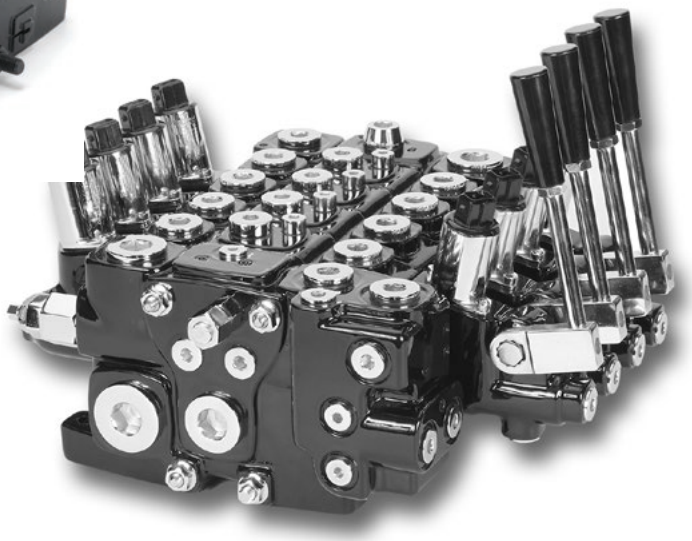

www.Parker.com/HydraulicValve

VP120LS Mobile Directional Control Valve

Build Program

Bulletin MSG14-2008-B1/US

August 2021

ENGINEERING YOUR SUCCESS.

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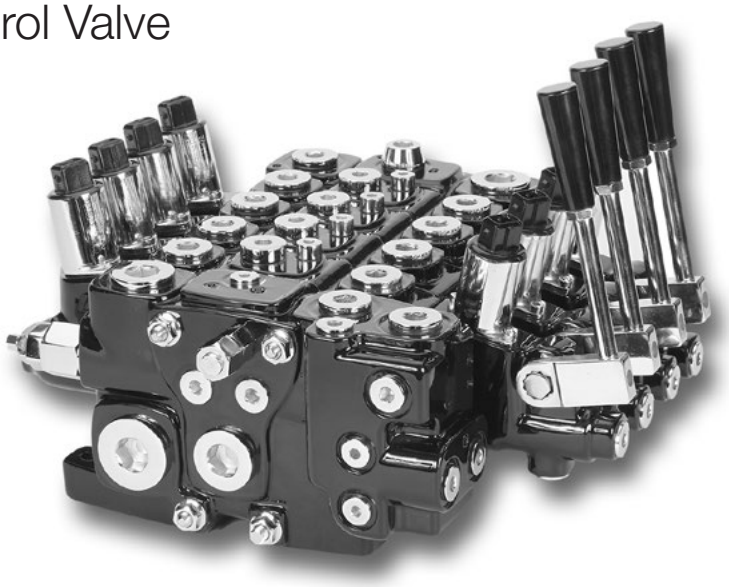
Parker Hannifin Corporation
Hydraulic Valve Division
Elyria, Ohio, USA

VP120LS

Load-Sense Directional Control Valve



General Description

The VP120LS can be configured either as pressure compensated load-sense (PCLS) or as load-sense (LS). Both have the flexibility of sectional construction. The PCLS work section has its own compensator, so that speed control of multiple functions is achieved, regardless of changes in pressure. The key technology inherent to the VP120LS is flow-sharing. In pump over-demand conditions, flow-sharing benefits machine productivity by maintaining the speed relationship of the selected functions, but at a reduced speed. Thus, the operator can maintain the rhythm of the machine.

Another new technology developed for the VP120LS is called margin control, which can be used to selectively boost or reduce the flow out of a work-section.

The standard inlet/outlet can be installed on both ends of the valve, facilitating the routing of pump/tank flow to both ends of the valve.

The valve can be operated manually, hydraulic-remote and with solenoids. The same solenoid is used for on/off and proportional control. A bypass compensator is available for use with fixed displacement pumps. Also, priority flow control is an option for steering requirements. In addition, low pressure regeneration is an option designed to overcome the damaging affects of cavitation – namely premature component wear and spongy operation.

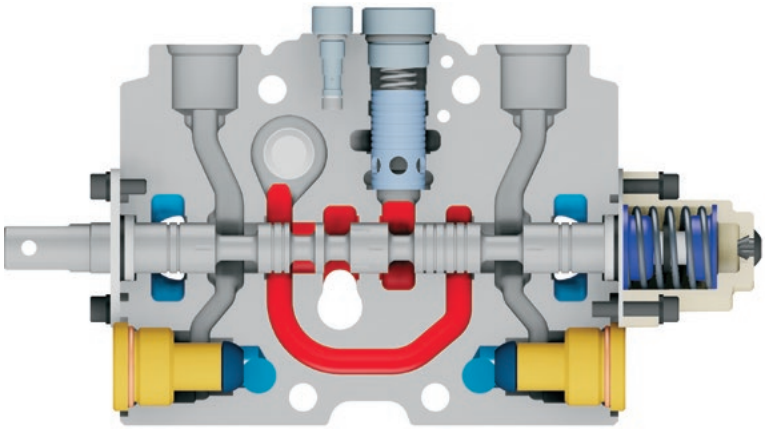
The VP120LS uses the same port accessories, load-sense relief valve and pressure-reducing valve that are shared among multiple valve series. The standard spool types are 3-way, 4-way and 4-position float. A full range of flow limited spools are available.

Operation

The VP120LS (PCLS) is an individually pressure compensated load-sense valve. For optimum horse-power utilization, it is normally used with a variable displacement pump. However, it does have the flexibility to be interfaced with a fixed displacement pump.

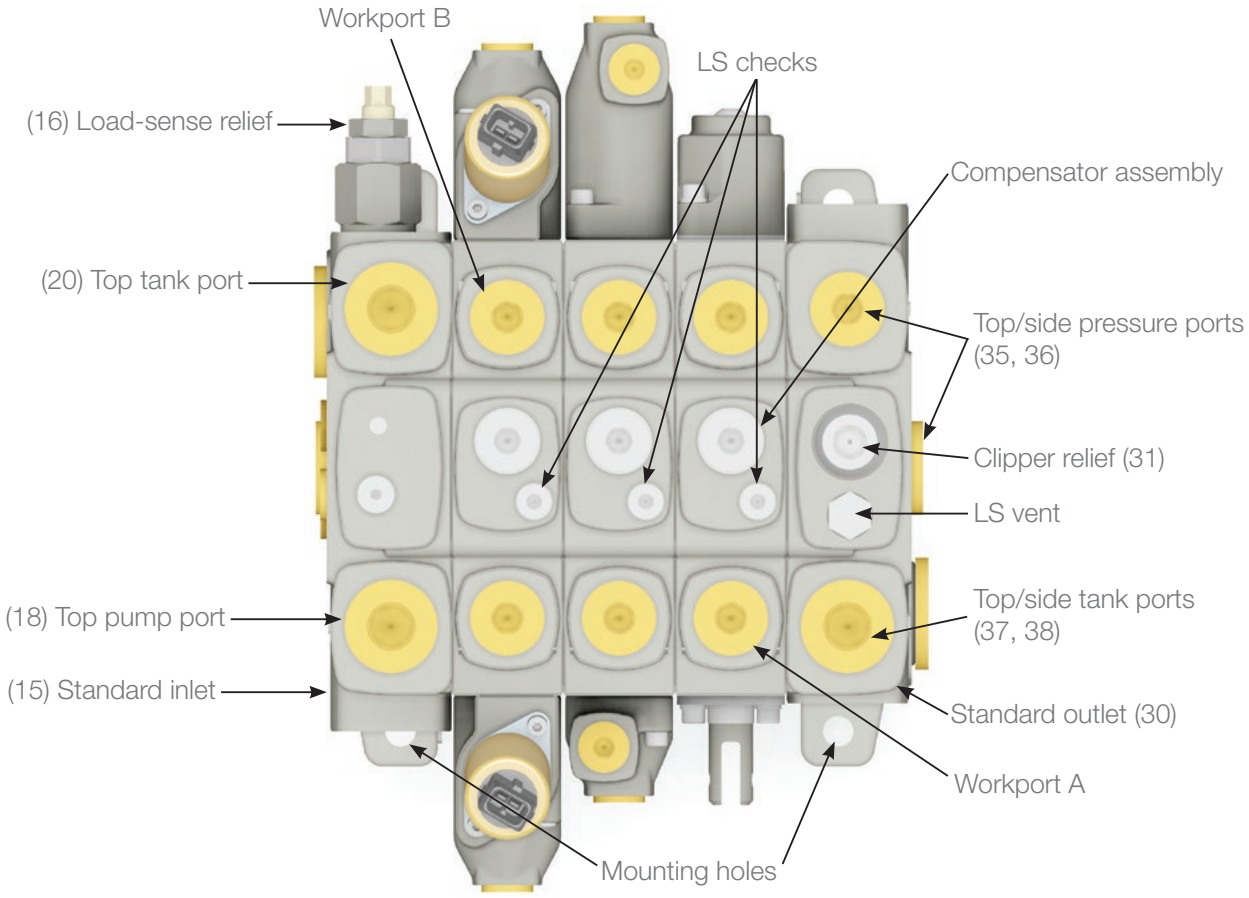
During single function use, the pump control will determine the flow to the valve, based upon the area opening of the spool notch and the load-sense signal being sent back to the pump.

During multi-function operation, the pump control will determine the flow for the highest loaded function, while the work-section compensator will control the flow for the lighter loaded function.



Parker Hannifin Corporation
Hydraulic Valve Division
Elyria, Ohio, USA

VP120LS



Features

- **Excellent machine controllability** – Individual pressure compensation in each work section delivers predictable metering with single and multi-function operation; regardless of changes in pressure and input flow. This enhances machine control, improves productivity and helps to make every operator an “expert” operator – all of which saves money. This valve type also lends itself to closed-loop control.
- **Improved system efficiency** – Optimized horsepower utilization and heat management are features that are inherent with load-sense pressure compensated valves due to a closer match between horsepower consumption and horsepower demand. Fuel savings of up to 30% can be achieved vs. open-center type systems. Also, better horsepower utilization may enable the use of a smaller engine or elimination of a heat exchanger.
- **Enhanced machine productivity** – The VP120LS incorporates flow-sharing technology. This means that during a pump over-demand condition the valve will automatically apportion the available flow to the selected functions, based upon the area openings of the spool notches. The selected functions will maintain their speed relationship, but at a lower overall speed. This automatic adjusting by the valve can improve machine productivity as much as 20% and reduce operator fatigue.
- **Enhanced speed control** – The optional margin control boosts or reduces flow of the selected work sections. This enables the hydraulic circuit designer to better utilize the available pump flow and possibly reduce the size of the engine.
- **Flexible design** – The VP120LS is available as a pressure compensated load-sense valve (PCLS) or just as a load-sense (LS) valve. The combination inlet/out casting can be installed on both ends of the valve, which means that pump flows can be routed to both ends of the valve.
- **Ease of service** – The load-sense check and the compensator are located on the top of the work section, making them accessible for trouble-shooting without having to disassemble the valve bank.

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Parker Hannifin Corporation
Hydraulic Valve Division
Elyria, Ohio, USA

Specifications

Description	Specification
Pressures	Pump inlets: 280 Bar (4060 PSI) Service Ports: 320 Bar (4640 PSI) Pilot-EH (input or internal supply): 35 Bar (508 PSI) Tank Return: 15 Bar (220 PSI) Solenoid Drain: 2 Bar (29 PSI) Pilot-Hydraulic Remote: 7-28 Bar (100-400 PSI)
Flow Rates	Maximum Input: 160 LPM (42 GPM) Maximum Flow out of Service Ports: 120 LPM (32 GPM)
Leakage Performance with mineral oil, 20 cSt (100 SSU) @ 49°C (120°F) at 80 Bar (1100 PSI) differential	Workport w/Steel Plug or no Accessory: 20 cc/min max. Thru reverse flow check only: 1,100 cc/min max.
Hydraulic Fluid	Mineral base oil. For other fluids consult factory. Viscosity, working range: 15-380mm²/s (15-380 cSt).
Hydraulic Oil Temperature	Recommended Operating Range without Solenoid Operation: -30° to 90°C (-22° to 194°F) Recommended Operating Range with Solenoid Operation: -20° to 80°C (-4° to 176°F)
Filtration (ISO 4406)	20/18/14 in Main Flow Paths 18/16/13 Pilot Supply

Weights

Inlets/Outlets

Description	Weight
Std. Combination Inlet/Outlet	4.58 kg (10.1 lb)
EH Combination Inlet/Outlet	5.81 kg (12.8 lb)
Combination Inlet/Outlet with priority flow divider	6.89 kg (15.2 lb)
Combination Inlet/Outlet with bypass compensator	6.94 kg (15.3 lb)
Combination Inlet/Outlet with low pressure regeneration	6.85 kg (15.1 lb)
Simple turnaround cover	3.1 kg (6.8 lb)
Work Sections	
Manual with 2 port access.	4.17 kg (9.2 lb)
Hydraulic Remote with 2 port access.	4.58 kg (10.1 lb)
EH with 2 port access.	6.03 kg (13.3 lb)

Mounting Surface

There is no restriction on orientation.
Flatness should be at least 0.5 mm (0.020")
Surface must be stable and not put stress on valve.

Connections

O-ring boss ports SAE-J1926-1
BSPP ports ISO 1179-1
Pump gage port standard
O-ring boss 9/16"-18 UNF, BSPP ports 1/4"-19

		Thread Size	
Description	**SAE #**	**O-ring Boss (UNF)**	**BSPP**
Inlet, top	12	1 1/16-12	3/4"-14
Inlet, side	12	1 1/16-12	3/4"-14
EH inlet, pilot	6	9/16-18	1/4"-19
Outlet, top	12	1 1/16-12	3/4"-14
Outlet, side	16	1 5/16-12	1"-11
Work section	8	3/4-12	(none)
Work section	10	7/8-14	1/2"-14

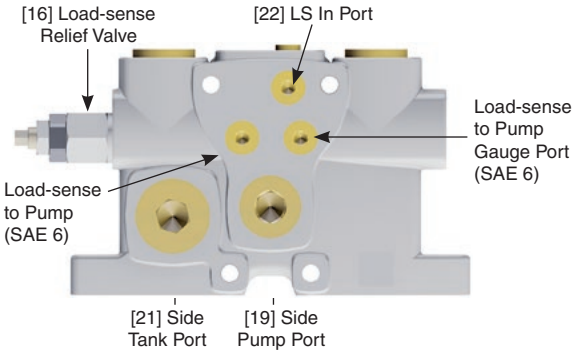
Solenoid Specifications

Description	Specification		
Voltage	12 or 24 VDC		
Pilot	35 Bar (508 PSI), 15-23 LPM (4-6 GPM)		
Current Input (I)	1.5A for 12 VDC 0.75A for 24 VDC		
Current (mA)		**12V**	**24V**
for Spool Shift	Start Shift	500	250
	Full Shift	1250	625
Insulation Material	Class H		
Duty Cycle	100%		
R20 Ohm	5.3 (±5%) for 12 VDC 21.2 (±5%) for 24 VDC		
Fluid Cleanliness	17/14 per ISO 4406		
Ambient Temperature	-30° to 80°C (-22° to 176°F)		
Fluid Temperature	-20° to 80°C (-4° to 176°F)		

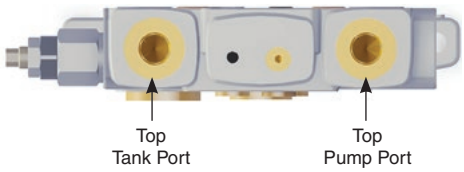
Standard Inlet

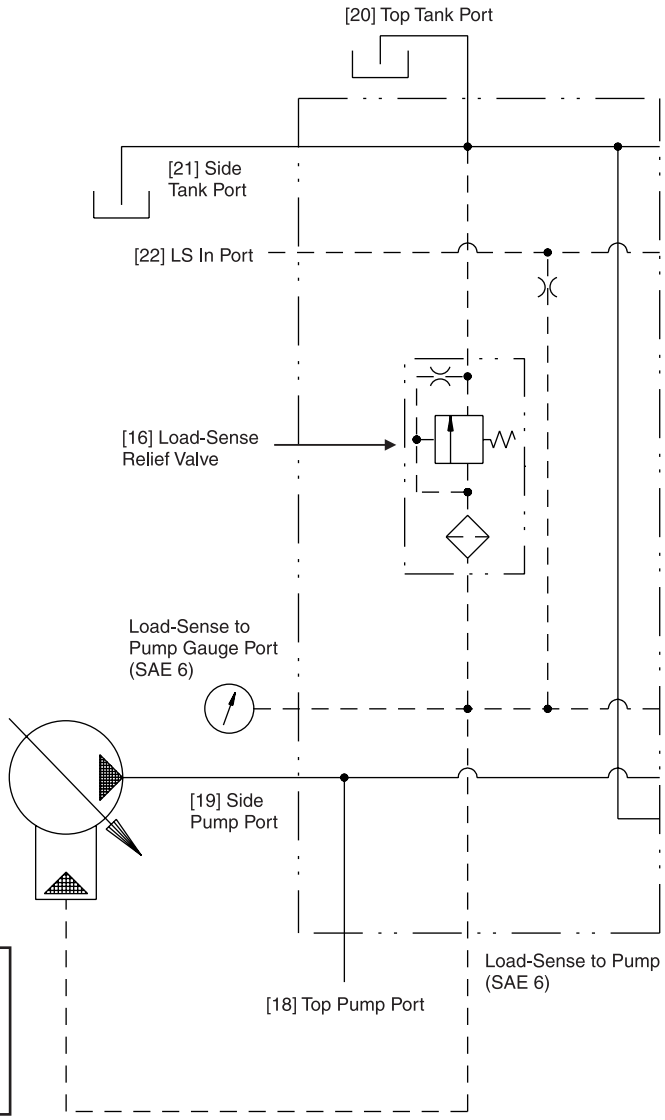
The standard inlet can be used with manual, hydraulic pilot, and electrohydraulic configurations. The pilot in port allows for solenoid pilot generation flow to be brought into the VP120LS valve assembly from an external source.

Front View



Top View





Schematic shows Load-Sense Relief with built-in drain. Only one LS drain in circuit allowed.

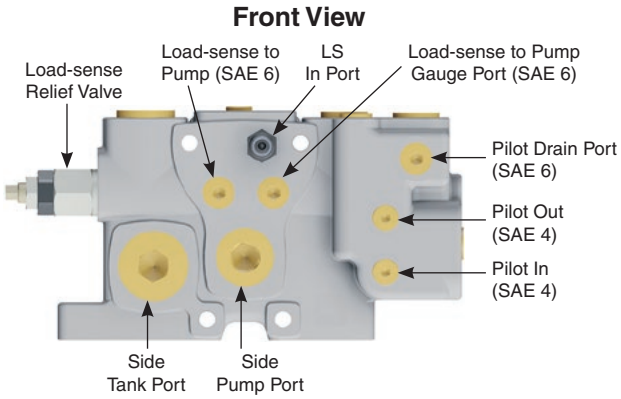
Ordering Information

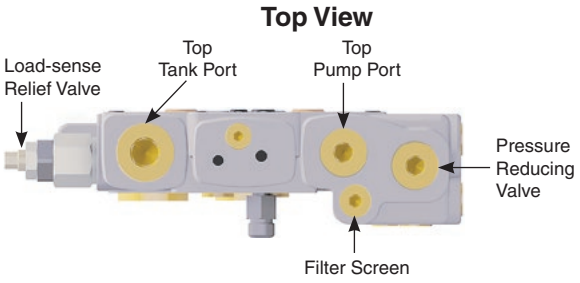
Description	Part Number	Top HP Porting	Side HP Porting	Top LP Porting	Side LP Porting	External Pilot	External Drain
Standard Inlet	4069105005	SAE 12	SAE 12	SAE 12	SAE 16		
Load-Sense Relief Cartridge	4069001001	—	—	—	—	—	with Drain
Load-Sense Relief Cartridge	4069001002	—	—	—	—	—	without Drain
LSRV Seal Kit	3961823655	—	—	—	—	—	—
Inlet Face Seal Kit	4069000023	—	—	—	—	—	—

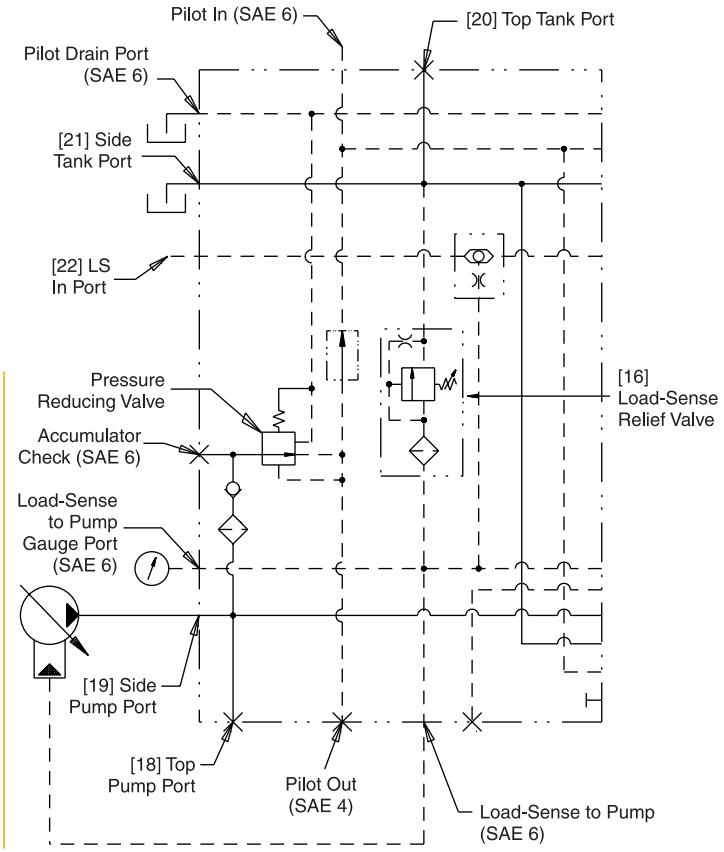
- Top inlet and side outlet ports with steel plug.
- Side LS “In” & side LS gage ports SAE 6 with steel plug.
- Side LS to pump & external pilot “In” port shipped with plastic enclosures.
- Includes section seals.
- Includes LS RV. Adjustable range in 179 – 280 Bar (2600 – 4060 PSI).

Pilot Generating Inlet

The pilot generating inlet is mainly used when electrohydraulic sections are in use to provide pilot flow and pressure to the section solenoids. Other reasons for the inlet with internal pilot generation could be to generate pilot flow and pressure for external operations (i.e., hydraulic pilot controllers) or for kidney loop filtration. The inlet with internal pilot generation also contains an optional accumulator porting with check valve to provide a standby flow and pressure for certain situations.







Ordering Information

Description	Part Number	Top HP Porting	Side HP Porting	Top LP Porting	Side LP Porting	External Pilot	External Drain
EH Inlet	4069105008	SAE 10	SAE 12	SAE 12	SAE 16	•	•
Load-Sense Relief Cartridge	4069001001	—	—	—	—	—	with Drain
Load-Sense Relief Cartridge	4069001002	—	—	—	—	—	without Drain
LSRV Seal Kit	3961823655	—	—	—	—	—	—
Inlet Face Seal Kit	4069000023	—	—	—	—	—	—

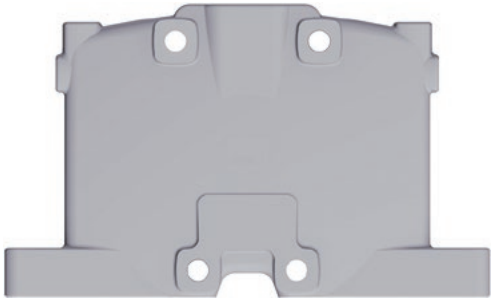
- **Top inlet and side outlet ports with steel plug.**
- **Side LS “In” & side LS gage ports SAE 6 with steel plug.**
- **Side LS to pump & external pilot “In” port shipped with plastic enclosures.**
- **Includes section seals.**
- **Includes LS RV. Adjustable range in 179 – 280 Bar (2600 – 4060 PSI).**

Continued in next column

Simple Outlet

Simple outlets blank off the outlet side of the valve and force the flow to enter and exit the valve in the inlet cover.

Front View



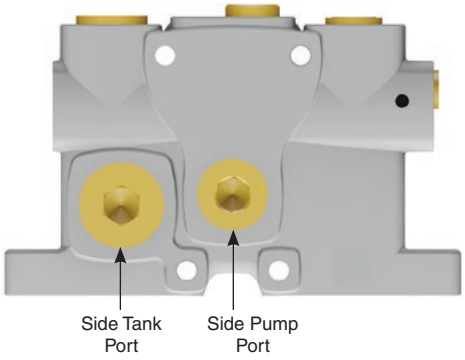
Top View

Pilot Drain Port is standard on simple outlets and must be used in one location on the VP120LS assembly to relieve pilot drain flow.

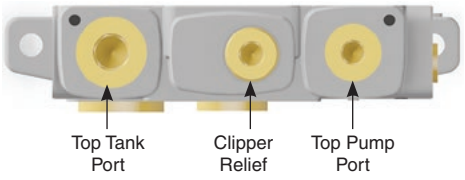
Combination Outlet

The combination outlet can be used with manual, hydraulic pilot, and electro-hydraulic actuation. All standard outlets contain a mandatory pilot drain port in the cover which can be plugged if pilot flow can be drained from an inlet cover.

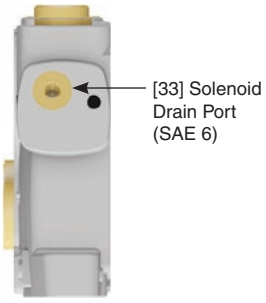
Right Cover



Top View



Right View



Ordering Information

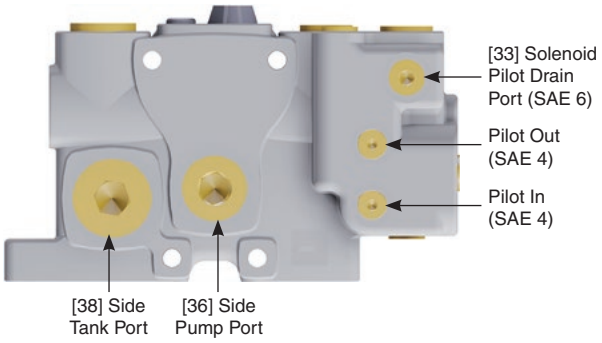
Description	Part Number	Top HP Porting	Side HP Porting	Top LP Porting	Side LP Porting	External Pilot	External Drain
Simple Outlet	4069106007	N/A	N/A	SAE 6	N/A		*
Combination Outlet	4069106013	SAE 10	SAE 12	SAE 12	SAE 16		

*** Included when ordering this part number.**

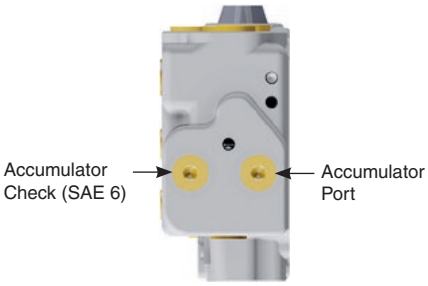
Pilot Generating Outlet

The pilot generating outlet is mainly used when electrohydraulic sections are in use to provide pilot flow and pressure to the section solenoids. Please note only one pilot generating outlet should be used. If already used as an inlet then the outlet option is not available. Other reasons the outlet with internal pilot generation could be to generate pilot flow and pressure for external operations (i.e., hydraulic pilot controllers) or for kidney loop filtration. All pilot generating outlets contain a mandatory pilot drain port in the cover which can be plugged if pilot flow will be drained from an inlet cover.

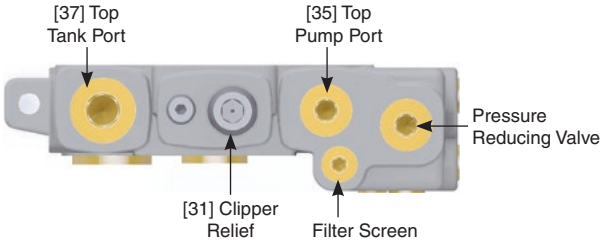
Right Cover



Right View



Top View



Ordering Information

Description	Part Number
EH Outlet	4069106008
Specifications	
Top HP Porting	SAE 10
Side HP Porting	SAE 12
Top LP Porting	SAE 12
Side LP Porting	SAE 16
External Pilot	*
External Drain	*

*** Included when ordering this part number.**

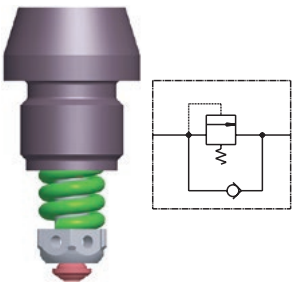
Clipper Relief Valve

The clipper relief valve is used for additional protection against pressure spikes in the pump supply line.

Description	Part Number	Pressure Setting Bar	(PSI)
Clipper relief valve	393000K176	50	(725)
Clipper relief valve	393000K177	63	(914)
Clipper relief valve	393000K178	80	(1160)
Clipper relief valve	393000K179	100	(1450)
Clipper relief valve	393000K180	125	(1813)
Clipper relief valve	393000K181	140	(2031)
Clipper relief valve	393000K182	160	(2321)
Clipper relief valve	393000K183	175	(2538)
Clipper relief valve	393000K184	190	(2756)
Clipper relief valve	393000K185	210	(3046)
Clipper relief valve	393000K186	230	(3336)
Clipper relief valve	393000K187	250	(3626)
Clipper relief valve	393000K188	260	(3771)
Clipper relief valve	393000K189	280	(4061)
Clipper relief valve	393000K193	Plug	

Continued in next column

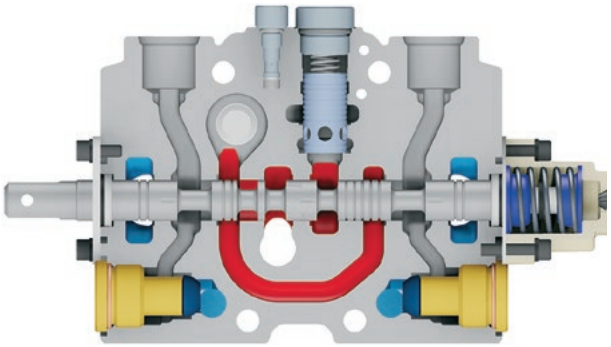
Code PA



Ordering Information

Description	Part Number
Clipper Relief Seal Kit	6760445 (5 pc)

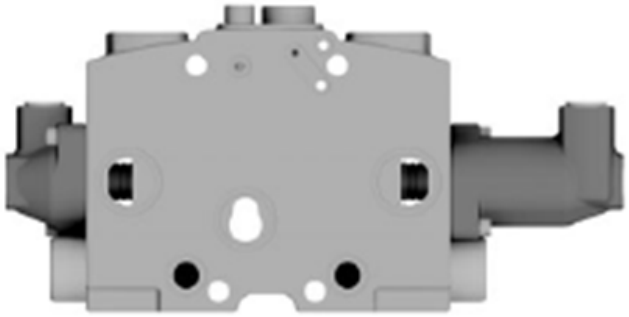
Manual – Spring Return



Description	Flow LPM (GPM)	Part Number
DA Cyl	15 (4)	4069102140
DA Cyl	30 (8)	4069102141
DA Cyl	45 (12)	4069102142
DA Cyl	68 (18)	4069102143
DA Cyl	91 (24)	4069102144
DA Cyl	121 (32)	4069102145
DA Cyl	Full Flow	4069102146
SA Cyl	15 (4)	4069101048
SA Cyl	30 (8)	4069101049
SA Cyl	45 (12)	4069101050
SA Cyl	68 (18)	4069101051
SA Cyl	91 (24)	4069101052
SA Cyl	121 (32)	4069101053
SA Cyl	Full Flow	4069101054
DA Motor	15 (4)	4069102147
DA Motor	30 (8)	4069102148
DA Motor	45 (12)	4069102149
DA Motor	68 (18)	4069102150
DA Motor	91 (24)	4069102151
DA Motor	121 (32)	4069102152
DA Motor	Full Flow	4069102153
SA Motor	15 (4)	4069101055
SA Motor	30 (8)	4069101056
SA Motor	45 (12)	4069101057
SA Motor	68 (18)	4069101058
SA Motor	91 (24)	4069101059
SA Motor	121 (32)	4069101060
SA Motor	Full Flow	4069101061

- All work ports are SAE 10.
- Section seals included.
- All worksections have machined port RV cavities with steel plugs.

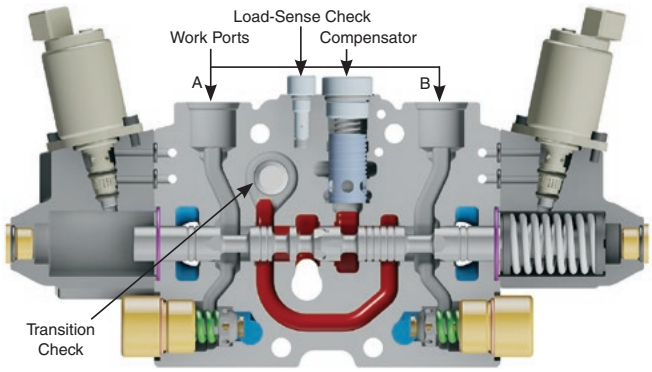
Hydraulic Remote



Description	Flow LPM (GPM)	Part Number
DA Cyl	15 (4)	4069102168
DA Cyl	30 (8)	4069102169
DA Cyl	45 (12)	4069102170
DA Cyl	68 (18)	4069102171
DA Cyl	91 (24)	4069102172
DA Cyl	121 (32)	4069102173
DA Cyl	Full Flow	4069102174
SA Cyl	15 (4)	4069101062
SA Cyl	30 (8)	4069101063
SA Cyl	45 (12)	4069101064
SA Cyl	68 (18)	4069101065
SA Cyl	91 (24)	4069101066
SA Cyl	121 (32)	4069101067
SA Cyl	Full Flow	4069101068
DA Motor	15 (4)	4069102175
DA Motor	30 (8)	4069102176
DA Motor	45 (12)	4069102177
DA Motor	68 (18)	4069102178
DA Motor	91 (24)	4069102179
DA Motor	121 (32)	4069102180
DA Motor	Full Flow	4069102181
SA Motor	15 (4)	4069101069
SA Motor	30 (8)	4069101070
SA Motor	45 (12)	4069101071
SA Motor	68 (18)	4069101072
SA Motor	91 (24)	4069101073
SA Motor	121 (32)	4069101074
SA Motor	Full Flow	4069101075

- All work ports are SAE 10.
- Section seals included.
- All worksections have machined port RV cavities with steel plugs.

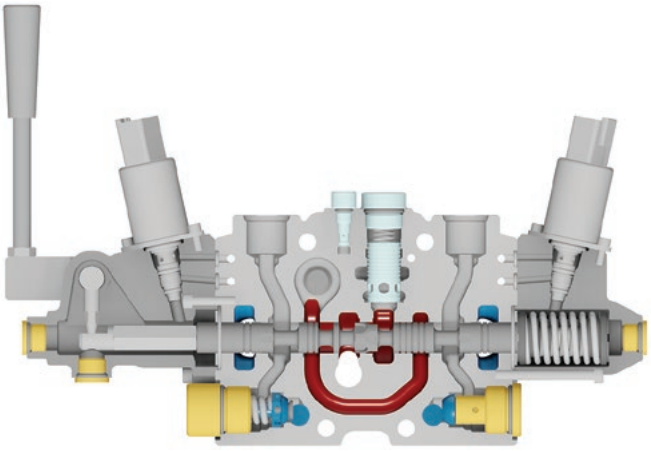
Solenoid – 12V w/Deutsch Connectors, No Handle



Description	Flow LPM (GPM)	Part Number
DA Cyl	15 (4)	4069102389
DA Cyl	30 (8)	4069102390
DA Cyl	45 (12)	4069102391
DA Cyl	68 (18)	4069102392
DA Cyl	91 (24)	4069102393
DA Cyl	121 (32)	4069102394
DA Cyl	Full Flow	4069102395
SA Cyl	15 (4)	4069101076
SA Cyl	30 (8)	4069101077
SA Cyl	45 (12)	4069101078
SA Cyl	68 (18)	4069101079
SA Cyl	91 (24)	4069101080
SA Cyl	121 (32)	4069101081
SA Cyl	Full Flow	4069101082
DA Motor	15 (4)	4069102197
DA Motor	30 (8)	4069102198
DA Motor	45 (12)	4069102199
DA Motor	68 (18)	4069102200
DA Motor	91 (24)	4069102201
DA Motor	121 (32)	4069102202
DA Motor	Full Flow	4069102203
SA Motor	15 (4)	4069101083
SA Motor	30 (8)	4069101084
SA Motor	45 (12)	4069101085
SA Motor	68 (18)	4069101086
SA Motor	91 (24)	4069101087
SA Motor	121 (32)	4069101088
SA Motor	Full Flow	4069101089

- All work ports are SAE 10.
- Section seals included.
- All worksections have machined port RV cavities with steel plugs.

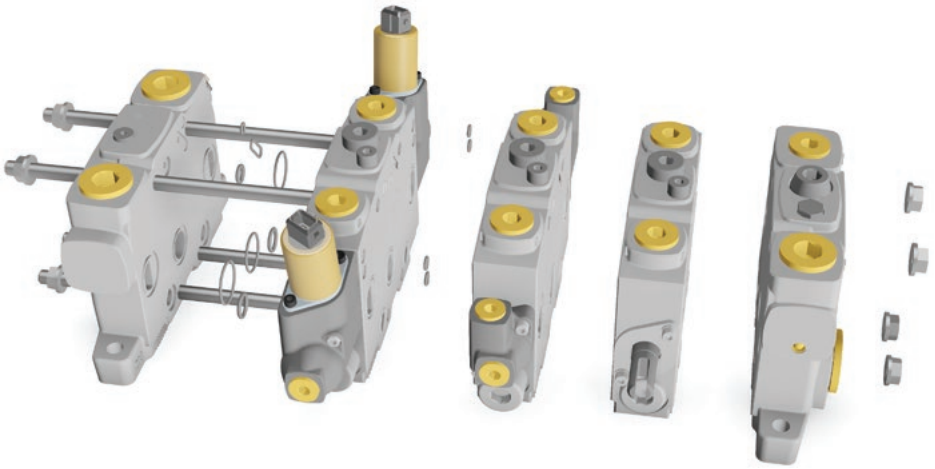
Solenoid – 12V w/Deutsch Connectors, w/Manual Override Handle



Description	Flow LPM (GPM)	Part Number
DA Cyl	15 (4)	4069102246
DA Cyl	30 (8)	4069102247
DA Cyl	45 (12)	4069102248
DA Cyl	68 (18)	4069102249
DA Cyl	91 (24)	4069102250
DA Cyl	121 (32)	4069102251
DA Cyl	Full Flow	4069102252
SA Cyl	15 (4)	4069101104
SA Cyl	30 (8)	4069101105
SA Cyl	45 (12)	4069101106
SA Cyl	68 (18)	4069101107
SA Cyl	91 (24)	4069101108
SA Cyl	121 (32)	4069101109
SA Cyl	Full Flow	4069101110
DA Motor	15 (4)	4069102253
DA Motor	30 (8)	4069102254
DA Motor	45 (12)	4069102255
DA Motor	68 (18)	4069102256
DA Motor	91 (24)	4069102257
DA Motor	121 (32)	4069102258
DA Motor	Full Flow	4069102259
SA Motor	15 (4)	4069101111
SA Motor	30 (8)	4069101112
SA Motor	45 (12)	4069101113
SA Motor	68 (18)	4069101114
SA Motor	91 (24)	4069101115
SA Motor	121 (32)	4069101116
SA Motor	Full Flow	4069101117

- All work ports are SAE 10.
- Section seals included.
- All worksections have machined port RV cavities with steel plugs.

Stud Assemblies



Stud Kits Used with Any Inlet and Standard, Pilot Generating, or Bypass Compensated Outlet

Description	Part Number
Stud kit for a (1) work section assembly	3969425037
Stud kit for a (2) work section assembly	3969425038
Stud kit for a (3) work section assembly	3969425039
Stud kit for a (4) work section assembly	3969425040
Stud kit for a (5) work section assembly	3969425041
Stud kit for a (6) work section assembly	3969425042
Stud kit for a (7) work section assembly	3969425043
Stud kit for a (8) work section assembly	3969425044
Stud kit for a (9) work section assembly	3969425045
Stud kit for a (10) work section assembly	3969425046

Notes:
- Each stud kit contains (4) studs and (8) serrated hex nuts. Stud torque is 264 inch lbs.

Stud Kits Used with Any Inlet and Simple Outlet

Description	Part Number
Stud kit for a (1) work section assembly	3969425047
Stud kit for a (2) work section assembly	3969425048
Stud kit for a (3) work section assembly	3969425049
Stud kit for a (4) work section assembly	3969425050
Stud kit for a (5) work section assembly	3969425051
Stud kit for a (6) work section assembly	3969425052
Stud kit for a (7) work section assembly	3969425053
Stud kit for a (8) work section assembly	3969425054
Stud kit for a (9) work section assembly	3969425055
Stud kit for a (10) work section assembly	3969425056

Notes:
- Each stud kit contains (4) studs and (8) serrated hex nuts. Stud torque is 264 inch lbs.

Spool Positioner Kits

Description	Part Number
Manual Spool Clevis Kit	4069000111
Standard Stroke Limiter Kit	4069000047
Manual MO Stroke Limiter Kit	4069000050

- Spools not included.

Seal Kits

Description	Part Number
Face Seals (All)	4069000023
EH End Cap	3961823654
Load Sense Relief Valve	3961823655
Solenoid Seals (5-pack)	6760507
Spool Seal (Manual)	25269001

Main Spools

Description	Flow LPM (GPM)	Part Number
DA Cyl	15 (4)	4068700104
DA Cyl	30 (8)	4068700108
DA Cyl	45 (12)	4068700112
DA Cyl	68 (18)	4068700118
DA Cyl	91 (24)	4068700124
DA Cyl	121 (32)	4068700132
DA Cyl	Full Flow	4068700100
SA Cyl	15 (4)	4068700304
SA Cyl	30 (8)	4068700308
SA Cyl	45 (12)	4068700312
SA Cyl	68 (18)	4068700318
SA Cyl	91 (24)	4068700324
SA Cyl	121 (32)	4068700332
SA Cyl	Full Flow	4068700300
DA Motor	15 (4)	4068700204
DA Motor	30 (8)	4068700208
DA Motor	45 (12)	4068700212
DA Motor	68 (18)	4068700218
DA Motor	91 (24)	4068700224
DA Motor	121 (32)	4068700232
DA Motor	Full Flow	4068700200
SA Motor	15 (4)	4068700404
SA Motor	30 (8)	4068700408
SA Motor	45 (12)	4068700412
SA Motor	68 (18)	4068700418
SA Motor	91 (24)	4068700424
SA Motor	121 (32)	4068700432
SA Motor	Full Flow	4068700400

- Spools do not come with a clevis.

Solenoid Kits

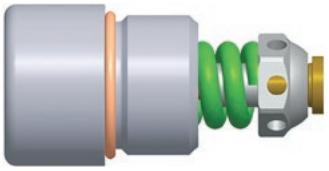
Description	Part Number
12V Solenoid – Deutsch	3961823726
12V Solenoid - Amp jr.	3961823724

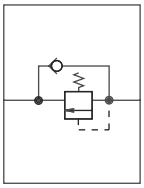
Note: Solenoid kits include mounting screws and 1 mm (.04") orifice cap.

Port Accessories

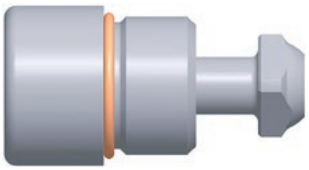
Description	Part Number	Pressure Setting Bar (PSI)
Relief Valve	6763034	25 (363)
Relief Valve	6763035	32 (464)
Relief Valve	6763036	40 (580)
Relief Valve	6763037	50 (725)
Relief Valve	6763038	63 (914)
Relief Valve	6763039	80 (1160)
Relief Valve	6763040	100 (1450)
Relief Valve	6763041	125 (1813)
Relief Valve	6763042	140 (2031)
Relief Valve	6763043	160 (2321)
Relief Valve	6763044	175 (2538)
Relief Valve	6763045	190 (2756)
Relief Valve	6763046	210 (3046)
Relief Valve	6763058	225 (3263)
Relief Valve	6763047	230 (3336)
Relief Valve	6763048	250 (3626)
Relief Valve	6763056	265 (3844)
Relief Valve	6763057	270 (3916)
Relief Valve	6763049	280 (4061)
Relief Valve	6763050	300 (4351)
Anti-Cavitation	4069004026	—
Port RV Plug	4069001006	—

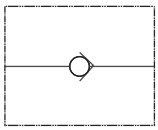
Code PA – Relief with Anticavitation Check



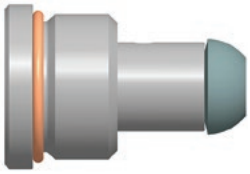


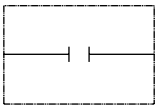
Code N2 – Anticavitation Check





Code Y2 – Relief Cavity Plug Closed to Tank





PARKER-HANNIFIN CORPORATION — HYDRAULIC VALVE DIVISION
OFFER OF SALE

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

Buyer: means any customer receiving a Quote for Products from Seller.
Goods: means any tangible part, system or component to be supplied by the Seller.
Products: means the Goods, Services and/or Software as described in a Quote provided by the Seller.
Quote: means the offer or proposal made by Seller to Buyer for the supply of Products.
Seller: means Parker-Hannifin Corporation, including all divisions and businesses thereof.
Services: means any services to be supplied by the Seller.
Software: means any software related to the Products, whether embedded or separately downloaded.
Terms: means the terms and conditions of this Offer of Sale or any newer version of the same as published by Seller electronically at www.parker.com/saleterms.

2. Terms. All sales of Products by Seller are contingent upon, and will be governed by, these Terms and, these Terms are incorporated into any Quote provided by Seller to any Buyer. Buyer's order for any Products whether communicated to Seller verbally, in writing, by electronic date interface or other electronic commerce, shall constitute acceptance of these Terms. Seller objects to any contrary or additional terms or conditions of Buyer. Reference in Seller's order acknowledgement to Buyer's purchase order or purchase order number shall in no way constitute an acceptance of any of Buyer's terms of purchase. No modification to these Terms will be binding on Seller unless agreed to in writing and signed by an authorized representative of Seller.

3. Price; Payment. The Products set forth in Seller's Quote are offered for sale at the prices indicated in Seller's Quote. Unless otherwise specifically stated in Seller's Quote, prices are valid for thirty (30) days and do not include any sales, use, or other taxes or duties. Seller reserves the right to modify prices at any time to adjust for any raw material price fluctuations. Unless otherwise specified by Seller, all prices are F.C.A. Seller's facility (INCOTERMS 2010). All sales are contingent upon credit approval and payment for all purchases is due thirty (30) days from the date of invoice (or such date as may be specified in the Quote). Unpaid invoices beyond the specified payment date incur interest at the rate of 1.5% per month or the maximum allowable rate under applicable law.

4. Shipment; Delivery; Title and Risk of Loss. All delivery dates are approximate. Seller is not responsible for damages resulting from any delay. Regardless of the manner of shipment, delivery occurs and title and risk of loss or damage pass to Buyer, upon placement of the Products with the shipment carrier at Seller's facility. Unless otherwise agreed, Seller may exercise its judgment in choosing the carrier and means of delivery. No deferment of shipment at Buyers' request beyond the respective indicated shipping date will be made except on terms that will indemnify, defend and hold Seller harmless against all loss and additional expense. Buyer shall be responsible for any additional shipping charges incurred by Seller due to Buyer's acts or omissions.

5. Warranty. The warranty related to the Products is as follows: (i) Goods are warranted against defects in material or workmanship for a period of eighteen (18) months from the date of delivery; (ii) Services shall be performed in accordance with generally accepted practices and using the degree of care and skill that is ordinarily exercised and customary in the field to which the Services pertain and are warranted for a period of six (6) months from the completion of the Services by Seller; and (iii) Software is only warranted to perform in accordance with applicable specifications provided by Seller to Buyer for ninety (90) days from the date of delivery or, when downloaded by a Buyer or end-user, from the date of the initial download. All prices are based upon the exclusive limited warranty stated above, and upon the following disclaimer:

DISCLAIMER OF WARRANTY: THIS WARRANTY IS THE SOLE AND ENTIRE WARRANTY PERTAINING TO PRODUCTS. SELLER DISCLAIMS ALL OTHER WARRANTIES, EXPRESS AND IMPLIED, INCLUDING 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. BUYER AGREES AND ACKNOWLEDGES THAT 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 the 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 PRODUCT, 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 ARISING OUT OF, OR AS THE RESULT OF, THE SALE, DELIVERY, NON-DELIVERY, SERVICING, NON-COMPLETION OF SERVICES, USE, LOSS OF USE OF, OR INABILITY TO USE THE PRODUCTS OR ANY PART THEREOF, LOSS OF DATA, IDENTITY, PRIVACY, OR CONFIDENTIALITY, OR FOR ANY CHARGES OR EXPENSES OF ANY NATURE INCURRED WITHOUT SELLER'S WRITTEN CONSENT, 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. Loss to Buyer's Property. Any designs, tools, patterns, materials, drawings, confidential information or equipment furnished by Buyer or any other items which are or become 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 such property. Seller shall not be responsible for any loss or damage to such property while it is in Seller's possession or control.

9. Special Tooling. Special Tooling includes but is not limited to tooling, jigs, fixtures and associated manufacturing equipment acquired or necessary to manufacture Products. A tooling charge may be imposed for any Special Tooling. 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 Special Tooling belonging to Seller that is utilized in the manufacture of the Products, even if such Special Tooling has been specially converted or adapted for such manufacture 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 in its sole discretion at any time.

10. Security Interest. To secure payment of all sums due, Seller retains a security interest in all Products delivered to Buyer and, Buyer's acceptance of these Terms is deemed to be a Security Agreement under the Uniform Commercial Code. Buyer authorizes Seller as its attorney to execute and file on Buyer's behalf all documents Seller deems necessary to perfect its security interest.

11. User Responsibility. The 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. The Buyer must analyze all aspects of the application and follow applicable industry standards, specifications, and other technical information provided with the Product. If Seller provides Product options based upon data or specifications provided by the Buyer, the Buyer is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the Products. In the event the Buyer is not the end-user, Buyer will ensure such end-user complies with this paragraph.

12. Use of Products. Indemnity by Buyer. Buyer shall comply with all instructions, guides and specifications provided by Seller with the Products. Unauthorized Uses. If Buyer uses or resells the Products for any uses prohibited in Seller's instructions, guides or specifications, or Buyer otherwise fails to comply with Seller's instructions, guides and specifications, Buyer acknowledges that any such use, resale, or non-compliance is at Buyer's sole risk. Buyer shall indemnify, defend, and hold Seller harmless from any losses, claims, liabilities, damages, lawsuits, judgments and costs (including attorney fees and defense costs), whether for personal injury, property damage, intellectual property infringement or any other claim, brought by or incurred by Buyer, Buyer's employees, or any other person, arising out of: (a) improper selection, application, design, specification or other misuse of Products provided by Seller; (b) any act or omission, negligent or otherwise, of Buyer; (c) Seller's use of patterns, tooling, equipment, plans, drawings, designs or specifications or other information or things furnished by Buyer; (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 or tampering with the Products for any reason; or (e) Buyer's failure to comply with these Terms. Seller shall not indemnify Buyer under any circumstance except as otherwise provided in these Terms.

13. Cancellations and Changes. Buyer may not cancel or modify any order for any reason, except with Seller's written consent and upon terms that will indemnify, defend and hold Seller harmless against all direct, incidental and consequential loss or damage. Seller, at any time, may change Product features, specifications, designs and availability.

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

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

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

17. Termination. Seller may terminate any agreement governed by or arising from these Terms for any reason and at any time by giving Buyer thirty (30) days prior written notice. Seller may immediately terminate, in writing, if Buyer: (a) breaches any provision of these Terms (b) appoints a trustee, receiver or custodian for all or any part of Buyer's property (c) files a petition for relief in bankruptcy on its own behalf, or one if filed by a third party (d) makes an assignment for the benefit of creditors; or (e) dissolves its business or liquidates all or a majority of its assets.

18. Ownership of Software. Seller retains ownership of all Software supplied to Buyer hereunder. In no event shall Buyer obtain any greater right in and to the Software than a right in the nature of a license limited to the use thereof and subject to compliance with any other terms provided with the Software.

19. Indemnity for Infringement of Intellectual Property Rights. Seller is not liable for infringement of any patents, trademarks, copyrights, trade dress, trade secrets or similar rights ("Intellectual Property Rights") except as provided in this Section. Seller will defend at its expense and will pay the cost of any settlement or damages awarded in an action brought against Buyer based on a third party claim that one or more of the Products sold hereunder infringes the Intellectual Property Rights of a third party in the country of delivery of the Products by the Seller to the Buyer. Seller's obligation to defend and indemnify Buyer is contingent on Buyer notifying Seller within ten (10) days after Buyer becomes aware of any such claim, and Seller having sole control over the defense of the claim including all negotiations for settlement or compromise. If one or more Products sold hereunder is subject to such a claim, Seller may, at its sole expense and option, procure for Buyer the right to continue using the Products, replace or modify the Products so as to render them non-infringing, or offer to accept return of the Products and refund the purchase price less a reasonable allowance for depreciation. Seller has no obligation or liability for any claim of infringement: (i) arising from information provided by Buyer; or (ii) directed to any Products provided hereunder for which the designs are specified in whole or part by Buyer; or (iii) resulting from the modification, combination or use in a system of any Products provided hereunder. The foregoing provisions of this Section constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for such claims of infringement of Intellectual Property Rights.

20. Governing Law. These Terms and the sale and delivery of all Products are deemed to have taken place in, and shall be governed and construed in accordance with, the laws of the State of Ohio, as applicable to contracts executed and wholly performed therein and without regard to conflicts of laws principles. Buyer irrevocably agrees and consents to the exclusive jurisdiction and venue of the courts of Cuyahoga County, Ohio with respect to any dispute, controversy or claim arising out of or relating to the sale and delivery of the Products.

21. Entire Agreement. These Terms, along with the terms set forth in the main body of any Quote, forms the entire agreement between the Buyer and Seller and constitutes the final, complete and exclusive expression of the terms of sale. In the event of a conflict between any term set forth in the main body of a Quote and these Terms, the terms set forth in the main body of the Quote shall prevail. All prior or contemporaneous written or oral agreements or negotiations with respect to the subject matter shall have no effect. These Terms may not be modified unless in writing and signed by an authorized representative of Seller.

22. Compliance with Laws. Buyer agrees to comply with all applicable laws, regulations, and industry and professional standards, including those of the United States of America, and the country or countries in which Buyer may operate, including without limitation the U.S. Foreign Corrupt Practices Act ("FCPA"), the U.S. Anti-Kickback Act ("Anti-Kickback Act"), U.S. and E.U. export control and sanctions laws ("Export Laws"), the U.S. Food Drug and Cosmetic Act ("FDCA"), and the rules and regulations promulgated by the U.S. Food and Drug Administration ("FDA"), each as currently amended. Buyer agrees to indemnify, defend, and hold harmless Seller from the consequences of any violation of such laws, regulations and standards by Buyer, its employees or agents. Buyer acknowledges that it is familiar with all applicable provisions of the FCPA, the Anti-Kickback Act, Export Laws, the FDCA and the FDA and certifies that Buyer will adhere to the requirements thereof and not take any action that would make Seller violate such requirements. Buyer represents and agrees that Buyer will not make any payment or give anything of value, directly or indirectly, to any governmental official, foreign political party or official thereof, candidate for foreign political office, or commercial entity or person, for any improper purpose, including the purpose of influencing such person to purchase Products or otherwise benefit the business of Seller. Buyer further represents and agrees that it will not receive, use, service, transfer or ship any Product from Seller in a manner or for a purpose that violates Export Laws or would cause Seller to be in violation of Export Laws.

5/17

Parker Safety Guide for Selecting and Using Hose, Tubing, Fittings and Related Accessories
Publication No. 4400-B.1
Revised: October 2015, Rev A

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 luid. 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 tec hnical service department.

2.0 HOSE, TUBE & 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 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 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 tool-

ing 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 INSRUCTIONS

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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