



MPI™ Medium Pressure Products

Air and Hand Pump:
Setup and Preset Instructional Manual

Bulletin 4234-B1

November 2022

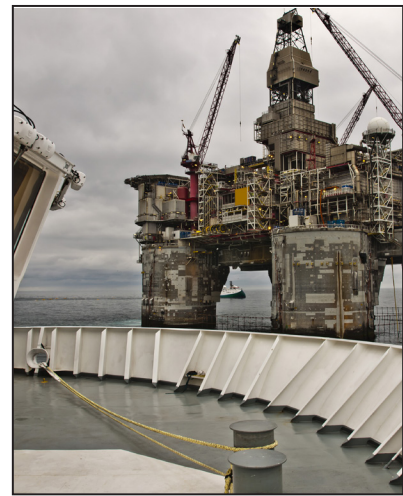
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filtration
fluid & gas handling
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pneumatics
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Table of Contents

MPI™ Overview	3
MPI™ Hydraulic Preset Tools	4
9 MPI™ Body Die with the MPI™ Large Preset Head	5
MPI™ Air Pump Kit, Setup	6
MPI™ Air Pump Kit, Presetting	9
MPI™ Hand Pump Kit, Setup	11
MPI™ Hand Pump Kit, Presetting	13
2507 Cone & Thread Tubing	15
Heavy Wall Annealed 316 Instrumentation Tubing	16
MPI™ Fitting, Assembly Instructions	17
Remake Instructions	17
MPI™ Fitting Presetting and Make Up Notes	18
MPI™ Connection - Reference Torques	18
Offer of Sale and Warranty	19



MPI™ Overview

Introduction

The MPI™ Presetting Instruction Manual documents the proper installation procedures for the MPI™ tube system. Parker MPI™ Fittings can be assembled either manually or by using hydraulic presetting equipment. This manual provides step by step instructions to successfully preset each type of tubing approved for use with MPI™ fittings using either manual or air driven presetting equipment.

MPI™ Fittings Pressure Ratings

Parker Hannifin has designed all fittings and valves using the following ASME Standards and associated Safety Factors:

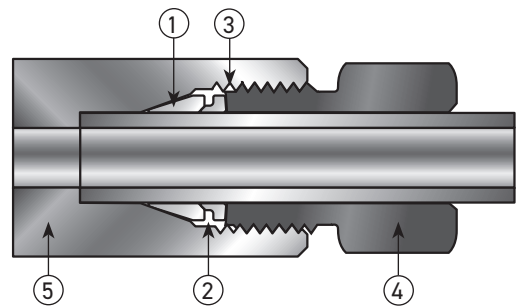
- ASME B31.1 Power Piping
- ASME B31.3 Process Piping
- ASME B31.3 Chapter IX High Pressure Piping

A significant difference between these ASME standards is Safety Factor. MPI is designed to cover the requirements of all three standards with ASME B31.3 Chapter IX allowing safe use to 15,000 psi MAWP@RT. The design engineer is responsible to understand and choose the standard that meets the requirements of the application.

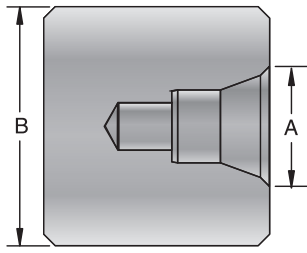
Advanced Features

Every MPI™ Fitting has the features shown below:

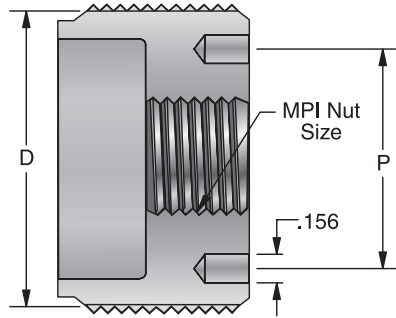
1. Front ferrule with corrosion-resistant Parker Suparcase® forms a seal between the tube, body and ferrule. It also provides a mechanical hold on the tube.
2. Back ferrule with corrosion-resistant Parker Suparcase® provides a strong mechanical hold on the tube.
3. Longer thread area for improved resistance to pressure and load on the ferrules.
4. Molybdenum disulfide-coated inverted nut helps prevent galling, provides easier assembly, and permits multiple remakes.
5. Long tube-support area improves resistance to vibration and line loads.



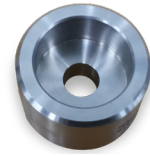
MPI™ Hydraulic Preset Tools



MPI™ Body Die



MPI™ Nut Die



Parker Part No.
9 MPI Body Die Adapter

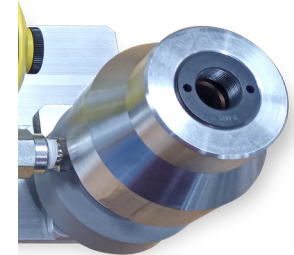


Parker Part No.
MPI™ Nut Die Handle

MPI™ Small Preset Assembly: Body Dies and Nut Dies Used

MPI Small Preset Assembly		Inches				
Body Die Part No.	Nut Die Part No.	A	B	D	P	MPI™ Nut Size
4 MPI Body Die	4 MPI Nut Die	.50	1.25	1.62	1.20	4
6 MPI Body Die	6 MPI Nut Die	.63	1.25	1.62	1.20	6
8 MPI Body Die	8 MPI Nut Die	.82	1.25	1.62	1.20	8
9 MPI Body Die	9 MPI Nut Die	.88	1.25	1.62	1.20	9

Dimensions in inches are for reference only, subject to change.

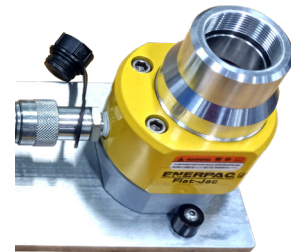


Parker Part No.
MPI™ SMALL Preset Assembly

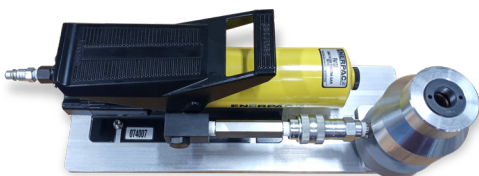
MPI™ Large Preset Assembly: Body Dies and Nut Dies Used

MPI Large Preset Assembly		Inches				
Body Die Part No.	Nut Die Part No.	A	B	D	P	MPI™ Nut Size
*9 MPI Body Die	9 MPI Large Nut Die	.88	1.25	2.00	1.67	9
12 MPI Body Die*	12 MPI Nut Die	1.13	1.75	2.00	1.67	12
16 MPI Body Die	16 MPI Nut Die	1.44	1.75	2.00	1.67	16

* Requires a 9 MPI Body Die Adapter
Dimensions in inches are for reference only, subject to change.



Parker Part No.
MPI™ LARGE Preset Assembly



Parker Part No.
MPI™ AIR PUMP KIT



Parker Part No.
MPI™ HAND PUMP KIT

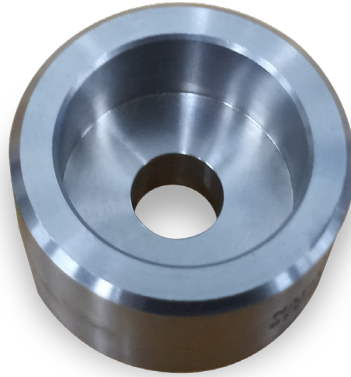
Note: One each Pump Kit, Preset Assembly, Body Die and Nut Die are required for presetting.
Pump Kits and Preset Assemblies can be interchanged but Body Dies and Nut Dies are for a specific Preset Assembly.

Using the 9 MPI™ Body Die with the MPI™ Large Preset Head

Step 1. Place the 9 MPI™ BODY DIE into the 9 MPI™ BODY DIE ADAPTER



9 MPI™ BODY DIE



9 MPI™ BODY DIE ADAPTER



ASSEMBLED

Step 2. Place the body die and die adapter into the MPI LARGE PRESET HEAD

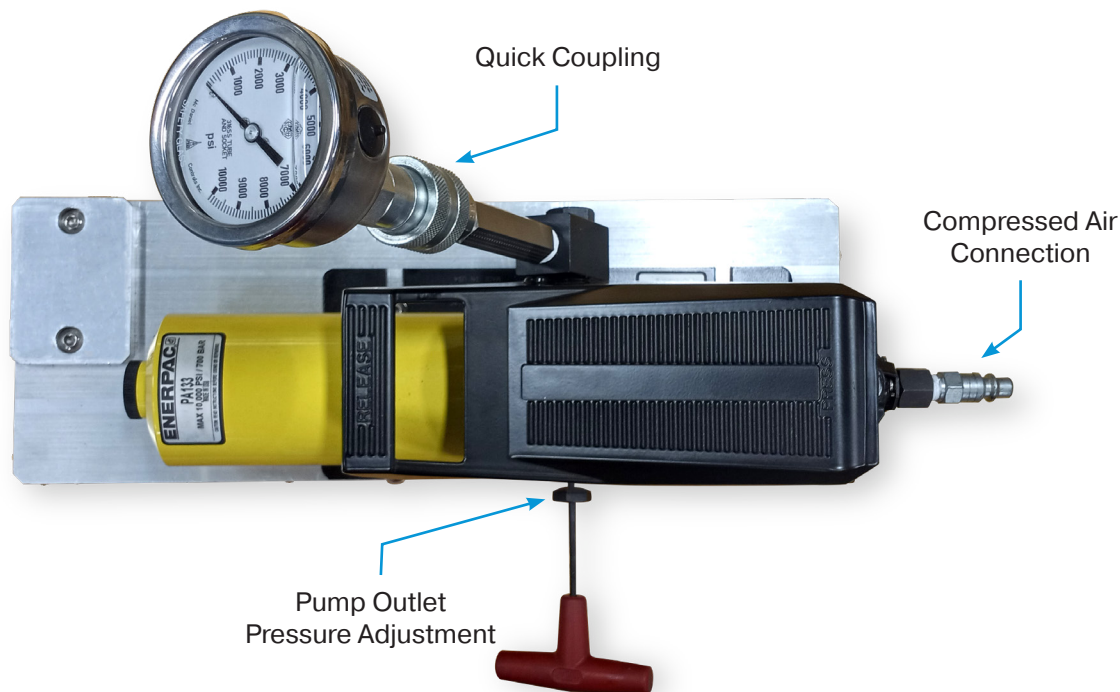


MPI™ LARGE PRESET HEAD

MPI™ Air Pump Kit - Setup

Step 1. Attach the Air Pump to a clean air supply of 60-120 psi and 9 scfm.

Step 2. Attach pressure gauge to air pump by pushing quick coupling on to the nipple and tightening the collar gently until it stops.



Step 3. Set pump preset pressure as follows. Identify the preset pressure for the preset head size (small or large), MPI™ fitting size and tube material from Tables 1 and 2. Remove the small black plastic cap on the swivel post and adjust the pump relief valve screw by inserting the Tee handle Allen wrench. Rotate the screw until the gauge reads the desired preset pressure with the pump activated. Refer to Pages 15 and 16 for additional presetting requirements for Cone & Thread tubing and Heavy Wall Annealed 316 tubing.

TABLE 1
316 and 317 MPI™ Tube Preset Pressure

	Preset Pressure (PSI)		
	Fitting Size	Standard Ferrules	-XF Ferrules
Small MPI™ Preset Assembly	4	3,200	-
	6	4,000	-
	8	6,800	-
	9	8,500	-
Large MPI™ Preset Assembly	9	3,600	-
	12	5,200	6,000
	16	8,000	8,000

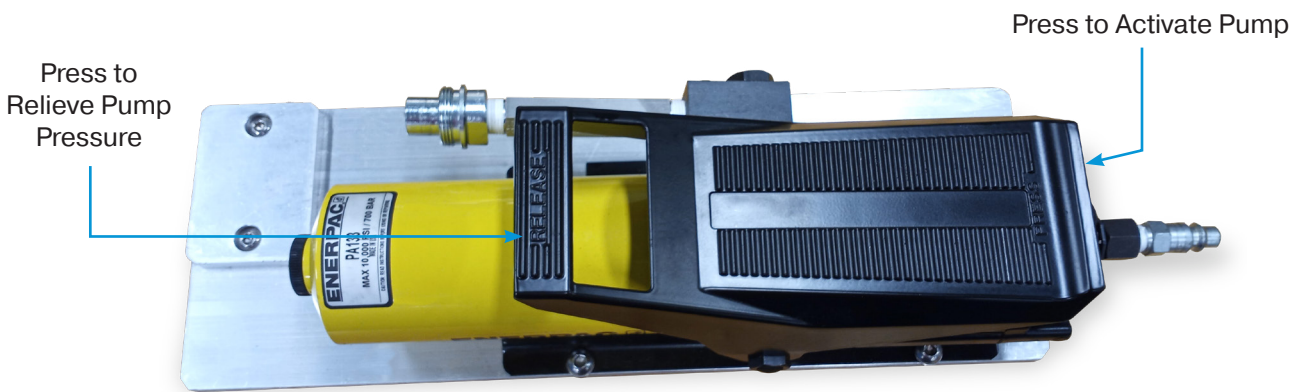
TABLE 2
2507 MPI™ & Instrument Tube Preset Pressure

	Preset Pressure (PSI)		
	Fitting Size	Standard Ferrules	-XF Ferrules
Small MPI™ Preset Assembly	4	4,000	-
	6	4,400	-
	8	8,000	-
	10	4,400	-
Large MPI™ Preset Assembly	12	5,600	6,000
	16	8,800	8,000

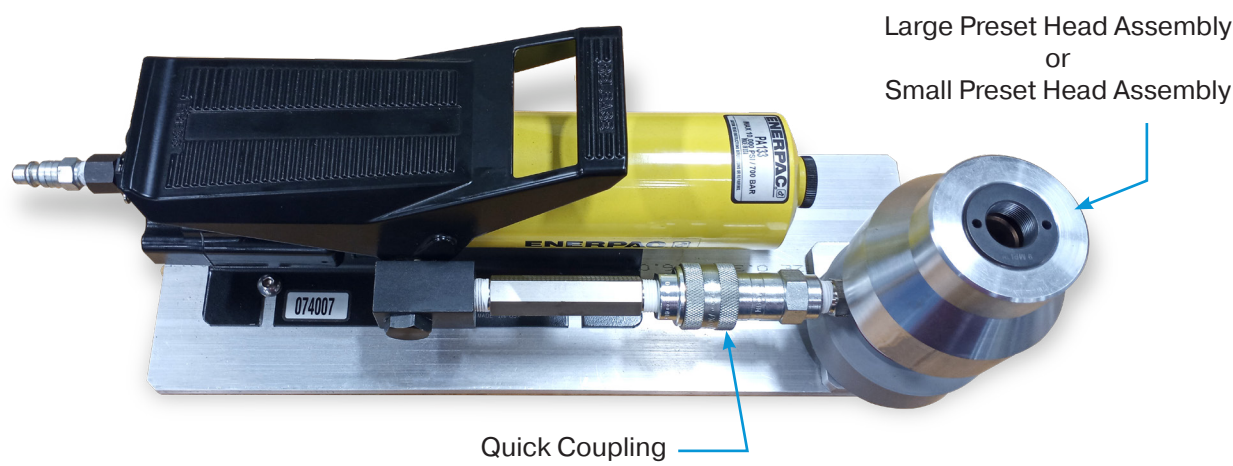


Pump Pressure Adjustment Screw is located inside Nut

Step 4. Relieve pump pressure by pressing the pedal down on the opposite side. Activate the pump again to check the preset pressure and then relieve the pressure again. After the gauge reads 0, unscrew the collar and remove the gauge by pulling straight out.



Step 5. Attach the preset head to the Air Pump by pushing quick coupling on to the nipple and tightening the collar gently until it stops.



Step 6. Sometimes air can become trapped in the hydraulic system which can cause longer preset times and a jerky preset motion. To bleed the air, rotate the preset head to point down and tilt the pump so the hydraulic line is inclined slightly upward from the head to the pump. Activate the pump briefly (2-3 seconds) and then relieve pressure. Activate and relieve pressure 2-5 times to remove the air.

Step 7. Rotate the Preset Head to point left, right, or up (depending on the desired angle of use) and the ram should rest flat against the pad.



Preset Head Angle Left

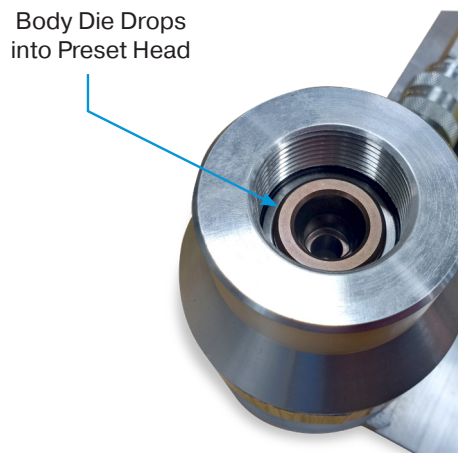


Preset Head Angle Right



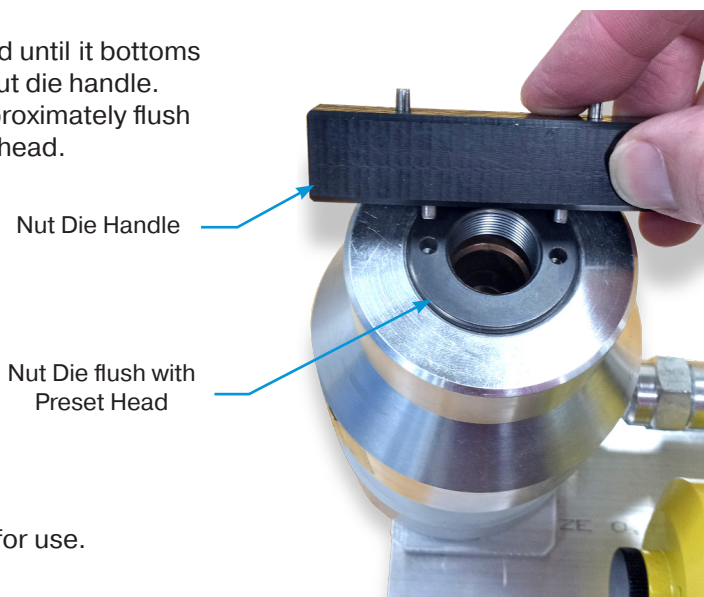
Preset Head Angle Up

Step 8. Insert preset body die into the head with the tapered body seat pointing out. If using the 9 MPI BODY DIE with the LARGE MPI PRESET ASSEMBLY refer to the additional instructions on Page 5.



Step 9. Screw the nut die into the preset head until it bottoms firmly against the bottom using the nut die handle. The face of the nut die should be approximately flush with the face to the top of the preset head.

Important - Size 12 and 16 nut die must be flush with top of preset head to properly preset -XF ferrules



Nut Die Handle

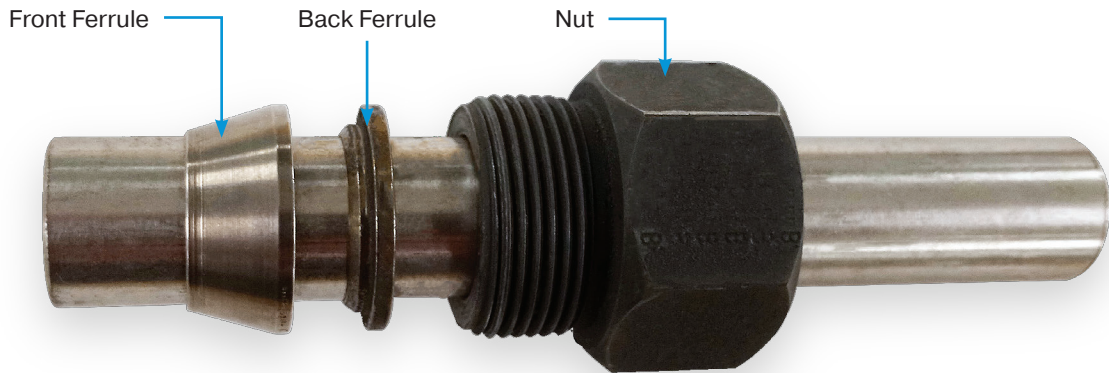
Nut Die flush with Preset Head

Step 10. The MPI™ Air Pump Kit is now ready for use.

MPI™ Air Pump Kit - Pre-Setting

Step 1. Square cut the end of the tube and remove burrs from tube OD and ID.

Step 2. Slide nut and ferrules onto the tube with tapered end of ferrules pointed toward the end of the tube. (proper sequence is nut, short back ferrule and then longer front ferrule)

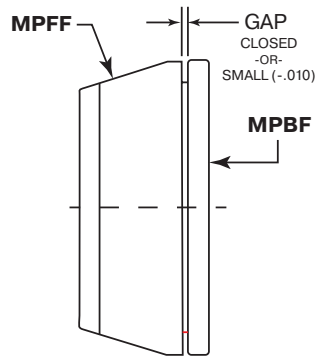


Step 3. Hold nut and ferrules on the tube while inserting the tube into the head and seat the end of the tube against the tube stop in the body die.



Step 4. Finger tighten (do not wrench) the nut into the nut die until the hex almost bottoms against the nut die. Leaving the nut approximately 1/4 turn from the nut die makes it easier to remove after presetting.

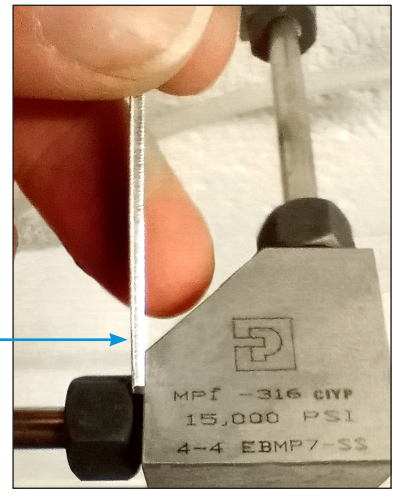
- Step 5.** Ensure tube is against body die stop and depress pump pedal until you hear the change in pump speed. Continue to depress pedal for at least 5 seconds. Pump speed should not slow sufficiently at the end of preset that individual strokes can be counted. ^(A)
- Step 6.** Relieve pressure by pushing down on the opposite side of the pedal and remove nut/ferrule assembly from the head by rotating the nut out. This should be easily done by hand without the use of a wrench.
- Step 7.** Inspect the preset nut/ferrule assembly to insure that the nut rotates easily, **the ferrules are seated firmly on the tube (they do not rotate)**, and the gap between the ferrules is closed (there may be a slight gap due to ferrule spring). If ferrules rotate, check preset and setup steps for cause. ^(B, C)



- Step 8.** Insert the preset nut/ferrule assembly into the fitting body until the ferrules seat firmly and tighten the nut by hand to the finger tight position. Hold the fitting body with a wrench to prevent rotation as you continue to wrench tighten the nut 1/2 turn. (A sharp increase in resistance is immediately felt as the ferrules are fully seated.)
Do not wrench the nut to pull restricted tubing into the body seat. ^(D,E)

- Step 9.** Check the gap between the nut and the body with the MPI™ GAP GAUGE. Insert the end of the gauge into the beveled gap between the nut hex and the body. Gently turn the gauge and it should “twist out” easily. **If the gauge slides into the gap and does not “twist out”, the fitting is not assembled properly, and you must check the entire preset procedure.** ^(F) **Use of the MPI™ Gap Gauge is mandatory for Size 12 and Size 16.**

Proper Assembled MPI™ Fitting
 MPI™ Gap Gage **does not** fit
 between nut and body.



^(A,B, C,D,E,F)
 See Page 18: MPI™ Presetting & Makeup
 Notes for additional details.

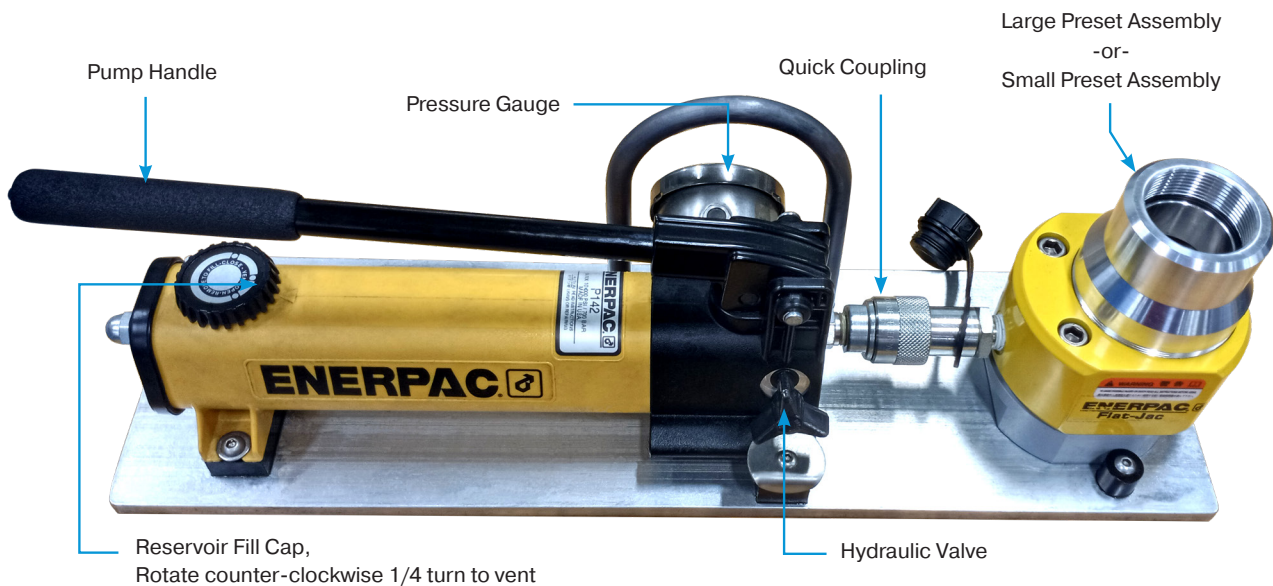
MPI™ Hand Pump Kit - Setup

Step 1. Based upon the MPI™ fitting size and tube material select the proper preset head size and presetting pressure from Tables 1 and 2. Refer to Pages 15 and 16 for additional presetting requirements for Cone & Thread tubing and Heavy Wall Annealed 316 tubing.

TABLE 1 316 and 317 MPI™ Tube Preset Pressure			
	Preset Pressure (PSI)		
	Fitting Size	Standard Ferrules	-XF Ferrules
Small MPI™ Preset Assembly	4	3,200	-
	6	4,000	-
	8	6,800	-
	9	8,500	-
Large MPI™ Preset Assembly	9	3,600	-
	12	5,200	6,000
	16	8,000	8,000

TABLE 2 2507 MPI™ & Instrument Tube Preset Pressure			
	Preset Pressure (PSI)		
	Fitting Size	Standard Ferrules	-XF Ferrules
Small MPI™ Preset Assembly	4	4,000	-
	6	4,400	-
	8	8,000	-
Large MPI™ Preset Assembly	10	4,400	-
	12	5,600	6,000
	16	8,800	8,000

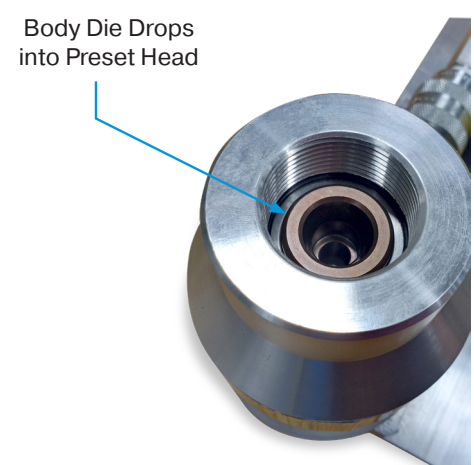
Step 2. Attach preset head to the Hand Pump by pushing quick coupling on to the nipple and tightening the collar gently until it stops. Rotate the preset head to point right, or up (depending on the desired angle of use).



Step 3. Relieve the reservoir pressure on the pump by rotating the cap approximately 1/4 turn counter clockwise to the “vent” position. Remember to close the cap before transporting the pump or hydraulic fluid can leak from the reservoir. Due to the small volume of fluid used in presetting, the pump can be used with the vent cap in the closed position, but it still should be vented and closed occasionally to relieve pressure due to temperature changes, etc.

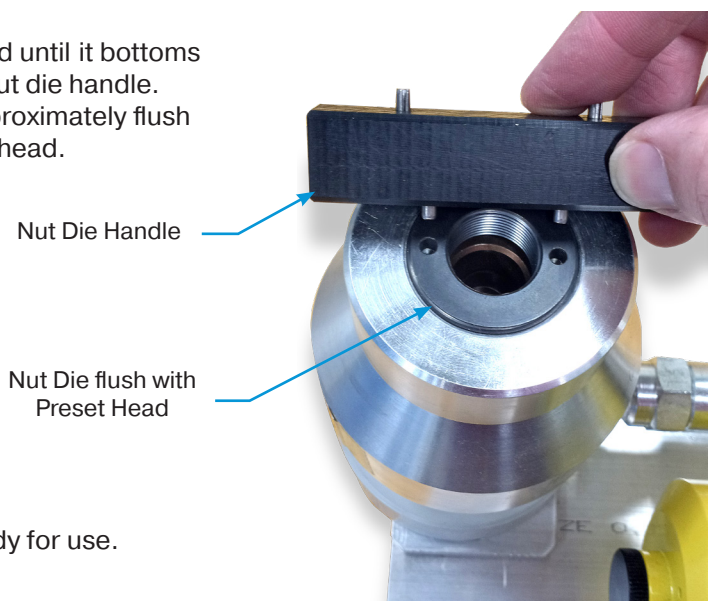
Step 4. Sometimes air can become trapped in the hydraulic system which can cause longer preset times and a jerky preset motion. To bleed the air, close the hydraulic valve by rotating handle clockwise until it stops. Pump the handle until light resistance is felt and the gauge starts to move. Tilt the pump so the head is straight down and relieve the pressure by turning the hydraulic valve counterclockwise. A gurgling sound will be heard if trapped air is forced back into the reservoir. Repeat this process 2-3 times to purge the air.

Step 5. Insert preset body die into the head with the tapered body seat pointing out. If using the 9 MPI™ BODY DIE with the LARGE MPI™ PRESET ASSEMBLY refer to the additional instructions on Page 5



Step 6. Screw the nut die into the preset head until it bottoms firmly against the bottom using the nut die handle. The face of the nut die should be approximately flush with the face to the top of the preset head.

Important - Size 12 and 16 nut die must be flush with top of preset head to properly preset -XF ferrules

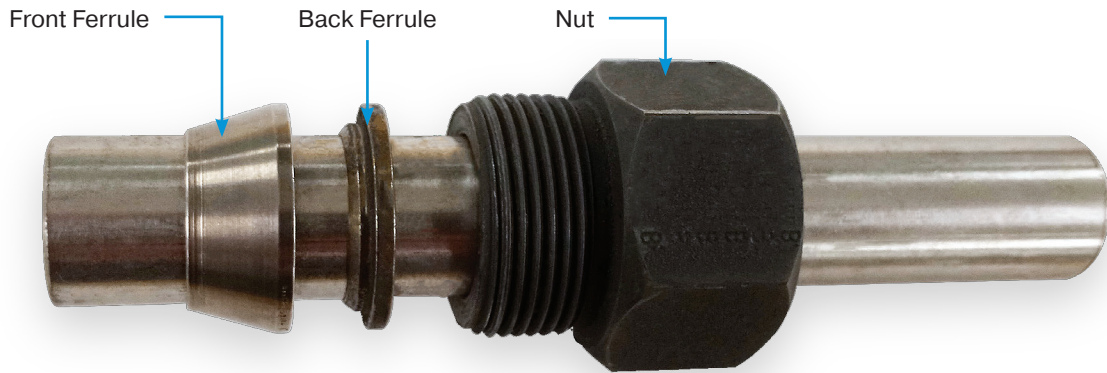


Step 7. The MPI™ Hand Pump Kit is now ready for use.

MPI™ Hand Pump Kit - Pre-Setting

Step 1. Square cut the end of the tube and remove burrs from tube OD and ID.

Step 2. Slide nut and ferrules onto the tube with tapered end of ferrules pointed toward the end of the tube. (proper sequence is nut, short back ferrule and then longer front ferrule)



Step 3. Hold nut and ferrules on the tube while inserting the tube into the head and seat the end of the tube against the tube stop in the body die.

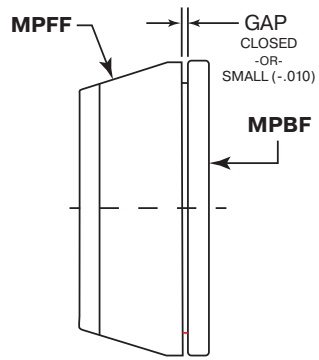


Step 4. Finger tighten (**do not wrench**) the nut into the nut die until the hex almost bottoms against the nut die. Leaving the nut approximately 1/4 turn from the nut die makes it easier to remove after presetting.

Step 5. Close the hydraulic valve by turning clockwise to a firm stop. Insure tube is against body die stop and pump the handle until the preset pressure is indicated on the gauge. Verify that the needle on the pressure gage is steady at the desired preset pressure. If the needle reaches the desired pressure and drops off continue slowly pumping the handle until the desired pressure is maintained.

Step 6. Relieve pressure by turning the hydraulic valve counter clockwise and remove nut/ferrule assembly from the head by rotating the nut out. This should be easily done by hand without the use of a wrench.

Step 7. Inspect the preset nut/ferrule assembly to insure that the nut rotates easily, **the ferrules are seated firmly on the tube (they do not rotate)**, and the gap between the ferrules is closed (there may be a slight gap due to ferrule spring). If ferrules rotate, check preset and setup steps for cause. ^(B, C)

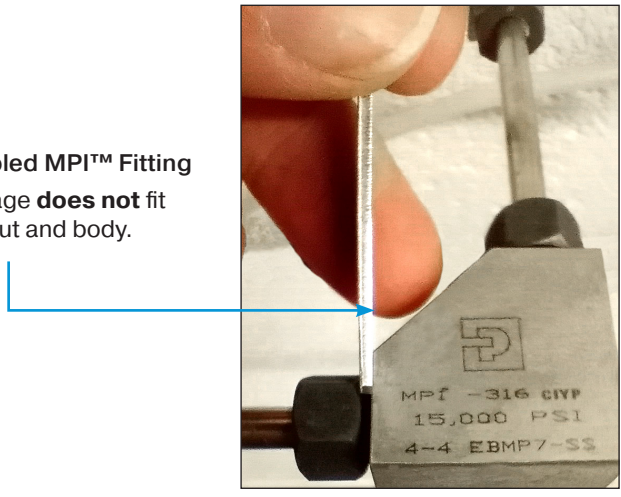


Step 8. Insert the preset nut/ferrule assembly into the fitting body until the ferrules seat firmly and tighten the nut by hand to the finger tight position. Hold the fitting body with a wrench to prevent rotation as you continue to wrench tighten the nut 1/2 turn. (A sharp increase in resistance is immediately felt as the ferrules are fully seated.)

Do not wrench the nut to pull restricted tubing into the body seat. ^(D,E)

Step 9. Check the gap between the nut and the body with the MPI™ GAP GAUGE. Insert the end of the gauge into the beveled gap between the nut hex and the body. Gently turn the gauge and it should “twist out” easily. **If the gauge slides into the gap and does not “twist out”, the fitting is not assembled properly, and you must check the entire preset procedure.** ^(F) **Use of the MPI™ Gap Gauge is mandatory for Size 12 and Size 16.**

Proper Assembled MPI™ Fitting
MPI™ Gap Gage **does not** fit
between nut and body.



^(A,B, C,D,E,F)
See Notes: MPI™ Presetting & Makeup
for additional details.

2507 Cone and Thread Tubing

Step 1. All sizes of Cone and Thread tubing used with MPI™ fittings must be hydraulically preset.

Step 2. Setup and operate the MPI™ Air Pump per the procedures on pages 6 thru 8. Preset 316 Cone & Thread Tube to the pressures in Table 1. Use the presetting head assembly and pressures in Table 3 below for 2507 Cone & Thread Tube.

	Fitting Size	Preset Pressure (PSI)
Small MPI™ Preset Assembly	4	3,200
	6	4,000
Large MPI™ Preset Assembly	9	3,600
	12	6,400
	16	8,000

Step 3. Setup and operate the MPI™ Hand Pump per the procedures on pages 11 and 12. Preset 316 Cone & Thread Tube to the pressures in Table 1. Use the presetting assembly and pressures in Table 3 above for 2507 Cone & Thread Tube.

Step 4. Assemble the MPI™ fittings per the procedure on Page 17 to Finger Tight plus ½ turn.

Step 5. Use the MPI™ Gap Gauge is to verify proper nut travel.

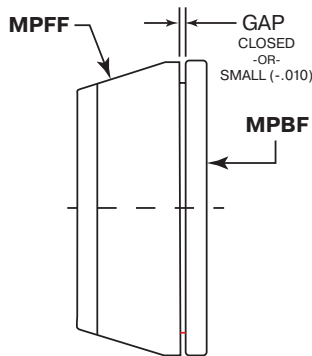
Heavy Wall Annealed 316 Instrumentation Tubing

- Step 1.** Heavy wall annealed 316 instrumentation tubing may be assembled by hand or preset.
- Step 2.** Setup and operate the MPI™ Air Pump per the procedures on Pages 6 thru 8. Preset pressures may be reduced to minimize tube swell during presetting.
Refer to Table 4 below for the Minimum Preset Pressure for 316 Heavy Wall Annealed Tubing.

TABLE 4 Annealed 316 Tube Minimum Preset Pressure		
	Fitting Size	Preset Pressure (PSI)
Small MPI™ Preset Assembly	4	2,600
	6	3,200
	8	5,400
Large MPI™ Preset Assembly	10	3,300
	12	4,100
	16	6,400

Additional Requirement for reduced presetting pressure:

Pressure must be greater than or equal to values in Table 4
 Ferrule Gap must close completely:



- Step 3.** Setup and operate the MPI™ Hand Pump per the procedures on pages 8 and 11. Preset pressures may be reduced to minimize tube swell during presetting.
Refer to Table 4 for the Minimum Preset Pressure for 316 Heavy Wall Annealed Tubing.
- Step 4.** Assemble the MPI™ fittings per the procedure on Page 17. Hand assembly (Non-Preset Ferrules) can be reduced to Finger Tight + 1 ¼ turns if the heavy wall annealed 316 tubing is sticking in the MPI™ fitting body. Preset ferrules must be assembled to Finger Tight + ½ turn.
- Step 5.** Use the MPI™ Gap Gauge to verify proper nut travel. Fittings that are assembled using either the reduced manual make up (FT+1 ¼) or reduced preset pressures (Table 4) can't be inspected using the MPI™ Gap Gauge.

MPI™ Fittings: Assembly Instructions

- Step 1.** Most Parker MPI™ Fittings can be easily assembled by hand but hydraulic preset is required for 3/4" and 1" to help insure proper makeup. See hydraulic presetting for details.
- Step 2.** Parker MPI™ Fittings are sold ready for use. Simply insert the tube until it bottoms in the fitting body. (If the fitting has been disassembled, loosen the nut, and ensure that the tapered ends of both ferrules point toward the body with the longer ferrule in front.)
- Step 3.** Turn the nut to the "finger-tight" position. Hold the fitting body with a wrench to prevent rotation as you continue to wrench tighten the nut 1 1/2 turns for hand assembly (1/2 turn only for a preset connection).
Parker recommends marking the nut and body with a scribe or marker to help count turns.
- Step 4.** Check the gap between the nut and the body with the MPI™ GAP GAUGE. Insert the end of the gauge into the beveled gap between the nut hex and the body. Gently turn the gauge and it should "twist out" easily. **If the gauge slides into the gap and does not "twist out", the fitting is not assembled properly, and you must check the entire assembly procedure.** ^(F)
Use of the MPI™ Gap Gauge is required for Size 12 and Size 16.

(F) See Page 18: MPI™ Presetting & Makeup Notes for additional details.

Remake Instructions

- Step 1.** For Maximum remakes, mark the fitting and nut before disassembly.
- Step 2.** Before retightening, insert the nut and ferrule assembly until the ferrules seat firmly in the body and tighten the nut by hand to the finger tight position.
- Step 3.** Hold the fitting body with a wrench to prevent rotation as you continue to wrench tighten the nut to the original position (or very slightly beyond).
 (A sharp increase in resistance is immediately felt as the ferrules are fully seated.)
Do not wrench the nut to pull restricted tubing into the body seat. ^(C,E)

(C,E) See Page 18: MPI™ Presetting & Makeup Notes for additional details.

MPI™ Fittings Presetting and Make Up Notes

- A.** Pump speed should not slow down sufficiently at the end of presetting that you can count the strokes (less than 2 strokes/sec). Pump speed does not affect relief valve preset pressure, but it can result in the operator stopping the pump before the connection is fully preset. This is usually an indication of insufficient air supply (volume and/or pressure), a contaminated air supply (moisture and/or particles) or a damaged pump.
- B.** Ferrule rotation is a simple first indication of improper preset and can be an indication of improper setup, preset pressure, insufficient air supply, etc. All steps of setup and preset should be checked until the cause is identified and corrected. The gap between the ferrule flanges after preset is dependent on many factors (tube OD & hardness, fitting size, etc.) but is barely detectable by naked eye. In general, it is less than .012" and usually less .008".
- C.** A Tube Insertion Gauge can be provided (if needed) to verify proper tube insertion after preset, makeup, and remake. This is a Parker diagnostic tool normally used to help determine cause of an assembly problem and not usually used as part of standard preset or assembly procedure.
- D.** In some applications where final assembly is very difficult to access, the user may prefer to complete the assembly in a vise where it is easier to ensure proper makeup and then mark the nut/body position. The connection is then separated and reassembled (remade) in the final location making sure that the nut/body marks align as there is a sharp increase in resistance.
- E.** Properly preset ferrules are firmly attached to the tube but do not reach full tube holding capability until they are reinforced by the body seat. Therefore, preset ferrules should not be used to pull a near rigid tube configuration into the body seat. This could cause the ferrules to break over their original grip/bite on the tube and significantly reduce their holding power.
- F.** The MPI™ GAP GAUGE can help identify connections that are significantly under-made. The gauge can be used with any size MPI™ fitting and is required for ¾" and 1" fittings.

Use of the gap gauge is recommended for all sizes of MPI™ where the final assembly is difficult to access or in situations that could inhibit proper assembly. The inspection gauge is most effective on the initial makeup of the connection and if other assembly factors were checked (ferrule) orientation, tube insertion, etc.). It is much less effective for remakes due to ferrule spring and variations in initial makeup.

MPI™ Connection: Reference Torques

MPI™ fittings should always be assembled, preset, or remade as indicated in the instructions if possible. However, it is difficult in some instances to find the finger tight position, the original position was not marked, etc. The reference torques listed below can be used as a baseline to check connections that are in doubt. These torques do not replace other assembly instructions and do not guarantee a leak tight connection but can provide assistance in some situations.

Size 4	300 in-lb	25 ft-lb	35 N-M
Size 6	500 in-lb	40 ft-lb	55 N-M
Size 8	780 in-lb	65 ft-lb	90 N-M
Size 9	960 in-lb	80 ft-lb	110 N-M
Size 12	2000 in-lb	165 ft-lb	255 N-M
Size 16	4200 in-lb	350 ft-lb	475 N-M

Terms of Sale with Warranty Limitations

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

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

2. Price Adjustments; Payments. Prices stated on the reverse side or preceding pages of this document are valid for 30 days. After 30 days, Seller may change prices to reflect any increase in its costs resulting from state, federal or local legislation, price increases from its suppliers, or any change in the rate, charge, or classification of any carrier. The prices stated on the reverse or preceding pages of this document do not include any sales, use, or other taxes unless so stated specifically. Unless otherwise specified by Seller, all prices are F.O.B. Seller's facility, and payment is due 30 days from the date of invoice. After 30 days, Buyer shall pay interest on any unpaid invoices at the rate of 1.5% per month or the maximum allowable rate under applicable law.

3. Delivery Dates; Title and Risk; Shipment. All delivery dates are approximate and Seller shall not be responsible for any damages resulting from any delay. Regardless of the manner of shipment, title to any products and risk of loss or damage shall pass to Buyer upon tender to the carrier at Seller's facility (i.e., when it's on the truck, it's yours). Unless otherwise stated, Seller may exercise its judgment in choosing the carrier and means of delivery. No deferral of shipment at Buyers' request beyond the respective dates indicated will be made except on terms that will indemnify, defend and hold Seller harmless against all loss and additional expense. Buyer shall be responsible for any additional shipping charges incurred by Seller due to Buyer's changes in shipping, product specifications or in accordance with Section 13, herein.

4. Warranty. Seller warrants that the Products sold here-under shall be free from defects in material or workmanship for a period of twelve months from the date of delivery to Buyer or 2,000 hours of normal use, whichever occurs first. This warranty is made only to Buyer and does not extend to anyone to whom Products are sold after purchased from Seller. The prices charged for Seller's products are based upon the exclusive limited warranty stated above, and upon the following disclaimer: **DISCLAIMER OF WARRANTY: THIS WARRANTY COMPRISES THE SOLE AND ENTIRE WARRANTY PERTAINING TO PRODUCTS PROVIDED HEREUNDER. SELLER DISCLAIMS ALL OTHER WARRANTIES, EXPRESS AND IMPLIED, INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.**

5. Claims; Commencement of Actions. Buyer shall promptly inspect all Products upon delivery. No claims for shortages will be allowed unless reported to the Seller within 10 days of delivery. No other claims against Seller will be allowed unless asserted in writing within 60 days after delivery or, in the case of an alleged breach of warranty, within 30 days after the date within the warranty period on which the defect is or should have been discovered by Buyer. Any action based upon breach of this agreement or upon any other claim arising out of this sale (other than an action by Seller for any amount due to Seller from Buyer) must be commenced within thirteen months from the date of tender of delivery by Seller or, for a cause of action based upon an alleged breach of warranty, within thirteen months from the date within the warranty period on which the defect is or should have been discovered by Buyer.

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

7. Contingencies. Seller shall not be liable for any default or delay in performance if caused by circumstances beyond the reasonable control of Seller.

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

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

10. Special Tooling. A tooling charge may be imposed for any special tooling, including without limitation, dies, fixtures, molds and patterns, acquired to manufacture Products.

Such special tooling shall be and remain Seller's property notwithstanding payment of any charges by Buyer. In no event will Buyer acquire any interest in apparatus belonging to Seller which is utilized in the manufacture of the Products, even if such apparatus has been specially converted or adapted for such manufacture and notwithstanding any charges paid by Buyer. Unless otherwise agreed, Seller shall have the right to alter, discard or otherwise dispose of any special tooling or other property in its sole discretion at any time.

11. Buyer's Obligation; Rights of Seller. To secure payment of all sums due or otherwise, Seller shall retain a security interest in the goods delivered and this agreement shall be deemed a Security Agreement under the Uniform Commercial Code. Buyer authorizes Seller as its attorney to execute and file on Buyer's behalf all documents Seller deems necessary to perfect its security interest. Seller shall have a security interest in, and lien upon, any property of Buyer in Seller's possession as security for the payment of any amounts owed to Seller by Buyer.

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

13. Cancellations and Changes. Orders shall not be subject to cancellation or change by Buyer for any reason, except with Seller's written consent and upon terms that will indemnify, defend and hold Seller harmless against all direct, incidental and consequential loss or damage. Seller may change product features, specifications, designs and availability with notice to Buyer.

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

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

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

17. Termination. This agreement may be terminated by Seller for any reason and at any time by giving Buyer thirty (30) days written notice of termination. In addition, Seller may by written notice immediately terminate this agreement for the following: (a) Buyer commits a breach of any provision of this agreement (b) the appointment of a trustee, receiver or custodian for all or any part of Buyer's property (c) the filing of a petition for relief in bankruptcy of the other Party on its own behalf, or by a third party (d) an assignment for the benefit of creditors, or (e) the dissolution or liquidation of the Buyer.

18. Governing Law. This agreement and the sale and delivery of all Products hereunder shall be deemed to have taken place in and shall be governed and construed in accordance with the laws of the State of Ohio, as applicable to contracts executed and wholly performed therein and without regard to conflicts of laws principles. Buyer irrevocably agrees and consents to the exclusive jurisdiction and venue of the courts of Cuyahoga County, Ohio with respect to any dispute, controversy or claim arising out of or relating to this agreement. Disputes between the parties shall not be settled by arbitration unless, after a dispute has arisen, both parties expressly agree in writing to arbitrate the dispute.

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

20. Taxes. Unless otherwise indicated, all prices and charges are exclusive of excise, sales, use, property, occupational or like taxes which may be imposed by any taxing authority upon the manufacture, sale or delivery of Products.

21. Equal Opportunity Clause. For the performance of government contracts and where dollar value of the Products exceed \$10,000, the equal employment opportunity clauses in Executive Order 11246, VEVRAA, and 41 C.F.R. §§ 60-1.4(a), 60-741.5(a), and 60-250.4, are hereby incorporated.

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WARNING

FAILURE, IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS AND/OR SYSTEMS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.

This document and other information from Parker Hannifin Corporation, its subsidiaries and authorized distributors provide product and/or system options for further investigation by users having technical expertise. It is important that you analyze all aspects of your application and review the information concerning the product or system in the current product catalog. Due to the variety of operating conditions and applications for these products or systems, the user, through its own analysis and testing, is solely responsible for making the final selection of the products and systems and assuring that all performance, safety and warning requirements of the application are met. The products described herein, including without limitation, product features, specifications, designs, availability and pricing, are subject to change by Parker Hannifin Corporation and its subsidiaries at any time without notice.

Offer of Sale

The items described in this document are available for sale by Parker Hannifin Corporation, its subsidiaries or its authorized distributors. Any sale contract entered by Parker will be governed by the provisions stated in Parker's standard terms and conditions of sale (copy available upon request).

