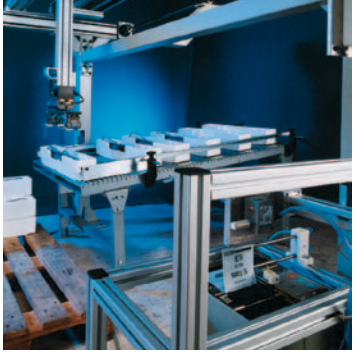

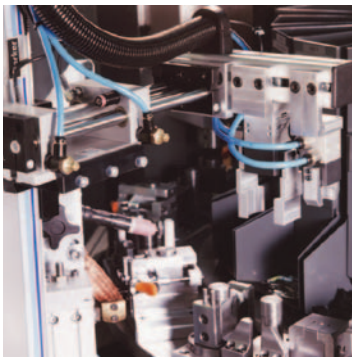

aerospace
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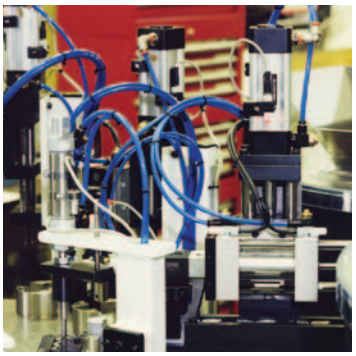
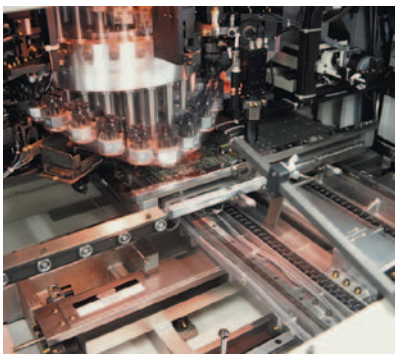


Rotary Table Units P5W Series

Sizes 10, 12, 20, 25, 35, 45 and 63mm

Catalog 0915



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Important !
Before carrying out any service work, ensure that the unit has been vented.
Remove the primary supply air hose to ensure total disconnection of the air supply before dismantling cylinder or blank connection blocks.

NB !
All technical data in this catalogue is typical only. The air quality is decisive for the unit life: see ISO 8573-1.

⚠ WARNING

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

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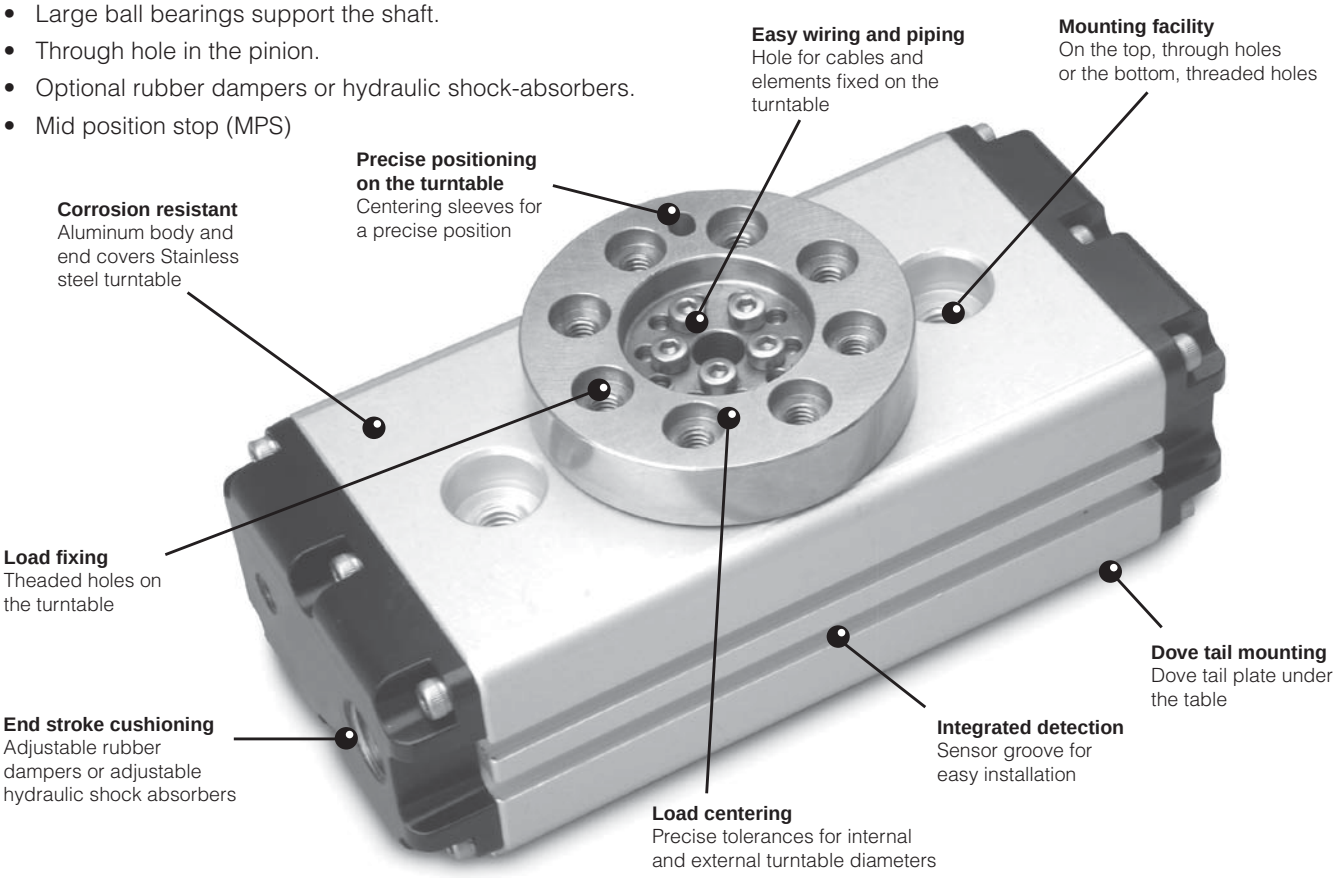
Features

- Rack and pinion patented movement.
- Continuously adjustable stroke.
- Large ball bearings support the shaft.
- Through hole in the pinion.
- Optional rubber dampers or hydraulic shock-absorbers.
- Mid position stop (MPS)



Technical Data

Size	10	12	20	25	35	45	63
Min. Max. pressure operation (bar)	1.5 to 8						
Operating temperature (°C)	+5 to +60						
Theoretical torque at 6 bar Nm (lb-in)	0.3 (2.5)	0.6 (5.0)	2 (17.5)	4 (35.1)	8 (69.0)	17 (147.7)	39 (347.5)
Rotation angle (°)	0 to 190						
Rotation time without load (Secs)	0.05	0.06	0.11	0.19	0.08	0.16	0.23
Max working frequency (Hz)	3	3	2	2	2	2	1
Type of drive	Rack-pinion						
Piston diameter (mm)	10	12	20	25	35	45	63
Axial load (N)	232	375	650	800	800	1075	1550
Radial load (N)	279	450	780	960	960	1290	1860
Repeatability (°)	± 0.02						
Operation	Filtered dry air, lubricated or not						
Cycle air consumption (cm^3)	3.3	6.3	23	45	92	230	520
Connection	M5	M5	M5	G1/8	G1/8	G1/4	G1/4
Central hole diameter (mm)	5	6	8	10	12	18	20
Diameter hydraulic shock absorber	M8 x 1	M10 x 1	M12 x 1	M12 x 1	M14 x 1.5	M20 x 1.5	M25 x 1.5
Weight (kg)	0.3	0.5	1.00	1.8	2.7	5.7	9.2

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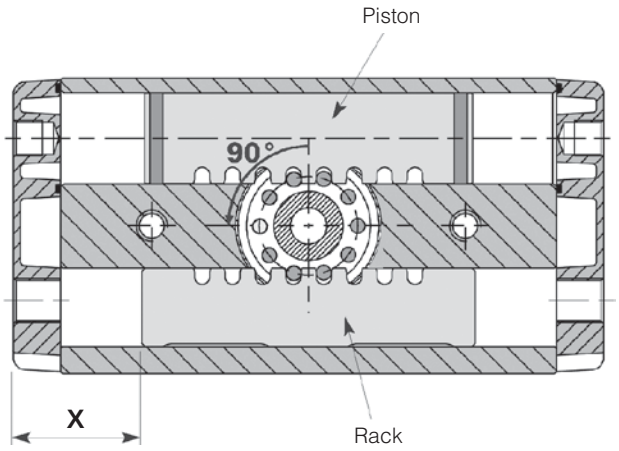
Accessories

For the stroke adjustment use hydraulic shock-absorbers or rubber dampers, according to the kinetic energy the units have to bear.

NEVER USE THE ROTARY UNIT WITHOUT STROKE ADJUSTERS OR SHOCKS



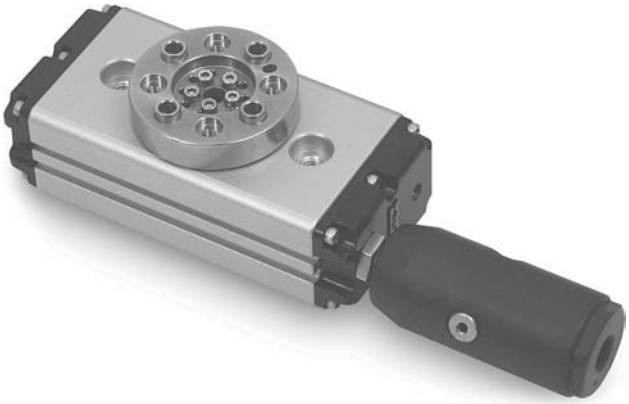
The table shows the codes of the suitable shock-absorbers and rubber dampers.

Shock-Absorbers and Dampers Options

Size		Hydraulic Shock-Absorbers Order Code	Rubber Dampers Order Code		X for 90° [mm]	Y for 1° [mm]
10	M8x1	**MC10MH**	**P5WCM10B**	(L=30 mm)	18.5	0.1047
12	M10x1	**MC25ML-NB**	**P5WCM12B**	(L=30 mm)	24.0	0.1417
20	M12x1	**MC75M-3-NB-111**	**P5WCM20B**	(L=35 mm)	27.5	0.1802
25	M12x1	**MC75M-3-NB-111**	**P5WCM20B**	(L=35 mm)	35.5	0.2317
35	M14x1.5	**MC150MH2**			37.0	0.2296
45	M20x1.5	**MC225MH2**			53.5	0.2976
63	M25x1.5	**MC600MH2**			60.0	0.3571

Mid Position Stop Kits

Mid position stop units are also available, to stop the rack by a larger pneumatic piston in the middle of its stroke (90°)



From the table above:

X for 90° = Minimum length of end stroke device required to achieve 90° rotation.

Y for 1° = Rack stroke for each 1° of rotation.

By using the accessories in the table above it is possible to reduce the rotation angle to 90°. If a larger stroke reduction is required then it is necessary to check if a longer end stroke device is required.

Example:

If a 70° rotation is required on a size 63 unit the dimension for X will be:

X = X for 90° + ((90 - 70) x Y for 1°)

X = 60.0mm + (20 x 0.3571) = 67.1mm.

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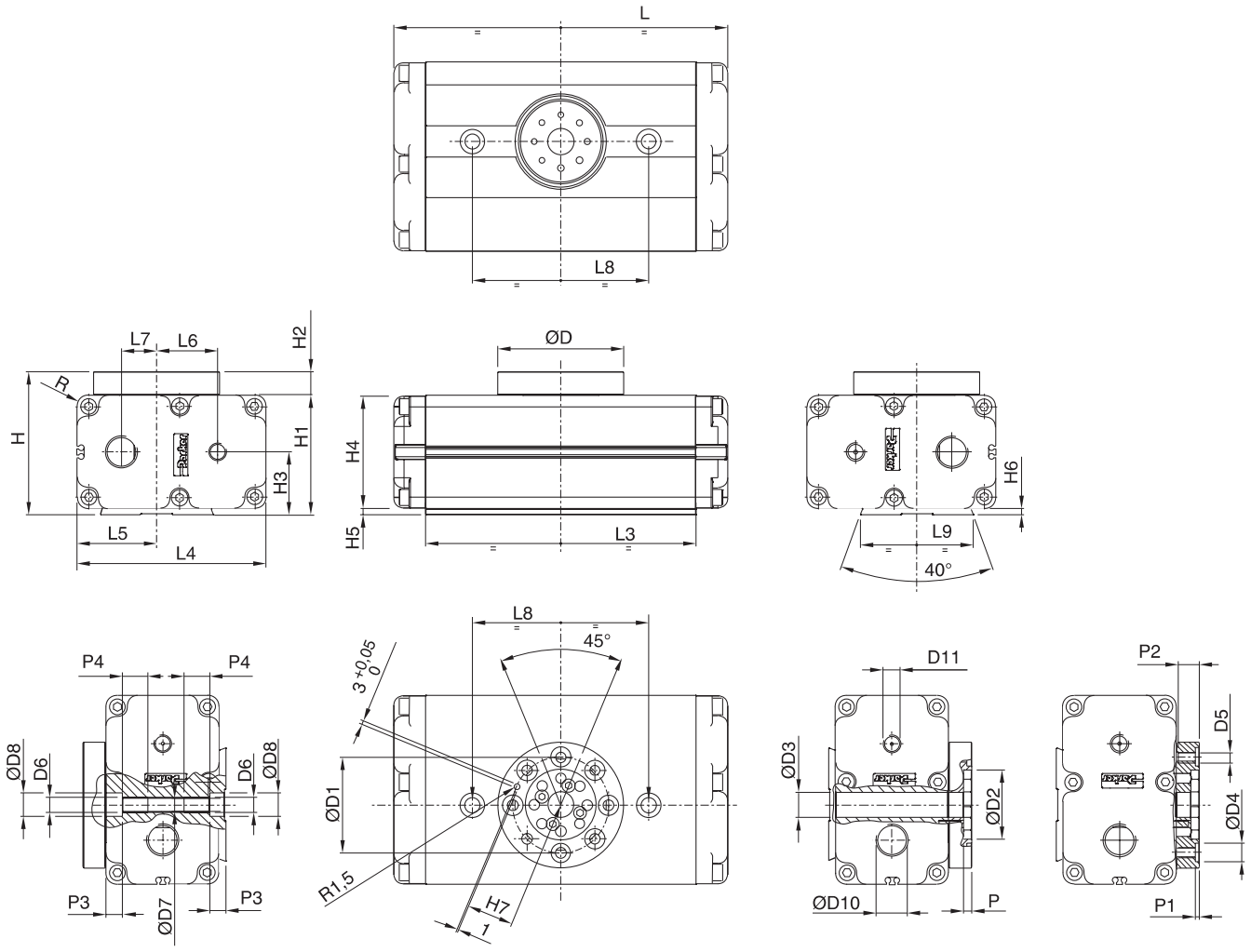

Dimensions	L	L3	L4	L5	L6	L7	L8 ±0.02	L9	D	D1 ±0.02	D2	D3	D4 H8	D5	D6	D7	D8 H8	D10	D11
Ø mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm			mm	mm		
10	81	65	38	19	10	9	50	40	32	23	–	5	7	M4	M5	4.3	9	M8x1	M5
12	108	88	50	25	13	13	59	40	45	31.5	22	6	7	M4	M6	5.2	11	M10x1	M5
20	130	110	65	32.5	16	13.5	72	56	45	31.5	22	8	7	M4	M6	5.2	11	M12x1	M5
25	162	136	80	40.5	24	18	86	70	65	50	37	10	9	M5	M8	6.8	15	M12x1	G1/8
35	170	140	100	47	28.5	17.5	86	70	65	50	37	12	9	M5	M8	6.8	15	M14x1.5	G1/8
45	230	180	120	56	37	26	140	90	100	76	55	18	15	M8	M12	10.5	19	M20x1.5	G1/4
63	265	215	150	63	48.5	28	140	90	100	76	55	20	15	M8	M12	10.5	19	M25x1.5	G1/4

Dimensions	H	H1	H2	H3	H4	H5	H6	H7	P	P1	P2	P3	P4	R
Ø mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
10	35	27	8	16	21.5	5.25	5	–	–	2.5	6.5	6	10	2.75
12	47	37	10	21	31	5.5	5	15.25	4	2.5	8	6	12	3.5
20	54	44	10	24.5	38	5.5	5	15.25	4	2.5	8	6	12	4.5
25	64	50	14	27.5	44	5.5	5	24,5	5	3	12	10	18	5
35	76	62	14	33.5	55	5.5	5	24.5	5	3	12	10	18	7
45	95.5	77	18.5	41	70	5.5	5	37.5	7	3.5	16	13	24	7
63	113.5	95	18.5	50	88	5.5	5	37.5	7	3.5	16	13	24	9

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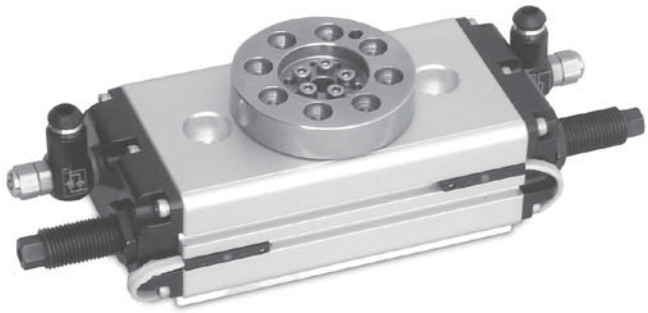
Compressed Air Supply

Compressed air from the working valve is connected to the rotary module end covers.
The compressed air system should be fitted with a soft start valve to prevent uncontrolled movements and damage.

The compressed air must be filtered from 5 - 40µm. Maintain the medium selected at the start, lubricated or not, for the complete service life of the unit.



Connection Diagram

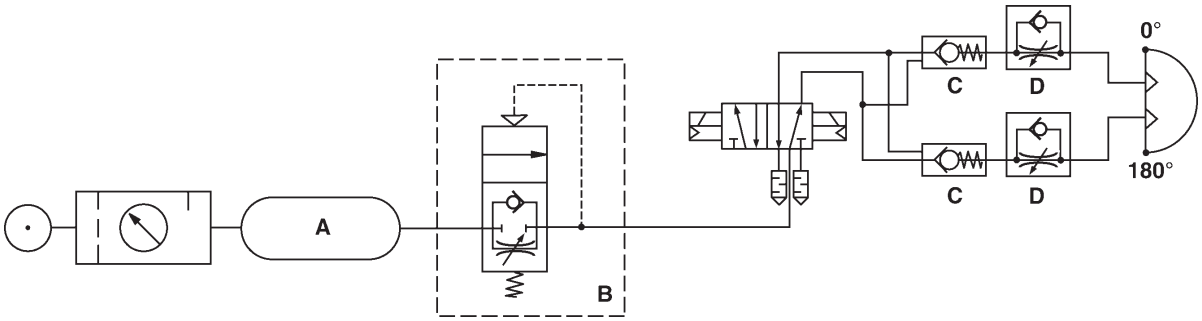
Note the following during installation:

A A check valve and an air volume are used to prevent pressure variations and sudden pressure loss to the soft start valve.

B A soft start valve is used to prevent uncontrolled movements on start-up.

C Pilot controlled check valves are used to prevent pressure loss in the rotary module.

D Flow control valves with by-pass are used for speed control of the rotary movements.



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Safety Loads

Check the table for maximum permitted loads.

Excessive loads or kinetic energy can damage the unit, cause functioning troubles and endanger the safety of the operator.

A [N] is the maximum axial load, compressive and tensile.

R [N] is the maximum radial load.

M [Nm] is the maximum bending torque.

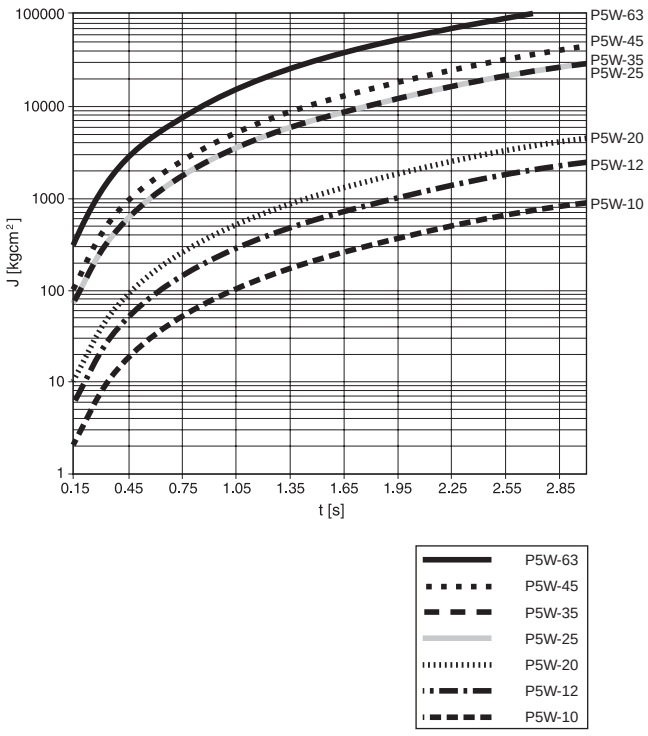
J [kgcm^2] is the moment of inertia of the rotating loads.

t [s] is the indexing time.

On the graph of kinetic energy, the point of intersection of J and t values, must be down the characteristic curve of the selected unit.

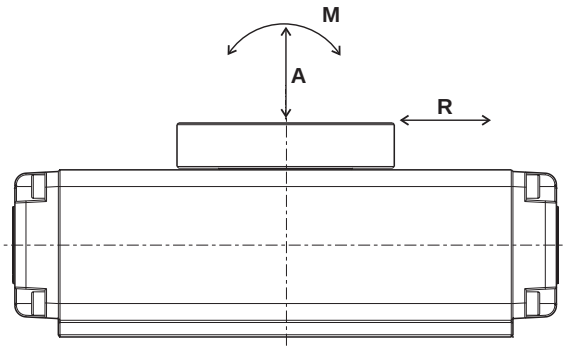
Use flow controls (not supplied) to obtain the correct speed.

Kinetic Energy



Permitted Loads and Torques

Size Ø mm	A N (lbs.)	R N (lbs.)	M Nm (lb-in)	Distance Between Bearing Centerlines mm
10	232 (52)	279 (63)	4.7 (41)	17
12	375 (84)	450 (101)	9.7 (86)	21.5
20	650 (146)	780 (175)	22 (195)	28
25	800 (180)	960 (216)	34 (301)	35
35	800 (180)	960 (216)	42 (372)	44
45	1075 (242)	1290 (290)	84 (743)	65
63	1550 (348)	1860 (418)	143 (1266)	77

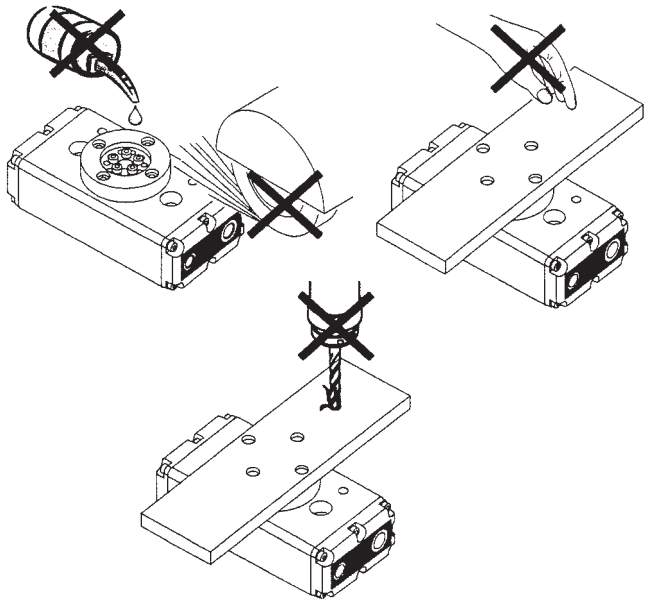


Safety Instructions

Caution

Avoid the unit coming into contact with the following media: corrosive coolants, emery powder or glowing sparks.

Make sure that nobody can place his/her hand in the area of the rotating load and there are no objects on its path. The swivelling unit must not run before the whole machine, on which it is mounted, complies with the laws or safety norms of your country.



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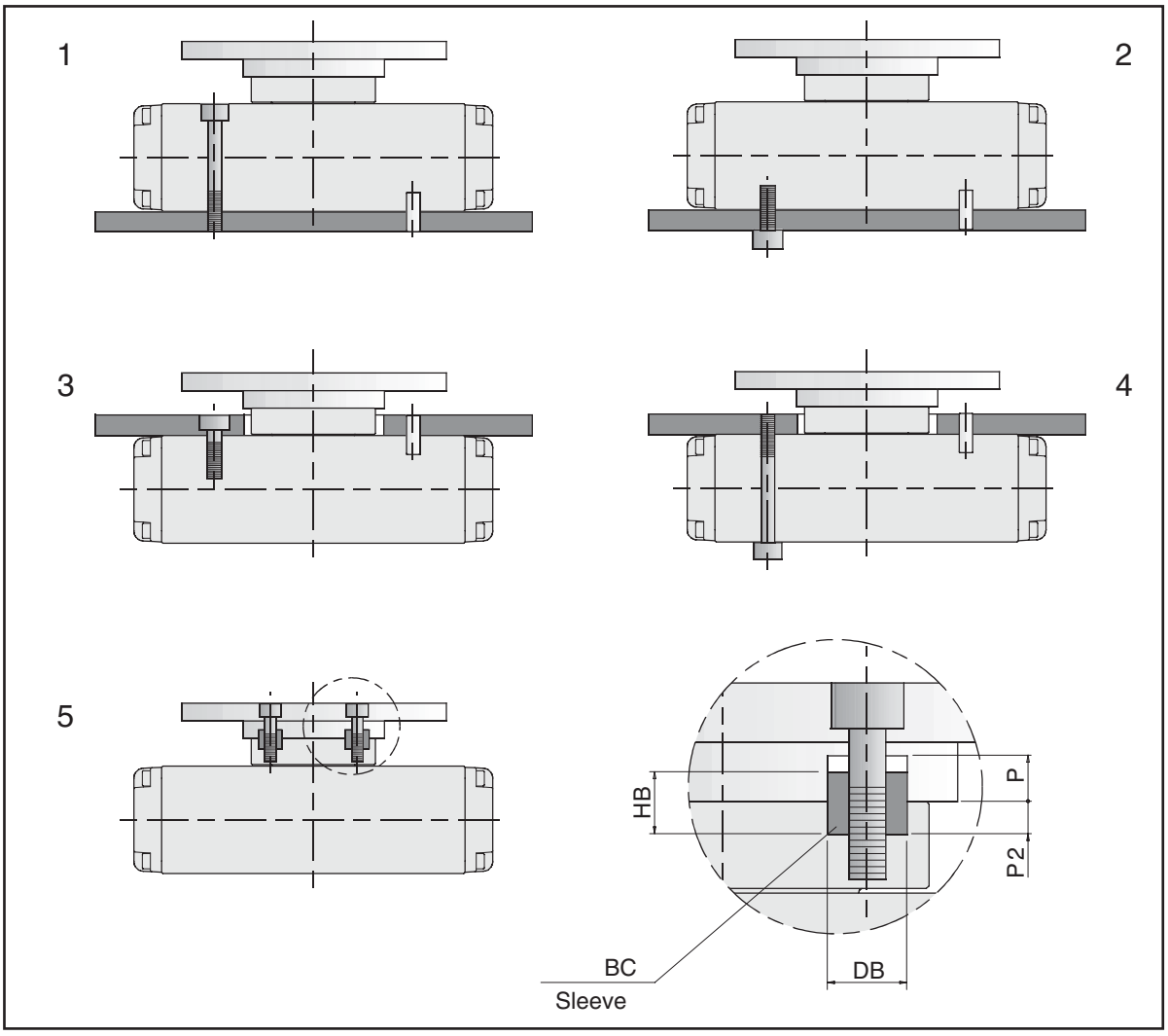
Mounting

The swiveling unit can be fastened to a static or a moving part. When on a moving part, you must pay attention to the forces created by inertia over the unit and its load.

Use the two sleeves provided in the packaging, to center the rotating load on the pinion.



Sleeves for Rotary Table

Dimensions Ø mm	DB h8 mm	HB ±0.1 mm	P mm	P2 mm	Order Code
10	Ø7	5	3	2.5	**P5WCM10S**
12	Ø7	5	3	2.5	**P5WCM10S**
20	Ø7	5	3	2.5	**P5WCM10S**
25	Ø9	6	3.5	3	**P5WCM25S**
35	Ø9	6	3.5	3	**P5WCM25S**
45	Ø15	7	4	3.5	**P5WCM45S**
63	Ø15	7	4	3.5	**P5WCM45S**

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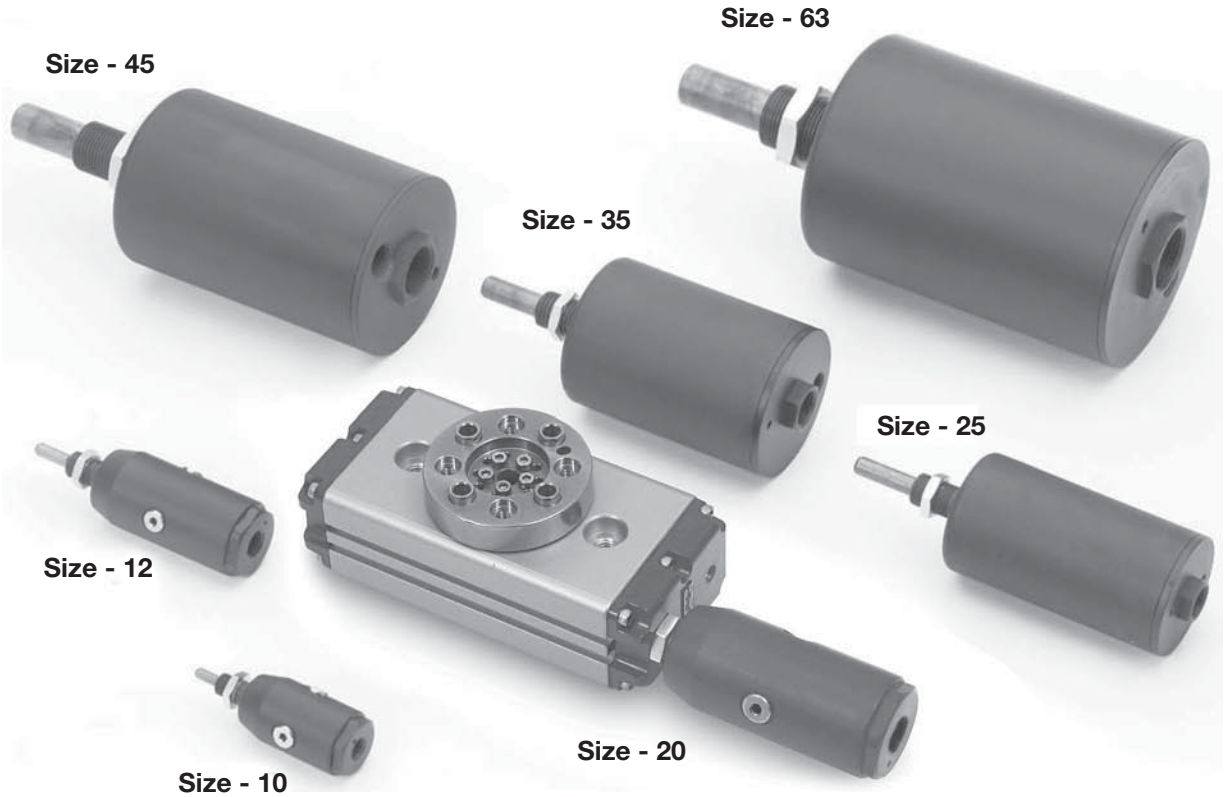
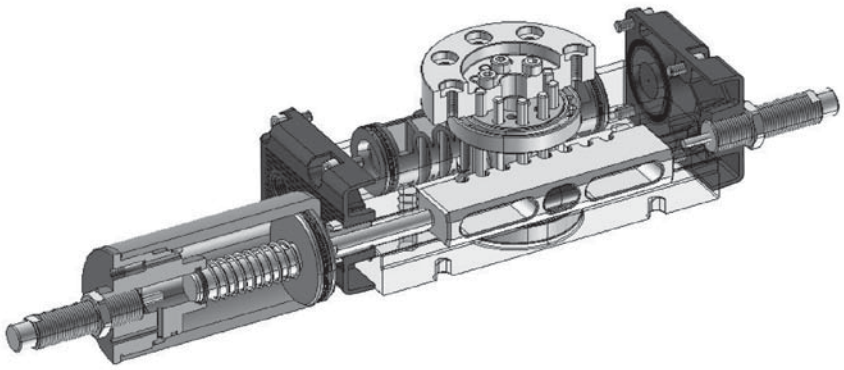
Mid Position Stop Units Series





Technical Data

Size	10	12	20	25	35	45	63
Medium	Filtered dry air, lubricated or not						
Maximum pressure range (bar)	8						
Temperature range (°C)	5°C - +60°C						
Stroke 90° (mm)	9.42	12.75	16.22	20.85	20.66	26.78	32.14
Piston bore (mm)	15	20	30	35	50	63	80
Consumption each stroke (cm^3)	2	7	21	37	74	154	339
Weight (kg)	0.055	0.10	0.19	0.30	0.45	1.00	1.68
To be used with base unit (size)	10	12	20	25	35	45	63

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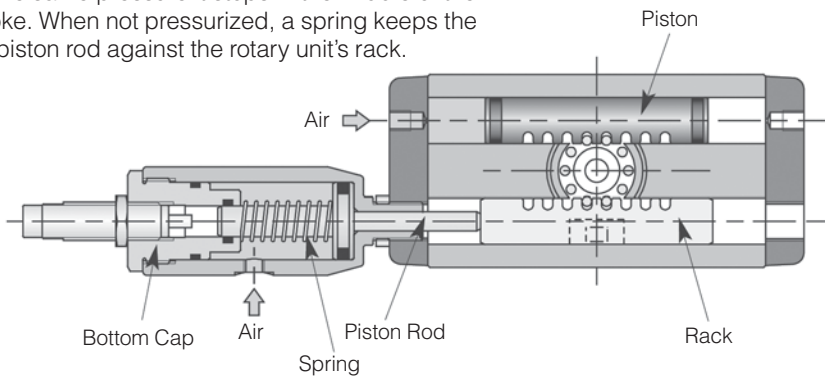
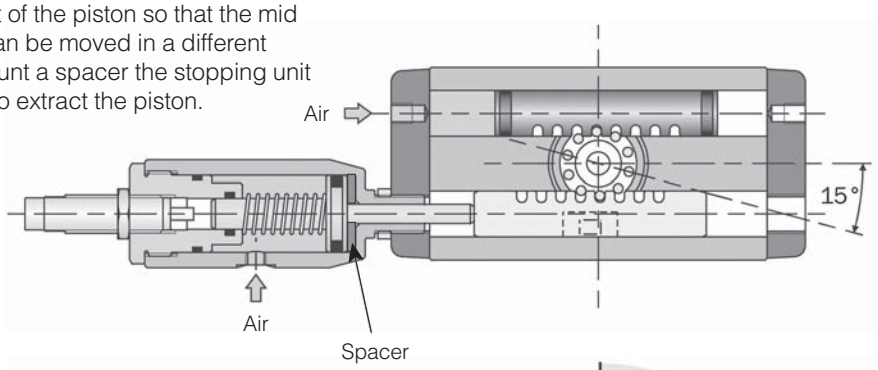
Mid Position Stop Operating Principle

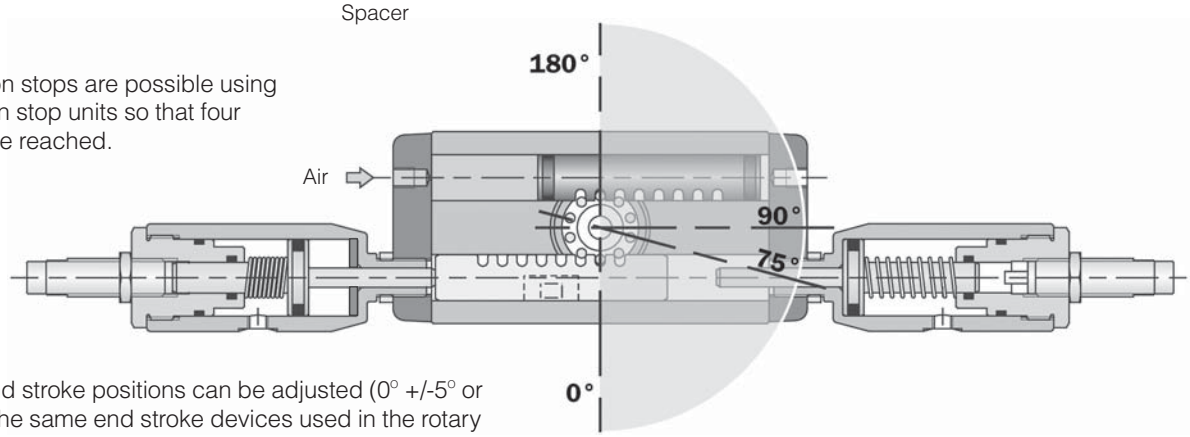
The Mid position stop unit is a stroke reducer, acting against the rack of the rotary table unit by a piston rod. The stopping unit's piston bore is larger than the rotary unit's and when pressurized at the same pressure it stops in the middle of the rotary unit's stroke. When not pressurized, a spring keeps the stopping unit's piston rod against the rotary unit's rack.



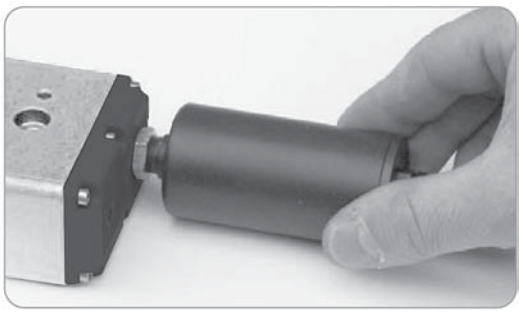
The stopping unit stroke can be modified by spacers in front of the piston so that the mid position stop can be moved in a different position. To mount a spacer the stopping unit must be open to extract the piston.



Two mid position stops are possible using two mid position stop units so that four positions can be reached.



The external end stroke positions can be adjusted (0° +/-5° or 180° +/-5°) by the same end stroke devices used in the rotary unit (shock-absorbers, rubber bumpers, grub screws).
The mid position stop can be adjusted (90° +/-5°) by moving the whole mid position stop unit body.



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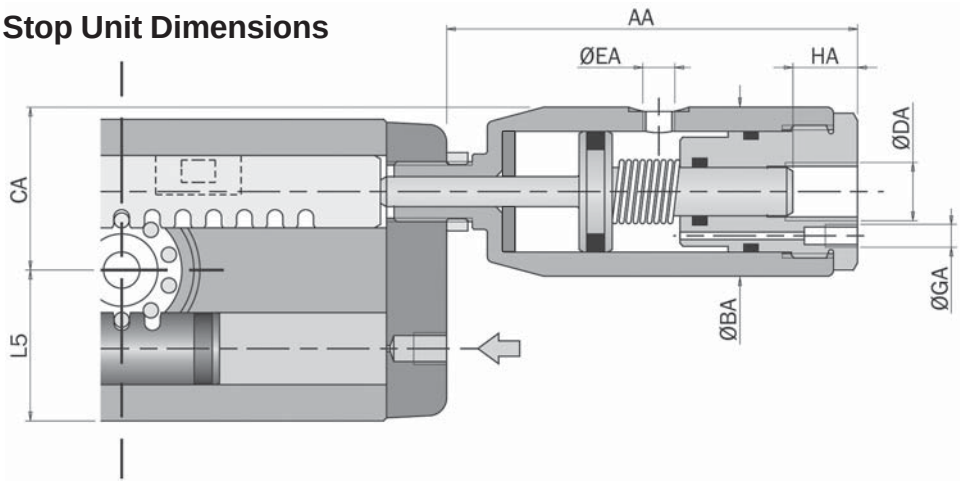
Mid Position Stop Unit Dimensions



	Size - 10	Size - 12	Size - 20	Size - 25	Size - 35	Size - 45	Size - 63
AA	48.8	68.3	85.3	97.8	96	124.6	143.6
BA	Ø 23	Ø 28	Ø 36	Ø 44	Ø 56	Ø 70	Ø 89
CA	20.5	27	34	42.5	50	61	71.5
DA	M8x1	M10x1	M12x1	M12x1	M14x1.5	M20x1.5	M25x1.5
EA	(n°3) M5	(n°3) M5	/	/	/	/	/
GA	/	/	M5	M5	G1/8	G1/4	G1/4
L5	19	25	32.5	40.5	53	64	87
HA	7.2	10.7	11.8	14	15.9	21.7	27.4

Pneumatic Circuit

Possible problems on a compressed air circuit:

1 - Pressure variation.

2 - Pressurized with exhausted cylinder.

3 - Sudden pressure loss.

4 - Excessive speed.

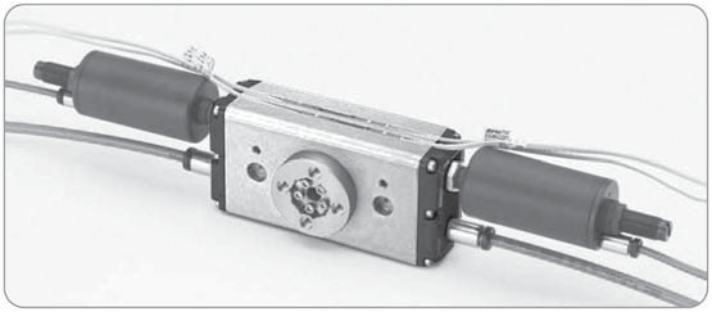
Possible solutions:

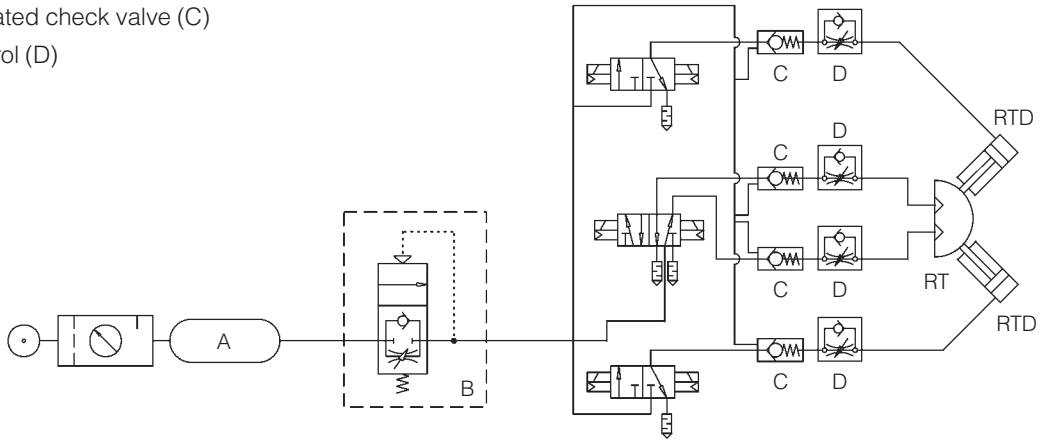
1 - Compressed air storage (A)

2 - Soft-start valve (B)

3 - Pilot operated check valve (C)

4 - Flow control (D)





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Order Codes

Rotary Table

Must be fitted with either external cushioning or other cushioning (MPS Units)

Size Ø mm	Connection	Weight kg	Order Code
10	M5	0.234	**P5WCM10NMN0190B**
12	M5	0.557	**P5WCM12NMN0190B**
20	M5	0.966	**P5WCM20NMN0190B**
25	G1/8	1.682	**P5WCM25NMN0190B**
35	G1/8	2.473	**P5WCM35NMN0190B**
45	G1/4	5.252	**P5WCM45NMN0190B**
63	G1/4	8.184	**P5WCM63NMN0190B**

External Cushioning

Size Ø mm	Thread	Weight kg	**Hydraulic Shock Absorbers Order Code**	Weight kg	**Rubber Dampers Order Code**
10	M8x1	0.008	**MC10MH**	0.009	**P5WCM10B**
12	M10x1	0.014	**MC25ML-NB**	0.016	**P5WCM12B**
20	M12x1	0.030	**MC75M-3-NB-111**	0.028	**P5WCM20B**
25	M12x1	0.030	**MC75M-3-NB-111**	0.028	**P5WCM20B**
35	M14x1.5	0.008	**MC150MH2**		–
45	M20x1.5	0.15	**MC225MH2**		–
63	M25x1.5	0.26	**MC600MH2**		–

Mid Position Stop Kits

Size Ø mm	Weight kg	**Intermediate Stop Order Code**
10	0.055	**P5WCM10M**
12	0.100	**P5WCM12M**
20	0.190	**P5WCM20M**
25	0.300	**P5WCM25M**
35	0.450	**P5WCM35M**
45	1.000	**P5WCM45M**
63	1.675	**P5WCM63M**

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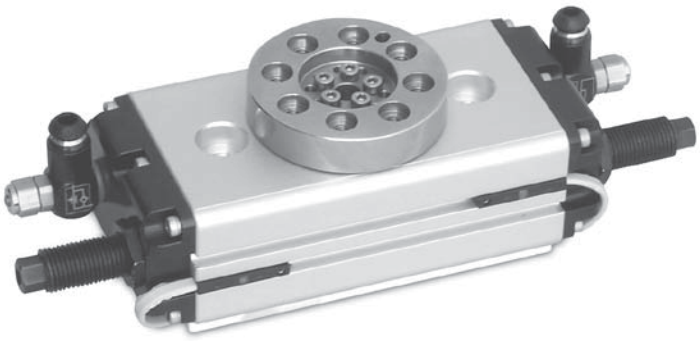
Magnetic Sensors

All switches are normally open (NO) in the unswitched position. When introduced to the magnetic field, the switch closes. Switches are designed for simple flush mounting without the need for additional brackets.



Features

- Integrated LED
- Compact robust design
- Integrated flying lead
- Optional plug-in connector
- Simple quick connection

Order codes

Function	Cable/Contact	Weight kg	**Order Code**
Electronic Sensor, 10 - 30 VDC			
			
Type PNP , normally open	2.5 m PUR-cable	0.007	**P8S-SPFL3**
Type NPN , normally open	2.5 m PUR-cable	0.007	**P8S-SNFL3**
Type PNP , normally open	0.3 m M8 / Snap-in	0.013	**P8S-SPSH3**
Type NPN , normally open	0.3 m M8 / Snap-in	0.013	**P8S-SNSH3**

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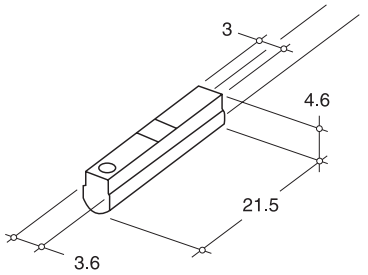
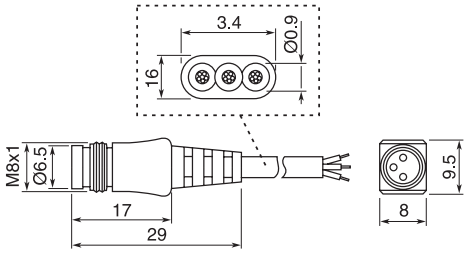
	Order Code			
	P8S-SPFL3	**P8S-SNFL3**	**P8S-SPSH3**	**P8S-SNSH3**
Cable length (m)	2.5	2.5	0.3	0.3
Connector	Flying cable	Flying cable	Plug-in male M8	Plug-in male M8
Type	PNP N.O.	NPN N.O.	PNP N.O.	NPN N.O.
Supply voltage (VDC)	3+ max 30			
Switching frequency (kHz)	200			
Switching current (A)	0.2			
Power (W)	max. 6			
Switching voltage (Vdc)	< 1			
Response time 'ON' (µs)	0.8			
Response time 'OFF' (µs)	0.3			
Working temperature (°C)	-10 to +70			
Inverse polarity protection	Yes			
Short circuit protection	Yes			
Life time (imp.)	10°			
Protection	IP67			
Body	Polyamid PA12			
Cable	Flat in PUR CEI20/22 II			

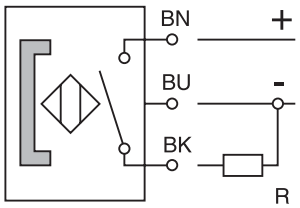
Dimensions (mm)



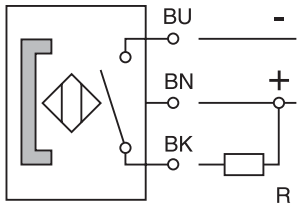


Wiring Diagrams

PNP



NPN



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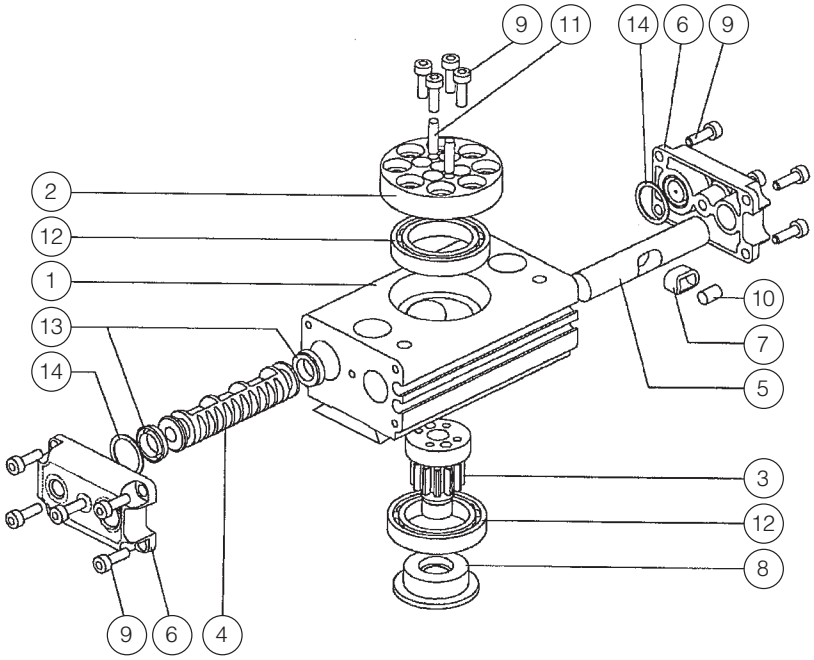
Rotary Table Units, Repair Kits

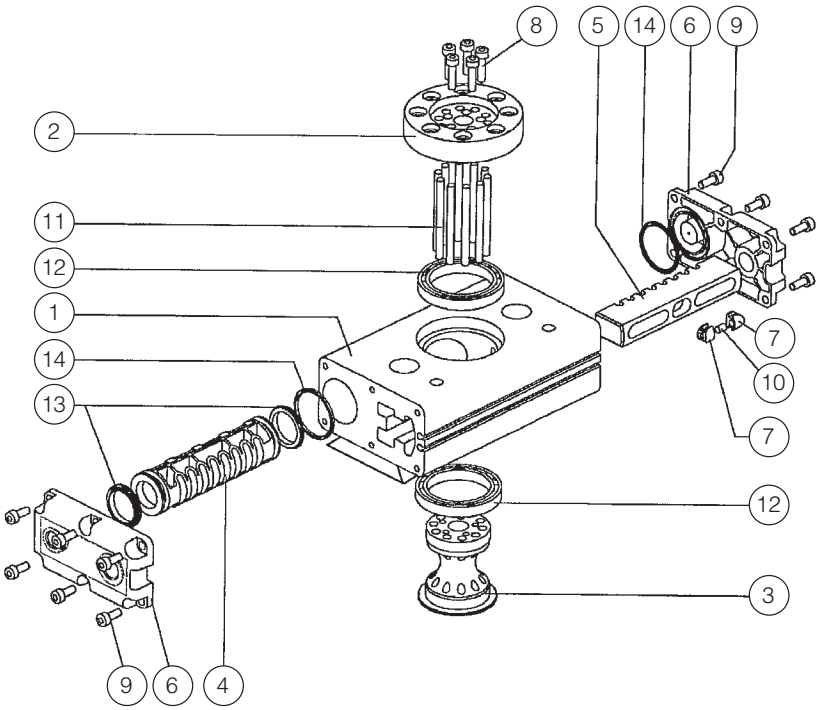
Parts List - Size 10mm

1	Housing
2	Disc
3	Shaft
4	Piston
5	Rack
6	End cap
7	Magnetic housing
8	Slotted round nut
9	Screw
10	Magnet
11	Dowel pin
12	Ball bearing
13	Dynamic gasket
14	O-ring



Parts List - Sizes 12 - 63mm

1	Housing
2	Disc
3	Shaft
4	Piston
5	Rack
6	End cap
7	Magnetic housing
8	Screw
9	Screw
10	Magnet
11	Dowel pin
12	Ball bearing
13	Dynamic gasket
14	O-ring



Repair Kits

Size Ø mm	**Order Code**
10	**P5WCM10N6RM**
12	**P5WCM12N6RM**
20	**P5WCM20N6RM**
25	**P5WCM25N6RM**
35	**P5WCM35N6RM**
45	**P5WCM45N6RM**
63	**P5WCM63N6RM**

Each kit contains two 'O' rings and two dynamic gasket seals.

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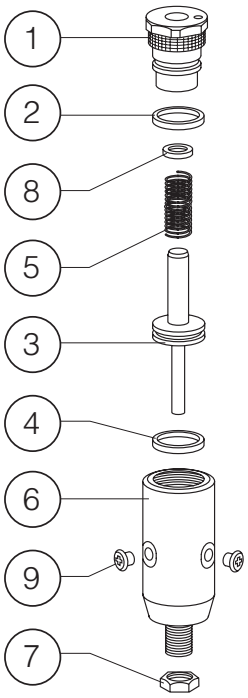
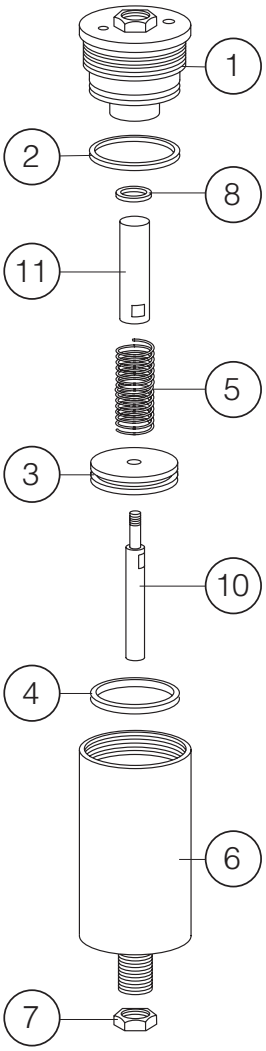
Mid Position Stop Unit Repair Kits

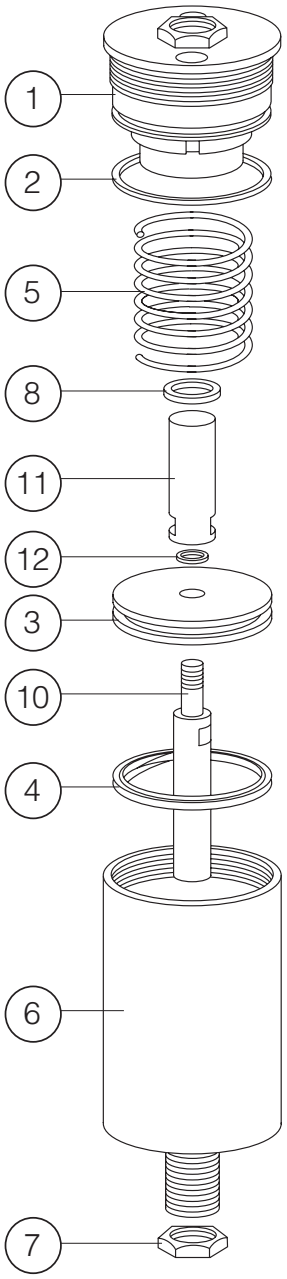
1	Bottom cap
2	O-Ring
3	Piston
4	Gasket
5	Spring
6	Body
7	Nut
8	O-Ring
9	Plug
10	Piston rod
11	End stroke stopper
12	O-ring



Sizes 10 & 12mm



Sizes 20 & 25mm



Sizes 35, 45 & 63mm

Repair Kits

Size Ø mm	**Order Code**
10	**P5WCM10M6RM**
12	**P5WCM12M6RM**
20	**P5WCM20M6RM**
25	**P5WCM25M6RM**
35	**P5WCM35M6RM**
45	**P5WCM45M6RM**
63	**P5WCM63M6RM**

Each kit contains O-rings and gasket seal.

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Safety Guide for Selecting and Using Hydraulic, Pneumatic Cylinders and Their Accessories

WARNING: ⚠ FAILURE OF THE CYLINDER, ITS PARTS, ITS MOUNTING, ITS CONNECTIONS TO OTHER OBJECTS, OR ITS CONTROLS CAN RESULT IN:

- **Unanticipated or uncontrolled movement of the cylinder or objects connected to it.**
- **Falling of the cylinder or objects held up by it.**
- **Fluid escaping from the cylinder, potentially at high velocity.**

THESE EVENTS COULD CAUSE DEATH OR PERSONAL INJURY BY, FOR EXAMPLE, PERSONS FALLING FROM HIGH LOCATIONS, BEING CRUSHED OR STRUCK BY HEAVY OR FAST MOVING OBJECTS, BEING PUSHED INTO DANGEROUS EQUIPMENT OR SITUATIONS, OR SLIPPING ON ESCAPED FLUID.

Before selecting or using Parker (The Company) cylinders or related accessories, it is important that you read, understand and follow the following safety information. Training is advised before selecting and using The Company's products.

1.0 General Instructions

1.1 Scope – This safety guide provides instructions for selecting and using (including assembling, installing, and maintaining) cylinder products. This safety guide is a supplement to and is to be used with the specific Company publications for the specific cylinder products that are being considered for use.

1.2 Fail Safe – Cylinder products can and do fail without warning for many reasons. All systems and equipment should be designed in a fail-safe mode so that if the failure of a cylinder product occurs people and property won't be endangered.

1.3 Distribution – Provide a free copy of this safety guide to each person responsible for selecting or using cylinder products. Do not select or use The Company's cylinders without thoroughly reading and understanding this safety guide as well as the specific Company publications for the products considered or selected.

1.4 User Responsibility – Due to very wide variety of cylinder applications and cylinder operating conditions, The Company does not warrant that any particular cylinder is suitable for any specific application. This safety guide does not analyze all technical parameters that must be considered in selecting a product. The hydraulic and pneumatic cylinders outlined in this catalog are designed to The Company's design guidelines and do not necessarily meet the design guideline of other agencies such as American Bureau of Shipping, ASME Pressure Vessel Code etc. The user, through its own analysis and testing, is solely responsible for:

- Making the final selection of the cylinders and related accessories.
- Determining if the cylinders are required to meet specific design requirements as required by the Agency(s) or industry standards covering the design of the user's equipment.
- Assuring that the user's requirements are met, OSHA requirements are met, and safety guidelines from the applicable agencies such as but not limited to ANSI are followed and that the use presents no health or safety hazards.
- Providing all appropriate health and safety warnings on the equipment on which the cylinders are used.

1.5 Additional Questions – Call the appropriate Company technical service department if you have any questions or require any additional information. See the Company publication for the product being considered or used, or call 1-800-CPARKER, or go to www.parker.com, for telephone numbers of the appropriate technical service department.

2.0 Cylinder and Accessories Selection

2.1 Seals – Part of the process of selecting a cylinder is the selection of seal compounds. Before making this selection, consult the "seal information page(s)" of the publication for the series of cylinders of interest.

The application of cylinders may allow fluids such as cutting fluids, wash down fluids etc. to come in contact with the external area of the cylinder. These fluids may attack the piston rod wiper and or the primary seal and must be taken into account when selecting and specifying seal compounds.

Dynamic seals will wear. The rate of wear will depend on many operating factors. Wear can be rapid if a cylinder is mis-aligned or if the cylinder has been improperly serviced. The user must take seal wear into consideration in the application of cylinders.

2.2 Piston Rods – Possible consequences of piston rod failure or separation of the piston rod from the piston include, but are not limited to are:

- Piston rod and or attached load thrown off at high speed.
- High velocity fluid discharge.
- Piston rod extending when pressure is applied in the piston retract mode.

Piston rods or machine members attached to the piston rod may move suddenly and without warning as a consequence of other conditions occurring to the machine such as, but not limited to:

- Unexpected detachment of the machine member from the piston rod.
- Failure of the pressurized fluid delivery system (hoses, fittings, valves, pumps, compressors) which maintain cylinder position.
- Catastrophic cylinder seal failure leading to sudden loss of pressurized fluid.
- Failure of the machine control system.

Follow the recommendations of the "Piston Rod Selection Chart and Data" in the publication for the series of cylinders of interest. The suggested piston rod diameter in these charts must be followed in order to avoid piston rod buckling.

Piston rods are not normally designed to absorb bending moments or loads which are perpendicular to the axis of piston rod motion. These additional loads can cause the piston rod to fail. If these types of additional loads are expected to be imposed on the piston rod, their magnitude should be made known to our engineering department.

The cylinder user should always make sure that the piston rod is securely attached to the machine member.

On occasion cylinders are ordered with double rods (a piston rod extended from both ends of the cylinder). In some cases a stop is threaded on to one of the piston rods and used as an external stroke adjuster. On occasions spacers are attached to the machine member connected to the piston rod and also used as a stroke adjuster. In both cases the stops will create a pinch point and the user should consider appropriate use of guards. If these external stops are not perpendicular to the mating contact surface, or if debris is trapped between the contact surfaces, a bending moment will be placed on the piston rod, which can lead to piston rod failure. An external stop will also negate the effect of cushioning and will subject the piston rod to impact loading. Those two (2) conditions can cause piston rod failure. Internal stroke adjusters are available with and without cushions. The use of external stroke adjusters should be reviewed with our engineering department.

The piston rod to piston and the stud to piston rod threaded connections are secured with an anaerobic adhesive. The strength of the adhesive decreases with increasing temperature. Cylinders which can be exposed to temperatures above +250°F (+121°C) are to be ordered with a non studded piston rod and a pinned piston to rod joint.

2.3 Cushions – Cushions should be considered for cylinder applications when the piston velocity is expected to be over 4 inches/second.

Cylinder cushions are normally designed to absorb the energy of a linear applied load. A rotating mass has considerably more energy than the same mass moving in a linear mode. Cushioning for a rotating mass application should be review by our engineering department.

2.4 Cylinder Mountings – Some cylinder mounting configurations may have certain limitations such as but not limited to minimum stroke for side or foot mounting cylinders or pressure de-ratings for certain mounts. Carefully review the catalog for these types of restrictions.

Always mount cylinders using the largest possible high tensile alloy steel socket head cap screws that can fit in the cylinder mounting holes and torque them to the manufacturer's recommendations for their size.

2.5 Port Fittings – Hydraulic cylinders applied with meter out or deceleration circuits are subject to intensified pressure at piston rod end.

The rod end pressure is approximately equal to:

$$\frac{\text{operating pressure x effective cap end area}}{\text{effective rod end piston area}}$$

Contact your connector supplier for the pressure rating of individual connectors.

3.0 Cylinder and Accessories Installation and Mounting

3.1 Installation

3.1.1 – Cleanliness is an important consideration, and cylinders are shipped with the ports plugged to protect them from contaminants entering the ports. These plugs should not be removed until the piping is to be installed. Before making the connection to the cylinder ports, piping should be thoroughly cleaned to remove all chips or burrs which might have resulted from threading or flaring operations.

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3.1.2 – Cylinders operating in an environment where air drying materials are present such as fast-drying chemicals, paint, or weld splatter, or other hazardous conditions such as excessive heat, should have shields installed to prevent damage to the piston rod and piston rod seals.

3.1.3 – Proper alignment of the cylinder piston rod and its mating component on the machine should be checked in both the extended and retracted positions. Improper alignment will result in excessive rod gland and/or cylinder bore wear. On fixed mounting cylinders attaching the piston rod while the rod is retracted will help in achieving proper alignment.

3.1.4 – Sometimes it may be necessary to rotate the piston rod in order to thread the piston rod into the machine member. This operation must always be done with zero pressure being applied to either side of the piston. Failure to follow this procedure may result in loosening the piston to rod-threaded connection. In some rare cases the turning of the piston rod may rotate a threaded piston rod gland and loosen it from the cylinder head. Confirm that this condition is not occurring. If it does, re-tighten the piston rod gland firmly against the cylinder head.

For double rod cylinders it is also important that when attaching or detaching the piston rod from the machine member that the torque be applied to the piston rod end of the cylinder that is directly attaching to the machine member with the opposite end unrestrained. If the design of the machine is such that only the rod end of the cylinder opposite to where the rod attaches to the machine member can be rotated, consult the factory for further instructions.

3.2 Mounting Recommendations

3.2.1 – Always mount cylinders using the largest possible high tensile alloy steel socket head screws that can fit in the cylinder mounting holes and torque them to the manufacturer's recommendations for their size.

3.2.2 – Side-Mounted Cylinders – In addition to the mounting bolts, cylinders of this type should be equipped with thrust keys or dowel pins located so as to resist the major load.

3.2.3 – Tie Rod Mounting – Cylinders with tie rod mountings are recommended for applications where mounting space is limited. The standard tie rod extension is shown as BB in dimension tables. Longer or shorter extensions can be supplied. Nuts used for this mounting style should be torqued to the same value as the tie rods for that bore size.

3.2.4 – Flange Mount Cylinders – The controlled diameter of the rod gland extension on head end flange mount cylinders can be used as a pilot to locate the cylinders in relation to the machine. After alignment has been obtained, the flanges may be drilled for pins or dowels to prevent shifting.

3.2.5 – Trunnion Mountings – Cylinders require lubricated bearing blocks with minimum bearing clearances. Bearing blocks should be carefully aligned and rigidly mounted so the trunnions will not be subjected to bending moments. The rod end should also be pivoted with the pivot pin in line and parallel to axis of the trunnion pins.

3.2.6 – Clevis Mountings – Cylinders should be pivoted at both ends with centerline of pins parallel to each other. After cylinder is mounted, be sure to check to assure that the cylinder is free to swing through its working arc without interference from other machine parts.

4.0 Cylinder and Accessories Maintenance, Troubleshooting and Replacement

4.1 Storage – At times cylinders are delivered before a customer is ready to install them and must be stored for a period of time. When storage is required the following procedures are recommended.

4.1.1 – Store the cylinders in an indoor area which has a dry, clean and noncorrosive atmosphere. Take care to protect the cylinder from both internal corrosion and external damage.

4.1.2 – Whenever possible cylinders should be stored in a vertical position (piston rod up). This will minimize corrosion due to possible condensation which could occur inside the cylinder. This will also minimize seal damage.

4.1.3 – Port protector plugs should be left in the cylinder until the time of installation.

4.1.4 – If a cylinder is stored full of hydraulic fluid, expansion of the fluid due to temperature changes must be considered. Installing a check valve with free flow out of the cylinder is one method.

4.1.5 – When cylinders are mounted on equipment that is stored outside for extended periods, exposed unpainted surfaces, e.g. piston rod, must be coated with a rust-inhibiting compound to prevent corrosion.

4.2 Cylinder Trouble Shooting

4.2.1 – External Leakage

4.2.1.1 – Rod seal leakage can generally be traced to worn or damaged seals. Examine the piston rod for dents, gouges or score marks, and replace piston rod if surface is rough.

Rod seal leakage could also be traced to gland wear. If clearance is excessive, replace rod bushing and seal. Rod seal leakage can also be traced to seal deterioration. If seals are soft or gummy or brittle, check compatibility of seal material with lubricant used if air cylinder, or operating fluid if hydraulic cylinder. Replace with seal material, which is compatible with these fluids. If the seals are hard or have lost elasticity, it is usually due to exposure to temperatures in excess of 165°F. (+74°C). Shield the cylinder from the heat source to limit temperature to 350°F. (+177°C.) and replace with fluorocarbon seals.

4.2.1.2 – Cylinder body seal leak can generally be traced to loose tie rods. Torque the tie rods to manufacturer's recommendation for that bore size.

Excessive pressure can also result in cylinder body seal leak. Determine maximum pressure to rated limits. Replace seals and retorque tie rods as in paragraph above. Excessive pressure can also result in cylinder body seal leak. Determine if the pressure rating of the cylinder has been exceeded. If so, bring the operating pressure down to the rating of the cylinder and have the tie rods replaced.

Pinched or extruded cylinder body seal will also result in a leak. Replace cylinder body seal and retorque as in paragraph above.

Cylinder body seal leakage due to loss of radial squeeze which shows up in the form of flat spots or due to wear on the O.D. or I.D. – Either of these are symptoms of normal wear due to high cycle rate or length of service. Replace seals as per paragraph above.

4.2.2 – Internal Leakage

4.2.2.1 – Piston seal leak (by-pass) 1 to 3 cubic inches per minute leakage is considered normal for piston ring construction. Virtually no static leak with lipseal type seals on piston should be expected. Piston seal wear is a usual cause of piston seal leakage. Replace seals as required.

4.2.2.2 – With lipseal type piston seals excessive back pressure due to over-adjustment of speed control valves could be a direct cause of rapid seal wear. Contamination in a hydraulic system can result in a scored cylinder bore, resulting in rapid seal wear. In either case, replace piston seals as required.

4.2.2.3 – What appears to be piston seal leak, evidenced by the fact that the cylinder drifts, is not always traceable to the piston. To make sure, it is suggested that one side of the cylinder piston be pressurized and the fluid line at the opposite port be disconnected. Observe leakage. If none is evident, seek the cause of cylinder drift in other component parts in the circuit.

4.2.3 – Cylinder Fails to Move the Load

4.2.3.1 – Pneumatic or hydraulic pressure is too low. Check the pressure at the cylinder to make sure it is to circuit requirements.

4.2.3.2 – Piston Seal Leak – Operate the valve to cycle the cylinder and observe fluid flow at valve exhaust ports at end of cylinder stroke. Replace piston seals if flow is excessive.

4.2.3.3 – Cylinder is undersized for the load – Replace cylinder with one of a larger bore size.

4.3 Erratic or Chatter Operation

4.3.1 – Excessive friction at rod gland or piston bearing due to load misalignment – Correct cylinder-to-load alignment.

4.3.2 – Cylinder sized too close to load requirements – Reduce load or install larger cylinder.

4.3.3 – Erratic operation could be traced to the difference between static and kinetic friction. Install speed control valves to provide a back pressure to control the stroke.

4.4 Cylinder Modifications, Repairs, or Failed Component – Cylinders as shipped from the factory are not to be disassembled and or modified. If cylinders require modifications, these modifications must be done at company locations or by The Company's certified facilities. The Cylinder Division Engineering Department must be notified in the event of a mechanical fracture or permanent deformation of any cylinder component (excluding seals). This includes a broken piston rod, tie rod, mounting accessory or any other cylinder component. The notification should include all operation and application details. This information will be used to provide an engineered repair that will prevent recurrence of the failure.

It is allowed to disassemble cylinders for the purpose of replacing seals or seal assemblies. However, this work must be done by strictly following all the instructions provided with the seal kits.

Offer of Sale

The items described in this document and other documents or descriptions provided by Parker Hannifin Corporation, its subsidiaries and Divisions ("Company") and its authorized distributors, are hereby offered for sale at prices to be established by the Company, its subsidiaries and its authorized distributors. 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 such item, when communicated to the Company, its subsidiary or an authorized distributor ("Seller") verbally or in writing, shall constitute acceptance of this offer.

1. Terms and Conditions of Sale: All descriptions, quotations, proposals, offers, acknowledgments, acceptances and sales of Seller's products are subject to and shall be governed exclusively by the terms and conditions stated herein. Buyer's acceptance of any offer to sell is limited to these terms and conditions. Any terms or conditions in addition to, or inconsistent with those stated herein, proposed by Buyer in any acceptance of an offer by Seller, are hereby objected to. No such additional, different or inconsistent terms and conditions shall become part of the contract between Buyer and Seller unless expressly accepted in writing by Seller. Seller's acceptance of any offer to purchase by Buyer is expressly conditional upon Buyer's assent to all the terms and conditions stated herein, including any terms in addition to, or inconsistent with those contained in Buyer's offer. Acceptance of Seller's products shall in all events constitute such assent.

2. Payment: Payment shall be made by Buyer net 30 days from the date of delivery of the items purchased hereunder. Amounts not timely paid shall bear interest at the maximum rate permitted by law for each month or portion thereof that the Buyer is late in making payment. Any claims by Buyer for omissions or shortages in a shipment shall be waived unless Seller receives notice thereof within 30 days after Buyer's receipt of the shipment.

3. Delivery: Unless otherwise provided on the face hereof, delivery shall be made F.O.B. Seller's plant. Regardless of the method of delivery, however, risk of loss shall pass to Buyer upon Seller's delivery to a carrier. Any delivery dates shown are approximate only and Seller shall have no liability for any delays in delivery.

4. Warranty: Seller warrants that the items sold hereunder shall be free from defects in material or workmanship for a period of 18 months from date of shipment from the Company. **THIS WARRANTY COMPRISES THE SOLE AND ENTIRE WARRANTY PERTAINING TO ITEMS PROVIDED HEREUNDER. SELLER MAKES NO OTHER WARRANTY, GUARANTEE, OR REPRESENTATION OF ANY KIND WHATSOEVER. ALL OTHER WARRANTIES, INCLUDING BUT NOT LIMITED TO, MERCHANTABILITY AND FITNESS FOR PURPOSE, WHETHER EXPRESS, IMPLIED, OR ARISING BY OPERATION OF LAW, TRADE USAGE, OR COURSE OF DEALING ARE HEREBY DISCLAIMED.**

NOTWITHSTANDING THE FOREGOING, THERE ARE NO WARRANTIES WHATSOEVER ON ITEMS BUILT OR ACQUIRED WHOLLY OR PARTIALLY, TO BUYER'S DESIGN OR SPECIFICATIONS.

5. Limitation of Remedy: SELLER'S LIABILITY ARISING FROM OR IN ANY WAY CONNECTED WITH THE ITEMS SOLD OR THIS CONTRACT SHALL BE LIMITED EXCLUSIVELY TO REPAIR OR REPLACEMENT OF THE ITEMS SOLD OR REFUND OF THE PURCHASE PRICE PAID BY BUYER, AT SELLER'S SOLE OPTION. IN NO EVENT SHALL SELLER BE LIABLE FOR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES OF ANY KIND OR NATURE WHATSOEVER, INCLUDING BUT NOT LIMITED TO LOST PROFITS ARISING FROM OR IN ANY WAY CONNECTED WITH THIS AGREEMENT OR ITEMS SOLD HEREUNDER, WHETHER ALLEGED TO ARISE FROM BREACH OF CONTRACT, EXPRESS OR IMPLIED WARRANTY, OR IN TORT, INCLUDING WITHOUT LIMITATION, NEGLIGENCE, FAILURE TO WARN OR STRICT LIABILITY.

6. Changes, Reschedules and Cancellations: Buyer may request to modify the designs or specifications for the items sold hereunder as well as the quantities and delivery dates thereof, or may request to cancel all or part of this order, however, no such requested modification or cancellation shall become part of the contract between Buyer and Seller unless accepted by Seller in a written amendment to this Agreement. Acceptance of any such requested modification or cancellation shall be at Seller's discretion, and shall be upon such terms and conditions as Seller may require.

7. Special Tooling: A tooling charge may be imposed for any special tooling, including without limitations, dies, fixtures, molds and patterns, acquired to manufacture items sold pursuant to this contract. 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 items sold hereunder, 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.

8. 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 (2) 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.

9. Taxes: Unless otherwise indicated on the face hereof, 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 the items sold hereunder. If any such taxes must be paid by Seller or if Seller is liable for the collection of such tax, the amount thereof shall be in addition to the amounts for the items sold. Buyer agrees to pay all such taxes or to reimburse Seller therefore upon receipt of its invoice. If Buyer claims exemption from any sales, use or other tax imposed by any taxing authority, Buyer shall save Seller harmless from and against any such tax, together with any interest or penalties thereon which may be assessed if the items are held to be taxable.

10. 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 Part 10. Seller will defend and indemnify Buyer against allegations of infringement of U.S. patents, U.S. trademarks, copyrights, trade dress and trade secrets (hereinafter "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 an item sold pursuant to this contract 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 an item sold hereunder 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 said item, replace or modify said item so as to make it noninfringing, or offer to accept return of said item 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 items 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 item sold hereunder. The foregoing provisions of this Part 10 shall constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for infringement of Intellectual Property Rights.

If a claim is based on information provided by Buyer or if the design for an item delivered hereunder is specified in whole or in part by Buyer, Buyer shall defend and indemnify Seller for all costs, expenses or judgements resulting from any claim that such item infringes any patent, trademark, copyright, trade dress, trade secret or any similar right.

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

12. Entire Agreement/Governing Law: The terms and conditions set forth herein, together with any amendments, modifications and any different terms or conditions expressly accepted by Seller in writing, shall constitute the entire Agreement concerning the items sold, and there are no oral or other representations or agreements which pertain thereto. This Agreement shall be governed in all respects by the law of the State of Ohio. No actions arising out of sale of the items sold hereunder or this Agreement may be brought by either party more than two (2) years after the cause of action accrues.

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