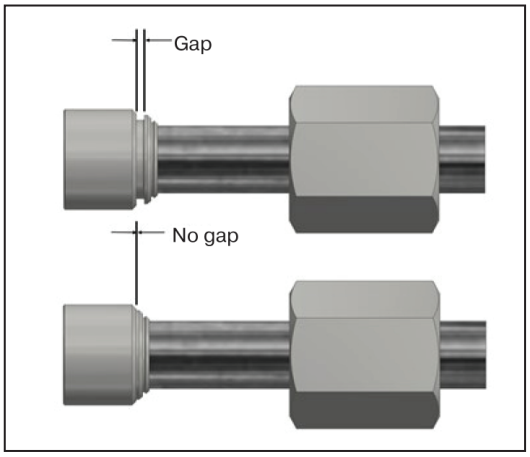

Fig. R27 – Gap Closure Inspection Reference

4. Installation

Once the gap is confirmed closed, assemble tube to fitting body and torque to the values shown in Table R17.

Tube OD	Final Assembly Torque in-lb (Nm) + 10%
1/4”	220 (25)
3/8”	360 (40)
1/2”	480 (55)
3/4”	1020 (115)

Table R17 – Final Assembly Torque

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FastSeal Troubleshooting

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Unsure if tube is bottomed	Use tube marking tool or insertion depths in **Table R16** to mark tube prior to insertion and to identify if you have met appropriate depth when tube is inserted into nut.
Unable or difficult to push tube into nut	Tube may be oversized or oval. Use tube making gauge to check for correct size and ovality. If tube does not fit in gauge do not use, select another tube and use gauge to verify the size and ovality before using. **OR** Ensure nut was not tightened more than finger tight onto fitting or mandrel body before inserting tube. Do not wrench tighten nut before tube is fully inserted this may cause bite ring to begin to preset, interfering with tube insertion.
Tube will not push to marked depth on tube	Avoid O-ring damage, **DO NOT FORCE TUBE**. Remove tube and ensure tube is properly deburred to at least 0.040in (1.0 mm) and is cleaned thoroughly. Inspect the tube to ensure it is round, within dimensional specs (should easily fit in tube marking gauge)and has no burrs. Ensure a small amount of oil is applied to end of tube before inserting, use slight twist when inserting. **DO NOT FORCE, DO NOT USE A HAMMER.**
Gap not closed after presetting	If gap of more than 0.01in (0.25mm) is detected, reassemble to last marked position, tighten nut ½ additional flat, inspect gap for closure.
Leaks at low pressure	Internal O-ring may be damaged. To replace seal, please contact division for assistance.
Leaks at high pressure	Inspect the ferrule and sleeve to confirm there was no gap after presetting, tighten until gap is 0-01". Internal O-ring may be damaged, to replace contact Division for assistance. Ensure connection was tightened to proper Seal-Lok assembly torque per table 3. Confirm ORFS seal is not damaged or missing.
Tube moves in nut after presetting or final assembly	Preset was not done correctly. **DO NOT USE CONNECTION.** Remake tube assembly.
Tube pulls out of nut after preset	Preset was not done correctly, tube too hard. **DO NOT USE CONNECTION**. Check tube material, wall thickness and size. FastSeal nuts are intended for use with low carbon steel seamless or DOM tube intended for hydraulic applications (reference SAE J524/J525).
Unsure what tubes to use	**FastSeal** Carbon Steel nuts are intended for use only with low carbon steel seamless or DOM tube intended for hydraulic applications (reference SAE J524/J525). FastSeal Stainless Steel nuts are intended for use only with 304 or 316 stainless steel seamless or DOM tube Use of the correct tube wall is critical to meet performance criteria. Recommended tube walls and pressure can be found in Table R15. Never mix carbon and stainless steel components and tubing.

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Seal-Lok Troubleshooting Guide

O-Ring Face Seal

CONDITION	PROBABLE CAUSE(S)	RECOMMENDATION
Immediate leakage when system is pressurized	• Improper tightening of joint	• Check for O-ring damage and re-tighten connection to the recommended torque value
Under-flanged assembly	• Undersized tube diameter resulting in tube slippage during flanging • Die gripping surface is worn or dirty	• 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	• Sleeve is positioned incorrectly in die	• Check for proper positioning of sleeve in die; if over-flanged, replace tubing
Flange out-of-round	• Tubing was not cut properly • Tube was not properly supported during flanging • Tubing is eccentric	• Cut tubing within 90° ±1° • Support tubing so that tube end is perpendicular to tube stop during flanging • Replace with quality tubing • Replace out-of-round flanges
Cracked flange	• Tubing too hard	• Replace tubing using recommended quality tube
Scored, pitted flange	• Improper deburring and cleaning of tube prior to flanging • Flange pin not cleaned and lubricated properly	• Replace flange using proper deburring and cleaning recommendations • Keep flanging pin clean and working surfaces well lubricated.
Leakage at braze joint	• 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	• 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	• Misalignment or improper fit • Damaged, pinched, improper, or missing O-ring • Extruded O-ring • Damaged fitting • Braze overflow on sealing surface	• Align tube end and connecting fitting properly before tightening tube nut, holding the flat face of the mating fitting against O-ring while tightening • Replace O-ring, properly installing it in the face seal groove • Replace O-ring and check for proper alignment and pressure surges exceeding rated pressure of fitting; tighten the nut to recommended torque or replace fitting if threads or sealing surface is grossly damaged. • Remove and replace sleeve which has braze overflow on its sealing surface.

Table R18 – Seal-Lok Troubleshooting guide

Dimensions and pressures for reference only, subject to change.

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Triple-Lok 37° Flare Fittings

For leak-free performance, the Triple-Lok fitting requires the following steps:

1. Cutting, deburring and cleaning of the tube
2. Flaring
3. Flare inspection
4. Installation

> **Caution:** Use only seamless or welded and drawn tube that is fully annealed for flaring and bending. (See page S17 for tube/fitting material compatibility information.)

For proper tube end preparation see pages R12-R13, or refer to the detailed blog post and video on www.TFDtechconnect.com.

For the recommended minimum and maximum tube wall thickness for Triple-Lok fittings, please refer to Table S16 on page S27.

Flaring

Several flaring methods are available, ranging from simple hand flaring to hydraulic/electric power flaring. Various tools for flaring are shown on pages Q31 through Q34. Power flaring is the preferred method as it is quicker and produces more accurate and consistent flares. Hand flaring should be limited to places where power flaring tools are not readily available. The Parflange machines shown on page Q23 also flare tube with an orbital flaring process and provide the best flare for steel and stainless steel tube.

Prior to flaring, determine the tube length allowance using Table R19. This tube length allowance should be added to the cut tube length to allow for the "loss" of tube caused by flaring.

Nominal Tube O.D. (in.)	Nominal Tube O.D. mm	A (in.)
1/8	—	0.07
3/16	—	0.08
1/4	6	0.09
5/16	8	0.08
3/8	10	0.08
1/2	12	0.12
5/8	14, 15, 16	0.13
3/4	18, 20	0.15
7/8	22	0.15
1	25	0.15
1 1/4	30, 32	0.20
1 1/2	38	0.18
2	42	0.28

Table R19 — Tube length allowance

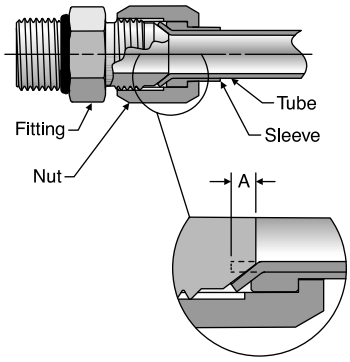


Fig. R28 — Tube length allowance

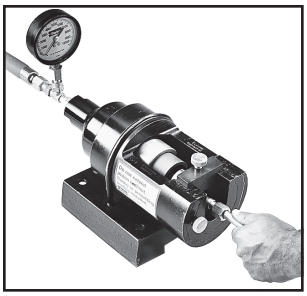


Fig. R29 – Flaring with Hydra-Tool

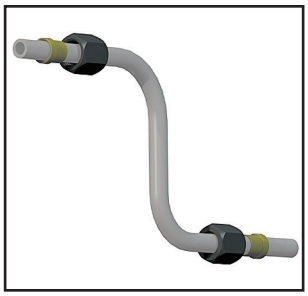


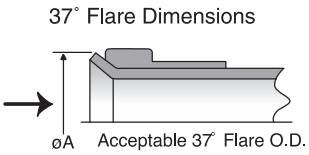
Fig. R30– Nuts and sleeves assembled before flaring

Flare Inspection

Inspect flare for dimensions and surface quality. Table R20 shows the proper flare dimensions. The sleeve can also be used for a quick check of the flare dimensions as shown in Fig. R31.

Inch Tube O.D. (in.)	Metric Tube O.D. (mm)	37° Flare Diameter ØA (in.)
1/4	6	.340/.360
5/16	8	.400/.430
3/8	10	.460/.490
1/2	12	.630/.660
5/8	15 & 16	.760/.790
3/4	18 & 20	.920/.950
1	25	1.170/1.200
1 1/4	30 & 32	1.480/1.510
1 1/2	38	1.700/1.730

Table R20 — 37° Flare Dimensions



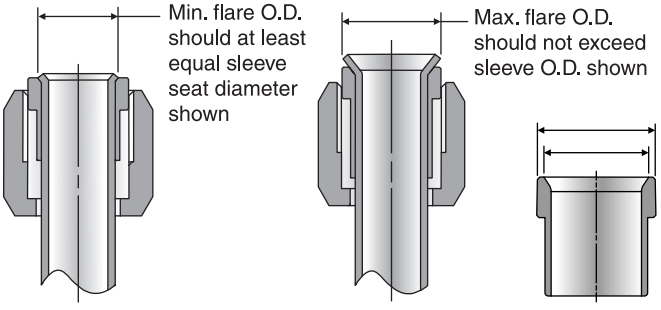


Fig. R31 – Comparing flare O.D. with sleeve seat and O.D.

Flare tube end using one of the flaring tools and following its operating instructions or see www.TFDToolSpec.com. Fig. R29 shows flaring with Hydra-Tool.

> **Note:** Be sure to insert a nut and a sleeve in proper sequence and orientation before flaring either end of a bent tube, or second end of a straight tube (see Fig. R29).

Underflaring (see Fig. R32) reduces contact area causing excessive nose collapse and leakage in extreme cases the tube may pull out under pressure.

Overflaring (see Fig. R32) causes tube nut thread interference, either preventing assembly altogether, or giving a false sense of joint tightness resulting in leakage.

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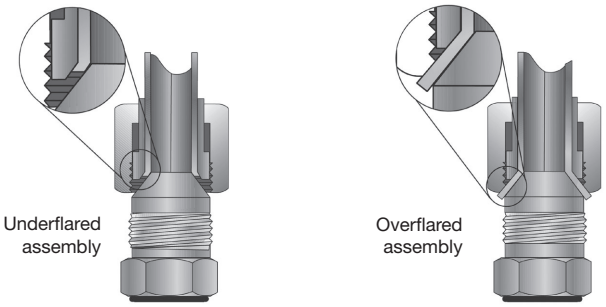

Fig. R32 – Underflaring and overflaring

The flare must be reasonably square and concentric with the tube O.D. Its surface must be smooth, free of rust, scratches, splits, weld beads, draw marks, embedded chips, burrs or dirt. If the flare does not meet the above requirements, cut it off, determine the probable cause from the troubleshooting guide shown in Table R26, take corrective action and re-flare.

Installation

Proper installation is critical for a trouble free operation. Improper flaring or installation causes over half of the leakage with flared fittings.

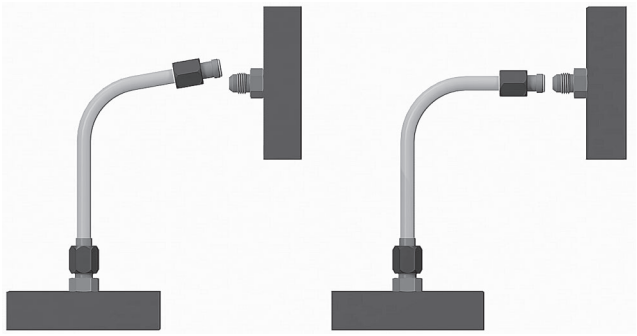

Fig. R33 – Improper bend and short tube

Align the tube on the flare (nose) of the fitting body and tighten the nut using one of two methods described below.

1. Flats from Wrench Resistance (FFWR) or “Flats” method
2. Torque method

> **Note:** Do not force an improperly bent tube into alignment (Fig. R31) or draw-in too short a tube using the nut. It puts undesirable strain on the joint leading, eventually, to leakage.

Flats Method

Tighten the nut lightly with a wrench (approximately 30 in.lb.), clamping the tube flare between the fitting nose and the sleeve. This is considered the Wrench Resistance (WR) position. Starting from this position, tighten the nut further by the number of flats from Table R22. A flat is referred to as one side of the hexagonal tube nut and equates to 1/6 of a turn.

This Flats method is more forgiving than the torque method. It circumvents the effects of differences in plating, lubrication, surface finishes, etc., that greatly influence the torque required to achieve proper joint tightness or clamping load. Therefore, it is recommended to use this method wherever possible, and especially where the plating combination of components is not known, and during maintenance and repair where the components may be oily. Use Table R21 as a guide for proper tightening method.

Condition	Recommended Tightening Method
1. Plating of all components is the same.	Either method is acceptable. Use Table R22.
2. Plating is mixed.	Use FFWR method.
3. Plating of nut and sleeve or hose end is unknown.	Use FFWR method.
4. Parts are oily.	Use FFWR method.
5. Stainless or brass components.	Use FFWR method.

Table R21 – Joint tightening method guide

Parker also recommends that wherever possible, the step of marking the nut position relative to the body should be done. This step serves as a quick quality assurance check for joint tightening. To do this, at the initial wrench resistance position, make a longitudinal mark on one of the flats of the nut and continue it on to the body hex with a permanent type ink marker as shown in Fig. R34a. Then, at the properly tightened position, extend the previous mark on the nut hex to the body hex, as shown in Fig. R34b.

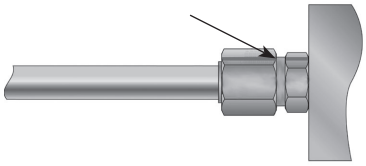

Fig. R34a – Tighten Joint to Wrench Resistance (Approximately 30 in-lb). Make reference mark on nut and fitting body.

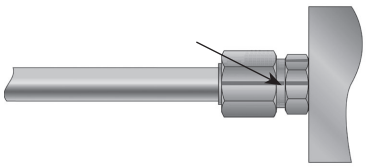

Fig. R34b – For initial assembly only, tighten by number of flats recommended in Table R22. Make a second reference mark on fitting body, lined up with mark on nut; 1 FFWR shown. See page R25 for reassembly procedure.

These marks serve two important functions:

1. The displaced marks serve as a quick quality assurance check that the joint has been tightened.
2. The second mark on the body serves as a proper tightening position after a joint has been loosened.

The flats method is slower than the torque method, but it has the two distinct advantages described earlier: circumvention of plating differences and a quick visual check for proper joint tightening.

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Torque Method

With proper tube flare alignment with the nose of the fitting, tighten the nut to appropriate torque value in Table R22. This method is fast and accurate when preset torque wrenches are used. Consistent component selection is recommended so that the effects of dissimilar plating is not an adverse factor in joint integrity. This makes it desirable for high production assembly lines. However, a joint assembled using the torque method can only be checked for proper tightening by torquing it again.

> **Note:** This method should not be used if the type of plating on the fitting and mating parts (sleeve + nut or hose swivel) is not known. The torque method should not be used for lubricated or oily parts as improper clamping forces may result. Over-tightening and fitting damage may occur as a result.

Triple-Lok Reassembly Method

Prior to loosening the joint, make a reference mark as seen in Fig. R34b. After the joint is loosened, this reference mark will represent the correct tightening position upon reassembly. When tightening the joint, ensure the mark on the nut lines up with, or is slightly past, the mark on the fitting body. Torque method is not recommended for reassembly.

How many times can you reassemble a 37-degree flare fitting? Read our article for what you need to know.

Tube O.D. (in.)	Tube O.D. (mm)	SAE Dash Size	Thread Size	Assembly Torque* (+10% -0) in. lb.	Assembly Torque* (+10% -0) ft. lb.	Tube Connection FFWR	Swivel Nut or Hose Connection FFWR
1/8	–	-2	5/16-24	35	3	—	—
3/16	–	-3	3/8-24	65	5	—	—
1/4	6	-4	7/16-20	155	13	2 1/2	2
5/16	8	-5	1/2-20	165	14	2	2
3/8	10	-6	9/16-18	265	22	2	1 1/2
1/2	12	-8	3/4-16	505	42	2	1 1/2
5/8	14, 15, 16	-10	7/8-14	720	60	1 1/2	1 1/2
3/4	18	-12	1 1/16-12	1000	84	1 1/2	1 1/4
7/8	22	-14	1 3/16-12	1200	100	1 1/2	1 1/4
1	25	-16	1 5/16-12	1415	118	1 1/2	1
1 1/4	28, 30, 32	-20	1 5/8-12	2015	168	1	1
1 1/2	35, 38	-24	1 7/8-12	2340	195	1	1
2	42, 50	-32	2 1/2-12	3180	265	1	1
2 1/2	–	-40	3-12	—	—	1	1

Table R22 – Triple-Lok assembly torques and FFWR

Notes:

1. Assembly Torque: Torque values are for unlubricated carbon steel components and properly lubricated stainless steel components. All stainless steel Triple-Lok tube nuts have an anti-seize lubricant to prevent galling during assembly. No additional lubricant is needed unless the tube nuts are washed or heated above 150ºF. Stainless steel fittings use the upper limit of torque range.
2. FFWR: The Flats From Wrench Resistance or "Flats" method is recommended for steel, stainless steel and brass components. Torque and FFWR: Torques and FFWR shown in the chart are for use with the tube materials, wall thickness, etc. recommended by Parker Hannifin Tube Fittings Division for use with Parker Triple-Lok fittings.
3. For brass and aluminum fittings, use approximately 65% of the torque values shown, unlubricated, however FFWR is same for all materials.
4. Reference Fig. R34a and R34b for example of FFWR method.
5. FFWR values are for initial assembly only.

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Hydra-Tool

Recommended Flaring Pressures For Metric Tube

Size (mm)	Material	Tube Wall Thickness 1.0	1.5	2.0	2.5	3.0	Min. Straight Length to Start of Bend
6	SS	400	700	1100			1-5/8
	Steel	300	500	800			
	Copper	150	200	350			
	Aluminum	150	200	350			
8	SS	500	800	1300			1-5/8
	Steel	400	600	1000			
	Copper	150	250	400			
	Aluminum	150	250	400			
10	SS	600	900	1500			1-5/8
	Steel	500	700	1100			
	Copper	200	300	500			
	Aluminum	200	300	500			
12	SS	800	1200	2000	2500		2-3/16
	Steel	600	900	1500	1900		
	Copper	250	350	600	750		
	Aluminum	250	350	600	750		
16	SS	900	2000	2500	2800	3000	2-5/16
	Steel	680	1500	1900	2100	2300	
	Copper	275	600	750	800	900	
	Aluminum	275	600	750	800	900	
18	SS	1000	1700	2500	3100	3500	2-5/16
	Steel	750	1300	1900	2300	2700	
	Copper	300	500	750	900	1100	
	Aluminum	300	500	750	900	1100	
20	SS		1500	2400	3000	3400	2-7/16
	Steel		1100	1800	2300	2600	
	Copper		500	700	900	1000	
	Aluminum		500	700	900	1000	
25	SS			2400	3000	3400	2-7/16
	Steel			1800	2300	2600	
	Copper			700	900	1000	
	Aluminum			700	900	1000	
30	SS			2800	3400	4000	2-1/2
	Steel			2100	2600	3000	
	Copper			800	1000	1200	
	Aluminum			800	1000	1200	
32	SS				4000	4500	2-7/8
	Steel				3000	3400	
	Copper				1200	1300	
	Aluminum				1200	1300	
38	SS				4500	5800	2-7/8
	Steel				3400	4400	
	Copper				1300	1700	
	Aluminum				1300	1700	
42	SS				4700	6500	2-7/8
	Steel				3600	5200	
	Copper				1500	1900	
	Aluminum				1500	1900	
50	SS				5200	7200	2-7/8
	Steel				3900	6100	
	Copper				1900	2300	
	Aluminum				1900	2300	

Table R23 — Recommended Flaring Pressures, Metric Tube

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Hydra-Tool

Recommended Flaring Pressures For Inch Tube

Size	Material	Tube Wall Thickness								Minimum Straight Length To Start of Bend
		0.035	0.049	0.065	0.083	0.095	0.109	0.120	0.134	
4	SS	400	700	1100						1-5/8
	Steel	300	500	800						
	Copper	150	200	350						
	Aluminum	150	200	350						
5	SS	500	800	1300						1-5/8
	Steel	400	600	1000						
	Copper	150	250	400						
	Aluminum	150	250	400						
6	SS	600	900	1500						1-5/8
	Steel	500	700	1100						
	Copper	200	300	500						
	Aluminum	200	300	500						
8	SS	800	1200	2000	2500					2-3/16
	Steel	600	900	1500	1900					
	Copper	250	350	600	750					
	Aluminum	250	350	600	750					
10	SS	900	2000	2500	2800	3000				2-5/16
	Steel	680	1500	1900	2100	2300				
	Copper	275	600	750	800	900				
	Aluminum	275	600	750	800	900				
12	SS	1000	1700	2500	3100	3500	4000			2-5/16
	Steel	750	1300	1900	2300	2700	3000			
	Copper	300	500	750	900	1100	1200			
	Aluminum	300	500	750	900	1100	1200			
14	SS		1500	2400	3000	3400	4200			2-7/16
	Steel		1100	1800	2300	2600	3200			
	Copper		500	700	900	1000	1300			
	Aluminum		500	700	900	1000	1300			
16	SS			2400	3000	3400	4200	4800		2-7/16
	Steel			1800	2300	2600	3200	3600		
	Copper			700	900	1000	1300	1400		
	Aluminum			700	900	1000	1300	1400		
20	SS			2800	3400	4000	4800	5300		2-1/2
	Steel			2100	2600	3000	3600	4000		
	Copper			800	1000	1200	1400	1600		
	Aluminum			800	1000	1200	1400	1600		
24	SS				4000	4500	5300	5800		2-7/8
	Steel				3000	3400	4000	4400		
	Copper				1200	1300	1600	1700		
	Aluminum				1200	1300	1600	1700		
32	SS					3300	4000	5000	6300	3
	Steel					2500	3000	3800	4700	
	Copper					1000	1200	1500	1900	
	Aluminum					1000	1200	1500	1900	

Table R24 — Recommended Flaring Pressures, Inch Tube

Note: If tube size and wall thickness are not shown on this chart, see page S25, Table S14 for recommended tube size for use with 37° flare fittings.

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Triple-Lok Troubleshooting Guide

37° Flare

CONDITION	PROBABLE CAUSE(S)	RECOMMENDATION
Tube nut binds to tube flare Tube nut cannot engage the fitting body	• Flare too large or tube wall too heavy	• Flare new tube end using proper flare diameters
Flare is out-of-round (lopsided)	• Tube cut at an angle	• Re-cut tube, reasonably square, to 90° ± 1° and flare new tube end
Nicks, scratches, pock marks on tube flare of fitting	• Contaminants on tube ID or flaring cone/pin prior to flaring • Worn/damaged flaring cone/pin • Poor-quality tube	• Flare new tube end using proper tube preparation techniques • Assure that flare cone is clean • Replace poor-quality tube
Tube crack on flare	• Poor-quality welded tube; work-hardened tube; tube not annealed (too hard)	• Flare new tube end using appropriate tube (e.g.,fully annealed) and tube cutting methods
Tube nut bottoms out before seats are mated properly	• Unintentional use of 45° flare tube nut, or tube sleeve was omitted	• Use appropriate 37° flare components (body, nut and sleeve)
Immediate leakage from tube nut	• Connection may not be tightened properly (if at all)	• Check joint for appropriate FFWR or torque; retighten as appropriate
Tube nut continues to back off or loosen	• Damaged Fitting • Excessive vibration • Improper assembly torque	• Replace damaged fitting • Re-route or clamp properly • Assemble to appropriate torque
Damaged fitting and/or nose collapse, flow reduction	• Frequent assembly and disassembly or over-tightening	• Fitting should be replaced and tightened properly; avoid frequent assembly/disassembly

Table R25 — Triple-Lok Troubleshooting guide

Dimensions and pressures for reference only, subject to change.

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Ferulok Flareless Bite Type Fittings

Ferulok fitting assembly consists of the following steps:

1. Cutting, deburring and cleaning of the tube
2. Ferrule pre-set
3. Pre-set inspection
4. Final installation

For proper tube end preparation see pages R12-R13, or refer to the detailed blog post and video on www.TFDtechconnect.com.

For the recommended minimum and maximum tube wall thickness for Ferulok fittings, please refer to Table S16 on page S27.

Prior to pre-setting, determine the tube length allowance "A" using Table R26.

Nominal Tube O.D.	A
1/8	0.19
3/16	0.23
1/4	0.23
5/16	0.25
3/8	0.25
1/2	0.31
5/8	0.35
3/4	0.35
7/8	0.35
1	0.42
1 1/4	0.42
1 1/2	0.49
2	0.49

Table R26 — Tube length allowance

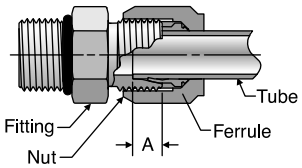


Fig. R35 — Tube length allowance

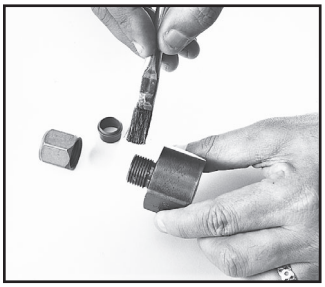
Ferrule Pre-set

Prior to final installation, the Ferulok fitting requires a pre-setting operation that creates a bite by the ferrule into the outer surface of the tubing. Pre-setting can be accomplished by two different methods: manually using a hardened Ferulset tool or the fitting body, or hydraulically using a Hyferset Tool or a Hydra-Tool.

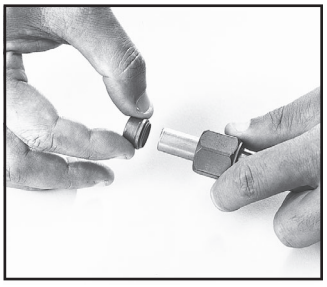
When using the Hyferset or Hydra-Tool method, the pressure build-up "bites" the ferrule into the tubing. When using the Ferulset or fitting body, thread the connection to finger tight and wrench an additional 1-3/4 turns. This will "bite" the ferrule into the tube.

Pre-setting using Ferulset Tool or Fitting Body

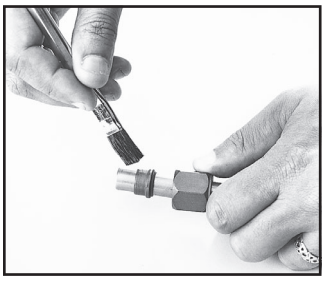
Ferulset pre-setting tools made from hardened steel are available for sizes 2 through 32. (See page Q43.) They are recommended over the fitting body because they can be used repeatedly to perform the pre-set operation. The fitting body can be used only once for pre-setting and should be used during final installation with the pre-set tube line. The following steps are required for proper pre-set of the ferrule using the Ferulset tool or fitting body.



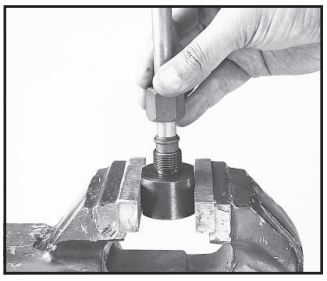
Step 1 – Lubricate thread and cone of Ferulset Tool (or fitting body).



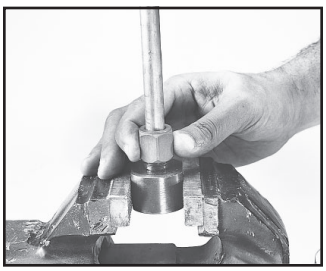
Step 2 – Slip nut and ferrule over deburred tube end. Be sure the long, straight end of the ferrule points toward tube end.



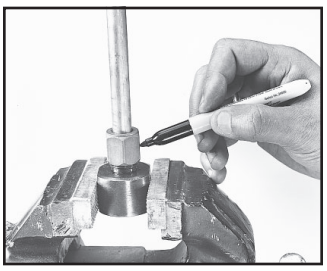
Step 3 – Lubricate ferrule with system fluid or a compatible lubricant. This ensures that the tooling won't stick to the ferrule.



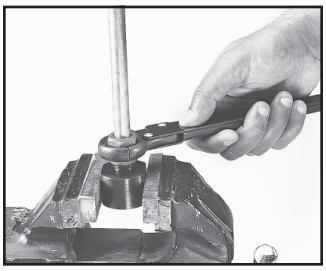
Step 4 – Bottom tube end firmly on internal shoulder of Ferulset Tool (or fitting body).



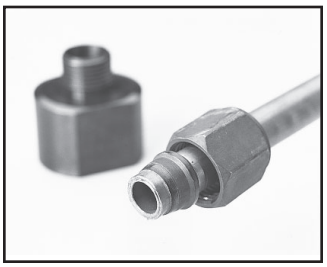
Step 5 – Manually screw nut onto Ferulset Tool or fitting body until finger tight.



Step 6 – Make reference mark on nut and tube.



Step 7 – Hold tube steady against internal shoulder of Ferulset Tool or fitting body and tighten nut an additional **1-3/4 turns.**



Step 8 – Loosen nut and check for proper pre-set. Use the following inspection criteria.

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Pre-setting with Hyferset Tool or Hydra-Tool

Pre-setting with hydraulic equipment (Hyferset or Hydra-Tool) is preferred for fittings larger than size 8 or large production quantities in any sizes.

For full instruction on the use of the Hyferset Tool (see Fig. R36), please refer to Bulletin 4393-B1, which is included with each shipment of the Hyferset Kit #611049C. For full instructions on the use of the Hydra-Tool, please refer to Bulletin 4392-B10. A22toolspec Bulletins and videos can be found at www.parker.com/TFD or www.TFDToolSpec.com.

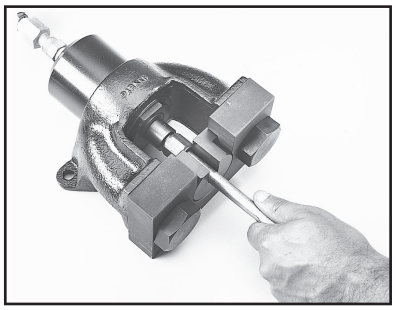

Fig. R36 – Hyferset tool

Pre-Set Inspection

All Ferulok fitting presets must be disassembled and inspected for proper ferrule pre-set before final installation. The following detailed inspection procedures must be followed regardless of the method used to pre-set the ferrule to the tube. (Refer to Fig. R37 for the five inspection points discussed below).

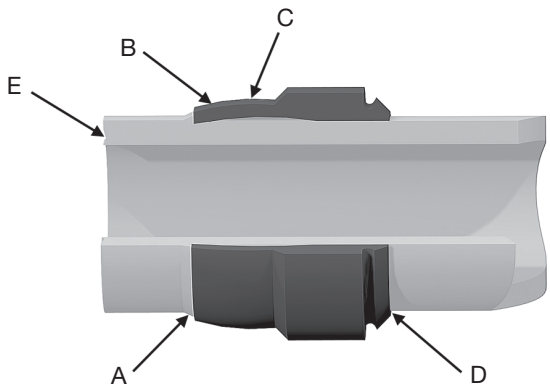

Fig. R37 – Ferulok preset inspection points

1. A ridge of metal (A) has been raised above the tube surface to a height of at least 50% of the thickness of the ferrule's leading edge, completely around the tube.
2. While the leading edge of the ferrule may be coined flat (B) there is a slight bow to the balance of the pilot section (C).
3. The tail or back end of the ferrule is snug against the tube (D).
4. There is a slight indentation around the end of the tube (E) that indicates the tube was bottomed in the tool or fitting during pre-setting.
5. Avoid rotating the ferrule. Steel ferrules should not be capable of moving back and forth along the tube beyond the bite area (a stainless steel ferrule will move more than steel because of it's spring back characteristics).

Caution: Wrench torque should never be used as the gauge for reliable Ferulok pre-set and/or assembly. The reliability of the pre-set and assembly of bite type fittings is dependent on the ferrule traveling a prescribed distance into the tapered fitting throat in order to bite into the tube and effect a strong grip and seal.

Installation

Use one of the following installation procedures, depending on the tooling used earlier to pre-set the ferrule to the tubing.

1. **Fitting body, Hyferset, Hydra-Tool, or Ferulset used to pre-set ferrule** – If the fitting body was used for pre-setting the ferrule, complete the final installation with the **same** fitting body. If one of the tools was used, select the compatible fitting body and lubricate* the threads. Tighten the nut until a sudden and noticeable wrench resistance is achieved. Then wrench an additional **1/6 to 1/4 turn** to complete the final assembly.
2. **Swivel nut assembly procedure (R6BU, C6BU and S6BU)** – For final assembly of swivel nut, a **3/4** turn from finger tight is required for all sizes.

*No additional lubrication is required with stainless steel fittings as the nuts are pre-lubricated.

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Hydra-Tool Pre-Setting Pressures for Ferulok Fittings[1) 2) 3)]

Tube Size	Wall Thickness – Steel							Wall Thickness – Stainless Steel						
	0.035	0.049	0.065	0.083	0.095	0.109	0.120	0.035	0.049	0.065	0.083	0.095	0.109	0.120
4	300	300	500	600	600	600		300	300	500	700	700	700	
6	300	500	600	700	700	700	700	300	500	700	700	700	700	800
8		500	700	800	900	1,000	1,000		600	700	1,000	1,000	1,100	1,100
10			700	900	1,000	1,100	1,100			800	1,000	1,100	1,300	1,300
12			900	1,000	1,100	1,100	1,300			1,000	1,100	1,300	1,300	1,500
14			1,000	1,100	1,100	1,300	1,500			1,000	1,300	1,300	1,500	1,600
16				1,100	1,300	1,500	1,600				1,500	1,500	1,600	1,600
20					1,500	1,600	1,800					1,600	2,000	2,000
24					1,800	2,000	2,300					2,100	2,300	2,300
32					2,800	2,900	3,300					3,100	3,300	3,300

Table R27 — Hydra-Tool Recommended Pre-Setting Pressures for Inch Tube

1) These values are provided as a guide only and normally will produce a satisfactory bite.
2) Ferulok pre-setting dies are positive stop dies. Use of above pressures is optional.
3) For wall thicknesses greater than those listed, contact the Tube Fittings Division.

Hyferset Pre-Setting Pressures for Ferulok Fittings[1)]

Tube Size	Wall Thickness — Steel							Wall Thickness — Stainless Steel						
	0.035	0.049	0.065	0.083	0.095	0.109	0.120	0.035	0.049	0.065	0.083	0.095	0.109	0.120
4	800	900	1,400	1,800	1,800	1,800		900	1,000	1,500	2,000	2,000	2,000	
6	900	1,400	800	2,000	2,000	2,000	2,200	1,000	1,500	2,000	2,000	2,000	2,000	2,500
8		1,600	2,000	2,500	2,700	3,000	3,200		1,800	2,200	3,000	3,000	3,500	3,500
10			2,200	2,700	3,000	3,500	3,500			2,500	3,000	3,500	4,000	4,000
12			2,700	3,000	3,500	3,500	4,000			3,000	3,500	4,000	4,000	4,500
14			3,000	3,500	3,500	4,000	4,500			3,000	4,000	4,000	4,500	5,000
16				3,500	4,000	4,500	5,000				4,500	4,500	5,000	5,000
18				4,000	4,500	4,500	5,000				4,500	5,000	5,000	5,500
20					4,500	5,000	5,500					5,000	6,000	6,000
24					5,500	6,000	7,000					6,500	7,000	7,000
28					7,000	7,500	8,000					7,500	8,000	8,500
32					8,500	9,000	10,000					9,500	10,000	10,000

Table R28 — Pre-Setting Pressures for Ferulok Fittings

1) Ferulok pre-setting dies are positive stop dies. Use of above pressures is optional.

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Ferulok Troubleshooting Guide

Problems with bite type hydraulic fittings are most often traced to faulty Pre-Set/Assembly procedure.

Problem / Probable Cause	Remedy
Tube not bottomed	Check for the indentation on the tube end or compare the length from the end of the tube to the front end of the ferrule of a known good assembly to that of the assembly in question. This assembly should be scrapped. (Fig. R38)
Shallow bite	Inspect for turned up ridge of material. A failure to achieve this ridge can be traced either to the nut not being tightened enough or the tube not being bottomed against the stop which allowed the tube to travel forward with the ferrule. In some instances this assembly may be re-worked. (Fig. R39)
Over-set ferrule	Too much pressure or more than 1 3/4 turns from finger tight were used to pre-set ferrule, or the nut was severely over-tightened in final assembly. This assembly should be scrapped. (Fig. R40)
Ferrule cocked on tube	The ferrule may become cocked on the tube when the tube end is not properly lined up with the body. Generally, this condition is caused by faulty tube bending. All bent tube assemblies should drop into the fitting body prior to make up. This assembly should be scrapped. (Fig. R41)
No bite	If all of the prior checks have been made and the ferrule still shows no sign of biting the tube, it may be that the tube is too hard. This assembly should be scrapped. (Fig. R42)

Table R29 – Ferulok fitting troubleshooting guide

Caution: Pre-set tools such as the Ferulset and Hyferset are preferred for pre-setting ferrules prior to final assembly. However, when an actual fitting body is used to pre-set the ferrule, that body should be connected only to the specific ferrule it was used to pre-set.

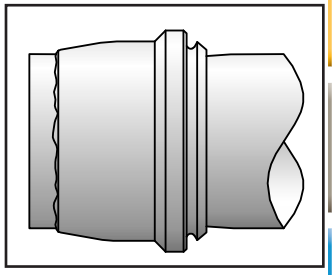

Fig. R38 – Tube not bottomed

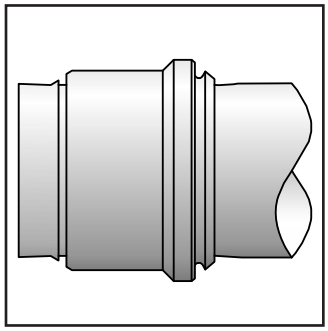

Fig. R39 – Shallow bite

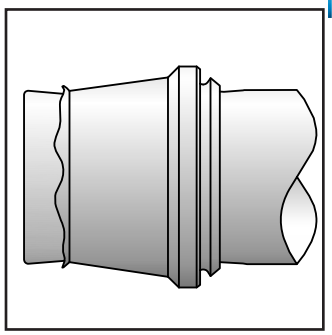

Fig. R40 – Over-set ferrule

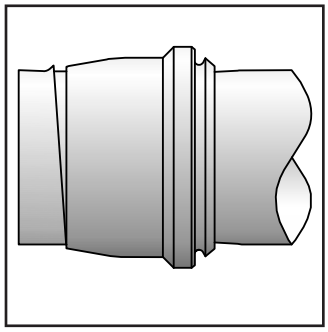

Fig. R41 – Ferrule cocked on tube

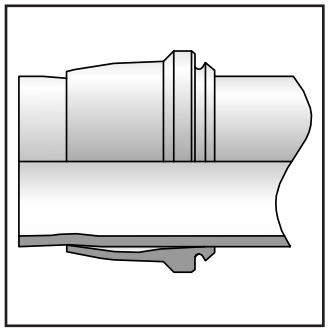

Fig. R42– No bite

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Ferulok Troubleshooting Guide

24° Flareless Bite

CONDITION	PROBABLE CAUSE(S)	RECOMMENDATION
Immediate leakage when system is pressurized	• Improper ferrule/bite ring orientation	• Reset ferrule to ensure that the leading edge of ferrule/bite ring is pointing towards end of tube and seat of the mating fitting
Additional/excessive stress apparent on bite	• Non-square tube cut; tube not being properly supported in seat of adapter	• Re-cut tube to 90° ± 1°
Flexural stresses allow tube to“rock” back and forth	• Tube not fully supported in fitting’s body seat	• Reset tube end. This time ensure that the tube is bottomed in the presetting tool or fitting body
Poor ferrule/bite ring pre-set and/or tube collapse	• Tube may be too hard; or preset pressure or torque might be too high • Tube is too thin	• Use fully annealed tube max hardness R_B 72 for steel, R_B 90 for stainless steel • Consult manufacturer's minimum tube wall thickness requirements; tube supports must be used with certain thin-walled steel or stainless-steel tube. Review preset requirements
Tube not bottoming out in fitting body	• Improper preset or wrong tool used for presetting	• In the presetting process, it is important to exert axial force on the tube to keep it fully bottomed in the tool. Check for indentation on end of the tube
Shallow bite of ferrule or cut ring into tube	• Worn preset tool • Too low preset pressure or torque • Tube too hard • Tube not bottomed against stop initially in preset	• Replace preset tool • Observe manufacturer’s recommendation for proper preset • Ensure that tube is of correct hardness or material • Hold tube against stop in preset
Tube pulls out of fitting in application and ferrule skives end of tube	• Improper preset • Tube too hard • Excessive internal pressure • Excessive axial load on tube • Inadequate make up	• Preset must be inspected for evidence of proper preset, such as raised ridge of metal in front of leading edge • Ensure that tube is of proper hardness and material • Ensure that internal pressure is within rating of fitting (tube might be of a higher rating) • Avoid additional axial load than that caused by internal pressure • Follow proper presetting and assembly procedures
Fitting nut is tight but leakage still occurs	• Overset ferrule • Cracked tube • Damaged components	• Excessive force used in presetting of ferrule can cause it not to spring back and effect a seal. Follow manufacturer’s recommendation for preset • Check tube for circumferential crack due to fatigue • Check components for damage such as nicks, scratches and cracks

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EO Metric Bite Type FIttings

The proper make-up and assembly of EO bite type fittings, as with other fittings, is critical to their proper functioning. Proper assembly consists of the following steps:

1. Cutting, deburring and cleaning of the tube
2. Pre-set of progressive ring
3. Pre-set inspection
4. Installation

For proper tube end preparation see pages R12-R13, or refer to the detailed blog post and video on www.TFDtechconnect.com.

Pre-set of Progressive Ring

The EO fitting requires a pre-set operation that creates a bite by the progressive ring into the outer surface of the tube. There are two methods of achieving the pre-set:

- Manually with the fitting body or hardened pre-assembly tool (not recommended for stainless steel tube).
- Hydraulically with the EO-Karrymat, Hydra Tool or Hyfer-set

Pre-set Using the Fitting Body or Hardened Pre-assembly Tool

Pre-setting with the fitting body is only recommended for small diameter steel and copper tubes. For frequent pre-setting, stainless steel tube and hose standpipe fittings, a hardened pre-assembly tool (VOMO) is strongly recommended (see Fig. R43).

Steps for pre-set using the fitting body or the hardened pre-assembly tool.

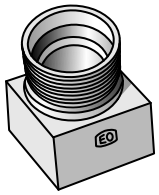
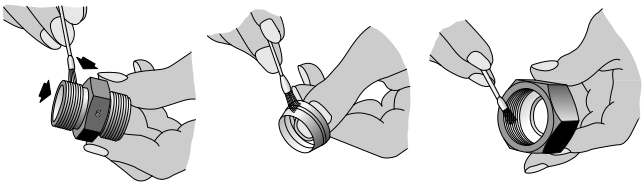
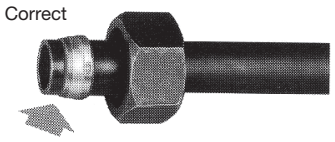


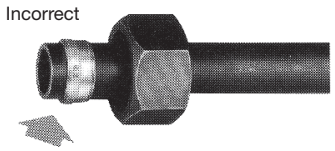
Fig. R43 – VOMO pre-assembly tool

1. Lubricate thread and cone of fitting body or hardened pre-assembly tool, as well as the progressive ring and nut threads.

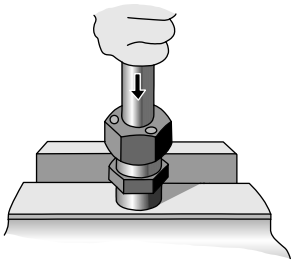


2. Slip nut and progressive ring over tube, assuring that they are in the proper orientation.

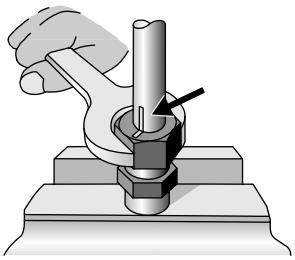




3. Screw nut onto fitting body or hardened pre-assembly tool until finger-tight or light wrench resistance. Hold tube against the shoulder in the cone of the fitting body or hardened pre-assembly tool.



4. Mark nut and tube in the finger-tight or light wrench-resistant position.



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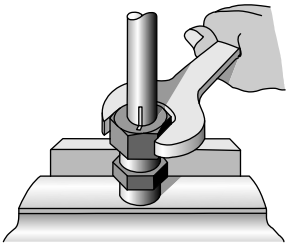
5. Tighten nut 1½ turns if using the fitting body or hardened pre-assembly tool. The tube must not turn with the nut. The stop edge in the progressive ring limits over tightening by sharply increasing the tightening torque.



Pre-set Using EO-Karrymat, Hydra-Tool or Hyferset

When pre-setting EO fittings larger than sizes 18 mm, it is recommended that a hydraulic tool be used. The EO-Karrymat, Hydra-Tool or the Hyferset (shown in Fig. R44) are recommended for low to medium volume production.

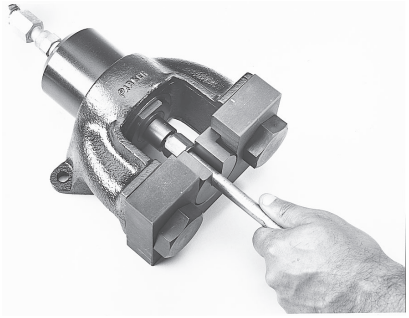


Fig. R44 – Hyferset tool

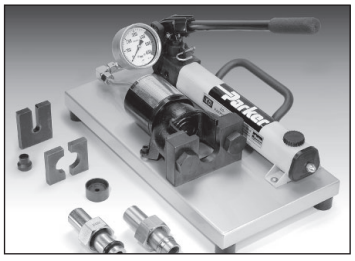


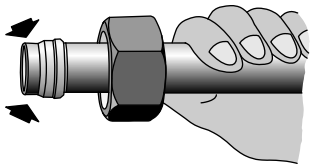
Fig. R45 – EO Karrymat

For full instruction on the use of these hydraulic tools, please refer to www.TFDToolSpec.com for the bulletins indicated below:

- EO-Karrymat – Bulletin 4044-T1/UK/DE/FR/T
- Hyferset - Bulletin 4393-B1
- Hydra-Tool – Bulletin 4392-B10

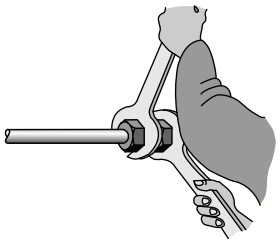
Pre-set Inspection

To inspect the pre-set, remove the nut and tube from the fitting and check if a visible collar fills the space completely in front of first cutting edge. If not, tighten slightly more. It does not matter if ring can be rotated on tube end.



Installation

To install the pre-set tube assembly to the fitting body, wrench-tighten nut to wrench resistance (light wrenching). From this position, tighten nut another 1/12 turn or 1/2 flat (30°) of the nut. Another wrench must be used to prevent movement of the fitting body.



Assembly with Support Sleeve (VH)

If the tube wall thickness is small relative to the tube O.D., this may lead to tube collapse. As a rule, the tube collapse (reduction in diameter) should not exceed 0.3 mm for tubes up to 16 mm O.D. and 0.4 mm for tubes from 18 mm O.D. and above.

When assembling thin walled tube, there is insufficient cross sectional rigidity where the progressive ring cuts. This will have a detrimental effect on the sealing efficiency. For this, internal support sleeves (VH) are available which are inserted in the tube to prevent tube collapse and also increase the cross-sectional rigidity.

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The shape of the tube supports allows them to be inserted easily in the tube. One end of the EO support sleeve is enlarged on its external diameter by a knurl. On insertion, this knurl forces itself into the interior wall of the tube and secures the sleeve against shifting or falling out during assembly and without widening the tube end.

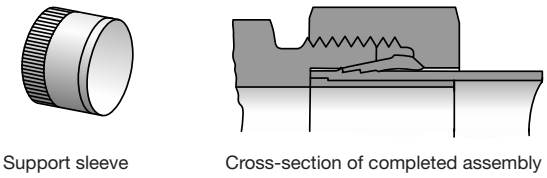


Fig. R46 — EO fitting completely assembled with support sleeve

Steel tubes made of 37.4 or soft metal tubes can be checked in accordance with Figs. R47 and R48, respectively, to see if they require support sleeves; for plastic tubes, (support) sleeves are always necessary (see Page D21 for E type sleeves).

For stainless steel tubes of material 1.4571/1.4541, refer to Fig. R44 to determine the need for a support tube.

For thin-walled steel tube of material St.37.4 and stainless steel tubes of material 1.4571/1.4541.

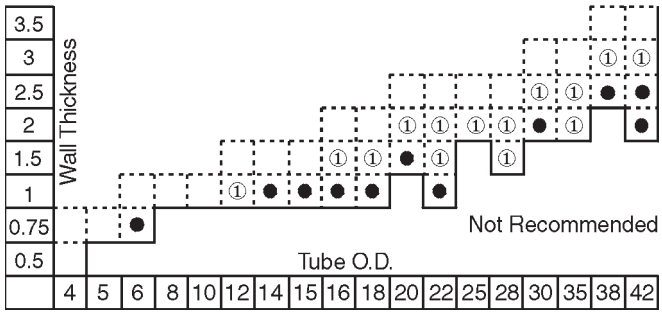


Fig. R47 — Recommended Tube Wall Thicknesses, Steel, SS

● Use of VH necessary

① Use of VH is recommended especially in case of frequent loosening and with heavy-duty tubes (vibrations)

For soft metal tubes

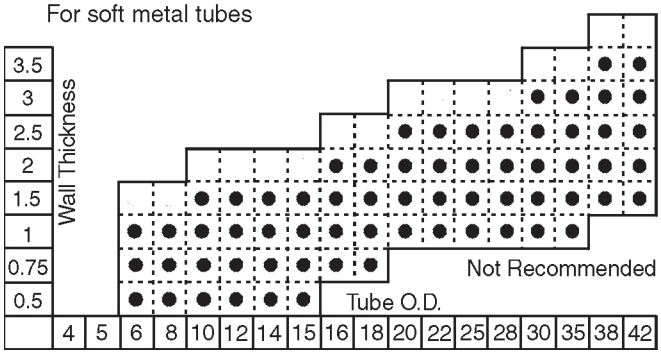


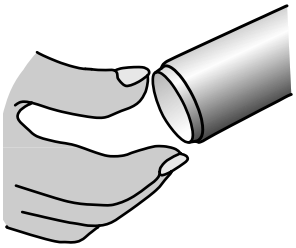
Fig. R48 — Recommended Tube Wall Thicknesses, Soft Metal Tubing

● Use of VH necessary

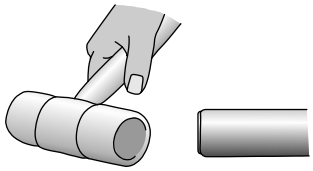
① Use of VH is recommended especially in case of frequent loosening and with heavy-duty tubes (vibrations)

Steps for Proper Assembly of Support Sleeve (VH)

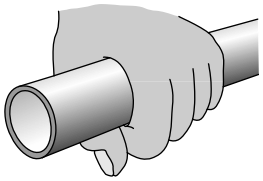
Step 1 – Insert support sleeve up to knurl.



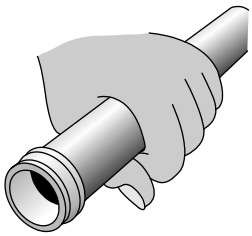
Step 2 – Drive knurled end of support into tube.



Step 3 – Ensure that support sleeve is flush with tube end.



Step 4 – Pre-set progressive ring following one of the pre-setting methods covered earlier (page R33). The support sleeve prevents collapse of tube.



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EO Troubleshooting Guide

Problems with bite type hydraulic fittings are most often traced to faulty pre-set/assembly procedure.

Problem	Solution
Tube not bottomed	Check for a visible mark on the tube end with EO fitting. (Fig. R49)
Shallow bite	Inspect for turned up ridge of material (collar). A failure to achieve this ridge can be traced either to the nut not being tightened enough or the tube not being bottomed against the stop which allowed the tube to travel forward with the ferrule. In some instances this assembly may be re-worked. (Fig. R50)
Over-set ferrule	Too much pressure or more than recommended turns from finger tight were used to pre-set ferrule, or the nut was severely over-tightened in final assembly. This assembly should be scrapped. (Fig. R51)
Ferrule cocked on tube	The ferrule may become cocked on the tube when the tube end is not properly lined up with the body. Generally, this condition is caused by faulty tube bending. All bent tube assemblies should drop into the fitting body prior to make up. This assembly should be scrapped. (Fig. R52)
No bite	If all of the prior checks have been made and the ferrule still shows no sign of biting the tube, it may be that the tube is too hard. This assembly should be scrapped. (Fig. R53)

Table R30 — EO Fitting troubleshooting guide

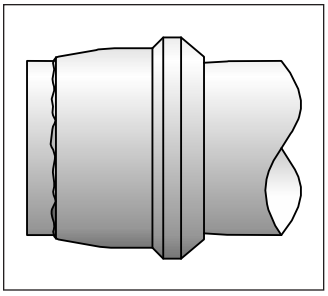

Fig. R49 — Tube not bottomed

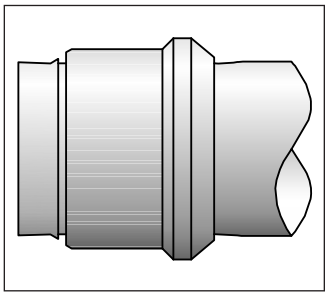

Fig. R50 — Shallow bite

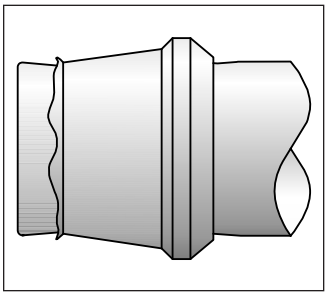

Fig. R51 — Over-set ferrule

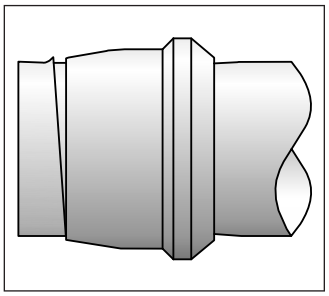

Fig. R52 — Ferrule cocked on tube

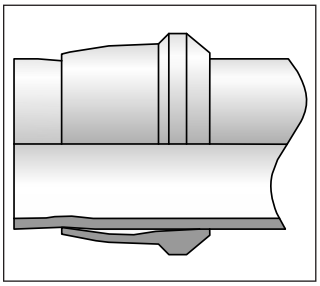

Fig. R53 — No bite

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EO-2 Metric Bite Type Fittings

The steps for the proper assembly of the EO-2 fittings are similar to those of the EO fitting:

1. Cutting, deburring and cleaning of the tube
2. Pre-set of the retaining ring
3. Inspection of the pre-set
4. Installation

For proper tube and preparation see pages R12-R13, or refer to the detailed blog post and video on www.TFDtechconnect.com.

Pre-set of the Retaining Ring

The EO-2 functional nut consists of the nut, the sealing ring and the retaining ring. Unlike the EO fitting, the sealing and holding functions are performed by two separate components: the sealing ring and the retaining ring. The retaining ring must be pre-set to create the necessary bite on the tube O.D. The two methods to pre-set the retaining ring are:

- Manually with the fitting body or hardened pre-assembly tool (VOMO)
- Hydraulically with the EO-Karrymat, Hydra Tool or Hyferset

Pre-set Using the Fitting Body or Hardened Pre-Assembly Tool

1. Prepare the fitting or hardened pre-assembly tool by lubricating the threads of the following sizes:

   Steel Fittings:
   20, 22, 25, 28 Lubrication is recommended for ease in assembly

   Stainless Steel Fitting:
   For all sizes, lubrication is recommended for ease in assembly

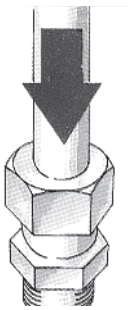
   High quality Niromont (liquid or paste) is recommended for lubrication of the fitting body threads.

   It is strongly recommended that a hydraulic tool be used to preset EO-2 fittings in sizes 30S, 35L, 38S and 42L.

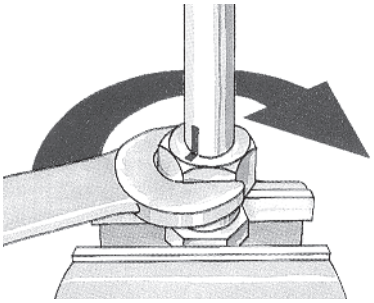
2. Insert tube into the EO-2 fitting body or hardened pre-assembled tool and press hard against the stop in the inner cone.

   Note: A faulty assembly will result if the tube is not against the tube stop in the fitting body or hardened pre-assembly tool. To achieve the necessary assembling force, an additional wrench leverage may be necessary for tube O.D.'s 20mm and larger.

3. Turn nut until wrench resistance is felt. Tighten nut further 1 to 1-1/2 turns. As a recommended process control, mark the position of the nut relative to the fitting body.



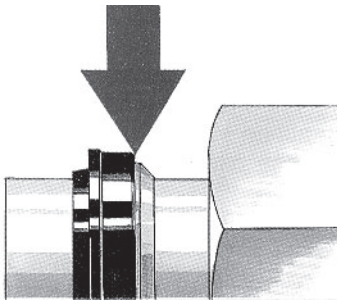
Pre-set Inspection



Loosen the nut and check that the gap between the sealing ring and retaining ring is fully closed. A slight gap (up to 0.2mm) due to spring back is acceptable.

*Refer to Fig. R47 and R48 for required support sleeves.

Pre-set Using EO-Karrymat, Hyferset, Hydra-Tool and EOMAT III



EO-Karrymat: Recommended for use with EO-2 fittings from 6mm through to 42mm.

Hyferset: Recommended for use with EO-2 fittings from 6mm through to 28mm.

Hydra-Tool: Recommended for use with EO-2 fittings from 6mm through to 42mm.

For instructions on operating one of these machines, refer to www.TFDToolSpec.com for the following bulletins:

- EO-Karrymat – Bulletin 4044-T1/UK/DE/FR/IT
- Hyferset – Bulletin 4393-B1
- Hydra-Tool – Bulletin 4392-B10

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Assembly with Support Sleeve (VH)

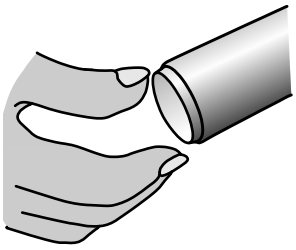
If the tube wall thickness is small relative to the tube O.D., this may lead to tube collapse. As a rule, the tube collapse (reduction in diameter) should not exceed 0.3 mm for tubes up to 16 mm O.D. and 0.4 mm for tubes from 18 mm O.D. and above.

When assembling thin walled tube, there is insufficient cross sectional rigidity where the progressive ring cuts. This will have a detrimental effect on the sealing efficiency. For this, internal support sleeves (VH) are available which are inserted in the tube to prevent tube collapse and also increase the cross-sectional rigidity.

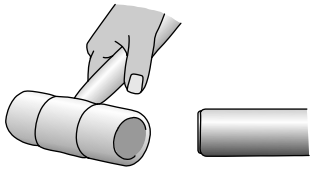
The shape of the tube supports allows them to be inserted easily in the tube. One end of the EO support sleeve is enlarged on its external diameter by a knurl. On insertion, this knurl forces itself into the interior wall of the tube and secures the sleeve against shifting or falling out during assembly and without widening the tube end.

Steps for Proper Assembly of Support Sleeve (VH)

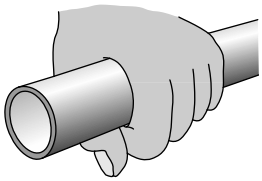
Step 1 – Insert support sleeve up to knurl.



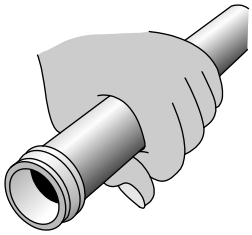
Step 2 – Drive knurled end of support into tube.



Step 3 – Ensure that support sleeve is flush with tube end.



Step 4 – Pre-set progressive ring following one of the pre-setting methods covered earlier (page R33). The support sleeve prevents collapse of tube.



Use of support sleeves "VH" with EO-2 fittings

Tube O.D.	0.5	0.75	1	1.5	2	2.5	3	3.5	4
4									
6									
8									
10									
12									
14									
15									
16									
18									
20									
22									
25									
28									
30									
35									
38									
42									

Functional test required for other materials or dimensions not specified.
Support sleeve VH not required for EO-2 steel (FM/CF) and steel tube.
For EO-2 stainless steel (FM/71) and stainless steel tube, a functional test is required.
Support sleeve VH not required for EO-2 and steel tube.
Support sleeve VH not required for EO-2/71 or EO-2/SSA and stainless steel tube.

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Hydra-Tool Pre-Setting Pressures for EO and EO-2 Fittings

Pre-Setting Pressures for EO & EO2 Fittings

Tube Size OD (mm)	Hydra-Tool using large piston	
	PSR/DPR	EO-2
	(psi)	
6	350	550
8	500	650
10	600	800
12	700	900
14	850	1100
15	850	1100
16	1100	1300
18	1100	1300
20	1400	1900
22	1300	1400
25	1900	2500
28	1650	1900
30	2400	3500
35	2100	2950
38	3300	4100
42	2700	3500

Table R31 — Pre-Setting Pressures for EO & EO2 Fittings

NOTE:

1. The values in this chart serve as a guideline and typically yield an acceptable initial bite when using the Parker Hydra-Tool. However, users may need to adjust the pressure to met the specifications outlined in the inspection instructions for optimal performance.

2. EO and EO-2 pre-setting dies are not designed with a positive stop mechanism. Therefore, pre-setting should be performed using the pressures specified in there charts.

Hyferset Pre-Setting Pressures for EO & EO2 Fittings

Tube Size OD (mm)	HYFERSET	
	PSR/DPR	EO-2
	(psi)	
6	1100	1600
8	1450	2000
10	1800	2350
12	2200	2700
14	2500	3400
15	2500	3400
16	3250	4000
18	3250	4000
20	4300	5750
22	4000	4300
25	5750	7600
28	5000	5750

Table R32— Pre-Setting Pressures for EO & EO2 Fittings

NOTE:

1. The values in this chart serve as a guideline and typically yield an acceptable initial bite when using the Parker Hyferset tool. However, users may need to adjust the pressure to met the specifications outlined in the inspection instructions for optimal performance.

2. EO and EO-2 pre-setting dies are not designed with a positive stop mechanism. Therefore, pre-setting should be performed using the pressures specified in there charts.

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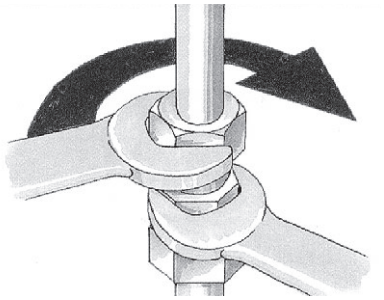
Installation

Connect tube and nut to fitting body. Holding the body rigid, tighten nut with a wrench until resistance is felt. Continue turning the nut approximately 1/6 to 1/4 turns (= 1 to 1-1/2 flats) to the same position as it was prior to disassembly.

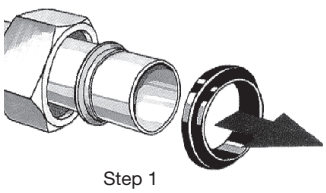
If the assembled position was marked, reassemble until the marks match. To achieve the necessary assembling force, use an additional wrench leverage for tube O.D.'s 20 mm and larger.



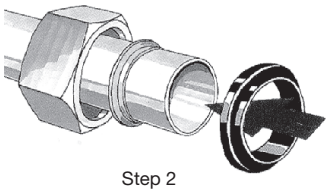
Caution: Improper tightening may reduce the seal reliability, pressure capability and the vibration resistance of the connection.

Re-Assembly with Replacement of Sealing Ring (DOZ)

1. After the nut has been loosened, the sealing ring can be pulled off the tube end. It must be checked for damage and replaced if necessary.
2. Push new sealing ring onto the tube, with metal inner cone facing the retaining ring.
3. Re-install using the installation procedures previously covered in this section.



Step 1



Step 2

EO-2 Troubleshooting Guide

Problems with bite type hydraulic fittings are most often traced to faulty pre-set/assembly procedure.

Problem/ Probable Cause	Remedy
Tube not bottomed	The tube end is not in firm contact with the fitting body at assembly. The tubing was not completely inserted into the throat of the fitting body until it bottomed out. Failure to bottom out the tubing against the tube stop of the fitting body during the presetting procedure will allow the tube to travel forward with the ferrule resulting in a shallow bite. This assembly should be scrapped.
Shallow bite	After presetting, inspect to see that the gap between the bite ring and the sealing ring is closed. A failure to achieve a closed gap can be traced to the nut not being tightened enough. This assembly can be reworked by completing the assembly instructions as indicated in the catalog. Utilization of lubrication and wrench elongation may be necessary for larger sizes.
Damaged Seals	Check sealing area for contamination such as chips, zinc particles or other dirt. Also check the inner cone of the fitting body and tubing for damage. Replace DOZ sealing ring if necessary.
Fatigue Crack at Bite	Ensure proper assembly techniques are utilized. Utilize lubrication and wrench elongation for larger sizes. Check that the gap between the sealing ring and bite ring are closed.
Fatigue Crack at Rear Shoulder of Bite Ring	Check that the application does not have excessive vibration. Utilize rigid clamping, tension piping or hose assemblies if relative movements are evident.
Distorted FM Functional Nut at Hydraulic Pre-Assembly	Utilize a split die nut back up plate for presetting of 35L and 42L functional nuts.

Table R33 — EO-2 troubleshooting guide

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24° Flareless Bite

CONDITION	PROBABLE CAUSE(S)	RECOMMENDATION
Immediate leakage when system is pressurized	• Improper ferrule/bite ring orientation	• Reset ferrule to ensure that the leading edge of ferrule/bite ring is pointing towards end of tube and seat of the mating fitting
Additional/excessive stress apparent on bite	• Non-square tube cut; tube not being properly supported in seat of adapter	• Re-cut tube to 90° ± 1°
Flexural stresses allow tube to“rock” back and forth	• Tube not fully supported in fitting’s body seat	• Reset tube end. This time ensure that the tube is bottomed in the presetting tool or fitting body
Poor ferrule/bite ring pre-set and/or tube collapse	• Tube may be too hard; or preset pressure or torque might be too high • Tube is too thin	• Use fully annealed tube max hardness R_B 72 for steel, R_B 90 for stainless steel • Consult manufacturer's minimum tube wall thickness requirements; tube supports must be used with certain thin-walled steel or stainless-steel tube. Review preset requirements
Tube not bottoming out in fitting body	• Improper preset or wrong tool used for presetting	• In the presetting process, it is important to exert axial force on the tube to keep it fully bottomed in the tool. Check for indentation on end of the tube
Shallow bite of ferrule or cut ring into tube	• Worn preset tool • Too low preset pressure or torque • Tube too hard • Tube not bottomed against stop initially in preset	• Replace preset tool • Observe manufacturer’s recommendation for proper preset • Ensure that tube is of correct hardness or material • Hold tube against stop in preset
Tube pulls out of fitting in application and ferrule skives end of tube	• Improper preset • Tube too hard • Excessive internal pressure • Excessive axial load on tube • Inadequate make up	• Preset must be inspected for evidence of proper preset, such as raised ridge of metal in front of leading edge • Ensure that tube is of proper hardness and material • Ensure that internal pressure is within rating of fitting (tube might be of a higher rating) • Avoid additional axial load than that caused by internal pressure • Follow proper presetting and assembly procedures
Fitting nut is tight but leakage still occurs	• Overset ferrule • Cracked tube • Damaged components	• Excessive force used in presetting of ferrule can cause it not to spring back and effect a seal. Follow manufacturer’s recommendation for preset • Check tube for circumferential crack due to fatigue • Check components for damage such as nicks, scratches and cracks

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Bulkhead Locknut Assembly

A bulkhead fitting allows one to connect tube or hose through a panel. This panel, often referred to as bulkhead, may be a structural element of the equipment, or an additional plate which is joined to the equipment, to facilitate convenient routing of hose and tube. Bulkhead fittings are also used as a transition point in a hydraulic system, such as connection of tube lines to hose lines or to a quick disconnect coupling.

The following steps are recommended for the proper assembly of the locknut for Triple-Lok, Ferulok and Seal-Lok bulkhead fittings.

1. Drill a pilot hole to dimension W + 0.015” (where W is shown in Tables R36 and R37).
2. Insert the bulkhead end of the fitting (without the locknut assembled) through the bulkhead opening and attach the locknut to the bulkhead end.
3. Finger tighten the locknut and wrench tighten further to the recommended torque shown in Table R36 for Seal-Lok fittings or Table R37 for Triple-Lok and Ferulok fittings.

TUBE FITTING PART #	THREAD SIZE UN/UNF	W*	ASSEMBLY TORQUE +10% - 0		
			in.-lb.	ft.-lb.	N-m
4 WLNL	9/16-18	0.56	180	15	20
6 WLNL	11/16-16	0.69	300	25	34
8 WLNL	13/16-16	0.81	—	55	75
10 WLNL	1-14	1.00	—	85	115
12 WLNL	1 3/16-12	1.19	—	135	180
14 WLNL	1 5/16-12	1.31	—	170	230
16 WLNL	1 7/16-12	1.44	—	200	270
20 WLNL	1 11/16-12	1.69	—	245	330
24 WLNL	2-12	2.00		270	365

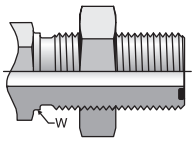
* Recommended clearance hole is W + 0.015”

Table R34 – Torque for Seal-Lok Bulkhead Fittings

TUBE FITTING PART #	THREAD SIZE UN/UNF	W*	ASSEMBLY TORQUE (+10 - 0)		
			in.-lb.	ft-lb	N-m
3 WLN	3/8-24	0.38	100	—	11
4 WLN	7/16-20	0.44	155	13	18
5 WLN	1/2-18	0.50	250	20	28
6 WLN	9/16-18	0.56	300	25	35
8 WLN	3/4-16	0.75	600	50	65
10 WLN	7/8-14	0.88		85	115
12 WLN	1 1/16-12	1.06		135	180
14 WLN	1 3/16-12	1.19		170	230
16 WLN	1 5/16-12	1.31		200	270
20 WLN	1 5/8-12	1.63		245	330
24 WLN	1 7/8-12	1.88		270	365
32 WLN	2 1/2-12	2.50		310	420

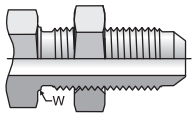
* Recommended clearance hole is W + 0.015”

Table R35 – Torque for Triple-Lok and Ferulok Bulkhead Fittings



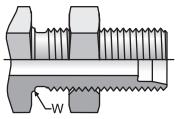
Seal-Lok Bulkhead Assembly

See page A8 for maximum bulkhead thickness.



Triple-Lok Straight Bulkhead

See page B8 for maximum bulkhead thickness.



Ferulok Straight Bulkhead

See page C6 for maximum bulkhead thickness.

Pipe Swivel Assembly (NPSM)

Unlike traditional pipe thread, these connections seal on the nose of the swivel end. The nose has a 60° inclusive angle that mates against a chamfer of the same angle on the male pipe thread end (also known as a 30˚ chamfer).

Fig. R52 - Illustration showing how swivel adapters seal on mating chamfer in male pipe thread end.

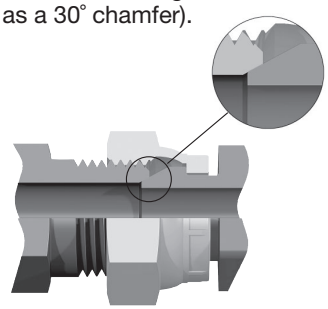


Fig. R54

NPSM Pipe Swivels

NPSM Pipe swivels, also known as Parker 07 Adapters, must connect with a male NPT/NPTF pipe thread with a 30˚ machined seat per SAE J514.

NPSM Size in.	Steel Assembly TORQUE (+10% - 0%)		
	in.-lb.	ft.-lb.	F.F.F.T.
1/8	106	9	1.0 - 1.5
1/4	156	13	1.0 - 1.5
3/8	192	16	1.0 - 1.5
1/2	396	33	1.0 - 1.5
3/4	580	48	2.0 - 2.5
1	1140	95	2.0 - 2.5
1 1/4	1420	118	2.0 - 2.5
1 1/2	2840	237	2.0 - 2.5
2	3720	310	2.0 - 2.5

Table R36– NPSM Pipe Swivel Torques

Steps:
1. Finger tight
2. Wrench tighten to torque specs in Table (R36)

R

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Routing and Clamping

Most hydraulic, pneumatic and lubrication systems require some form of tube line fabrication and fitting installation for completion. Proper fabrication and installation are essential for the overall efficiency, leak free performance, and general appearance of any system.

The following factors should be considered early in the design process, after sizing the tube lines and selecting the appropriate style of fitting:

1. Proper routing of tube lines
2. Adequate tube line support (clamping)

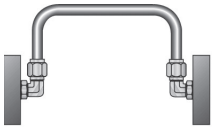
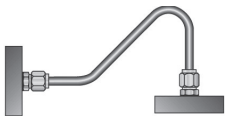
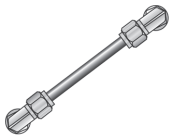
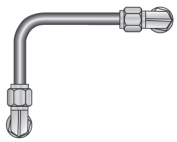
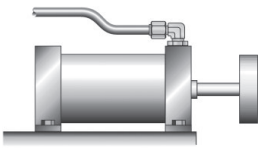
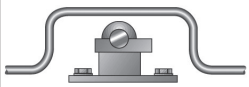
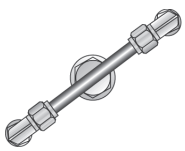
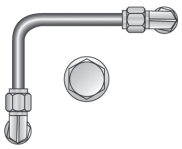
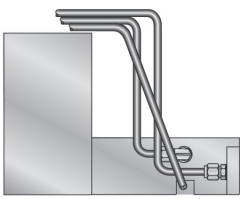
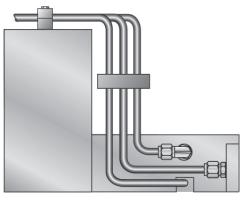
Routing of Lines

Routing of lines is one of the most difficult, yet most significant of these system design considerations. Proper routing involves getting a connecting line from one point to another through the most logical path, while considering other factors as discussed below.

The most logical path is not always the direct path and should have the following characteristics:

- **Avoid excessive strain on joint —** A strained joint will eventually leak. A straight line tube assembly (with no bends) or a joint that is forced into position are common examples of strain applied to tube assemblies.
- **Allow for expansion and contraction —** Use a "U" bend or a hose in long lines to allow for expansion and contraction due to pressure or temperature fluctuations.
- **Allow for motion under load —** Even some apparently rigid systems do move under load. Use an offset ("S") bend.
- **Get around obstructions without using excessive amount of 90° bends —** Pressure drop due to one 90° bend is greater than that due to two 45° bends.
- **Keep tube lines away from components that require regular maintenance**.
- **Leave fitting joints as accessible as possible —** Inaccessible joints are more difficult to assemble and tighten properly, and more time consuming to service.
- **Have a neat appearance and allow for easy trouble-shooting, maintenance and repair**.

The following illustrations provide several examples of typical routing situations. The graphics show the preferred and non-preferred path along with an explanation.

Non-preferred Routing	Preferred Routing	Explanation
		Avoid straight tube lines. There is no margin for error on a straight line, resulting in excess joint strain. Straight tube lines do not allow for expansion and contraction due to pressure and temperature fluctuations.
		
		
		
		Allow for expansion and contraction of lines by utilizing "U" bend.
		Offset ("S") bend allows for motion under load.
		Avoid excessive pressure drop by getting around obstructions without using 90° bends. One 90° bend causes more pressure drop than two 45° bends.
		Avoid creating an obstruction by routing lines around areas that require service. Leave adequate clearance for wrenches.
		Route lines to allow for proper clamping. When done properly, several lines can typically be clamped together. Route lines to allow for trouble-shooting. Lines that cross and are not in logical order tend to be difficult to work with during maintenance.

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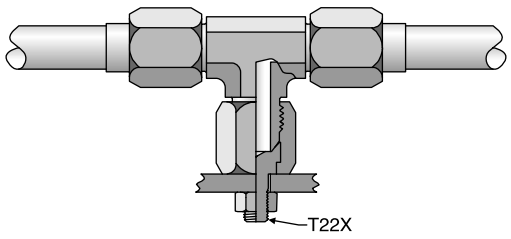
Tube Clamping

Tube line supports (clamps) serve two primary purposes in tube line systems: mounting and vibration dampening. Fatigue failure due to mechanical vibration accounts for the majority of tube line failures. Proper clamping of the tube also reduces system noise.

Use a clamping system such as Parker's ParKlamp series along with proper clamp spacing provided in Table R41.

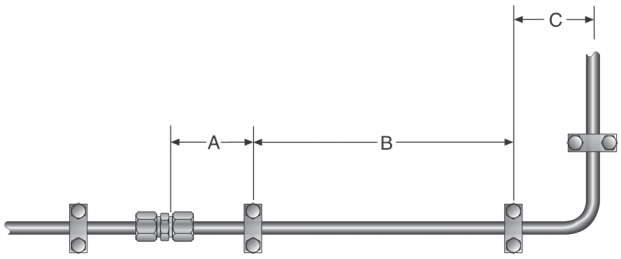
For tube clamps to dampen vibration effectively, they need to be anchored to a rigid structure. Clamping several tubes together, without rigid structural anchoring, does not provide effective dampening.

A mountie can be used in lieu of clamps in certain product lines by anchoring a tee fitting to the equipment's structure (see Fig. R55).



The Mountie Caps the End and Provides an Anchor

Fig. R55 — Mountie cap used with Triple-Lok for anchoring tube lines



Tube O.D. (in.)	Tube O.D. (mm)	A (in.)	B (ft.)	C (in.)
1/4	6	2	3	4
5/16	8			
3/8	10			
1/2	12	4	5	8
5/8	14			
3/4	18			
7/8	22			
1	25			
1-1/4	30	6	7	12
1-1/2	38			
2	50			

Table R39 — Recommended tube clamp spacing

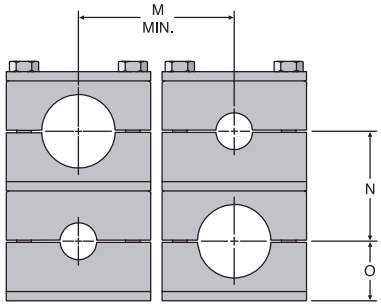
Layout Data for Tube, Pipe and Hose Clamps: Standard (Inch) and Series A (Metric)

Group #		Installation Dimensions M	P	N	O	R
1	in.	1 5/16	1 3/16	1 3/16	5/8	15/16
	mm	33	30	30	16.5	24.5
1a	in.	1 7/16		1 1/8	5/8	15/16
	mm	36		29	16	24.0
2	in.	1 11/16		1 7/16	3/4	1 1/16
	mm	42		36	19.5	27.5
3	in.	2		1 1/2	13/16	1 1/8
	mm	50		38	20.5	28.5
4	in.	2 3/8		1 3/4	15/16	1 1/4
	mm	60		45	24	32.0
5	in.	2 13/16		2 3/8	1 1/4	1 9/16
	mm	70		61	32	40.0
6	in.	3 1/2		2 11/16	1 7/16	1 3/4
	mm	88		69	36	44.0

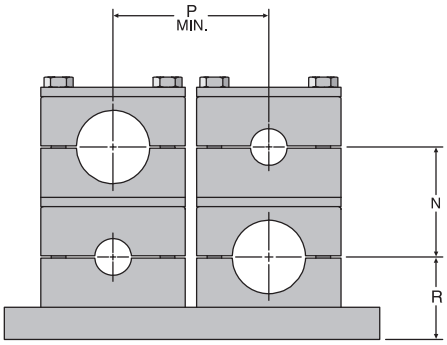
Table R37— ParKlamp Standard Series Installation Dimensions

Bolt Thread	Torque in.-lbs.	Torque Nm
1/4 - 20 UNC	70	8

Table R38 — ParKlamp Standard Series maximum tightening torque



With Weld Plate



Rail Mounting

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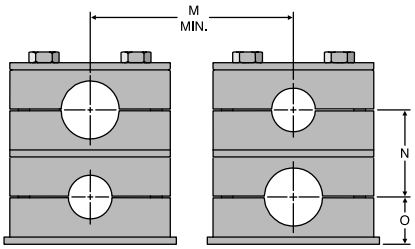
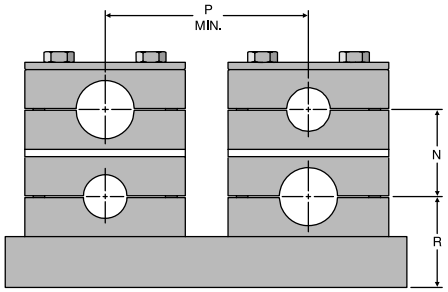
Layout Data for Tube, Pipe and Hose Clamps: Heavy Series (Inch) and Series C (Metric)

Group #		Installation Dimensions				
		M	N	O	P	R
H3	in.	2 15/16	1 9/16	15/16	2 5/16	1 1/2
	mm	74	40	24	58	38
H4	in.	3 1/2	2 3/16	1 1/4	2 7/8	1 13/16
	mm	89	56	32	73	46
H5	in.	4 1/16	2 11/16	1 1/2	3 7/16	2 1/16
	mm	103	68	38	87	52
H6	in.	5 7/8	3 7/8	2 1/8	4 5/8	2 5/8
	mm	150	98	54	118	66
H7	in.	7 1/8	5 1/16	2 3/4	N/A	N/A
	mm	180	129	69	N/A	N/A

Table R40 — ParKlamp Heavy Series installation dimensions



With Weld Plate



Rail Mounting

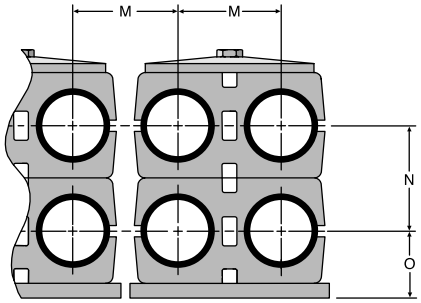
Group #	Bolt Thread	Torque	
		in-Lb	Nm
H3, H4	3/8 - 16 UNC	106	12
H5	3/8 - 16 UNC	133	15
H6	7/16 - 14 UNC	265	30
H7	5/8 - 11 UNC	398	45

Table R41— ParKlamp Heavy Series maximum tightening torque

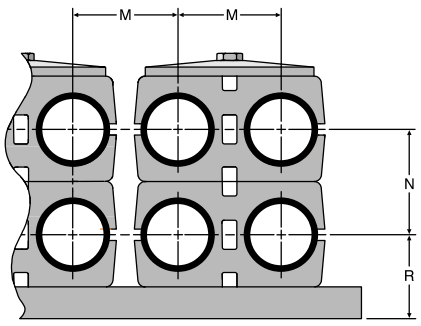
Layout Data for Tube, Pipe and Hose Clamps: Twin Series (Inch) and Series B (Metric)

Group #		Installation Dimensions			
		M	N	O	R
T1	in.	13/16	13/16	9/16	13/16
	mm	20	20	15	21
T2	in.	1 1/8	1	11/16	15/16
	mm	29	26	18	24
T3	in.	1 7/16	1 7/16	15/16	1 3/16
	mm	36	37	23.5	29.5
T4	in.	1 3/4	1 11/16	1	1 1/4
	mm	45	42	26	32
T5	in.	2 3/16	2 1/8	1 1/4	1 1/2
	mm	56	54	32	38

Table R42— ParKlamp Twin Series installation dimensions



With Weld Plate



Rail Mounting

Group #	Bolt Thread	Torque	
		in.-lbs.	Nm
T1	1/4 - 20 UNC	45	5
T2 - T4	5/16 - 18 UNC	104	12
T5	5/16 - 18 UNC	70	8

Table R43 — ParKlamp Twin Series maximum tightening torque

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Tools for Tube Bending

For smooth, wrinkle free tube bending without excessive flattening, there are a number of benders that can be selected. Consult the specific bender's instruction bulletins for CLR (centerline radius), wall thickness, and tube material recommendations and limitations. For crank and hydraulic benders, utilize both the mandrel bending determination chart (Fig. R59) and the Parker Bender Capacity Guides on page Q7.

1. **Hand held lever type benders** (see pages Q4-Q6). Individually sized for tube sizes 1/8" through 1" and 6mm through 25mm.
2. **Manual crank, table mount or vise mount benders:**

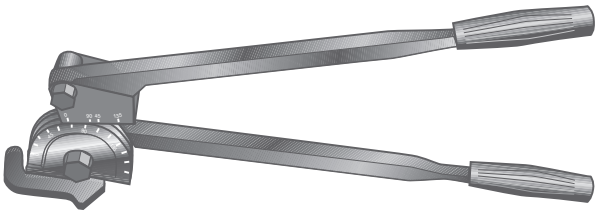

Fig. R56 — Hand held tube bender

1) Model 412 (page Q8). For bending 1/4" through 3/4" O.D. tube or 6mm through 20mm.
2) Model 424 (page Q9). For bending 1/4" through 1 1/2" O.D. tube or 6mm through 38mm.

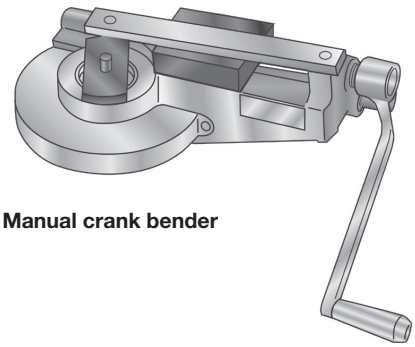

Fig. R57 — Manual crank bender

3. **Hydraulically powered bender**

   Model 632 (page Q12). For bending 3/8" through 2" O.D. tube or 10mm through 50mm.

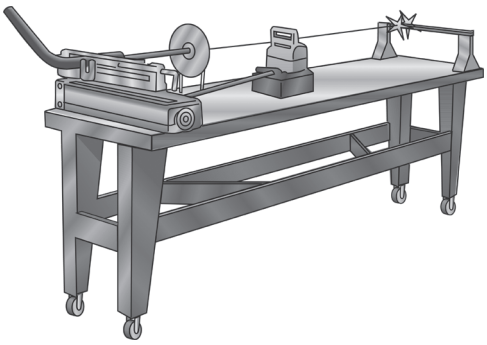

Fig. R58 — Hydraulic bender with portable table for mandrel bending

Mandrel Bending Tools

When bending thin wall tube it may be necessary to insert a mandrel into the tube to prevent excessive distortion, flattening or wrinkling. To determine whether mandrel bending is required, see the Mandrel Bending Requirements Chart and example below.

To accomplish such bending, a mandrel, mandrel rod, and a mandrel rod stop assembly are required. The rod stop assembly holds the end of the mandrel rod in proper alignment with the tube while the mandrel, which is threaded onto the other end of the mandrel rod, supports the tube on its I.D., thus preventing tube kinking or flattening during bending.

Mandrel Bending Requirements Chart

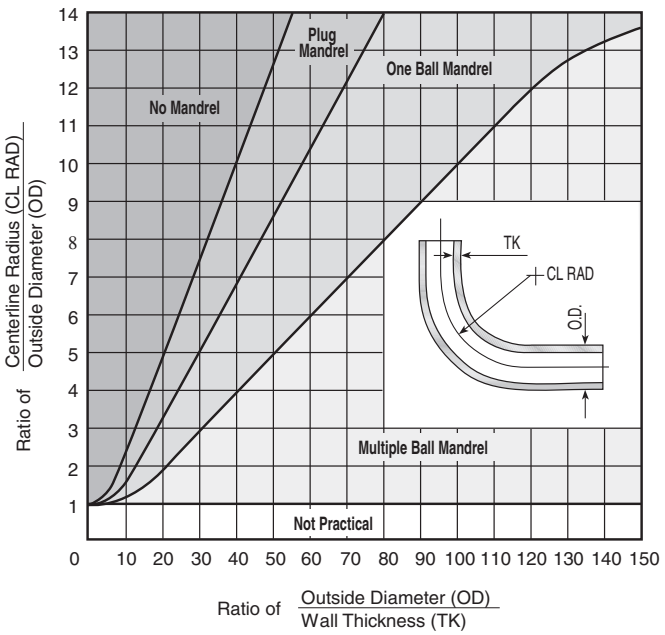

Fig. R59 — Mandrel bending requirements chart

Example: Determine if it's necessary to use mandrel for bending 3/4 x .049 steel tube through a 3" bend radius without excessive flattening.

Centerline Radius/Tube Outside Diameter = 3 / .75 = 4

Outside Diameter / Wall Thickness = .75/.049 = 15.3

Intersection of these two ratios on the graph falls within the area indicating that no mandrel is required. Note, however, that for the same tube O.D. at a smaller bend radius (e.g. 2") or with a thinner wall thickness (e.g. .035"), a mandrel would be required for preventing excessive flattening.

If the tube wall is very thin, then a plug mandrel alone may not be adequate to prevent wrinkling. In such cases, special ball type mandrels and wiper shoes may be necessary (See page R48 for illustrations of plug and ball type mandrels). As a rule of thumb, if the tube wall thickness is less than 7% of the tube O.D. then mandrel bending is recommended.

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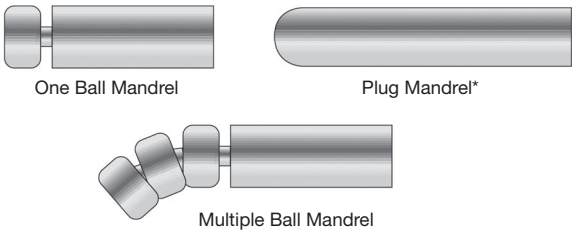

Fig. R60 — Types of mandrels

*Parker Tube Fittings Division offers only the plug mandrel.

Plumbing and Assembly Hints

Even after choosing the appropriate type of fitting for your application, there are certain instances when a particular style has advantages over others.

1. Straight thread adjustable elbows and tees have several advantages over similar shaped fittings using tapered pipe threads:

Adjustable straight thread connections:

- Permit exact positioning
- Provide leak free joint
- Eliminate distortion and cracking of boss due to over-tightening
- Are easier to maintain

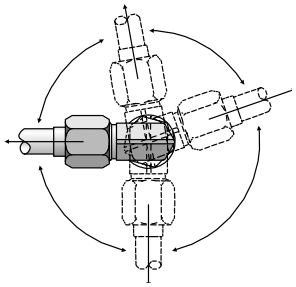

Fig. R61 — Top view of adjustable straight thread connection – allows for 360° positioning of fitting without losing its sealing capability

2. Swivel nut fitting should be used with a straight connector to allow for connections in tight spaces, where an elbow or tee fitting cannot be fully rotated (see Fig. R62).

This same combination of fittings, shown in Fig. R60, can also be used to stack tube lines or provide clearance for ports that are relatively close and within the same plane (see Fig. R63).

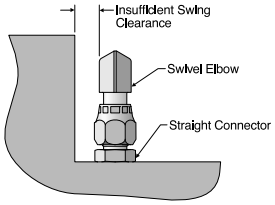

Fig. R62 — Swivel nut fitting used with straight connector in tight space

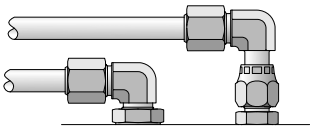

Fig. R63 — Swivel end fitting with straight connector provides clearance above regular elbow

3. Use reducers/expanders and jump size fittings.

   There are some instances when it becomes necessary to connect tube lines of different sizes or tube lines to ports of different sizes. This can be accomplished by using either tube reducers, port expanders, port reducers, or jump size fittings. Achieving the reduction or enlargement is the main concern, but this should be accomplished by using the minimum number of connections (potential leak points and wrenching requirements) possible.

4. Use conversion fittings and adapters.

   There are instances when it becomes necessary to use conversion adapters for connecting a fitting to a port with different style threads, for example, UNF thread fitting to a metric thread port. There are also some instances when it is necessary to connect tube ends or hose ends with different style terminations to one another or to a fitting. This can be achieved by using conversion fittings.

5. Use of other adapters and fittings for special applications are shown below.

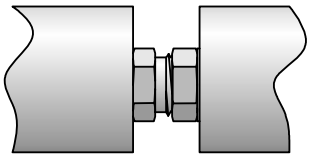

Fig. R64 — F5OHAO for close coupling of components with two SAE Straight thread ports

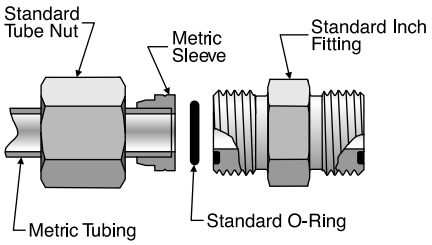

Fig. R65 — Metric sleeve adapts metric tube to standard Seal-Lok

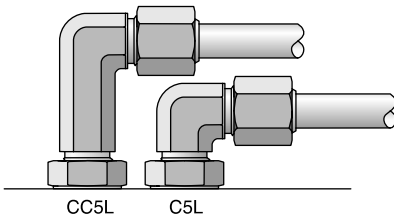

Fig. R66 — Long elbow (CC5L) stacks above regular elbow (C5L)

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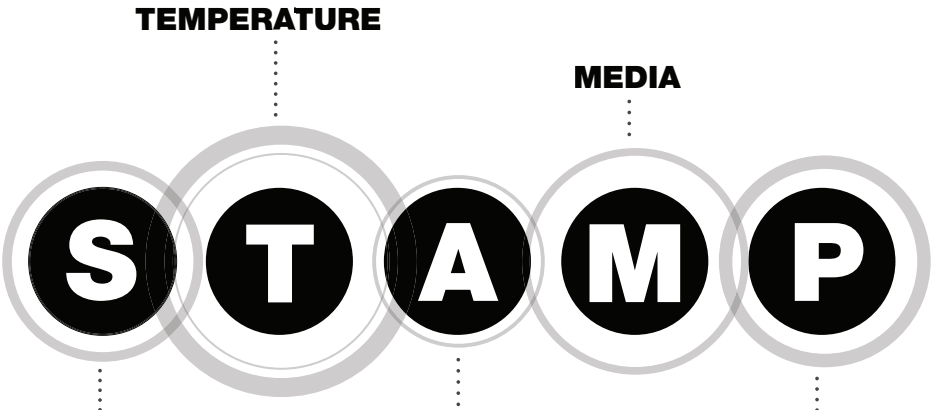

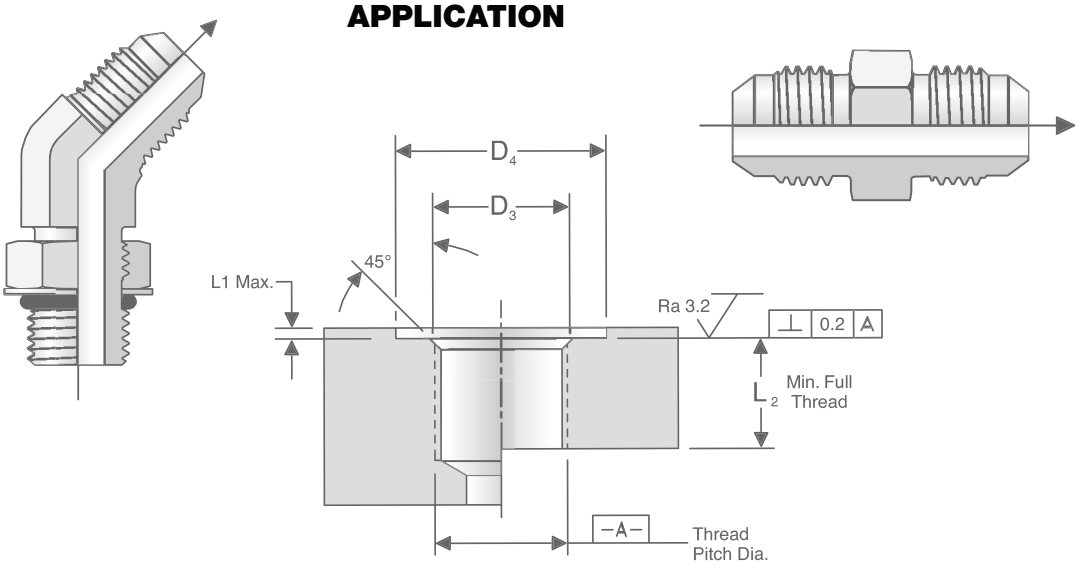

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STAMP OVERVIEW

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Tube Fitting and Adapter Selection Process

Critical information needed prior to tube fitting and adapter selection can start:

In general, even though a tube fitting or adapter is just a small component in a complex system, all the system information is needed to ensure the proper tube fitting or adapter selection. Without taking these into consideration, system issues will occur.

Below is the minimum system information needed to start this process:

- Flow rate
- Temperature range
- Media type
- Working pressure

With this information, a process named “STAMP” can be followed to choose a proper tube fitting or adapter. STAMP is an industry acronym that stands for Size, Temperature, Application, Media or Material, and Pressure. When STAMP is followed, the tube fittings and adapters with the proper size, appropriate material of construction and correct pressure rating for the application will result.

Below is an overview of each part of STAMP:

Size: Fitting and tube internal diameter (I.D.) and outside diameter (O.D.)
The I.D. can be calculated based on flow rate and velocity, and the O.D. will be determined based on pressure rating and considerations from other categories.

Temperature: System and environment temperature range.
Fitting and seal material types, connection types and pressure rating are temperature dependent.

Application: Severity of service, industry custom, regulation, standards, geographic region, serviceability, etc.
Severe, hazardous or critical to safety service needs more robust solutions. Some industries have special standards or regulation requirements. As well, certain regions tend to use specific types of products.

Media or Material: System and environment media, fitting and seal material type
Fitting and seal material must be compatible with system media and the environment. Incompatible material can result in excessive corrosion, system contamination, and leakage.

Pressure: System pressure requirements and fitting pressure rating
Fittings and tubes must meet the system pressure rating requirements.

Tube Fitting and Adapter Selection Steps using STAMP S

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On the following pages, detailed steps on how to properly pick tube fittings and adapters for your system using STAMP are outlined.

The blank table below can be used to organize the information from each of the steps. This table can also be printed and used as a worksheet for any tube fitting and adapter selection. At the end of this section (page S31), a completed table has been filled out as an example.

Summary Information				
Size	**I.D.**		**O.D.**	
Temperature	**Material Conveyed**		**Environment**	
	Min.	**Max.**	**Min.**	**Max**
Application	**Industrial Standards**	**Connection Styles**	**Severity of Service**	**Other**
Material Media	**Internal Media**		**External Environment**	
Pressure	**Max. Working Pressure**		**Spikes**	**Vacuum**
Selection Process				
STAMP Process			**Explanation**	

STEP 1: SIZE

The first step of fitting selection is to determine the size. Fitting size is driven by flow diameter or internal diameter (I.D.). System flow rate and flow velocity are needed to calculation flow diameter. Normally system flow rate is expressed in gallons per minute (GPM) or litters per minute (LPM). Flow velocity is expressed in feet per second (ft/sec) or meters per second (m/sec). The following formulae can be used to calculate the fitting I.D.

In hydraulic systems, the following maximum flow velocities are commonly used:

- Pressure lines: 25 ft/sec or 7.62 m/sec
- Return lines: 10 ft/sec or 3.05 m/sec
- Suction lines: 4 ft/sec or 1.22 m/sec

$$\text{Tube/Fitting I.D. (in)} = 0.64 \sqrt{\frac{\text{Flow in GPM}}{\text{Velocity in ft/sec}}}$$

OR

$$\text{Tube/Fitting I.D. (mm)} = 4.61 \sqrt{\frac{\text{Flow in LPM}}{\text{Velocity in m/sec}}}$$

Recommended Flow Diameter — In Inches

For your convenience, the flowing tables have been prepared based on the formula and maximum flow velocities on the previous page.

Maximum Flow Rate GPM	Recommended Flow Diameter in Inches		
	Pressure Lines	Return Lines	Suction Lines
0.25	0.064	0.101	0.160
0.50	0.091	0.143	0.226
0.75	0.111	0.175	0.277
1.00	0.128	0.202	0.320
1.25	0.143	0.226	0.358
1.50	0.157	0.247	0.392
1.75	0.169	0.267	0.423
2.00	0.181	0.286	0.453
2.50	0.202	0.319	0.506
3.00	0.222	0.350	0.554
3.50	0.239	0.378	0.599
4.00	0.256	0.404	0.640
4.50	0.272	0.429	0.679
5.00	0.286	0.452	0.716
5.50	0.300	0.474	0.750
6.00	0.314	0.495	0.784
6.50	0.326	0.515	0.816
7.00	0.339	0.534	0.847
7.50	0.351	0.553	0.876
8.00	0.362	0.571	0.905
8.50	0.373	0.589	0.933
9.00	0.384	0.606	0.960
9.50	0.395	0.623	0.986
10.00	0.405	0.639	1.012
11.00	0.425	0.670	1.061
12.00	0.443	0.700	1.109
13.00	0.462	0.728	1.154
14.00	0.479	0.756	1.197
15.00	0.496	0.782	1.239
16.00	0.512	0.808	1.280
17.00	0.528	0.833	1.319
18.00	0.543	0.857	1.358
19.00	0.558	0.880	1.395
20.00	0.572	0.905	1.431
21.00	0.587	0.927	1.466

Maximum Flow Rate GPM	Recommended Flow Diameter in Inches		
	Pressure Lines	Return Lines	Suction Lines
22.00	0.600	0.947	1.501
24.00	0.627	0.990	1.568
26.00	0.653	1.030	1.632
28.00	0.677	1.069	1.693
30.00	0.701	1.106	1.753
32.00	0.724	1.143	1.810
34.00	0.746	1.178	1.866
36.00	0.768	1.212	1.920
38.00	0.789	1.245	1.973
40.00	0.810	1.278	2.024
42.00	0.830	1.309	2.074
44.00	0.849	1.340	2.123
46.00	0.868	1.370	2.170
48.00	0.887	1.399	2.217
50.00	0.905	1.428	2.263
55.00	0.949	1.498	2.373
60.00	0.991	1.565	2.479
65.00	1.032	1.629	2.580
70.00	1.071	1.690	2.677
75.00	1.109	1.749	2.771
80.00	1.145	1.807	2.862
85.00	1.180	1.862	2.950
90.00	1.214	1.916	3.036
95.00	1.248	1.969	3.119
100.00	1.280	2.020	3.200
110.00	1.342	2.119	3.356
120.00	1.402	2.213	3.505
130.00	1.459	2.303	3.649
140.00	1.515	2.390	3.786
150.00	1.568	2.474	3.919
160.00	1.619	2.555	4.048
170.00	1.669	2.634	4.172
180.00	1.717	2.710	4.293
190.00	1.764	2.784	4.411
200.00	1.810	2.857	4.525

Table S1 — Recommended Flow Diameters, in Inches

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Recommended Flow Diameter — In Millimeters

Maximum Flow Rate LPM*	Recommended Flow Diameter in mm		
	Pressure Lines	Return Lines	Suction Lines
1.00	1.67	2.64	4.18
2.00	2.36	3.73	5.91
3.00	2.89	4.57	7.24
4.00	3.34	5.28	8.36
5.00	3.73	5.90	9.35
6.00	4.09	6.47	10.24
7.00	4.42	6.99	11.06
8.00	4.72	7.47	11.82
9.00	5.01	7.92	12.54
10.00	5.28	8.35	13.22
11.00	5.54	8.75	13.84
12.00	5.79	9.15	14.48
14.00	6.25	9.88	15.64
16.00	6.68	10.56	16.72
18.00	7.09	11.20	17.73
20.00	7.47	11.81	18.69
22.00	7.83	12.38	19.61
24.00	8.18	12.93	20.48
26.00	8.52	13.46	21.31
28.00	8.84	13.97	22.12
30.00	9.15	14.46	22.90
32.00	9.45	14.93	23.65
34.00	9.74	15.39	24.37
36.00	10.02	15.84	25.08
38.00	10.30	16.27	25.77
40.00	10.56	16.70	26.44
45.00	11.20	17.71	28.04
50.00	11.81	18.67	29.56
55.00	12.39	19.58	31.00
60.00	12.94	20.45	32.38
65.00	13.46	21.28	33.70
70.00	13.97	22.09	34.97
75.00	14.46	22.86	36.20

Maximum Flow Rate LPM*	Recommended Flow Diameter in mm		
	Pressure Lines	Return Lines	Suction Lines
80.00	14.94	23.61	37.39
85.00	15.40	24.34	38.54
90.00	15.84	25.05	39.66
95.00	16.28	25.73	40.74
100.00	16.70	26.40	41.80
110.00	17.52	27.69	43.84
120.00	18.29	28.92	45.79
130.00	19.04	30.10	47.66
140.00	19.76	31.24	49.46
150.00	20.45	32.33	51.19
160.00	21.12	33.39	52.87
170.00	21.77	34.42	54.50
180.00	22.41	35.42	56.08
190.00	23.02	36.39	57.62
200.00	23.62	37.34	59.11
220.00	24.77	39.16	62.00
240.00	25.87	40.90	64.76
260.00	26.93	42.57	67.40
280.00	27.94	44.18	69.95
300.00	28.93	45.73	72.40
320.00	29.87	47.23	74.77
340.00	30.79	48.68	77.08
360.00	31.69	50.09	79.31
380.00	32.55	51.46	81.48
400.00	33.40	52.80	83.60
450.00	35.43	56.00	88.67
500.00	37.34	59.03	93.47
550.00	39.17	61.91	98.03
600.00	40.91	64.67	102.39
650.00	42.58	67.31	106.57
700.00	44.18	69.85	110.59
750.00	45.74	72.30	114.47
800.00	47.24	74.67	118.23

Table S2 — Recommended Flow Diameters, in Millimeters

*LPM = Liters Per Minute

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Proceed to step 2 once size is determined.

For deeper understanding, the detailed information below explains the effect of tube fitting and adapter size. It is provided only as a reference for further understanding.

Effect of fitting size:

Fitting size directly affects system efficiency. Proper sizing for various parts of a hydraulic system results in an optimum combination of efficient and cost-effective performance.

A tube or fitting that is too small causes high fluid velocity, which has many detrimental effects. In suction lines, it causes cavitation which starves and damages pumps. In pressure lines, it causes high friction losses and turbulence, both resulting in high pressure drops, noise and heat generation. High heat accelerates wear in moving parts and rapid aging of seals and hoses, all resulting in reduced component life. High heat generation also means wasted energy, and hence, low efficiency.

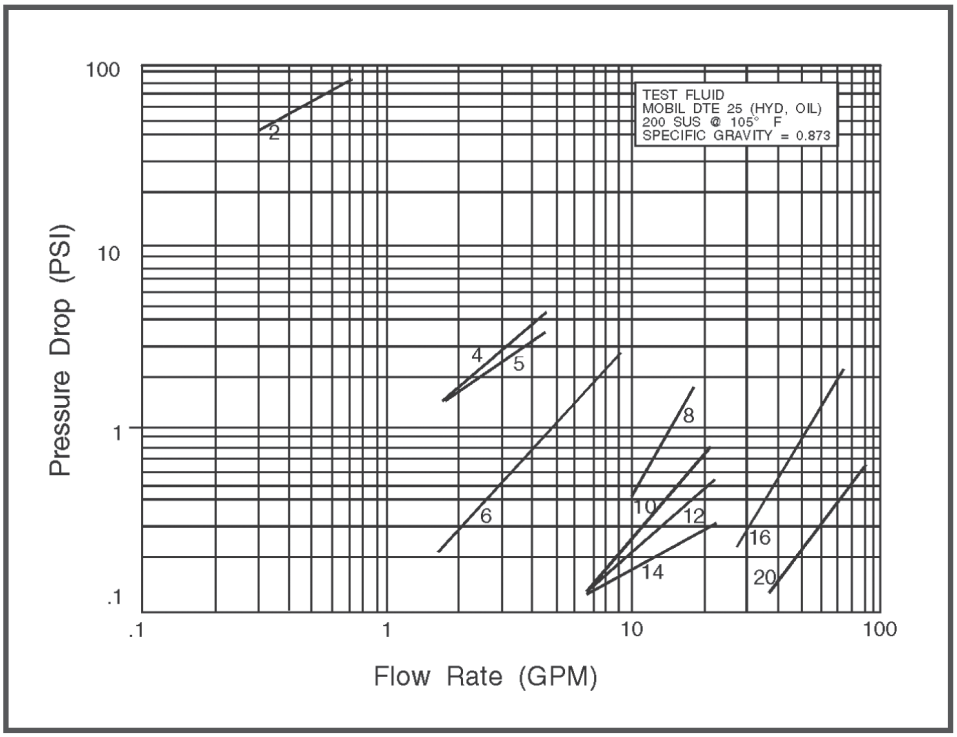
Too large of a tube or fitting increases system cost, weight and envelop size. Therefore, fitting size selection should balance considerations of efficiency, cost, weight and size.

Hydraulic systems efficiency can be simply measured by pressure drop. Pressure drop represents loss of energy and therefore should be kept to a minimum with the constraints of acceptable system cost and overall size. Pressure loss in straight tubing and fittings is mainly caused by the frictional resistance of the walls, while in shaped fittings it is mainly caused by changes in the magnitude or direction of the fluid velocity. Mathematical analysis of pressure drop, even though possible, may not be exact because of the interrelationship of factors such as fluid density, velocity, flow area and frictional coefficients.

The following pressure drop charts were derived from actual test data and may be used as a guide for determining pressure drops at various flow rates through fittings for fluid indicated. To determine pressure drop for a given flow, trace a vertical line up from the flow axis to the desired size line then trace a horizontal line from this intersection over to the pressure drop axis.

Example:

The Parker fitting 8 CTX (1/2” OD 90-degree elbow fitting), with oil similar to the test fluid, flowing through it at 4 gallons per minute, would cause a pressure drop of approximately 2.3 psi, as shown in Fig. 2. Conversions will have to be made for fluids which are not similar to the test fluid.



Examples:

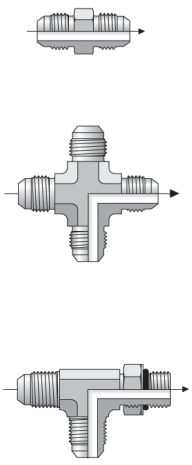


Fig. 1 — Pressure Drop Chart for Straight Fittings and Run Legs of Tees and Crosses (Triple-Lok)

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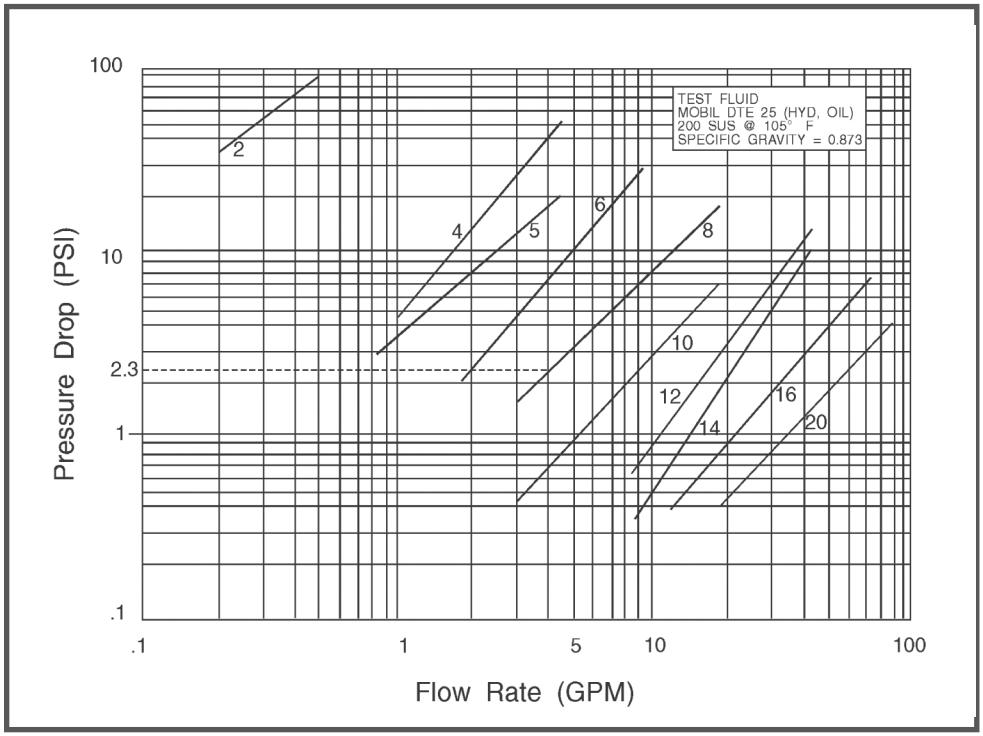
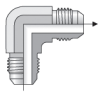


Example:



Examples:

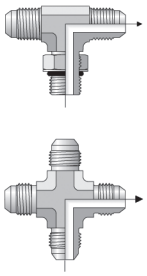
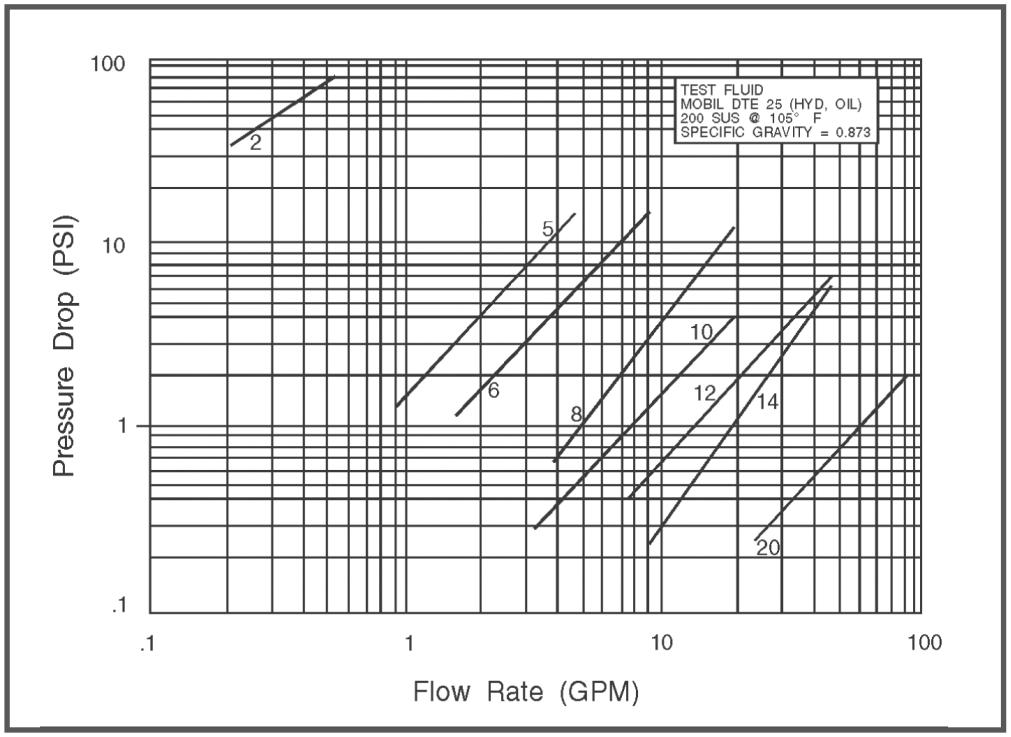


Fig. 2 — Pressure Drop Chart for 90° Fittings or Branch Path Through a Tee or Cross Fitting (Triple-Lok)



Example:

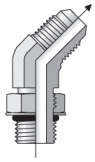


Fig. 3 — Pressure Drop Chart for 45° Elbow Fittings (Triple-Lok)

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Pressure Drops for Other Fittings:

These pressure drop curves were established with Triple-Lok 37-degree flare fittings. The pressure drop values can be adjusted for other fittings of the same size by multiplying the value from the chart by the ratio of Triple-Lok flow diameter to that of the other fitting, raised to the 4th power.

Example: Find pressure drop for 6 C5L (Seal-Lok O-Ring Face Seal Fitting) at 5 gallons per minute flow rate:

From the chart, the pressure drop for 6 C5X is 10 psi.

Also, the ratio of 6 C5X to 6 C5L flow diameters is 0.297/0.264, or 1.125.

Therefore, the pressure drop for Seal-Lok O-Ring Face Seal fitting = 10 x $(1.125)^4$ = 16 psi.

Pressure Drops for Other Fluids:

Pressure drop through a fitting is mainly caused by change in direction and velocity of the fluid. Therefore, it is directly proportional to the specific gravity of the fluid. The drop due to friction, which is dependent on the viscosity of the fluid, is so small in this case that it can be ignored. Thus, the pressure drop with a different fluid can be estimated by multiplying the value from the graph above by the ratio of specific gravity of the two fluids, or:

$$\text{New Drop} = \text{Value from the graph} \times \frac{\text{Specific Gravity of New Fluid}}{\text{Specific Gravity of Test Fluid (0.873)}}$$

Read our TFD techConnect blog post "Sizing Tube to Maximize Hydraulic System Efficiency" for more details.

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STEP 2: TEMPERATURE

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Temperature range is a very import factor to consider during tube fitting and adapter selection. Both environment temperature and system media temperature should be considered. Ensure that the tube fitting or adapter, tube and seal material temperature ranges are adequate for the system temperature range.

Temperature range of common tube fitting, adapter, and seal materials can be found in Table S3 and S4.

Material	Specification	Construction	Condition	Max Hardness	Temperature Range
Carbon Steel C-1010	SAE J524 (ASTM A179)	Seamless	Fully Annealed	HRB 72	-65° to 500°F -55° to 260°C
	SAE J525 (ASTM A178)	Welded & Drawn			
	SAE J356	Welded & Flash Controlled			
Carbon Steel C-1021	SAE J2467	Welded & Flash Controlled	Fully Annealed	HRB 75	-65° to 500°F -55° to 260°C
	SAE J2435	Welded & Drawn			
Carbon Steel High Strength Low Alloy (HSLA)	SAE 2613	Welded & Flash Controlled	Sub-critically annealed	HRB 90	-65° to 500°F -55° to 260°C
	AE J2614	Welded & Drawn			
Alloy Steel 4130	ASTM A519	Seamless			-65° to 500°F -55° to 260°C
St 37.4 (Carbon Steel)	DIN 2391 Part 2 (Metric)	Seamless	Fully Annealed	HRB 72	-65° to 500°F -55° to 260°C
Stainless Steel 304 & 316	ASTM A213 ASTM A269	Seamless	Fully Annealed	HRB 90	-425° to 1200°F -255° to 650°C
	ASTM A249 ASTM A269	Welded & Drawn			
1.4571 1.4541 Stainless Steel	DIN 17458 Tab 8 (Metric)	Seamless	Fully Annealed	HRB 90	-425° to 1200°F -255° to 650°C
Copper	SAE J528 (ASTM B75)	Seamless	Soft Annealed Temper O	60 Max. Rockwell 15T	-325° to 400°F -200° to 205°C
Aluminum 6061	ASTM B210	Seamless	T6 Temper	HRB 56	-325° to 400°F -200° to 205°C
			O & T4 Temper	HRB 30	
Monel 400	ASTM B165	Seamless	Fully Annealed	HRB 70	-400° to 800°F -240° to 425°C
Nylon		Extruded	Flexibe & Semi-Rigid		-60° to 200°F -50° to 95°C
Polyethylene	ASTM D1248	Extruded	Instrument Grade		-80° to 150°F -60° to 65°C
PVC		Extruded	Instrument & Laboratory Grade		0° to 140°F -20° to 60°C
PFTE		Extruded & Cintered			-65° to 400°F -55° to 205°C

Table S3 — Temperature range for common tube and fitting materials

Polymer Family	Abbreviated Name	Parker Compound No.	Color	SAE J515 Type	Hardness Shore "A"[7]	Temperature Range (°F)	Recommended For	Not Recommended For
Nitrile-Butadiene	NBR	N1490/N0552	Black	CH[2]	90[6]	-30° to 250°	Petroleum base oils and fluids, mineral oils, ethylene glycol base fluids, silicone and di-ester base lubricants, air, water under 150°F, and natural gas.	Phosphate ester base hydraulic fluids, automotive brake fluids, strong acids, ozone, freons, ketones, halogenated hydrocarbons, and methanol.
Nitrile-Butadiene	NBR	N0674	Black	—	70	-30° to 250°		
Nitrile-Butadiene	NBR	N0103	Black	—	70	-65° to 225°		
Nitrile-Butadiene (Low compression set)	NBR	N1059	Black	CH[2]	90	-30° to 275°		
Nitrile-Butadiene	NBR	N0507	Black	—	90	-65° to 225°	Meets FDA requirements for food products	
Nitrile-Butadiene	NBR	N0304	Black	—	75	-65° to 180°		
Nitrile-Butadiene	NBR	N0508	Black	—	75	-65° to 225°		
Nitrile-Butadiene	NBR	N0756	Black	—	75[6]	-35° to 250°		
Ethylene-Propylene	EPDM	E0540	Black	CA[3]	80	-65° to 275°	Phosphate ester base hydraulic fluids, hot water, steam to 400°F, silicone oils and greases, dilute acids and alkalis, ketones, alcohols and automotive brake fluids.	Petroleum base oils and di-ester base lubricants.
Ethylene-Propylene	EPDM	E0893	Purple[1]	CA[3]	80	-65° to 275°		
Ethylene-Propylene	EPDM	E0962	Black	—	90	-65° to 275°	CO2 climate control systems.	
Neoprene	CR	C0873	Black	—	70	-45° to 250°	Refrigerants (freons, ammonia), high aniline point petroleum oils, mild acids, and silicate ester lubricants.	Phosphate ester fluids and ketones.
Neoprene	CR	C0944	Red[1]	—	70	-45° to 250°		
Fluorcarbon	FKM5)	V0747	Black	—	75	-15° to 400°	Petroleum base oils and fluids, some phosphate ester base fluids, silicone and silicate ester base lubricants, di-ester base lubricants, acids and halogenated hydrocarbons.	Ketones, skydrol fluids, amines (VDMH), anhydrous ammonia, low molecular weight esters and ethers, and hot hydrofluoric or chlorosulfonic acids.
	or FPM	V0884	Brown[1]	—	75	-15° to 400°		
		V1412/V0894	Brown[1], 5)	HK[4]	90[6]	-15° to 400°		
Silicone	Si	S0604	Rust[1]	—	70	-65° to 450°	Dry Hear (air to 400°) and high aniline point oils.	Most petroleum fluids, ketones, water and steam.

1) These Parker "Chromassure" color assurance O-Rings are available from the Parker Hannifin O-Ring Division. They help eliminate assembly errors, reduce warranty costs and liability risks, and assure safety in aftermarket business.
2) Formerly SAE Type I.
3) Formerly SAE Type II.
4) Formerly SAE Type III.
5) "FKM" is the ASTM designation for fluorocarbon. Its ISO designation is "FPM". For "DIN" Fittings, color is green.
6) Standard compounds available from stock.
7) Use 90 durometer hard O-Rings for applications with 1500 psi or higher pressures.

Table S4 — Temperature range and media compatibility for common seal materials

Standard seals supplied with Parker tube fittings and adapters are 90 durometer hard nitrile (Buna-N) Parker compound **N1490, N0552 or similar.** These O-Rings are well suited for most industrial hydraulic and pneumatic systems. They have high extrusion resistance making them suitable for very high-pressure static applications. Optional high temperature fluorocarbon, Parker compound **V1412 or V0894**, is also available for higher temperature specifications.

Seals for other than normal hydraulic media or higher temperature applications can be selected from Table S4. The table should be used only as a general guide. Before making final selection for a given application, it is recommended that appropriate tests be conducted to assure compatibility with the fluid, temperature, pressure and other environmental conditions.

S

High operating temperature also reduces allowable working pressure of fittings. Temperature derating factors for various metals are given in Table S5. Where applicable, temperature derating factors should be applied to the design pressure values to arrive at the maximum recommended working pressure. The derating factors are based on allowable design stress values at various temperatures per ASME B31.1 code for pressure piping.

Maximum Operating Temperature (°F)	Steel C-1010 and C-4130	Stainless Steel		Brass CA360 CA377	Copper	Aluminum 6061-T6	Monel Type 4000
		304	316				
100	1.00	1.00	1.00	1.00	1.00	1.00	1.00
150	1.00	0.91	1.00	0.94	0.85	1.00	0.97
200	1.00	0.84	1.00	0.90	0.80	1.00	0.94
250	1.00	0.79	1.00	0.87	0.80	0.94	0.91
300	1.00	0.75	1.00	0.83	0.78	0.80	0.88
350	0.99	0.72	0.99	0.80	0.67	0.60	0.86
400	0.98	0.69	0.97	0.40	0.50	0.43	0.85
500	0.96	0.65	0.90				0.84
600		0.61	0.85				0.84
700		0.59	0.82				0.84
800		0.57	0.80				0.83
900		0.54	0.78				
1000		0.52	0.77				
1100		0.47	0.62				
1200		0.32	0.37				

Table S5 — Temperature derating factor for common metals

STEP 3: APPLICATION

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The nature of applications must be carefully evaluated, such as vibration, side load, severity of service, external environment, regional custom and convention, industry standards, regulation, etc. Table S6 lists different service categories and their recommended design factors.

Severity of Service	Description	Design Factor	Derating Factor
A (Normal)	Moderate mechanical and hydraulic shocks.	4.00	1.00
B (Severe)	Severe hydraulic shocks and mechanical strain.	6.00	0.67
C (Hazardous)	Hazardous application with severe service conditions.	8.00	0.50

Table S6 — Severity of Service Design and Derating Factors

Today many different types of connectors are being used around the world. Most of these have come about through historical use and local preference for a certain design concept. Some of them are only used in a specific geographic region or a particular industry. Some connections of North American origin such as four bolt flange, SAE straight thread, and 37° flare have found some degree of acceptance and use in Europe and Japan as a result of the exports of U.S. machinery to the regions after World War II. But, most of the usage is made up of a variety of indigenous port and tube connections. A quick review of the commonly used connections around the world reveals that there are eight different port connections and eleven different tube/hose connections.

Port Connections

- ISO 6149 (Metric Straight Thread O-Ring Port)
- SAE Straight Thread (UN/UNF)
- NPTF
- 4-Bolt Flange
- ISO 1179 (BSPP)
- ISO 9974 (Metric)
- JIS-PT (BSPT)
- JIS-B2351 (BSPP similar to SAE)

Tube/Hose Connections:

- O-Ring Face Seal (SAE)
- 37° Flare (SAE)
- 24° Flareless, Inch Threads (SAE)
- 24° Cone, Metric (DIN)
- 60° Cone Swivel, NPSM (SAE)
- 60° Cone, BSPP (BSI)
- 60° Cone, BSPP (JIS)
- 60° Cone, Metric (JIS)
- 30° Flare, BSPP (JIS)
- 24° Flareless, Metric (JIS)
- 37° Flare, Metric (Russia)

To promote interchangeability and reduce complexity, the following table lists preferred connection types according to ISO recommendations. The preferred fitting styles should be selected when possible.

Application	Port	Tube/Hose Connection			
		24° Cone Flareless (Din) (Bite Type)	37° Flare (Inch Threads)	ORFS	24° Cone Weld Nipple
For All Designs	Metric ISO 6149 (SAE J2244)	ISO 8434-1	ISO 8434-2	ISO 8434-3	ISO 8434-1
Not for New Designs in Hydraulic Fluid Power	Metric ISO 1179 (DIN 3852-2)	ISO 8434-1	ISO 8434-2	— —	ISO 8434-1
	Metric ISO 9974 (DIN 3852-1)	ISO 8434-1	— —	— —	ISO 8434-1
	UN/UNF ISO 11926 (SAE J1926)	— —	ISO 8434-2	— —	— —

Table S7 — ISO Standard Port and Tube/Hose Connection Combinations

Table S8 on the following page shows a summary of port connections

See our TFD techConnect blog post "Spatial Allowance for Fittings in Fluid and Gas Systems" for the seven questions Parker recommends asking when selecting fittings.

Learn the difference between AN 37 (degree sign) Flare vs Industrial 37 (degree sign) Flare Fittings in our TFD techConnect blog post.

Port End Summary

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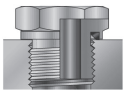
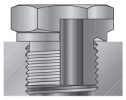
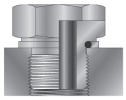
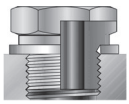
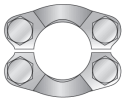
Port End Type and Seal Style	Illustration	Pressure — Dynamic	Pressure — Static	Temperature	Positioning	Contamination	Seal Reliability	Reusability	Fluid Compatibility
Tapered (NPT, NPTF, BSPT and Metric Taper)		Poor	Good	Excellent	Poor	Poor	Poor	Poor	Excellent
O-Ring in Chamfer (SAE J1926, ISO 6149 and JIS B2351)		Excellent	Excellent	Limited by Seal	Excellent	Very Good	Excellent	Excellent	Limited by Seal
Spot Face with ED Seal (ISO 1179-2 and ISO 9974-2)		Excellent	Excellent	Limited by Seal	Not Applicable	Very Good	Excellent	Excellent	Limited by Seal
Spot Face with Bonded Seal (ISO 1179 and ISO 9974)		Good	Good	Good	Not Applicable	Very Good	Good	Excellent	Limited by Seal
Spot Face with Cutting Face (ISO 1179-4 and ISO 9974-3)		Poor	Fair	Excellent	Not Applicable	Fair	Poor	Poor	Excellent
Spot Face with O-Ring and Retaining Ring (ISO 1179-3)		Good	Good	Good	Excellent	Very Good	Good	Excellent	Limited by Seal
Spot Face with Hard Metal Seal (ISO 1179 and ISO 9974)		Poor	Fair	Excellent	Not Applicable	Fair	Poor	Poor	Excellent
Spot Face with Soft Metal Seal (ISO 1179 and ISO 9974 with copper gasket)		Poor	Fair	Good	Not Applicable	Very Good	Poor	Fair	Excellent
4 Bolt Flange (SAE J518 and ISO 6162)		Excellent	Excellent	Good	Good	Very Good	Good	Excellent	Limited by Seal
4 Bolt Flange (ISO 6164)		Excellent	Excellent	Good	Good	Good	Good	Excellent	Limited by Seal

Table S8 — Application of Common Port Ends

Table S9 on the following page shows a summary of tube connections

Dimensions and pressures for reference only, subject to change.

Parker Hannifin Corporation
Tube Fittings Division
Columbus, Ohio
http://www.parker.com/tfd

Tube End Summary

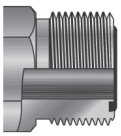
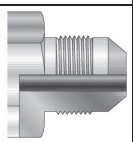
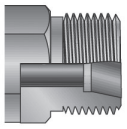
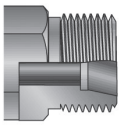
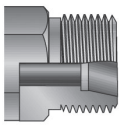
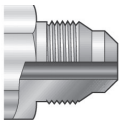
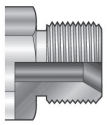
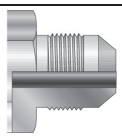
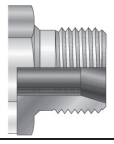
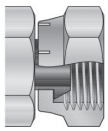
Tube/Hose End Type	Illustration	Pressure — Dynamic	Pressure — Static	Seal Reliability	Vibration Resistance (in Rigid Systems)	Ease of Installation	Ease of Maintenance	Reusability	Temperature
Seal-Lok O-Ring Face Seal		Excellent	Excellent	Excellent	Very Good	Excellent	Excellent	Excellent	Limited by Seal
Triple-Lok 37°Flare		Very Good	Very Good	Good	Good	Good	Very Good	Good	Excellent
Ferulok Inch Bite Type		Very Good	Very Good	Very Good	Very Good	Good	Good	Very Good	Excellent
EO Metric Bite Type		Excellent	Excellent	Very Good	Very Good	Good	Good	Very Good	Excellent
EO-2 Soft Seal Metric Bite Type		Excellent	Excellent	Excellent	Very Good	Very Good	Good	Excellent	Limited by Seal
JIS 30°Flare		Good	Good	Very Good	Not Applicable	Very Good	Very Good	Very Good	Limited by Seal
JIS 60° Cone B8363		Good	Good	Very Good	Not Applicable	Very Good	Very Good	Very Good	Limited by Seal
Komatsu 30°Flare		Good	Good	Very Good	Not Applicable	Very Good	Very Good	Very Good	Limited by Seal
K4 BSP Adapters		Good	Good	Very Good	Not Applicable	Very Good	Very Good	Very Good	Limited by Seal
NPSM (Swivel)		Good	Good	Very Good	Not Applicable	Good	Good	Very Good	Very Good

Table S9 — Application of Common Tube Ends

Dimensions and pressures for reference only, subject to change.

Parker Hannifin Corporation
Tube Fittings Division
Columbus, Ohio
http://www.parker.com/tfd

STEP 4: MEDIA OR MATERIAL

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In additional to temperature, proper selection of tube, fitting and adapter material will also depend on the system media and corrosive nature of the service environment. Table S10 can be used to select the proper fitting and seal material based on system media type.

This table is intended as a guide only and is not to be considered as a sole selection criteria when choosing Parker Tube Fittings and adapters for a specific application or with a specific fluid.

	Fitting Material			Seal Material			
Media	Brass	Steel	316 SS	BUNA-N	Ethylene Propylene	Fluorocarbon	Neoprene
Acetylene	NR	F	S	S	S	S	F
Air (oil free) @ 190°F	S	F	S	S	S	S	S
Air (oil free) @ 300°F	S	F	S	F	F	S	F
Air (oil free) @ 400°F	S	F	S	NR	NR	S	NR
Alcohol, Ethyl	S	NR	NR	NR	S	NR	S
Animal Oils (Lard Oil)	F	F	F	S	F	S	F
Aromatic Fuel - 50%	ID	ID	ID	F	NR	S	NR
Aromatic Solvents	ID	ID	F	F	ID	S	NR
Asphalt	NR	NR	S	F	NR	S	F
ASTM Oil #1	S	S	S	S	NR	S	S
ASTM Oil #2	S	S	S	S	NR	S	F
ASTM Oil #3	S	S	S	S	NR	S	NR
ASTM Oil #4	S	S	S	F	NR	S	NR
ATF Oil	S	S	S	S	NR	S	F
Automotive Brake Fluid	ID	ID	ID	NR	S	NR	F
Benzene	NR	F	NR	NR	NR	S	NR
Brine (Sodium Chloride)	NR	NR	S	S	S	S	S
Butane	NR	S	S	S	NR	S	S
Carbon Dioxide	S	F	S	S	S	S	S
Carbon Monoxide	S	S	S	S	S	S	F
Chlorine (Dry)	F	F	NR	NR	ID	F	F
Compressed Air	S	F	S	S	S	S	S
Crude Oil	NR	F	S	F	NR	S	NR
Cutting Oil	ID	S	S	S	NR	S	F
Diesel Fuel	S	S	S	S	NR	S	NR
Ethanol	S	NR	S	NR	S	NR	S
Ethers	S	S	S	NR	F	F	NR
Freon 11	S	ID	ID	F	NR	F	NR
Freon 12	S	S	NR	F	NR	S	S
Freon 22	S	NR	S	NR	NR	NR	S
Fuel Oil	NR	S	S	S	NR	S	F
Gasoline	S	F	S	S	NR	S	NR
Gas, Liquid Propane (LPG)	S	S	S	S	NR	S	F
Gas, Natural	F	S	S	S	NR	S	S
Helium	S	S	S	S	S	S	S
Hydraulic Oil, Petroleum Base	S	S	S	S	NR	S	S
Hydraulic Oil, Water Base	ID	S	S	F	S	NR	F
Hydrogen Gas	S	S	S	S	S	S	S
Jet Fuel	S	S	S	S	NR	S	NR
Kerosene	S	S	S	S	NR	S	F
Lubricating Oil SAE 10, 20, 30, 40, 50	S	S	S	S	NR	S	F
Methanol	S	S	S	S	S	NR	S
MIL-F-8192 (JP-9)	S	S	S	NR	NR	S	NR
MIL-H-5606	S	S	S	S	NR	S	F
MIL-H-6083	S	S	S	S	NR	S	S
MIL-H-7083	S	S	S	S	S	F	F
MIL-H-8446 (MLO-8515)	F	S	S	F	NR	S	S
Mil-L-2104 & 2104B	S	S	S	S	NRX	S	F

Table S10 — Fitting, Seal Material and Media Compatibility *(Cont'd)*

Codes: S = Satisfactory F = Fair NR = Not recommended ID = Insufficient Data

Dimensions and pressures for reference only, subject to change.

Parker Hannifin Corporation
Tube Fittings Division
Columbus, Ohio
http://www.parker.com/tfd

	Fitting Material			Seal Material			
Media	Brass	Steel	316 SS	BUNA-N	Ethylene Propylene	Fluorocarbon	Neoprene
MIL-L-7808	NR	F	S	S	NR	S	NR
Mineral Oil	S	S	S	F	NR	S	F
Nitrogen	S	S	S	F	S	S	S
Petrolatum	S	S	S	S	NR	S	F
Petroleum Oil (<250°F)	S	S	S	S	NR	S	F
Propane	S	S	S	S	NR	S	F
R134A	S	S	S	NR	S	NR	NR
Sea Water	F	NR	S	S	S	S	F
Skydrol 500, Type 2	NR	S	S	NR	S	NR	NR
Skydrol 7000, Type 2	NR	S	S	NR	S	F	NR
Soap Solutions	NR	NR	S	S	S	S	F
Steam (<400°F)	F	S	S	NR	S	NR	NR
Stoddard Solvent	F	S	S	S	NR	S	F
Transmission Fluid (Type A)	S	S	S	S	NR	S	F
Trichloroethane	ID	F	S	NR	NR	S	NR
Water	S	F	S	S	S	F	F

Table S10 — Fitting, Seal Material and Media Compatibility *(Cont'd)*

Codes: S = Satisfactory F = Fair NR = Not recommended ID = Insufficient Data

In additional to being compatible with the media, tube fittings and adapters must also be compatible with tube material and type. Table S11 lists several common tube types with their recommended operating temperature ranges, general application, and fitting and adapter compatibility. Based on the fluid system parameters and media, select the appropriate tube fitting or adapter type and material. As a general rule, tube and fitting materials should be the same. Since operating conditions differ with applications, different material combinations in this table should be used only as a guide and not a firm recommendation. Before making a final decision on material combination, it should be sufficiently tested under appropriate conditions to assure suitability for the intended application.

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Tube Material	Specification	Construction	Condition	Max. Hardness	Temperature Range (7)	Application	Tube Material to Fitting & Material Compatibility										
							Seal-Lok ORFS (SAE J1453)			Triple-Lok 37°Flare (SAE J514)				Ferulok Flareless (SAE J514)			EO/EO-2 Flareless (ISO 8434-1)
							S	SS	B	S	SS	B	M	S	SS	M	S, SS ,B
Carbon Steel C-1010	SAE J524 (ASTM A179) (8)	Seamless	Fully Annealed	HRB 72	-65° to 500°F -55° to 260°C	High pressure hydraulic, air, & some specialty chemicals	E	NR	(6)	G	NR	(6)	NR	E	NR	NR	NR
	SAE J525 (ASTM A178) (8)	Welded & Drawn					E	NR	(6)	E	NR	(6)	NR	E	NR	NR	NR
	SAE J356	Welded & Flash Controlled					G	NR	(6)	NR	NR	(6)	NR	G	NR	NR	NR
Carbon Steel C-1021	SAE J2435	Welded & Flash Controlled	Fully Annealed	HRB 75	-65° to 500°F -55° to 260°C	High pressure hydraulic	E	NR	(6)	NR	NR	(6)	NR	E	NR	NR	NR
	SAE J2467	Welded & Drawn					E	NR	(6)	E	NR	(6)	NR	E	NR	NR	NR
Carbon Steel High Strength Low Alloy (HSLA)	SAE 2613	Welded & Flash Controlled	Sub-critically annealed	HRB 90	-65° to 500°F -55° to 260°C	High pressure hydraulic	E (10)	NR	(6)	NR	NR	(6)	NR	NR	NR	NR	NR
	SAE J2614	Welded & Drawn					E	NR	(6)	NR	NR	(6)	NR	NR	NR	NR	NR
Alloy Steel 4130	ASTM A519	Seamless			-65° to 500°F -55° to 260°C	High pressure hydraulics	E (4)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
St 37.4 (Carbon Steel)	DIN 2391 Part 2 (Metric)	Seamless	Fully Annealed	HRB 72	-65° to 500°F -55° to 260°C	High pressure hydraulic, air, & some specialty chemicals	E	NR	NR	G	NR	NR	NR	NR	NR	NR	E
Stainless Steel 304 & 316	ASTM A213 ASTM A269	Seamless	Fully Annealed	HRB 90	-425° to 1200° -255° to 650°C (3)	High pressure, high temperature, or generally corrosive media (1)	(6)	E	(6)	(6)	G	(6)	NR	(6)	E	NR	E
	ASTM A249 ASTM A269	Welded & Drawn					(6)	E	(6)	(6)	E	(6)	NR	(6)	E	NR	E
1.4571 1.4541 Stainless Steel	DIN 17458 Tab 8 (Metric)	Seamless	Fully Annealed	HRB 90	-425° to 1200° -255° to 650°C (3)	High pressure, high temperature, or generally corrosive media (1)	(6)	E	NR	(6)	G	NR	NR	NR	E	NR	E
Copper	SAE J528 (ASTM B75) (8)	Seamless	Soft Annealed Temper 0	60 Max. Rockwell 15T	-325° to 400°F -200° to 205°C	Low pressure, low temperature, water, oil & air	E	(6)	E	G	(6)	E	NR	G (2)	NR	NR	E
Aluminum 6061	ASTM B210	Seamless	T6 Temper	HRB 56	-325° to 400°F -200° to 205°C	Low pressure, low temperature, water,oil, air & some specialty chemicals	NR	NR	NR	G	NR	NR	NR	E (2)	NR	NR	NR
			0 & T4 Temper	HRB 30			E (5)	NR	NR	G	NR	NR	NR	E (2)	NR	NR	NR
Monel 400	ASTM B165	Seamless	Fully Annealed	HRB 70	-400° to 800°F -240° to 425°C	Sour gas, marine & general chemical processing media	NR	(6)	NR	NR	(6)	NR	E	NR	(6)	E	NR
Nylon		Extruded	Flexible & Semi-Rigid		-60° to 200°F -50° to 95°C	Lube lines, chemical process controls & air	NR	NR	NR	NR	NR	NR	NR	G (2)	G (2)	G (2)	G (2), (9)
Polyethylene	ASTM D1248	Extruded	Instrument Grade		-80° to 150°F -60° to 65°C	Instrumentation lines	NR	NR	NR	NR	NR	NR	NR	G (2)	G (2)	G (2)	G (2), (9)
PVC		Extruded	Instrument & Laboratory Grade		0° to 140°F -20° to 60°C	General purpose laboratory use	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
PFTE		Extruded & Cintered			-65° to 400°F -55° to 205°C	Very low pressure, high temperature, fuel, lube, chemical & air applications	NR	NR	NR	NR	NR	NR	NR	G (2)	G (2)	G (2)	G (2), (9)

Table S11 — Tube and Fitting Material Compatibility

Notes:

1) For highly corrosive media or service environment, contact the Tube Fittings Division.
2) Requires different assembly procedure. Contact the Tube Fittings Division.
3) Low temperature limit for stainless steel Ferulok fittings is -20°F (-30°C).
4) For brazing only. Grade 4130 not recommended with Parflange process.
5) For use with Parflange process only. Not recommended with brazing.
6) Use depends on specific application. Contact the Tube Fittings Division.
7) Applies to tube material.
8) Comparable specifications to SAE.
9) With metric version of tubing.
10) Not tested with Parflange. Contact the Tube Fittings Division.

Ratings Key:
NR Not Recommended
F Fair
G Good
E Excellent

Fitting Materials Code:
S Steel
SS Stainless Steel
B Brass
M Monel

S

Dimensions and pressures for reference only, subject to change.

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Tube Fittings Division
Columbus, Ohio
http://www.parker.com/tfd

If elastomer seals are used in a tube fitting or adapter, the seals must be compatible with the media and environment as well. Table S12 lists compatible seal material based on media type.

Recommended for	Temperature Range	Not Recommended For	Polymer	Abbreviated Name	Parker Compound	No. Color	SAE J515 Type	Shore Hardness
Acids	-15° to 400°F	Ketones, skydrol fluids, amines (VDMH), anhydrous ammonia, low molecular weight esters and ethers, hot hydroflouric or chlorosulfuric acids	Fluorocarbon	FKM[5] or FPM	V0747	Black	—	75
Acids	-15° to 400°F	Ketones, skydrol fluids, amines (VDMH), anhydrous ammonia, low molecular weight esters and ethers, hot hydroflouric or chlorosulfuric acids	Fluorocarbon	FKM[5] or FPM	V0884	Brown[1]	—	75
Acids	-15° to 400°F	Ketones, skydrol fluids, amines (VDMH), anhydrous ammonia, low molecular weight esters and ethers, hot hydroflouric or chlorosulfuric acids	Fluorocarbon	FKM[5] or FPM	V0894	Brown[1],[5]	HK[4]	90[6]
Air	-30° to 250°	Phosphate ester base hydraulic fluids, automotive brake fluids, strong acids, ozone, freons, ketones, halogenergated hydrocarbons and methonal	Nitrile-Butadiene	NBR	N0674	Black	—	70
Air	-30° to 250°F	Phosphate ester base hydraulic fluids, automotive brake fluids, strong acids, ozone, freons, ketones, halogenergated hydrocarbons and methonal	Nitrile-Butadiene	NBR	N0552	Black	CH[2]	90[6]
Air	-30° to 275°F	Phosphate ester base hydraulic fluids, automotive brake fluids, strong acids, ozone, freons, ketones, halogenergated hydrocarbons and methonal	Nitrile-Butadiene	NBR	N1059	Black	CH[2]	90
Air	-65° to 225°	Phosphate ester base hydraulic fluids, automotive brake fluids, strong acids, ozone, freons, ketones, halogenergated hydrocarbons and methonal	Nitrile-Butadiene	NBR	N0103	Black	—	70
Alcohols	-65° to 225°F	Petroleum based oils and di-ester base lubricants	Ethylene-Propylene	EPDM	E0540	Black	CA[3]	80
Alcohols	-65° to 225°F	Petroleum based oils and di-ester base lubricants	Ethylene-Propylene	EPDM	E0893	Purple[1]	CA[3]	80
Automotive brake fluids	-65° to 225°F	Petroleum based oils and di-ester base lubricants	Ethylene-Propylene	EPDM	E0540	Black	CA[3]	80
Automotive brake fluids	-65° to 225°F	Petroleum based oils and di-ester base lubricants	Ethylene-Propylene	EPDM	E0893	Purple[1]	CA[3]	80
$C0^2$ Climate control systems	-65° to 225°F	Petroleum based oils and di-ester base lubricants	Ethylene-Propylene	EPDM	E0962	Black	—	90
CNG Applications	-58° to 300°F	Phosphate ester base hydraulic fluids, automotive brake fluids, strong acids, ozone, freons, ketones, halogenergated hydrocarbons and methonal	Nitrile-Butadiene	HNBR	KA183	Black	—	85
Di-ester base lubricants	-15° to 400°F	Ketones, skydrol fluids, amines (VDMH), anhydrous ammonia, low molecular weight esters and ethers, hot hydroflouric or chlorosulfuric acids	Fluorocarbon	FKM[5] or FPM	V0747	Black	—	75
Di-ester base lubricants	-15° to 400°F	Ketones, skydrol fluids, amines (VDMH), anhydrous ammonia, low molecular weight esters and ethers, hot hydroflouric or chlorosulfuric acids	Fluorocarbon	FKM[5] or FPM	V0884	Brown[1]	—	75
Di-ester base lubricants	-15° to 400°F	Ketones, skydrol fluids, amines (VDMH), anhydrous ammonia, low molecular weight esters and ethers, hot hydroflouric or chlorosulfuric acids	Fluorocarbon	FKM[5] or FPM	V0894	Brown[1],[5]	HK[4]	90[6]
Dilute acids and alkalis	-65° to 275°F	Petroleum based oils and di-ester base lubricants	Ethylene-Propylene	EPDM	E0540	Black	CA[3]	80
Dilute acids and alkalis	-65° to 275°F	Petroleum based oils and di-ester base lubricants	Ethylene-Propylene	EPDM	E0893	Purple[1]	CA[3]	80
Dry heat (air to 400°F)	-65° to 450°F	Most petroleum fluids, ketones, water and steam	Silicone	Si	S0604	Rust[1]	—	70
Ethylene glycol base fluids	-30° to 250°	Phosphate ester base hydraulic fluids, automotive brake fluids, strong acids, ozone, freons, ketones, halogenergated hydrocarbons and methonal	Nitrile-Butadiene	NBR	N0674	Black	—	70

Table S12 – Seal and Media Compatibility *(Cont'd)*

Recommended for	Temperature Range	Not Recommended For	Polymer	Abbreviated Name	Parker Compound	No. Color	SAE J515 Type	Shore Hardness
Ethylene glycol base fluids	-30° to 250°F	Phosphate ester base hydraulic fluids, automotive brake fluids, strong acids, ozone, freons, ketones, halogenergated hydrocarbons and methonal	Nitrile-Butadiene	NBR	N0552	Black	CH[2)]	90[6)]
Ethylene glycol base fluids	-30° to 275°F	Phosphate ester base hydraulic fluids, automotive brake fluids, strong acids, ozone, freons, ketones, halogenergated hydrocarbons and methonal	Nitrile-Butadiene	NBR	N1059	Black	CH[2)]	90
Ethylene glycol base fluids	-65° to 225°	Phosphate ester base hydraulic fluids, automotive brake fluids, strong acids, ozone, freons, ketones, halogenergated hydrocarbons and methonal	Nitrile-Butadiene	NBR	N0103	Black	—	70
Food product applications (meets FDA requirements)	-35° to 250°	Phosphate ester base hydraulic fluids, automotive brake fluids, strong acids, ozone, freons, ketones, halogenergated hydrocarbons and methonal	Nitrile-Butadiene	NBR	N0508	Black	—	75
Halogenated hydrocarbons	-15° to 400°F	Phosphate ester base hydraulic fluids, automotive brake fluids, strong acids, ozone, freons, ketones, halogenergated hydrocarbons and methonal	Fluorocarbon	FKM[5)] or FPM	V0747	Black	—	75
Halogenated hydrocarbons	-15° to 400°F	Ketones, skydrol fluids, amines (VDMH), anhydrous ammonia, low molecular weight esters and ethers, hot hydroflouric or chlorosulfuric acids	Fluorocarbon	FKM[5)] or FPM	V0884	Brown[1)]	—	75
Halogenated hydrocarbons	-15° to 400°F	Ketones, skydrol fluids, amines (VDMH), anhydrous ammonia, low molecular weight esters and ethers, hot hydroflouric or chlorosulfuric acids	Fluorocarbon	FKM[5)] or FPM	V0894	Brown[1),5)]	HK[4)]	90[6)]
High aniline point oils	-65° to 450°F	Most petroleum fluids, ketones, water and steam	Silicone	Si	S0604	Rust[1)]	—	70
High aniline point petroleum oils	-45° to 250°F	Phosphate ester fluids and ketones	Neoprene	CR	C0873	Black	—	70
High aniline point petroleum oils	-45° to 250°F	Phosphate ester fluids and ketones	Neoprene	CR	C0944	Red[1)]	—	70
Hot water	-65° to 275°F	Petroleum based oils and di-ester base lubricants	Ethylene-Propylene	EPDM	E0540	Black	CA[3)]	80
Hot water	-65° to 275°F	Petroleum based oils and di-ester base lubricants	Ethylene-Propylene	EPDM	E0893	Purple[1)]	CA[3)]	80
Hydrogen Fuel Cells	-65° to 180°F	Phosphate ester base hydraulic fluids, automotive brake fluids, strong acids, ozone, freons, ketones, halogenergated hydrocarbons and methonal	Nitrile-Butadiene	NBR	N0507	Black	—	90
Hydrogen Fuel Cells	-65° to 225°F	Phosphate ester base hydraulic fluids, automotive brake fluids, strong acids, ozone, freons, ketones, halogenergated hydrocarbons and methonal	Nitrile-Butadiene	NBR	N0304	Black	—	75
Ketones	-65° to 275°F	Petroleum based oils and di-ester base lubricants	Ethylene-Propylene	EPDM	E0540	Black	CA[3)]	80
Ketones	-65° to 275°F	Petroleum based oils and di-ester base lubricants	Ethylene-Propylene	EPDM	E0893	Purple[1)]	CA[3)]	80
Mild Acids	-45° to 250°F	Phosphate ester fluids and ketones	Neoprene	CR	C0873	Black	—	70
Mild Acids	-45° to 250°F	Phosphate ester fluids and ketones	Neoprene	CR	C0944	Red[1)]	—	70
Mineral Oils	-30° to 250°	Phosphate ester base hydraulic fluids, automotive brake fluids, strong acids, ozone, freons, ketones, halogenergated hydrocarbons and methonal	Nitrile-Butadiene	NBR	N0674	Black	—	70
Mineral Oils	-30° to 250°F	Phosphate ester base hydraulic fluids, automotive brake fluids, strong acids, ozone, freons, ketones, halogenergated hydrocarbons and methonal	Nitrile-Butadiene	NBR	N0552	Black	CH[2)]	90[6)]
Mineral Oils	-30° to 275°F	Phosphate ester base hydraulic fluids, automotive brake fluids, strong acids, ozone, freons, ketones, halogenergated hydrocarbons and methonal	Nitrile-Butadiene	NBR	N1059	Black	CH[2)]	90
Mineral Oils	-65° to 225°	Phosphate ester base hydraulic fluids, automotive brake fluids, strong acids, ozone, freons, ketones, halogenergated hydrocarbons and methonal	Nitrile-Butadiene	NBR	N0103	Black	—	70
Natural Gas	-30° to 250°	Phosphate ester base hydraulic fluids, automotive brake fluids, strong acids, ozone, freons, ketones, halogenergated hydrocarbons and methonal	Nitrile-Butadiene	NBR	N0674	Black	—	70
Natural Gas	-30° to 250°F	Phosphate ester base hydraulic fluids, automotive brake fluids, strong acids, ozone, freons, ketones, halogenergated hydrocarbons and methonal	Nitrile-Butadiene	NBR	N0552	Black	CH[2)]	90[6)]

Table S12 – Seal and Media Compatibility *(Cont'd)*

Dimensions and pressures for reference only, subject to change.

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Recommended for	Temperature Range	Not Recommended For	Polymer	Abbreviated Name	Parker Compound	No. Color	SAE J515 Type	Shore Hardness
Natural Gas	-30° to 275°F	Phosphate ester base hydraulic fluids, automotive brake fluids, strong acids, ozone, freons, ketones, halogenergated hydrocarbons and methonal	Nitrile-Butadiene	NBR	N1059	Black	CH[2)]	90
Natural Gas	-65° to 225°	Phosphate ester base hydraulic fluids, automotive brake fluids, strong acids, ozone, freons, ketones, halogenergated hydrocarbons and methonal	Nitrile-Butadiene	NBR	N0103	Black	—	70
Petroleum based oils and fluids	-30° to 250°	Phosphate ester base hydraulic fluids, automotive brake fluids, strong acids, ozone, freons, ketones, halogenergated hydrocarbons and methonal	Nitrile-Butadiene	NBR	N0674	Black	—	70
Petroleum based oils and fluids	-15° to 400°F	Ketones, skydrol fluids, amines (VDMH), anhydrous ammonia, low molecular weight esters and ethers, hot hydroflouric or chlorosulfuric acids	Fluorocarbon	FKM[5)] or FPM	V0747	Black	—	75
Petroleum based oils and fluids	-15° to 400°F	Ketones, skydrol fluids, amines (VDMH), anhydrous ammonia, low molecular weight esters and ethers, hot hydroflouric or chlorosulfuric acids	Fluorocarbon	FKM[5)] or FPM	V0884	Brown[1)]	—	75
Petroleum based oils and fluids	-15° to 400°F	Ketones, skydrol fluids, amines (VDMH), anhydrous ammonia, low molecular weight esters and ethers, hot hydroflouric or chlorosulfuric acids	Fluorocarbon	FKM[5)] or FPM	V0894	Brown[1),5)]	HK[4)]	90[6)]
Petroleum based oils and fluids	-30° to 250°F	Phosphate ester base hydraulic fluids, automotive brake fluids, strong acids, ozone, freons, ketones, halogenergated hydrocarbons and methonal	Nitrile-Butadiene	NBR	N0552	Black	CH[2)]	90[6)]
Petroleum based oils and fluids	-30° to 275°F	Phosphate ester base hydraulic fluids, automotive brake fluids, strong acids, ozone, freons, ketones, halogenergated hydrocarbons and methonal	Nitrile-Butadiene	NBR	N1059	Black	CH[2)]	90
Petroleum based oils and fluids	-65° to 225°	Phosphate ester base hydraulic fluids, automotive brake fluids, strong acids, ozone, freons, ketones, halogenergated hydrocarbons and methonal	Nitrile-Butadiene	NBR	N0103	Black	—	70
Phosphate ester base hydraulic fluids	-65° to 275°F	Petroleum based oils and di-ester base lubricants	Ethylene-Propylene	EPDM	E0540	Black	CA[3)]	80
Phosphate ester base hydraulic fluids	-65° to 275°F	Petroleum based oils and di-ester base lubricants	Ethylene-Propylene	EPDM	E0893	Purple[1)]	CA[3)]	80
Phosphate ester base hydraulic fluids (some)	-15° to 400°F	Ketones, skydrol fluids, amines (VDMH), anhydrous ammonia, low molecular weight esters and ethers, hot hydroflouric or chlorosulfuric acids	Fluorocarbon	FKM[5)] or FPM	V0747	Black	—	75
Phosphate ester base hydraulic fluids (some)	-15° to 400°F	Ketones, skydrol fluids, amines (VDMH), anhydrous ammonia, low molecular weight esters and ethers, hot hydroflouric or chlorosulfuric acids	Fluorocarbon	FKM[5)] or FPM	V0884	Brown[1)]	—	75
Phosphate ester base hydraulic fluids (some)	-15° to 400°F	Ketones, skydrol fluids, amines (VDMH), anhydrous ammonia, low molecular weight esters and ethers, hot hydroflouric or chlorosulfuric acids	Fluorocarbon	FKM[5)] or FPM	V0894	Brown[1),5)]	HK[4)]	90[6)]
Refrigerants (freons, ammonia)	-45° to 250°F	Phosphate ester fluids and ketones	Neoprene	CR	C0873	Black	—	70
Refrigerants (freons, ammonia)	-45° to 250°F	Phosphate ester fluids and ketones	Neoprene	CR	C0944	Red[1)]	—	70
Silicate ester lubricants	-45° to 250°F	Phosphate ester fluids and ketones	Neoprene	CR	C0873	Black	—	70
Silicate ester lubricants	-45° to 250°F	Phosphate ester fluids and ketones	Neoprene	CR	C0944	Red[1)]	—	70
Silicone and di-ester base lubricants	-30° to 250°	Phosphate ester base hydraulic fluids, automotive brake fluids, strong acids, ozone, freons, ketones, halogenergated hydrocarbons and methonal	Nitrile-Butadiene	NBR	N0674	Black	—	70
Silicone and di-ester base lubricants	-30° to 250°F	Phosphate ester base hydraulic fluids, automotive brake fluids, strong acids, ozone, freons, ketones, halogenergated hydrocarbons and methonal	Nitrile-Butadiene	NBR	N0552	Black	CH[2)]	90[6)]
Silicone and di-ester base lubricants	-30° to 275°F	Phosphate ester base hydraulic fluids, automotive brake fluids, strong acids, ozone, freons, ketones, halogenergated hydrocarbons and methonal	Nitrile-Butadiene	NBR	N1059	Black	CH[2)]	90
Silicone and di-ester base lubricants	-65° to 225°	Phosphate ester base hydraulic fluids, automotive brake fluids, strong acids, ozone, freons, ketones, halogenergated hydrocarbons and methonal	Nitrile-Butadiene	NBR	N0103	Black	—	70

Table S12 – Seal and Media Compatibility *(Cont'd)*

Dimensions and pressures for reference only, subject to change.

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Recommended for	Temperature Range	Not Recommended For	Polymer	Abbreviated Name	Parker Compound	No. Color	SAE J515 Type	Shore Hardness
Silicone and silicate ester based lubricants	-15° to 400°F	Ketones, skydrol fluids, amines (VDMH), anhydrous ammonia, low molecular weight esters and ethers, hot hydroflouric or chlorosulfuric acids	Fluorocarbon	FKM[5] or FPM	V0747	Black	—	75
Silicone and silicate ester based lubricants	-15° to 400°F	Ketones, skydrol fluids, amines (VDMH), anhydrous ammonia, low molecular weight esters and ethers, hot hydroflouric or chlorosulfuric acids	Fluorocarbon	FKM[5] or FPM	V0884	Brown[1]	—	75
Silicone and silicate ester based lubricants	-15° to 400°F	Ketones, skydrol fluids, amines (VDMH), anhydrous ammonia, low molecular weight esters and ethers, hot hydroflouric or chlorosulfuric acids	Fluorocarbon	FKM[5] or FPM	V0894	Brown[1],[5]	HK[4]	90[6]
Silicone oils and greases	-65° to 275°F	Petroleum based oils and di-ester base lubricants	Ethylene-Propylene	EPDM	E0540	Black	CA[3]	80
Silicone oils and greases	-65° to 275°F	Petroleum based oils and di-ester base lubricants	Ethylene-Propylene	EPDM	E0893	Purple[1]	CA[3]	80
Steam to 400°F	-65° to 275°F	Petroleum based oils and di-ester base lubricants	Ethylene-Propylene	EPDM	E0540	Black	CA[3]	80
Steam to 400°F	-65° to 275°F	Petroleum based oils and di-ester base lubricants	Ethylene-Propylene	EPDM	E0893	Purple[1]	CA[3]	80
Water under 150°F	-30° to 250°	Phosphate ester base hydraulic fluids, automotive brake fluids, strong acids, ozone, freons, ketones, halogenergated hydrocarbons and methonal	Nitrile-Butadiene	NBR	N0674	Black	—	70
Water under 150°F	-30° to 250°F	Phosphate ester base hydraulic fluids, automotive brake fluids, strong acids, ozone, freons, ketones, halogenergated hydrocarbons and methonal	Nitrile-Butadiene	NBR	N0552	Black	CH[2]	90[6]
Water under 150°F	-30° to 275°F	Phosphate ester base hydraulic fluids, automotive brake fluids, strong acids, ozone, freons, ketones, halogenergated hydrocarbons and methonall	Nitrile-Butadiene	NBR	N1059	Black	CH[2]	90
Water under 150°F	-65° to 225°	Phosphate ester base hydraulic fluids, automotive brake fluids, strong acids, ozone, freons, ketones, halogenergated hydrocarbons and methonal	Nitrile-Butadiene	NBR	N0103	Black	—	70

Table S12 – Seal and Media Compatibility

1) These Parker "Chromassure" color assurance O-Rings are available from the Parker Hannifin O-Ring Division. They help eliminate assembly errors, reduce warranty costs and liability risks, and assure safety in aftermarket business.
2) Formerly SAE Type I.
3) Formerly SAE Type II.
4) Formerly SAE Type III.
5) "FKM" is the ASTM designation for fluorocarbon. Its ISO designation is "FPM". For "DIN" Fittings, color is green.
6) Standard compounds available from stock.
7) Use 90 durometer hard O-Rings for applications with 1500 psi or higher pressures.

Caution: When working with highly corrosive media, always consult the Tube Fittings Division

Other material considerations:

Protective coatings such as electroplated zinc and zinc phosphate are usually applied to steel fittings for extending their useful service life in corrosive environments. Zinc corrodes sacrificially, protecting the steel substrate from normal atmospheric rusting due to the common presence of oxygen, moisture and acidic gases. They are, however, rapidly attacked by many fluids including those containing acidic hydrogen and reactive fluorine, chlorine, bromine, iodine, and nitrogen. Zinc plating will further be attacked by strong bases or water with pH > 12. Zinc reacts with glycol-based fire-resistant fluids and forms a gelatinous compound that can plug up filters and be harmful otherwise, in a system with many zinc plated tube and hose fittings. Stainless-steel fittings, along with brass fittings in low pressure applications, are viable options.

The other option is to run the fluid through the system, without components with moving parts in it, with an auxiliary power source, to generate and flush the gelatinous compound. Then re-connect all components, change filters and charge the system with new fluid.

Zinc-Nickel plating offers enhanced performance over Chromium-6 Free zinc plating.

Caution: Where low toxicity and low corrosion are required, as in food or beverage applications, steel coated with any form of zinc or other protective coatings is not recommended.

Tube and tube fitting and adapter materials should be similar when possible. If different materials must be used, galvanic corrosion prevention needs to be considered. The susceptibility of different base metals to corrosion while in contact, depends upon the difference between the contact potentials, or the electromotive voltages of the metals involved. The electromotive potential of common metals is listed in table S13. The greater the potential difference is, the greater

is the tendency for corrosion. The metal with the higher potential forms the anode and is corroded. In other words, the larger the separation distance in the electromotive chart between the two metals in contact, the higher the contact potential and chances for corrosion. For example, zinc-nickel and aluminum are very short distance apart in the chart. Therefore, potential for corrosion when these two metals are in contact is very low. On the other hand, aluminum and passivated 316 stainless steel are far apart; hence, when in contact, the potential for corrosion is very high. Aluminum, being more anodic metal, will corrode in this combination.

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As a general guideline, if the metals are half the length of the chart or more apart, the combination should be avoided. Also, it is not a good idea to combine an anodic metal part with thin cross section, such as thin wall tubing, with a cathodic or less anodic metal part of a heavy cross section, such as a fitting. For example, a thin wall brass tube with steel fitting is a better, although not ideal, combination than a thin wall steel tube with brass fitting.

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Electromotive or Galvanic Series for Metals	
+ Anodic (least noble) corroded	Magnesium
	Magnesium Alloys
	Zinc
	Zinc-Nickel (Parker steel fittings are zinc-nickel plated)
Electric current flows from plus to minus Direction of attack	Beryllium
	Aluminum 5052, 3004, 3003, 1100, 6053
	Cadmium
	Aluminum 2117, 2017, 2024 T4
	Mild steel (1018), wrought iron, free machining steel (12L14)
	Low alloy high strength steel, cast iron
	Chrome iron (active)
	430 Stainless (active)
	302, 303, 321, 347, 410, 416, stainless steel (active)
	Ni-resist
	316, 317 stainless steel (active)
	Carpenter 20Cb-3 stainless (active)
	Aluminum bronze (CA 687)
	Hastelloy C (active) Inconnel 625 (active) Titanium (active)
	Lead/Tin solder
	Lead
	Tin
	Inconnel 600 (active)
	Nickel (active)
	60 Ni-15 Cr (active)
	80 Ni-20 Cr (active)
	Hastelloy B (active)
	Naval brass (CA 464), Yellow brass (CA 268), Brass (CA360)
	Red brass (CA 230), Admiralty brass (CA 443)
	Copper (CA 102)
	Maganese bronze (CA 675), Tin bronze (CA 903, 905)
	410, 416 Stainless (passive) Phospher bronze (CA 521, 524)
	Silicon bronze (CA 651, 655)
	Nickel silver (CA 732, 735, 745, 752, 754, 757, 764, 770, 794)
	Cupro Ni 90-10
	Cupro Ni 80-20
	430 Stainless steel (passive)
	Cupro Ni 70-30
	Nickel aluminum bronze (CA 630, 632)
	Monel 400, K500
	Silver solder
	Nickel (passive)
	60 Ni 15 Cr (passive)
	Inconnel 600 (passive)
	80 Ni 20 Cr (passive)
	Chrome iron (passive)
	302, 303, 304, 321, 347 stainless steel (passive)
	316, 317 stainless steel (passive) (Parker stainless steel fittings are passivated)
	Carpenter 20 Cb-3 stainless (passive), Incoloy 825
	Silver
	Titanium (passive), Hastelloy C & C276 (passive), Inconnel 625 (passive)
- Cathodic (most noble) protected	Graphic
	Zirconium
	Gold
	Platinum

Table S13 — Electromotive or Galvanic Series for Metals

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STEP 5: PRESSURE

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Finally, any selected tube fitting or adapter and tubing should have a pressure rating satisfying the system requirement. Pressure ratings shown on the product pages of Tube Fittings catalog are for dynamic systems with normal severity of service (see Table S6) at standard temperature range. A vast majority of systems where our tube fittings and adapters are used fall in this category. However, there are applications, such as hydraulic jacks, where the system pressure is essentially static once it is pressurized. For this type of an application the tube fittings and adapters can be used at higher pressures. On the other hand, there are applications where temperature is elevated, or service is severe or even hazardous. The pressure ratings in the catalog shall be derated accordingly.

Dynamic and static systems can be defined as follows:

Dynamic: A system in which the operating pressure fluctuates, in accordance with load, up to a maximum pressure limited by the relief valve. In addition, the system may also experience shocks, vibration and temperature excursions.

Example: A backhoe.

Static: A system, once pressurized, is essentially free of pressure fluctuations, shock, vibration and temperature excursions, with such pressurizations not exceeding 30,000 times in the life of the system.

Example: A hydraulic jack.

Dynamic pressure ratings are based on a minimum design factor of 4. In other words, the fitting is capable of holding a pressure equal to 4 times the rated pressure before leakage or failure. For static applications, the design factor can be 3. So, the static rating can be determined by multiplying the dynamic rating by 1.33.

Static pressure rating = 1.33 x Dynamic pressure rating

Example: Static pressure rating for a fitting rated at 6000 psi
= 1.33 x 6000 = 8000 psi

Selected tubes should have enough wall thickness and I.D. to satisfy pressure and flow requirements. Once I.D. and wall thickness are determined, O.D. can be calculated. Tube fitting size should match selected tube O.D. size. Some fittings can only work with limited wall thickness ranges. Therefore, selected fittings should be able to accept the selected tube wall thickness. Tables S14 and S15 shows the wall thickness range for common fittings.

Tube Material / Size		Steel St. Steel Copper Aluminum	Steel St. Steel Monel	Steel Alloy Steel St. Steel Copper Monel
O.D. (in.)	Dash #	SAE 37° Flare Triple-Lok	SAE Flareless Ferulok	SAE O-Ring Face Seal Seal-Lok
1/8	-2	.010 - .035	.010 - .035	—
3/16	-3	.010 - .035	.020 - .049	—
1/4	-4	.020 - .065	.028 - .065	.020 - .083
5/16	-5	.020 - .065	.028 - .065	.020 - .095
3/8	-6	.020 - .065	.035 - .095	.020 - .109
1/2	-8	.028 - .083	.049 - .120	.028 - .148
5/8	-10	.035 - .095	.058 - .120	.035 - .134
3/4	-12	.035 - .109	.065 - .120	.035 - .148
7/8	-14	.035 - .109	.072 - .120	.035 - .156
1	-16	.035 - .120	.083 - .148	.035 - .188
1 1/4	-20	.049 - .120	.095 - .188	.049 - .220
1 1/2	-24	.049 - .120	.095 - .220	.049 - .250
2	-32	.058 - .134	.095 - .220	.058 - .250

1) Brazing to attach sleeve can be used for all wall thicknesses.
2) Thinner wall can be used for Ferulok with support of an insert.
3) Thicker wall can be used for Ferulok but pressure capability is limited by fittings.

Table S14 – Recommended Inch Tube Wall Thickness Ranges for Common Fittings

Read more about Pressure Ratings in our article The Truth About Pressure Ratings for Hydraulic Fittings and Adapters.

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Dimensions and pressures for reference only, subject to change.

Parker Hannifin Corporation
Tube Fittings Division
Columbus, Ohio
http://www.parker.com/tfd

Tube O.D. (mm)	Recommended Wall Thickness (mm)								
	Seal-Lok			Triple-Lok			EO/EO2		
	Fitting Size	Min.	Max.	Fitting Size	Min.	Max.	Fitting Size	Min.	Max.
6	-4	0.5	2.25	-4	0.5	2.0	6LL, 6L, 6S	1.0	2.0
8	-6	1.0	2.5	-5	0.5	2.0	8LL, 8L, 8S	1.0	2.5
10	-6	1.0	3.0	-6	0.5	2.0	10LL, 10L, 10S	1.0	3.0
12	-8	1.0	3.5	-8	1.0	2.0	12LL, 12L, 12S	1.5	3.5
14	-10	1.0	4.0	-10	1.0	2.5	14S	1.5	4.0
15	-10	1.0	3.0	-10	1.0	2.5	15L	1.5	4.0
16	-10	1.0	3.0	-10	1.0	2.5	16S	2.0	4.0
18	-12	1.0	3.0	-12	1.0	3.0	18L	2.0	4.0
20	-12	1.5	4.0	-12	1.0	3.0	20S	2.5	4.0
22	-16	1.0	3.0	-14	1.0	3.0	22L	2.5	4.0
25	-16	2.0	5.0	-16	1.0	3.0	25S	2.5	4.5
28	-20	1.5	5.0	-20	1.5	3.0	28L	2.5	4.5
30	-20	2.0	5.0	-20	1.5	3.0	30S	3.0	5.0
32	-20	2.0	2.5	-20	1.5	3.0	-	-	-
35	-24	2.0	6.0	-24	1.5	3.0	35L	3.0	5.0
38	-24	2.5	7.0	-24	1.5	3.0	38S	3.5	6.0
42	-	-	-	-	-	-	42L	3.5	7.0
50	-	-	-	-32	1.5	3.5	-	-	-

1) Brazing to attach sleeve can be used for all wall thicknesses.
2) Thinner wall can be used for EO/EO2 with support of an insert.
3) Thicker wall can be used for EO/EO2 but pressure capability is limited by fittings.

Table S15 – Recommended Metric Tube Wall Thickness Ranges for Common Fittings

One final consideration in choosing the right wall thickness for tubing is bending. If the tube will be bent, and bending without the use of a mandrel is desired, then wall thickness of less than 7% of the tube O.D. should not be used.

Some parts are capable of performing at higher pressures than those shown on the product pages. For information on higher ratings, contact Tube Fittings Division.

Additional Information

Tubing Pressure Ratings

Use Tables S16 and S17 to determine the tube O.D. and wall thickness combination that satisfies the following two conditions:

A. Has recommended design pressure equal to or higher than maximum operating pressure.
B. Provides tube I.D. equal to or greater than required flow diameter determined earlier.

Design pressure values in Tables S16 and S17 are based on the severity of service rating “A” (design factor of 4) in Table S6, and temperature derating factor of 1 in Table S5. If more severe operating conditions are involved, the values in Tables S16 and S17 should be multiplied by appropriate derating factors from Tables S5 and S6 before determining the tube O.D. and wall thickness combination. Contact the Tube Fittings Division when in doubt.

Inch Tube Pressure Ratings

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Inch Tubes*							Inch Tubes*						
			Design Pressure							Design Pressure			
Tube O.D. (in.)	Wall Thick. (in.)	Tube I.D. (in.)	Steel C-1010	Steel C-1021	Stainless Steel 304 & 316, 4130 HSLA	Copper K or Y	Tube O.D. (in.)	Wall Thick. (in.)	Tube I.D. (in.)	Steel C-1010	Steel C-1021	Stainless Steel 304 & 316, 4130 HSLA	Copper K or Y
0.125	0.010	0.105	1,900	2,550	3,200	1,000	0.625	0.058	0.509	2,250	3,000	3,750	1,200
0.125	0.020	0.085	4,100	5,500	6,850	2,200	0.625	0.065	0.495	2,550	3,400	4,250	1,350
0.125	0.028	0.069	5,950	7,950	9,950	3,150	0.625	0.083	0.459	3,350	4,450	5,600	1,750
0.125	0.035	0.055	7,550	10,100	12,650	4,050	0.625	0.095	0.435	3,900	5,200	6,500	2,050
0.188	0.010	0.168	1,250	1,650	2,100	650	0.625	0.109	0.407	4,500	6,050	7,550	2,400
0.188	0.020	0.148	2,600	3,500	4,400	1,400	0.625	0.120	0.385	5,050	6,700	8,400	2,700
0.188	0.028	0.132	3,800	5,050	6,350	2,000	0.625	0.134	0.357	5,700	7,600	9,500	3,000
0.188	0.035	0.118	4,850	6,500	8,150	2,600	0.750	0.035	0.680	1,050	1,450	1,800	550
0.188	0.049	0.090	7,000	9,400	11,750	3,750	0.750	0.049	0.652	1,550	2,050	2,600	800
0.250	0.020	0.210	1,900	2,550	3,200	1,000	0.750	0.058	0.634	1,850	2,450	3,100	1,000
0.250	0.028	0.194	2,750	3,700	4,650	1,450	0.750	0.065	0.620	2,100	2,800	3,500	1,100
0.250	0.035	0.180	3,350	4,750	5,900	1,900	0.750	0.083	0.584	2,750	3,650	4,550	1,450
0.250	0.049	0.152	5,150	6,900	8,600	2,750	0.750	0.095	0.560	3,150	4,250	5,300	1,700
0.250	0.058	0.134	6,200	8,300	10,350	3,300	0.750	0.109	0.532	3,700	4,950	6,150	1,950
0.250	0.065	0.120	7,000	9,350	11,700	3,750	0.750	0.120	0.510	4,100	5,500	6,850	2,200
0.250	0.083	0.084	8,950	11,950	14,900	4,750	0.750	0.134	0.482	4,650	6,200	7,750	2,450
0.313	0.020	0.273	1,500	2,000	2,500	800	0.750	0.148	0.454	5,200	6,950	8,650	2,750
0.313	0.028	0.257	2,150	2,900	3,600	1,150	0.750	0.188	0.374	6,750	9,000	11,250	3,600
0.313	0.035	0.243	2,750	3,700	4,600	1,450	0.875	0.035	0.805	900	1,200	1,550	500
0.313	0.049	0.215	4,000	5,350	6,700	2,150	0.875	0.049	0.777	1,300	1,750	2,200	700
0.313	0.058	0.197	4,850	6,450	8,100	2,550	0.875	0.058	0.759	1,550	2,100	2,600	800
0.313	0.065	0.183	5,500	7,350	9,150	2,900	0.875	0.065	0.745	1,750	2,350	2,950	950
0.313	0.083	0.147	7,150	9,550	11,950	3,800	0.875	0.083	0.709	2,300	3,100	3,850	1,200
0.313	0.095	0.123	8,200	10,950	13,700	4,350	0.875	0.095	0.685	2,650	3,600	4,500	1,400
0.375	0.020	0.335	1,250	1,650	2,100	650	0.875	0.109	0.657	3,100	4,150	5,200	1,650
0.375	0.028	0.319	1,800	2,400	3,000	950	0.875	0.120	0.635	3,450	4,650	5,800	1,850
0.375	0.035	0.305	2,250	3,050	3,800	1,200	0.875	0.134	0.607	3,900	5,250	6,550	2,100
0.375	0.049	0.277	3,300	4,400	5,500	1,750	0.875	0.148	0.579	4,350	5,850	7,300	2,300
0.375	0.058	0.259	3,950	5,300	6,600	2,100	1.000	0.035	0.930	800	1,050	1,350	400
0.375	0.065	0.245	4,500	6,000	7,500	2,400	1.000	0.049	0.902	1,150	1,500	1,900	600
0.375	0.083	0.209	5,900	7,850	9,850	3,150	1.000	0.058	0.884	1,350	1,800	2,300	700
0.375	0.095	0.185	6,800	9,100	11,400	3,650	1.000	0.065	0.870	1,550	2,050	2,550	800
0.375	0.109	0.157	7,850	10,500	13,150	4,200	1.000	0.083	0.834	2,000	2,650	3,350	1,050
0.500	0.028	0.444	1,300	1,750	2,200	700	1.000	0.095	0.810	2,300	3,100	3,850	1,200
0.500	0.035	0.430	1,650	2,200	2,800	850	1.000	0.109	0.782	2,700	3,600	4,500	1,400
0.500	0.049	0.402	2,400	3,200	4,000	1,250	1.000	0.120	0.760	3,000	4,000	5,000	1,600
0.500	0.058	0.384	2,900	3,850	4,800	1,500	1.000	0.134	0.732	3,350	4,500	5,650	1,800
0.500	0.065	0.370	3,250	4,350	5,450	1,750	1.000	0.148	0.704	3,750	5,050	6,300	2,000
0.500	0.083	0.334	4,300	5,700	7,150	2,250	1.000	0.156	0.688	4,000	5,350	6,700	2,100
0.500	0.095	0.310	4,950	6,650	8,300	2,650	1.000	0.188	0.624	4,900	6,550	8,200	2,600
0.500	0.109	0.282	5,800	7,750	9,700	3,100	1.000	0.220	0.560	5,850	7,800	9,750	3,100
0.500	0.120	0.260	6,450	8,600	10,750	3,400	1.250	0.049	1.152	900	1,200	1,500	450
0.500	0.134	0.232	7,250	9,650	12,100	3,850	1.250	0.058	1.134	1,050	1,450	1,800	550
0.500	0.148	0.204	8,000	10,700	13,350	4,250	1.250	0.065	1.120	1,200	1,600	2,050	650
0.500	0.188	0.124	9,900	13,250	16,550	5,300	1.250	0.083	1.084	1,550	2,100	2,650	800
0.625	0.028	0.569	1,050	1,400	1,750	550	1.250	0.095	1.060	1,800	2,450	3,050	950
0.625	0.035	0.555	1,300	1,750	2,200	700	1.250	0.109	1.032	2,100	2,800	3,550	1,100
0.625	0.049	0.527	1,900	2,500	3,150	1,000	1.250	0.120	1.010	2,350	3,150	3,900	1,250

Table S16 — Inch Tube Pressure Ratings
See Table S11 for tube specifications.

Dimensions and pressures for reference only, subject to change.

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http://www.parker.com/tfd

Inch Tube Pressure Ratings (cont'd)

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Inch Tubes*						
			Design Pressure			
Tube O.D. (in.)	Wall Thick. (in.)	Tube I.D. (in.)	Pressure C-1010	Steel C-1021	Stainless Steel 304 & 316, 4130 HSLA	Copper K or Y
1.250	0.134	0.982	2,650	3,550	4,400	1,400
1.250	0.148	0.954	2,950	3,950	4,900	1,550
1.250	0.156	0.938	3,100	4,150	5,200	1,650
1.250	0.188	0.874	3,850	5,100	6,400	2,050
1.250	0.220	0.810	4,550	6,100	7,650	2,450
1.500	0.065	1.370	1,000	1,350	1,650	500
1.500	0.083	1.334	1,300	1,750	2,150	700
1.500	0.095	1.310	1,500	2,000	2,500	800
1.500	0.109	1.282	1,750	2,300	2,900	900
1.500	0.120	1.260	1,900	2,550	3,200	1,000
1.500	0.134	1.232	2,150	2,900	3,600	1,150
1.500	0.148	1.204	2,400	3,200	4,050	1,250
1.500	0.156	1.188	2,550	3,400	4,250	1,350
1.500	0.188	1.124	3,150	4,200	5,250	1,650
1.500	0.220	1.060	3,750	5,000	6,250	2,000
1.500	0.250	1.000	4,300	5,750	7,200	2,300
2.000	0.065	1.870	750	1,000	1,250	400
2.000	0.083	1.834	950	1,250	1,600	500
2.000	0.095	1.810	1,100	1,450	1,850	550
2.000	0.109	1.782	1,250	1,700	2,150	650
2.000	0.120	1.760	1,400	1,900	2,350	750
2.000	0.134	1.732	1,600	2,100	2,650	850
2.000	0.148	1.704	1,750	2,350	2,950	950
2.000	0.156	1.688	1,850	2,500	3,150	1,000
2.000	0.188	1.624	2,300	3,050	3,800	1,200
2.000	0.220	1.560	2,700	3,650	4,550	1,450
2.000	0.250	1.500	3,100	4,200	5,250	1,650
2.000	0.281	1.438	3,550	4,750	5,950	1,900

Table S16 — Inch Tube Pressure Ratings *(cont'd.)*
See Table S11 for tube specifications.

Metric Tube Pressure Ratings

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Metric Tubes				
			Static Design Pressure (Bar)	
Tube O.D. (mm.)	Wall Thick. (mm.)	Tube I.D. (mm.)	Steel Low-Carbon St. 37.4	Stainless Steel 1.4571
4	0.5	3.0	313	
4	0.75	2.5	409	
4	1.0	2.0	522	600
5	1.0	3.0	432	
6	0.75	4.5	333	
6	1.0	4.0	389	426
6	1.5	3.0	549	600
6	2.0	2.0	692	
6	2.25	1.5	757	
8	1.0	6.0	333	368
8	1.5	5.0	431	472
8	2.0	4.0	549	
8	2.5	3.0	658	
10	1.0	8.0	282	294
10	1.5	7.0	373	389
10	2.0	6.0	478	498
10	2.5	5.0	576	
10	3.0	4.0	666	
12	1.0	10.0	235	245
12	1.5	9.0	353	368
12	2.0	8.0	409	426
12	2.5	7.0	495	
12	3.0	6.0	576	
12	3.5	5.0	651	
14	1.5	11.0	302	315
14	2.0	10.0	357	420
14	2.5	9.0	434	452
14	3.0	8.0	507	
14	3.5	7.0	576	
14	4.0	6.0	641	
15	1.0	13.0	188	196
15	1.5	12.0	282	294
15	2.0	11.0	336	392
15	3.0	9.0	478	
16	1.5	13.0	264	276
16	2.0	12.0	353	368
16	2.5	11.0	386	403
16	3.0	10.0	452	472
18	1.0	16.0	157	
18	1.5	15.0	235	245
18	2.0	14.0	313	327
18	2.5	13.0	392	

Metric Tubes				
			Static Design Pressure (Bar)	
Tube O.D. (mm.)	Wall Thick. (mm.)	Tube I.D. (mm.)	Steel Low-Carbon St. 37.4	Stainless Steel 1.4571
18	3.0	12.0	409	
20	1.5	17.0	212	
20	2.0	16.0	282	294
20	2.5	15.0	353	368
20	3.0	14.0	373	389
20	3.5	13.0	426	
20	4.0	12.0	478	
22	1.5	19.0	192	200
22	2.0	18.0	256	267
22	2.5	17.0	320	
22	3.0	16.0	343	
25	2.0	21.0	226	
25	2.5	20.0	282	294
25	3.0	19.0	338	353
25	4.0	17.0	394	
25	4.5	16.0	437	
25	5.0	15.0	478	
28	1.5	25.0	151	158
28	2.0	24.0	201	210
28	2.5	23.0	252	
28	3.0	22.0	302	
30	2.0	26.0	188	
30	2.5	25.0	235	245
30	3.0	24.0	282	294
30	4.0	22.0	336	392
30	5.0	20.0	409	
35	2.0	31.0	161	168
35	2.5	30.0	201	
35	3.0	29.0	242	
35	4.0	27.0	322	
38	2.5	33.0	186	
38	3.0	32.0	223	
38	4.0	30.0	297	309
38	5.0	28.0	332	
38	6.0	26.0	390	
38	7.0	24.0	446	
42	2.0	38.0	134	140
42	3.0	36.0	201	210
42	4.0	34.0	269	
50	6.0	38.0	338	
50	9.0	32.0	437	
65	8.0	49.0	347	

Table S17 — Metric Tube Pressure Ratings

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Dimensions and pressures for reference only, subject to change.

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Tube Fittings Division
Columbus, Ohio
http://www.parker.com/tfd

The pressure tables above are calculated using LAME's equation:

Design Pressure Formula (LAME'S)

$$P = S\left(\frac{D^2 - d^2}{D^2 + d^2}\right)$$ where:

D = Outside diameter of tube, in.
d = Inside diameter of tube (D-2T), in
P = Recommended design pressure, psi
S = Allowable stress for design factor of 4, psi
T = Tube wall thickness, in.

Table S18 — Design Pressure Formula

*For thin wall tubes (D/T ≥ 10) the following formula may be used: **P = 2ST/D**

The allowable stress for popular material in the equations is listed in table below. The design factor is generally applied to ultimate strength of material (or burst pressure of tubing) to provide a measure of design margin against the unknowns in material and operating conditions.

Material and Type	Allowable Design Stress for Factor of 4 at 72°F	Tube Specification
Steel C1010	11,250 PSI	SAE J356, J524, J525
Steel C1021	15,000 PSI	SAE J2435, L2467
Steel, High Strength Low Alloy (HSLA)	18,000 PSI	SAE J2613, J2614
Stainless Steel 304 & 316	18,800 PSI	ASTM A213, A249, A269
Alloy Steel C4130	18,800 PSI	ASTM A519
Copper, K or Y	6,000 PSI	SAE J528, ASTM B75
Aluminum 6061-T6	10,500 PSI	ASTM B210
Monel, 400	17,500 PSI	ASTM B165

Table S19 — Design Stress Values

FITTING AND TUBE SELECTION EXAMPLE:

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As mentioned at the beginning of this section, the form below can be used as a guide when determining the proper tube fittings and adapters for your system. Below outlines an example application and illustrates how the table could be filled out.

A hydraulic power unit for a factory press in the U.S. has the following operating parameters:

- Type of fluid: Petroleum based hydraulic fluid
- Operating temperature range: -20°F to +140°F
- Maximum operating pressure: 3500psi
- Maximum flow rate through each line: 10GPM
- Severity of service: normal

For clarity, the application information can be organized into the Summary Information section of the table, and the selection steps can be documented in the Selection Process section.

Summary Information				
Size	**I.D.**		**O.D.**	
	TBD		TBD	
Temperature	**Material Conveyed**		**Environment (in a typical factory)**	
	Min.	**Max.**	**Min.**	**Max**
	-20°F	+140°F	+32°F	+100°F
Application	**Industrial Standards**	**Connection Styles**	**Severity of Service**	**Other**
	SAE(U.S.)	TBD	normal	NA
Material/Media	**Internal Media**		**External Environment**	
	Petroleum based hydraulic fluid		Inside a factory	
Pressure	**Max. Working Pressure**		**Spikes**	**Vacuum**
	3500psi		Normal	Low in suction line

Selection Process	
STAMP Process	**Explanation**
Size I.D.: • 10 GPM flow rate • Pressure line I.D. = 0.405 • Return line I.D. = 0.639 • Suction line I.D. = 1.012 • O.D. and fitting size will be determined later	• Given • Use Table S1
Temperature: • Operating temperature range: -20°F to +140°F • Potential fitting material: steel, stainless steel or brass • Potential seal material: NBR, EPDM, CR or SI	• Given • Use Table S3 • Use Table S4

(Continued)

Parker Hannifin Corporation
Tube Fittings Division
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Application: • Hydraulic power unit • Severity of service: normal • Geographic region: U.S. • No extreme pressure spikes, excessive vibration, extreme temperature swings or hazardous environment • Potential fitting types: SAE fittings	• Given • Given • Given • Based on normal service and experience with the hydraulic power unit • For U.S. use
Material/Media: • Petroleum based hydraulic fluid • Environment: indoors factory setting • Fitting material: narrow down to steel • Seal material: narrow down to NBR	• Given • Given • Use Table S3 and S10 and cost, availability • Use Table S4 and S10 and cost, availability
Pressure: • System type: dynamic • Design factor: 4:1 • Derating factor: 1 • Pressure line: 3500psi o Tube: 5/8” O.D. x .083” wall, C1010 material (.095” and. 109” wall can also be used) o Fitting size: -10 o Fitting type: Seal-Lok • Return line: < 100psi o Tube: 3/4” O.D. x .035” wall, C1010 material (.049” wall can also be used) o Fitting Size: -12 o Fitting type: Seal-Lok • Suction line: low vacuum o Tube: 1 1/4” O.D. x .049” wall, C1010 material (thicker wall up to .083” can also be used) o Fitting Size: -20 o Fitting type: Seal-Lok	• Power unit for press is normally dynamic • Table S6 • Table S5 and S6 • Given • Use Table S27 • To connect to 5/8” O.D. tube • Table S11 and S14 pressure rating, superior performance and availability in the U.S. • Experience • Use table S27 • To connect to 3/4” O.D. tube • To be consistent with pressure line • Experience • Use Table S27 • To connect to 1 1/4” O.D. tube • To be consistent with pressure line

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1. Tube and Port Size Pairing:

Table S20 and S21 provides the optimum tube to port size pairing. When the listed pairs are selected, the flow diameters of tube and port are closely matched.

Tube O.D.			Port Thread			
Inch (Dash Size)		Metric (mm.)	SAE	ISO	NPTF	BSPP
1/8	(-2)	4	5/16-24	M8 x 1	1/16-27	G 1/8-28
3/16	(-3)	5	3/8-24	M10 x 1	1/8-27	G 1/8-28
1/4	(-4)	6	7/16-20	M10 x 1	1/8-27	G 1/8-28
5/16	(-5)	8	1/2-20	M12 x 1.5	1/8-27	G 1/4-19
3/8	(-6)	10	9/16-18	M14 x 1.5	1/4-18	G 1/4-19
1/2	(-8)	12	3/4-16	M16 x 1.5	3/8-18	G 3/8-19
—		15	3/4-16	M18 x 1.5	1/2-14	G 1/2-14
5/8	(-10)	16, 18	7/8-14	M22 x 1.5	1/2-14	G 1/2-14
3/4	(-12)	20	1 1/16-12	M27 x 2	3/4-14	G 3/4-14
7/8	(-14)	22	1 3/16-12	M27 x 2	3/4-14	G 3/4-14
1	(-16)	25, 28	1 5/16-12	M33 x 2	1-11 1/2	G 1-11
1 1/4	(-20)	30, 35	1 5/8-12	M42 x 2	1 1/4-11 1/2	G 1 1/4-11
1 1/2	(-24)	38, 42	1 7/8-12	M48 x 2	1 1/2-11 1/2	G 1 1/2-11
2	(-32)	50	2 1/2-12	M60 x 2	2-11 1/2	G 2-11

Table S20 — Tube to Port Pairing for Medium Pressure Applications

1) Ports are in accordance with the standards listed below:
   SAE J1926-1, ISO 6149-1, NPTF-SAE J476 and BSPP-ISO 1179-1
2) The pressure range covering all the sizes shown is 1000 to 5000 PSI.

Tube O.D.			Port Thread			
Inch (Dash Size)		Metric (mm.)	SAE	ISO	NPTF	BSPP
1/8	(-2)	4	5/16-24	M8 x 1	1/16-27	G 1/8-28
3/16	(-3)	5	3/8-24	M10 x 1	1/8-27	G 1/8-28
1/4	(-4)	6	7/16-20	M12 x 1.5	1/8-27	G 1/8-28
5/16	(-5)	8	1/2-20	M14 x 1.5	1/8-27	G 1/4-19
3/8	(-6)	10	9/16-18	M16 x 1.5	1/4-18	G 1/4-19
1/2	(-8)	12	3/4-16	M18 x 1.5	3/8-18	G 3/8-19
5/8	(-10)	14, 16	7/8-14	M22 x 1.5	1/2-14	G 1/2-14
3/4	(-12)	20	1 1/16-12	M27 x 2	3/4-14	G 3/4-14
7/8	(-14)	—	1 3/16-12	M30 x 2	3/4-14	G 3/4-14
1	(-16)	25	1 5/16-12	M33 x 2	1-11 1/2	G 1-11
1 1/4	(-20)	30	1 5/8-12	M42 x 2	1 1/4-11 1/2	G 1 1/4-11
1 1/2	(-24)	38	1 7/8-12	M48 x 2	1 1/2-11 1/2	G 1 1/2-11
2	(-32)	50	2 1/2-12	M60 x 2	2-11 1/2	—

Table S21 — Tube to Port Pairing for High Pressure Applications

1) Ports are in accordance with the standards listed below:
   SAE J1926-1, ISO 6149-1, NPTF-SAE J476 and BSPP-ISO 1179-1
2) The pressure range covering all the sizes shown is 2500 to 9000 PSI

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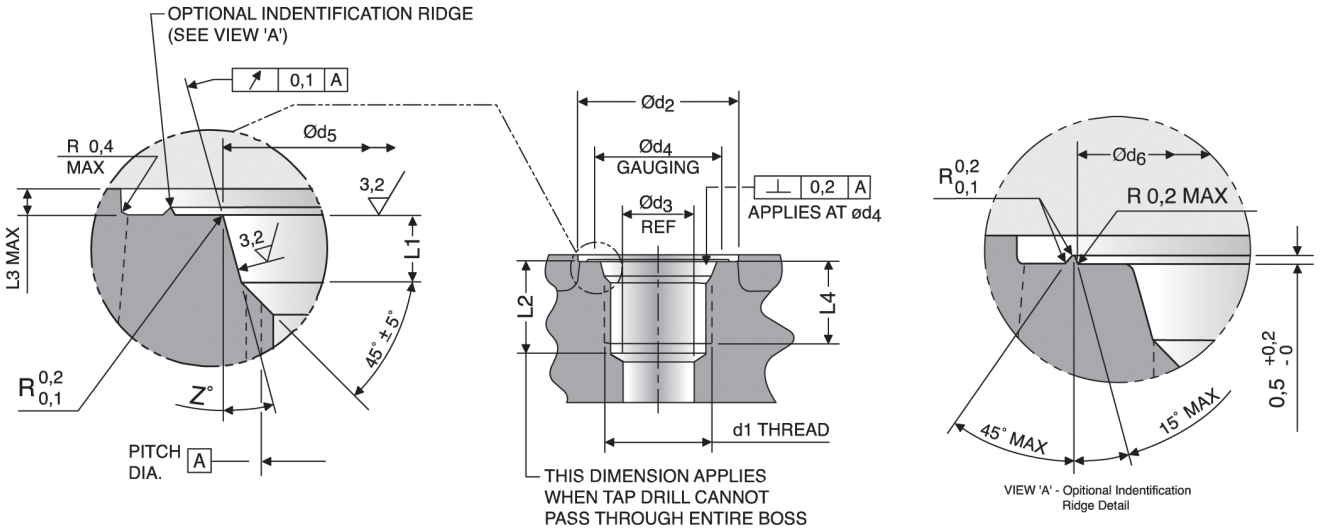
2. Common Port Details:

ISO 6149-1 — Metric Straight Thread O-Ring Port

(SAE 2244-1/DIN 3852, Part 3) Metric ISO 261, “M” Thread



Thread Size d1[1]	Large d2[2] min	Small d2[3] min.	d3[4] ref.	d4	d5 +0.1 0	d6 +0.5 0	L1 +0.4 0	L2[5] min.	L3 max	L4 min. full thread	Z° ±1°	Parker O-Ring Size[8]
M8 X 1	17	14	3	12.5	9.1	14	1.6	11.5	1	10	12°	M8 ISO O-Ring
M10 X 1	20	16	4.5	14.5	11.1	16	1.6	11.5	1	10	12°	M10 ISO O-Ring
M12 X 1.5	23	19	6	17.5	13.8	19	2.4	14	1.5	11.5	15°	M12 ISO O-Ring
M14 X 1.5[6]	25	21	7.5	19.5	15.8	21	2.4	14	1.5	11.5	15°	M14 ISO O-Ring
M16 X 1.5	28	24	9	22.5	17.8	24	2.4	15.5	1.5	13	15°	M16 ISO O-Ring
M18 X 1.5	30	26	11	24.5	19.8	26	2.4	17	2	14.5	15°	M18 ISO O-Ring
M22 X 1.5	33	29	14	27.5	23.8	29	2.4	18	2	15.5	15°	M22 ISO O-Ring
M27 X 2	40	34	18	32.5	29.4	34	3.1	22	2	19	15°	M27 ISO O-Ring
M30 X 2	44	38	21	36.5	32.4	38	3.1	22	2	19	15°	M30 ISO O-Ring
M33 X 2	49	43	23	41.5	35.4	43	3.1	22	2.5	19	15°	M33 ISO O-Ring
M42 X 2	58	52	30	50.5	44.4	52	3.1	22.5	2.5	19.5	15°	M42 ISO O-Ring
M48 X 2	63	57	36	55.5	50.4	57	3.1	25	2.5	22	15°	M48 ISO O-Ring
M60 X 2	74	67	44	65.5	62.4	67	3.1	27.5	2.5	24.5	15°	M60 ISO O-Ring

FOR CARTRIDGE VALVE CAVITIES ONLY (SEE ISO 7789)

M20X1.5[7]	32	27	— —	25.5	21.8	27	2.4	— —	2	14.5	15°	M20 ISO O-Ring

Table S22 — Port Detail — ISO 6149-1

1) Per ISO 261 tolerance class 6H. Tap drill per ISO 2306 class 6H.
2) Spotface diameter with the optional identification ridge.
3) Spotface diameter without identification ridge. Port to be identified by marking “metric” or “M” next to it or “ISO 6149-1 Metric” on component name plate.
4) Reference only. Connecting hole application may require a different size.
5) Tap drill depths given require use of a bottoming tap to produce the specified full thread lengths. Where standard taps are used, increase tap drill depths accordingly.
6) Preferred for diagnostic port applications.
7) For cartridge valve cavity applications only.
8) 90 durometer nitrile is standard for hydraulic applications.

NOTE: For port tapping tools, see page S40. See page R5 for assembly torques.

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SAE J1926-1 — SAE Straight Thread O-Ring Port (ISO 11926-1)

UN/UNF Threads

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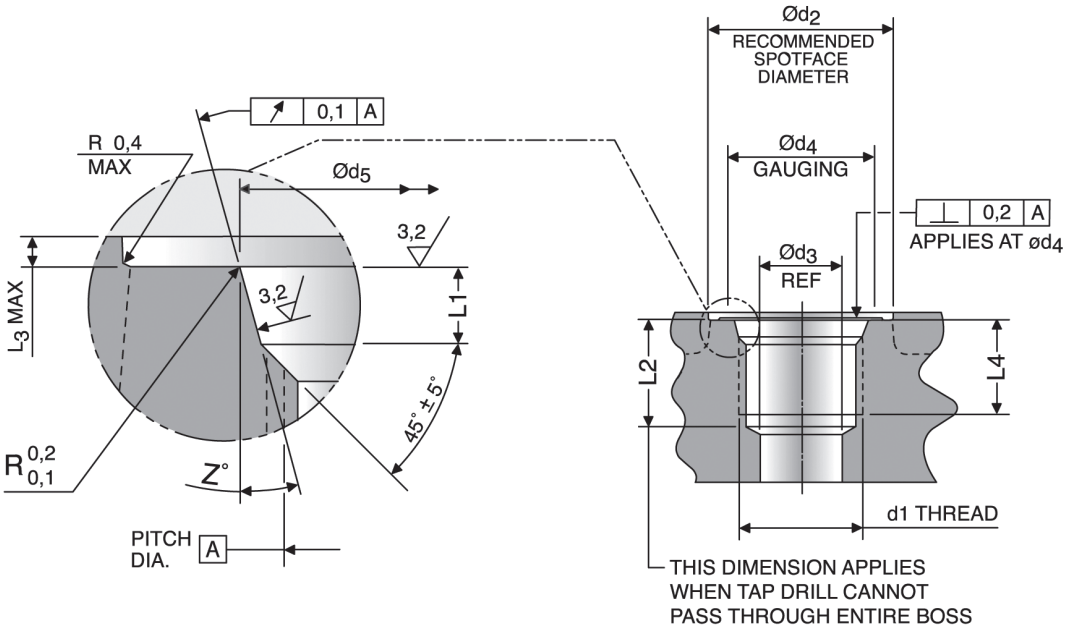

Nominal Tube OD[1]			Thread Size	d2 dia.[3]	d3 dia.	d4 dia.	d5 dia.[4]	L1	L2[5]	L3[3],[6]	L4	Z	
Nom[2] SAE Dash Size	Inch (in.)	Metric (mm.)	ANSI B1.1 (ISO 263) (in.)	(mm.)	min. (mm.)	min. (mm.)	+0.13 -0.00 (mm.)	+0.4 -0.00 (mm.)	min. (mm.)	max (mm.)	Full Thread min. (mm.)	±1° deg.	Parker O-Ring Size[7]
-2	1/8	— — —	5/16-24 UNF-2B	17	1.6	11	9.1	1.9	12.0	1.6	10.0	12°	3-902
-3	3/16	4	3/8-24 UNF-2B	19	3.2	13	10.7	1.9	12.0	1.6	10.0	12°	3-903
-4	1/4	6	7/16-20 UNF-2B	21	4.4	15	12.4	2.4	14.0	1.6	11.5	12°	3-904
-5	5/16	8	1/2-20 UNF-2B	23	6.0	16	14.0	2.4	14.0	1.6	11.5	12°	3-905
-6	3/8	10	9/16-18 UNF-2B	25	7.5	18	15.6	2.5	15.5	1.6	12.7	12°	3-906
-8	1/2	12	3/4-16 UNF-2B	30	10.0	22	20.6	2.5	17.5	2.4	14.3	15°	3-908
-10	5/8	14, 15, 16	7/8-14 UNF-2B	34	12.5	26	23.9	2.5	20.0	2.4	16.7	15°	3-910
-12	3/4	18, 20	1 1/16-12 UN-2B	41	16.0	32	29.2	3.3	23.0	2.4	19.0	15°	3-912
-14	7/8	22	1 3/16-12 UN-2B	45	18.0	35	32.3	3.3	23.0	2.4	19.0	15°	3-914
-16	1	25, 28	1 5/16-12 UN-2B	49	21.0	38	35.5	3.3	23.0	3.2	19.0	15°	3-916
-20	1 1/4	30, 32, 35	1 5/8-12 UN-2B	58	27.0	48	43.5	3.3	23.0	3.2	19.0	15°	3-920
-24	1 1/2	38, 42	1 7/8-12 UN-2B	65	33.0	54	49.8	3.3	23.0	3.2	19.0	15°	3-924
-32	2	50	2 1/2-12 UN-2B	88	45.0	70	65.7	3.3	23.0	3.2	19.0	15°	3-932

Table S23 — Port Detail — SAE J1926-1 (ISO 11926-1)

1) Nominal tube OD is shown for the standard inch sizes and the conversion to equivalent millimeter sizes. Figures are for reference only, as any boss can be used for a tubing size depending upon other design criteria.
2) See SAE J846 for more information.
3) If face of boss is on a machined surface, dimensions d2 and L3 need not apply as long as corner radius R0.2 is maintained.
4) Diameter d5 shall be concentric with thread pitch diameter within 0.004 in (0.1mm) FIM, and shall be free from longitudinal and spiral tool marks. Annular tool marks up to 100 µin (2.5µm) max. shall be permissible.
5) Tap drill depths given require use of bottoming taps to produce the specified full thread lengths. Where standard taps are used, the tap drill depths must be increased accordingly.
6) Maximum recommended spotface depth to permit sufficient wrench grip for proper tightening of the fitting or locknut.
7) 90 durometer nitrile is standard for hydraulic applications.

For assembly torques see page R5.

Learn more about the size differences of SAE J1926 port ends in our TFD techConnect blog "Important System Design Considerations for SAE J1926 Ports.

Dimensions and pressures for reference only, subject to change.

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ISO 6162 — Four-Bolt Flange Connection (Includes SAE J518)

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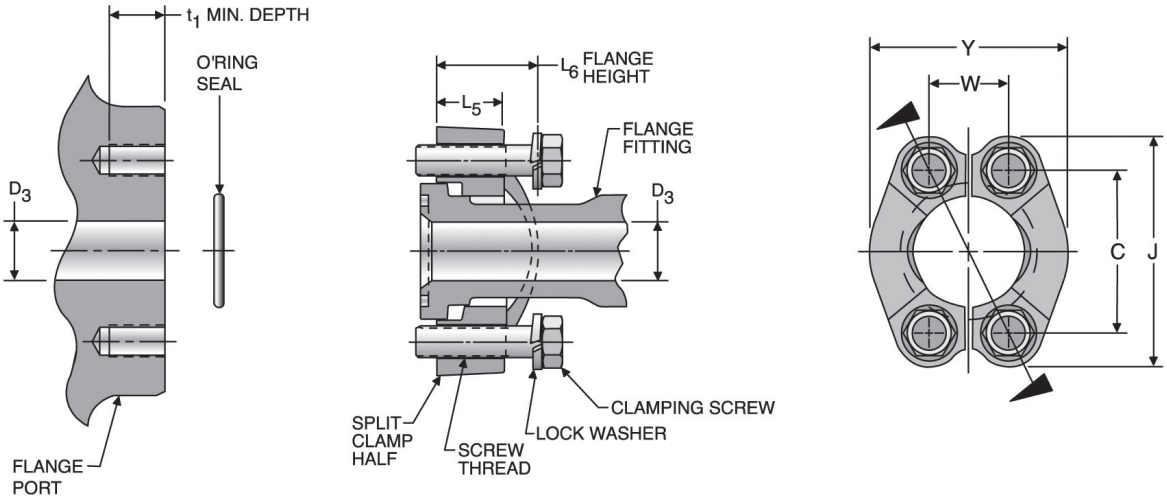

Nominal Flange Size D3		2.5 to 31.5 MPa Series[1] (SAE Code 61)											O-Rings[3]	
		Clamping Screws Screw Holes				Flange Half and Bolt Pattern								
		Type I		Type II[2] (SAE J518)		C	J		W	Y	L5	L6	ISO 3601-1 ID x Section	Parker O-Ring Size
(in.)	(mm.)	Thread	t_1 Min. depth	Thread (UNC)	t_1 Min. depth	± 0.25	max.	min.	± 0.25	Ref.				
1/2	13	M8 x 1.5	12.5	5/16 - 18	24	38.1	54.9	53.1	17.5	46	13	19	19 x 3.55	2-210
3/4	19	M10 x 1.5	16.5	3/8 - 16	22	47.6	65.8	64.3	22.3	52	14	22	25 x 3.55	2-214
1	25	M10 x 1.5	14.5	3/8 - 16	22	52.4	70.6	69.1	26.2	59	16	22	32.5 x 3.55	2-219
1 1/4	32	M10 x 1.5	16.5	7/16 - 14	28	58.7	80.3	78.5	30.2	73	14[4]	24	37.5 x 3.55	2-222
1 1/2	38	M12 x 1.75	19.5	1/2 - 13	27	69.9	94.5	93.0	35.7	83	16	25	47.5 x 3.55	2-225
2	51	M12 x 1.75	19.5	1/2 - 13	27	77.8	103.1	100.1	42.9	97	16	26	56 x 3.55	2-228
2 1/2	64	M12 x 1.75	21.5	1/2 - 13	30	88.9	115.8	112.8	50.8	109	19	38	69 x 3.55	2-232
3	76	M16 x 2	28.5	5/8 - 11	30	106.4	136.7	133.4	61.9	131	22	41	85 x 3.55	2-237
3 1/2	89	M16 x 2	28.5	5/8 - 11	33	120.7	153.9	150.9	69.9	140	22	28	97.5 x 3.55	2-241
4	102	M16 x 2	25.5	5/8 - 11	30	130.2	163.6	160.3	77.8	152	25	35	112 x 3.55	2-245
5	127	M16 x 2	27.5	5/8 - 11	33	152.4	182.6	185.7	92.1	181	28	41	136 x 3.55	2-253

Nominal Flange Size D3		40 MPa Series[1] (SAE Code 62)											O-Rings[3]	
		Clamping Screws Screw Holes				Flange Half and Bolt Pattern								
		Type I		Type II[2] (SAE J518)		C	J		W	Y	L5	L6	ISO 3601-1 ID x Section	Parker O-Ring Size
(in.)	(mm.)	Thread	t_1 Min. depth	Thread (UNC)	t_1 Min. depth	± 0.25	max.	min.	± 0.25	Ref.				
1/2	13	M8 x 1.5	14.5	5/16 - 18	21	40.5	57.2	55.6	18.2	48	16	22	19 x 3.55	2-210
3/4	19	M10 x 1.5	16.5	3/8 - 16	24	50.8	72.1	70.6	23.8	60	19	28	25 x 3.55	2-214
1	25	M12 x 1.75	21.5	7/16 - 14	27	57.2	81.8	80.3	27.8	70	24	33	32.5 x 3.55	2-219
1 1/4	32	M12 x 1.75	18.5	1/2 - 13	25	66.6	96.0	94.5	31.8	78	27	38	37.5 x 3.55	2-222
1 1/2	38	M16 x 2	25.5	5/8 - 11	35	79.3	114.3	111.3	36.5	95	30	43	47.5 x 3.55	2-225
2	51	M20 x 2.5	33.5	3/4 - 10	38	96.8	134.9	131.8	44.5	114	37	52	56 x 3.55	2-228

Table S24 — Port Detail — ISO 6162

1) 1 MPa = 10 bar = 145 PSI.
2) Not for new design.
3) 90 durometer nitrile is standard for hydraulic applications.

See page R5 for assembly torques.

Dimensions and pressures for reference only, subject to change.

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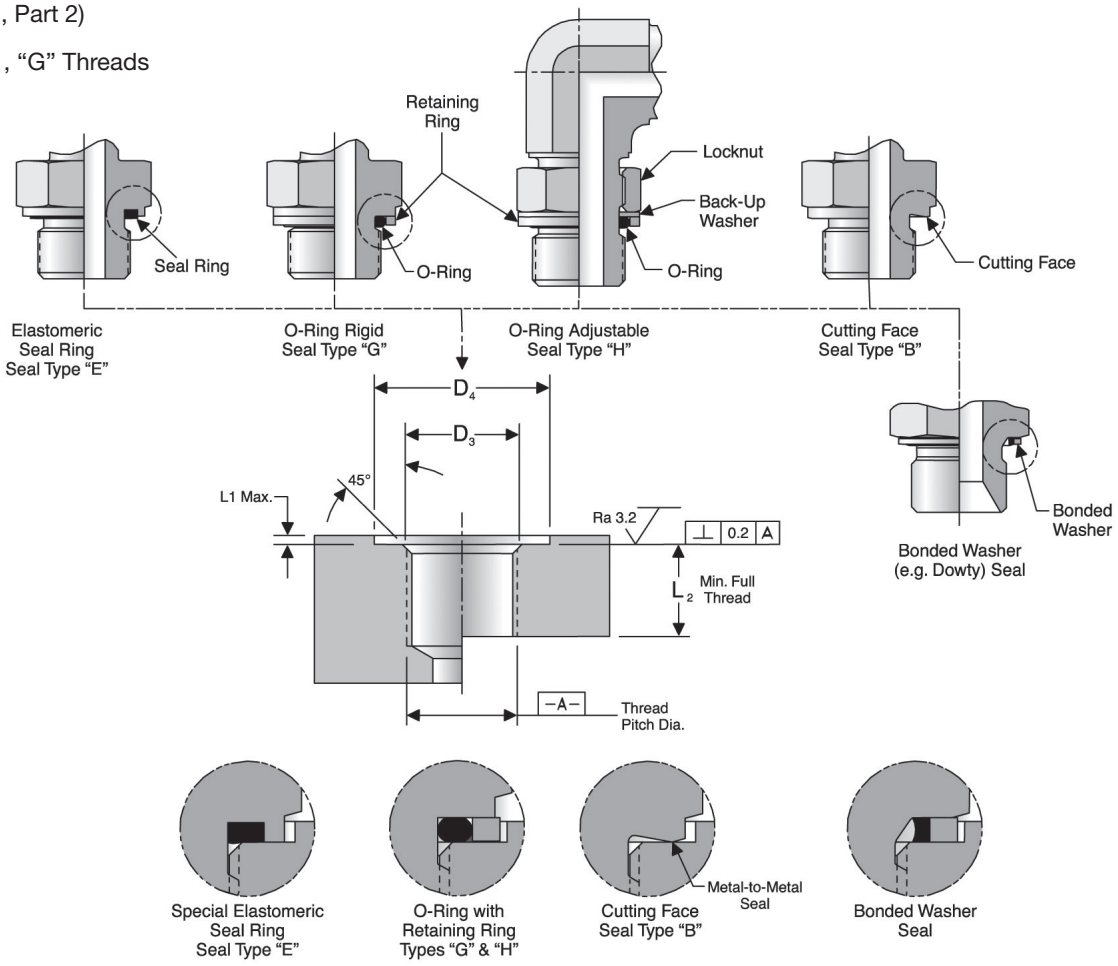
ISO 1179-1[1] — Flat Face Port with British Standard Pipe, Parallel (BSPP) Threads

(DIN 3852, Part 2)

ISO 228-1, "G" Threads



Port Sealing Methods

Thread Size (ISO 228-1)	D3 (mm.)	D4 (mm.)		L1 max. (mm.)	L2 min. (mm.)	EOlastic Seal (Type E)	O-Ring and Retaining Ring (Types G & H)			Bonded Washer Part No.[3]
		Narrow Types B & E	Wide Types G & H			Part No.	O-Ring Size[1]	O-Ring ID x section (mm.)	Retaining Ring Part No.	
G 1/8-28	9.9	15	17.2	1.0	8.5	ED10X1X	5-585	7.98 x 1.88	1/8 RR	D9DT-2
G 1/4-19	13.3	20	20.7	1.5	12.5	ED14X1.5X	2-111	10.77 x 2.62	1/4 RR	D9DT-4
G 3/8 19	16.8	23	24.5	2.0	12.5	EDR3/8X	2-113	13.94 x 2.62	3/8 RR	D9DT-6
G 1/2-14	21.1	28	34.0	2.5	14.5	EDR1/2X	5-256	17.96 x 2.62	1/2 RR	D9DT-8
G 3/4-14	26.6	33	40.0	2.5	16.5	ED26X1.5X	2-119	23.47 x 2.62	3/4 RR	D9DT-12
G 1-11	33.5	41	46.1	2.5	18.5	ED33X2X	2-217	29.74 x 3.53	1 RR	D9DT-16
G 1 1/4-11	42.2	51	54.0	2.5	20.5	ED42X2X	2-222	37.69 x 3.53	1 1/4 RR	D9DT-20
G 1 1/2-11	48.1	56	60.5	2.5	22.5	ED48X2X	2-224	44.04 x 3.53	1 1/2 RR	D9DT-24
G 2-11	59.9	69	73.3	3.0	26.0	—	—	—	—	D9DT-32

Table S25 — Port Detail — ISO 1179-1

1) 90 durometer nitrile is standard for hydraulic applications.
2) See page M6 for O-ring and retaining ring ordering information.
3) See page M3 for details.

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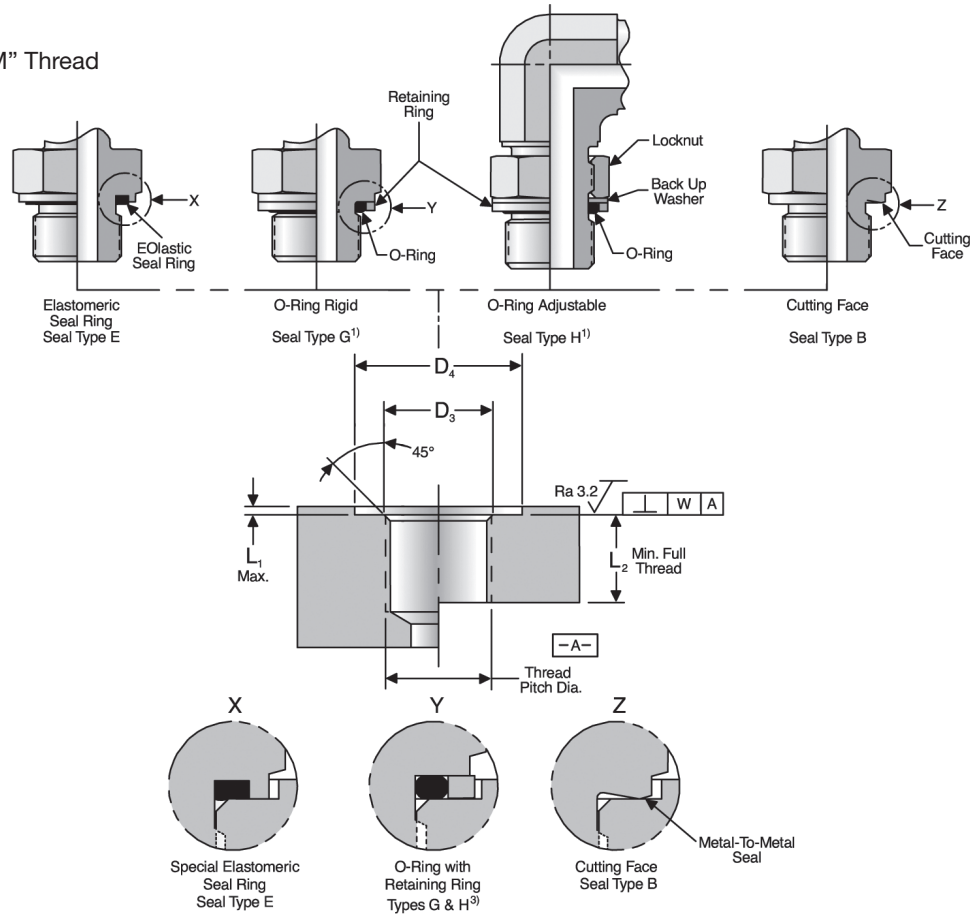
ISO 9974-1 — Flat Face Port with Metric Threads

(DIN 3852, Part 1)

Metric ISO261, “M” Thread



(See Note 1)

ISO 9974 Port seal types available from Parker

Thread Size (ISO 261)	D3 (mm.)	D4 (mm.)	L1 max. (mm.)	L2 min. (mm.)	W (mm.)	EOlastic Seal (Type E)	O-Ring and Retaining Ring[1]		
						Part No.	O-Ring Size[2]	O-Ring ID x section (mm.)	Retaining Ring Part No.
M8 x 1	8 +0.2	13	1	8		ED8X1X	3-902	6.07 x 1.63	M8 RR
M10 x 1	10 +0.2	15	1	8		ED10X1X	6-074	8.00 x 1.50	M10 RR
M12 x 1.5	12 +0.2	18	1.5	12		ED12X1.5X	2-012	9.25 x 1.78	M12 RR
M14 x 1.5	14 +0.2	20	1.5	12	0.1	ED14X1.5X	2-013	10.82 x 1.78	M14 RR
M16 x 1.5	16 +0.2	23	1.5	12		ED16X1.5X	3-907	13.46 x 2.08	M16 RR
M18 x 1.5	18 +0.2	25	2	12		ED18X1.5XX	2-114	15.54 x 2.62	M18 RR
M20 x 1.5[3]	20 +0.2	27	2	14		ED20X1.5X	2-017	17.17 x 1.78	M20 RR
M22 x 1.5	22 +0.2	28	2.5	14		ED22X1.5X	2-018	18.77 x 1.78	M22 RR
M24 x 1.5[4]	24 +0.2	30	2.5	14		—	2-019	20.35 x 1.78	M24 RR
M26 x 1.5	26 +0.2	33	2.5	16		ED26X1.5X	2-118	21.89 x 2.62	M26 RR
M27 x 2	27 +0.2	33	2.5	16		ED26X1.5X	2-119	23.47 x 2.62	M27 RR
M33 x 2	33 +0.3	41	2.5	18	0.2	ED33X2X	2-122	28.24 x 2.62	M33 RR
M36 x 2[4]	36 +0.3	43	2.5	18		—	2-124	31.42 x 2.62	M36 RR
M42 x 2	42 +0.3	51	2.5	20		ED42X2X	2-128	37.77 x 2.62	M42 RR
M45 x 2[4]	45 +0.3	50	2.5	20		—	2-130	40.94 x 2.62	M45 RR
M48 x 2	48 +0.3	56	2.5	22		ED48X2X	2-132	44.12 x 2.62	M48 RR

Table S26 — Port Detail — ISO 9974-1

1) Seal types G and H are not covered in ISO 9974-1. See page M5 for retaining ring and O-ring ordering information.
2) 90 durometer nitrile is standard for hydraulic applications.
3) For diagnostic applications.
4) These sizes are not covered in ISO 9974-1.

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NPTF and BSPT Dimensions

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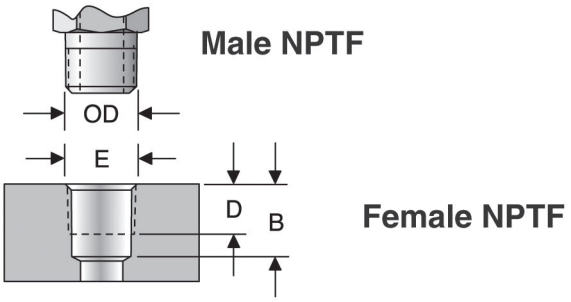
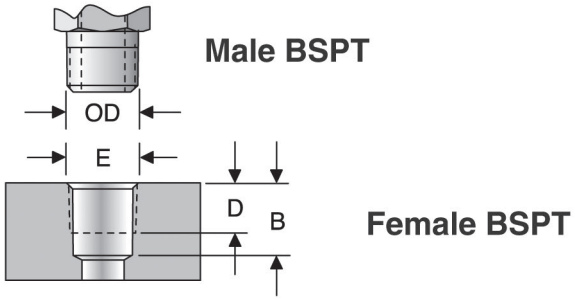


Thread Size NPTF	O.D. Male Thread Large Dia.	D Min.. Thread Length	B Min.. Tap Drill Depth[1)]	E Chmf. Dia.
1/8-27	0.41	0.31	0.38	0.42
1/4-18	0.55	0.44	0.47	0.55
3/8-18	0.68	0.47	0.53	0.69
1/2-14	0.85	0.59	0.69	0.85
3/4-14	1.06	0.63	0.75	1.06
1-11 1/2	1.33	0.75	0.84	1.34
1 1/4-11 1/2	1.67	0.78	0.84	1.68
1 1/2-11 1/2	1.91	0.81	0.88	1.92
2-11 1/2	2.39	0.81	0.91	2.39

Table S27 — NPTF Dimensions

1) For bottoming taps only.



Thread Size BSPT	O.D. Male Thread Large Dia.	D Min.. Thread Length	B Min.. Tap Drill Depth[1)]	E Chmf. Dia.
1/8-28	0.39	0.31	0.38	0.42
1/4-19	0.53	0.44	0.47	0.55
3/8-19	0.67	0.47	0.53	0.69
1/2-14	0.84	0.59	0.69	0.85
3/4-14	1.06	0.63	0.75	1.06
1-11	1.33	0.75	0.84	1.34
1 1/4-11	1.67	0.78	0.84	1.68
1 1/2-11	1.90	0.81	0.88	1.92
2-11	2.37	0.81	0.91	2.39

Table S28 — BSPT Dimensions

1) For bottoming taps only.
2) Male BSPT may be used with female BSPP ports.

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Recommended Use of Porting Tools

Parker recommends porting tools for machining precision ports (glands) conforming to DIN 3852-1, SAE J1926-1 (SAE straight thread port) and ISO 6149-1. Please see the equipment section for the available Parker porting tools.

Machining ports to accept Parker tube fittings is completed in three simple steps.

To begin, select the appropriate size port tooling for the fitting end in question. Next, follow these machining steps.

1. Pilot Hole Drilling.

First, make a pilot hole for the counterbore by using an appropriate drill or bore size. Make hole depth according to the port detail on pages S34, S35, S37 and S38.

2. Port Counterboring.

Run the counterbore tool into the pilot diameter created in step 1. All features and dimensions of the port and O-ring cavity are built into the counterboring tool except the depth. The depth of the counterbore machining may vary from a light spotface, up to the maximum spotface depth listed on the port detail on pages S34 and S35.

3. Thread Tapping.

Lastly, the machined port must be threaded to accommodate the fitting. Use the appropriate tap intended for the same thread type, size, and class.

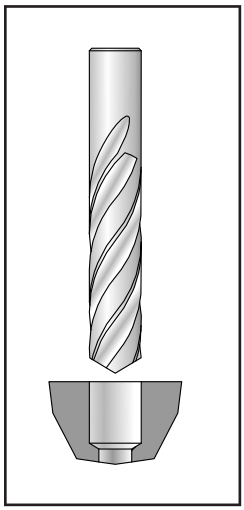

Fig. S4 — Pilot drilling for counterbore tool

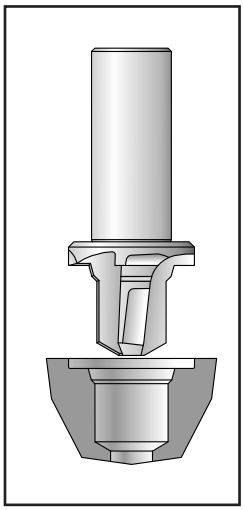

Fig. S5 — Counterboring tool

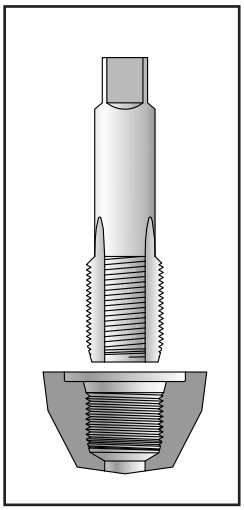

Fig. S6 — Tapping

Note: It is necessary to create a spotface surface which is flat and perpendicular to the port, and with a smooth finish to prevent leakage or O-ring extrusion. Cast or forged surfaces must be spotface machined to meet these requirements. Even on smooth surfaces (machined surfaces), it is necessary to lightly touch the surfact to assure a smooth radius at the entrance of the port.

3. Common Tube End Thread Size

Tube End Connections

Thread Size Guide — Inch Thread

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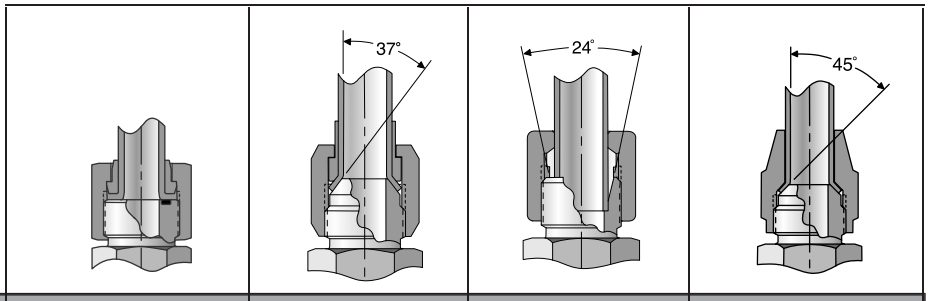

Tube O.D. or Adapter Size			O-ring Face Seal (ORFS)	37° Flare	Inch 24° cone[3] Flareless	SAE 45° Flare[3]
Nominal metric size[3]	Nominal Inch size	Nominal Inch SAE dash size	SAE J1453 "Seal-Lok"	SAE J514 "Triple-Lok"	SAE J514 "Ferulok"	SAE J512
(mm)	(in)		Inch ANSI B1.1, unified (ISO 263)	Inch ANSI B1.1, unified (ISO 263)	Inch ANSI B1.1, unified (ISO 263)	Inch ANSI B1.1, unified (ISO 263)
—	1/8	-2	—	5/16-24	5/16-24	5/16-24
4	—	—	—	—	—	—
5	3/16	-3	—	3/8-24	3/8-24	3/8-24
6	1/4	-4	9/16-18	7/16-20	7/16-20	7/16-20
8	5/16	-5	—	1/2-20	1/2-20	1/2-20
10	3/8	-6	11/16-16	9/16-18	9/16-18	5/8-18
12	1/2	-8	13/16-16	3/4-16	3/4-16	3/4-16
14	5/8	-10	1-14	7/8-14	7/8-14	7/8-14
15[1]	5/8	-10	1-14	7/8-14	—	—
16	5/8	-10	1-14	7/8-14	—	—
18[1]	3/4	-12	1 3/16-12	1 1/16-12	1 1/16-12	1 1/16-14
20	3/4	-12	1 3/16-12	1 1/16-12	—	—
22[1]	7/8	-14	—	1 3/16-12	1 3/16-12	—
25	1	-16	1 7/16-12	1 5/16-12	1 5/16-12	—
28[1]	1 1/4	-20	1 11/16-12	—	1 5/8-12	—
30	1 1/4	-20	1 11/16-12	1 5/8-12	—	—
32[2]	1 1/4	-20	1 11/16-12	1 5/8-12	—	—
38	1 1/2	-24	2-12	1 7/8-12	1 7/8-12	—
50	2	-32	2 1/2-12	2 1/2-12	2 1/2-12	—

Table S29 — Tube End Connections

1) Not preferred for high pressure applications.
2) Non-preferred size. Use 30mm size in place of 32mm size.
3) Metric tube sizes do not apply to "Ferulok" and 45° flare fittings.

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Tube End Connections

Thread Size Guide — Metric, BSPP and JIS Threads

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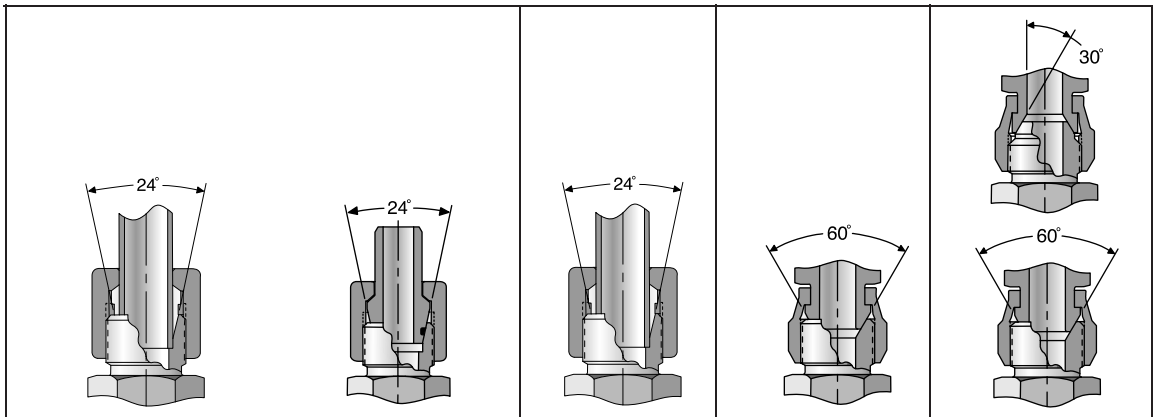

Tube O.D. or Adapter Size	Metric 24° cone Flareless DIN 3861 "EO" and "EO-2"		Weld Nipple DIN 3865 "EO" and "EO-2"	Metric 24° cone Flareless JIS B2351 "JIS"	60° Cone BS 5200	30° Flare and 60° Cone JIS B8363
	LL Series Metric ISO 261	L Series Metric ISO 261	S Series Metric ISO 261	Metric ISO 261 (JIS B0207)	ISO 228-1 (BSPP)[5]	ISO 228-1 (JIS B 0202) (BSPP)[5]
(mm)						
—	—	—	—	—	—	—
4	M8 x 1	—	—	—	—	—
5	M10 x 1[3]	—	—	—	—	—
6	M10 x 1	M12 x 1.5	M14 x 1.5	M12 x 1.5	G 1/8 A	G 1/4 B
8	M12 x 1	M14 x 1.5	M16 x 1.5	M14 x 1.5	G 1/4 A	—
9[2]	—	—	—	—	—	G 3/8 B
10	M14 X 1[4]	M16 x 1.5	M18 x 1.5	M16 x 1.5	G 3/8 A	—
12	M16 x 1[4]	M18 x 1.5	M20 x 1.5	M18 x 1.5	G 1/2 A	G 1/2 B
14	—	—	M22 x 1.5	—	—	—
15[1]	—	M22 x 1.5	—	—	—	—
16	—	—	M24 x 1.5	M24 x 1.5	G 5/8 A[6]	—
18[1]	—	M26 x 1.5	—	—	—	—
19[2]	—	—	—	—	—	G 3/4 B
20	—	—	M30 x 2	M28 x 1.5	G 3/4 A	—
22[1]	—	M30 x 2	—	—	—	—
25	—	—	M36 x 2	M35 x 1.5	G 1 A	G 1 B
28[1]	—	M36 x 2	—	—	—	—
30	—	—	M42 x 2	M40 x 1.5	G 1-1/4 A	—
32[2]	—	—	—	—	—	G 1-1/4 B
35[1]	—	M45 x 2	—	—	—	—
38	—	—	M52 x 2	M48 x 1.5	G 1-1/2 A	G 1-1/2 B
42[1]	—	M52 x 2	—	—	—	—
50	—	—	—	—	G 2 A	G 2 B

Table S30— Tube End Connections

1) Not preferred for high pressure applications.
2) Not preferred sizes. Use 10mm, 20mm and 30mm sizes in place of 9mm, 19mm and 32mm sizes, respectively.
3) Covered in ISO 8434-1. Non-standard with Parker.
4) Not part of DIN or ISO standards, but offered by Parker.
5) ISO 228-1 G threads and JIS B 0202 G or PF threads can be interchanged. "A" and "B" indicate different tolerance classes on the male threads, "A" having tighter tolerances than "B".
6) Non-preferred size.

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4. Conformance Standards:

Tube End Connections

Threads, Conformance Specifications and Use

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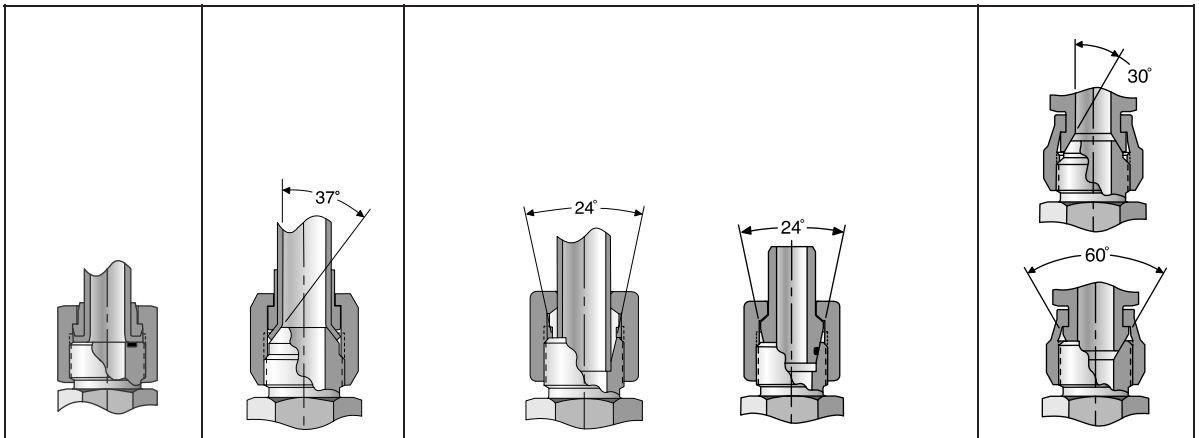

Description	O-Ring Face Seal (ORFS) "Seal-Lok"	37° Flare "Triple-Lok"	Inch 24° Cone Flareless "Ferulok"	Metric 24° Cone Flareless "EO" and "EO2"	Metric 24° Cone Flareless "JIS"	30° Flare and 60° Cone "JIS"
Thread Type	ISO 263 ANSI B1.1 unified	ISO 263 ANSI B1.1, unified	ISO 263 ANSI B1.1, unified	ISO 261 Metric fine	ISO 261 JIS B 0207	ISO 228-1 JIS B0202, BS2779
ISO No.	8434-3 (12151-1)[1]	8434-2 (12151-6)[1]	—	8434-1 & -4 (12151-2)[1]	—	—
SAE No.	J1453/J516[2]	J514/J516[2]	J514	—	—	—
DIN No.	—	—	—	3861, 3865 & 20078[2]	—	—
JIS No.	—	—	—	Similar to B2351	B2351	B8363[3]
BSI No.	—	—	—	—	—	Similar to BS 5200[4]
Current use	Mainly used in North America gaining acceptance in Europe and Japan.	Used throughout the world with major usage in North America.	Mainly used in North America.	Mainly used in Europe. Slowly gaining acceptance in North America.	Mainly used in Japan for hard plumbed systems.	Mainly used in Japan, U.K. and British common-wealth countries.

Table S31 — Tube End Connections

1) Hose fitting specification no.
2) Hose fitting specification no.
3) Adapter and hose fitting specification no.
4) 60° cone fittings only. See page S42 for more information.

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Port End Connections
Threads, Conformance Specifications, and Use

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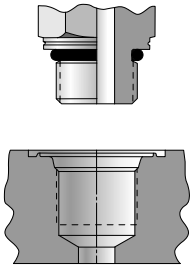
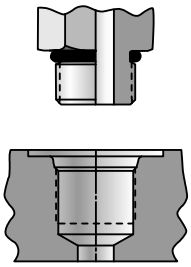
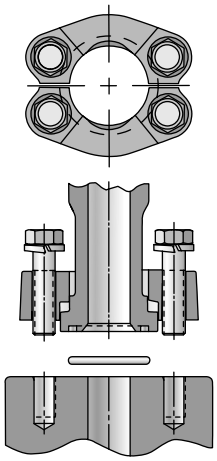
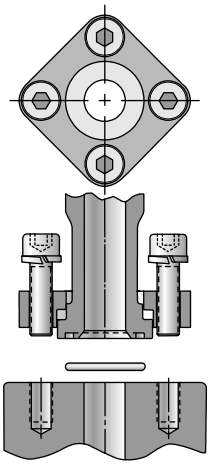
Port Description	**Metric Straight Thread O-Ring Port**	**SAE Straight Thread O-Ring Port**	**Four Screw Split Flange**	**Four Screw One Piece Square Flange**
				
Thread Type	ISO 261 Metric Fine	ISO 263 ANSI B1.1, Unified	Metric screws: ISO 261 Inch screws: ISO 263	ISO 261
ISO No.	6149	11926	6162	6164
SAE No.	J2244	J1926	J518	—
DIN No.	3852-3 Form “W”	—	—	—
JIS No.	—	—	B8363 (covers flange head only)	—
BSI No.	—	—	—	—
Current use	Gaining use in U.S. and western Europe. Widely used in former Soviet block countries.	Widely used in North America.	Widely used throughout the world.	Mainly used in Germany. Limited use elsewhere.

Table S32 — Port End Connections

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Port End Connections
Threads, Conformance Specifications, and Use

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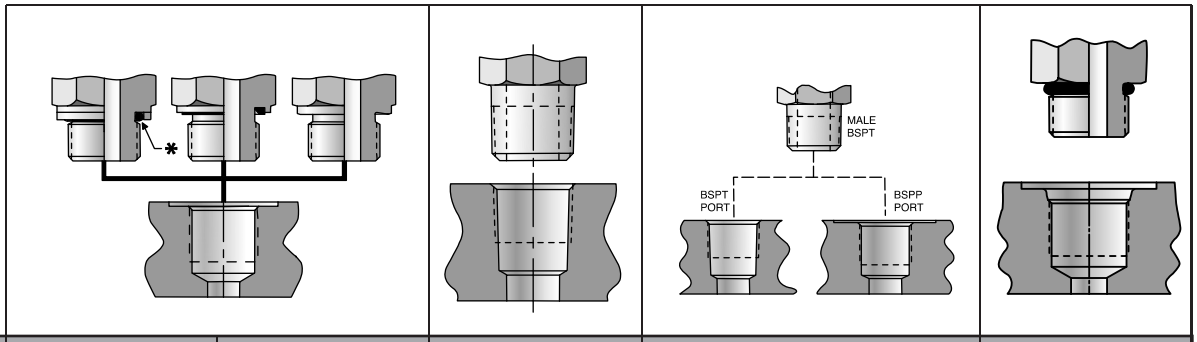

Port Description	British Standard Pipe Parallel (BSPP) Flat Face Port	Metric Straight Thread Flat Face Port	NPTF - Dryseal American Standard Taper Pipe	JIS/BSPT British Standard Pipe, Taper	JIS/BSPP British Standard Pipe, Parallel O-ring Port
Thread Type	ISO 228-1 BS 2779	ISO 261 Metric Fine	ANSI B1.20.3	ISO 7 BS 21 JIS B 0203	ISO 228-1 BS 2779 JIS B 0202
ISO No.	1179	9974	—	—	—
SAE No.	—	—	J476	—	—
DIN No.	3852-2 Form X or Y	3852-1 Form X or Y	—	Similar to: 3852-2 form Z	—
JIS No.	—	—	—	B8363	B2351 Type “O”
BSI No.	—	—	—	—	Similar to BS 5380
Current use	Most popular in western Europe and former UK colonies. Limited use in rest of the world.	Moderate use in Europe, mainly in Germany.	Mainly used in North America some use in rest of the world.	Mainly used in Japan and parts of western Europe.	Mainly used in Japan. Some use in U.K. of similar port, BS5380.

Table S33 — Port End Connections

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Fitting Materials

Material				Product Type				
				Seal-Lok, Triple-Lok, Ferulok, Pipe, Port Adapters, JIS, Komatsu, Flanges				
Type	Condition	Standard	Grade	Body	Nut	Sleeve	Ferrule	Welding Parts
Steel[1]	Bar Stock	ASTM A108	12L14	•	•	•	•	
		ASTM A108	1215	•	•	•	•	
		ASTM A108	C1045	•	•	•		
		ASTM A108	C1018		•			•
	Cold Form	ASTM A576	C1008	•	•	•		
		ASTM A576	C1010	•	•	•		
		ASTM A576	C1012	•	•	•		
		ASTM A576	C1020			•		
	Forging	ASTM A576	1214	•				
		ASTM A576	1215	•				
		ASTM A576	C1045	•	•			
Stainless Steel[2]	Bar Stock	ASTM A479	316	•	•	•		
		ASTM A479	316L	•	•	•		•
		ASTM A564	630				•	
	Cold Form	ASTM A479	316	•	•	•		
		ASTM A479	316L	•	•	•		•
	Forging	ASTM A182	316	•	•			
		ASTM A182	316L	•	•			•
Brass[3]	Bar Stock	ASTM B16	CA360	•	•	•	•	
		ASTM B453	CA345	•	•			
		ASTM B371	CA694			•		
	Cold Form	ASTM B121	CA335	•	•			
		ASTM B111	CA443			•		
		ASTM B111	CA444			•		
	Forging	ASTM B124	CA377	•	•			
Aluminum	Bar Stock	ASTM B211	2024-T351	•	•	•		
		ASTM B211	6061-T6	•	•	•		
	Forging	AMS 4133	2014-T6	•				

Table S34 — Standard Material Specifications

[1] Standard steel products have silver/clear zinc chromium 6 free or grey zinc nickel plating. Brazing and welding products are not plated.
[2] Stainless steel fittings are passivated. Standard stainless steel nuts are coated to prevent galling during assembly.
[3] Brass is not available for Ferulok.

Material					Product Type		
					EO, EO2, K4		
Type	Condition	Standard	Grade	U.S. Equivalent grade	Body	Nut	Welding Parts
Steel[1]	Bar Stock	DIN EN 10277-3	1.0718	12L14	•		
		DIN EN 10277-3	1.0715	1213/1215	•		
		DIN EN 10277-3	1.0727	1146	•		
		DIN EN 10277-3	1.0401	C1015			•
	Cold Form	DIN EN 10263	1.0214	C1010		•	
	Forging	DIN 1651	1.0710		•		
		DIN EN 10087	1.0764		•		
		DIN EN 10083	1.0503	C1045 modified		•	
Stainless Steel	Bar Stock	DIN EN 10088	1.4571	316Ti	•	•	•
	Forging	DIN EN 10088	1.4571	316Ti	•	•	•
Brass	Bar Stock	DIN 17660	2.0540		•	•	
	Forging	DIN 17660	2.0540		•		

[1] Standard steel products have silver/clear zinc chromium 6 free or grey zinc nickel plating. Brazing and welding products are not plated.

Table S35 — Standard Material Specifications for EO and K4 Product

Fitting Designs:

Parker's tube fittings and adapters meets the following industrial standards:

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Fitting Family	Specifications
Seal-Lok ORFS	SAE J1453
	ISO 8434-3
Triple-Lok 37-Degree Flare	SAE J514
	ISO 8434-2
Ferulok Flareless	SAE J514
EO and EO-2 Metric Flareless	ISO 8434-1
	ISO 8434-4
	DIN 3861
	DIN 3865
	DIN 3859
Flange Adapters and Hydraulic Flanges	SAE J518
	ISO 6162
	ISO 6164
JIS Adapters	JIS B8363 (with some exceptions)
K4 Adapters	ISO 8434-6
	BS 5200
Pipe Fittings and Adapters, and Swivels	SAE J514
Pipe Plugs	SAE J531
Straight Thread Plugs	SAE J1926

Fitting Performance:

Many Parker tube fittings meet various performance standards recognized by diverse organizations, among which are:

- American Bureau of Shipping (ABS)
- American National Standards Institute (ANSI)
- American Society of Mechanical Engineers (ASME)
- Canadian Technical Standards and Safety Registration (CRN)
- China Classification Society (CCS)
- Det Norske Veritas (DNV)
- Deutscher Verein des Gas- und Wasserfaches (DVGW)
- Germanischer Lloyd (GL)
- Lloyds Register of Shipping (LR)
- Russian Maritime Register of Shipping (RMS)

Attention:

Performance Type Approvals usually are limited to certain products, applications, working conditions, validity time or other restrictions. Please contact Tube Fittings Division for detailed information.

Surface Finish Type	Specification
Carbon Steel – Zinc Nickel Plating	ASTM B841 Class 2, Type AN/E, Grade 8
	ASTM F1941 Fe/Zn-Ni 8BNSL
Stainless Steel - Passivation	ASTM A967, ASTM A380

Test Methods	Specification
Leak, Proof, Burst, Impulse, Over-Torque, Vacuum, and Repeated Assembly	ISO 19879
Rotary Flexure Vibration	NFPA T3.8.3, ISO 19879, ISO 7257

Table S36— Conformance Standards

Some parts do not meet dimensional requirements.

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How to Order Seal-Lok, Triple-Lok, Ferulok, JIS and K4

TFD Standard Nomenclature Construction

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Box 1	Box 2	Box 3	Box 4	Box 5
Size	Shape or Style	Sub-Style	Type	Material
1 to 4 sets of numbers from Box 1	Letter code from Box 2	Number/Letter code from Box 3	Number/Letter code from Box 4	Letter code from Box 5

Example: Steel Seal-Lok Adjustable Elbow Connector — 3/8" O.D. (-6) Tube to 7/16-20 UNF (-4) ORB = 6-4 C5L-S

(See the shading in the boxes below for the construction of this example)

Box 1 — Paired Tube and Port End Size Code Table

Tube End		Port End		Port End	
Dash Size	Tube O.D.	Dash Size	SAE Straight Thread	Dash Size	NPTF Pipe Thread
-2	1/8	-2	5/16-24	-2	1/8
-3	3/16	-3	3/8-24	-2	1/8
-4	1/4	-4	7/16-20	-2	1/8
-5	5/16	-5	1/2-20	-2	1/8
-6	3/8	-6	9/16-18	-4	1/4
-8	1/2	-8	3/4-16	-6	3/8
-10	5/8	-10	7/8-14	-8	1/2
-12	3/4	-12	1 1/16-12	-12	3/4
-14	7/8	-14	1 3/16-12	-12	3/4
-16	1	-16	1 5/16-12	-16	1
-20	1 1/4	-20	1 5/8-12	-20	1 1/4
-24	1 1/2	-24	1 7/8-12	-24	1 1/2
-32	2	-32	2 1/2-12	-32	2

Box 2 — Shape or Style

Straights	
B	Nut
F*	Male Connector
FF*	Long Male Connector or Pipe Nipple
FFF*	Extra Long Male Connector or Pipe Nipple
FN	Cap
G*	Female Connector
H	Union
HH	Long Union
HPN*	Plug, Straight Thread, Hollow Hex
LH	Large Hex Union
PN*	Plug, Straight Thread. Hex Head
T	Sleeve or Ferrule
TP	Sleeve, Parflange
TR	Tube Reducer
T22	Mountie
W	Bulkhead Union
WF	Bulkhead Male
WG	Bulkhead Female
WLN	Bulkhead Locknut for Triple-Lok, Ferulok
WLNL	Bulkhead Locknut for Seal-Lok

90° Elbows	
C*	Male Elbow Connector
CC*	Long Male Elbow
CCC*	Extra Long Male Elbow
D	Female Elbow
E	Union Elbow
WE	Bulkhead Union Elbow
45° Elbows	
N	Union Elbow
V*	Male Elbow Connector
WN	Bulkhead Union Elbow
Tees	
J	Union Tee
M	Female Run Tee
O	Female Branch Tee
R*	Male Run Tee
S*	Male Branch Tee
WJ	Bulkhead Branch Tee
WJJ	Bulkhead Run Tee
Cross	
K	Union Cross

Box 3 — Sub-Style Modifiers (Connectors, Swivels and Plugs)

Connectors (a)	
3	BSPT Port End
4**	BSPP Port End, O-ring & RR
5**	SAE Straight Thread Port End
8**	Metric Port End, O-ring & RR
9	SAE-ORB with Metal Seal
42	BSPP Port End, "ED" Seal
47**	BSPP O-ring Port, B2351
82	Metric Port End, "ED" Seal
87**	ISO 6149 Port End
J4 (e)	Banjo Connection, BSPP, Soft Seal
J8 (e)	Banjo Connection, Metric, Soft Seal
Swivel Unions (b)	
6	Female Swivel
Swivel Connectors (c)	
63	BSPT Port, Swivel Connector
64**	BSPP Port, Swivel Connector
642	BSPP, "ED" Seal, Swivel Connector
65**	SAE-ORB, Swivel Connector
68**	Metric Port, Swivel Connector
682	Metric Port, Swivel Connector
687**	ISO 6149, Swivel Connector
Straight Thread Plugs (d) (Modifiers for P)	
4, 5 ,8 ,9 and 87 as in Connectors above.	
Notes	
a. Modifiers for Connectors as noted with asterisk in Box 2.	
b. Modifier for C, V, R ,S ,H ,E and J in Box 2.	
c. Modifiers for F only in Box 2.	
d. Modifiers for P only in PN and HPN in Box 2.	
e. Applies to 90° elbows and tees only.	

Box 4 — Fitting Type

K4	60° Cone BSPP
L**	Seal-Lok
P4	JIS 60° Cone
T4	JIS 30° Flare
U	Ferulok
X	Triple-Lok

Box 5 — Material Code

B	Brass
S	Steel w/ zinc-nickel plating
SS	Stainless Steel 316/316L passivated

**Placing the letter "O" after these sub-style modifiers and fitting types will indicate that you would like an O-Ring on that corresponding end.

Use Parker's FittingFinder App to easily identify the part number of the fitting or adapter you need. Download Parker FittingFinder from the App Store or Google Play, or use the web app at https://www.ParkerFittingFinder.com

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How to Order 4-Bolt Hydraulic Flanges

TFD Standard Nomenclature Construction

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Box 1	Box 2	Box 3	Box 4	Box 5	Box 6	Box 7
Flange Size	Connection Description	Shape	Flange Connection Type	Mounting Style	Material	Kit Designation

Box 1 — Port/Tube/Pipe Flange Size

Symbol	Description
One-to-two digit codes	Size in inches x 16

One code is required if end connections are the same size. Two codes are required if they are different sizes (e.g., 16-12).

Box 2 — Port/Tube/Pipe Connection Description

Symbol	Description
B3	Braze Socket — silver braze
CP1	Connector Plate — Code 61
CP2	Connector Plate — Code 62
FCC1	Flange Clamp, Captive — Code 61
FCC2	Flange Clamp, Captive — Code 62
FCCT1	Flange Clamp, Captive with Tapped Holes — Code 61
FCCT2	Flange Clamp, Captive with Tapped Holes — Code 62
FCS1	Flange Clamp, Split — Code 61
FCS2	Flange Clamp, Split — Code 62
G	NPTF Port
G3	BSPT Port
G4	BSPP Port
G5	SAE Port
P	Plug (blanking end)
SP	Spacer w/o Gage Ports
SPG	Spacer w/ 1/4-18 NPTF Gage Port
SPG5	Spacer w/ 7/16-20 UNF Gage Port
SPGG5	Spacer w/ 1/4-18 NPTF & 7/16-20 UNF Ports
WSD1	Weld Saddle — Pipe
WSD2	Weld Saddle — Tube
W4	Flat Weld Socket — Tube
W4S	Flat Weld Socket — Tube (shallow)
W5	Flat Weld Socket — Pipe
W5S	Flat Weld Socket — Pipe (shallow)
W6	Extended Weld Socket — Tube
W6S	Extended Weld Socket — Tube (shallow)
W7	Extended Weld Socket — Pipe
W7S	Extended Weld Socket — Pipe (shallow)
WB1	Weld Butt — Schedule 40
WB3	Weld Butt — Schedule 80
WB5	Weld Butt — Schedule 160
WB7	Weld Butt — Schedule XXS
WBT	Weld Butt — Tank Pilot
WPL	Weld Plate
W	Weld Socket
W2	Weld Nipple
W3 or WB	Weld Nipple — Weld Butt, Tube

Box 3 — Shape Description

Symbol	Description
None	Block and Pad, Straight*
E	Elbow 90°
H	Barstock, Straight
J	Tee

*The “Block” has O-ring and drilled mounting holes, while the “Pad” has no O-ring groove and tapped mounting holes.

Box 4 — Flange Connection Type

Symbol	Description
Q1	Code 61 Flange Head w/ O-ring Groove
Q1N	Code 61 Flange Head w/o O-ring Groove
Q2	Code 62 Flange Head w/ O-ring Groove
Q2N	Code 62 Flange Head w/o O-ring Groove
Q1B	Code 61 Flange Block w/ O-ring Groove and Drilled Mounting Holes
Q1P	Code 61 Flange Block w/o O-ring Groove and Drilled Mounting Holes
Q2B	Code 62 Flange Block w/ O-ring Groove and Drilled Mounting Holes
Q2P	Code 62 Flange Pad w/o O-ring Groove and Tapped Mounting Holes
QSB	Square Flange Block w/ O-ring Groove and Drilled Mounting Holes
QSP	Square Flange Pad w/o O-ring Groove and Tapped Mounting Holes

Box 5 — Mounting Style

Symbol	Description
Omit	Inch Mounting Bolts (screws)
M	Metric Mounting Bolts (screws)

Box 6 — Material

Symbol	Description
S	Steel, Zinc-Nickel Plated (braze or weld parts may not be plated)
SX	Steel, Oil Dipped
SS	Stainless Steel

Box 7 — Kit Designation

Symbol	Description
Omit	Flange Only
K	Kit (O-ring, 4 bolts and washers)

How to Order EO and EO-2 Fittings and Accessories

TFD Standard Nomenclature Construction

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Box 1	Box 2	Box 3	Box 4	Box 5	Box 6	Box 7	Box 8	Box 9
Shape/Style	Tube Size (mm.)	EO-2 Designator	Pressure Series	Port Size/ Designator	Port Sealing Method Modifier	Modifier 1	Material	Modifier 2

Box 1 — Shape/Style Code			
Straights		**Tees**	
AS	Weld Connector	EL	Swivel Nut Run
AS__/	Weld Flange	ET	Swivel Nut Branch
BFG	Square Flange Connector	GMA1/	Union w/ Test Point, Pin
DA	Distance Adapter	GMA3/	Union w/ Test Point, M16x2
DG101/	Rotary Union	LEE	Adjustable Run
DG102/	Rotary Connector	T	Union
DG107/	Rotary Bulkhead Union	TEE	Adjustable Branch
DVGE	Plain Bearing Rotary	TH	High Pressure Banjo
EGE	Swivel Nut Connector	TR	Reducer Union
EGEO	ISO 6149 Swivel Nut Connector	WV	Alternating Valve
ESV	Weld Bulkhead Union	Cross	
G	Union	K	Union
GAI	Female Connector	Accessories	
GE	Male Connector	D	Cutting Ring
GEO	ISO 6149 Connector	DKI	Pressure Gage Seal
GFS__/	Flange Connector	DOZ	EO-2 Seal Ring
GR	Reducer Union	DPR	Progressive Ring
GZ	Swivel Union	E	Insert
GZR	Reducer Swivel Union	ED	EOlastic Seal
MAV	Gage Connector	FM	EO-2 Functional Nut
MAVE	Swivel Nut Gage Connector	GM	Bulkhead Locknut
RED	Tube End Reducer	KD	Plastic Seal
SKA	Weld Adapter	M	Tube Nut
SV	Bulkhead Union	OR	O-ring
VKA1/	Test Point Connector, Pin	PSR	Progressive Ring (new)
VKA3/	Test Point Connector, M16x2	R	Tube
90° Elbows		ROV	Plug
BFW	Square Flange Connector	VH	Insert
DG103/	Rotary Union	VKA	Cap
DG104/	Rotary Connector	VSTI	Hollow Hex Plug
DG108/	Rotary Bulkhead Union	**Valves**	
DVWE	Plain Bearing Rotary	RHD	Union Check
EW	Swivel Nut	RHV	Connector Check
SWVE	Banjo	RHZ	Connector Check
W	Union	RHDI	Female Check
WAS	Weld Connector	RVP	Cartridge Check
WE	Male Connector	KH	2-way Ball Valve
WEE	Adjustable	KH3/2-	3-way Ball Valve
WFS__/	Flange Connector	WV	Alternating Union Tee
WH	High Pressure Banjo		
WSV	Bulkhead Union		
Double 90° Elbows			
DG105/	Rotary Union		
DG106/	Rotary Connector		
45° Elbows			
EV	Swivel Nut		
VEE	Adjustable		

Box 2 — Tube Size (mm.)
04
05
06
08
10
12
14
15
16
18
20
22
25
28
30
35
38
42

Box 3 — EO-2 Designator	
Z	EO-2 Assy.

Box 4 — Pressure Series	
LL	Very Light
L	Light
S	Heavy

Box 5 — Port Size/ Designator (optional)	
Metric	
M_	Metric Parallel
M_X_	Metric Parallel (Jump Size)
M_X_keg	Metric Taper
NPT — Inch	
1/8NPT	NPT Thread
1/4NPT	NPT Thread
3/8NPT	NPT Thread
1/2NPT	NPT Thread
3/4NPT	NPT Thread
1NPT	NPT Thread
1 1/3NPT	NPT Thread
1 1/2NPT	NPT Thread
SAE-ORB	
7/16UNF	Inch Parallel Thread
9/16UNF	Inch Parallel Thread
3/4UNF	Inch Parallel Thread
3/4UNF	Inch Parallel Thread
7/8UNF	Inch Parallel Thread
11/16UNF	Inch Parallel Thread
15/16UNF	Inch Parallel Thread
1 5/8UNF	Inch Parallel Thread
1 7/8UNF	
BSPP/BSPT	
R_	BSPP
R_/_keg	BSPT

Box 6 — Port Sealing Method Modifier (optional)	
ED	EOlastic Seal
OR	ISO 6149 O-ring

Box 7 — Modifier 1 (optional)	
OMD	Without Nut and Sleeve
VIT	FPM (omitted for Stainless)
NBR	Nitrile Seals (omitted for Steel and Brass)
_ _ B	Special Cracking Pressure (check valve)

Box 8 — Material	
CF	Zinc-Nickel Plating
MS	Brass
71	Stainless Steel
VZ	Zinc Plated (tube only)

Box 9 — Modifier 2 (optional)	
X	Unassembled

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KITS

Replacement Seal, O-Rings, and Retaining Rings and Plugs and Caps for System Connection Repairs

Seals, O-rings and Retaining Rings Replacement Kits

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Tube Ends	**PKT02586** Seal-Lok O-Ring Face Seal (ORFS) NBR O-Ring Kit T3	**PKT02973** Seal Lok O-Ring Face Seal FKM O-Ring Kit T3	**PKT05620** Seal-Lok O-Ring Face Seal CNG O-Ring Kit T3	**Port Ends**	**PKT02585** SAE Straight Thread Port NBR O-Ring Kit T3
PKT02972 SAE Straight Thread Port End FKM O-Ring Kit T3	**PKT05621** SAE Port End CNG O-Ring Kit T3	**PKT02725** ISO 6149 NBR O-Ring Kit T3	**PKT02726** BSPP NBR O-Ring Kit T3	**PKT07683** BSPP NBR O-Ring and Retaining Ring Kit T4	**PKT02727** Metric NBR O-Ring Kit T4
PKT13423 Metric ISO 9974-1 FKM O-Ring Kit T4	**PKT07684** Metric NBR O-Ring and Retaining Ring Kit T4	**PKT16929** EO-Lastic NBR Seal Kit T4	**Code 61 and 62 Flanges**	**PKT02584** Code 61 and 62 Flange NBR O-Ring Kit T4	

Plugs and Caps Kits

Tubs and Hose Ends	**PKT06355** Seal-Lok O-Ring Face Seal (ORFS) Cap and Plug Kit T5	**PKT06354** Triple-Lok JIC 37° Flare Cap and Plug Kit T5	**PKT16942** DIN Light Duty Plug and Cap Kit T5	**PKT16943** DIN Heavy Duty Plug and Cap Kit T5	**PKT13169** JIS Plug and Cap Kit T6
Port Ends	**PK06353** SAE and NPT Cap and Plug Kit T6	**PKT06356** Metric, BSPP and ISO 6149 Plug Kit T6	**PKT11799** BSPP Plug and Cap Kit T6	**Code 61 and 62 Flanges**	**PKT06842** Code 62 Flange Plug Kit T7
PKT06843 Code 61 Flange ORFS Plug Kit T7					

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PKT02586
Seal-Lok O-ring Face Seal (ORFS) NBR O-Ring Kit

ORFS NBR O-Ring		
Part Number	Size	Qty
2-011 NBR	-4	25
2-012 NBR	-6	25
2-014 NBR	-8	25
2-016 NBR	-10	25
2-018 NBR	-12	25
2-021 NBR	-16	10
2-025 NBR	-20	10
2-029 NBR	-24	10

PKT02973
Seal Lok O-Ring Face Seal (ORFS) FKM O-Ring Kit

ORFS FKM O-Ring		
Part Number	Size	Qty
2-011 FKM	-4	25
2-012 FKM	-6	25
2-014 FKM	-8	25
2-016 FKM	-10	25
2-018 FKM	-12	25
2-021 FKM	-16	10
2-025 FKM	-20	10
2-029 FKM	-24	10

PKT05620
Seal-Lok O-Ring Face Seal CNG O-Ring Kit

ORFS CNG O-Ring		
Part Number	Size	Qty
2-011 CNG	-4	25
2-012 CNG	-6	25
2-014 CNG	-8	25
2-016 CNG	-10	25
2-018 CNG	-12	25
2-021 CNG	-16	10
2-025 CNG	-20	10
2-029 CNG	-24	10

PKT02585
SAE Straight Thread Port NBR O-Ring Kit

SAE NBR O-Ring		
Part Number	Size	Qty
3-902 NBR	-2	10
3-903 NBR	-3	10
3-904 NBR	-4	15
3-905 NBR	-5	10
3-906 NBR	-6	15
3-908 NBR	-8	15
3-910 NBR	-10	10
3-912 NBR	-12	15
3-914 NBR	-14	10
3-916 NBR	-16	15
3-920 NBR	-20	10
3-924 NBR	-24	10

PKT02972
SAE Straight Thread Port End FKM O-Ring Kit

SAE FKM O-Ring		
Part Number	Size	Qty
3-902 FKM	-2	10
3-903 FKM	-3	10
3-904 FKM	-4	15
3-905 FKM	-5	10
3-906 FKM	-6	15
3-908 FKM	-8	15
3-910 FKM	-10	10
3-912 FKM	-12	15
3-914 FKM	-14	10
3-916 FKM	-16	15
3-920 FKM	-20	10
3-924 FKM	-24	10

PKT05621
SAE Port End CNG O-Ring Kit

SAE CNG O-Ring		
Part Number	Size	Qty
3-904 CNG	-4	15
3-906 CNG	-6	15
3-908 CNG	-8	15
3-910 CNG	-10	10
3-912 CNG	-12	15
3-916 CNG	-16	15
3-920 CNG	-20	10
3-924 CNG	-24	10

PKT02725
ISO 6149 NBR O-Ring Kit

ISO 6149 NBR O-Ring Kit		
Part Number	Size	Qty
M-10 ISO O-Ring	M-10	20
M-12 ISO O-Ring	M-12	20
M-14 ISO O-Ring	M-14	15
M-16 ISO O-Ring	M-16	20
M-18 ISO O-Ring	M-18	15
M-22 ISO O-Ring	M-22	15
M-27 ISO O-Ring	M-27	10
M-33 ISO O-Ring	M-33	5
M-42 ISO O-Ring	M-42	5
M-48 ISO O-Ring	M-48	5

PKT02726
BSPP NBR O-Ring Kit

BSPP NBR O-Ring Kit		
Part Number	Size	Qty
5-585 NBR	1/8"	10
2-111 NBR	1/4"	20
2-113 NBR	3/8"	10
5-256 NBR	1/2"	15
2-119 NBR	3/4"	15
2-217 NBR	1"	10
2-224 NBR	1 1/4"	6
2-222 NBR	1 1/2"	7

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PKT07683

BSPP NBR O-Ring and Retaining Ring Kit

BSPP Steel Retaining Ring		
Part Number	Size	Qty
8207-1/8	1/8"	10
8207-1/4	1/4"	20
8207-3/8	3/8"	10
8207-1/2	1/2"	15
8207-3/4	3/4"	15
8207-1	1"	10
8207-1-1/4	1 1/4 "	6
8207-1-1/2	1 1/2"	7

BSPP O-Ring		
Part Number	Size	Qty
5-585 NBR	1/8"	10
2-111 NBR	1/4"	20
2-113 NBR	3/8"	10
5-256 NBR	1/2"	15
2-119 NBR	3/4"	15
2-217 NBR	1"	10
2-224 NBR	1 1/4"	6
2-222 NBR	1 1/2"	7

PKT02727

Metric NBR O-Ring Kit

Metric NBR O-Ring Kit		
Part Number	Size	Qty
6-074 NBR	10mm	15
2-012 NBR	12mm	20
2-013 NBR	14mm	15
2-114 NBR	18mm	15
2-017 NBR	20mm	15
2-018 NBR	22mm	10
2-119 NBR	27mm	5
2-122 NBR	33mm	5
2-128 NBR	42mm	5
2-132 NBR	48mm	5

PKT13423

Metric ISO 9974-1 FKM O-Ring Kit

ISO 9974-1 FKM O-Ring		
Part Number	Size	Qty
6-074 FKM	10mm	15
2-012 FKM	12mm	20
2-013 FKM	14mm	15
3-907 FKM	16mm	20
2-114 FKM	18mm	15
2-017 FKM	20mm	15
2-018 FKM	22mm	10
2-119 FKM	27mm	5
2-122 FKM	33mm	5
2-128 FKM	42mm	5
2-132 FKM	48mm	5

PKT07684

Metric NBR O-Ring and Retaining Ring Kit

Metric Steel Retaining Ring		
Part Number	Size	Qty
M10RR	10mm	15
M12RR	12mm	20
M14RR	14mm	15
M16RR	16mm	20
M18RR	18mm	15
M20RR	20mm	15
M22RR	22mm	10
M27RR	27mm	5
M33RR	33mm	5
M42RR	42mm	5
M48RR	48mm	5

Metric O-Ring		
Part Number	Size	Qty
6-074 NBR	10mm	15
2-012 NBR	12mm	20
2-013 NBR	14mm	15
3-097 NBR	16mm	20
2-114 NBR	18mm	15
2-017 NBR	20mm	15
2-018 NBR	22mm	10
2-119 NBR	27mm	5
2-122 NBR	33mm	5
2-128 NBR	42mm	5
2-132 NBR	48mm	5

PKT16929

EO-Lastic NBR Seal Kit

Metric ED Seal		
Part Number	Size	Qty
ED8X1X	M8X1	20
ED10X1X	M10X1	20
ED12X1.5X	M12X1.5	20
ED14X1.5X	M14X1.5	20
ED16X1.5X	M16X1.5	20
ED18X1.5X	M18X1.5	20
ED20X1.5X	M20X1.5	20
ED22X1.5X	M22X1.5	20
ED26X1.5X	M26X1.5	20
ED33X2X	M22X2	20
ED42X2X	M42X2	20
ED48X2X	M48X2	20

BSPP ED Seal		
Part Number	Size	Qty
ED3/8X	G 3/8 A	20
ED1/2X	G 1/2 A	20

PKT02584

Code 61 and 62 Flange NBR O-Ring Kit

SAE 4-Bolt Flange O-Ring		
Part Number	Size	Qty
2-210 NBR	-8	10
2-214 NBR	-12	10
2-219 NBR	-16	15
2-222 NBR	-20	15
2-225 NBR	-24	15
2-228 NBR	-32	8
2-232 NBR	-40	6
2-237 NBR	-48	6

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PKT06355

Seal-Lok O-Ring Face Seal (ORFS) Cap and Plug Kit

ORFS Plug		
Part Number	Size	Qty
4 PNLO-S	-4	10
6 PNLO-S	-6	10
8 PNLO-S	-8	4
10 PNLO-S	-10	3
12 PNLO-S	-12	2
16 PNLO-S	-16	2

ORFS Cap		
Part Number	Size	Qty
4 FNL-S	-4	10
6 FNL-S	-6	10
8 FNL-S	-8	4
10 FNL-S	-10	3
12 FNL-S	-12	2
16 FNL-S	-16	2

PKT06354

Triple-Lok JIC 37-degree Flare Cap and Plug Kit

JIC Plug		
Part Number	Size	Qty
4 PNTX-S	-4	10
6 PNTX-S	-6	10
8 PNTX-S	-8	5
12 PNTX-S	-12	2
16 PNTX-S	-16	2
20 PNTX-S	-20	2

JIC Cap		
Part Number	Size	Qty
4 FNTX-S	-4	10
6 FNTX-S	-6	10
8 FNTX-S	-8	5
12 FNTX-S	-12	2
16 FNTX-S	-16	2
20 FNTX-S	-20	2

PKT16942

DIN Light Duty Plug and Cap Kit

Light Duty Plug		
Part Number	Size	Qty
ROV06LCF	6mm	4
ROV08LCF	8mm	4
ROV10LCF	10mm	6
ROV12LCF	12mm	6
ROV15LCF	15mm	6
ROV18LCF	18mm	4
ROV22LCF	22mm	4
ROV28LCF	28mm	2

Light Duty Cap		
Part Number	Size	Qty
VKAM06LCF	6mm	4
VKAM08LCF	8mm	4
VKAM10LCF	10mm	6
VKAM12LCF	12mm	6
VKAM15LCF	15mm	6
VKAM18LCF	18mm	4
VKAM22LCF	22mm	4
VKAM28LCF	28mm	2

PKT16943

DIN Heavy Duty Plug and Cap Kit

Heavy Duty Plug		
Part Number	Size	Qty
ROV06SCF	6mm	4
ROV08SCF	8mm	4
ROV10SCF	10mm	6
ROV12SCF	12mm	6
ROV14SCF	14mm	4
ROV16SCF	16mm	4
ROV20SCF	20mm	2
ROV25SCF	25mm	2

Heavy Duty Cap		
Part Number	Size	Qty
VKAM06SCF	6mm	4
VKAM08SCF	8mm	4
VKAM10SCF	10mm	6
VKAM12SCF	12mm	6
VKAM14SCF	14mm	4
VKAM16SCF	16mm	4
VKAM20SCF	20mm	2
VKAM25SCF	25mm	2

WARNING: This product can expose you to chemicals including Lead and Lead Compounds 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.

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PKT13169

JIS Plug and Cap Kit

JIS Plug		
Part Number	Size	Qty
4PNMKAS	G 1/4-19	2
6PNMKAS	G 3/8-19	2
8PNMKAS	G 1/2-14	2
12PNMKAS	G 3/4-14	2
16PNMKAS	G 1-11	2

JIS Cap		
Part Number	Size	Qty
4FNMKAS	G 1/4-19	2
6FNMKAS	G 3/8-19	2
8FNMKAS	G 1/2-14	2
12FNMKAS	G 3/4-14	2
16FNMKAS	G 1-11	2

PKT06353

SAE-ORB and NPT Cap and Plug Kit

NPT Plug		
Part Number	Size	Qty
1/4 HP-S	1/4"	8
3/8 HP-S	3/8"	4
1/2 HP-S	1/2"	3
3/4 HP-S	3/4"	2

SAE-ORB Plug		
Part Number	Size	Qty
4 P5ON-S	-4	10
6 P5ON-S	-6	10
8 P5ON-S	-8	5
10 P5ON-S	-10	3
12 P5ON-S	-12	3
16 P5ON-S	-16	2

PKT06356

Metric, BSPP and ISO 6149 Plug Kit

Metric-ED Plug		
Part Number	Size	Qty
VSTI10x1EDCF	M10X1	4
VSTI12x1.5EDCF	M12X1.5	4
VSTI14x1.5EDCF	M14X1.5	4
VSTI16x1.5EDCF	M16X1.5	4
VSTI18x1.5EDCF	M18X1.5	2
VSTI22x1.5EDCF	M22X1.5	2
VSTI26x1.5EDCF	M26X1.5	2

ISO 6149		
Part Number	Size	Qty
M10P87OMNS	M10X1	4
M12P87OMNS	M12X1.2	4
M14P87OMNS	M14X1.5	4
M16P87OMNS	M16X1.5	4
M18P87OMNS	M18X1.5	2
M22P87OMNS	M22X1.5	2

BSPP-ED		
Part Number	Size	Qty
VSTI1/4EDCF	1/4-19	4
VSTI3/8EDCF	3/8-19	4
VSTI1/2EDCF	1/2-14	4
VSTI3/4EDCF	3/4-14	2
VSTI1EDCF	1-11	2

PKT11799

BSPP Plug & Cap

BSPP Plug		
Part Number	Size	Qty
4PNMK4S	G 1/8-28	4
6PNMK4S	G 1/4-19	4
8PNMK4S	G 3/8-19	4
10PNMK4S	G 1/2-14	2
12PNMK4S	G 5/8-14	4
16PNMK4S	G 3/4-14	2
16PNMK4S	G 1-11	2

BSPP Cap		
Part Number	Size	Qty
2FNMK4S	G 1/8-28	4
4FNMK4S	G 1/4-19	4
6FNMK4S	G 3/8-19	4
8FNMK4S	G 1/2-14	4
10FNMK4S	G 5/8-14	2
12FNMK4S	G 3/4-14	4
16FNMK4S	G 1-11	2

WARNING: This product can expose you to chemicals including Lead and Lead Compounds 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.

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PKT06842

Code 62 Flange Plug Kit

O-Ring Face Flange Head Plug		
Part Number	Size	Qty
12PQ2SX	-12	2
16PQ2SX	-16	2
20PQ2SX	-20	2
24PQ2SX	-24	2
32PQ2SX	-32	2

4-Bolt Flange O-Ring		
Part Number	Size	Qty
2-214 NBR	-12	2
2-219 NBR	-16	2
2-222 NBR	-20	2
2-225 NBR	-24	2
2-228 NBR	-32	2

PKT06843

Code 61 Flange Plug Kit

O-Ring Face Flange Head Plug		
Part Number	Size	Qty
12PQ1SX	-12	2
16PQ1SX	-16	2
20PQ1SX	-20	2
24PQ1SX	-24	2
32PQ1SX	-32	2

4-Bolt Flange O-Ring		
Part Number	Size	Qty
2-214 NBR	-12	2
2-219 NBR	-16	2
2-222 NBR	-20	2
2-225 NBR	-24	2
2-228 NBR	-32	2

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Applicable Standards For TFD Products
by Standard Number

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ASTM A269	Seamless and welded type 316 Stainless Steel tubing
ASTM B633	Zinc plating
ASTM F1387	Mechanically attached fittings — Triple-Lok, Ferulok and Seal-Lok
DIN 2353	24° cone compression (bite-type) fitting range (configurations)
DIN 3852-1	Metric parallel thread port (ISO 9974-1)
DIN 3852-2	BSPP parallel thread port (ISO 1179-1)
DIN 3852-3	Metric O-ring port (ISO 6149-1)
DIN 3861	24° cone machining and sleeve for compression (bite-type) fittings
DIN 3865	24° cone nipple with O-ring
DIN 3859	Technical delivery conditions for compression fittings
DIN 1630	Seamless steel tube
DIN 2391	Seamless precision steel tubes
DIN 17458	Stainless steel tubes
ISO 1179	BSPP, flat face port and stud ends – same as DIN 3852 - Part 2
ISO 3304	Seamless precision steel tubes
ISO 3305	Welded precision steel tubes
ISO 6149	Metric straight thread O-ring port and stud ends – same as SAE J2244 and DIN 3852, Part 3
ISO 6162	Four bolt split flange connections – inch and metric bolts (inch bolt, Part II – same as SAE J518)
ISO 8434-1	24° cone bite type fittings (EO fittings)
ISO 8434-2	Metric 37° flare fittings (Metric Triple-Lok)
ISO 8434-3	Metric face seal fitting with ISO 6149 port end – (Metric Seal-Lok)
ISO 8434-4	24° cone bite type fittings with weld nipple (EO Fittings)
ISO 19879	Test methods for threaded fluid connectors
ISO 8434-6	60° cone connectors with BSPP threads
ISO 9974	Metric flat face port and stud ends – same as DIN 3852 - Part 1
JIS B8363	60° cone (male and female) hose adapters
MIL-16142	UN/UNF straight thread O-ring port – same as SAE J1926-1
MIL-F-18866	37° flare and flareless tube fittings – Triple-Lok and Ferulok (dimensionally similar to SAE J514)
MIL-33649	Straight thread O-ring port – **different from SAE J1926-1**
NFPA T3.8.3[2)]	Test methods for steel separable tube fittings
SAE J343	Tests and procedures for hose and hose assemblies (impulse test applies to fittings)
SAE J356	Welded and flash controlled low carbon steel tubing
SAE J512	Automotive tube fittings - 45° flare type - Inverted flare type - Tapered sleeve compression type
SAE J514	Hydraulic tube fittings - 37° flare (Triple-Lok) - Flareless – 24° bite type (Ferulok) - O-ring plugs - Pipe fittings - Adapter unions (pipe swivel – “07” adapters)
SAE J515	Hydraulic O-rings (SAE straight thread, face seal, four-bolt split flange, and metric O-ring port)
SAE J518	Code 61 and 62 four-bolt split flange connections – (same as ISO 6162 Type II flange connection)
SAE J524	Seamless low carbon steel tubing
SAE J525	Welded and cold drawn low carbon steel tubing
SAE J527	Brazed double wall steel tubing
SAE J528	Seamless copper tube
SAE J531	Automotive pipe, filler and drain plugs (HP and HHP plugs)
SAE J533	Flares for tubing – 37° and 45° single and double flares
SAE J846	Coding system for identification of fluid connectors
SAE J1065	Pressure ratings for hydraulic tubing
SAE J1231	Beaded tube hose fittings
SAE J1453	O-ring face seal fitting with SAE port end – (Seal-Lok)
SAE J1644	Test methods for fluid connectors
SAE J1926	SAE straight thread O-ring port and stud ends – same as ISO 11926
SAE J2244	Metric straight thread O-ring port and stud ends – same as ISO 6149
SAE J2435	Welded and flash controlled C-1021 tubing
SAE J2467	Welded and cold drawn, C-1021 tubing
SAE J2613	Welded and flash controlled high strength low alloy (HSLA) tubing
SAE J2614	Welded and cold drawn HSLA tubing

Table U1 — Applicable Standards by Standard Number

Dimensions and pressures for reference only, subject to change.

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Thread Designations and Standards for Threads Used in Fluid Connectors

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Abbreviation	Description	Applicable Std.
Straight Pipe		
NPSC	American Standard Straight Pipe Threads in Pipe Couplings Couplings	ANSI B1.20.1 FED-STD-H28/7
NPSF	Dryseal American Standard Fuel Internal Straight Pipe Threads (generally used in soft or ductile materials to mate with NPTF external taper threads)	SAEJ476 ANSI B1.20.3 FED-STD-H28/8
NPSI	Dryseal American Intermediate Internal Straight Pipe Threads (for brittle or hard materials; intended to mate with PTF-SAE short external taper threads)	SAE J476 ANSI B1.20.3 FED-STD-H28/8
NPSM	American Standard Straight Pipe Threads for Free-Fitting Mechanical Joints for Fixtures (these threads fit freely over NPTF threads. They are used in swivel nuts of 07 adapters)	ANSI B1.20.1 FED-STD-H28/7
Taper Pipe		
ANPT	Aeronautical National Taper Pipe Threads (similar to NPT with various additional requirements in gaging)	MIL-P-7105
NPT	American Standard Taper Pipe Threads for General Use	ANSI B1.20.1 FED-STD-H28/7
NPTF	Dryseal American Standard Taper Pipe Threads (used in all of our steel and brass fittings)	SAE J476 ANSI B1.20.3 FED-STD-H28/8
PTF — SAE Short	Dryseal SAE Short Taper Pipe Threads (mainly used in low pressure pneumatic and fuel applications)	SAE J476 ANSI B1.20.3 FED-STD-H28/8
PTF — SPL Short[1)]	Dryseal Special Short Taper Pipe Threads	ANSI B1.20.3
PTF — SPL Extra Short[1)]	Dryseal Special Extra Short Taper Pipe Threads	ANSI B1.20.3
Unified Threads		
UN	Unified Constant Pitch Threads (standard series: 4, 6, 8, 12, 16, 20, 28, 32)	ANSI B1.1 FED-STD-H28/2
UNC	Unified Coarse Threads	ANSI B1.1 FED-STD-H28/2
UNEF	Unifed Extra Fine Threads	ANSI B1.1 FED-STD-H28/2
UNF	Unified Fine Threads	ANSI B1.1 FED-STD-H28/2
UNS	Unified Special Pitch Threads	ANSI B1.1 FED-STD-H28/3
UNJ	Unified Controlled Root Radius Threads	ANSI B1.15 FED-STD-H28/4

Table U2— Thread Designations and Standards for Threads Used in Fluid Connectors **(continued on the next page)**

1) Used in some pneumatic components where shortened thread depth is required because of lack of enough material due to component size limitations.

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Thread Designations and Standards for Threads Used in Fluid Connectors (Continued)

Abbreviation	Description	Applicable Std.
Metric Threads		
M	Metric Screw Threads — M profile	ISO 261 ANSI B1.13M FED-STD-H28/21
M — Keg	Metric Taper Threads (mainly used in Germany)	DIN 158
British Standard Pipe Threads		
R (BSPT)	British Standard Taper Pipe Threads, External	BS 21 ISO 7/1
Rc (BSPT)	British Standard Taper Pipe Threads, Internal	BS 21 ISO 7/1
Rp or G (BSPP)	British Standard Pipe (Parallel) Threads	BS 2779 ISO 228/1
Japanese Standard Pipe Threads		
PF[1)]	JIS Parallel Pipe Threads	JIS B202 ISO 228/1
PT[1)]	JIS Taper Pipe Threads	JIS B203 ISO 7/1
PS	JIS Parallel Internal Pipe Threads (to mate with PT threads)	JIS B203

Table U2 (Cont'd) — Thread Designations and Standards for Threads Used in Fluid Connectors

1) PF and PT threads are functionally interchangeable with BSPP and BSPT threads, respectively.
These are old designations. They are being replaced with G (for PF) and R and Rc (for PT) as documents are revised.

Document Sources for Connector Specifications

ANSI American National Standards Institute
11 West 42nd Street, 13th Floor
New York, New York 10036-8002
Phone: 212-642-4900
Fax: 212-398-0023
www.ansi.org/public/std_info.html

BSI British Standards Institution
389 Chiswick High Road
London, W4 4AL
United Kingdom
Phone: 44-181-996-9000
Fax: 44-181-996-7400
www.bsi.org.uk/bsis/index.htm

British Standards are also available from ANSI

DIN Deutsches Institut Fur Normung
(German Institute for Standards)
Burggrafenstrasse 6
Postfach 1107
D - 1000 Berlin 30, Germany
www.beuth.de/beuth.htm/?datenbanken

English translations of some German Standards can be obtained from:

ANSI

— or —

Global Engineering Documents
15 Inverness Way East
Englewood, CO 80112-9660
Phone: 1-800-854-7179

FED-STD Federal Standard
Department of Defense Single Stock Point
Commanding Officer
Naval Publications and Forms Center
5801 Taber Avenue
Philadelphia, PA 19120-5099

ISO International Organization for Standardization
Case Postale 56
I, Rue de Varembe
CH - 1211 Geneve 20
Switzerland
www.iso.ch/infoe/catinfo.html

ISO Documents are also available from ANSI

JIS Japanese Industrial Standards
Published by Japanese Standards Association
1-24 Akasaka 4
Minto-ku, Tokyo 107-8440
Japan
Phone: 81-3-3583-8000
Fax: 81-3-3586-2014

English translations of some Japanese Standards can be obtained from ANSI

SAE SAE International
400 Commonwealth Drive
Warrendale, PA 15096-0001
Phone: 412-776-4841
Fax: 412-776-0002
www.sae.org/prodserv/stds/stdsinfo/standard.html

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SI Prefixes		
Prefix	SI Symbol	Multiplication Factor
tera	T	10^{12}
giga	G	10^{9}
mega	M	10^{6}
kilo	k	10^{3}
hecto	h	10^{2}
deka	da	10^{1}
deci	d	10^{-1}
centi	c	10^{-2}
milli	m	10^{-3}
micro	m	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}
femto	f	10^{-15}
atto	a	10^{-18}

Table U3 — SI Prefixes

Derived Units			
Quantity	Unit	SI Symbol	Formula
Acceleration	Meter per Second Squared	—	m/s^2
Angular Velocity	Radian per Second	—	rad/s
Area	Square Meter	—	m^2
Density	Kilogram per Cubic Meter	—	kg/m^3
Electric Resistance	Ohm	W	V/A
Energy & Work	Joule	J	N.m
Force	Newton	N	$kg.m/s^2$
Frequency	Hertz	Hz	cycles/s
Power	Watt	W	J/s
Pressure & Stress	Pascal	Pa	N/m^2
Quantity of Heat	Joule	J	N.m
Specific Heat	Joule per Kilogram-Kelvin	—	J/kg.K
Thermal Conductivity	Watt per Meter-Kelvin	—	W/m.K
Velocity	Meter per second	—	m/s
Viscosity, Dynamic	Pascal Second	—	Pa.s
Viscosity, Kinematic	Square Meter per Second	—	m^2/s
Voltage	Volt	V	W/A
Volume	Cubic Meter	—	m^3

Table U4 — Derived Units

Basic Units		
Quantity	Unit	SI Symbol
Length	Meter	m
Mass	Kilogram	kg
Time	Second	s
Electric Current	Ampere	A
Thermodynamic Temperature	Kelvin	K
Amount of Substance	Mole	mol
Luminous Intensity	Candela	cd

Table U5 — Basic Units

Supplementary Units		
Quantity	Unit	SI Symbol
Plane Angle	Radian	rad
Solid Angle	Sterodian	sr

Table U6 — Supplementary Units

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	English to Metric			Metric to English		
	To Convert From	**To**	**Multiply By**	**To Convert From**	**To**	**Multiply By**
Area	sq. in. (in^2)	sq. mm (mm^2)	645.16	square millimeters (mm^2)	square inches (in^2)	0.00155
	sq. in. (in^2)	sq. cm (cm^2)	6.4516			
	sq. ft. (ft^2)	sq. meters (m^2)	0.0929			
Density	pounds/cubic ft (lb/ft^3)	Kilograms/cubic meter (kg/m^3)	16.02	kilograms/cubic meter (kg/m^3)	pounds/cubic ft (lb/ft^3)	0.0624
Energy	British thermal units (Btu) (1 J = Ws = 0.2388 cal)	joules (J)	1055	joules (J)	British thermal units (Btu)	0.000947
Force	pounds - force (lbf) (1N = 0.102 kgf)	newtons (N)	4.448	newtons (N)	pounds - force (lbf)	0.2248
Length	inches (in)	millimeters (mm)	25.4	millimeters (mm)	inches (in)	0.03937
	feet (ft)	meters (m)	0.3048	meters (m)	feet (ft)	3.281
	miles (mi)	kilometers (km)	1.609	kilometers (km)	miles (mi)	0.621
Mass (Weight)	ounces (oz)	grams (g)	28.35	grams (g)	ounces (oz)	0.035
	pounds-mass (lb)	kilograms (kg)	0.4536	kilograms (kg)	pounds-mass (lb)	2.205
	short tons (2000 lb) (tn)	metric tons (1000 kg) (t)	0.9072	metric tons (1000 kg) (t)	short tons (2000 lb) (tn)	1.102
Power	horsepower (550 ft. lb/s) (hp)	kilowatts (kW)	0.7457	kolowatts (kW)	horsepower (550 ft. lb/s) (hp)	1.341
Pressure	pounds/square inch (psi)	kilograms (f)/square cm (kg (f)/cm^2)	0.0703	kilograms (f)/square cm (kg (f)/cm^2)	pounds/square inch (psi)	14.22
	pounds/square inch (psi)	kilopascals (kPa)	6.8948	kolopascals (kPa)	pounds/square inch (psi)	0.145
	pounds/square inch (psi)	bars (100 kPa)	0.06895	bars (100 kPa)	pounds/square inch (psi)	14.503
Stress	pounds/square inch (psi) (1 N/mm^2 = 1 MPa)	megapascals (MPa)	0.006895	megapascals (MPa) (1 N/mm^2 = 1 MPa)	pounds/square inch (psi)	145.039
Temperature	degrees fahrenheit (°F)	degrees celsius (°C)	5/9 (after subtracting 32)	degrees celsius (°C)	degrees fahrenheit (°F)	9/5 (then add 32)
Torque or Bending Moment	pounds-force-foot (lb-ft)	Newtons-meter (Nm)	1.3567	Newtons-meter (Nm)	pounds-force-foot (lb-ft)	0.737
	pounds-force-inch (lb-in)	Newtons-meter (Nm)	0.113	Newtons-meter (Nm)	pounds-force-inch (lb-in)	8.85
Velocity	feet/second (ft/s)	meters/second (m/s)	0.3048	meters/second (m/s)	feet/second (ft/s)	3.2808
Viscosity	dynamic (centipoise)	pascal-second (Pas)	0.001	pascal-second)Pas)	dynamic (centipoise)	1000
	kenematic-$foot^2$/sec (ft^2/s)	$meter^2$/sec (m^2/s)	0.0929	$meter^2$/sec (m^2/s)	$foot^2$/sec (ft^2/s)	10.7643
Volume	cubic inch (in^3)	cubic centimeter (cm^3) (milliliter)	16.3871	cubic centimeter (cm^3) (milliliter)	cubic inch (in^3)	0.061
	quarts (qt)	liters (1000 cm^3)	0.9464	liters (1000 cm^3)	quarts (qt)	1.057
	gallons (gal)	liters	3.7854	liters	gallons (gal)	0.2642

Table U7 — English to Metric and Metric to English Conversions

Glossary of Key Tube Fittings, Fluid Power and Other Engineering Terms

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Alloy: A substance having metallic properties and composed of two or more chemical elements of which at least one is a metal.

Annealing: Heat treating process used primarily to soften metals or to stabilize their structures.

Boss: A relatively short protrusion or projection from the surface of a forging or casting, often cylindrical in shape.

Brass: An alloy consisting mainly of copper (over 50%) and zinc, to which smaller amounts of other elements may be added.

Braze 505: Braze 505 is a trademark of the Handy & Harman Company.

Brazing: The joining of metals through the use of heat and capillary flow of a filler metal. The filler metal having a melting temperature above 840 degrees Fahrenheit, but below the melting point of the metals being joined.

Bright Annealing: Annealing in a protective atmosphere to prevent discoloration of the bright surface.

Brinell Hardness Test: A test for determining the hardness of a material by forcing a hard steel or carbide ball of specified diameter into it under a specified load.

Brittle Fracture: A fracture which is accompanied by little or no plastic deformation.

Brittleness: The quality of a material that leads to crack propagation without appreciable plastic deformation.

Bulk Modulus: The measure of resistance to compressibility of a fluid. It is the reciprocal of the compressibility.

Burnishing: Smoothing surfaces of a work piece through frictional contact between it and some hardened tooling.

Carbonitriding: A case hardening process of suitable ferrous material that is effected by the simultaneous absorption of nitrogen and carbon into the surface of the work piece, by heating above the lower transformation temperature in a suitable gaseous atmosphere.

Cavitation: A localized gaseous condition within a liquid stream which occurs when the pressure is reduced to the vapor pressure. Generally occurs in pumps and suction lines where fluid velocity is too high due to poorly sized (too small) line size.

Chatter: The undesirable wavy surface on a machined surface, produced by vibration of the tool, grinding wheel or work piece itself during machining or grinding.

Chromate Treatment: A treatment of metal in a solution of a hexavalent chromium compound to produce a conversion coating of chromium compounds on the surface of the metal, thus improving the resistance to corrosion.

Cold Heading: Working metal at room temperature in such a manner that the cross-sectional area of a portion or all of the stock is increased.

Cold Working (Cold Forming): Permanently deforming metal, usually at room temperature, by the application of an external force in order to produce a near net shape component.

Compressibility: The change in volume of a unit volume of a fluid when subjected to a unit change in pressure.

Corrosion: The deterioration of a metal by chemical or electrochemical reaction with its environment.

Creep: Time dependent strain occuring under stress. This phenomenon may result in relaxation i.e.the relief of pre-load/ pre-stress in assembled components.

Crimping: A swaging and squeezing operation usually used to secure components, such as, nuts and shells to their mating parts.

Deburring: Removing burrs, sharp edges or fins from metal parts usually by filing, grinding or tumbling the work in a barrel containing suitable liquid medium and abrasives.

Density: Ratio of the mass of an object (including fluids) to its volume.

Diamond Pyramid Hardness Test (DPH): An indentation hardness test employing a 136° diamond pyramid indenter and variable loads.

Ductility: The ability of a metal to deform plastically (permanently) without fracturing.

Dynamic Pressure Rating: See PRESSURE, RATED DYNAMIC.

Easy Flo 45: Easy Flo 45 is a trademark of the Handy & Harman Company.

Elastic Deformation: Change of dimensions accompanying stress in the elastic range, original dimensions being restored upon release of stress.

Elastomer: Often referred to as rubber, is a high polymer that can be, or has been modified to a state exhibiting little plastic flow and quick recovery from an extending force.

Erosion: Destruction of metals or other materials by the abrasive action of moving fluids, or particles.

Extrusion: Conversion of an ingot slug or billet into lengths of uniform cross section by plastically forcing the metal through a die orifice having the desired cross sectional profile.

Fatigue/Endurance Limit: The maximum stress below which a material can presumably endure an infinite number of stress cycles.

Fatigue Fracture: The initiation of minute cracks, propagating into ultimate fracture under the application of repeated or fluctuating stresses having a maximum value less than the tensile strength of the material.

Ferrous Metal: A metal in which the major constituent is iron.

Fire Point: The temperature to which a fluid must be heated to *ignite* and *burn* for at least five seconds in the presence of air when a small flame is applied.

Fitting: A connector or closure for fluid power lines and passages.

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Fitting: A connector or closure for fluid power lines and passages.

Flare Test: A test applied to tubing, involving a tapered expansion over a cone, in order to verify tube ductility and resistance to cracking during flaring operation.

Flaring: Forming an outward acute-angle flange on a tubular part.

Flash Point: The temperature to which a liquid must be heated to form a mixture with air that can be ignited *momentarily* by a flame.

Flow: Movement of fluid generated by pressure differences.

Flow, Laminar: A flow situation in which fluid moves in parallel lamina or streamlined layers.

Flow Lines: A fiber pattern, frequently observed in wrought metal, which indicates the manner in which the metal flowed during forming.

Flow Rate: The volume, mass or weight of a fluid passing through any conductor per unit of time.

Flow, Turbulent: A flow situation in which the fluid particles move in a random fluctuation manner. This is generally caused by too high fluid velocity.

Fluid Friction: Friction due to the viscosity of the fluid.

Fluid Power System: A system that transmits and controls power through the use of a pressurized fluid within an enclosed circuit.

Fluorocarbon Rubber: An elastomeric material which is extensively used for O-ring. Fluorocarbon (Viton) is recommended for higher temperatures than nitrile (Buna N) material.

Flux: In brazing, cutting, soldering or welding, material used to dissolve or facilitate the removal of oxides and other undesirable substances.

Folds: Defects in metals, usually on or near the surface caused by continued fabrication of overlapping surfaces.

Forgeabiltiy: Term used to describe the relative ability of materials to deform without rupture.

Forging: Plastically deforming metal, usually hot, into desired shapes with compressive force, with or without dies.

Forging Die: A forging whose shape is determined by impressions in specially prepared dies.

Free Machining: Denotes the machining characteristics of an alloy to which one or more ingredients have been introduced to produce small broken chips, lower power consumption, better surface finish and longer tool life.

Galling: Localized welding on mating surfaces of metal parts caused from excessive friction developed during the rubbing action that occurs during assembly.

Galvanic Corrosion: Corrosion resulting from the placing of two dissimilar metals in direct contact with each other then exposing them to an incompatible fluid or atmosphere.

Hammer, Liquid: Pressure and depression waves created by relatively rapid flow changes and transmitted through the system.

Handy Flux: Handy Flux is a trademark of the Handy & Harman Company.

Hardening: Increasing the hardness of a material by suitable treatment, usually involving heating and rapid cooling.

Hardness: Resistance of a material to scratching, abrasion, cutting or deformation.

Head, Pressure: The pressure due to the height of a column or body of fluid.

Heading: See COLD HEADING.

Hot Finishing/Hot Forming: A deformation operation performed at elevated temperature, usually above the recrystallization temperature of the metal.

Hydraulic Power: Power derived from flow rate and pressure differential of the fluid.

Hydraulics: Engineering science pertaining to liquid pressure and flow.

Hydrogen Embrittlement: A condition of low ductility in metals resulting from the absorption of hydrogen.

Hydropneumatics: Engineering science pertaining to the combination of hydraulic and pneumatic fluid power.

Impact Test: A single blow to determine the behavior of materials when subjected to high rates of loading, usually sudden and in the bending, tension or torsion mode. Charpy or Izod tests are typically used to measure materials' impact energy characteristics.

Inclusions: Nonmetallic materials in solid metallic matrix.

Intergranular Corrosion: A preferential corrosive attack at the grain boundaries of a metal.

LB2000: Registered Trademark of ITW.

Lubricant: Any substance used to reduce friction between two surfaces which are in contact.

MPG 2: Registered Trademark of Dubois Chemical Inc.

Machinability: The relative ease of machining a metal.

Machining: Removing material, in the form of chips, from work, usually through the use of a machine.

Malleability: The characteristic of metals that permits plastic deformation in compression without rupture.

Mandrel: (1) A metal bar around which other metal may be cast bent, formed, or shaped. (2) A rod used to retain the cavity in hollow metal products during working.

Mechanical Properties: The properties of a material that reveal its elastic and inelastic behavior under the application of force, thus indicating the material's suitability for mechanical applications. Examples of such properties are: tensile strength, elongation, modulus of elasticity, yield strength, reduction in area and fatigue limit.

Microhardness: The hardness of microscopic areas or of the individual microconstituents in a metal.

Microstructure: The structure of polished and etched metals as revealed by a microscope at a magnification greater than ten diameters.

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Flare Test: A test applied to tubing, involving a tapered expansion over a cone, in order to verify tube ductility and resistance to cracking during flaring operation.

Flaring: Forming an outward acute-angle flange on a tubular part.

Flash Point: The temperature to which a liquid must be heated to form a mixture with air that can be ignited *momentarily* by a flame.

Flow: Movement of fluid generated by pressure differences.

Flow, Laminar: A flow situation in which fluid moves in parallel lamina or streamlined layers.

Flow Lines: A fiber pattern, frequently observed in wrought metal, which indicates the manner in which the metal flowed during forming.

Flow Rate: The volume, mass or weight of a fluid passing through any conductor per unit of time.

Flow, Turbulent: A flow situation in which the fluid particles move in a random fluctuation manner. This is generally caused by too high fluid velocity.

Fluid Friction: Friction due to the viscosity of the fluid.

Fluid Power System: A system that transmits and controls power through the use of a pressurized fluid within an enclosed circuit.

Fluorocarbon Rubber: An elastomeric material which is extensively used for O-ring. Fluorocarbon (Viton) is recommended for higher temperatures than nitrile (Buna N) material.

Flux: In brazing, cutting, soldering or welding, material used to dissolve or facilitate the removal of oxides and other undesirable substances.

Folds: Defects in metals, usually on or near the surface caused by continued fabrication of overlapping surfaces.

Forgeabiltiy: Term used to describe the relative ability of materials to deform without rupture.

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Malleability: The characteristic of metals that permits plastic deformation in compression without rupture.

Mandrel: (1) A metal bar around which other metal may be cast bent, formed, or shaped. (2) A rod used to retain the cavity in hollow metal products during working.

Mechanical Properties: The properties of a material that reveal its elastic and inelastic behavior under the application of force, thus indicating the material's suitability for mechanical applications. Examples of such properties are: tensile strength, elongation, modulus of elasticity, yield strength, reduction in area and fatigue limit.

Microhardness: The hardness of microscopic areas or of the individual microconstituents in a metal.

Microstructure: The structure of polished and etched metals as revealed by a microscope at a magnification greater than ten diameters.

Mild Steel: Carbon steel with a maximum of .25 percent carbon.

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Nitriding: A case hardening process conducted by the introduction of nitrogen into the surface of a solid ferrous alloy.

Nitrile (Buna N): A copolymer of butadienne and acrylonitrile. It is the elastomer most widely used to manufacture O-rings.

Nondestructive: Inspection or test by methods that do not destroy the part.

O-ring: A torus, or doughnut shaped object, generally made from elastomer and is used primarily for sealing.

Passivation: A process used to improve corrosive behavior of a metal by changing its chemically active surface to a much less reactive state.

Pipe: (l) The defect in wrought or cast products resulting from the central cavity formed by contraction in metal, especially ingots, during solidification. (2) A tubular metal product that includes iron pipe size (I.P.S.) and schedule number in its classification.

Pipe Thread, Dry Seal: Tapered pipe threads in which sealing is a function of root and crest interference.

Pitting: Forming small sharp cavities in a metal surface by corrosion, mechanical action or nonuniform electrodeposition.

Plastic Deformation: Deformation that does or will remain permanent in an element after removal of the stress that caused it.

Pneumatics: Engineering science pertaining to gaseous pressure and flow.

Port: A terminus of a passage in a component to which conductors can be connected.

Port, Pipe: A port which conforms to pipe thread standards.

Port, Straight Thread: A port which conforms to straight thread standards. It typically employs an O-ring compressed in a wedge-shaped cavity.

Power Supply, Fluid: Energy source which generates and maintains a flow of fluid under pressure.

Precipitation Hardening: Hardening caused by the precipitation of a constituent from a supersaturated solid solution.

Pressure: Force per unit area, usually expressed in pounds per square inch (psi).

Pressure, Absolute: The pressure above absolute zero, i.e., the sum of atmospheric pressure plus gage pressure.

Pressure, Atmospheric: Pressure exerted by the atmosphere at any specific location. [Sea level atmospheric pressure is approximately 14.7 pounds per square inch (about 1 bar)]

Pressure, Burst: The pressure which causes failure of, and consequential loss of fluid through the product envelope.

Pressure, Cyclic Test: A pressure range applied in cyclic endurance tests that are performed to help determine recommended working pressure.

Pressure, Differential (Pressure Drop): The difference in pressure between any two points of a system or a component.

Pressure, Gage: Pressure differential above or below ambient atmospheric pressure.

Pressure, Nominal: A pressure value assigned to a component or system for the purpose of convenient designation.

Pressure, Operating: See WORKING PRESSURE.

Pressure, Proof: The non-destructive test pressure, in excess of the maximum rated operating pressure, which causes no permanent deformation, external leakage, or other resulting malfunction.

Pressure, Rated Dynamic: The maximum fluctuating pressure load that a pressure containing envelope is capable of sustaining for a minimum of 1 million operating cycles without failure.

Pressure, Rated Static: The maximum pressure that a pressure containing envelope is capable of sustaining in an application not exceeding 30,000 operating cycles in a system free of pressure surges, shocks, vibration, temperature excursions, etc.

Pressure, Relief: The pressure at which the relief valve is set for actuation. This pressure is generally slightly higher than the system working pressure.

Pressure Shock: A pressure wave front which moves at a sonic velocity, due to sudden stoppage of fluid flow.

Pressure, Static: The pressure in a fluid at rest.

Pressure, Surge: The pressure increases resulting from pressure fluctuations in a hydraulic system.

Pressure, Working: The pressure at which the apparatus is being operated in a given application.

Pressure, Working Rated: The qualified operating pressure which is recommended for a system or a component by the manufacturer.

Proof Load: A pre-determined load, generally some multiple of the service load, to which a specimen or structure is submitted before acceptance for use.

Quenching: Rapid cooling method used in heat treating process.

Residual Stress: Stress existing in a body that is free of external forces or thermal gradients.

Rockwell Hardness Test: A test for determining the hardness of a material based upon the depth of penetration of a specified penetrator into the specimen.

Roughness: Relatively finely-spaced surface irregularities, the height, width and direction of which establish the predominant surface pattern.

STP: Distributed by First Brand Corp. Danbury, CT.

Scaling: (1) Forming a thick layer of oxidation products on metals at high temperatures. (2) Depositing water-insoluble constituents on a metal surface, as in cooling tubes and water boilers.

Seam: A fold or lap on the surface of a metal appearing as a crack, usually resulting from a defect obtained in casting or in working.

Segregation: Concentration of alloying elements in specific regions in a metallic object.

Shear Strength: The load divided by the original cross-sectional area of a section separated by a shear force.

Sour Environment: Fluids containing water as a liquid and hydrogen sulfide, and may cause sulfide stress cracking (SSC) of susceptible materials.

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Specific Gravity, Liquid: The ratio of the weight of a given volume of liquid to an equal volume of water.

Spot Facing: Machining in the mating component, a flat seat for a bolt head, nut, locknut or other similar element.

Springback: (1) The elastic recovery of metal after stressing. (2) The degree to which metal tends to return to its original shape or contour after undergoing a forming operation.

Stainless Steel: Basically, low carbon alloy steels containing at least 11.5% chromium. These steels are characterized by their high resistance to corrosion.

Static Pressure Rating: See pressure, rated static

Steel: An iron-based alloy, containing: manganese, usually carbon, and often other alloying elements.

Strain: A measure of the relative change in size or shape of a body. Example, linear strain is computed as the ratio of change in length to the original length.

Stress: The result of a force acting on a given surface area. Computed as the ratio of the applied force to the affected area.

Stress Corrosion Cracking (SCC): Fracture in a material resulting from the combined action of applied stress and corrosive environment.

Stress Raisers/Concentration: Changes in contour or discontinuities in structure that cause local increases in stress.

Stringer: In wrought materials, an elongated configuration of microconstituents or foreign material aligned in the direction of working.

Sulfide Stress: Brittle failure by cracking under the combined action of tensile stress and corrosion in the presence of water Cracking (SSC) and hydrogen sulfide.

Surge: A transient rise of pressure or flow.

Swaging: Forming a taper or a reduction on metal products such as rod and tubing by forging, squeezing or hammering.

Temperature, Ambient: The temperature of the environment in which the apparatus is working.

Tensile Strength: In tensile testing, the ratio of maximum load to original cross-sectional area.

Tensile Strength, Ultimate: The maximum stress that a material can withstand.

Torque: Turning effort (moment) applied to a component for fastening, tightening or assembling.

Torsion: A twisting action resulting in shear stresses and strain.

Toughness: Ability of a metal to absorb energy and deform without fracturing.

Tube: Hollow, cylindrical products having outside diameters that are not standardized for threading. Tubes are dimensionally classified in terms of their outside diameters and wall thicknesses.

Upsetting: See COLD HEADING.

Vacuum: Pressure less than ambient atmospheric pressure.

Vibra-Seal: Vibra-Seal is a registered trademark of Loctite Corporation.

Viscosity: A measure of the internal friction or the resistance of a fluid to flow.

Viton: Viton is a registered trademark of E.I. Du Pont de Nemours and Company.

Welding: Joining two or more pieces of metal by applying heat, pressure or both with or without filler metal, to produce a localized union through fusion or recrystallization across the interface.

Work Hardening: An increase in hardness and strength caused by plastic deformation at temperatures lower than the recrystallization range. (Same as Strain Hardening. See also, Cold Working.)

Working Pressure, Dynamic: See PRESSURE, RATED DYNAMIC.

Working Pressure, Static: See PRESSURE, RATED STATIC.

Yield Strength: The maximum stress that can be applied to a material, which upon removal, the material will return to approximately its original shape.

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

Parker Publication No. 4400-B.1

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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 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 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" 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

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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, 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 that 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.

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

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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 check 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.

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

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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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PARKER-HANNIFIN CORPORATION
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1. Definitions. As used herein, the following terms have the meanings indicated.

Buyer:	means any customer receiving a Quote for Products.
Buyer's Property	means any tools, patterns, plans, drawings, designs, specifications materials, equipment, or information furnished by Buyer, or which are or become Buyer's property.
Confidential Information:	means any technical, commercial, or other proprietary information of Seller, including, without limitation, pricing, technical drawings or prints and/or part lists, which has been or will be disclosed, delivered, or made available, whether directly or indirectly, to Buyer.
Goods:	means any tangible part, system or component to be supplied by Seller.
Intellectual Property Rights:	means any patents, trademarks, copyrights, trade dress, trade secrets or similar rights.
Products:	means the Goods, Services and/or Software as described in a Quote.
Quote:	means the offer or proposal made by Seller to Buyer for the supply of Products.
Seller:	means Parker-Hannifin Corporation, including all divisions, subsidiaries and businesses selling Products under these Terms.
Seller's IP:	means patents, trademarks, copyrights, or other intellectual property rights relating to the Products, including without limitation, names, designs, images, drawings, models, software, templates, information, any improvements or creations or other intellectual property developed prior to or during the relationship contemplated herein.
Services:	means any services to be provided by Seller.
Software:	means any software related to the Goods, whether embedded or separately downloaded.
Special Tooling:	means equipment acquired by Seller or otherwise owned by Seller necessary to manufacture Goods, including but not limited to tools, jigs, and fixtures.
Terms:	means the terms and conditions of this Offer of Sale.

2. Terms. All sales of Products by Seller will be governed by, and are expressly conditioned upon Buyer's assent to, these Terms. These Terms are incorporated into any Quote provided by Seller to 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 or conditions of purchase. Any Quote made by Seller to Buyer shall be considered a firm and definite offer and shall not be deemed to be otherwise despite any language on the face of the Quote. Seller reserves all rights to accept or reject any purported acceptance by Buyer to Seller's Quote if such purported acceptance attempts to vary the terms of the Quote. If Seller ships Products after Buyer issues an acceptance to the Quote, any additional or different terms proposed by Buyer will not become part of the parties' business relationship unless agreed to in a writing that is signed by an authorized representative of Seller, excluding email correspondence. If the transaction proceeds without such agreement on the part of Seller, the business relationship will be governed solely by these Terms and the specific terms in Seller's Quote.

3. Price; Payment. The Products set forth in the Quote are offered for sale at the prices indicated in the Quote. Unless otherwise specifically stated in the 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 for any reason and at any time by giving ten (10) days prior written notice. Unless otherwise specified by Seller, all prices are F.C.A. Seller's facility (INCOTERMS 2020). All sales are contingent upon credit approval and full payment for all purchases is due thirty (30) days from the date of invoice (or such date as may be specified in the Quote). Under any circumstances, Buyer may not withhold or suspend payment of any amounts due and payable as a deduction, set-off or recoupment of any amount, claim or dispute with Seller. 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. Seller reserves the right to require advance payment or provision of securities for first and subsequent deliveries if there is any doubt, in Seller's sole determination, regarding the Buyer's creditworthiness or for other business reasons. If the requested advance payment or securities are not provided to Seller's satisfaction, Seller reserves the right to suspend performance or reject the purchase order, in whole or in part, without prejudice to Seller's other rights or remedies, including the right to full compensation. Seller may revoke or shorten any payment periods previously granted in Seller's sole determination. The rights and remedies herein reserved to Seller are cumulative and in
addition to any other or further rights and remedies available at law or in equity. No waiver by Seller of any breach by Buyer of any provision of these terms will constitute a waiver by Seller of any other breach of such provision.

4. Shipment; Delivery; Title and Risk of Loss. All delivery dates are approximate, and Seller is not responsible for damages or additional costs resulting from any delay. All deliveries are subject to our ability to procure materials from our suppliers. 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 carrier at Seller's facility. Unless otherwise agreed prior to shipment and for domestic delivery locations only, Seller will select and arrange, at Buyer's sole expense, the carrier and means of delivery. When Seller selects and arranges the carrier and means of delivery, freight and insurance costs for shipment to the designated delivery location will be prepaid by Seller and added as a separate line item to the invoice. Buyer shall be responsible for any additional shipping charges incurred by Seller due to Buyer's acts or omissions. Buyer shall not return or repackage any Products without the prior written authorization from Seller, and any return shall be at the sole cost and expense of Buyer.

5. Warranty. The warranty for 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 date of completion of the Services; 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: EXEMPTION CLAUSE; DISCLAIMER OF WARRANTY, CONDITIONS, REPRESENTATIONS: THIS WARRANTY IS THE SOLE AND ENTIRE WARRANTY, CONDITION, AND REPRESENTATION, PERTAINING TO PRODUCTS. SELLER DISCLAIMS ALL OTHER WARRANTIES, CONDITIONS, AND REPRESENTATIONS, WHETHER STATUTORY, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THOSE RELATING TO DESIGN, NONINFRINGEMENT, MERCHANTABILITY, AND FITNESS FOR A PARTICULAR PURPOSE. SELLER DOES NOT WARRANT THAT THE SOFTWARE IS ERROR-FREE OR FAULT-TOLERANT, OR THAT BUYER'S USE THEREOF WILL BE SECURE OR UNINTERRUPTED, UNLESS OTHERWISE AUTHORIZED IN WRITING BY SELLER, THE SOFTWARE SHALL NOT BE USED IN CONNECTION WITH HAZARDOUS OR HIGH-RISK ACTIVITIES OR ENVIRONMENTS. EXCEPT AS EXPRESSLY STATED HEREIN, ALL PRODUCTS ARE PROVIDED "AS IS".

6. Claims; Commencement of Actions. Buyer shall promptly inspect all Products upon receipt. No claims for shortages will be allowed unless reported to Seller within ten (10) days of delivery. Buyer shall notify Seller of any alleged breach of warranty within thirty (30) days after the date the non-conformance is or should have been discovered by Buyer. Any claim or action against Seller based upon breach of contract or any other theory, including tort, negligence, or otherwise must be commenced within twelve (12) months from the date of the alleged breach or other alleged event, without regard to the date of discovery.

7. LIMITATION OF LIABILITY. IN THE EVENT OF A BREACH OF WARRANTY, SELLER WILL, AT ITS OPTION, REPAIR OR REPLACE THE NON-CONFORMING PRODUCTS, RE-PERFORM THE SERVICES, OR REFUND THE PURCHASE PRICE PAID WITHIN A REASONABLE PERIOD OF TIME. IN NO EVENT IS SELLER LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES INCLUDING ANY LOSS OF REVENUE OR PROFITS, WHETHER BASED IN CONTRACT, TORT OR OTHER LEGAL THEORY. IN NO EVENT SHALL SELLER'S LIABILITY UNDER ANY CLAIM MADE BY BUYER EXCEED THE PURCHASE PRICE PAID FOR THE PRODUCTS.

8. Confidential Information. Buyer acknowledges and agrees that Confidential Information has been and will be received in confidence and will remain the property of Seller. Buyer further agrees that it will not use Seller's Confidential Information for any purpose other than for the benefit of Seller and shall return all such Confidential Information to Seller within thirty (30) days upon request.

9. Loss to Buyer's Property. Buyer's Property will be considered obsolete and may be destroyed by Seller after two (2) consecutive years have elapsed without Buyer ordering the Products manufactured using Buyer's Property. Also, Seller shall not be responsible for any loss or damage to Buyer's Property while it is in Seller's possession or control.

10. Special Tooling. Seller may impose a tooling charge for any Special Tooling. Special Tooling shall be and remain Seller's property. In no event will Buyer acquire any interest in the Special Tooling, even if such Special Tooling has been specially converted or adapted for manufacture of Goods for Buyer and notwithstanding any charges paid by Buyer. Unless otherwise agreed, Seller has the right to alter, discard or otherwise dispose of any Special Tooling or other property owned by Seller in its sole determination at any time.

11. Security Interest. To secure payment of all sums due from Buyer, 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 Seller's security interest.

12. User Responsibility. Buyer, through its own analysis and testing, is solely responsible for making the final selection of the Products and assuring that all performance, endurance, maintenance, safety and warning requirements of the application of the Products are met. Buyer must analyze all aspects of the application and follow applicable industry standards, specifications, and any technical information provided with the Quote or the Products, such as Seller's instructions, guides and specifications. If Seller provides options of or for Products based upon data or specifications provided by Buyer, Buyer is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable

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uses of the Products. In the event Buyer is not the end-user of the Products, Buyer will ensure such end-user complies with this paragraph.

13. Use of Products, Indemnity by Buyer. Buyer shall comply with all instructions, guides and specifications provided by Seller with the Quote or the Products. If Buyer uses or resells the Products in any way prohibited by 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. Further, 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, arising out of or in connection with: (a) improper selection, design, specification, application, or any misuse of Products; (b) any act or omission, negligent or otherwise, of Buyer; (c) Seller's use of Buyer's Property; (d) damage to the Products from an external cause, repair or attempted repair by anyone other than Seller, failure to follow instructions, guides and specifications provided by Seller, use with goods not provided by Seller, or opening, modifying, deconstructing, tampering with or repackaging the Products; or (e) Buyer's failure to comply with these Terms, including any legal or administrative proceedings, collection efforts, or other actions arising from or relating to such failure to comply. Seller shall not indemnify Buyer under any circumstance except as otherwise provided in these Terms.

14. Cancellations and Changes. Buyer may not cancel or modify, including but not limited to movement of delivery dates for the Products, 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 and any additional expense. Seller, at any time, may change features, specifications, designs and availability of Products.

15. Assignment. Buyer may not assign its rights or obligations without the prior written consent of Seller.

16. Force Majeure. Seller is not liable for delay or failure to perform any of its obligations by reason of any events or circumstances beyond its reasonable control. Such circumstances include without limitation: accidents, labor disputes or stoppages, government acts or orders, acts of nature, pandemics, epidemics, other widespread illness, or public health emergency, cyber related disruptions, cyber-attacks, ransomware sabotage, delays or failures in delivery from carriers or suppliers, shortages of materials, sudden increases in the price of raw material or components, shutdowns or slowdowns affecting the supply of raw materials or components, or the transportation thereof, oil shortages or oil price increases, energy crisis, energy or fuel interruption, war (whether declared or not) or the serious threat of same, riots, rebellions, acts of terrorism, embargoes, fire or any reason whether similar to the foregoing or otherwise. Seller will resume performance as soon as practicable after the event of force majeure has been removed. All delivery dates affected by an event of force majeure shall be tolled for the duration of such event of force majeure and rescheduled for mutually agreed dates as soon as practicable after the event of force majeure ceases to exist. The right to allocate capacity is in the Seller's sole discretion. An event of force majeure shall not include financial distress, insolvency, bankruptcy, or other similar conditions affecting one of the parties, affiliates and/or subcontractors. An event of force majeure in the meaning of these Terms means any circumstances beyond Seller's control that permanently or temporarily hinders performance, even where that circumstance was already foreseen. Buyer shall not be entitled to cancel any orders following its claim of an event of force majeure.

17. Waiver and Severability. Failure to enforce any provision of these Terms will not invalidate that provision; nor will any such failure prejudice either party's right to enforce that provision in the future. Invalidation of any provision of these Terms shall not invalidate any other provision herein and, the remaining provisions will remain in full force and effect.

18. Duration. Unless otherwise stated in the Quote, any agreement governed by or arising from these Terms shall: (a) be for an initial duration of one (1) year; and (b) shall automatically renew for successive one-year terms unless terminated by Buyer with at least 180-days written notice to Seller or if Seller terminates the agreement pursuant to Section 19 of these Terms.

19. Termination. Seller may, without liability to Buyer, 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) becomes or is deemed insolvent, (c) appoints or has appointed a trustee, receiver or custodian for all or any part of Buyer's property,(d) files a petition for relief in bankruptcy on its own behalf, or one is filed against Buyer by a third party, (e) makes an assignment for the benefit of creditors; or (f) dissolves its business or liquidates all or a majority of its assets.

20. Ownership of Rights. Buyer agrees that (a) Seller (and/or its affiliates) owns or is the valid licensee of Seller's IP and (b) the furnishing of information, related documents or other materials by Seller to Buyer does not grant or transfer any ownership interest or license in or to Seller's IP to Buyer, unless expressly agreed in writing. Without limiting the foregoing, Seller retains ownership of all Software supplied to Buyer. In no event shall Buyer obtain any greater right in and to the Software than a right in a license limited to the use thereof and subject to compliance with any other terms provided with the Software. Buyer further agrees that it will not, directly or through intermediaries, reverse engineer, decompile, or disassemble any Software (including firmware) comprising or contained within a Product, except and only to the extent that such activity may be expressly permitted, either by applicable law or, in the case of open source software, the applicable open source license.

21. Indemnity for Infringement of Intellectual Property Rights. Seller is not liable for infringement of any 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 infringes the Intellectual Property Rights of a third party in the country of delivery of the Products by Seller to 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 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 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 (including Seller's use of Buyer's Property); or (ii) directed to any Products 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. The foregoing provisions of this Section constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for claims of infringement of Intellectual Property Rights.

22. Governing Law. These Terms, the terms of any Quote, 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.

23. Entire Agreement. These Terms, along with the terms set forth in the Quote, forms the entire agreement between the Buyer and Seller and constitutes the final, complete and exclusive expression of the terms of sale and purchase. In the event of a conflict between any term set forth in the Quote and these Terms, the terms set forth in the Quote shall prevail. All prior or contemporaneous written or oral agreements or negotiations with respect to the subject matter shall have no effect. No modification to these Terms will be binding on Seller unless agreed to in a writing that is signed by an authorized representative of Seller, excluding email correspondence, 'clickwrap' or other purported electronic assent to different or additional terms. Sections 2-25 of these Terms shall survive termination or cancellation of any agreement governed by or arising from these Terms.

24. No 'Wrap' Agreements/No Authority to Bind. Seller's clicking any buttons or any similar action, such as clicking "I Agree" or "Confirm," to utilize Buyer's software or webpage for the placement of orders, is NOT an agreement to Buyer's Terms and Conditions. NO EMPLOYEE, AGENT OR REPRESENTATIVE OF SELLER HAS THE AUTHORITY TO BIND SELLER BY THE ACT OF CLICKING ANY BUTTON OR SIMILAR ACTION ON BUYER'S WEBSITE OR PORTAL.

25. 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 represents 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 Products from Seller in a manner or for a purpose that violates Export Laws or would cause Seller to be in violation of Export Laws. Buyer agrees to promptly and reliably provide Seller all requested information or documents, including end-user statements and other written assurances, concerning Buyer's ongoing compliance with Export Law.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 Seller's security interest.

Parker's Motion & Control Technologies

At Parker, we're guided by a relentless drive to help our customers become more productive and achieve higher levels of profitability by engineering the best systems for their requirements. It means looking at customer applications from many angles to find new ways to create value. Whatever the motion and control technology need, Parker has the experience, breadth of product and global reach to consistently deliver. No company knows more about motion and control technology than Parker.

For further info, call 1 800 C-Parker (1 800 272 7537).

Aerospace

Key Markets

Aftermarket services
Commercial transports
Engines
General & business aviation
Helicopters
Launch vehicles
Military aircraft
Missiles
Power generation
Regional transports
Unmanned aerial vehicles

Key Products

Control systems & actuation products
Engine systems & components
Fluid conveyance systems & components
Fluid metering, delivery & atomization devices
Fuel systems & components
Fuel tank inerting systems
Hydraulic systems & components
Thermal management
Wheels & brakes

Climate Control

Key Markets

Agriculture
Air conditioning
Construction Machinery
Food & beverage
Industrial machinery
Life sciences
Oil & gas
Precision cooling
Process
Refrigeration
Transportation

Key Products

Accumulators
Advanced actuators
CO_2 controls
Electronic controllers
Filter driers
Hand shut-off valves
Heat exchangers
Hose & fittings
Pressure regulating valves
Refrigerant distributors
Safety relief valves
Smart pumps
Thermostatic expansion valves

Electromechanical

Key Markets

Aerospace
Factory automation
Life science & medical
Machine tools
Packaging machinery
Paper machinery
Plastics machinery & converting
Primary metals
Semiconductor & electronics
Textile
Wire & cable

Key Products

AC/DC drives & systems
Electric actuators, gantry robots & slides
Electrohydrostatic actuation systems
Electromechanical actuation systems
Human machine interface
Linear motors
Stepper motors, servo motors, drives & controls
Structural extrusions

Filtration

Key Markets

Aerospace
Food & beverage
Industrial plant & equipment
Life sciences
Marine
Mobile equipment
Oil & gas
Power generation & renewable energy
Process
Transportation
Water Purification

Key Products

Analytical gas generators
Compressed air filters & dryers
Engine air, coolant, fuel & oil filtration systems
Fluid condition monitoring systems
Hydraulic & lubrication filters
Hydrogen, nitrogen & zero air generators
Instrumentation filters
Membrane & fiber filters
Microfiltration
Sterile air filtration
Water desalination & purification filters & systems

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Fluid & Gas Handling

Key Markets

Aerial lift
Agriculture
Bulk chemical handling
Construction machinery
Food & beverage
Fuel & gas delivery
Industrial machinery
Life sciences
Marine
Mining
Mobile
Oil & gas
Renewable energy
Solenoid valves
Transportation

Key Products

Check valves
Connectors for low pressure fluid conveyance
Deep sea umbilicals
Diagnostic equipment
Hose couplings
Industrial hose
Mooring systems & power cables
PTFE hose & tubing
Quick couplings
Rubber & thermoplastic hose
Tube fittings & adapters
Tubing & plastic fittings

Hydraulics

Key Markets

Aerial lift
Agriculture
Alternative energy
Construction machinery
Forestry
Industrial machinery
Machine tools
Marine
Material handling
Mining
Oil & gas
Power generation
Refuse vehicles
Renewable energy
Truck hydraulics
Turf equipment

Key Products

Accumulators
Cartridge valves
Electrohydraulic actuators
Human machine interfaces
Hybrid drives
Hydraulic cylinders
Hydraulic motors & pumps
Hydraulic systems
Hydraulic valves & controls
Hydrostatic steering
Integrated hydraulic circuits
Power take-offs
Power units
Rotary actuators
Sensors

Pneumatics

Key Markets

Aerospace
Conveyor & material handling
Factory automation
Life science & medical
Machine tools
Packaging machinery
Transportation & automotive

Key Products

Air preparation
Brass fittings & valves
Manifolds
Pneumatic accessories
Pneumatic actuators & grippers
Pneumatic valves & controls
Quick disconnects
Rotary actuators
Rubber & thermoplastic hose & couplings
Structural extrusions
Thermoplastic tubing & fittings
Vacuum generators, cups & sensors

Process Control

Key Markets

Alternative fuels
Biopharmaceuticals
Chemical & refining
Food & beverage
Marine & shipbuilding
Medical & dental
Microelectronics
Nuclear Power
Offshore oil exploration
Oil & gas
Pharmaceuticals
Power generation
Pulp & paper
Steel
Water/wastewater

Key Products

Analytical Instruments
Analytical sample conditioning products & systems
Chemical injection fittings & valves
Fluoropolymer chemical delivery fittings, valves & pumps
High purity gas delivery fittings, valves, regulators & digital flow controllers
Industrial mass flow meters/ controllers
Permanent no-weld tube fittings
Precision industrial regulators & flow controllers
Process control double block & bleeds
Process control fittings, valves, regulators & manifold valves

Sealing & Shielding

Key Markets

Aerospace
Chemical processing
Consumer
Fluid power
General industrial
Information technology
Life sciences
Microelectronics
Military
Oil & gas
Power generation
Renewable energy
Telecommunications
Transportation

Key Products

Dynamic seals
Elastomeric o-rings
Electro-medical instrument design & assembly
EMI shielding
Extruded & precision-cut, fabricated elastomeric seals
High temperature metal seals
Homogeneous & inserted elastomeric shapes
Medical device fabrication & assembly
Metal & plastic retained composite seals
Shielded optical windows
Silicone tubing & extrusions
Thermal management
Vibration dampening

ENGINEERING YOUR SUCCESS.

Parker Fluid Connectors Group
North American Divisions & Distribution Service Centers

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Fittings:
Available in inch and metric sizes covering SAE, BSP, DIN, GAZ, JIS and ISO thread configurations, manufactured from steel, stainless steel, brass, aluminum, nylon and thermoplastic.

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Worldwide Availability:
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North American Divisions

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fax 269 694 4614

Hose Products Division
Wickliffe, OH
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fax 440 943 3129

Parflex Division
Ravenna, OH
phone 330 296 2871
fax 330 296 8433

Quick Coupling Division
Minneapolis, MN
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fax 763 544 3418

Tube Fittings Division
Columbus, OH
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fax 614 279 7685

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fax 419 878 7001
fax 419 878 7420
(FCG Kit Operations)

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phone 905 693 3000
fax 905 876 1958
(Contact Milton for other Service Center locations.)

Mexico
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fax (52) 722 2722 168

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