



# ***HTR Hydraulic Rotary Actuators***

*For working pressures up to 210 bar*

*Catalogue HY07-1220/UK  
November 2002*



**HTR Rotary Actuators**

The HTR Series of heavy duty hydraulic rack and pinion rotary actuators converts fluid power into rotary motion. They are suitable for a wide variety of applications, including material handling and valve actuation, in industries as diverse as machine tools, primary metals, mining and oil field equipment.

HTR Series rotary actuators employ conventional tie rod cylinder construction and are rated for use at working pressures up to 210 bar. The pinion and output shaft are supported in large tapered roller bearings, allowing the unit to

support high external and thrust loads. All HTR Series rotary actuators feature a high strength, ductile iron housing, for ease of mounting and good shock resistance.

In addition to the standard HTR Series rotary actuators described in this catalogue, special designs can be produced to suit customer requirements. Our engineers will be pleased to advise on unique designs to meet specific applications.

<b>Contents</b>	<b>Page</b>	<b>Index</b>	<b>Page</b>
Applications	3	Air Bleeds	8
Design Features and Benefits	4	Applications	
General Specifications	5	– Data Check List	17
Dimensions	6	– General	3
Mounting Styles	8	Bearing Load Capacities	13
Port Sizes and Positions	8	Construction	4
Air Bleeds	8	Cushioning	4, 10
Shaft Options	9	Design Features and Benefits	4
Cushioning	10	Dimensions	6, 7
Piston Seals	12	Feedback Devices	15
Seal Kits	12	Filtration	12
Filtration	12	Maintenance	16
Stroke Adjusters	12	Model Numbers	16
Bearing Load Capacities	13	Mounting Styles	8
Position Switches	14	Ordering Information	16
Feedback Devices	15	Pistons and Seals	4, 12
Ordering Information	16	Port Positions	8
Maintenance and Spare Parts	16	Port Sizes	8
Applications Data Check List	17	Position Switches	14
		Rack and Pinion	4
		Seals and Seal Kits	4, 12
		Selection – Check List	17
		Shaft Options	4, 9
		Spare Parts	16
		Specifications	3, 5
		Stroke Adjusters	12
		Torque Outputs	5
		Weights	5

**Parker Hannifin Corporation . . .**

is a world leader in the manufacture of components and systems for motion control. Parker has more than 800 product lines for hydraulic, pneumatic and electro-mechanical applications in some 1200 industrial and aerospace markets. With over 45,000 employees and some 210 manufacturing plants and administrative offices around the world, Parker provides its customers with technical excellence and first class customer service.

Parker Hannifin's Cylinder Division is the world's largest supplier of hydraulic actuators and accumulators for industrial applications.

In addition to the HTR Series of rotary actuators featured in this catalogue, Parker also manufactures a wide range of other hydraulic and electro-hydraulic actuator products. Linear actuators are available in a wide range of sizes, mounting styles and operating pressures.

Catalogues describing our standard products are available on request from your nearest Parker sales office – see rear cover for addresses. Where an application demands a non-standard approach, special products can be designed to order – our engineers will be pleased to advise.

Note: In line with our policy of continuing product improvement, specifications in this catalogue are subject to change without notice.

**Why use a Rotary Actuator?**

- provides uniform torque in both directions
- simple, compact design
- wide range of sizes
- high torque output from a small envelope
- no external linkage needed for rotary motion
- excellent holding capability
- rotation can be specified to suit application
- will support radial and thrust loads

**Specifications**

- Max. non-shock operating pressure 210 bar
- Design pressure 315 bar
- Rotational range Standard – 90°, 180°, 360°  
Special order – any rotation to a maximum of 1800°
- Rotational tolerance -0°, +2°
- Output torque at 210 bar 100 – 68000Nm
- Min. operating pressure 5 bar
- Max. angular backlash –  
HTR.9 – HTR10 30 minutes  
HTR15 – HTR150 15 minutes  
HTR300 – HTR600 10 minutes
- Self-energizing, wear-compensating polyurethane piston seals

**Optional Features**

HTR Series rotary actuators are available with a wide range of options including port positions, cushioning, different seal types and mounting styles. Feedback devices and proximity sensors can be fitted to provide fine control of position and velocity.

**Rotary Actuator Application Guide**

Full guidance for the selection and application of rotary actuators is available in the Rotary Actuator Application Guide – please ask for catalogue no. 1230.

**Typical Rotary Actuator Applications****Power Generation**

Gas Turbines

- Diverter flap valves

Nuclear

- Fail-safe valve operation, typically using different sizes of rack and piston with one side 'pushing' against an accumulator

**Steel and Aluminium Mills**

- coil boxes in rolling mills, using a back-and-forth rolling action to reduce ingots to slabs, then strips
- walking beam, for moving material
- pickling process in tube mill, for immersion/agitation of tubes in sulphuric acid tank
- ladle turrets on continuous-casting process, with slotted mounts to allow for thermal expansion
- crust breaking

**Safety Systems**

- fire door closure, using a spring-return actuator cylinder and fitted with high temperature seals

**Petro-Chemical Industries**

- process control valves

**Satellite/Aeronautical**

- pre-launch disconnection of monitoring and loading equipment

**Tyre Industry**

- drop valves for rubber mixing/processing, using high temperature seals

**Marine Engineering**

- trim and drain valves
- missile tube closure systems

**Handling Systems**

- self-unloading mechanisms for bulk carriers

**General Engineering**

- dumping, indexing, bending, screwing, clamping & toggle clamping

## 1 Rack and Pinion

Maximum strength and shock resistance result from the use of through-hardened chrome alloy steel for the rack and for the one-piece pinion and output shaft. Gears are packed with molybdenum disulphide grease on assembly, to reduce wear and prolong gear life under conditions of extreme pressure.

## 2 Bronze Rack Bearings

Generous support for the rack is provided by a bronze rack bearing, reducing wear and extending pinion life. The bronze rack bearing, a standard feature on HTR15 models and above, is available as an option on smaller units.

## 3 Gear Housing

High strength ductile iron provides resistance to shock loads under the most arduous operating conditions. Four mounting holes in both the front and rear faces permit flexibility in machine design, with base and pilot mounting styles available as options.

## 6 Tie Rod Cylinders

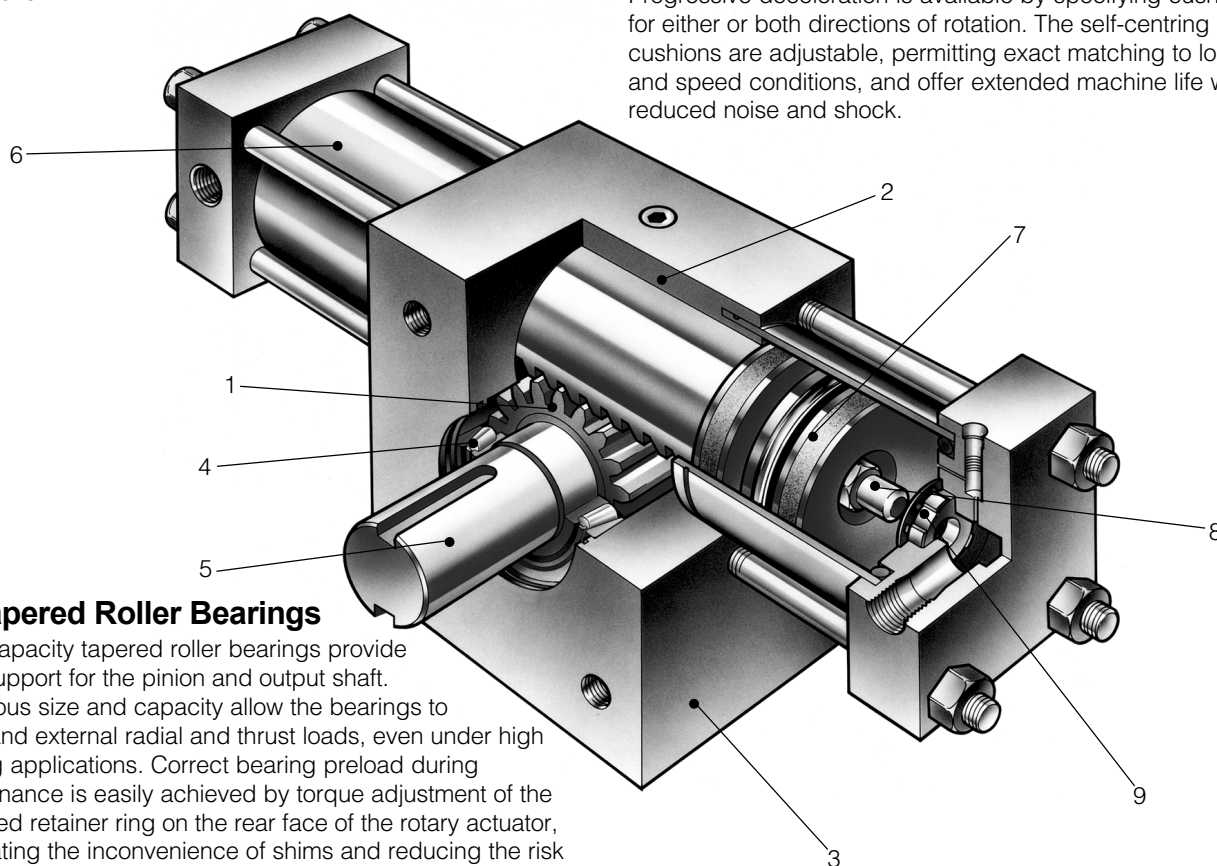
Proven tie rod construction, using standard cylinder bore sizes, guarantees reliability and ease of maintenance for the hydraulic cylinders which drive the rack and pinion. Heavy-walled alloy steel tubing is micro-finished for long piston and seal life, while tie rods are drawn from alloy steel, with precision rolled threads for high strength and resistance to fatigue.

## 7 Pistons and Seals

Rugged one-piece steel pistons (not HTR.9 or HTR1.8) are fitted as standard with polyurethane seals and PTFE wear rings, preventing metal-to-metal contact. The piston seals are self-compensating for long life and reduced maintenance and, subject to access, seals and wear rings can be inspected or replaced without removing the actuator from the machine.

## 8 Cushioning

Progressive deceleration is available by specifying cushions for either or both directions of rotation. The self-centring cushions are adjustable, permitting exact matching to load and speed conditions, and offer extended machine life with reduced noise and shock.



## 4 Tapered Roller Bearings

High capacity tapered roller bearings provide rigid support for the pinion and output shaft. Generous size and capacity allow the bearings to withstand external radial and thrust loads, even under high cycling applications. Correct bearing preload during maintenance is easily achieved by torque adjustment of the threaded retainer ring on the rear face of the rotary actuator, eliminating the inconvenience of shims and reducing the risk of damage to the bearing through incorrect adjustment.

## 5 Shaft Options

A plain male shaft with two keyways, the most widely used style of shaft, is supplied as standard with all HTR Series rotary actuators. The keyways are set at the 12- and 6-o'clock positions at mid-stroke for ease of positioning and assembly, and are as large as possible to ensure maximum strength. Shaft options include a female shaft with keyway, and male and female splined types. Both single and double shaft options are available, providing the greatest possible flexibility for the machine designer.

## 9 Floating Cushion Bushes

Closer tolerances – and therefore more effective cushioning – are permitted by the use of floating cushion bushes. Lifting of the bronze cushion bush minimises fluid restriction to the start of the return stroke, allowing full pressure to be applied over the whole area of the piston, to provide full power and rapid cycle times.

## Advantages of Parker's Rack and Pinion Rotary Actuators

- **Cost-effectiveness** – especially above 90°, where linear actuators need increasingly intricate linkages to generate rotary motion.
- **Simplicity** – a rotary actuator with a hollow, or female, shaft can replace support bearings and pillow blocks, due to the high load capacity of the bearings.
- **Resistance to Hostile Environments** – no extending/retracting sealing surfaces exposed to abrasive or corrosive substances. Special materials and coatings ensure long life in arduous usage.
- **Ease of Maintenance** – servicing of pistons and seals can be carried out with the actuator in place on the machine, subject to access.
- **Leakage Resistance** – pressurized fluid is remote from the output side of the mechanism; piston seals are the only dynamic seals subject to system pressure.
- **Long Life** – the rack/pinion/bearing assembly is packed with molybdenum grease on assembly and does not come into contact with hydraulic fluid.
- **Premium Quality** – every Parker rotary actuator is proof tested before shipping.

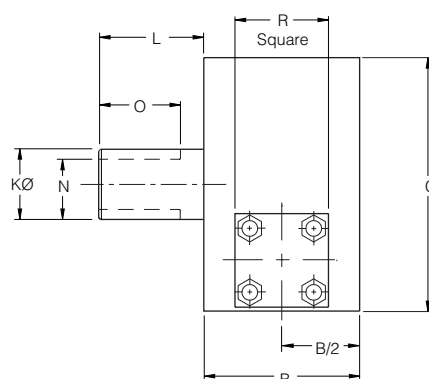
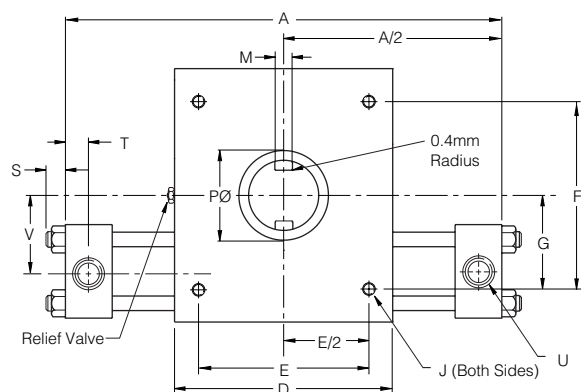
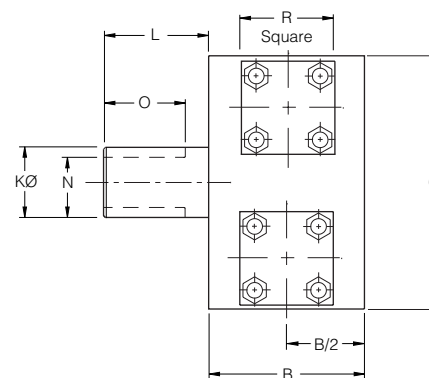
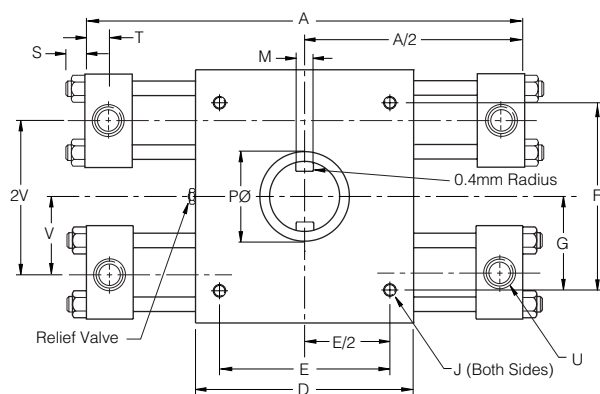
## General Specification – Volumes

Model		cm <sup>3</sup> per degree	cm <sup>3</sup> per radian	Displacement - cm <sup>3</sup>		
Single Rack	Double Rack			90° Rotation	180° Rotation	360° Rotation
HTR.9		0.1	6	9	19	37
	HTR1.8	0.2	12	19	37	74
HTR3.7		0.4	25	40	80	159
	HTR7.5	0.9	51	79	159	318
HTR5		0.6	33	51	102	205
	HTR10	1.1	65	102	205	410
HTR15		1.6	93	145	291	582
	HTR30	3.2	185	291	582	1164
HTR22		2.5	145	227	455	910
	HTR45	5.1	290	455	910	1819
HTR75		8.4	480	754	1508	3016
	HTR150	17	960	1508	3016	6032
HTR300		32	1855	2913	5827	11653
	HTR600	65	3707	5823	11645	23290

## General Specification – Torque Outputs, Pressure Ratings and Weights

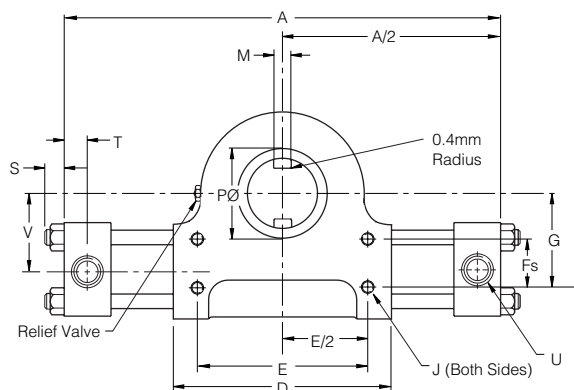
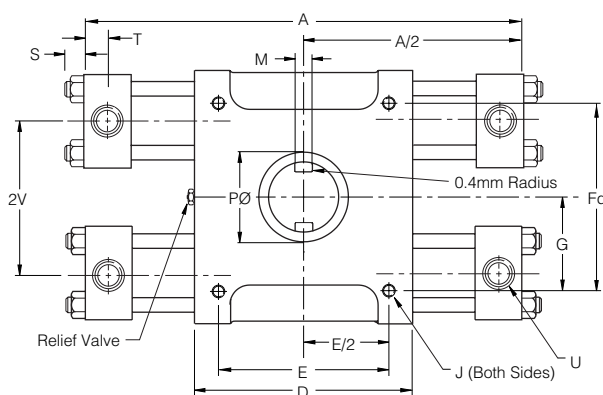
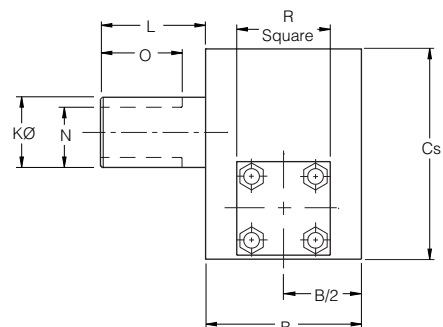
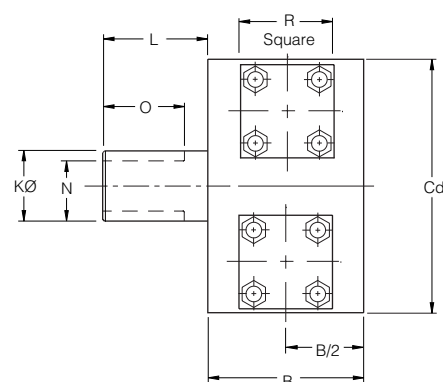
Model		Continuous Duty <sup>1</sup>		Intermittent Duty <sup>2</sup>		Static Duty <sup>3</sup>		Weights – kg		
Single Rack	Double Rack	Torque Nm	Pressure bar	Torque Nm	Pressure bar	Torque Nm	Pressure bar	90° Rotation	180° Rotation	360° Rotation
HTR.9		80	160	100	210	100	210	5	6	9
	HTR1.8	160	160	200	210	200	210	7	9	11
HTR3.7		260	125	390	190	420	210	13	14	17
	HTR7.5	540	130	800	200	850	210	16	19	24
HTR5		330	120	495	180	565	210	17	18	22
	HTR10	700	130	1000	190	1130	210	20	25	30
HTR15		960	115	1440	175	1700	210	25	27	32
	HTR30	2000	120	3000	190	3400	210	40	44	53
HTR22		960	80	1440	115	1700	140	27	30	36
	HTR45	2000	80	3000	120	3400	140	45	49	61
HTR75		4500	110	6750	165	8500	210	90	100	120
	HTR150	9500	115	14200	170	17000	210	146	167	206
HTR300		13000	80	19500	120	34000	210	345	382	414
	HTR600	28000	85	42000	130	68000	210	505	573	709

<sup>1</sup> Continuous duty – >10<sup>7</sup> cycles    <sup>2</sup> Intermittent duty – <10<sup>4</sup> cycles    <sup>3</sup> Static duty – maximum rating (no dynamic loads)

**HTR.9 to HTR5  
Single Rack Models****HTR1.8 to HTR10  
Double Rack Models****Dimensions – with Face Mount and Male Keyed Shaft**

Model	Bore	Rotation	A max.	B	C	Cd	Cs	D	E ±0.13	F ±0.13	Fd ±0.13	Fs ±0.13	G
HTR.9	22.2	90°	190	76	92.5	-	-	89	70	60	-	-	30
HTR1.8		180°	237										
		360°	333										
HTR3.7	38.1	90°	257	100	133.5	-	-	102	75	90	-	-	45
HTR7.5		180°	333										
		360°	464										
HTR5	50.8	90°	289	100	152.5	-	-	102	75	125	-	-	62.5
HTR10		180°	372										
		360°	562										
HTR15	63.5	90°	406	127	-	-	175	178	150	-	-	50	85
HTR30		180°	543			206.5	-				170	-	
		360°	816			-	176				-	50	
HTR22	101.6	90°	416	127	-	-	176	178	150	-	-	115	145
HTR45		180°	553			213	-				170	-	
		360°	822			-	254				-	125	
HTR75	152.4	90°	514	191	-	-	387	216	165	-	-	125	195
HTR150		180°	702			327	-				290	-	
		360°	1073			-	476.5				350	-	
HTR300	152.4	90°	794	305	-	-	387	403	330	-	-	125	195
HTR600		180°	1111			476.5	-				350	-	
		360°	1749										

All dimensions are in millimetres unless otherwise stated.

**HTR15 to HTR300  
Single Rack Models****HTR30 to HTR600  
Double Rack Models****Dimensions – with Face Mount and Male Keyed Shaft**

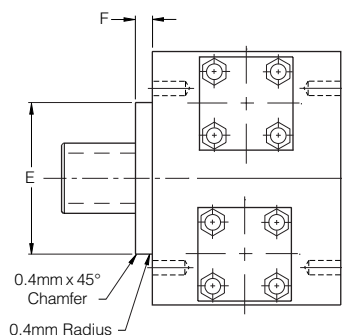
Model	Bore	J	K +0.00 -0.02	L	M P9	N	O	P	R	S	T	U (BSPP)	V
HTR.9	22.2	M8 x 1.25 x 13	22	33	6	18.5 <sup>+0.0</sup> <sub>-0.1</sub>	25	25	45	10	13	G <sup>1</sup> / <sub>4</sub>	24
HTR1.8													
HTR3.7	38.1	M10 x 1.5 x 16	28	48	8	24 <sup>+0.0</sup> <sub>-0.2</sub>	38	38	64	13	18	G <sup>1</sup> / <sub>4</sub>	35
HTR7.5													
HTR5													
HTR10	50.8	M10 x 1.5 x 16	44	66	12	39 <sup>+0.0</sup> <sub>-0.2</sub>	50	45	64	13	18	G <sup>1</sup> / <sub>4</sub>	41
HTR15													
HTR22	63.5	M12 x 1.75 x 19	54	86	16	48 <sup>+0.0</sup> <sub>-0.2</sub>	60	73	89	16	18	G <sup>1</sup> / <sub>2</sub>	62
HTR45													
HTR75	101.6	M20 x 2.5 x 30	76	115	22	67 <sup>+0.0</sup> <sub>-0.2</sub>	85	95	127	26	21	G <sup>3</sup> / <sub>4</sub>	89
HTR150													
HTR300	152.4	M30 x 3.5 x 48	125	190	32	114 <sup>+0.0</sup> <sub>-0.2</sub>	152	165	191	32	32	G1	130
HTR600													

All dimensions are in millimetres unless otherwise stated.

## Base and Pilot Mountings

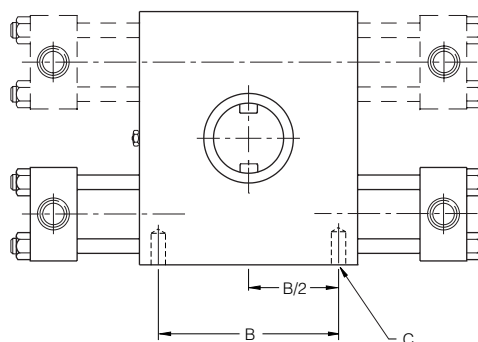
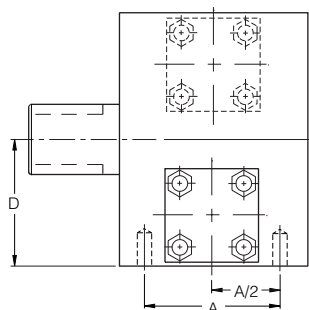
HTR Series rotary actuators are available with the options of face, base or pilot mounting styles, to suit the requirements of different applications. Mounting dimensions for the face

mounting styles are shown with other major dimensions on pages 6 and 7. The equivalent dimensions for base and pilot mounting styles are shown in the table.



Model	Base Mounting				Pilot Mounting	
	A	B	C	D	E <sup>+0</sup> <sub>-0.05mm</sub>	F
HTR.9 & 1.8	60	70	M8x1.25 x 13	46.1	47.625	6.5
HTR3.7 & 7.5	75	75	M10x1.5 x 16	66.7	66.675	6.5
HTR5 & 10	75	75	M10x1.5 x 16	76.2	73.025	6.5
HTR15 & 22	100	150	M12x1.75 x 19	103.2	107.950	10
HTR30 & 45	100	150	M12x1.75 x 19	106.4	107.950	10
HTR75 & 150	145	165	M20x2.5 x 30	163.5	139.700	10
HTR300 & 600	240	330	M30x3.5 x 48	238.2	222.250	12

## Pilot Mounting



## Base Mounting

## Port Sizes and Positions

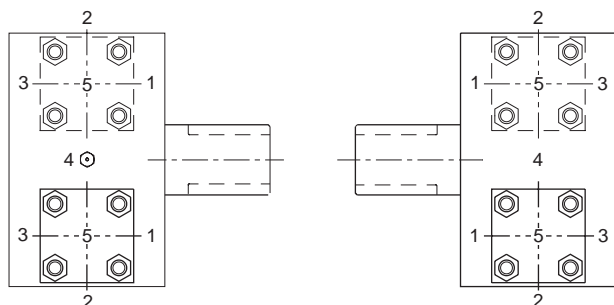
The standard port style for HTR Series rotary actuators is a BSP (parallel) port, but NPTF, SAE, and metric port styles to DIN 3852/1 and ISO 6149/1 are also available. The relevant sizes of port for each model of rotary actuator are shown in the table.

Ports will be supplied in position 1, as shown in the diagram, unless a different position is specified on the order. Ports are available in positions 2, 3 and 4 at no extra cost; position 5 is available as an extra cost option.

Model	BSP	Metric DIN & ISO	SAE	NPTF
HTR.9 & 1.8	G <sup>1</sup> / <sub>4</sub>	M14 x 1.5	<sup>9</sup> / <sub>16</sub> -18 (SAE 6)	<sup>1</sup> / <sub>4</sub>
HTR3.7 & 7.5	G <sup>1</sup> / <sub>4</sub>	M14 x 1.5	<sup>9</sup> / <sub>16</sub> -18 (SAE 6)	<sup>1</sup> / <sub>4</sub>
HTR5 & 10	G <sup>1</sup> / <sub>4</sub>	M14 x 1.5	<sup>9</sup> / <sub>16</sub> -18 (SAE 6)	<sup>1</sup> / <sub>4</sub>
HTR15 & 22	G <sup>1</sup> / <sub>2</sub>	M22 x 1.5	<sup>3</sup> / <sub>4</sub> -16 (SAE 8)	<sup>1</sup> / <sub>2</sub>
HTR30 & 45	G <sup>1</sup> / <sub>2</sub>	M22 x 1.5	<sup>3</sup> / <sub>4</sub> -16 (SAE 8)	<sup>1</sup> / <sub>2</sub>
HTR75 & 150	G <sup>3</sup> / <sub>4</sub>	M27 x 2	1 <sup>1</sup> / <sub>16</sub> -12 (SAE 12)	<sup>3</sup> / <sub>4</sub>
HTR300 & 600	G1	M33 x 2	1 <sup>5</sup> / <sub>16</sub> -12 (SAE 16)	1

## Air Bleeds

These may be fitted in positions unoccupied by ports.

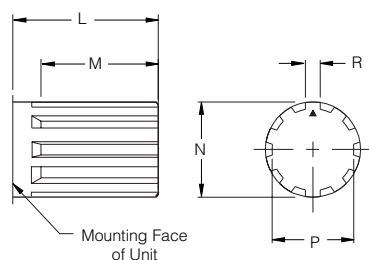


All dimensions are in millimetres unless otherwise stated.

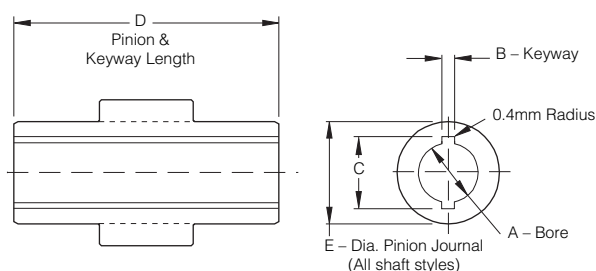


**Shaft Options**

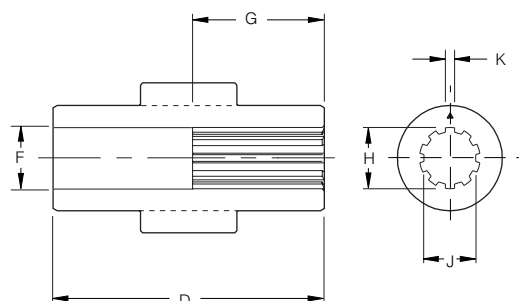
Keyed and splined shaft designs are available for the HTR Series rotary actuators, in both male and female forms. The standard male, twin key shaft style is illustrated with other major dimensions on pages 6 and 7, while other shaft options are shown below. All the shaft options illustrated are shown in the mid-stroke position.

**Male Splined Shaft****Male Splined Shaft to DIN/ISO 14**

Model	L	M	N <sub>a11</sub>	P	R	No. of splines
HTR.9 & 1.8	33	22	22	18	5	6
HTR3.7 & 7.5	48	32	28	23	6	6
HTR5 & 10	66	44	42	36	7	8
HTR15 & 30	86	58	54	46	9	8
HTR22 & 45	86	58	54	46	9	8
HTR75 & 150	115	76	72	62	12	8
HTR300 & 600	190	125	125	112	18	10

**Female Keyed Shaft****Female Keyed Shaft to DIN 6885**

Model	A <sub>H7</sub>	B <sub>P9</sub>	C <sup>+0.4</sup>	D	E
HTR.9 & 1.8	16	5	20.6	74.6	25.4
HTR3.7 & 7.5	22	6	27.6	98.4	38.1
HTR5 & 10	32	10	38.6	98.4	44.5
HTR15 & 30	48	14	55.6	125.4	73.0
HTR22 & 45	48	14	55.6	125.4	73.0
HTR75 & 150	72	20	81.8	188.9	95.2
HTR300 & 600	125	32	139.8	303.2	165.1

**Female Splined Shaft****Female Splined Shaft to DIN/ISO 14**

Model	D	F	G	H <sub>H10</sub>	J <sub>H7</sub>	K	No. of splines
HTR.9 & 1.8	74.6	17	16	16	13	3.5	6
HTR3.7 & 7.5	98.4	23	22	22	18	5	6
HTR5 & 10	98.4	29	29	28	23	6	6
HTR15 & 30	125.4	49	50	48	42	8	8
HTR22 & 45	125.4	49	50	48	42	8	8
HTR75 & 150	188.9	73	76	72	62	12	8
HTR300 & 600	303.2	126	127	125	112	18	10

All dimensions are in millimetres unless otherwise stated.

**Cushions and  
Cushion Adjustment Location**

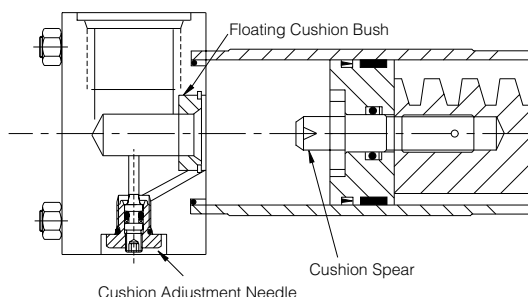
Cushioning is recommended as a means of controlling the deceleration of masses. Machine life is extended as a result of the reduced shock, permitting faster cycle times with lower levels of noise. Cushions are recommended for high kinetic energy applications and/or where the full rotation of the actuator is being used. They are available as an option on all HTR Series rotary actuators, for one or both rotations, and do not affect the actuator's envelope or mounting dimensions. For the HTR Series rotary actuator, the standard angle of cushioning is 20° (0.349 rads).

Each cushion is adjustable individually, allowing cushion performance to be matched to the application. The positions of cushion adjusters, relative to port positions, are shown in the table – numbers relate to the diagram of port positions on page 8.

\* Single rack models only

Port Position	Cushion Position
1	2
2	3
3	2
4*	3
5	2

**Note: Where cushioning is required on double rack units, the High Performance Cushion option described on page 11 should be specified.**



Note that cushion performance will be affected by the use of high water content fluids. Please consult the factory for details.

The energy absorption capacity of the cushion decreases with drive pressure, which in normal circuits is the relief valve pressure.

**Formulae**

For a load that moves in the horizontal plane, only the kinetic energy need be considered. If the load is to move vertically, then the potential energy change of the load during cushioning must also be taken into account. Both conditions are described by the following equations. The resulting figure for energy to be absorbed can then be applied to the graph of Cushion Energy Absorption Capacity, to identify a rotary actuator with adequate cushion capacity. **Note: the graph of Cushion Energy Absorption Capacity should only be used for initial sizing. For accurate sizing, please contact the factory.**

For masses moving horizontally:

$$E = \frac{1}{2} J_m \omega^2$$

For masses moving downwards:

$$E = \frac{1}{2} J_m \omega^2 + mgR\theta$$

For masses moving upwards:

$$E = \frac{1}{2} J_m \omega^2 - mgR\theta$$

Where:

- E = energy to be absorbed, Joules
- $J_m$  = rotational mass moment of inertia,  $\text{kgm}^2$
- $\omega$  = rotational velocity of load, rads/sec
- m = mass of load, kg
- g = acceleration due to gravity,  $9.81\text{m/s}^2$
- R = radius of rotation, m
- $\theta$  = angle of cushioning, radians ( $0.349\text{ rads} = 20^\circ$ )

**Example**

P = 100 bar

m = 200 kg

R = 0.2 m

$\omega$  = 6 rpm

Standard cushions =  $20^\circ = 0.349\text{ rads}$ .

$$E = \frac{1}{2} J_m \omega^2 + mgR\theta$$

$$E = \left( \frac{1}{2} \times [200 \times 0.2^2] \times \left[ 6 \times \frac{2\pi}{60} \right]^2 \right) + (200 \times 9.81 \times 0.2 \times 0.349)$$

$$E = 1.6 + 136.9$$

$$E = 138.5\text{ Joules}$$

From the graph of Cushion Energy Absorption Capacity, it can be seen that an HTR7.5 (double rack unit) is capable of absorbing this energy where the High Performance Cushion option is specified. An HTR15 (single rack unit) is also capable of absorbing this energy.

## High Performance Cushions

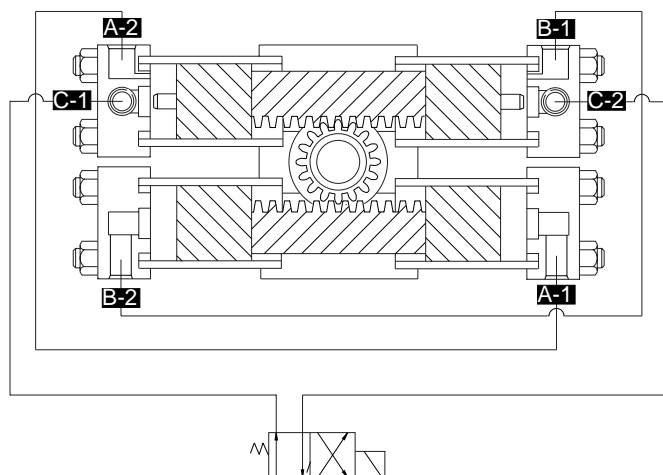
The High Performance Cushion option can only be specified on double rack rotary actuators. Double rack rotary actuators can achieve very high torques, which need to be decelerated at the end of the movement. This cushion energy is absorbed efficiently by the use of High Performance Cushions. External piping ensures that during cushioning the maximum deceleration torque is available. External interconnecting pipework for the High Performance Cushion is not supplied with the rotary actuator.

### Operation

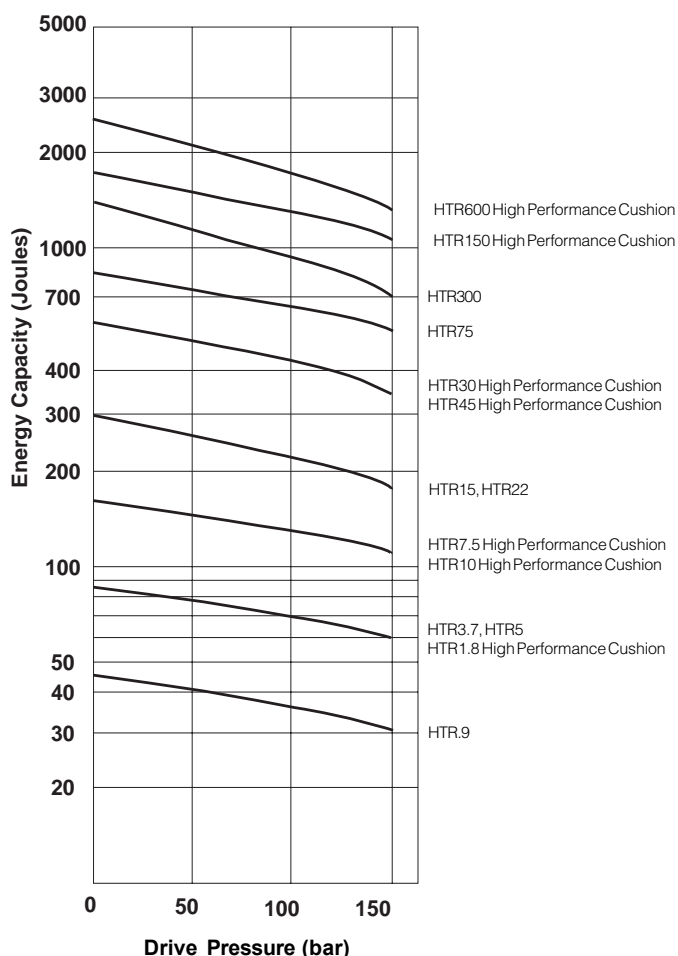
The work ports of a standard directional valve are connected directly to ports C-1 and C-2 of the rotary actuator, as shown. Port A-1 is connected directly to A-2, and B-1 is connected directly to B-2. When pressure is applied directly to port C-1 (clockwise shaft rotation), fluid is also directed through line A to the other rack. Exhaust flow from B-1 and B-2 is directed through the cushion bush and cushion adjustment screw until the cushion spear closes off the main passage. The total flow from both end caps is then directed across one cushion adjustment screw, equalizing back pressure and improving cushion performance. Pressurizing C-2 and exhausting C-1 reverses the operation.

### Notes

1. Pipework between A-1 and A-2, and B-1 and B-2 should be kept to a minimum to reduce the inertia of the fluid. Fluid flow should be less than 5m/s.
2. Connection ports will have the same specification as the working ports.



## Cushion Energy Absorption Capacity – All Cushion Options



**Note:** Cushion performance may be affected by the addition of a stroke limiter. Please consult the factory in critical applications.

### Port Positions

Rotary actuators with High Performance Cushions differ from standard double rack units only in their port positions – all external dimensions of the units remain unaltered.

Work Ports C-1 & C-2 Port Position	Cushion Adjuster Position	Connection Ports A-1, A-2, B-1, B-2 Port Position
1	2	3
2	3	1
3	2	1
5	2	3

## Piston Seals and Seal Kits

The Wear-Pak piston fitted as standard to all HTR Series rotary actuators employs a polyurethane seal to contain hydraulic pressure, and a PTFE wear ring (not for HTR.9 or HTR1.8) to prevent metal-to-metal contact. For higher temperatures or use with synthetic fluids, FPM seals should be specified for the piston; for water glycol or high water content fluids, nitrile seals are available.

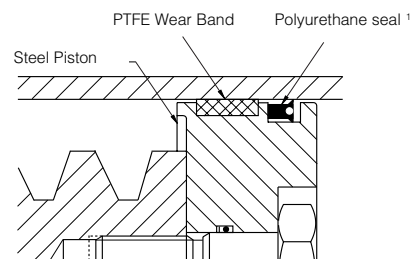
## Filtration

Effective filtration is vital to the long life and satisfactory performance of a rotary actuator. If the piston seals of a rack and pinion rotary actuator are worn or damaged, fluid which leaks past the piston will enter the gear housing.

In the event of internal leakage into the gear housing, the pressure relief valve will ensure that the housing does not

become over-pressurized. Any external leakage from the gear housing, therefore, is indicative of worn or damaged piston seals and these should be examined and, if necessary, replaced, at the earliest opportunity.

**Note:** it is essential that all hydraulic lines are thoroughly flushed before connection to the rotary actuator.



Seal Class	Materials		Fluid Medium	Temperature Range	Seal Kit Code	Filtration
	Seal	Wear Ring				
Standard	Polyurethane	Filled PTFE	General purpose, petroleum-based fluids	-30°C to +80°C	PSKHTR.9 <sup>2</sup>	ISO Class 17/14 Cleanliness Level
V	FPM	Filled PTFE	High Temperature and/or Synthetic Fluids	-20°C to +150°C	PSKHTR.9V <sup>2</sup>	
W	Carboxylated Nitrile	Filled PTFE	Water Glycol, High Water Content Fluids	0°C to +80°C	PSKHTR.9W <sup>2</sup>	

<sup>1</sup> FPM seals also include a back-up washer.

<sup>2</sup> The part numbers shown are for HTR.9 seals. For other seals,

replace '.9' with the appropriate size. For example, a FPM seal kit for a HTR15 will be PSKHTR15V.

## Stroke Limiters

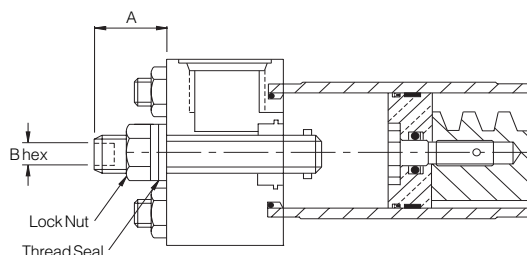
Fine control of the end of travel points of the rotary actuator can be obtained by specifying stroke limiters. These operate by reducing the maximum travel of the actuator within preset limits of either 5° or 30° in each direction. Adjustment within this range is infinitely variable and may be carried out by the user. Several types of stroke limiter are available – the design illustrated is suitable for applications requiring infrequent adjustment.

## Stroke Limiters and Cushions

5° stroke limiters may be combined with the cushioning devices shown on page 10. 30° stroke limiters cannot be combined with cushions.

The addition of stroke limiters requires an increase in build

length. On double rack units with cushions, the cushion is fitted to the upper rack and the stroke limiter to the lower. The increase in build length, for both single and double rack units, is shown as dimension A in the table. Cushion performance may be affected by the addition of a stroke limiter. Please consult the factory in critical applications.



Model	Adjustment per Full Turn	A max - Increased Build Length			B Hex Socket Screw in.
		5° Limiter Without Cushion	5° Limiter With Cushion	30° Limiter Without Cushion	
HTR.9 & 1.8	4.0°	13	22	19	5/32
HTR3.7 & 7.5	3.3°	16	29	29	1/4
HTR5 & 10	2.5°	16	29	29	1/4
HTR15 & 30	2.0°	22	46	41	3/8
HTR22 & 45	2.0°	22	46	41	3/8
HTR75 & 150	2.0°	65	95	90	Square Limiter
HTR300 & 600	1.2°	90	154	N/A	

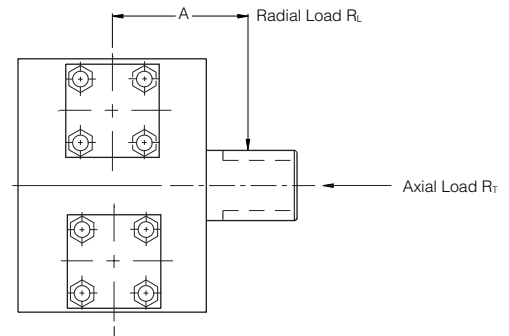
All dimensions are in millimetres unless otherwise stated.

## Bearing Load Capacities

The radial and thrust loads and overhung moments which can be supported by each model of HTR rotary actuator at different operating pressures are shown in the table. These figures should be read in conjunction with the notes below.

### Notes

- 1 Static bearing load capacities = dynamic values x 1.5
- 2 Standard male shafts provide a 4:1 design factor. At the operating conditions marked \*, a smaller design factor is achieved and the values listed are 'bearing' moment capacities. For higher capacities, larger shaft sizes are available – please consult the factory for details.



## Dynamic Bearing Load Capacities vs. Operating Pressure

Model	Radial Load kN $R_L$ per Bearing @			Thrust Load kN $R_T$ @			Overhung Moment kN.m $R_L \times A$ @		
	70 bar	140 bar	210 bar	70 bar	140 bar	210 bar	70 bar	140 bar	210 bar
HTR.9	16.6	15.2	13.9	12.0	11.5	11.1	0.28	0.25	0.23
HTR1.8	17.9	17.9	17.9	12.4	12.4	12.4	0.30	0.30	0.30 *
HTR3.7	26.3	22.2	18.3	16.1	15.0	13.9	0.71	0.59	0.49
HTR7.5	30.0	30.0	30.0	17.0	17.0	17.0	0.80	0.80	0.80 *
HTR5	34.1	30.2	26.3	18.9	17.9	17.0	0.87	0.77	0.67
HTR10	38.1	38.1	38.1	19.9	19.9	19.9	0.97	0.97	0.97
HTR15	61.4	54.4	47.4	54.7	52.6	50.4	2.85	2.53	2.20
HTR30	68.4	68.4	68.4	56.9	56.9	56.9	3.18	3.18	3.18
HTR22	57.9	47.4	-	53.7	50.4	-	2.69	2.20	-
HTR45	68.4	68.4	-	56.9	56.9	-	3.18	3.18	-
HTR75	72.7	44.8	16.8	73.6	62.6	51.5	7.37	4.54	1.70
HTR150	100.7	100.7	100.7	84.6	84.6	84.6	10.20	10.20 *	10.20 *
HTR300	129.3	66.4	3.4	107.2	87.7	68.3	19.53	10.02	0.52
HTR600	192.2	192.2	192.2	126.7	126.7	126.7	29.04	29.04	29.04 *

**Position Switches**

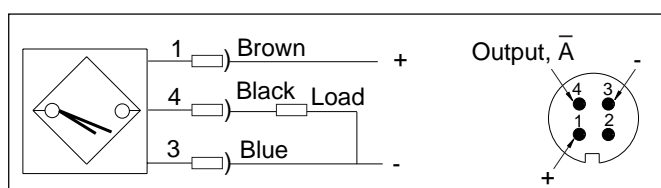
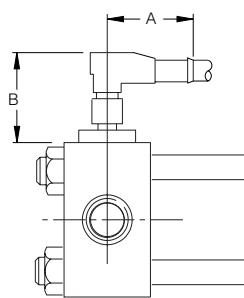
Accurate end of rotation indication can be obtained by specifying position switches. These solid state, inductive-type switches are fitted to the caps of the hydraulic cylinders, where a non-contacting probe senses the presence of a ferrous spear attached to the piston. Position switches are not available on rotary actuators fitted with stroke limiters.

Both flange mounted (EPS-6 and EPS-7) and threaded type (PS201) position switches are available. Both types of switch can be used to operate relay coils, or as direct input to a PLC. All switches incorporate short-circuit protection. The fault condition must be corrected and the power disconnected in order to reset the switch, preventing automatic restarts.

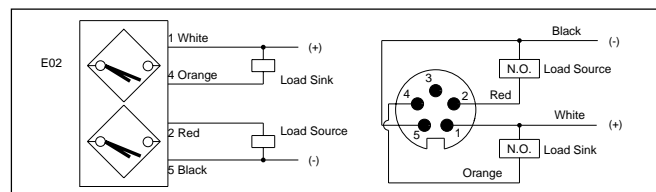
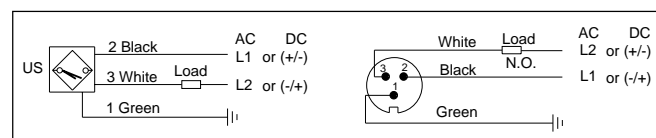
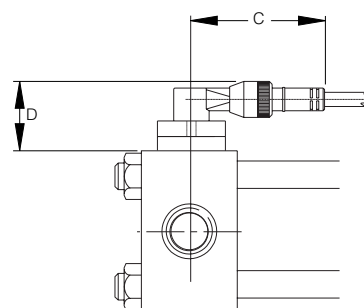
Two LEDs (in the switch or in the connector) indicate power and switch status.

**CE Marking**

The position switches fitted by Parker are CE marked to certify that they meet the requirements of the EC Directive 89/336/EEC for electromagnetic compatibility.

**DC 3-wire Sensor (PS201, 202 and 203)****Wiring Diagram****Dimensions**

Model	PS201, 202 and 203	
	A	B
HTR.9 & 1.8	Consult factory	
HTR3.7 & 7.5	32	63
HTR5 & 10		63
HTR15 & 30		86
HTR22 & 45		79
HTR75 & 150		67
HTR300 & 600		88

**DC 4-wire Sensor (EPS-6)****Wiring Diagram****AC/DC 2-wire Sensor (EPS-7)****Wiring Diagram****Dimensions**

Model	EPS-6 and EPS-7	
	C	D
HTR.9 & 1.8	105	52
HTR3.7 & 7.5		65
HTR5 & 10		65
HTR15 & 30		62
HTR22 & 45		56
HTR75 & 150		43
HTR300 & 600		83

**Note:** Connectors not supplied. Please order as an accessory.

Sensor Type	EPS-6	PS201, 202 and 203	EPS-7
Connector	105000A01F060	PS 011	103000A01F060
Output Function	PNP/NPN, normally open	PNP, normally open	Normally open
Operating Voltage	10 – 30V DC	10 – 30V DC	20 – 250V AC @ 40 – 60 Hz 20 – 300V DC
Operating Current	< 200 mA	200 mA	< 300 mA
Operating Temperature	-25°C to +70°C	-25°C to +80°C	-25°C to +70°C
Protection Class	IP67	IP67 to IEC60529	IP67
Connector Orientation	direct, switching	dependent on switch adjustment	direct, switching
Signal	in sensor	in connector	in sensor

**Feedback Devices**

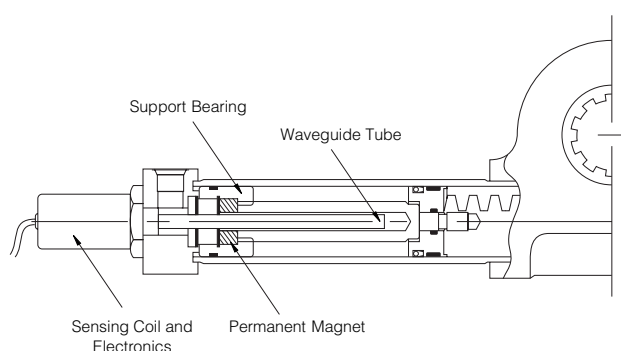
A linear feedback device or a position sensor can be supplied for continual monitoring of the rotational range.

The linear feedback device is built into the cap of the cylinder and registers the position of the rack, and thus indirectly the pinion. This type of position feedback is offered when the rotational range is greater than 355°.

The position sensor is mounted at the back of the housing and directly registers the position of the pinion.

**Linear Feedback Devices**

Linear feedback devices are supplied with an optional ultrasonic feedback system. Other types of feedback devices with alternative analogue or digital output signals are available on request. Please consult the factory for further information.

**Note**

When considering rotary actuator applications using a sensor, it should be borne in mind that rack and pinion actuators have a small amount of backlash. This can be overcome by use of a special hydraulic circuit. Please consult the factory for details.

**Rotary Actuators  
Series HTR****Angular Position Transducer**

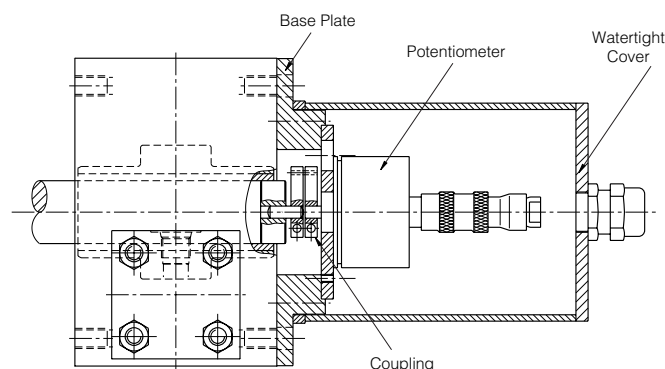
Angular Position Transducers are supplied with a rotary potentiometer, which requires user input. Integral signal conditioning is also available as an option.

**Technical Data****Potentiometer**

Type:	single turn precision servo-mount with conductive plastic element
Port:	Connector LXES-0033 <sup>1</sup>
Effective mechanical angle:	360°
Effective electrical angle:	355° ±2°
Resistance:	5 kΩ
Resistance tolerance:	±20%
Linearity:	±0.075%
Maximum voltage:	42V DC
Maximum current:	10 mA
Recommended operating current:	< 1 μA
Temperature rating:	-40°C to +100°C
Protection class:	IP65

**Potentiometer with Integral Signal Conditioning**

Type:	single turn precision servo-mount with conductive plastic element
Port:	Connector LXES-0033 <sup>1</sup>
Effective mechanical angle:	360°
Effective electrical angle:	90° or 345°
Output signal:	0 or 4 to 20 mA
Current:	30 mA
Load resistance:	0-500 Ω
Linearity:	±0.1% (345°) ±3% (90°)
Repeatability:	0.007°
Operating voltage:	24V DC
Temperature rating:	-25°C to +70°C
Protection class:	IP65



<sup>1</sup> Available as an accessory – please specify in order

Product Type	Model Code	Rotation	Cushions	Stroke Limiters	Mounting Style	Shaft Style	Port Type	Port Location	Seals	Design Series	Options
HTR										D	xxxx

Code	Rotation	Page
090	90°	3
180	180°	3
360	360°	3
Other – please specify		

Code	Bore	Page
.9	22.2 mm	5
1.8	22.2 mm	5
3.7	38.1 mm	5
7.5	38.1 mm	5
5	38.1 mm	5
10	38.1 mm	5
15	50.8 mm	5
30	50.8 mm	5
22	63.5 mm	5
45	63.5 mm	5
75	101.6mm	5
150	101.6 mm	5
300	152.4 mm	5
600	152.4 mm	5

Code	Cushioning <sup>1</sup>	Page
	None – standard	10
1	Clockwise rotation <sup>5</sup>	10
2	Anti-clockwise rotation <sup>5</sup>	10
3	Both directions <sup>5</sup>	10
8	High Performance Cushion	10
9	Special – add to 'Options'	10

Code	Stroke limiter <sup>1</sup>	Page
	None – standard	12
A	0-5° Clockwise rotation <sup>3</sup>	12
B	0-5° Anti-clockwise rotation <sup>3</sup>	12
C	0-5° Both rotations <sup>3</sup>	12
D	0-30° Clockwise rotation <sup>4</sup>	12
E	0-30° Anti-clockwise rotation <sup>3</sup>	12
F	0-30° Both rotations <sup>4</sup>	12
X	Special – add to 'Options'	12

Code	Mounting	Page
C	Face – standard	6
D	Base	8
T	Pilot	8

Code	Seal	Page
-	Polyurethane – standard	12
V	FPM	12
W	Carboxilated nitrile	12

Code	Location	Page
1-4	Side – specify positions 1-4	8
5	End	8
9	Special – add to 'Options'	8

Code	Type	Page
4	BSPP – standard	8
5	Metric – to DIN 3852/1	8
6	Metric – to ISO 6149/1	8
1	SAE straight thread	8
2	NPTF	8
9	Special – add to 'Options'	8

Code	Style	Page
H	Male, single ended, double key – standard	6
G	Female, double key	9
K	Male, double ended, double key	9
L	Female spline	9
M	Male spline, single ended	9
N	Male spline, double ended	12
X	Special – add to 'Options'	12

Code	Option	Page
1000	Actuator model code defined above – Standard	
1111	Actuator model code with special options:	
	eg: Air Bleeds – specify positions 1-4	8
	Position switches	14
	Feedback device	15
	Bronze rack bearing (HTR.9-10)	4

**Please attach full details of Special Options required**

**Notes:**<sup>1</sup> Viewed from shaft end<sup>2</sup> Double rack models only<sup>3</sup> Not available with end ports<sup>4</sup> Not available with end ports and cushions<sup>5</sup> Only available on single rack units**Maintenance and Spare Parts**

Full instructions for the maintenance of HTR Series rotary actuators, together with a complete list of the spares available, is contained in the HTR Series Rotary Actuator Maintenance Bulletin. Please ask for bulletin no. 1220/M1-GB.



(To be completed when requesting further information)

Parker Ref.

### Contact Information

Name ..... Job Title .....  
Company .....  
Address .....  
..... Post Code .....  
Telephone ..... Fax ..... E-mail .....

### Application Details (see page)

Sketch

- 1 Rotation – ° (3) .....
- 2 Operating Pressure – bar .....
- 3 Operating Temperature – °C (12) .....
- 4 Design Torque – Nm (5) .....
- 5 External Bearing Load – kN (13) .....
- 6 Rotation Time – sec. ....
- 7 Rotational Acceleration – rad/s<sup>2</sup> .....
- 8 Number of rotations per day – .....
- 9 Mass – kg .....
- 10 Lever length – mm .....
- 11 Moment of Inertia – kgm<sup>2</sup> .....
- 12 Plane of movement – horizontal/vertical .....
- 13 Brief Description of Application  
(Please supply a sketch if necessary)  
.....  
.....  
.....

### Actuator Details (see page)

- |                                     |   |
|-------------------------------------|---|
| 14 Mounting Style (8) .....         | 19 Stroke Limiters (12) .....               |
| .....                               | 20 Position/Feedback Devices (14, 15) ..... |
| 15 Type of Shaft (9) .....          | .....                                       |
| .....                               | 21 Special Requirements .....               |
| 16 Port Type and Location (8) ..... | .....                                       |
| 17 Seals (12) .....                 | .....                                       |
| 18 Cushioning (10) .....            | .....                                       |

Please photocopy, complete and forward/fax to:

**Parker Hannifin plc.**

Greycaine Road, Watford, Herts. WD24 7QA, UK

Tel. 01923 492000 Fax: 01923 210562

e-mail: cldemarketing@parker.com



## **Cylinder Division Sales Offices**

---

### **Austria – Marchtrenk**

Parker Hannifin GmbH  
Tel: (7242) 56921  
Fax: (7242) 5692120

### **Belgium – Nivelles**

Parker Hannifin S.A. N.V.  
Tel: 67 280 900  
Fax: 67 280 999

### **Czech Republic – Praha**

Parker Hannifin Corporation  
Tel: 283 085 224  
Fax: 283 085 360

### **Denmark – Ishøj**

Parker Hannifin Danmark A/S  
Tel: 43 56 04 00  
Fax: 43 73 31 07

### **Finland – Vantaa**

Parker Hannifin Oy  
Tel: 9 476 731  
Fax: 9 476 73200

### **France – Contamine-sur-Arve**

Parker Hannifin S.A.  
Tel: 4 50 25 80 25  
Fax: 4 50 03 67 37

### **Germany – Cologne**

Parker Hannifin GmbH  
Tel: (0221) 71720  
Fax: (0221) 7172219

### **Hungary – Budapest**

Parker Hannifin Corp.  
Tel: 1 25 28 137  
Fax: 1 25 28 129

### **Ireland – Clonée**

Parker Sales (Ireland) Ltd.  
Tel: (353) 1 801 4010  
Fax: (353) 1 801 4132

### **Italy – Arsago-Seprio**

Parker Hannifin S.p.A.  
Tel: (0331) 765611  
Fax: (0331) 765612

### **Netherlands – Oldenzaal**

Parker Hannifin B.V.  
Tel: (0541) 585000  
Fax: (0541) 585459

### **Norway – Ski**

Parker Hannifin A/S  
Tel: 64 91 10 00  
Fax: 64 91 10 90

### **Poland – Warsaw**

Parker Hannifin Corp.  
Tel: (22) 863 49 42  
Fax: (22) 863 49 44

### **Portugal – Leca da Palmeira**

Parker Hannifin Portugal Lda.  
Tel: (22) 999 7360  
Fax: (22) 996 1527

### **Slovakia –**

ref. Czech Republic

### **Spain – Madrid**

Parker Hannifin España S.A.  
Tel: (91) 675 73 00  
Fax: (91) 675 77 11

### **Sweden – Spånga**

Parker Hannifin AB.  
Tel: 08-5979 50 00  
Fax: 08-5979 51 20

### **Switzerland – Romanshorn**

Hydrel A.G. Romanshorn  
Tel: (714) 66 66 66  
Fax: (714) 66 66 80

### **Turkey – Istanbul**

Hidroser Hidrolik - Pnömatik  
Tel: (212) 886 72 70  
Fax: (212) 886 69 35

### **United Kingdom – Watford**

Parker Hannifin Plc  
Tel: (01923) 492000  
Fax: (01923) 248557

Visit us at [www.parker.com/uk](http://www.parker.com/uk)

### **Need a Parker Part?**

Call Parker's European Product Information Centre  
on 00800 27 27 5374

