aerospace
climate control
electromechanical
filtration
fluid & gas handling
hydraulics
pneumatics
process control
sealing & shielding

High Force Electric Actuators

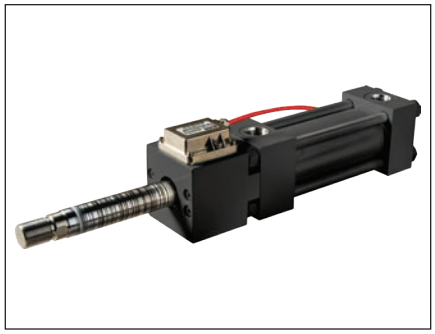
Series ETH

Parker

ENGINEERING YOUR SUCCESS.

Series XFC

- All Steel Construction
- Elastomeric Seals throughout
- Standard Metric Hydraulic Tie Rod Construction
- Opposed Preloaded Angular Contact Bearings
- Roller Screw Drive System
- Inline and Parallel Gear Drive Configurations
- Speeds up to 40 Inches per Second
- 178kN Continuous Thrust (40,000 Pounds)
- Parker Bayside Stealth Gearhead Direct Mount
- Parker MPP Max Plus Motors Standard
- Strokes from 50mm to 2000 mm in 1 mm increment



Intellinder

- Integrates a highly engineered sensor into the hydraulic cylinder, eliminating the time and cost associated with gun drilling
- Cylinder feedback installation is virtually plug-and-play
- Signals absolute positioning, rather than position relative to the starting location of the rod
- Position identifying bar codes are marked right on the rod, position is communicated continually and directly to the controller
- Position report occurs at power-on
- Allows for full utilization of double-rod cylinder applications requiring position feedback
- Sustains performance in applications exposed to vibration, dust, gravel, corrosives, chemicals, axial load, side load, and immersion
- Remains impervious to electronic noise and has been tested to ensure signal strength in the most rigourous applications
- Performs across a wide range of temperatures and provides long stroke capabilities of 20 feet (6,096 mm)

WaveScale

- Linear displacement transducer (LDT) feedback
- WaveScale embedded design maintains NFPA dimensions 2.00"-6.00" bores
- Eliminates need for limit switches, deceleration valves, shock absorbers and mechanical linkages in many applications
- Nominal pressures up to 3000 psi (207 bar)
- Piston rod diameters 1.000"-6.000"
- Wide variety of stroke lengths available
- Exclusive “Jewel” Rod Gland with TS-2000 Rod Seal
- Parker Stepped Cushion for increased performance and productivity
- Low friction seals available
- Seven bolt-on and four integral manifolds available
- Simplifies machine design and reduces number of hydraulic lines
- Integral mounted valve eliminates assembly time and fittings

In line with our policy of continuing product improvement, specifications and information contained in this catalog are subject to change.

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ETH Series Electric Cylinders

The Parker ETH series is the next generation version of the well known, widely used ET Series.

The ETH design offers unrivaled power density due to larger screw and bearing designs in smaller packages. The result is a product that offers increased force output from a given frame size or increased product life at the same force output.

Available in three profile sizes with both in-line and parallel motor configurations, ETH cylinders provide stroke lengths up to 1600 mm and speeds to 1.7 m/sec.

Typical ETH Applications

The ETH electric cylinder closes the gap between electromechanical and hydraulic cylinder performance making it suitable to use in higher force applications where increased reliability is required in the production process. Taking the costs of the hydraulic system components into consideration you will find that in most cases an electromechanical system such as the ETH electric cylinder offers the more economical solution. Combined with a wide choice of accessories, it offers many possibilities in the following areas of application:

- Test equipment and laboratory
- Valve and flap actuation
- Pressing
- Packaging machinery
- Food and beverage process automation
- Material handling and feed systems including: wood and plastic working, vertical actuators for machine tool loading, textile tensioning/gripping, automotive component transport/feeding

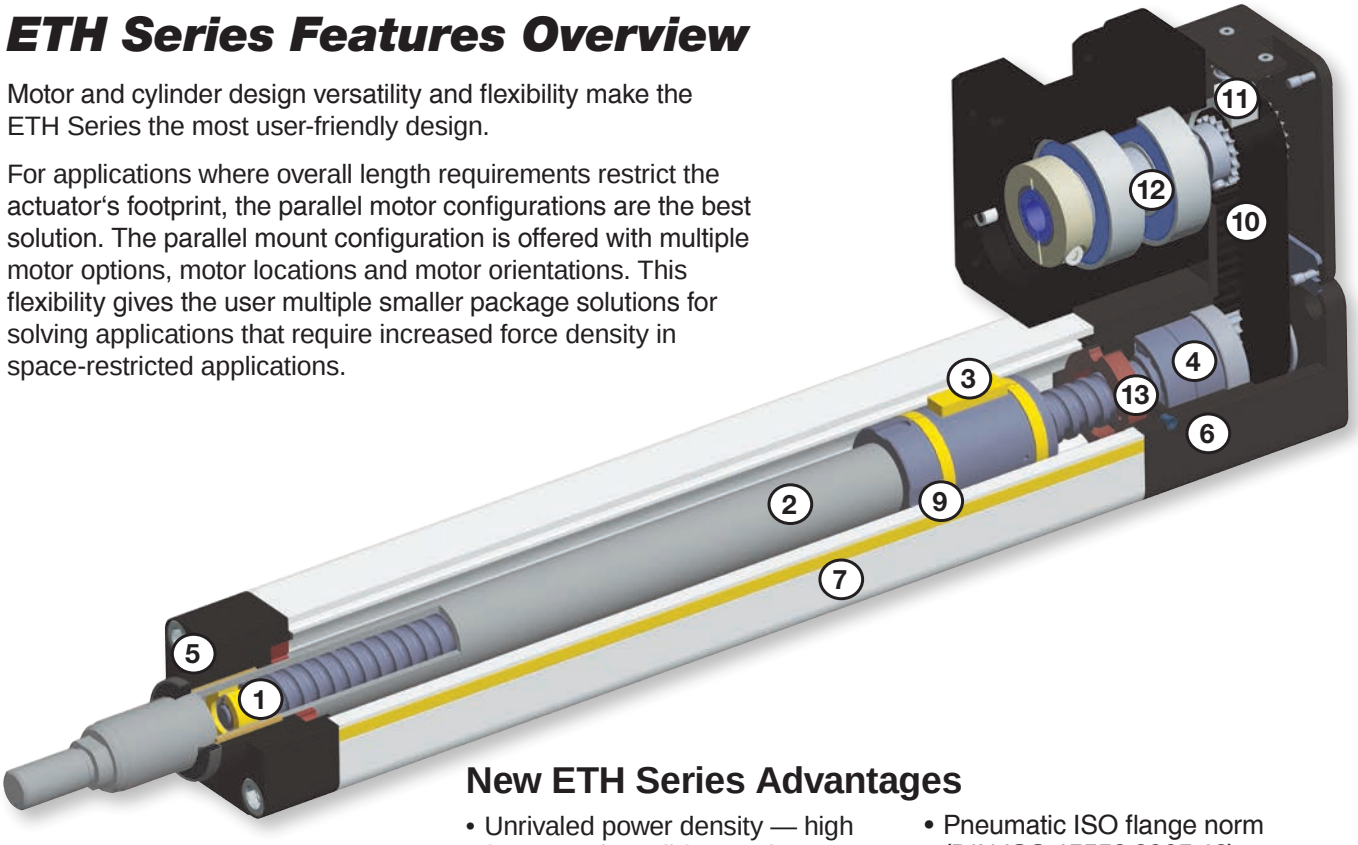
Table of Contents

Parker Hannifin Corporation
Cylinder Division
Des Plaines, Illinois USA

ETH Series Features Overview

Motor and cylinder design versatility and flexibility make the ETH Series the most user-friendly design.

For applications where overall length requirements restrict the actuator's footprint, the parallel motor configurations are the best solution. The parallel mount configuration is offered with multiple motor options, motor locations and motor orientations. This flexibility gives the user multiple smaller package solutions for solving applications that require increased force density in space-restricted applications.



New ETH Series Advantages

- Unrivaled power density — high forces and small frame sizes
- Sensor cables can be concealed in the profile
- Optimized for safe handling and simple cleaning
- Long service life
- Reduced maintenance costs thanks to lubricating hole in the cylinder flange
- Pneumatic ISO flange norm (DIN ISO 15552:2005-12) conformity
- Anti-rotation device integrated
- Reduced noise emission
- Complete system from a single source: Parker offers matching controllers, motors and gearheads for all ETH cylinders

Design Features

(1) Support Bearing

The non-motor end of the screw is supported by a hardened polymer bushing which eliminates vibration and minimizes noise for smoother, quieter motion. This also improves precision, increases dynamic performance, and lengthens screw life.

(2) Precision Ballscrew Drive

The ETH drive train features a Class 7 ballscrew (ISO 3408) providing low frictional resistance for smooth motion over the entire speed range. This design also ensures longer product life, excellent efficiency and a lower dB rating. The ballscrew drive provides higher speeds and force capabilities than comparably-sized alternative drive mechanisms.

(3) Unique Anti-rotation Guide

The ETH features a unique piston rod anti-rotation device. This high quality, maintenance free polymer bushing offers robust guidance that prevents the piston rod from twisting as the rod extends and retracts.

(4) Screw Support Bearing

A set of double stacked angular contact bearings allows high thrust forces in both extend and retract directions. This design provides high force density and minimizes backlash when changing the direction of motion.

(5) Piston Rod Support Bearing

The piston rod is supported by an extra long rod bushing. This bushing braces the rod in all directions allowing for smooth travel with high side loading capabilities.

(5) Combination Lip and Wiper Seal

The lip and wiper seal keeps contaminants out and lubricating grease in for increased actuator life. For harsh environments, the ETH is available in a robust IP65 version for maximum protection.

(6) Lubrication Port

The ETH comes standard with an integrated lubrication port located in the rear endcap of the cylinder, making scheduled maintenance quick, simple and easy. An optional lubrication bore is available in the middle of the cylinder body for applications where the integrated lubrication port is inaccessible.

(7) Extruded Cylinder Body

The extrusion of the ETH was designed to reduce the number

Performance Characteristics

For precise motion, positioning, setting and actuating, the electric cylinder offers:

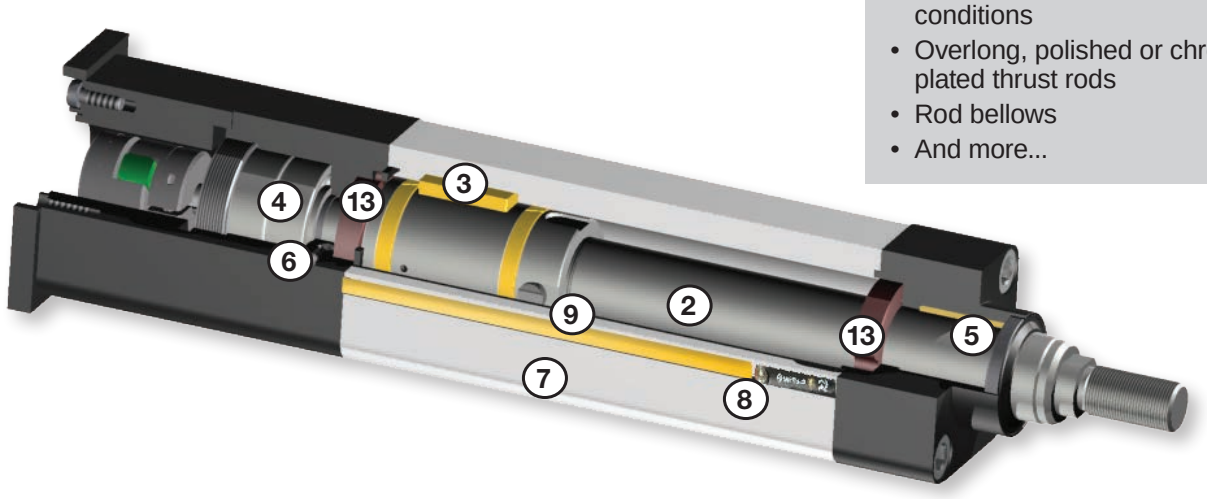
- High mechanical efficiency up to 90%
- Strokes up to 1600 mm
- High traction/thrust force up to 25 100 N
- Repeatability up to ±0.03 mm
- Speeds up to 1.7 m/s
- Toothed belt drive (for parallel motor mounting)
- 5 mm to 32 mm screw leads offering fine resolution or high speed options
- Three ISO cylinder profile sizes with 30, 40 or 60 mm diameter thrust rods
- Predefined standardized motor and gearhead flanges for simplified selection. The motors are available directly from Parker (all from one source).
- Three protection classes available:
  - IP54 with galvanized steel hardware
  - IP54 with stainless steel hardware
  - IP65 epoxy coated cylinder

ETH Solutions for Critical Conditions

If your electric cylinder installation needs to withstand harsh environmental conditions or meet a critical design specification, please contact us.

We offer many non-standard design options not covered in this brochure that will help match the ETH to your specific application requirements, including:

- Oil-splash lubrication
- Customized mountings and rod ends
- Mounting of customer motors
- Hardened cylinder protection for aggressive environmental conditions
- Overlong, polished or chrome-plated thrust rods
- Rod bellows
- And more...



ETH Series Performance Overview

Performance by Cylinder Size and Screw Lead*

Cylinder Size			ETH032			ETH050			ETH080		
Screw Lead Designation			**M05**	**M10**	**M16**	**M05**	**M10**	**M20**	**M05**	**M10**	**M32**
Screw Lead		mm	5	10	16	5	10	20	5	10	32
Screw diameter		mm		16			20			32	
Available strokes**		mm		50-1000			50-1200			50-1600	
Max. speed at designated stroke:											
50 – 400 mm		mm/s	333	667	1067	333	667	1333	267	533	1707
600 mm			286	540	855	333	666	1318	267	533	1707
800 mm			196	373	592	238	462	917	267	533	1707
1000 mm			146	277	440	177	345	684	264	501	1561
1200 mm			–	–	–	139	270	536	207	394	1233
1400 mm			–	–	–	–	–	–	168	320	1006
1600 mm			–	–	–	–	–	–	140	267	841
Max. Acceleration		m/s^2	4	8	12	4	8	15	4	8	15
Axial Force – In-line		N	3600	3700	2400	9300	7000	4400	17 800	25 100	10 600
Axial Force – Parallel	**n < 100**	N	3600	3280	2050	9300	4920	2460	17 800	11 620	3630
@ "n" rpm	**100 < n < 300**		3600	2620	1640	7870	3930	1960	17 800	11 620	3630
Motor Speed	**n > 300**		3600	1820	1140	5480	2740	1370	17 800	10 720	3350
Axial Force – 2500 km Service Life		N	1130	1700	1610	2910	3250	2740	3140	7500	6050
Thrust Force Factor In-line Motor		N/Nm	1131	565	353	1131	565	283	1131	565	177
Transmissible Torque	**n < 100**	Nm		6.5			9.7			22.8	
Parallel Motor @ "n"	**100 < n < 300**			5.2			7.7			22.8	
rpm Motor Speed	**n > 300**			3.6			5.4			21.1	
Force Constant Parallel Motor		N/Nm	1018	509	318	1018	509	254	1018	509	159
Max. Torque – No Load		Nm	0.77	0.85	0.94	0.85	1.28	1.70	1.87	2.13	2.38
Weight – with zero stroke											
Basic unit (including cylinder rod)		kg	1.2	1.2	1.3	2.2	2.3	2.5	6.9	7.6	8.7
Cylinder rod only				0.06			0.15			0.59	
Weight of additional length											
Basic unit (including cylinder rod)		kg/m		4.8			8.6			18.7	
Cylinder rod only				0.99			1.85			4.93	
Moments of Inertia ***											
In-line – without stroke		$kgmm^2$	7.1	7.6	12.9	25.3	25.7	33.1	166.2	164.5	252.9
Parallel – without stroke			8.3	8.8	14.1	30.3	30.6	38.0	215.2	213.6	301.9
In-line/Parallel – per meter stroke		$kgmm^2/m$	41.3	37.6	41.5	97.7	92.4	106.4	527.7	470.0	585.4
Accuracy: Repeatability (ISO230-2)											
In-line		mm					±0.03				
Parallel							±0.05				
Efficiency – including friction torques											
In-line		%					90				
Parallel							81				
Temperature											
Operating		°C					-10 ... +70				
Ambient							-10 ... +40				
Storage							-20 ... +40				
Humidity		%					0 ... 95 % (non-condensing)				
Elevation (Max.)		m					3000				

* Technical data based on normal conditions and only for single cylinder and load mode. For compound loads, please verify in accordance with normal physical laws and technical standards whether individual ratings should be reduced. Please contact Parker with any questions.

** Refer to Ordering Information (page 49) for standard strokes available for specified model size and type.

*** To convert kg/mm^2 to kg/m^2 multiply by 0.000001

ETH032 Speed-Thrust

See page 32 for instructions on how to use the data on these graphs

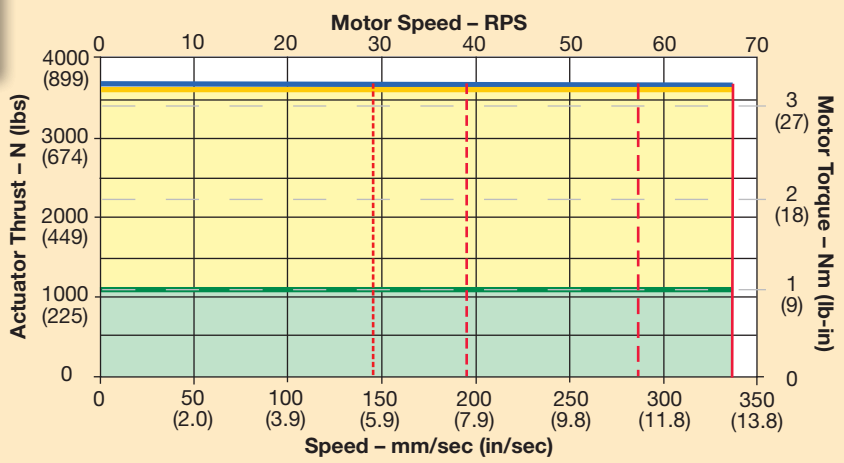
Maximum Thrust*:
- Inline motor mount
- Parallel motor with timing belt limitation
- Max thrust at 2540 km of life (see page 45 for details)

Maximum Speed:
- 1000 mm stroke
- 800 mm stroke
- 600 mm stroke
- Max actuator speed

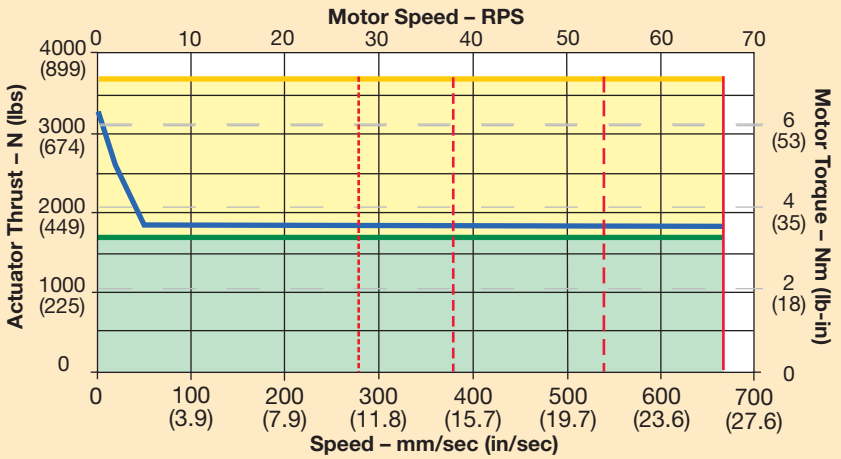
Performance Zones:
- Full life region (greater than 2540 km of life)
- Acceptable zone for Inline motor mounts only (motor mount option A or B)
- Intermittent zone (operation will result in reduced life of the actuator and is not acceptable for parallel motor options if above the parallel limitation curve)

*Maximum thrust assumes a cylinder mounting orientation with a fixed mounting position and a guided load, for limitations on column buckling, please see page 43.

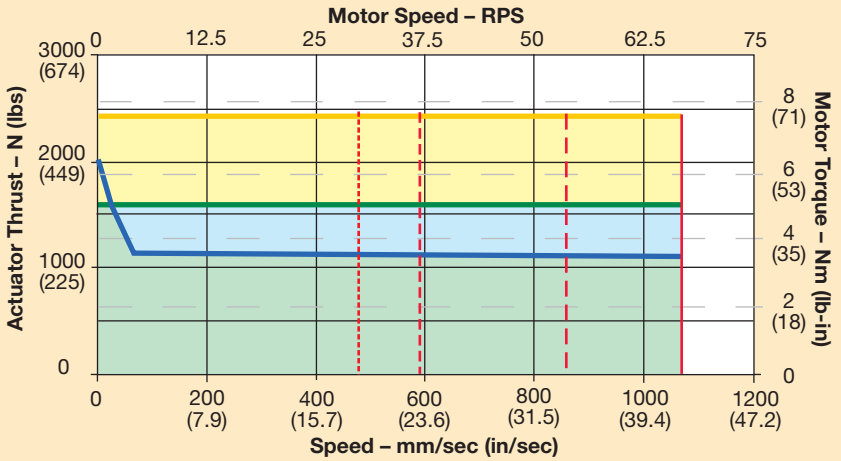
ETH032M05



ETH032M10



ETH032M16



ETH Series Performance Overview

ETH050 Speed-Thrust

See page 32 for instructions on how to use the data on these graphs

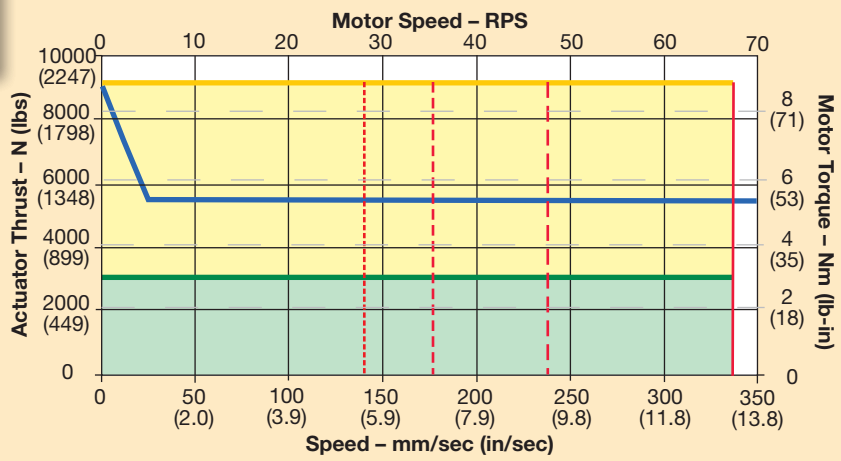
Maximum Thrust*:
- Inline motor mount
- Parallel motor with timing belt limitation
- Max thrust at 2540 km of life (see page 45 for details)

Maximum Speed:
- 1200 mm stroke
- 1000 mm stroke
- 800 mm stroke
- Max actuator speed

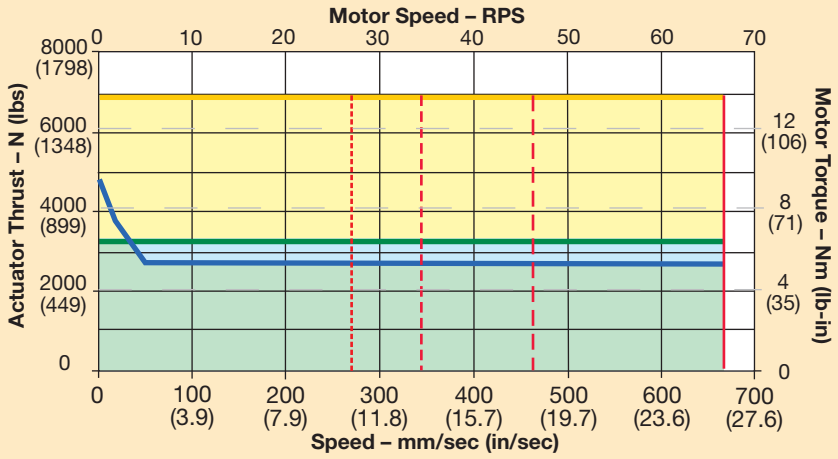
Performance Zones:
- Full life region (greater than 2540 km of life)
- Acceptable zone for Inline motor mounts only (motor mount option A or B)
- Intermittent zone (operation will result in reduced life of the actuator and is not acceptable for parallel motor options if above the parallel limitation curve)

*Maximum thrust assumes a cylinder mounting orientation with a fixed mounting position and a guided load, for limitations on column buckling, please see page 43.

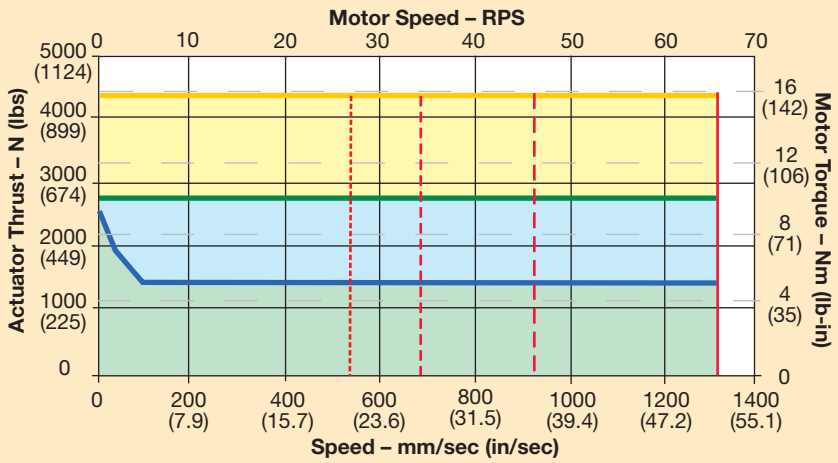
ETH050M05



ETH050M10



ETH050M20



ETH080 Speed-Thrust

See page 32 for instructions on how to use the data on these graphs

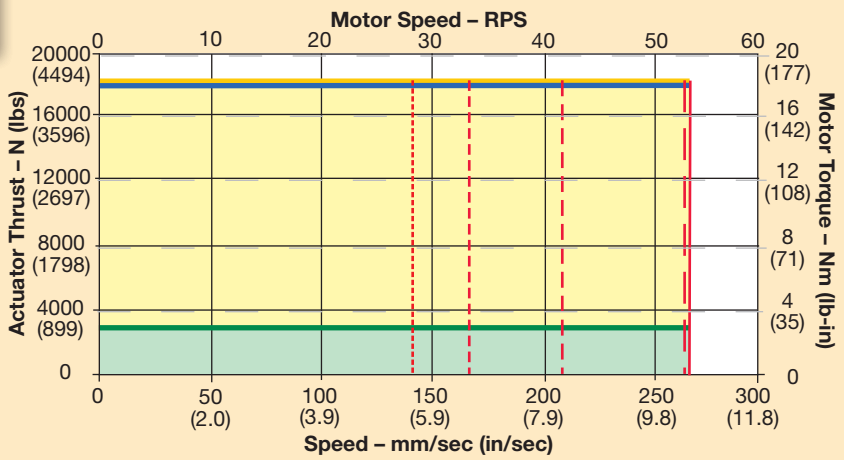
Maximum Thrust*:
- Inline motor mount
- Parallel motor with timing belt limitation
- Max thrust at 2540 km of life (see page 45 for details)

Maximum Speed:
- 1600 mm stroke
- 1400 mm stroke
- 1200 mm stroke
- 1000 mm stroke
- Max actuator speed

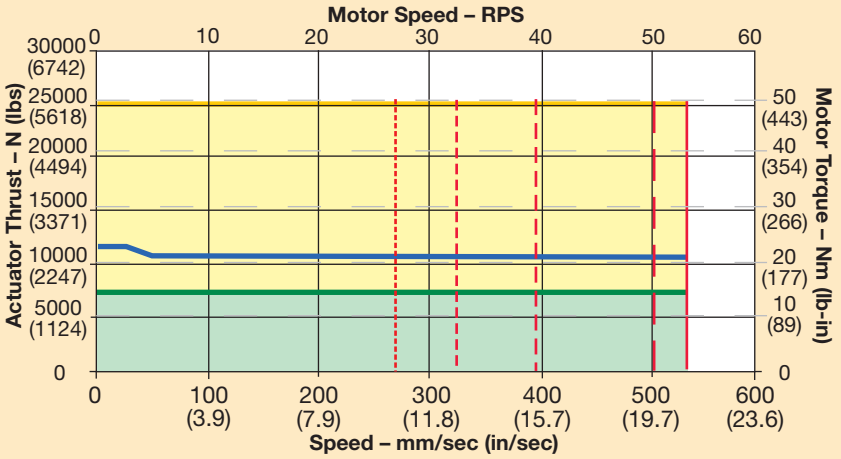
Performance Zones:
- Full life region (greater than 2540 km of life)
- Acceptable zone for Inline motor mounts only (motor mount option A or B)
- Intermittent zone (operation will result in reduced life of the actuator and is not acceptable for parallel motor options if above the parallel limitation curve)

*Maximum thrust assumes a cylinder mounting orientation with a fixed mounting position and a guided load, for limitations on column buckling, please see page 43.

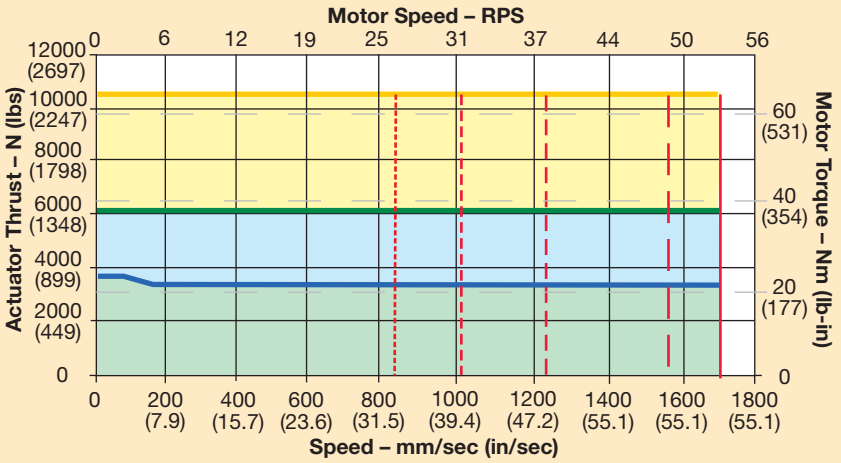
ETH080M05



ETH080M10

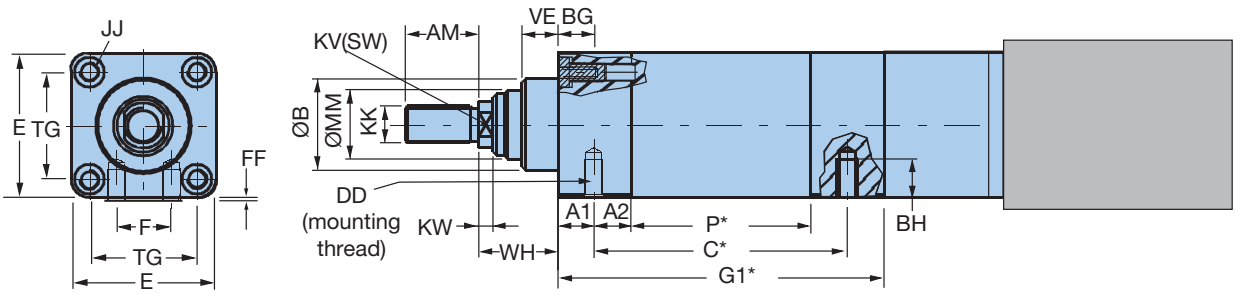


ETH080M32



ETH Motor Mounting Configurations

Inline Dimensions



* Specified dimension + selected stroke

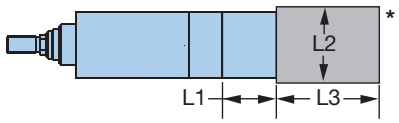
Cylinder Size		ETH032			ETH050			ETH080		
Screw Lead		M05	M10	M16	M05	M10	M20	M05	M10	M32
C	IP54	93.5	103.0	106.5	99.5	105.5	117.5	141.5	159.5	189.5
	IP65	94.5	103.5	107.5	100.5	106.5	118.5	142.5	160.5	190.5
G1	IP54	133.0	142.0	146.0	154.0	160.0	172.0	197.0	215.0	245.0
	IP65	180.5	189.5	193.5	198.5	204.5	216.5	259.5	277.5	307.5
P		66.0	75.0	79.0	67.0	73.0	85.0	89.0	107.0	137.0

A1	IP54	14.0	15.5	21.0
	IP65	60.0	58.5	82.0
A2		17.0	18.5	32
AM		22.0	32.0	40.0
BG		16.0	25.0	26.0
BH		9.0	12.7	18.5
DD		M6x1.0	M8x1.25	M12x1.75
E		46.5	63.5	95.0
F		16.0	24.0	30.0
FF		0.5	0.5	1.0
JJ		M6x1.0 (1)	M8x1.25	M10x1.5
KK		M10x1.25	M16x1.5	M20x1.5
KV		10.0	17.0	22.0
ØMM		22.0	28.0	45.0
TG		32.5	46.5	72.0
KW		5.0	6.5	10.0

VE	12.0	16.0	20.0
WH	26.0	37.0	46.0
ØB	30.0	40.0	60.0

(1) Thru holes should have a minimum diameter of 7 mm on any component attached to the front threaded screw holes on bolt pattern TG.

Inline Mounts with Xpress Motors



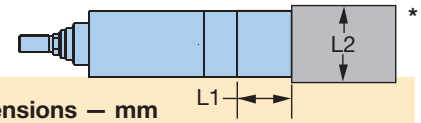
Flange & Coupling to Accept Xpress Motor			Dimensions — mm						
Cylinder Size	Xpress Order Code	Motor (w/Gearhead) Description	Pilot	Bolt Circle	Shaft Ø	Shaft Length	L1	L2	L3
ETH032	XPC	BE233FJ-KPSN	38.10	66.68	9.52	20.8	66.0	58.0	145.0
	XPD	CM233FJ-115027	38.10	66.68	9.52	20.8	66.0	58.0	177.0
	XPG	BE344LJ-KPSN	73.03	98.43	12.70	30.2	65.0	85.0	188.0
	XPH	BE344LJ-KPSB	73.03	98.43	12.70	30.2	65.0	85.0	231.0
ETH050	XPC	BE233FJ-KPSN	38.10	66.68	9.52	31.8	65.0	65.0	145.0
	XPD	CM233FJ-115027	38.10	66.68	9.52	31.8	65.0	65.0	177.0
	XPG	BE344LJ-KPSN	73.03	98.43	12.70	30.2	63.0	85.0	188.0
	XPH	BE344LJ-KPSB	73.03	98.43	12.70	30.2	63.0	85.0	231.0
	XPL [3]	MPP1003D1E-KPSN	95.00	115.00	19.00	40.0	88.0	98.0	175.0
	XPM [3]	MPP1003D1E-KPSB	95.00	115.00	19.00	40.0	88.0	98.0	223.0
	XPN	MPP1003D1E-KPSN [1]	73.03	98.43	12.70	31.8	63.0	100.0	288.0
	XPP	MPP1003D1E-KPSB [1]	73.03	98.43	12.70	31.8	63.0	100.0	336.0
	XPQ [3]	MPP1003R1E-KPSN	95.00	145.00	19.00	40.0	88.0	98.0	175.0
	XPR [3]	MPP1003R1E-KPSB	95.00	145.00	19.00	40.0	88.0	98.0	223.0
	XPS	MPP1003R1E-KPSN [1]	73.03	98.43	12.70	31.8	63.0	100.0	288.0
	XPT	MPP1003R1E-KPSB [1]	73.03	98.43	12.70	31.8	63.0	100.0	336.0
ETH080	XPG	BE344LJ-KPSN	73.03	98.43	12.70	30.2	92.5	98.0	188.0
	XPH	BE344LJ-KPSB	73.03	98.43	12.70	30.2	92.5	98.0	231.0
	XPL	MPP1003D1E-KPSN	95.00	115.00	19.00	40.0	101.5	98.0	175.0
	XPM	MPP1003D1E-KPSB	95.00	115.00	19.00	40.0	101.5	98.0	223.0
	XPN	MPP1003D1E-KPSN [1]	73.03	98.43	12.70	31.8	92.5	100.0	288.0
	XPP	MPP1003D1E-KPSB [1]	73.03	98.43	12.70	31.8	92.5	100.0	336.0
	XPQ	MPP1003R1E-KPSN	95.00	115.00	19.00	40.0	101.5	98.0	175.0
	XPR	MPP1003R1E-KPSB	95.00	115.00	19.00	40.0	101.5	98.0	223.0
	XPS	MPP1003R1E-NPSN [1]	73.03	98.43	12.70	31.8	92.5	100.0	288.0
	XPT	MPP1003R1E-NPSB [1]	73.03	98.43	12.70	31.8	92.5	100.0	336.0
	XPU	MPP1154B1E-KPSN	110.00	130.00	24.00	50.0	111.5	113.0	203.0
	XPV	MPP1154B1E-KPSB	110.00	130.00	24.00	50.0	111.5	113.0	252.0
	XPW	MPP1154B1E-KPSN [2]	110.00	130.00	24.00	50.0	111.5	115.0	352.5
	XPX	MPP1154B1E-KPSB [2]	110.00	130.00	24.00	50.0	111.5	115.0	401.5
	XPY	MPP1154P1E-KPSN [2]	110.00	130.00	24.00	50.0	111.5	115.0	203.0
	XPZ	MPP1154P1E-KPSB [2]	110.00	130.00	24.00	50.0	111.5	115.0	252.0
	XP1	MPP1154P1E-KPSN [2]	110.00	130.00	24.00	50.0	111.5	115.0	352.5
	XP2	MPP1154P1E-KPSB [2]	110.00	130.00	24.00	50.0	111.5	115.0	401.5

[1] With Parker PV34FE-003 gearhead
[2] With Parker PV115FB-003 gearhead
[3] Requires coupling housing on ETH050 with a square dimension of 80 mm to accommodate a larger coupling.

* L1 = Length Coupling Housing + Flange
L2 = Maximum Motor or Gearhead Square Flange
L3 = Length Motor + Gearhead

ETH Motor Mounting Configurations

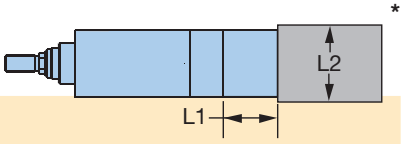
Inline Mounts for other Parker Motors



Flange & Coupling to Accept Parker Motor			Dimensions — mm					
Cylinder Size	Kit Order Code	Parker Motor Description	Pilot	Bolt Circle	Shaft Ø	Shaft Length	L1	L2
ETH032	KCB	SM23X	38.10	66.68	9.52	20.8	60.0	58.0
	KBB	BE23X	38.10	66.68	9.52	31.8	66.0	58.0
	KCA	SM16/BE16	20.00	46.69	6.35	25.0	62.0	58.0
	KEA	LV23/HV23	38.10	66.68	6.35	20.8	60.0	58.0
	KBC	BE34X	73.03	98.43	12.70	30.2	65.0	85.0
	KEB	LV34/HV34	73.03	98.43	12.70	37.1	73.0	85.0
ETH050	KCB	SM23X	38.10	66.68	9.52	20.8	57.5	65.0
	KBB	BE23X	38.10	66.68	9.52	31.8	65.0	65.0
	KBC	BE34X	73.03	98.43	12.70	30.2	63.0	85.0
	KAA	MPP92/MPJ92	80.00	100.00	16.00	40.1	74.0	90.0
	KEB	LV34/HV34	73.03	98.43	12.70	37.1	70.0	85.0
	KAB [1]	MPP100/MPJ100	95.00	115.00	19.00	40.1	88.0	98.0
ETH080	KAA	MPP92/MPJ92	80.00	100.00	16.00	40.1	101.5	98.0
	KAB	MPP100/MPJ100	95.00	115.00	19.00	40.0	101.5	98.0
	KAC	MPP115/MPJ115	110.00	130.00	24.00	50.0	111.5	113.0

[1] Requires coupling housing on ETH050 with a square dimension of 80 mm to accommodate a larger coupling.

Inline Mounts for Parker Gearheads

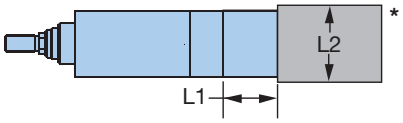


Flange & Coupling to Accept Parker Gearhead			Dimensions — mm					
Cylinder Size	Kit Order Code	Parker Gearhead Description	Pilot	Bolt Circle	Shaft Ø	Shaft Length	L1	L2
ETH032	PAN	PV60FB/PX60	50.00	70.00	16.00	25.0	61.0	62.0
	PCN	PV23FE/PX23	38.10	66.68	9.52	25.4	60.0	58.0
	PDN	PV34FE/PX34	73.03	98.43	12.70	31.8	65.0	85.0
ETH050	PAN	PV60FB/PX60	50.00	70.00	16.00	25.0	60.5	65.0
	PBN [1]	PV90FB/PX90	80.00	100.00	20.00	40.0	93.0	90.0
	PCN	PV23FE/PX23	38.10	66.68	9.52	25.4	65.0	65.0
	PDN	PV34FE/PX34	73.03	98.43	12.70	31.8	63.0	85.0
ETH080	PBN	PV90FB/PX90	80.00	100.00	20.00	40.0	101.5	90.0
	PJN	PV115FB/PX115	95.00	115.00	24.00	50.0	111.5	113.0
	PDN	PV34FE/PX34	73.03	98.43	12.70	31.8	92.5	98.0
	PEN	PV42FE/PX42	55.55	125.70	15.88	38.1	100.0	113.0

[1] Requires coupling housing on ETH050 with a square dimension of 80 mm to accommodate a larger coupling.

* L1 = Length Coupling Housing + Flange
L2 = Maximum Motor or Gearhead Square Flange

Inline Mounts for Non-Standard Motors



* L1 = Length Coupling Housing + Flange
L2 = Maximum Motor or Gearhead Square Flange

Inline Mounting Compatible Motor Dimensions – mm

Model	Maximum Motor Shaft Ø	
	With Key	Without Key
ETH032	16	16
ETH050	24	24
ETH080	28	28

Couplers

Order Code	Coupler Size (Motor Shaft Ø)	Compatibility		
		ETH032	ETH050	ETH080
A	No Coupler	•	•	•
B	0.25"	•		
C	0.375"	•	•	
D	0.5"	•	•	
E	0.625"	•	•	
H	6 mm	•		
J	8 mm	•		
K	9 mm	•	•	
L	11 mm	•	•	
M	14 mm	•	•	•
N [1]	16 mm	•	•	•
P [1]	19 mm		•	•
Q [1]	20 mm		•	•
R [1]	22 mm			•
S [1]	24 mm			•

[1] Requires coupling housing on ETH050 with a square dimension of 80 mm to accommodate a larger coupling.

Ordering Non-Standard Motor Mounts

Use the appropriate order codes from the charts to build the desired "Flange Only" or "Flange and Coupler" Kit Order Code. Note: all non-standard motor mount kits use three character descriptions beginning with an N, followed by a Coupler and a Flange designator.

Kit Order Code Designators:	①	②	③
	N		

① **Non-standard motor mount**
② **Coupler order code**
③ **Flange order code**

Kit Order Code Examples	Kit Order Code
No flange, no coupler	NAA
Flange C (for ETH050), no coupler	NAC
Flange C (for ETH050), 0.5" coupler	NDC

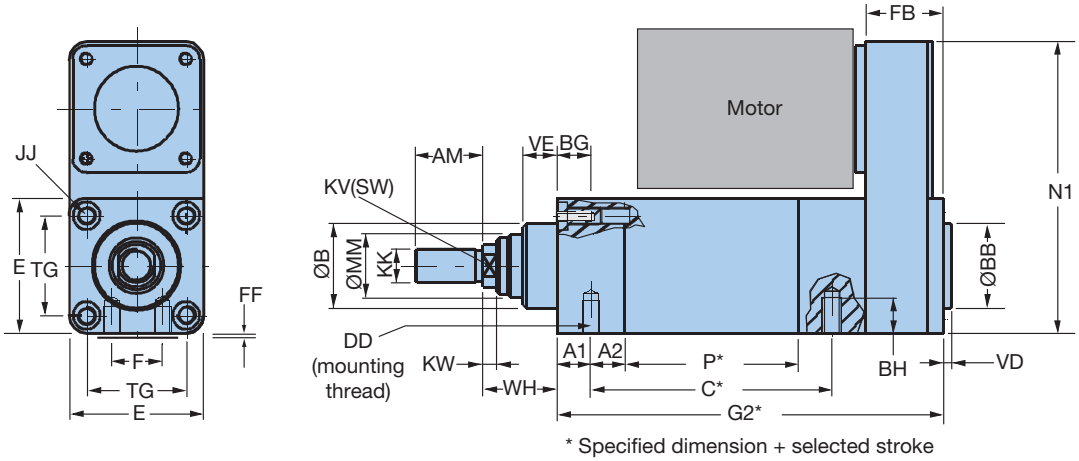
Flanges

Order Code	Dimensions — mm											
	Bolt Circle	Bolt Hole	Pilot Ø	Pilot Depth	Motor Shaft Length	Compatibility					
						ETH032		ETH050		ETH080	
						L1	L2	L1	L2	L1	L2
A			No Flange			0.0		0.0		0.0	
B	46.00	M3	30.00	3.5	25.0	60.0	58.0	—	—	—	—
C	63.00	M4	40.00	3.5	20.0	60.0	58.0	57.5	65.0	—	—
D	70.00	M5	50.00	3.5	30.0	67.0	65.0	65.5	65.0	—	—
E	75.00	M5	60.00	3.5	23.0	60.0	70.0	59.0	70.0	—	—
F	75.00	M5	60.00	3.5	30.0	66.0	70.0	59.0	70.0	—	—
G	90.00	M6	70.00	3.5	40.0	—	—	84.0	96.0	92.5	96.0
H	95.00	M5	50.00	3.5	30.0	76.0	82.0	65.5	82.0	—	—
J	100.00	M6	80.00	3.5	40.0	76.0	89.0	84.0	96.0	94.5	96.0
K	115.00	M8	95.00	3.5	40.0	—	—	84.0	100.0	94.5	100.0
L	130.00	M8	110.00	3.5	50.0	—	—	—	—	104.5	115.0
M	130.00	M8	95.00	3.5	50.0	—	—	—	—	101.5	115.0

Parker Hannifin Corporation
Cylinder Division
Des Plaines, Illinois USA

ETH Motor Mounting Configurations

Parallel Dimensions



* Specified dimension + selected stroke

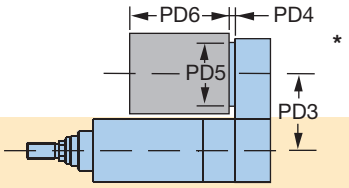
Cylinder Size		ETH032			ETH050			ETH080		
Screw Lead		**M05**	**M10**	**M16**	**M05**	**M10**	**M20**	**M05**	**M10**	**M32**
C	IP54	93.5	103.0	106.5	99.5	105.5	117.5	141.5	159.5	189.5
	IP65	94.5	103.5	107.5	100.5	106.5	118.5	142.5	160.5	190.5
G2	IP54	180.5	189.5	193.5	194.0	200.0	212.0	257.0	275.0	305.0
	IP65	228.5	237.5	241.5	239.0	245.0	257.0	320.0	338.0	368.0
P		66.0	75.0	79.0	67.0	73.0	85.0	89.0	107.0	137.0

A1	IP54	14.0	15.5	21.0
	IP65	60.0	58.5	82.0
A2		17.0	18.5	32
AM		22.0	32.0	40.0
BG		16.0	25.0	26.0
BH		9.0	12.7	18.5
DD		M6x1.0	M8x1.25	M12x1.75
E		46.5	63.5	95.0
F		16.0	24.0	30.0
FF		0.5	0.5	1.0
JJ		M6x1.0 (1)	M8x1.25	M10x1.5
KK		M10x1.25	M16x1.5	M20x1.5
KV		10.0	17.0	22.0
ØMM		22.0	28.0	45.0
TG		32.5	46.5	72.0
KW		5.0	6.5	10.0
N1		126.0	160.0	233.5
FB	IP54	47.5	40.0	60.0
	IP65	48.0	40.5	60.5
VD		4.0	4.0	4.0
ØBB		30.0	40.0	45.0

VE	12.0	16.0	20.0
WH	26.0	37.0	46.0
ØB	30.0	40.0	60.0

(1) Thru holes should have a minimum diameter of 7 mm on any component attached to the front threaded screw holes on bolt pattern TG.

Parallel Mounts with Xpress Motors



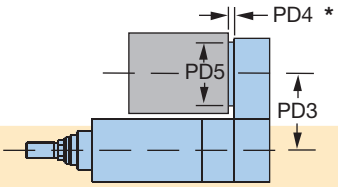
Flange & Coupling to Accept Xpress Motor			Dimensions — mm							
Cylinder Size	Xpress Order Code	Motor (w/Gearhead) Description	Pilot	Bolt Circle	Shaft Ø	Shaft Length	PD3	PD4	PD5	PD6
ETH032	XPC	BE233FJ-KPSN	38.10	66.68	9.52	31.8	67.5	78.5	62.0	145.0
	XPD	CM233FJ-115027	38.10	66.68	9.52	31.8	67.5	78.5	62.0	177.0
	XPG	BE344LJ-KPSN	73.03	98.43	12.70	30.2	67.5	78.5	80.0	188.0
	XPH	BE344LJ-KPSB	73.03	98.43	12.70	30.2	67.5	78.5	80.0	231.0
ETH050	XPC	BE233FJ-KPSN	38.10	66.68	9.52	31.8	87.5	78.5	62.0	145.0
	XPD	CM233FJ-115027	38.10	66.68	9.52	31.8	87.5	78.5	62.0	177.0
	XPG	BE344LJ-KPSN	73.03	98.43	12.70	30.2	87.5	84.0	90.0	188.0
	XPH	BE344LJ-KPSB	73.03	98.43	12.70	30.2	87.5	84.0	90.0	231.0
	XPL	MPP1003D1E-KPSN	95.00	115	19.00	40.0	87.5	92.5	100.0	175.0
	XPM	MPP1003D1E-KPSB	95.00	115	19.00	40.0	87.5	92.5	100.0	223.0
	XPN	MPP1003D1E-KPSN *	73.03	98.43	12.70	31.8	87.5	128.0	100.0	175.0
	XPP	MPP1003D1E-KPSB *	73.03	98.43	12.70	31.8	87.5	128.0	100.0	223.0
	XPQ	MPP1003R1E-KPSN	73.03	98.43	12.70	31.8	87.5	92.5	100.0	175.0
	XPR	MPP1003R1E-KPSB	73.03	98.43	12.70	31.8	87.5	92.5	100.0	223.0
	XPS	MPP1003R1E-KPSN *	73.03	98.43	12.70	31.8	87.5	128.0	100.0	175.0
	XPT	MPP1003R1E-KPSB *	73.03	98.43	12.70	31.8	87.5	128.0	100.0	223.0
ETH080	XPG	BE344LJ-KPSN	73.03	98.43	12.70	30.2	130.0	84.0	90.0	188.0
	XPH	BE344LJ-KPSB	73.03	98.43	12.70	30.2	130.0	84.0	90.0	231.0
	XPL	MPP1003D1E-KPSN	95.00	115.00	19.00	40.0	130.0	95.3	100.0	175.0
	XPM	MPP1003D1E-KPSB	95.00	115.00	19.00	40.0	130.0	95.3	100.0	223.0
	XPN	MPP1003D1E-KPSN **	73.03	98.43	12.70	31.8	130.0	137.0	100.0	175.0
	XPP	MPP1003D1E-KPSB **	73.03	98.43	12.70	31.8	130.0	137.0	100.0	223.0
	XPQ	MPP1003R1E-KPSN	95.00	115.00	19.00	40.0	130.0	95.3	100.0	175.0
	XPR	MPP1003R1E-KPSB	95.00	115.00	19.00	40.0	130.0	95.3	100.0	223.0
	XPS	MPP1003R1E-KPSN **	73.03	98.43	12.70	31.8	130.0	137.0	100.0	175.0
	XPT	MPP1003R1E-KPSB **	73.03	98.43	12.70	31.8	130.0	137.0	100.0	223.0
	XPU	MPP1154B1E-KPSN	110.00	130.00	24.00	50.0	130.0	127.0	115.0	203.0
	XPV	MPP1154B1E-KPSB	110.00	130.00	24.00	50.0	130.0	127.0	115.0	252.0
	XPW	MPP1154B1E-KPSN ***	110.00	130.00	24.00	50.0	130.0	170.0	115.0	203.0
	XPX	MPP1154B1E-KPSB ***	110.00	130.00	24.00	50.0	130.0	170.0	115.0	252.0
	XPY	MPP1154P1E-KPSN	110.00	130.00	24.00	50.0	130.0	127.0	115.0	203.0
	XPZ	MPP1154P1E-KPSB	110.00	130.00	24.00	50.0	130.0	127.0	115.0	252.0
	XP1	MPP1154P1E-KPSN ***	110.00	130.00	24.00	50.0	130.0	170.0	115.0	203.0
	XP2	MPP1154P1E-KPSB ***	110.00	130.00	24.00	50.0	130.0	170.0	115.0	252.0

* With Parker PV34FE-003 gearhead
** With Parker PV90FB-003 gearhead
*** With Parker PV115FB-003 gearhead

* PD4 = Flange + Gearhead/overhung load adaptor
PD5 = Flange + Gearhead/overhung load adaptor
PD6 = Motor only

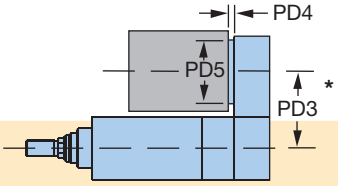
ETH Motor Mounting Configurations

Parallel Mounts for other Parker Motors



Flange & Coupling to Accept Parker Motor			Dimensions — mm						
Cylinder Size	Kit Order Code	Parker Motor Description	Pilot	Bolt Circle	Shaft Ø	Shaft Length	PD3	PD4	PD5
ETH032	KCB	SM23X	38.10	66.68	9.52	20.8	67.5	72.5	62.0
	KBB	BE23X	38.10	66.68	9.52	31.8	67.5	78.5	62.0
	KCA	SM16/BE16	20.00	46.69	6.35	25.0	67.5	72.5	62.0
	KEA	LV23/HV23	38.10	66.68	6.35	20.8	67.5	72.5	62.0
	KBC	BE34X	73.03	98.43	12.70	30.2	67.5	78.5	80.0
	KEB	LV34/HV34	73.03	98.43	12.70	37.1	67.5	78.5	80.0
ETH050	KCB	SM23X	38.10	66.68	9.52	20.8	87.5	72.5	62.0
	KBB	BE23X	38.10	66.68	9.52	31.8	87.5	78.5	62.0
	KBC	BE34X	73.03	98.43	12.70	30.2	87.5	84.0	90.0
	KAA	MPP92/MPJ92	80.00	100	16.00	40.1	87.5	92.5	90.0
	KEB	LV34/HV34	73.03	98.43	12.70	37.1	87.5	92.5	90.0
	KAB	MPP100/MPJ100	95.00	115	19.00	40.1	87.5	92.5	100.0
ETH080	KAA	MPP92/MPJ92	80.00	100.00	16.00	40.1	130.0	96.0	90.0
	KAB	MPP100/MPJ100	95.00	115.00	19.00	40.0	130.0	96.0	100.0
	KAC	MPP115/MPJ115	110.00	130.00	24.00	50.0	130.0	127.0	115.0

Parallel Mounts for Parker Gearheads



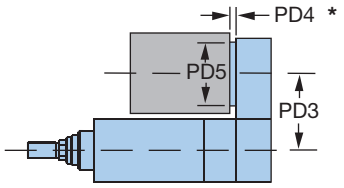
Flange & Coupling to Accept Parker Motor			Dimensions — mm						
Cylinder Size	Kit Order Code	Parker Gearhead Description	Pilot	Bolt Circle	Shaft Ø	Shaft Length	PD3	PD4	PD5
ETH032	PAN	PV60FB/PX60	50.00	70.00	16.00	25.0	67.5	12.0	62.0
ETH050	PAN	PV60FB/PX60	50.00	70.00	16.00	25.0	87.5	12.0	63.5
	PDN	PV34FE/PX34	73.03	98.43	12.70	31.8	87.5	15.0	90.0
ETH080	PBN	PV90FB/PX90	80.00	100.00	20.00	40.0	130.0	18.0	90.0
	PJN	PV115FB/PX115	110.00	130.00	24.00	50.0	130.0	20.0	115.0

* PD4 = Flange + Gearheadoverhung load adaptor
PD5 = Flange + Geahead/overhung load adaptor
PD6 = Motor only

Parallel Mounts for Non-Standard Motors

Parallel Mounting Compatible Motor Dimensions - mm

Cylinder Size	Max. Shaft Ø		Max. Square Motor Flange
	With Key	Without Key	
ETH032	—	14 (w/PV60 gearhead)	85
ETH050	—	20 (w/PV90 gearhead} or	100
ETH080	—	24 (w/PV115 gearhead}	150



* PD4 = Flange + Gearheadoverhung load adaptor
PD5 = Flange + Geahead/overhung load adaptor
PD6 = Motor only

Sleeves

Order Code	Sleeve Size (Motor Shaft Ø)	Compatibility		
		ETH032	ETH050	ETH080
B	0.25”	•		
C	0.375”	•	•	
D	0.5”	•	•	
E	0.625”	•	•	
H	6 mm	•		
J	8 mm	•		
K	9 mm	•	•	
L	11 mm	•	•	
M	14 mm	•	•	•
N	16 mm		•	•
P	19 mm		•	•
Q	20 mm			•
R	22 mm			•
S	24 mm			•

Ordering Non-Standard Motor Mounts

Use the appropriate order codes from the charts to build the desired “Flange Only” or “Flange and Sleeve” Kit Order Code. Note: all non-standard motor mount kits use three character descriptions beginning with an N, followed by a Sleeve and a Flange designator.

Kit Order Code Designators:	(1)	(2)	(3)
	N		

(1) **Non-standard motor mount**
(2) **Coupler order code**
(3) **Flange order code**

Kit Order Code Examples	Kit Order Code
Flange C (for ETH050), no sleeve	NAC
Flange C (for ETH050), 0.5” sleeve	NDC

Flanges

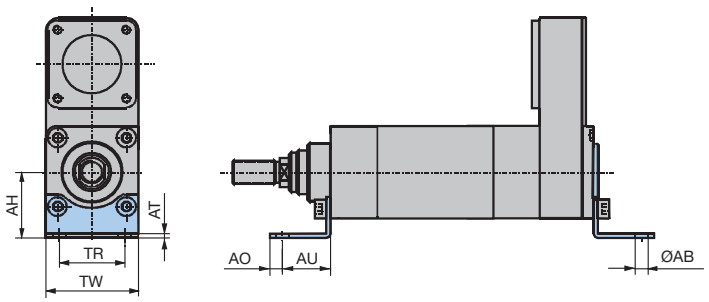
Order Code	Dimensions — mm													
	Bolt Circle	Bolt Thread	Pilot Ø	Pilot Depth	Motor Shaft Length	Compatibility								
						ETH032			ETH050			ETH080		
						PD3	PD4	PD5	PD3	PD4	PD5	PD3	PD4	PD5
A	No Flange						0.0			0.0			0.0	
B	46.00	M3	30.00	3.5	25.0	67.5	72.5	62.0	—	—	—	—	—	—
C	63.00	M4	40.00	3.5	20.0	67.5	72.5	62.0	87.5	72.5	60.0	—	—	—
D	70.00	M5	50.00	3.5	30.0	67.5	78.5	62.0	87.5	78.5	63.5	—	—	—
E	75.00	M5	60.00	3.5	23.0	67.5	78.5	62.0	87.5	84.0	90.0	—	—	—
F	75.00	M5	60.00	3.5	30.0	67.5	72.5	62.0	87.5	84.0	90.0	—	—	—
G	90.00	M6	70.00	3.5	40.0	—	—	—	—	—	—	130.0	96.0	90.0
H	95.00	M5	50.00	3.5	30.0	67.5	78.5	82.0	87.5	84.0	90.0	—	—	—
J	100.00	M6	80.00	3.5	40.0	—	—	—	87.5	92.5	90.0	130.0	96.0	90.0
K	115.00	M8	95.00	3.5	40.0	—	—	—	87.5	92.5	100.0	130.0	96.0	100.0
L	130.00	M8	110.00	3.5	50.0	—	—	—	—	—	—	130.0	127.0	115.0
M	130.00	M8	95.00	3.5	50.0	—	—	—	—	—	—	130.0	116.0	115.0

ETH Motor Mounting Options

Order Code

B Foot Mount

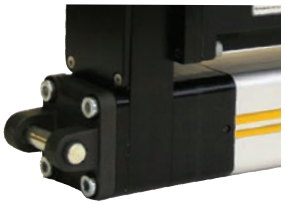
Available with parallel motor configurations only



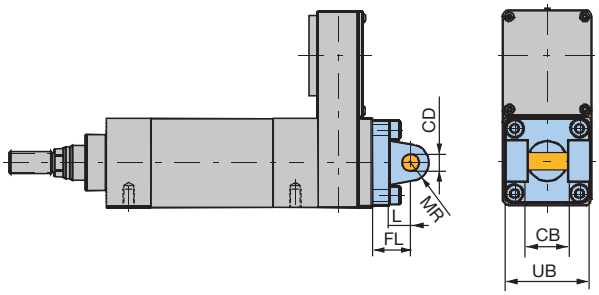
Size	Part Number* (1 piece each) Rear Bracket	Front Bracket	Dimensions — mm AH	AT	TR	ØAB (H14)	AO	AU	TW
ETH032	0111.065		32	4	32	7.0	8	24	48
ETH050	0121.065		45	4	45	9.0	12	32	65
ETH080	0131.065-01	0131.065-02	63	6	63	13.5	15	41	95

* Use order code when ordering cylinder; use part number for ordering spare replacement parts

C Rear Clevis Mount



Available with parallel motor configurations only

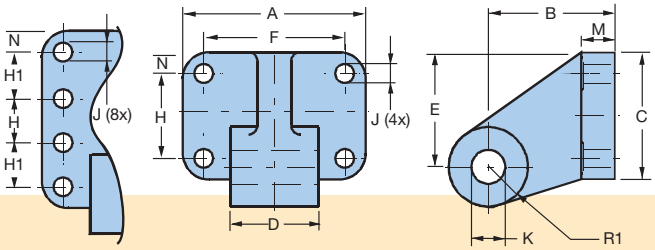


Size	Part Number*	Dimensions — mm UB (h13)	CB (H14)	ØCD (H9)	MR	L	FL ±0.2
ETH032	0112.031	46.5	26	10	9.5	13	22
ETH050	0122.031	63.5	32	12	12.5	16	27
ETH080	0132.031	95	50	16	17.5	22	36

* Use order code when ordering cylinder; use part number for ordering spare replacement parts

Optional Bearing Block

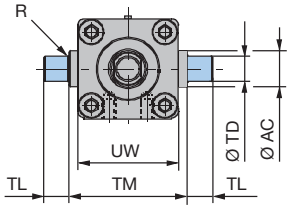
Mating mount bracket to rear clevis.
Please order separately.

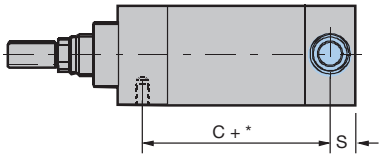


Cylinder Size	Part Number	Dimensions — mm A	B	C	D	E	F	H	H1	ØJ (H13)	ØK (H9)	M	R1
ETH032	0112.039	55	32	55	26	43.0	38	38	—	9	10	8	11.0
ETH050	0122.039	70	45	70	32	52.5	48	48	—	11	12	12	13.0
ETH080	0132.039	95	63	150	50	130.5	72	45	40	13	16	16	16.5

Order Code

D Center Trunnion Mount



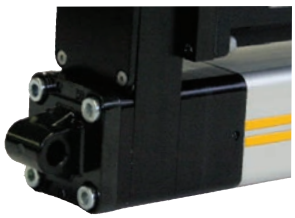


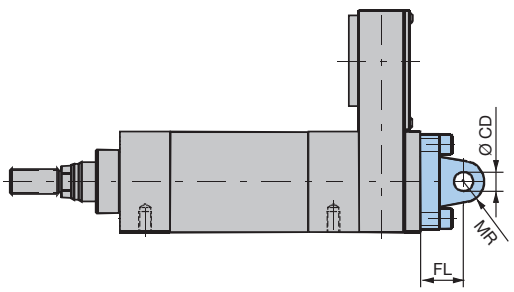
Factory installed. Cannot be ordered separately.

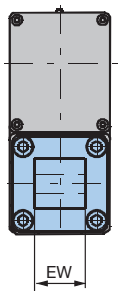
Cylinder Size	Dimensions — mm					
	UW	ØTD**	R	TL	TM	ØAC
ETH032	46.5	12	1	12	50	18
ETH050	63.5	16	1	16	75	25
ETH080	95.3	25	2	25	110	35

* Dimension C+ = Dimension + length of desired stroke (see page 40 for calculating stroke)
**: ØTD in accordance with ISO tolerance zone h8
Note: For relubrication option "1" (Integrated lubrication port) please see mounting method with option "D" center trunnion always on 6 o'clock!

E Rear Eye Mount





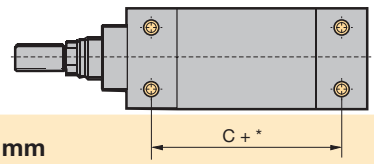


Available with parallel motor configurations only

Cylinder Size	Part Number*	Dimensions — mm			
		EW	ØCD	MR (H9)	FL ±0.2
ETH032	0112.033	26	10	11	22
ETH050	0122.033	32	12	13	27
ETH080	0132.033	50	16	17	36

* Use order code when ordering cylinder; use part number for ordering spare replacement parts

F Tapped Bottom Holes (Standard)



Mounting with 4 threaded holes on bottom of the cylinder.

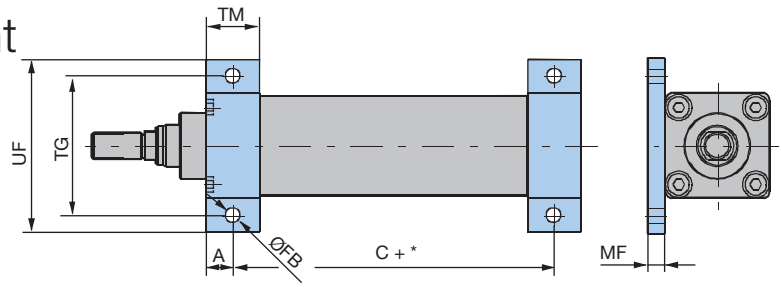
Cylinder Size		Dimension C + — mm								
		ETH032			ETH050			ETH080		
Screw Lead		**M05**	**M10**	**M16**	**M05**	**M10**	**M20**	**M05**	**M10**	**M32**
C + *	IP54	93.5	103.0	106.5	99.5	105.5	117.5	141.5	159.5	189.5
	IP65	94.5	103.5	107.5	100.5	106.5	118.5	142.5	160.5	190.5

* Dimension C+ = Dimension + length of desired stroke (see page 40 for calculating stroke)

ETH Motor Mounting Options

Order Code

G Side Flange Mount

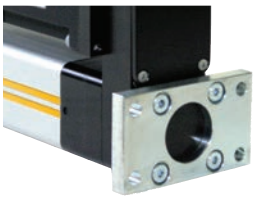


Flanges are stainless steel

Cylinder Size	Part Number**	Dimensions — mm					
		TG	UF	ØFB	TM	MF	A
ETH032	1440.079	62	78	6.6	25	8	12.5
ETH050	1441.093	84	104	9.0	30	10	15.0
ETH080	0131.078	120	144	13.5	40	12	20.0

* Dimension C+ = Dimension + length of desired stroke (see page 40 for calculating stroke)
** Use order code when ordering cylinder; use part number for ordering spare replacement parts (one piece per part number)

H Rear Plate Mount



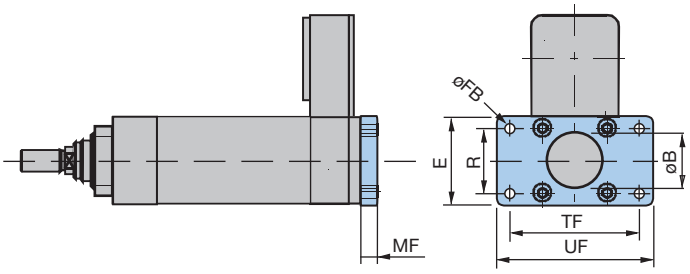


Plate is stainless steel

Cylinder Size	Part Number*	Dimensions — mm						
		MF	UF	TF	E	R	ØFB	ØB
ETH032	0111.064	10	80	64	48	32	7	30
ETH050	0121.064	12	110	90	65	45	9	40
ETH080	0131.064-01	16	150	126	95	63	12	45

* Use order code when ordering cylinder; use part number for ordering spare replacement parts (one piece per part number)

Order Code

J Front Plate Mount

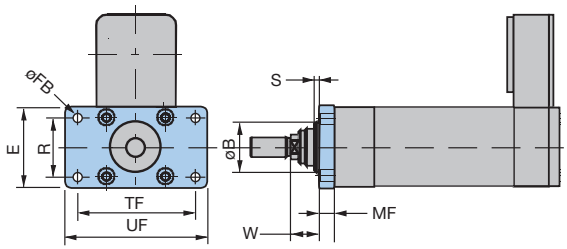
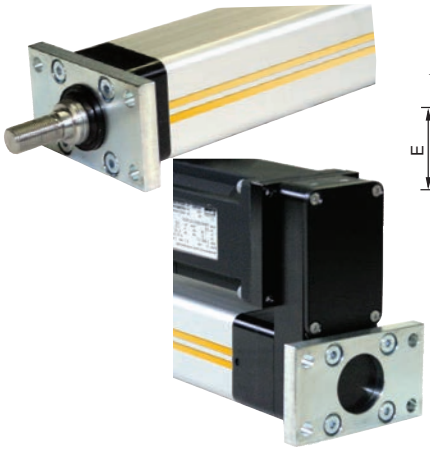


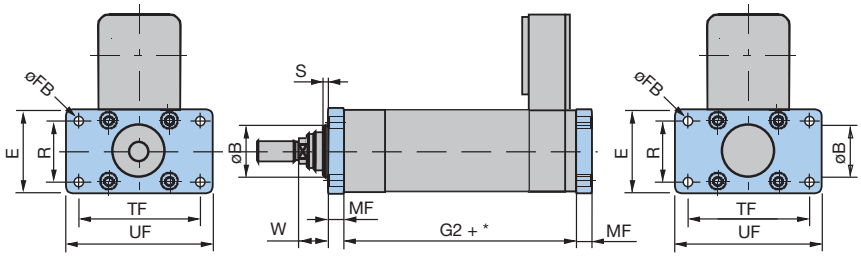
Plate is stainless steel

Cylinder Size	Part Number*	Dimensions — mm								
		S	W	MF	UF	TF	E	R	ØFB	ØB
ETH032	0111.064	2	16	10	80	64	48	32	7	30
ETH050	0121.064	4	25	12	110	90	65	45	9	40
ETH080	0131.064-02	4	30	16	150	126	95	63	12	60

* Use order code when ordering cylinder; use part number for ordering spare replacement parts (one piece per part number)

N Front & Rear Plate Mount





Plates are stainless steel

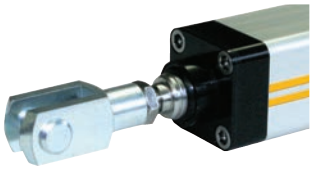
Cylinder Size	Part Number**		Dimensions — mm								
			S	W	MF	UF	TF	E	R	ØFB	ØB
ETH032	Front & Rear	0111.064	2	16	10	80	64	48	32	7	30
ETH050	Front & Rear	0121.064	4	25	12	110	90	65	45	9	40
ETH080	Front	0131.064-02	4	30	16	150	126	95	63	12	60
	Rear	0131.064-01									45

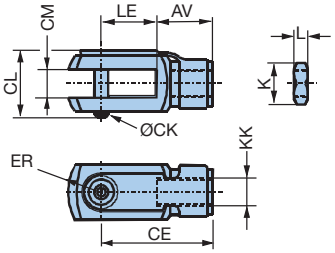
* Dimension G2+ (parallel) or G1+ (inline) = Dimension + length of desired stroke (see page 40 for calculating stroke)
** Use order code when ordering cylinder; use part number for ordering spare replacement parts (one piece per part number)

ETH Rod End Options

Order Code

C Clevis Rod End

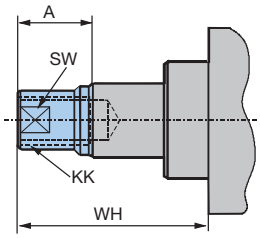




Cylinder Size	Part Number*	Mass [kg]	Dimensions — mm									
			KK	CL	CM		LE	CE	AV	ER	ØCK (h11/E9)	K	L
ETH032	4309	0.09	M10 x 1.25	26.0	10.2	+0.13/-0.05	20	40	20	14	10	17	5
ETH050	4312	0.34	M16 x 1.5	39.0	16.2	+0.13/-0.05	32	64	32	22	16	24	8
ETH080	4314	0.69	M20 x 1.5	52.5	20.1	+0.02/-0.0	40	80	40	30	20	30	10

*Use order code when ordering cylinder; use part number for ordering spare replacement parts (cylinder rod with male thread is required)

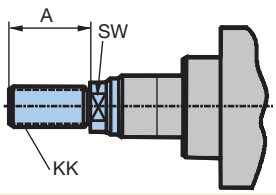
F Female Threaded Rod End



Cylinder Size	Part Number*	Dimensions — mm				
		Mass [kg]	A	KK	WH	SW**
ETH032	0111.029	0.04	14	M10 x 1.25	32	12
ETH050	0121.029	0.14	24	M16 x 1.5	50	20
ETH080	0131.029	0.42	29	M20 x 1.5	59	26

*Use order code when ordering cylinder; use part number for ordering spare replacement parts
** SW = width across flat (position of the flat is not fixed)

M Male Threaded Rod End

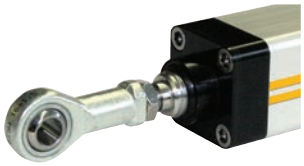


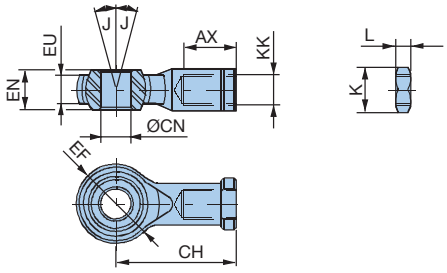
Cylinder Size	Part Number*	Dimensions — mm			
		Mass [kg]	A	KK	SW**
ETH032	0111.028	0.06	22	M10 x 1.25	10
ETH050	0121.028	0.15	32	M16 x 1.5	17
ETH080	0131.028	0.48	40	M20 x 1.5	22

*Use order code when ordering cylinder; use part number for ordering spare replacement parts
** SW = width across flat (position of the flat is not fixed)

Order Code

S Spherical Rod End

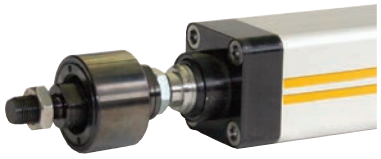




Cylinder Size	Part Number*	Mass [kg]	Dimensions — mm									
			KK	ØCN (H9)	EN (h12)	EU	AX	CH	ØEF	J°	K	L
ETH032	4078-10	0.07	M10 x 1.25	10	14	10.5	20	43	28	13	17	5
ETH050	4078-16	0.23	M16 x 1.5	16	21	15.0	28	64	42	15	24	8
ETH080	4078-20	0.41	M20 x 1.5	20	25	18.0	33	77	50	14	30	10

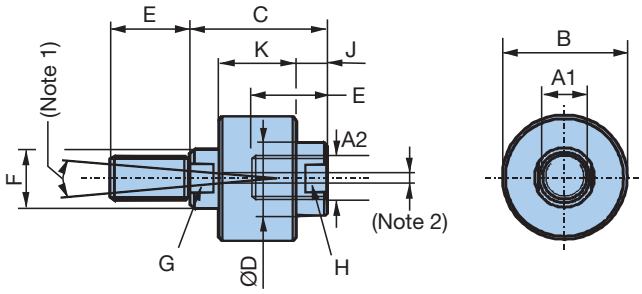
* Use order code when ordering cylinder; use part number for ordering spare replacement parts (cylinder rod with male thread is required)

L Alignment Coupler



The alignment coupler mounts on the end of the cylinder rod to:

- Balance misalignments
- Increase the mounting tolerance
- Simplify cylinder mounting
- Increase cylinder guide service life
- Compensate for offsets between components and relieves guides from lateral force influences
- Maintain traction/thrust force bearing capacity



(1) Angle offset ±5° from centerline (2) Axial offset: ±1.5 mm from centerline

Cylinder Size	Part Number*	Mass [kg]	Dimensions — mm										
			A1	A2	B	C	ØD	E	F	G	H	J	K
ETH032	LC32-1010	0.26	M10x1.25	M10x1.25	40	51	19	19	16	13	16	13	26
ETH050	LC50-1616	0.64	M16x1.5	M16x1.5	54	59	32	29	25	22	29	14	33
ETH080	LC80-2020	1.30	M20x1.5	M20x1.5	54	59	32	29	25	22	29	14	33

*Use order code when ordering cylinder; use part number for ordering spare replacement parts (cylinder rod with male thread is required)

ETH Rod End Options

Order Code

R Linear Guide Module

Linear Guide Module offers:

- Anti-rotation control for higher torques
- Absorption of lateral forces

Additional stability and precision is achieved by:

- 2 hardened stainless steel guiding rods
- 4 linear ball bearings

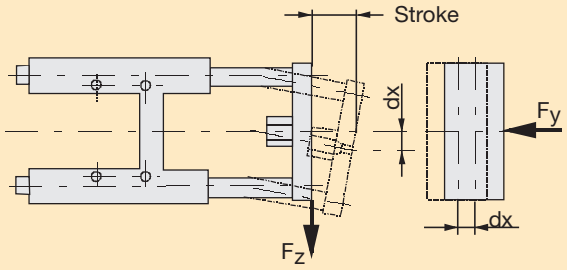
Not available with IP65 models

Linear Guide Module Specifications

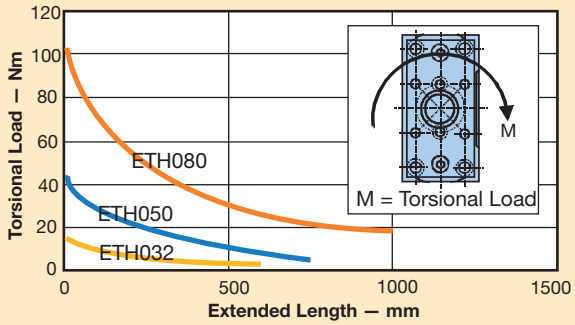
Cylinder Size	Part Number*	Total Mass (w/Zero Stroke) [kg]	Moving Mass (w/Zero Stroke) [kg]	Additional Mass [kg/m]
ETH032	32-2800R-xxxx	0.97	0.60	1.78
ETH050	50-2800R-xxxx	2.56	1.84	4.93
ETH080	80-2800R-xxxx	6.53	4.36	7.71

*Use order code when ordering cylinder; use part number for ordering spare replacement parts replacing xxxx with the desired stroke length. For example, order 50-2800R-0200 for 200 mm stroke. (Be sure to specify the same stroke as ordered on the matching ETH cylinder.)

Deflection*

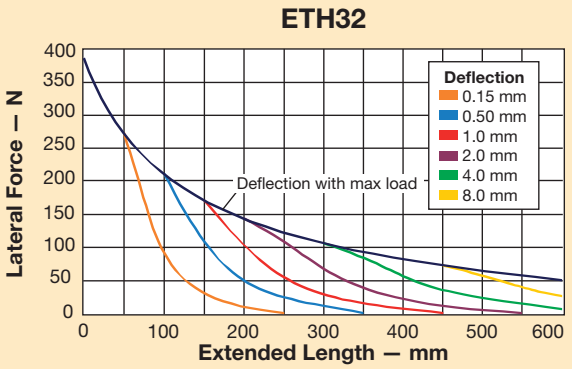


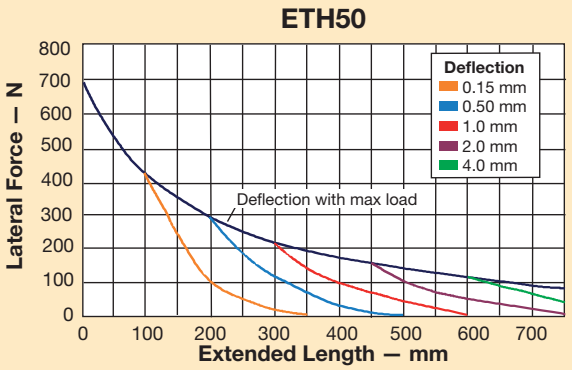
dx: Deflection valid for F_y and F_z

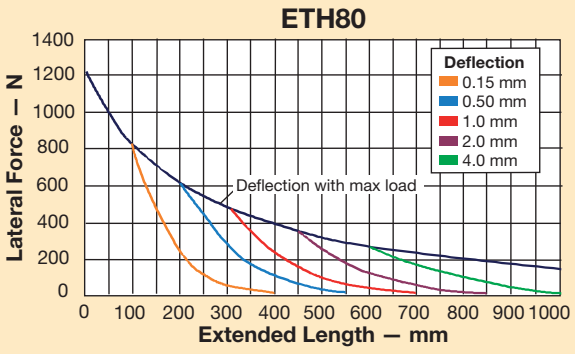


* Deflection curves represent cylinders mounted in any orientation

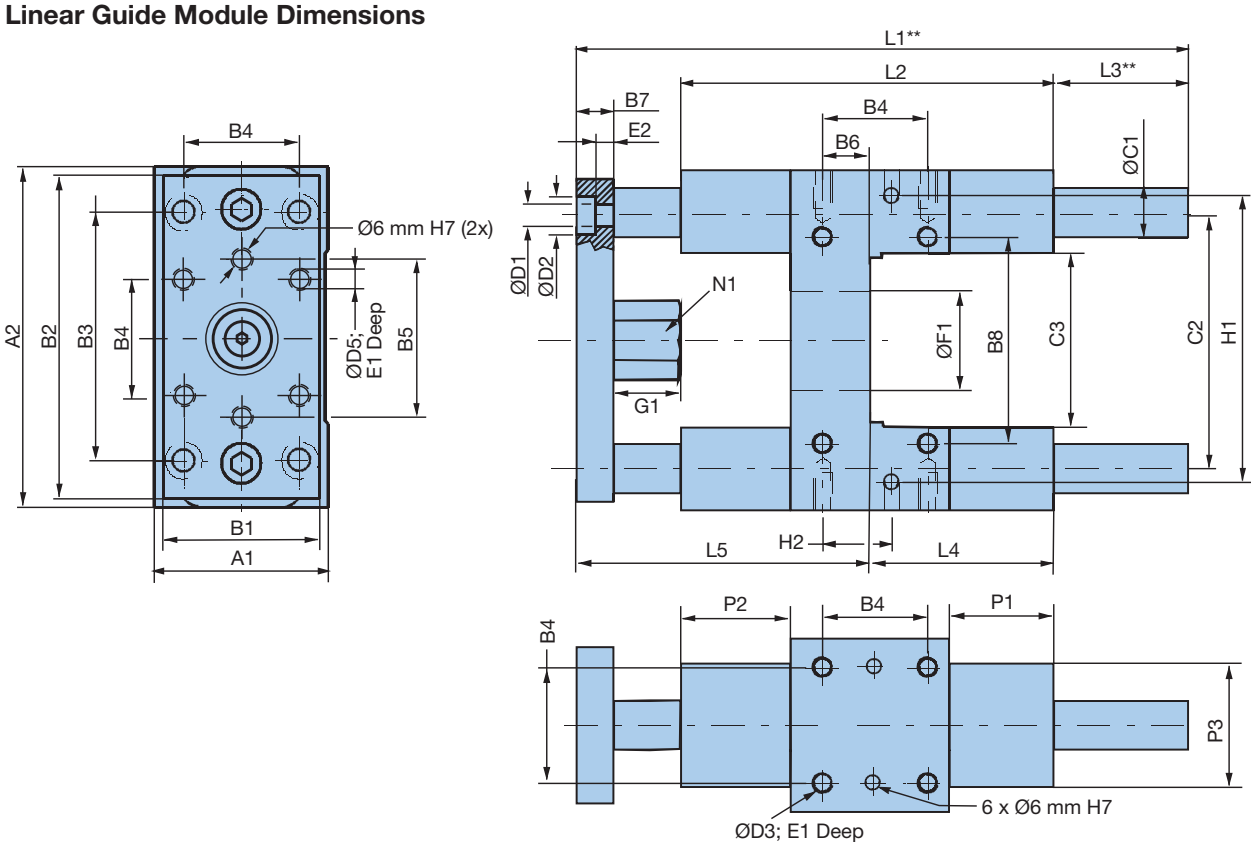
Cylinder Rigidity with Linear Guide Module







Linear Guide Module Dimensions



Part Number	Dimensions — mm									
	A1	A2	B1	B2	B3	B4	B5	B6	B7	B8
32-2800R-xxxx	50.0	97.0	45.0	90.0	78.0	32.5	50.0	4.0	12.0	61.0
50-2800R-xxxx	70.0	137.0	63.0	130.0	100.0	46.5	72.0	19.0	15.0	85.0
80-2800R-xxxx	105.0	189.0	100.0	180.0	130.0	72.0	106.0	21.0	20.0	130.0

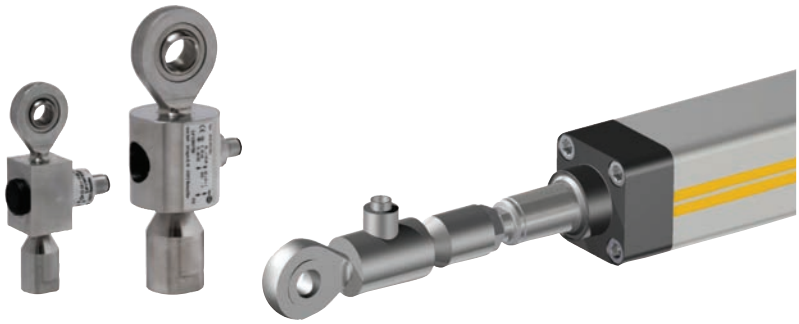
Part Number	ØC1	C2	C3	ØD1	ØD2	ØD3	E1 (Depth)	E2 (Depth)	ØF1	G1
32-2800R-xxxx	12.0	73.5	50.0	6.6	11.0	M6 x 1.00	12.0	7.25	30.0	17.0
50-2800R-xxxx	20.0	103.5	70.0	8.4	15.0	M8 x 1.25	16.0	9.25	40.0	27.0
80-2800R-xxxx	25.0	147.0	105.0	10.5	18.0	M10 x 1.50	20.0	11.25	60.0	32.0

Part Number	H1	H2	L1+*	L2	L3+*	L4	L5	N1 **	P1	P2	P3
32-2800R-xxxx	81.0	16.0	152.0	120.0	17.0	71.0	64.0	17.0	36.0	31.0	40.0
50-2800R-xxxx	119.0	23.0	193.0	150.0	25.0	79.0	89.0	24.0	42.0	44.0	50.0
80-2800R-xxxx	166.0	36.0	253.0	200.0	30.0	113.0	110.0	30.0	50.0	52.0	70.0

* L1+ and L3+ = Dimension + length of desired stroke (see page 40 for calculating stroke)
** N1: Hexagon head; Linear guide module not available on IP65 models

ETH Accessories

Force Sensor Rod End



Jointed swivel head design with integrated force sensor

Swivel heads are important construction components with respect to rotary, pivoting and tilting movements. Force measurements are more and more frequently required in those applications.

The force transducers are suitable for direct mounting on the cylinder rod. They can, for example, be used to measure contact forces or overloads.

Thanks to thin film technology, the swivel head force transducers are very robust and long time stable. An integrated amplifier emits an output signal of 4 ... 20 mA.

The sensors correspond to the EN 61326 standard for electro-magnetic compatibility (EMC) and are sense both thrust and traction forces.

Requires male thread rod end option “M”, see page 22

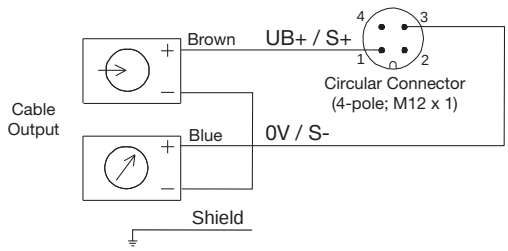
Features

- **Measuring range: traction/ thrust forces up to ±25 kN**
- **Thin film implants (instead of conventional bonded foil strain gauges)**
- **Corrosion resistant stainless steel version**
- **Integrated amplifier**
- **Small temperature drift**
- **High long term stability**
- **High shock and vibration resistance**
- **For dynamic or static measurements**
- **Good repeatability**
- **Simple mounting**

	ETH032			ETH050			ETH080		
	M05	**M10**	**M16**	**M05**	**M10**	**M20**	**M05**	**M10**	**M32**
Part Number	0111.916	0111.916	0111.917	0121.916	0121.917	0121.918	0131.916	0131.917	0131.918
Accuracy — %	0.2								
Material	Stainless steel								
Protection class	IP67								
Calibration — kN	±3.7	±3.7	±2.4	±9.3	±7.0	±4.4	±17.8	±25.1	±10.6
Accuracy – N	14.8	14.8	9.6	37.2	28.0	17.6	71.2	100.4	42.4

Electrical Connection

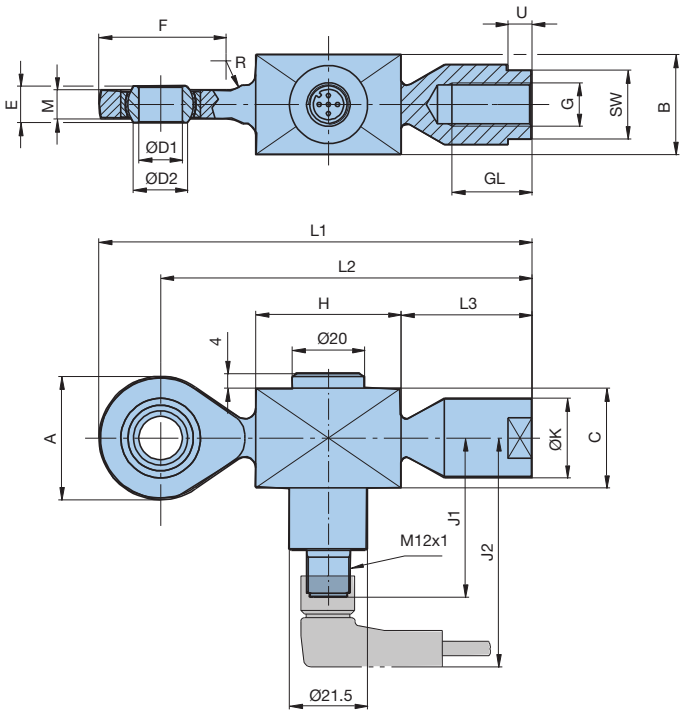
Analog output 4...20 mA (two-wire technology)



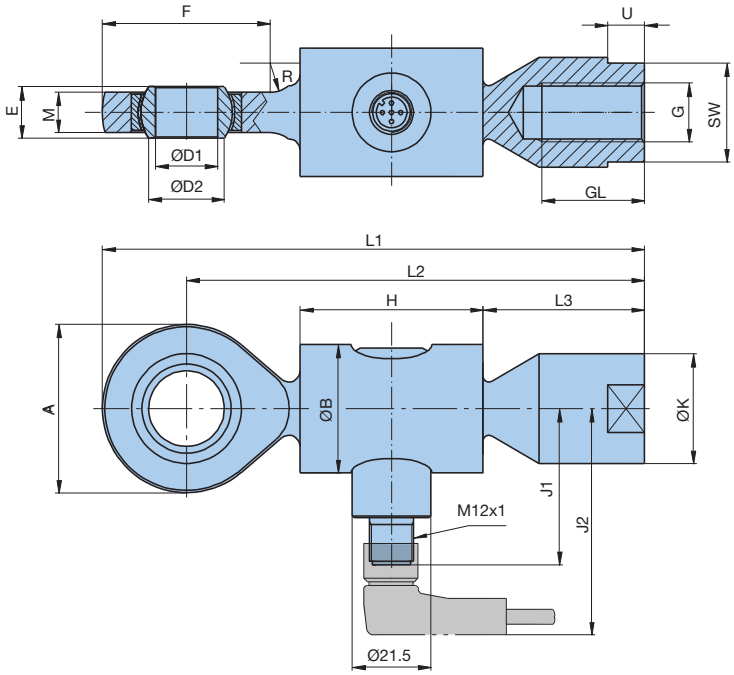
Force Sensor Cables

Part Number	Description
080-900446	2M sensor cable, straight connector, M12 to flying leads
080-900447	5M sensor cable, straight connector, M12 to flying leads
080-900456	2M sensor cable, 90 degree (symbol) angled connector, M12 to flying leads
080-900457	5M sensor cable, 90 degree (symbol) angled connector, M12 to flying leads

Force Sensor Rod End for ETH032



Force Sensor Rod End for ETH050 & ETH080



Cylinder Size	Dimensions — mm																		
	A	B	ØB	C	ØD1	ØD2 0.008	E	F	G	GL	H	J1	J2	ØK	L1	L2	L3	M	SW*	U
ETH032	34	27	—	27	12	15	10	35	M10x1.25	22	40	44	63	22	119	102	36	8	19	8
ETH050	46	—	35	—	17	20.7	14	46	M16x1.5	28	50	43	62	30	148	125	44	11	27	12
ETH080	53	—	54	—	20	24.2	16	54	M20x1.5	33	54	44	63	35	171	144.5	54	13	32	13

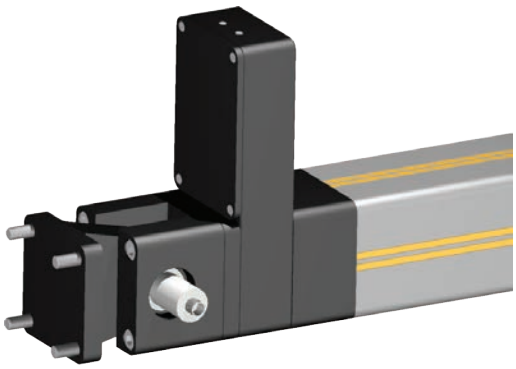
*SW = width across flat

ETH Accessories

Force Sensor Rear Clevis

In some force measurement applications, a force sensor on the cylinder rod is not possible or will affect the application's scope. For these applications, Parker developed a special option for the ETH, where the force sensor is integrated into the end-cap of the cylinder. One of the main advantages of this design is that the sensor cable does not move as the rod extends and retracts. All force sensors are configured as traction/thrust sensors.

Analog standard output signals 4...20 mA are available. The sensors correspond to the EN 61326 standard for electromagnetic compatibility (EMC).



Features

- **Measuring range: traction/ thrust forces up to ±25 kN**
- **Thin film implants (instead of conventional bonded foil strain gauges)**
- **Corrosion resistant stainless steel version**
- **Integrated amplifier**
- **Small temperature drift**
- **High long term stability**
- **High shock and vibration resistance**
- **For dynamic or static measurements**
- **Good repeatability**
- **Simple mounting**

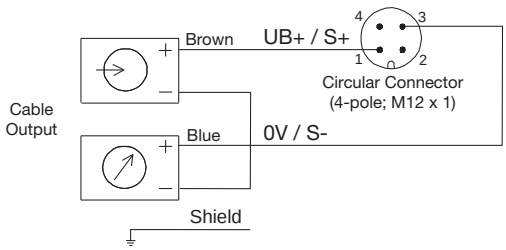
Compatible with parallel motor configurations only.

Requires tapped bottom hole cylinder mounting option "F", see page 19.

	ETH032			ETH050			ETH080		
	M05	**M10**	**M16**	**M05**	**M10**	**M20**	**M05**	**M10**	**M32**
Part Number	0112.034-01	0112.034-01	0112.034-02	0122.034-01	0122.034-02	0122.034-03	0132.034-01	0132.034-02	0132.034-03
Accuracy — %	1								
Material	Stainless steel								
Protection class	IP67								
Calibration — kN	±3.7	±3.7	±2.4	±9.3	±7.0	±4.4	±17.8	±25.1	±10.6
Accuracy – N	74.0	74.0	48.0	186.0	140.0	88.0	356.0	502.0	212.0

Electrical Connection

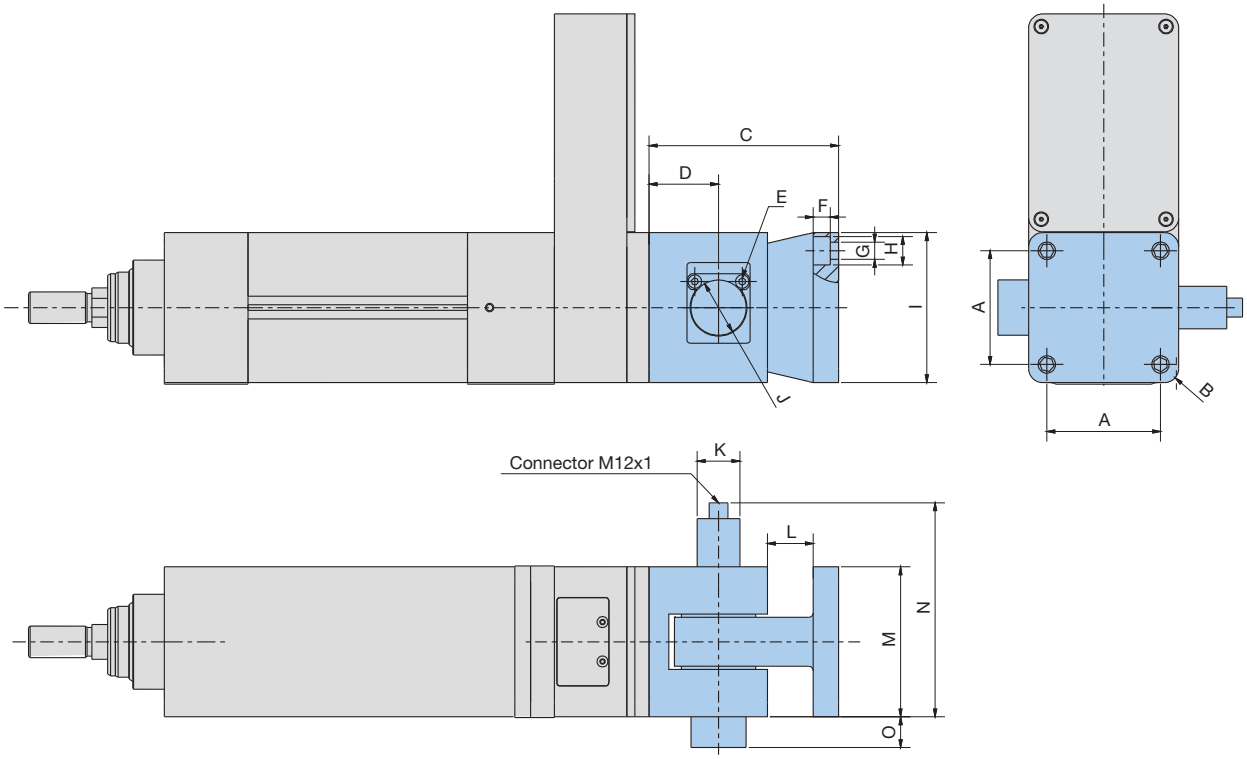
Analog output 4...20 mA (two-wire technology)



Force Sensor Cables

Part Number	Description
080-900446	2M sensor cable, straight connector, M12 to flying leads
080-900447	5M sensor cable, straight connector, M12 to flying leads
080-900456	2M sensor cable, 90 degree (symbol) angled connector, M12 to flying leads
080-900457	5M sensor cable, 90 degree (symbol) angled connector, M12 to flying leads

Force Sensor Rear Clevis for ETH032, ETH050, ETH080



Size	Dimensions — mm														
	A	B	C	D	E*	F	G	H	I	ØJ	ØK	L	M	N	O
ETH032	32.5	R7	72	27	SW3	6.4	6.6	11	46.5	20	27	12	46.5	98.25	6.75
ETH050	46.5	R8.5	89	32	SW3	8.8	9	15	63.5	25	27	17	63.5	111.75	3.25
ETH080	72.0	R9	123	47	SW4	10.8	11	18	95.0	35	27	29	95.0	135.50	0

*SW = width across flat

ETH Accessories

Limit Sensors

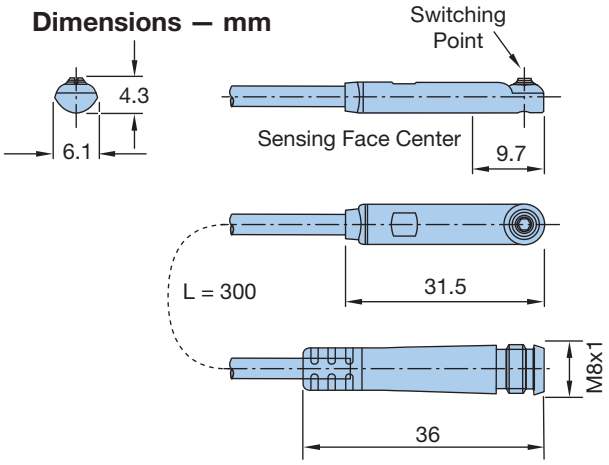
The ETH uses the Parker Global Sensor which can be mounted in the longitudinal grooves running along the cylinder body. These new sensors mount flush to the extrusion body, minimizing the overall width of the actuator.

The sensor cable can be concealed under the yellow T-slot covers which are provided with each unit.

Permanent magnets integrated into the screw nut actuate the sensors as the rod extends and retracts.

ETH032 and ETH050 sizes have two grooves on opposite sides of the cylinder; the ETH080 has two grooves on all four sides of the cylinder.

Dimensions — mm

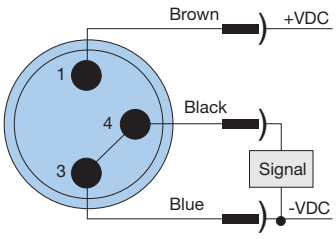


Note: Only PNP logic sensors are compatible with Compax3.

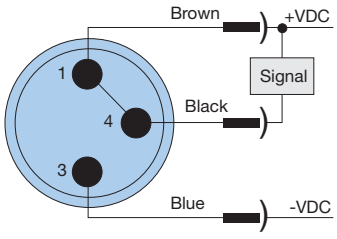
Common Specifications:

Electric current drain: 100 mA (max)
Switching current: 10 mA (max)
Supply voltage: 10 – 30 VDC
Switching Frequency: 5 kHz

PNP Wiring



NPN Wiring



Magnetic LED Cylinder Sensors

Model Number	Function	Logic	Cable	Compatible w/ Compax3
P8S-GPFAX	N.O.	PNP	3 m	Yes
P8S-GNFAX		NPN		No
P8S-GPCHX		PNP	0.3 m cable with M8 connector*	Yes
P8S-GNCHX		NPN		No
P8S-GQFAX	N.C.	PNP	3 m	Yes
P8S-GMFAX		NPN		No
P8S-GQCHX		PNP	0.3 m cable with M8 connector*	Yes
P8S-GMCHX		NPN		No

* 003-2918-01 is a 5 m extension cable to flying leads for these cables

Modular Systems Drives
AC890 Systems Drive

Features

Range of feedback options

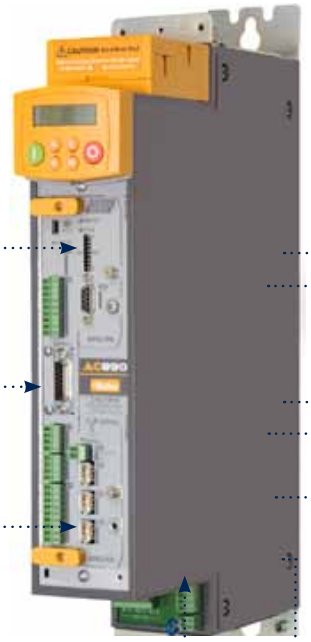
- Incremental encoder
- EnDat® 2.1 (SinCos) encoder
- Resolver

Versatile communications

- Ethernet/IP
- Modbus/TCP
- CANopen
- Profibus-DP
- Profinet/IO
- EtherCAT
- RS485
- DeviceNet
- ControlNet
- FireWire IEEE 1394
- USB port

Ultra-fast control loops

- Torque loop: 62.5µs
- Speed loop: 62.5µs
- Position loop: 62.5µs



Serves the most demanding applications

Taking advantage of leading edge control algorithms running on a fast 150 Mhz microprocessor, the AC890 drive can achieve very high bandwidth control loops. This allows you to use the drive for the most demanding industrial applications e.g. printing, registration, cut-to-length, position synchronization, rotary shear, converting and slitting.

Benefits

Integrated safety functionality

The integrated Safe Torque Off (STO) functionality offers protection against unexpected motor start-up, in accordance to EN13849-1 PLe, SIL 3 as standard.

Minimal delay between fieldbus setpoints and the control loops

Designed to integrate in existing automation systems, the AC890 features high performance ports linked directly to the fast control loops of the drive. Minimum delay exists between your digital setpoint sent through a fieldbus and the control loops.

Replacement of analog solutions

Your existing analog setpoint-based solutions can be replaced by a digital fieldbus-based solution with minimum bandwidth loss.

Flexible feedback options

The AC890 offers system designers complete flexibility in their choice of feedback technology to best suit the needs of their application.

Open standards for protection of investment

The AC890 has been specifically designed to integrate seamlessly into your automation network. To connect to your PLC or fieldbus network you can simply choose from the wide range of communication technology boxes.

Two performance levels to suit all applications:

Advanced Performance

Motion control with position control, Motion control function blocks: incremental move, absolute move, move home Section Control : line drive master ramp, winder blocks (speed and current winder), PID process, sequencer, more...

High Performance

All “Advanced Performance” features PLUS: Library of pre-engineered application specific LINK VM function blocks such as: Shaftless printing, cut-to-length, advanced winding, advanced traversing and others.

Sizing/Selection

How to use Speed Thrust Curves

Option 1: Xpress System Sizing

Parker offers pre-selected motor and motor/gearhead combinations to maximize the power output of each ETH frame size. This option is ideal for customer's working on time-sensitive applications and/or those that value the many benefits of a single-source solution.

To select the system solution, use the graphs on pages 33–38 to locate the application's required linear velocity and thrust.

If the point lies within a green shaded region, and it is not to the right of the relevant critical speed line, then the application can be solved with the motor or motor/gearhead combination corresponding to the number in that region while still getting full rated life (2,540 Km).

If the point is in the yellow intermittent zone, then the actuator will experience a reduced life, in which case another screw lead or a larger profile size is recommended.

If the point falls above the solid blue line, then the application cannot be solved with that actuator profile size and lead combination when using a motor mounted in parallel.

Once a solution is found simply order the ETH with the correct Xpress motor code and pair with the recommended Compax3 drive and motor power and feedback cables from page 31 to complete the Xpress system.

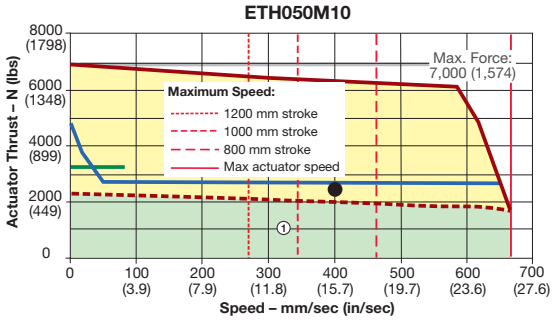
Example:
For an application needing 1000 N thrust at 400 mm/sec velocity, both the XPG and XPH motor/gearhead combinations will solve the application. Note: the actuator stroke must be less than approximately 900 mm in order to reach the required speed.

Solution:
Cylinder: ETH050M10xxXPGxxxxxxxx
Servo motor: BE344LJ-KPSN
Drive: C3S100V2F12IxxTxxMxx
Cables: P-3B1-xx and F-2C1-xx

Performance Zones:

Motor Codes	Continuous Operation
	①
XPG (1)	•
XPH (2)	•

(1) Without brake (2) With brake
* In-line motor mount only



Option 2: Hybrid Speed/Thrust Graphs

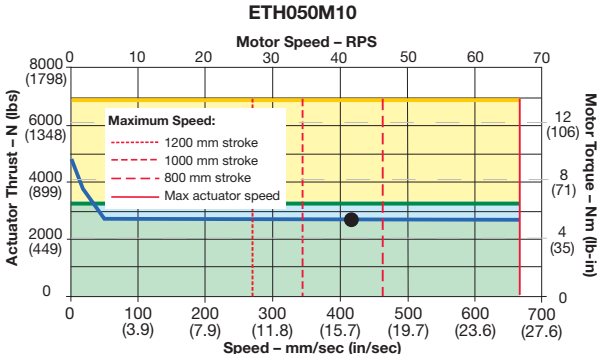
Back by popular demand, Parker has recreated the hybrid speed/thrust graphs for the new ETH Series actuators. These graphs are an ideal way to size an actuator for non-Xpress or third-party motors. These speed/thrust graphs plot linear velocity, linear thrust, required motor velocity, required motor torque, and critical speed.

To select a motor or motor/gearhead combination, use the graphs on pages 7-9 to locate the application's required linear velocity and thrust on the graph.

Once that point is determined, extend the lines to the secondary axes to determine the required motor torque and motor speed for the application.

Once the motor requirements are known, simply order the ETH with the proper Parker motor or gearhead mounting kits or use one of the non-standard mounting kit options.

Example:
For an application needing 1000 N thrust at 400 mm/sec linear velocity, and requiring a minimum life of 2,540 Km, the motor would have to be sized for 2 Nm of torque at 40 rps. Note: the actuator stroke must be less than approximately 900 mm to reach the required speed.



Option 3: Traditional Step-by-step Selection Process

For the most dynamic applications, or to double check critical application elements when using sizing options 1 and 2, the traditional step-by-step process (starting on page 39), can be used to size the ETH cylinder.

ETH032 Speed-Thrust with Motors (170 VDC)

Maximum Thrust with Motor*:

- Parallel motor mount limitation
- Max thrust w/2540 km life (see page 45 for details)

XPC – BE233FJ
- Peak
- Continuous

XPG – BE344LJ
- Peak
- Continuous

Maximum Speed:

- 1000 mm stroke
- 800 mm stroke
- 600 mm stroke
- Max actuator speed

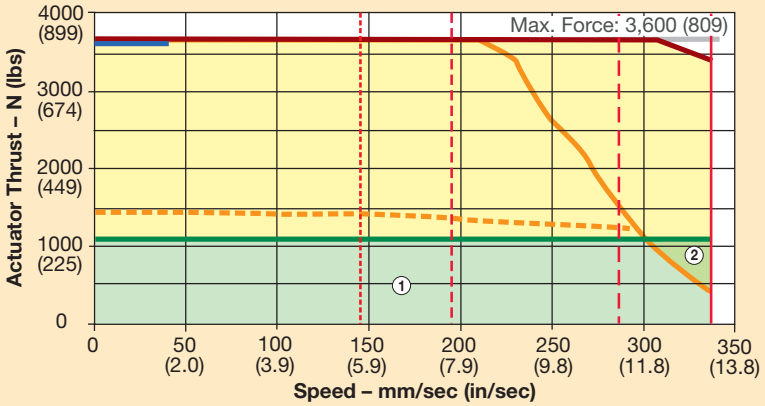
Performance Zones:

Motor Codes	Continuous Operation ①	②	③
XPC (1)	•		
XPD (2)	•		
XPG (1)	•	•	•*
XPH (2)	•	•	•*

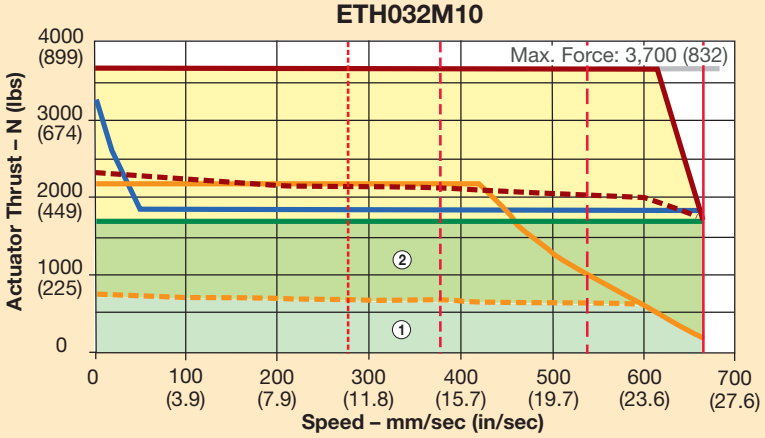
(1) Without brake (2) With brake
* In-line motor mount only

Intermittent Zone – Consult Factory (operation will result in reduced life of the actuator and is not acceptable for parallel motor options if above the parallel motor mount limitation curve)

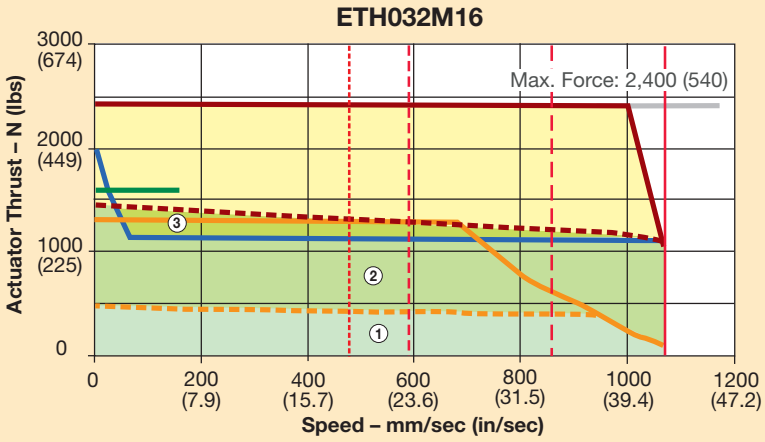
ETH032M05



ETH032M10



ETH032M16



* Maximum thrust assumes a cylinder mounting orientation with a fixed mounting position and a guided load. For limitations on column buckling, please see page 43.

Sizing/Selection

ETH032 Speed-Thrust with Motors (340 VDC)

Maximum Thrust with Motor*:

- Parallel motor mount limitation
- Max thrust w/2540 km life (see page 45 for details)

XPC – BE233FJ
- Peak
- Continuous

XPG – BE344LJ
- Peak
- Continuous

Maximum Speed:

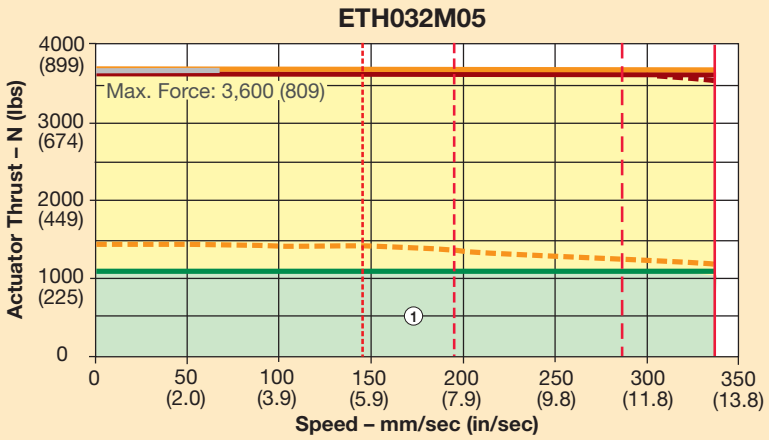
- 1000 mm stroke
- 800 mm stroke
- 600 mm stroke
- Max actuator speed

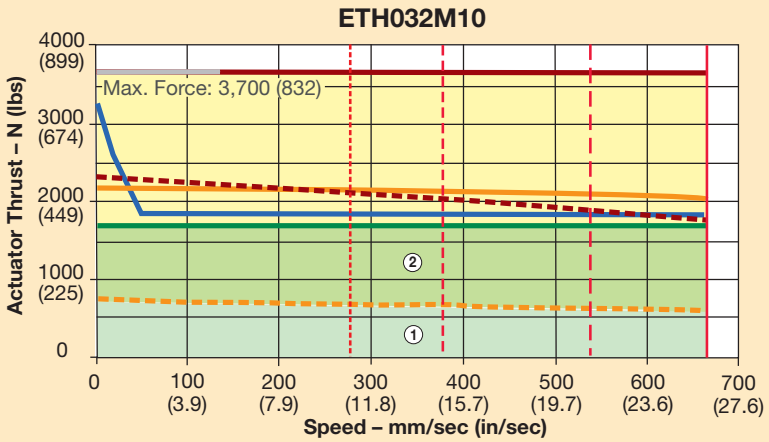
Performance Zones:

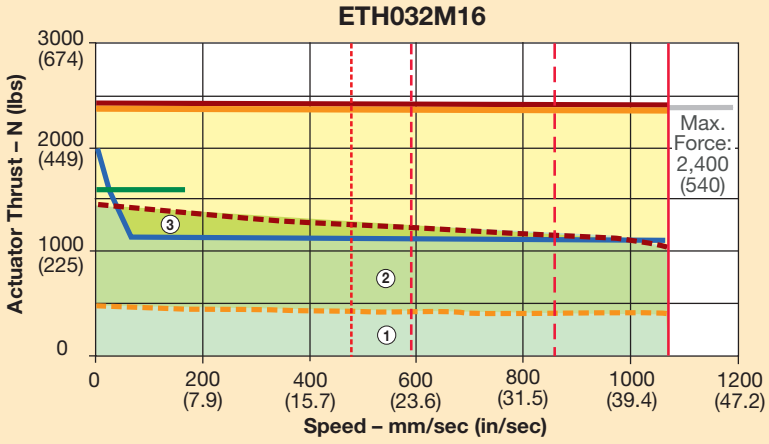
Motor Codes	Continuous Operation ①	②	③
XPC [1]	•		
XPD [2]	•		
XPG [1]	•	•	•*
XPH [2]	•	•	•*

[1] Without brake [2] With brake
* In-line motor mount only

Intermittent Zone – Consult Factory (operation will result in reduced life of the actuator and is not acceptable for parallel motor options if above the parallel motor mount limitation curve)







* Maximum thrust assumes a cylinder mounting orientation with a fixed mounting position and a guided load. For limitations on column buckling, please see page 43.

ETH050 Speed-Thrust with Motors (170 VDC)

Maximum Thrust with Motor*:

- Parallel motor mount limitation
- Max thrust w/2540 km life (see page 45 for details)

XPG – BE344LJ
- Peak
- Continuous

Maximum Speed:

- 1200 mm stroke
- 1000 mm stroke
- 800 mm stroke
- Max actuator speed

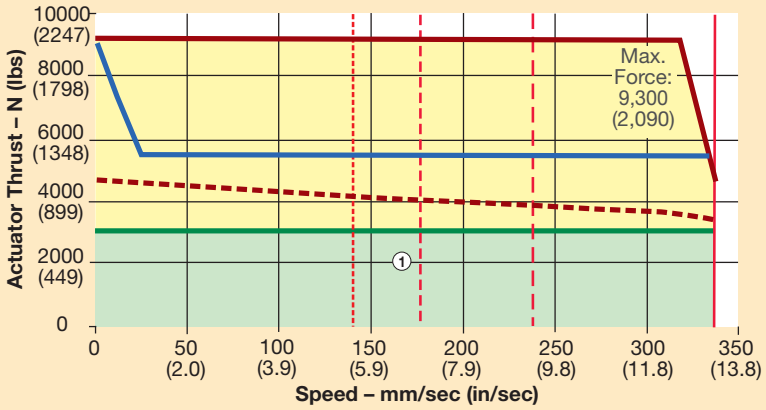
Performance Zones:

Motor Codes	Continuous Operation
	①
XPG [1]	•
XPH [2]	•

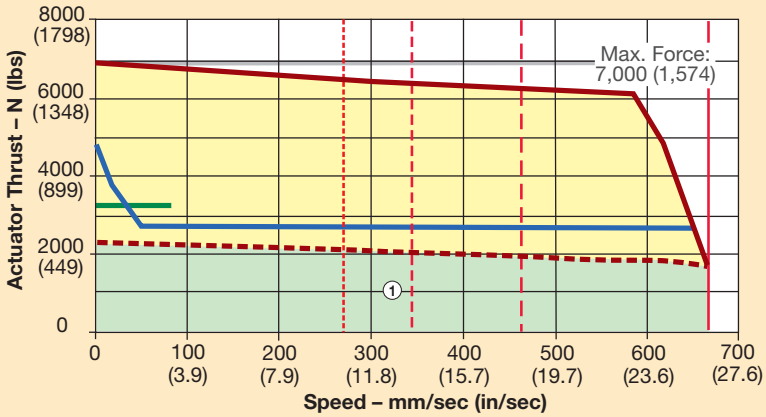
[1] Without brake [2] With brake
* In-line motor mount only

Intermittent Zone –
Consult Factory
(operation will result in reduced life of the actuator and is not acceptable for parallel motor options if above the parallel motor mount limitation curve)

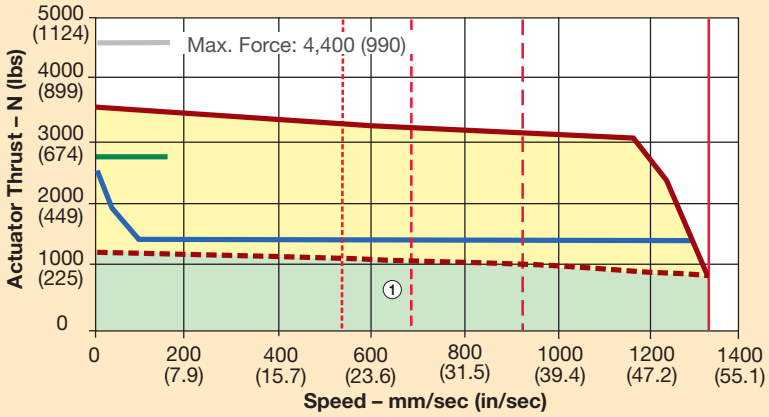
ETH050M05



ETH050M10



ETH050M20



* Maximum thrust assumes a cylinder mounting orientation with a fixed mounting position and a guided load. For limitations on column buckling, please see page 43.

Sizing/Selection

ETH050 Speed-Thrust with Motors (340 VDC)

Maximum Thrust with Motor*:

- Parallel motor mount limitation
- Max thrust w/2540 km life (see page 45 for details)

XPL – MPP1003D1E
- Peak
- Continuous

XPN – MPP1003D1E (with PV34FE-003)
- Peak
- Continuous

Maximum Speed:

- 1200 mm stroke
- 1000 mm stroke
- 800 mm stroke
- Max actuator speed

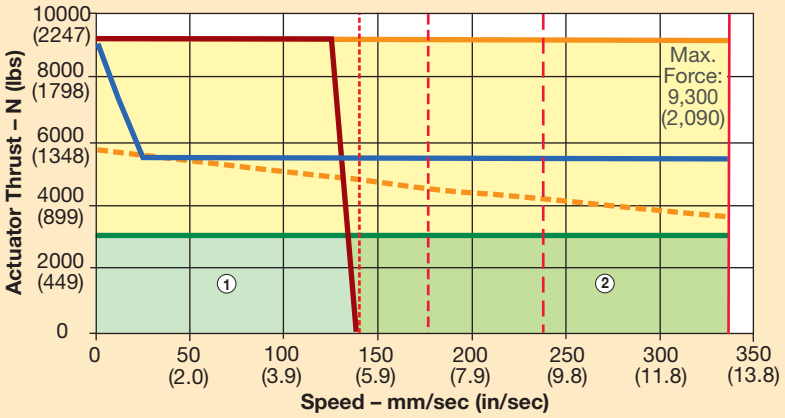
Performance Zones:

Motor Codes	Continuous Operation ①	②	③	④
XPL [1]	•		•	
XPM [2]	•		•	
XPN [1]	•	•		•*
XPP [2]	•	•		•*

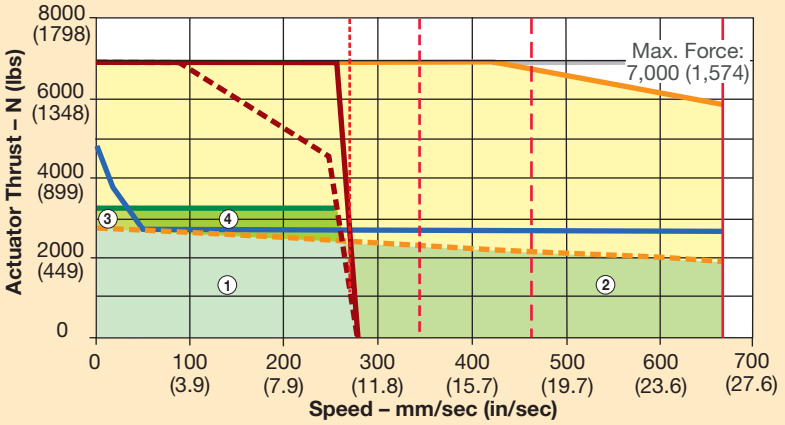
[1] Without brake [2] With brake
* In-line motor mount only

Intermittent Zone –
Consult Factory
(operation will result in reduced life of the actuator and is not acceptable for parallel motor options if above the parallel motor mount limitation curve)

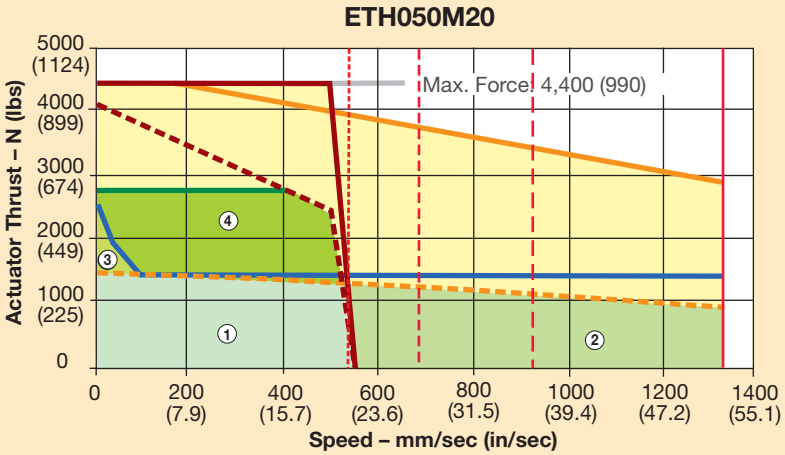
ETH050M05



ETH050M10



ETH050M20



* Maximum thrust assumes a cylinder mounting orientation with a fixed mounting position and a guided load. For limitations on column buckling, please see page 43.

ETH050 Speed-Thrust with Motors (680 VDC)

Maximum Thrust with Motor*:

- Parallel motor mount limitation
- Max thrust w/2540 km life (see page 45 for details)

XPQ – MPP1003R1E
- Peak
- Continuous

XPS – MPP1003R1E (with PV34FE-003)
- Peak
- Continuous

Maximum Speed:

- 1200 mm stroke
- 1000 mm stroke
- 800 mm stroke
- Max actuator speed

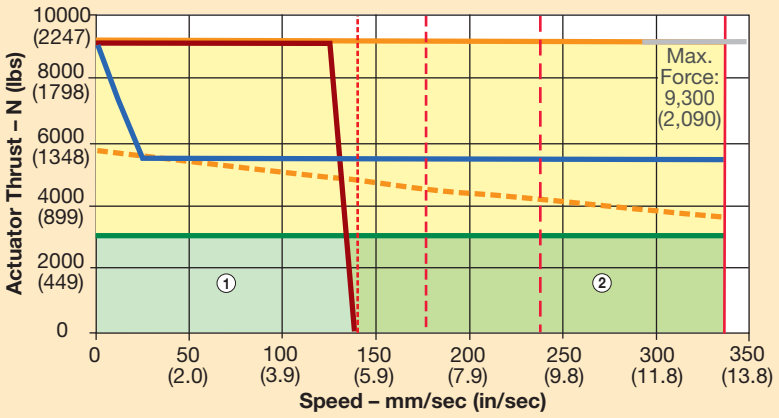
Performance Zones:

Motor Codes	Continuous Operation ①	②	③	④
XPQ (1)	•		•	
XPR (2)	•		•	
XPS (1)	•	•		•*
XPT (2)	•	•		•*

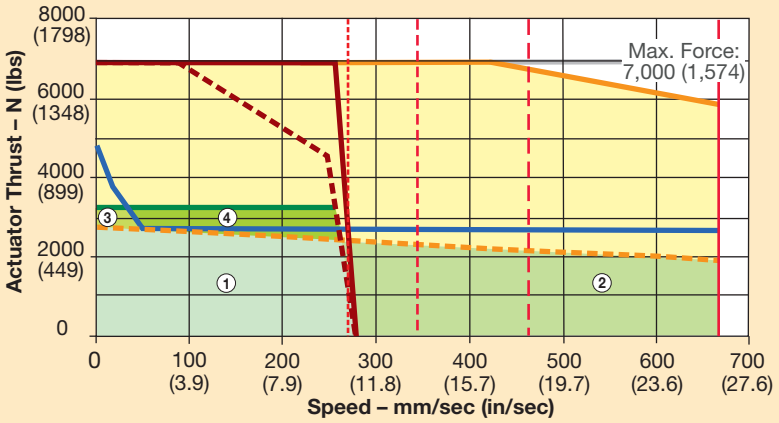
(1) Without brake (2) With brake
* In-line motor mount only

Intermittent Zone –
Consult Factory
(operation will result in reduced life of the actuator and is not acceptable for parallel motor options if above the parallel motor mount limitation curve)

ETH050M05



ETH050M10



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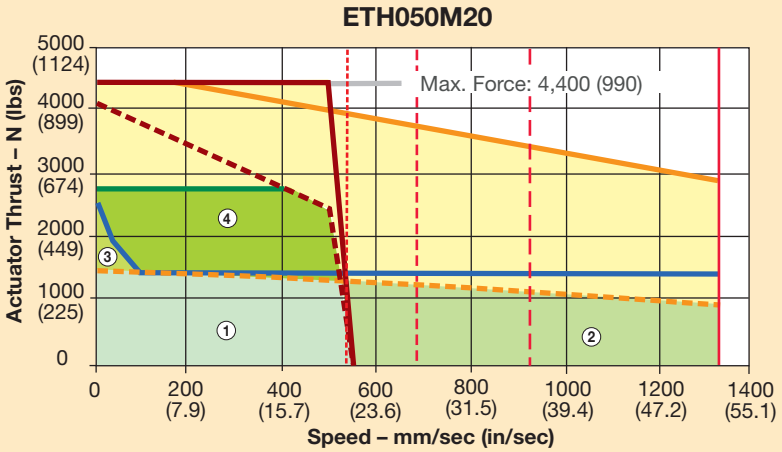


* Maximum thrust assumes a cylinder mounting orientation with a fixed mounting position and a guided load. For limitations on column buckling, please see page 43.

Sizing/Selection

ETH080 Speed-Thrust with Motors (340 & 680 VDC)

Maximum Thrust with Motor*:

- Parallel motor mount limitation
- Max thrust w/2540 km life (see page 45 for details)

XPQ – MPP1003R1E
- Peak
- Continuous

XPS – MPP1003R1E (with PV34FE-003)
- Peak
- Continuous

XPU – MPP1154B1E
- Peak
- Continuous

XPW – MPP1154B1E (with PV115-003)
- Peak
- Continuous

Maximum Speed:

- 1600 mm stroke
- 1400 mm stroke
- 1200 mm stroke
- 1000 mm stroke
- Max actuator speed

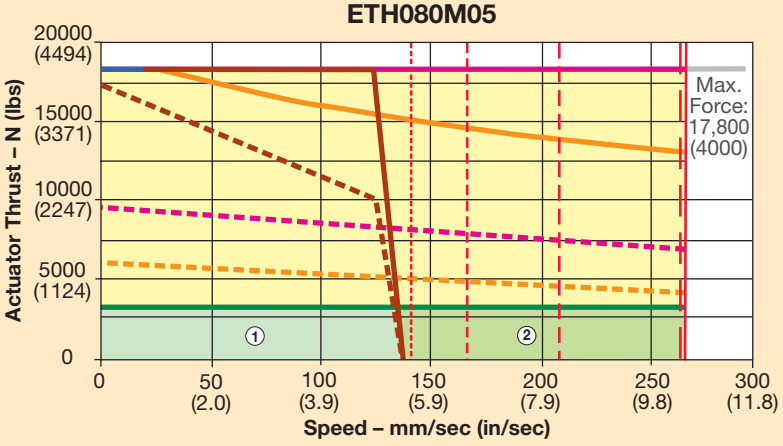
Performance Zones:

Motor Codes	Continuous Operation					
	①	②	③	④	⑤	⑥
XPQ (1)	•	•	•			
XPR (2)	•	•	•			
XPS (1)	•	•		•		
XPT (2)	•	•		•		
XPU (1)	•	•	•			
XPV (2)	•	•	•			
XPW (1)	•			•	•	•*
XPX (2)	•			•	•	•*

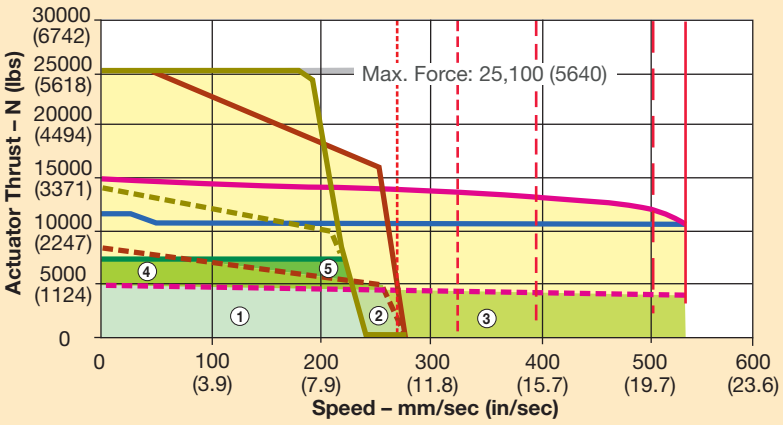
(1) Without brake (2) With brake
* In-line motor mount only

Intermittent Zone –
Consult Factory
(operation will result in reduced life of the actuator and is not acceptable for parallel motor options if above the parallel motor mount limitation curve)

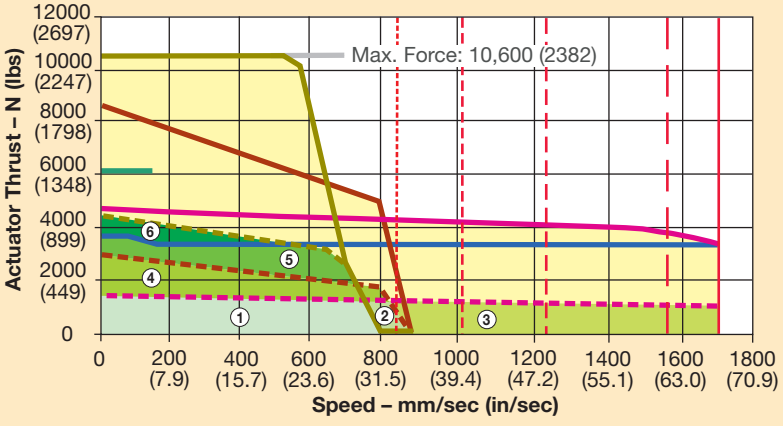
ETH080M05



ETH080M10



ETH080M32



* Maximum thrust assumes a cylinder mounting orientation with a fixed mounting position and a guided load. For limitations on column buckling, please see page 43.

Sizing/Selection Design Considerations

Step	Sizing/Selection Design Consideration	Recommendation	See Page
1	**Basic Operating Parameters**	Check the basic conditions for the use of the ETH in your application. Use the performance chart (page 6) and the speed-thrust graphs (pages 7-9), to confirm the ETH can meet your application's basic performance (e.g. force, velocity, acceleration) mechanical and environmental conditions	6, 7-9
2	**Required Space**	Check the space available in your application and choose the appropriate motor mounting option: inline or parallel. Basic cylinder dimensions, along with dimensions for motor mounting options, can be found on pages 10-17.	10-17
3	**Maximum Velocity**	Select the screw lead required to reach the application's maximum velocity	6, 7-9
4	**Maximum Acceleration**	Verify that the maximum acceleration does not exceed the cylinder's limits	6
5	**Axial Forces**	Calculate the axial forces required in the individual segments of the application.	42
6	**Maximum Force Required**	Determine the maximum required axial force that the electric cylinder must provide.	42
7	**Select Stroke**	Determine the usable stroke and safety travels required for the application, then:	40
		• Select the desired stroke from the list of standard strokes	6, 49
		• Or, if standard stroke will not work choose a desired stroke in steps of one mm. Please do not exceed the maximum permissible stroke given for each frame size.	6
8	**Buckling Risk**	Check that the maximum required axial force does not exceed the rod buckling limitations.	43
9	**Service Life**	Calculate the service life using the equivalent axial forces, the operational environment (application factor), and the load-life curves.	44-45
10	**Lateral Forces/Side Loads**	Determine the lateral forces present in the application and compare them to the permissible lateral forces for the cylinder.	41
11	**Relubrication**	Determine the lubricating cycle (maintenance schedule) and check that it is suitable.	46
12	**Motor/Gearhead Selection**	Calculate the required torque needed to the generate the required force of the ETH.	47
13	**Motor Mounting Flange**	Select a suitable motor mounting flange	10-17
14	**Mounting Type**	Select the mounting method of the electric cylinder	18-21
15	**Cylinder Rod End**	Select the desired rod end for load mounting	22-24
16	**Model number**	Develop model number	48-49

Sizing/Selection

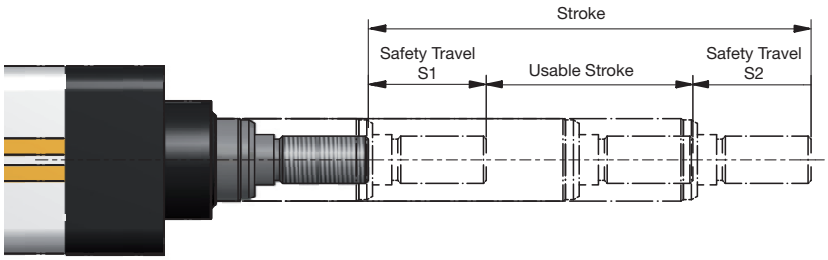
Design Considerations — Stroke, Usable Stroke and Safety Travel

Stroke:

The stroke to be indicated in the order code is the mechanically maximal possible stroke, which is the stroke between the internal end stops.

Usable Stroke:

The usable stroke is the distance needed for the application. It is always shorter than the stroke.



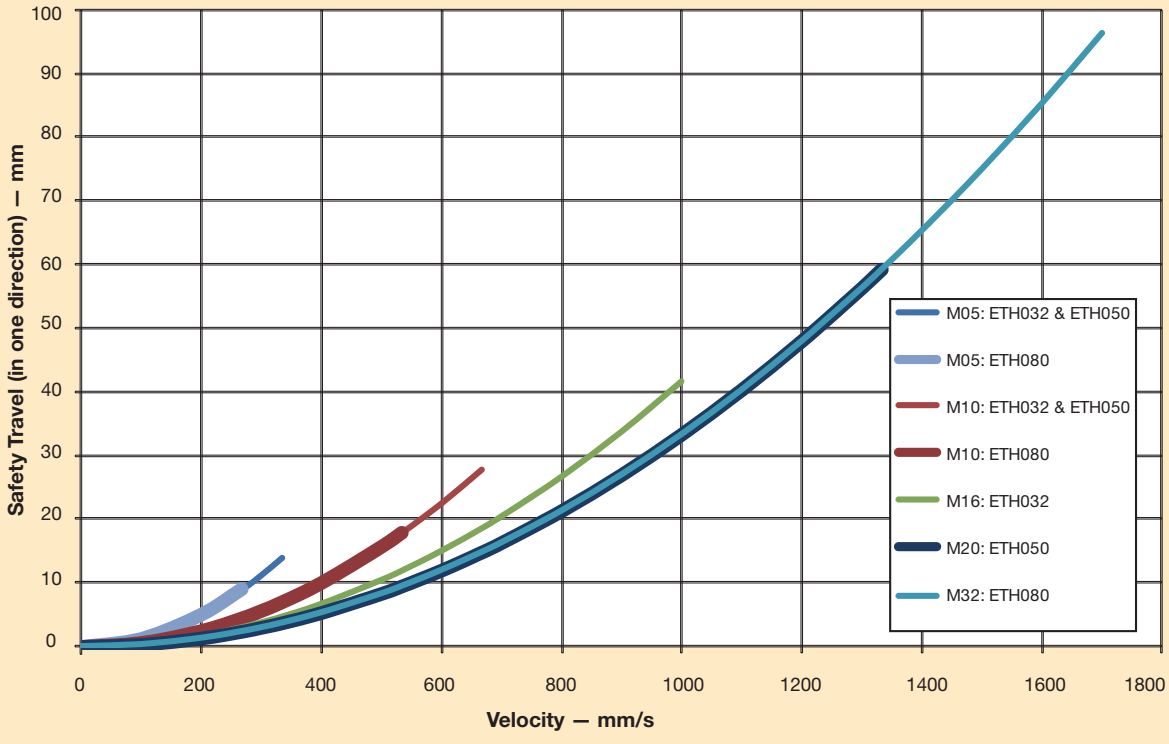
Safety Travel (S1 & S2)

The safety travels are required to slow down the cylinder after it has passed a limit switch, Emergency stop in order to avoid contact with the mechanical limit stops.

Depending on the screw lead and the maximum speed, the following diagram recommends a minimum safety travel, which is sufficient for most applications according to experience.

With demanding applications (great masses and high dynamic), the safety travel has to be calculated and enlarged accordingly (dimensioning on demand).

The safety travel shown in the diagram is for one direction only. The diagram value must be multiplied by two for the total safety travel for both extend and retract directions.

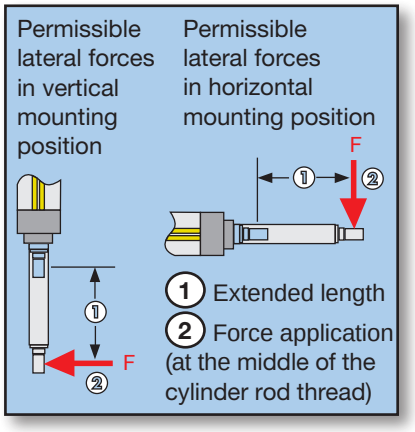


Design Considerations — Permissible Side Load

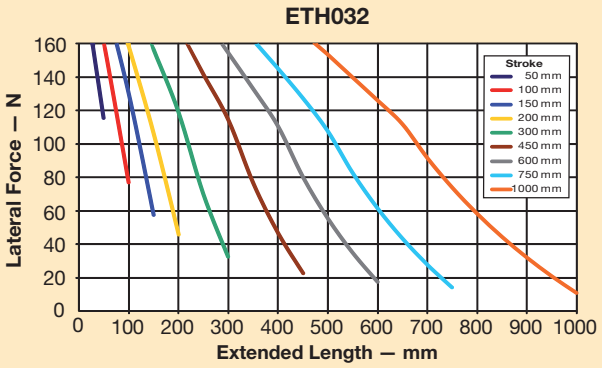
The electric cylinder features a generously dimensioned cylinder rod and screw nut bearing in the form of high-quality plastic sliding bushings to absorb the lateral force.

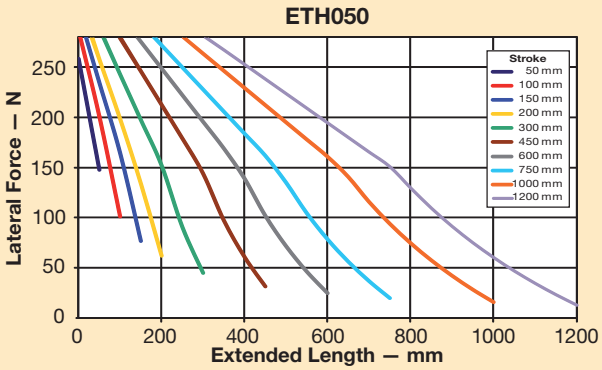
Please note that electric cylinders with a longer stroke permit a higher lateral force at the same extension length. It may therefore be useful to choose a longer stroke than required for the application in order to increase the permissible lateral force.

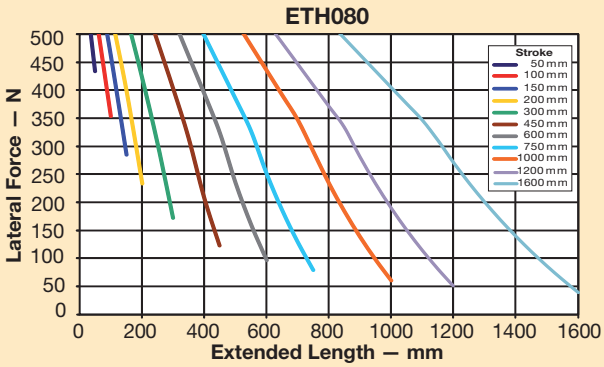
If the permissible lateral forces are exceeded or if the maximum axial force occurs at the same time, the optional outrigger bearing (option R) must be used.



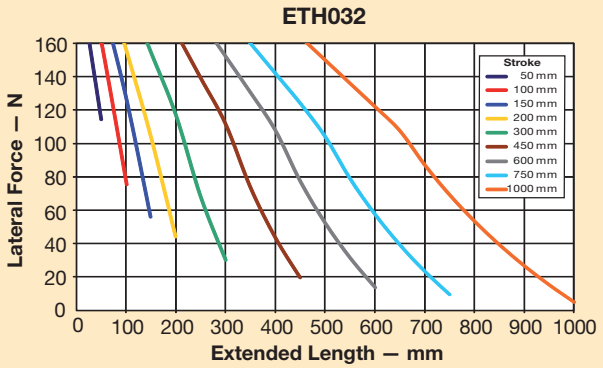
Vertical Mounting Positions*

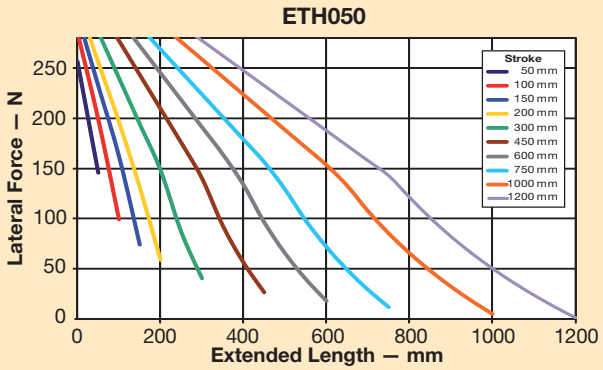


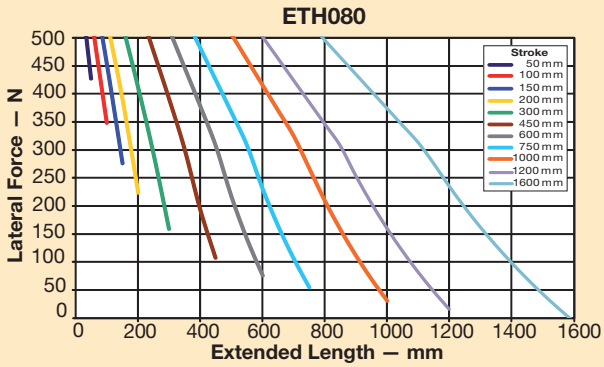




Horizontal Mounting Positions*







* The diagrams apply for a medium travel speed of 0.5 m/s, an ambient temperature of 20°C and all housing orientations.

Sizing/Selection

Design Considerations — Calculating Axial Force

Use the equations below to calculate the thrust required to extend and retract the piston rod.

Once the individual segments are calculated, the maximum required axial force can be determined. This maximum axial force is used to determine the size of the cylinder and to check that the buckling load limit is not exceeded (see page 43). Note that the axial forces calculated for each segment are later used as the calculation basis for the service life (see page 44).

Calculation of Axial Forces:

Determine the axial forces occurring during each individual segment of the application cycle. (Index “j” for the individual segments of the application cycle.)

Cylinder Rod Extending:

$$F_{x,a,j} = \left| F_{x,ext} + (m_{ext} + m_{Kse} + m_{Ks,0} + m_{Ks,Hub} \bullet Hub) \bullet (a_{K,j} + \sin\alpha \bullet 9{,}81\tfrac{m}{s^2}) \right|$$

Cylinder Rod Retracting:

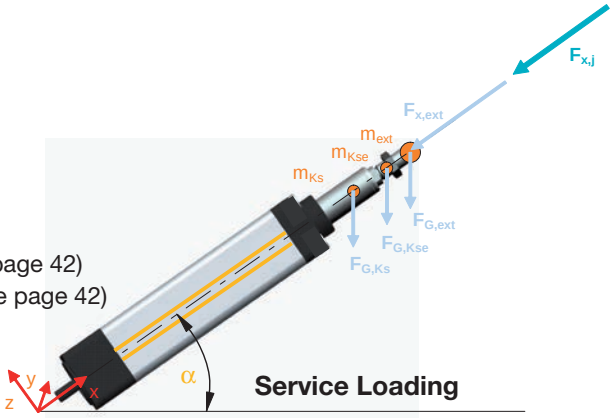
$$F_{x,e,j} = \left| - F_{x,ext} + (m_{ext} + m_{Kse} + m_{Ks,0} + m_{Ks,Stroke} \bullet Stroke) \bullet (a_{K,j} + \sin\alpha \bullet 9{,}81\tfrac{m}{s^2}) \right|$$

The values Fx,a,j and Fx,e,j are always positive.

Formula Abbreviations

$F_{x,a,j}$	Axial forces during extension (N)
$F_{x,e,j}$	Axial forces during retraction (N)
$F_{x,ext}$	External axial force (N)
$F_{G,ext}$	Weight force caused by an additional mass (N)
$F_{G,Kse}$	Weight force caused by the cylinder rod end (N)
$F_{G,Ks}$	Weight force caused by the cylinder rod (N)
m_{ext}	Additional mass (kg)
m_{Kse}	Mass of the cylinder rod end (kg) (see “Rod End Options” pages 22 - 25)
$m_{Ks,0}$	Mass of the cylinder rod at zero stroke in kg (see page 42)
$m_{Ks,stroke}$	Mass of the cylinder rod per mm of stroke (kg) (see page 42)
Stroke	Selected stroke (m)
$a_{K,j}$	Acceleration at the cylinder rod (m/s²)
α	Alignment angle (°)
$F_{x,max}$	Maximum permissible axial force (N)

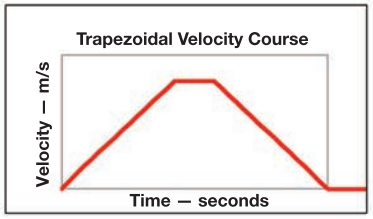
Index “j” for the individual segments of the application cycle



Example Calculation

Vertical Mounting

- ETH50
- Stroke = 500 mm = 0.5 m
- Pitch = 5 mm
- Rod End: External thread
- Trapezoidal velocity course
- Acceleration a_K = 4 m/s²
- m_{ext} = 150 kg
- $F_{x,ext}$ = 1000 N
- m_{Kse} = 0.15 kg
- $m_{Ks,0}$ = 0.15 kg
- $m_{Ks,Stroke}$ = 1.85 kg/m
- Alignment angle α = -90°



Thrust rod extending: Mass is moved downwards

Load case: Acceleration

$$F_{x,1} = \left| 1000N + \left(150kg + 0{,}15kg + 0{,}15kg + 1{,}85\tfrac{kg}{m} \cdot 0{,}5m \right) \cdot \left(4\tfrac{m}{s^2} + \sin(-90°) \cdot 9{,}81\tfrac{m}{s^2} \right) \right| = 121N$$

Load case: Constant Velocity

$$F_{x,2} = \left| 1000N + \left(150kg + 0{,}15kg + 0{,}15kg + 1{,}85\tfrac{kg}{m} \cdot 0{,}5m \right) \cdot \left(0\tfrac{m}{s^2} + \sin(-90°) \cdot 9{,}81\tfrac{m}{s^2} \right) \right| = 484N$$

Load case: Deceleration

$$F_{x,3} = \left| 1000N + \left(150kg + 0{,}15kg + 0{,}15kg + 1{,}85\tfrac{kg}{m} \cdot 0{,}5m \right) \cdot \left(-4\tfrac{m}{s^2} + \sin(-90°) \cdot 9{,}81\tfrac{m}{s^2} \right) \right| = 1088N$$

Thrust rod retracting: Mass is moved upwards

Load case: Acceleration

$$F_{x,4} = \left| -1000N + \left(150kg + 0{,}15kg + 0{,}15kg + 1{,}85\tfrac{kg}{m} \cdot 0{,}5m \right) \cdot \left(4\tfrac{m}{s^2} - \sin(-90°) \cdot 9{,}81\tfrac{m}{s^2} \right) \right| = 1088N$$

Load case: Constant Velocity

$$F_{x,5} = \left| -1000N + \left(150kg + 0{,}15kg + 0{,}15kg + 1{,}85\tfrac{kg}{m} \cdot 0{,}5m \right) \cdot \left(0\tfrac{m}{s^2} - \sin(-90°) \cdot 9{,}81\tfrac{m}{s^2} \right) \right| = 484N$$

Load case: Deceleration

$$F_{x,6} = \left| -1000N + \left(150kg + 0{,}15kg + 0{,}15kg + 1{,}85\tfrac{kg}{m} \cdot 0{,}5m \right) \cdot \left(-4\tfrac{m}{s^2} - \sin(-90°) \cdot 9{,}81\tfrac{m}{s^2} \right) \right| = 121N$$

Design Considerations — Permissible Axial Force

The risk of buckling is dependent on the stroke and mounting method. Use the charts below for the applicable mounting method and cylinder size to verify that the application's maximum axial force (calculations on page 43), is possible with the planned mounting method at the desired stroke. Please note that the retraction forces do not pose a buckling risk.

Method 1

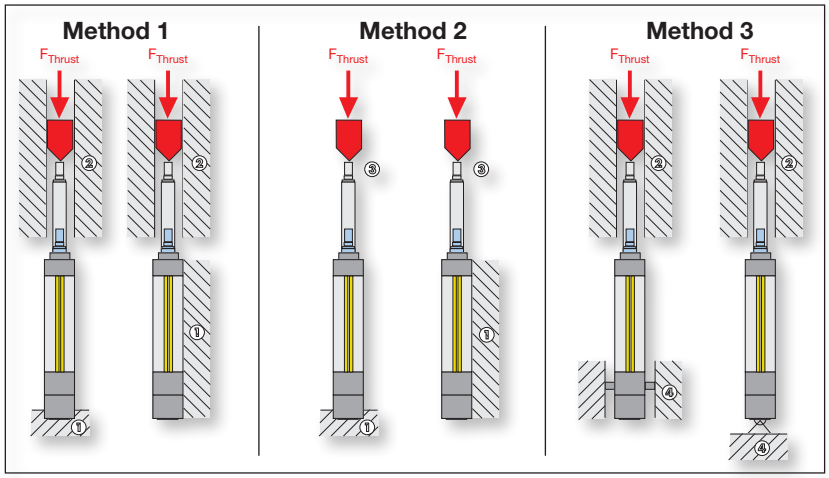
1. Cylinders fixed with mounting flanges, foot mounting or mounting plates
2. Thrust rod with axial guiding

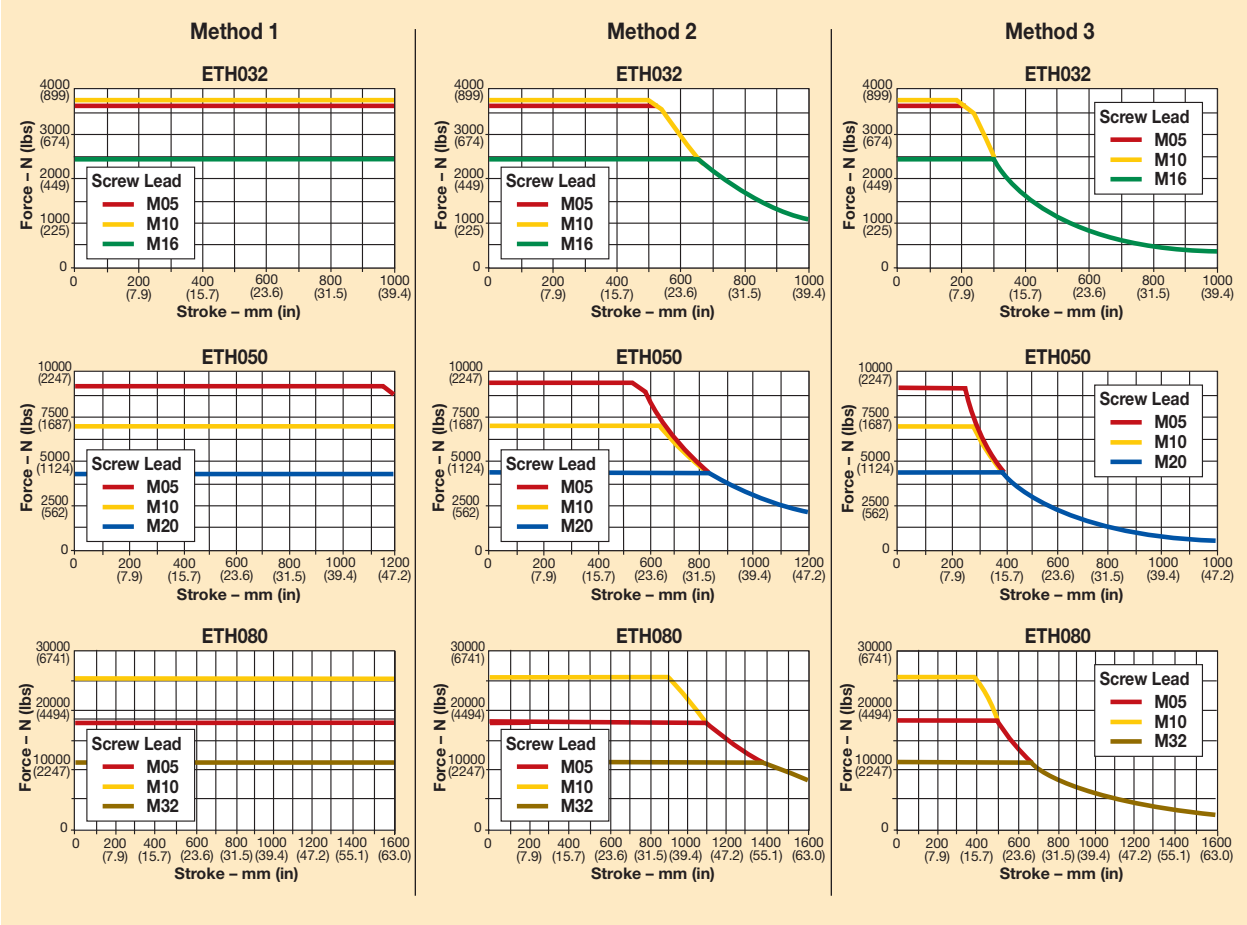
Method 2

1. Cylinders fixed with mounting flanges, foot mounting or mounting plates
3. Thrust rod without axial guiding

Method 3

4. Cylinders mounted via center trunnion or rear clevis
2. Thrust rod with axial guiding





Sizing/Selection

Design Considerations — Service Life

Nominal Service Life[1]

The nominal service life of the electric cylinder can be determined with the aid of the known forces.

The nominal service life is calculated as follows:

The forces calculated for each individual segment of the application cycle must be summarized into an equivalent axial force Fm (see "Calculating Required Axial Force", page 42).

$$F_m = \sqrt[3]{\frac{1}{s_{ges}} \left(F^3_{x,1} \bullet s_1 + F^3_{x,2} \bullet s_2 + F^3_{x,3} \bullet s_3 + \ldots\right)}$$

(Index "j" for the individual segments of the application cycle. For example, the first segment would be F^3_{x1} where j = 1, the second segment would be F^3_{x2} where j = 2, etc.)

Nominal Service Life Prerequisites

- Bearing and screw temperature between 20°C and 40°C
- No impairment of the lubrication, for example by external particles
- Relubrication in accordance with the specifications
- The given values for thrust force, speed and acceleration must be adhered to at any rate
- No approaching the mechanical end stops (external or internal), no other abrupt loads, as the given maximum force of the cylinder may never be exceeded
- The given lateral forces applied to the cylinder rod must always be respected
- No high exploitation of several power features at a time (for example maximum speed or thrust force)
- No regulating oscillation at standstill

[1] Nominal service life is the service life reached by 90 % of a sufficient number of similar electric cylinders until the first signs of material fatigue occur.

Actual Service Life

The actual service life can only be approximated due to a variety of different effects. The nominal service life L calculation does, for instance, not take insufficient lubrication, impacts and vibrations into consideration. These effects can however be estimated with the aid of the application factor f_w.

The actual service life is calculated as follows:

$$L_{fw} = \frac{L}{f_w^3}$$

If you need the service life as the number of possible cycles, just divide the service life in kilometers by twice the stroke traveled.

Standstill times are not taken into consideration when determining the equivalent axial force (Fm), as sj=0.

CAUTION: always consider the stroke as well as the return stroke.

Formula Abbreviations

F_m	Equivalent axial force (N)
F_x F_j	Resulting axial force in N (see formula 1 & 2, page 44)
s_j	Travel given a defined force Fx,a,j (mm)
s_{total}	Total travel (mm)
L	Nominal service life in km (see Service Life graphs on page 45)
L_{fw}	Service life as a function of the application factor (km)
f_w	Application factor (see "Application Factor F_w" table at right)

Application Factor f_w **

Movement Cycle	Shocks/Vibrations None	Light	Medium	Heavy
More than 2.5 screw rotations	1.0	1.2	1.4	1.7
1.0 to 2.5 screw rotations* (short stroke applications)	1.8	2.1	2.5	3.0

* After max. 10 000 movement cycles, a lubrication run must be performed (see lubrication run intervals table).

**** Boundary Conditions for Application Factor f_w:**

- Externally guided electric cylinders
- Accelerations <10 m/s²
- Application factor <1.5
- For other conditions, please contact Parker

Lubrication Run Lengths for Short Stroke Applications

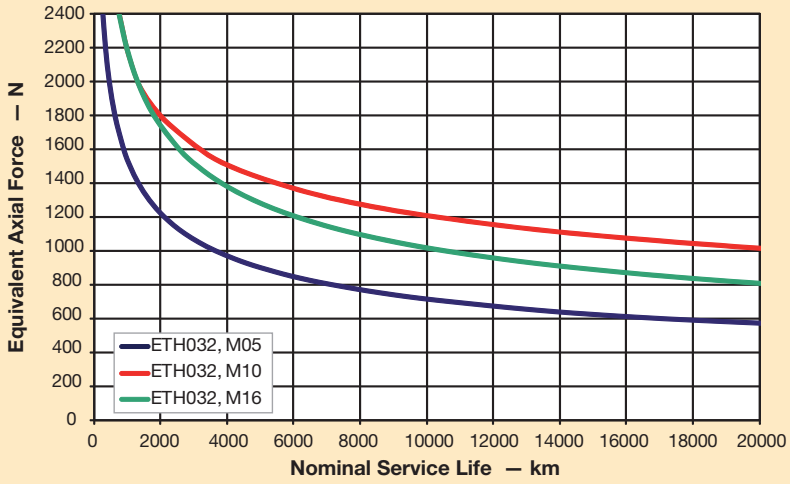
	ETH032			ETH050			ETH080		
Run Length	M05	M10	M16	M05	M10	M20	M05	M10	M32
mm	>45	>54	>58	>40	>46	>58	>47	>65	>95

Design Considerations — Service Life

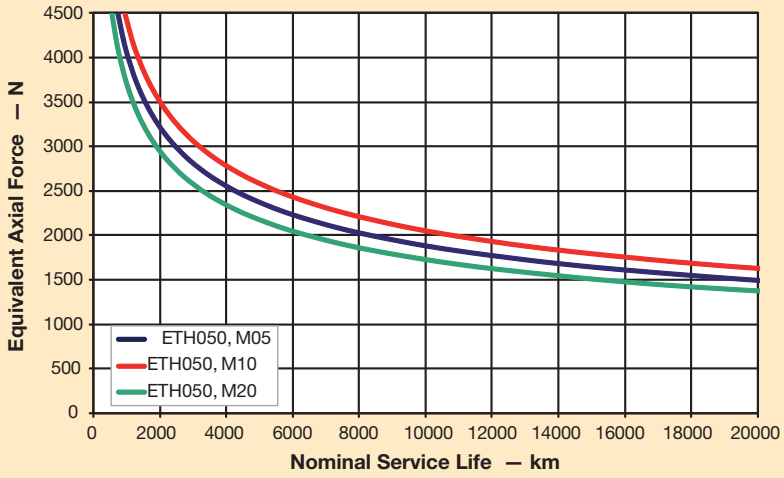
Values are based on following recommended lubrication intervals.

(See relubrication for details, page 46).

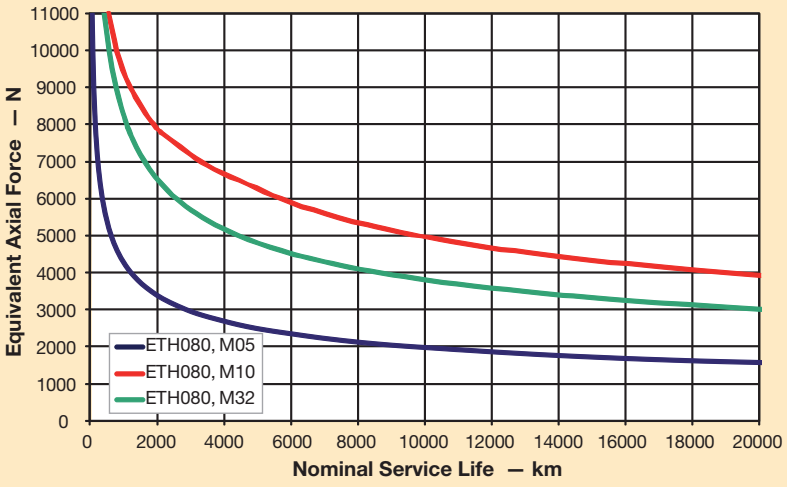
ETH032



ETH050



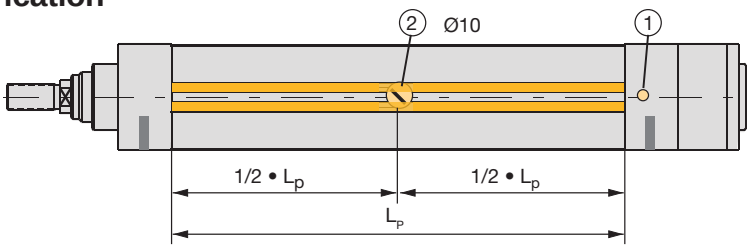
ETH080



Sizing/Selection

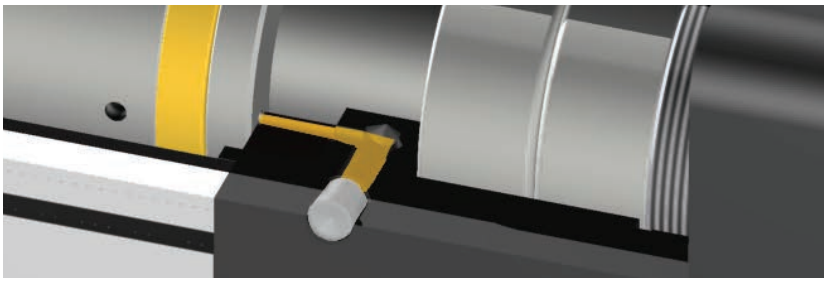
Design Considerations — Relubrication

All frame sizes are designed with a range of lubrication port locations for maximum easy access. Contact factory for special needs not shown.



(1) Central lubrication (standard)
(2) Optional lubrication (possible on all 4 sides):
L_P: Length of profile

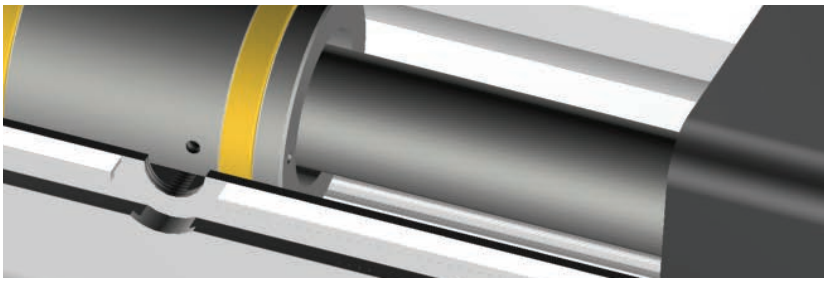
Option 1: Integrated lubrication Port (standard)



Relubrication is simple with the easy access port. Users simply perform a controlled retract of the cylinder approaching the endstop under slow speed and grease the cylinder.

The standard easy access port is always at the 3 o'clock position.

Option 2...5: Lubrication Hole (optional)



If a space constraint does not allow easy access to the standard lubrication port, other options in the part number configuration allow for a port at the center of the extrusion.

Free access to this bore even after integration of the cylinder into a system can be ensured by choosing the corresponding profile orientation (see order code page 48). The bore is located exactly in the middle of the aluminum profile.

Lubrication Intervals*

Lubrication intervals depend on the operating conditions (nominal size, pitch, speed, acceleration, loads, etc.) and the ambient conditions (e.g. temperature). Ambient influences such as high loads, impacts and vibrations shorten the lubrication intervals.

Under normal operating conditions, the given lubrication intervals apply. If the total travel per year is shorter than the given intervals, the cylinder must be relubricated at least once per year. In the event of small loads and if the application is impact and vibration free, the lubrication intervals can be extended.

The lubricant used is Klüber and is available worldwide.

Normal Operating Conditions:

- Medium screw velocity 2000 rpm
- Operating factor f_w=1.0
- No impacts and vibrations

ETH032			ETH050			ETH080		
M05	**M10**	**M16**	**M05**	**M10**	**M20**	**M05**	**M10**	**M32**
300 km	600 km	960 km	300 km	600 km	1200 km	300 km	600 km	1500 km

Design Considerations — Motor and Gearhead Selection

Drive Torque Calculation

The torques to be produced by the motor result from the acceleration, the load and the friction torque. The drive torques must be calculated for all segments of the application cycle (represented by index "j"). Index "j" for the individual segments of the application cycle.

Calculation of the **acceleration torque** with respect to the rotary moments of inertia:

$$M_{B,j} = \left((J_{i/p,0} + J_{i/p,Hub} \bullet Hub) \bullet \frac{1}{\eta_{ETH}} \bullet \boxed{\frac{1}{i_G{}^2 \bullet \eta_G} + J_G} + J_M \right) \bullet 10^{-3} \bullet \frac{6{,}28 \bullet a_{K,j}}{P_h}$$

(use only with gearhead)

The acceleration forces due to the translatory moved masses are taken into consideration in the calculation of the axial forces on page 47.

The **load torques** result from the occurring axial forces:

$$M_{L,j} = \frac{F_{x,a\,/\,e,j}}{\text{Thrust force factor}} \boxed{\bullet \frac{1}{i_G \bullet \eta_G}}$$

(use only with gearhead)

The motor must therefore generate the following **drive torques**:

$$M_{M,j} = M_{B,j} + M_{L,j}$$

The peak torque of the motor must exceed the maximum occurring drive torque.

The **effective torque** can be deduced from the drive torques for all segments of the application cycle:

$$M_{eff} = \sqrt[2]{\frac{1}{t_{ges}} \bullet (M_{M1}{}^2 \bullet t_1 + M_{M2}{}^2 \bullet t_2 + ...)}$$

The nominal torque of the motor must exceed the calculated effective torque. Refer to the Motor Mounting Configuration charts (pages 10-17), to verify that the motor is mechanically compatible to the corresponding electric cylinder.

Formula Abbreviations

$M_{B,j}$	Variable acceleration torque in Nm
$J_{i/p,0}$	Red. rot. mass moment of inertia at zero stroke for inline/parallel motor configuration in kgmm² (see page 47)
$J_{i/p,\,stroke}$	Red. rot. mass moment of inertia per mm of stroke for inline/parallel motor configuration in kgmm² (see page 47)
Stroke	Selected stroke in mm
η_{ETH}	Efficiency of the electric cylinder (0.9 – inline drive configuration; 0.81 – parallel motor)
i_G	Gearhead ratio
ηG	Efficiency of the gearhead (see gearhead manufacturer specifications)
J_M	Motor mass moment of inertia in kgmm² (see motor manufacturer specifications)
J_G	Gearhead mass moment of inertia in kgmm² (see gearhead manufacturer specifications)
$a_{K,j}$	Acceleration at the cylinder rod in m/s²
P_h	Screw pitch in mm
$M_{L,j}$	Load torque in Nm
$F_{x,a/e,j}$	Loads in x direction in N (see page 47)
$M_{M,j}$	Drive torque in Nm
M_{eff}	Effective value — motor in Nm
t_{total}	Total cycle time in s
t_j	Amount of time in the cycle in s

Ordering Information

Fill in an order code from each of the numbered fields to create a complete ETH model order code. Refer to the pages listed for further details.

	①	②	③	④	⑤	⑥	⑦	⑧		⑨	⑩	
Order Example:	ETH	032	M05	A	2	XPC	B	C	N	0200	C	B

① Series
ETH

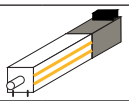
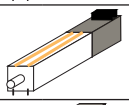
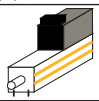
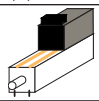
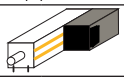
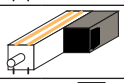
② Frame Size
(see "Performance by Cylinder Size and Screw Lead" chart and graphs, pages 6-9)

032	ISO32 cylinder size
050	ISO50 cylinder size
080	ISO80 cylinder size

③ Drive Screw
(see "Performance by Cylinder Size and Screw Lead" chart, page 6)

M05	5 mm metric ballscrew
M10	10 mm metric ballscrew
M16	16 mm metric ballscrew (size ETH032 only)
M20	20 mm metric ballscrew (size ETH050 only)
M32	32 mm metric ballscrew (size ETH080 only)

④ Motor Mount/Cylinder Orientation

A		Inline w/groove for Initiator 3 & 9 o'clock
B		Inline w/groove for Initiator 6 & 12 o'clock
C		Parallel 12 o'clock w/groove for Initiator 3 & 9 o'clock
D		Parallel 12 o'clock w/groove for Initiator 6 & 12 o'clock
E		Parallel 3 o'clock w/groove for Initiator 3 & 9 o'clock*
F		Parallel 3 o'clock w/groove for Initiator 6 & 12 o'clock*
G		Parallel 6 o'clock w/groove for Initiator 3 & 9 o'clock
H		Parallel 6 o'clock / groove for Initiator 6 & 12 o'clock
J		Parallel 9 o'clock / groove for Initiator 3 & 9 o'clock
K		Parallel 9 o'clock w/groove for Initiator 6 & 12 o'clock

*When ordered with a lubrication bore option (item 5, order code 3), check to make sure the motor/gearbox length does not block the lubrication port option. This will be an issue for shorter strokes.

⑤ Lubrication Bore Option
(see Relubrication Section for details, page 46)

1	Integrated lubrication port*
2	Lubrication hole at center of extrusion 12 o´clock
3	Lubrication hole at center of extrusion 3 o´clock
4	Lubrication hole at center of extrusion 6 o´clock
5	Lubrication hole at center of extrusion 9 o´clock

* Not available with Motor Mount/Cylinder Orientation with 3 o'clock orientation (order codes E and F)

⑥ Motor Mounting Configurations
Motor-specific mounting configurations are categorized into four primary groups:

"XP": With Parker Xpress motor systems (listed below)

"K": Flange & coupling kits for other Parker motor

"P": Flange & coupling kits for Parker Gearheads

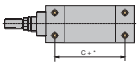
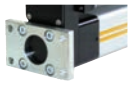
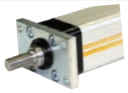
"N": Kits for Non standard motors

(Refer to pages 10-17 for appropriate order codes and mounting specifications for available inline and parallel motor mounting configurations)

Parker Xpress Motor Systems		**ETH032**	**ETH050**	**ETH080**
XPC	BE233FJ-KPSN	•	•	
XPD	CM233FJ-115027	•	•	
XPG	BE344LJ-KPSN	•	•	•
XPH	BE344LJ-KPSB	•	•	•
XPL	MPP1003D1E-KPSN		•	•
XPM	MPP1003D1E-KPSB		•	•
XPN	MPP1003D1E-KPSN *		•	•
XPP	MPP1003D1E-KPSB *		•	•
XPQ	MPP1003R1E-KPSN		•	•
XPR	MPP1003R1E-KPSB		•	•
XPS	MPP1003R1E-KPSN *		•	•
XPT	MPP1003R1E-KPSB *		•	•
XPU	MPP1154B1E-KPSN			•
XPV	MPP1154B1E-KPSB			•
XPW	MPP1154B1E-KPSN **			•
XPX	MPP1154B1E-KPSB **			•
XPY	MPP1154P1E-KPSN ***			•
XPZ	MPP1154P1E-KPSB			•
XP1	MPP1154P1E-KPSN **			•
XP2	MPP1154P1E-KPSB **			•

* With PV34FE-003 gearhead on all inline and parallel sizes except size ETH080 parallel which comes with PV90FB-003
** With PV115FB-003 gearhead
*** Motor without gear head option

⑦ Cylinder Mounting Options
(see pages 18-21 for details)

B		Foot mount
C		Rear clevis
D		Center trunnion
E		Rear eye
F		Bottom tapped (standard)
G		Side flange mount
H		Rear flange plate
J		Front flange plate
N		Front and rear flange plates (combining H and J options

⑧ Rod End Mounting Options
(see pages 22-25 for details)

C		Clevis
F		Female thread
M		Male thread
S		Spherical rod end
L		Alignment coupler
R		Linear guide module

⑨ Stroke
For fastest delivery please choose a standard stroke length from the chart below. (See page 40 “Stroke, Usable Stoke and Safety Travel” to calculate appropriate stroke length.)

Custom Lengths

	ETH032	ETH050	ETH080
XXXX	50 – 1000	50 – 1200	50 – 1600
	(Customized length in 1 mm increments)		

Standard Lengths

	ETH032	ETH050	ETH080
0050	•	•	
0100	•	•	•
0150	•	•	•
0200	•	•	•
0300	•	•	•
0400	•	•	•
0600	•	•	•
0900		•	•
1000	•		
1200		•	•
1600			•

⑩ IP Rating

A	IP54 with galvanized steel hardware
B	IP54 with stainless steel hardware
C	IP65 epoxy coated cylinder

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 Hannifin Corporation (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 1-847-298-2400, 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 reviewed 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.

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.

Series ETH Applications Worksheet

Please provide as much information as possible

Completed form can be returned via email to cylproductinfo@parker.com or faxed to (800) 892-1008.

Customer Information

Company Name _____
(Customer #)
Contact: _____

Phone: _____ **Fax:** _____

E-Mail: _____

Address: _____

_____

Cylinder Information: Quantity: _____

Move Distance: _____ in. _____ mm
or
Overall Stroke: _____ in. _____ mm

Rod End: Male English
Female Metric
Rod Eye
Other: _____

Mounting
Primary: _____

Secondary: _____

Rod Orientation: Horizontal Up Down
Angle: _____ Degrees

Environmental: _____
(Temperature, Humidity, Washdown, etc.)

Application Information:

Force Required: _____ lbs / kN

External Applied Force: _____ lbs / kN

Load/Fixture Weight: _____ lbs / kN

Speed:
Maximimum: _____ in./sec. _____ mm/sec.

Minimum: _____ in./sec. _____ mm/sec.

Move Time: _____ seconds

Total Cycle Time: _____ seconds

Repeatability: _____ in. _____ mm

Accuracy: _____ in. _____ mm

Load Guided? Yes No

Rod Side Loading? Yes No
Value: _____ lbs.

Motor Mounting: Inline or Parallel

AC Drive Power: 230V / 1 460V / 3 50 Hz
230V / 3 Other: _____ 60 Hz

Expected Life: _____
Cycles or Years

Applications Sketch and Notes:

Notes

Notes

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

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

2. Price; Payment. The Products set forth in the Quote are offered for sale at the prices indicated in the Quote. Unless otherwise specifically stated in the Quote, prices are valid for thirty (30) days and do not include any sales, use, or other taxes or duties. Seller reserves the right to modify prices at any time to adjust for any raw material price fluctuations. Unless otherwise specified by Seller, all prices are F.C.A. Seller's facility (INCOTERMS 2020). All sales are contingent upon credit approval and full payment for all purchases is due thirty (30) days from the date of invoice (or such date as may be specified in the Quote). Unpaid invoices beyond the specified payment date incur interest at the rate of 1.5% per month or the maximum allowable rate under applicable law.

3. Shipment; Delivery; Title and Risk of Loss. All delivery dates are approximate, and Seller is not responsible for damages resulting from any delay. Regardless of the manner of shipment, delivery occurs and title and risk of loss or damage pass to Buyer, upon placement of the Products with the carrier at Seller's facility. Unless otherwise agreed prior to shipment and for domestic delivery locations only, Seller will select and arrange, at Buyer's sole expense, the carrier and means of delivery. When Seller selects and arranges the carrier and means of delivery, freight and insurance costs for shipment to the designated delivery location will be prepaid by Seller and added as a separate line item to the invoice. Buyer shall be responsible for any additional shipping charges incurred by Seller due to Buyer's acts or omissions. Buyer shall not return or repackage any Products without the prior written authorization from Seller, and any return shall be at the sole cost and expense of Buyer.

4. Warranty. The warranty for the Products is as follows: (i) Goods are warranted against defects in material or workmanship for a period of eighteen (18) months from the date of delivery or 2,000 hours of use, whichever occurs first; (ii) Services shall be performed in accordance with generally accepted practices and using the degree of care and skill that is ordinarily exercised and customary in the field to which the Services pertain and are warranted for a period of six (6) months from the date of completion of the Services; and (iii) Software is only warranted to perform in accordance with applicable specifications provided by Seller to Buyer for ninety (90) days from the date of delivery or, when downloaded by a Buyer or end-user, from the date of the initial download. All prices are based upon the exclusive limited warranty stated above, and upon the following disclaimer: **EXEMPTION CLAUSE; DISCLAIMER OF WARRANTY, CONDITIONS, REPRESENTATIONS: THIS WARRANTY IS THE SOLE AND ENTIRE WARRANTY, CONDITION, AND REPRESENTATION, PERTAINING TO PRODUCTS. SELLER DISCLAIMS ALL OTHER WARRANTIES, CONDITIONS, AND REPRESENTATIONS, WHETHER STATUTORY, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THOSE RELATING TO DESIGN, NONINFRINGEMENT, MERCHANTABILITY, AND FITNESS FOR A PARTICULAR PURPOSE. SELLER DOES NOT WARRANT THAT THE SOFTWARE IS ERROR-FREE OR FAULT-TOLERANT, OR THAT BUYER'S USE THEREOF WILL BE SECURE OR UNINTERRUPTED. UNLESS OTHERWISE AUTHORIZED IN WRITING BY SELLER, THE SOFTWARE SHALL NOT BE USED IN CONNECTION WITH HAZARDOUS OR HIGH RISK ACTIVITIES OR ENVIRONMENTS. EXCEPT AS EXPRESSLY STATED HEREIN, ALL PRODUCTS ARE PROVIDED "AS IS".**

5. Claims; Commencement of Actions. Buyer shall promptly inspect all Products upon receipt. No claims for shortages will be allowed unless reported to Seller within ten (10) days of delivery. Buyer shall notify Seller of any alleged breach of warranty within thirty (30) days after the date the non-conformance is or should have been discovered by Buyer. Any claim or action against Seller based upon breach of contract or any other theory, including tort, negligence, or otherwise must be commenced within twelve (12) months from the date of the alleged breach or other alleged event, without regard to the date of discovery.

6. LIMITATION OF LIABILITY. IN THE EVENT OF A BREACH OF WARRANTY, SELLER WILL, AT ITS OPTION, REPAIR OR REPLACE THE NON-CONFORMING PRODUCT, RE-PERFORM THE SERVICES, OR REFUND THE PURCHASE PRICE PAID WITHIN A REASONABLE PERIOD OF TIME. **IN NO EVENT IS SELLER LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES INCLUDING ANY LOSS OF REVENUE OR PROFITS, WHETHER BASED IN CONTRACT, TORT OR OTHER LEGAL THEORY. IN NO EVENT SHALL SELLER'S LIABILITY UNDER ANY CLAIM MADE BY BUYER EXCEED THE PURCHASE PRICE PAID FOR THE PRODUCTS.**

7. Confidential Information. Buyer acknowledges and agrees that any technical, commercial, or other confidential information of Seller, including, without limitation, pricing, technical drawings or prints and/or part lists, which has been or will be disclosed, delivered or made available, whether directly or indirectly, to Buyer ("Confidential Information"), has been and will be received in confidence and will remain the property of Seller. Buyer further agrees that it will not use Seller's Confidential Information for any purpose other than for the benefit of Seller.

8. Loss to Buyer's Property. Any tools, patterns, materials, equipment or information furnished by Buyer or which are or become Buyer's property ("Buyer's Property"), will be considered obsolete and may be destroyed by Seller after two (2) consecutive years have elapsed without Buyer ordering the Products manufactured using Buyer's Property. Furthermore, Seller shall not be responsible for any loss or damage to Buyer's Property while it is in Seller's possession or control.

9. Special Tooling. "Special Tooling" includes but is not limited to tools, jigs, fixtures and associated manufacturing equipment acquired or necessary to manufacture Goods. Seller may impose a tooling charge for any Special Tooling. Such Special Tooling shall be and remain Seller's property notwithstanding payment of any charges by Buyer. In no event will Buyer acquire any interest in the Special Tooling, even if such Special Tooling has been specially converted or adapted for manufacture of Goods for Buyer and notwithstanding any charges paid by Buyer. Unless otherwise agreed, Seller has the right to alter, discard or otherwise dispose of any Special Tooling or other property owned by Seller in its sole discretion at any time.

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

11. User Responsibility. Buyer, through its own analysis and testing, is solely responsible for making the final selection of the Products and assuring that all performance, endurance, maintenance, safety and warning requirements of the application of the Products are met. Buyer must analyze all aspects of the application and follow applicable industry standards, specifications, and any technical information provided with the Quote or the Products, such as Seller's instructions, guides and specifications. If Seller provides options of or for Products based upon data or specifications provided by Buyer, Buyer is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the Products. In the event Buyer is not the end-user of the Products, Buyer will ensure such end-user complies with this paragraph.

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

13. Cancellations and Changes. Buyer may not cancel or modify, including but not limited to movement of delivery dates for the Products, any order for any reason except with Seller's written consent and upon terms that will indemnify, defend and hold Seller harmless against all direct, incidental and consequential loss or damage and any additional expense. Seller, at any time, may change features, specifications, designs and availability of Products.

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

15. Force Majeure. Seller is not liable for delay or failure to perform any of its obligations by reason of events or circumstances beyond its reasonable control. Such circumstances include without limitation: accidents, labor disputes or stoppages, government acts or orders, acts of nature, pandemics, epidemics, other widespread illness, or public health emergency, delays or failures in delivery from carriers or suppliers, shortages of materials, war (whether declared or not) or the serious threat of same, riots, rebellions, acts of terrorism, fire or any reason whether similar to the foregoing or otherwise. Seller will resume performance as soon as practicable after the event of force majeure has been removed. All delivery dates affected by force majeure shall be tolled for the duration of such force majeure and rescheduled for mutually agreed dates as soon as practicable after the force majeure condition ceases to exist. Force majeure shall not include financial distress, insolvency, bankruptcy, or other similar conditions affecting one of the parties, affiliates and/or sub-contractors.

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

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

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

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

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

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

22. Compliance with Laws. Buyer agrees to comply with all applicable laws, regulations, and industry and professional standards, including those of the United States of America, and the country or countries in which Buyer may operate, including without limitation the U.S. Foreign Corrupt Practices Act ("FCPA"), the U.S. Anti-Kickback Act ("Anti-Kickback Act"), U.S. and E.U. export control and sanctions laws ("Export Laws"), the U.S. Food Drug and Cosmetic Act ("FDCA"), and the rules and regulations promulgated by the U.S. Food and Drug Administration ("FDA"), each as currently amended. Buyer agrees to indemnify, defend, and hold harmless Seller from the consequences of any violation of such laws, regulations and standards by Buyer, its employees or agents. Buyer acknowledges that it is familiar with all applicable provisions of the FCPA, the Anti-Kickback Act, Export Laws, the FDCA and the FDA and certifies that Buyer will adhere to the requirements thereof and not take any action that would make Seller violate such requirements. Buyer represents and agrees that Buyer will not make any payment or give anything of value, directly or indirectly, to any governmental official, foreign political party or official thereof, candidate for foreign political office, or commercial entity or person, for any improper purpose, including the purpose of influencing such person to purchase Products or otherwise benefit the business of Seller. Buyer further represents and agrees that it will not receive, use, service, transfer or ship any Products from Seller in a manner or for a purpose that violates Export Laws or would cause Seller to be in violation of Export Laws. Buyer agrees to promptly and reliably provide Seller all requested information or documents, including end-user statements and other written assurances, concerning Buyer's ongoing compliance with Export Laws. 08/2020

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