Direct Drive Servomotor

Direct Drive technology has recently become more and more commonplace in machine and factory automation. Parker's Electromechanical Division has been well known for many years as a specialist in direct drive technology. Parker offers various kinds of torque motor, in „ready to run" and kit form, as well as linear motors. These motors are ideal for solutions in printing machines, bending machines or machine tools which require extremely smooth rotation, especially at very low speed, and very high accuracy. Frequently there is also a requirement for a hollow shaft.

Designed with the aim of addressing new industrial needs, Parker has developed the ST range of low inertia motors for Direct Drive providing acceleration rates up to 20 000rad/s². The ST range is available in three diameters, 145mm, 190mm and 300mm, with either hollow or solid shafts of 60mm till 75mm diameter respectively. Rated torques range from 15Nm to 235Nm in natural convection, with peak torques from 55Nm to 1161Nm. The motors can reach rated speeds of 200pm till 1 500rpm according to winding type and provide exceptional speed regulation at low speed.

The 145mm, 190mm and 300mm ST ranges offer outstanding performance with a continuous torque-to-weight ratio up to 3.7Nm/kg and a peak torque-to-weight ratio up to18Nm/kg.

Parker has also expanded its product portfolio with a new range of Direct Drive frameless motors.
Complementary to its ST range, these kit motors (stator + rotor) are designed to be integrated within machine tools such as rotary tables and grinding heads. These applications frequently require a large-diameter hollow shaft as well as high accuracy and speed regulation.

The new STK frameless motor range offers outstanding rated torque from 15Nm to 2 700Nm in natural convection, and can reach 6 100Nm using fluid cooling. The peak torque is 3 times higher than the rated torque (up to 9 000Nm) and is available up to the rated speed.

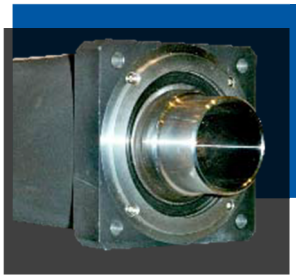
The large-diameter hollow shaft provides an internal clearance between 56mm and 630mm.

Parker Direct Drive motors have been designed and industrialised with the aim of ensuring excellent performance as well as acceptable cost for users.

Compax**3**
-Servo Drives of the Third Generation-
Modern digital control technology aids the realisation of highly productive and flexible automation solutions. It forms the basis of a stable control system and, most importantly, the precise positioning of linear actuators or other direct drive technologies. Without requiring any additional options, **Com**pax**3** supports diverse motor technologies including synchronous servo motors, linear servo motors and even torque motors.
Due to its inherently modular structure, the **Com**pax**3** intelligent servo drive can be employed in a wide range of industrial applications. Based on a standard version of the drive, Parker Hannifin is able to offer a large number of additional PLC- and advanced technology functions for the **Com**pax**3**.



Direct drive is more than just a good idea!



ST series

Brushless torque motor in complete form

Designed with the aim of addressing new industrial applications, Parker has introduced the ST range of direct-drive low inertia motors offering verry high acceleration rates. The ST range is available in three diameters, 145mm, 190mm and 300mm, with either hollow or solid shafts of 60mm till 75mm diameter respectively.
Rated torques range between 15Nm and 235Nm, based on natural convection, with peak torques from 55Nm to 1161Nm. The motors have rated speeds of 200, 500, 800, 1000 or 1500rpm according to the winding type and offer exceptionally smooth rotation at low speed.

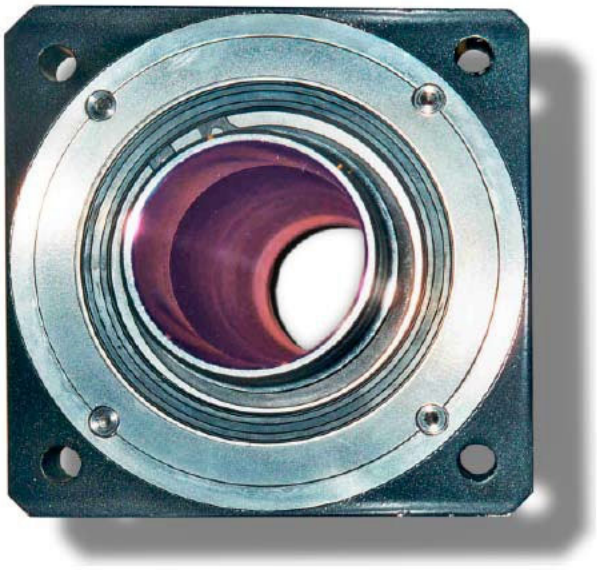
The 145mm,190mm and 300mm ST ranges provide an outstanding performance with a continuous torque-to-weight ratio up to 3.7Nm/Kg and a peak torque-to-weight ratio up to 18Nm/Kg.

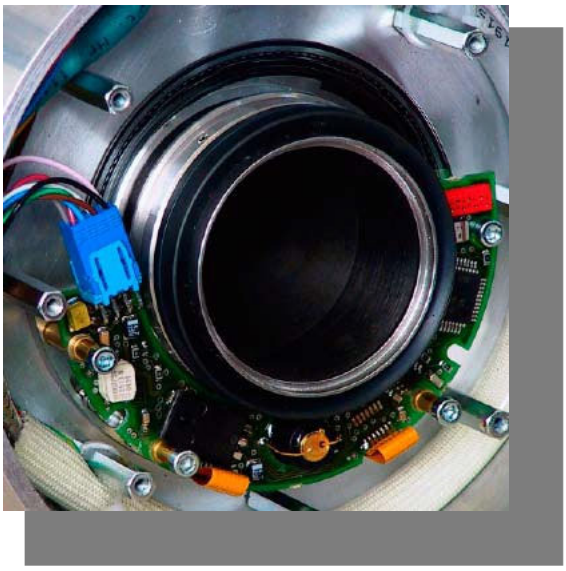
Main characteristics

- Continuous torque up to 235Nm and peak torque up to 1161Nm
- Hollow shaft options (up to 75mm diameter)
- Rated speeds from 200 to 1500rpm
- Two motor technologies:
  - ▷ HP: High precision
  - ▷ SP: Standard precision
- Position feedback options:
  - ▷ Resolver: precision ±1arc-min or ±10arc-min
  - ▷ SinCos encoders: incremental, or with commutation track
  - ▷ ENDAT Absolute encoders
  - ▷ HIPERFACE® encoders
- Protection degree: IP54

Benefits

- High dynamic performance
- No gear reducer required
- No backlash
- High accuracy
- Reduced maintenance
- Simplified servo system
- Lower noise
- Optimised machine design
- Diverstiy feedback systems possible





Motor type 145ST

400/460VAC Version

			145ST2M		145ST4M		145ST6M		145ST8M	
Rated speed		rpm	500			500				
Continuous torque at stall [4]		Nm	14.6		26.4		37.3		47.4	
Current at continuous torque [1]		A	2.3	5.2	3.7	9.2	5.0	12.7	6.4	15.7
Peak torque [2][3]		Nm	55		110		165		220	
Current at peak torque [2]		A	10.2	23.1	17.8	45,5	27.3	68.3	35.6	91.1
Rated Power [1]		W	735	2 032	1 247	3			2 200	3 850
Inertia without position feedback [8]	**Solid shaft**	kg · m²	1						3 620	
	Hollow shaft Ø30		1						3 660	
	Hollow shaft Ø56		3 440		4 400		5 350		6 300	
	Hollow shaft Ø60		2 860		3 690		4 510		5 330	
Weight **Without position feedback**[6][7] **With B5 flange**	**Solid shaft**	kg	8.8		12.6		16.7		20.6	
	Hollow shaft Ø30		8.5		12.3		16.4		20.3	
	Hollow shaft Ø56		13.1		17.0		21.1		25.0	
	Hollow shaft Ø60		12.6		16.3		20.3		24.0	
Thermal time constant [1][5]		s	1 012		1 399		1 667		1 866	
Thermal resistance [1][5]		°C/W	0.394		0.324		0.275		0.239	
Resistance (phase-to-phase) at 20°C [2]		Ω	22.34	4.42	10.74	1.65	5.99	0.95	4.35	0.66
Inductance (phase-to-phase) at I continuous		mH	115.53	21.48	77.08	11.78	48.84	7.79	38.45	5.89
Electrical time constant [2]		ms	5.1		7.2		8.2		8.9	
Motor Voltage Constant (phase-to-phase)		V/1000rpm	427	189	479	193	501	197	498	203
Number of Poles			12							

(1) Ambient temperature: 20°C
Winding temperature rise: 120°C
Motor in natural convection mounted on a □150 flange

(2) Cold motor at 20°C

(3) Overload characteristics on a 540VDC bus Peak torque is available up to:
- 300rpm for 500rpm version
- 1 000rpm for 1 500rpm version

At nominal speed, peak torque is limited to the value of continuous torque at stall.

See torque vs speed characteristics on:
(Direct Drives ⇨ Torque motor)

(4) Consider a 7% derating with position feedback codes '2' and '7'.

(5) Housing – Ambient

(6) B14 flange: +0.2kg

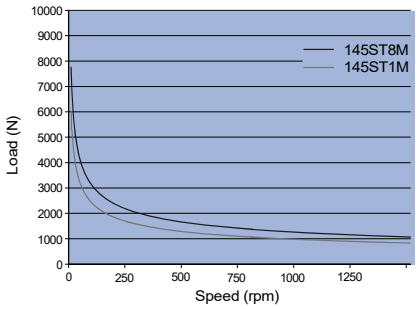
(7) Position feedback options
1*: +1.5kg
2*, 7*: +1.2kg
3*: +0.34kg
5*, 8*, 9*: +0.25kg
6*: +0.1kg

(8) Position feedback options
1*: 1 500kg · mm²
2*, 7*: 340kg · mm²
3*: 150kg · mm²
5*, 8*, 9*: 2 600kg · mm²
6*: 2 500kg · mm²

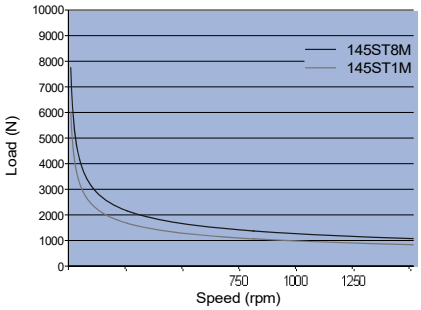
* The numbers refer to the order code on page 24.

Maximum load for a 20 000h life time and axial load < 30% of radial load

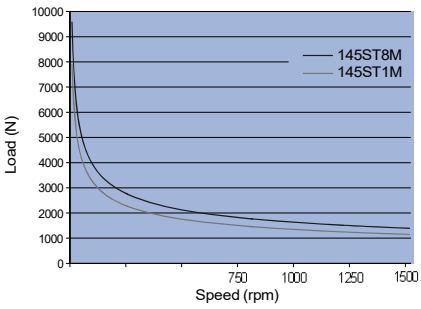
145ST with solid shaft



145ST with hollow shaft Ø30



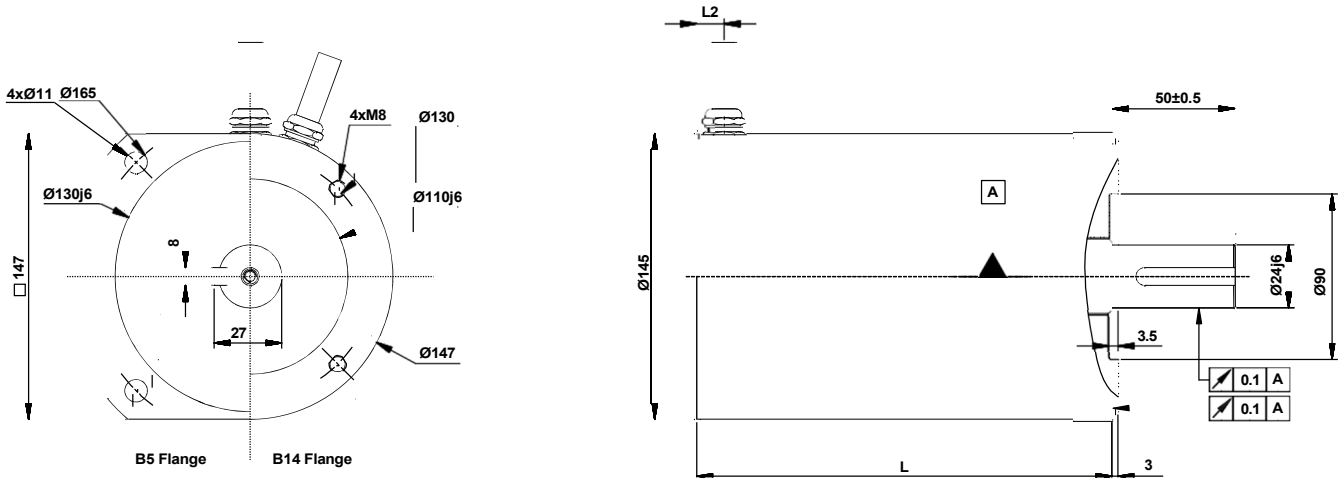
145ST with hollow shaft Ø56 & Ø60



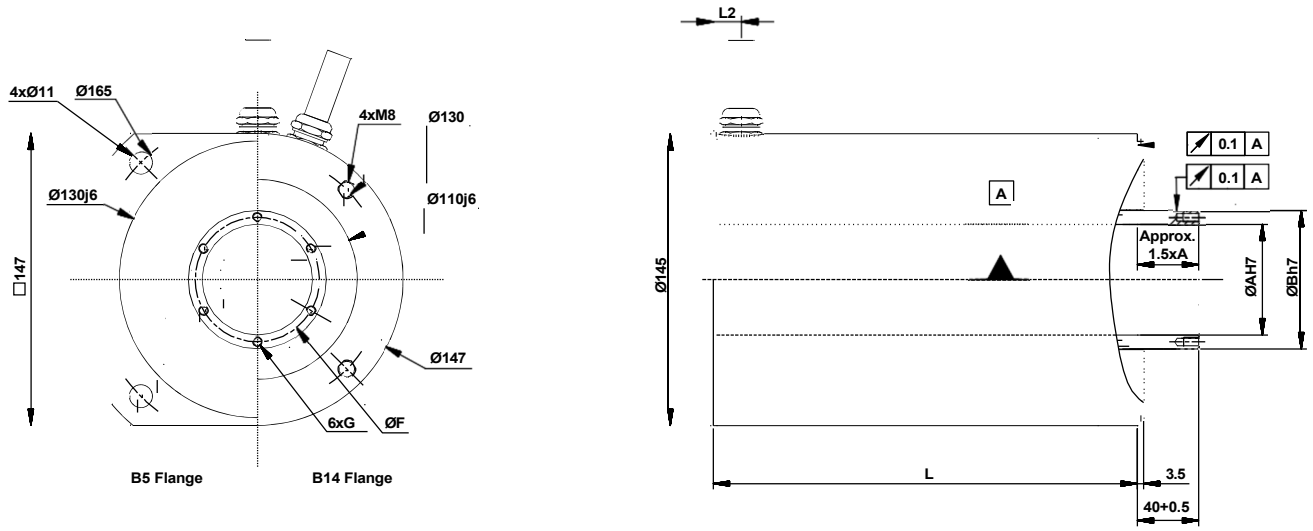
Load graphs are accurate if:
- Loads are gradual with no shock loading
- The motor is operating within its designed operating envelope
- Loads are applied to the midpoint of the shaft (no incurring large moments loads)

For irregular operating conditions (e. g. shocks, vibratios, cyclic loading, temperature, enviroment) please contact us.

Motor Dimensions: 145ST with Solid Shaft



Motor Dimensions: 145ST with Hollow Shaft



	Solid Shaft				Hollow Shaft Ø30		Hollow Shaft Ø56	Hollow Shaft Ø60
	L				G=M5, F=37.5, A=30, B=45		G=M6, F=65.5, A=56, B=75	No threads A=60, B=75
	L2=66		L2=21		L		L	*Same length dimensions as Ø56 hollow shaft motor*
Position Feedback	**1***	**3***	**5*, 8*, 9***	**6***	**1*, 3***	**2*, 7***	**1***	
145ST2M	195.50	167.00	177.00	159.00	*Same length dimensions as solid shaft motor*	193.00	212.00	
145ST4M	249.50	221.00	231.00	213.00		247.00	266.00	
145ST6M	303.50	275.00	285.00	267.00		301.00	320.00	
145ST8M	357.50	329.00	339.00	321.00		355.00	374.00	

* The numbers refer to the order code on page 24.

Motor type 190ST

400/460VAC Version

			190ST2M	190ST4M	190ST6M	190ST8M
Rated speed		**rpm**	500		500 1 000	500 1 000
Continuous torque at stall [4]		**Nm**	36	63	89	111
Current at continuous torque [1]		**A**	5 11.7	8 20	11.5 19	14 23.3
Peak torque [2][3]		**Nm**	119	238	357	476
Current at peak torque [2]		**A**	18.6 48.9	34.2 93.2	56.9 102.5	73.2 128.1
Rated Power [1]		**W**	1 600 3 780	2 504 3 307	2 940 4 570	3 780 5 355
Inertia without position feedback [8]	**Solid shaft**	**kg · m²**	4 500	7 460	10 430	13 400
	Hollow shaft Ø40		4 420	7 390	10 360	13 320
	Hollow shaft Ø72		8 660	11 630	14 600	17 560
	Hollow shaft Ø75		7 700	10 400	13 100	15 800
Weight **Without position feedback**[6][7] **With B5 flange**	**Solid shaft**	**kg**	19.7	28.6	37.6	46.6
	Hollow shaft Ø40		18.2	27.2	36.2	45.1
	Hollow shaft Ø72		21.2	30.1	39.1	48.1
	Hollow shaft Ø75		20.5	29.2	38.0	46.8
Thermal time constant [1][5]		**s**	1 506	2 129	2 559	2 865
Thermal resistance [1][5]		**°C/W**	0.253	0.203	0.170	0.146
Resistance (phase-to-phase) at 20°C [2]		**Ω**	8.2446 1.1951	3.6719 0.485	1.8 0.5369	1.3337 0.433
Inductance (phase-to-phase) at I continuous		**mH**	83.485 12.124	49.883 6.755	27.193 8.3138	21.997 7.1014
Electrical time constant [2]		**ms**	10.1	13.6	15.6	16.5
Motor Voltage Constant (phase-to-phase)		**V/1000rpm**	484 207	529 212	520 315	532 320
Number of Poles			12			

(1) Ambient temperature: 20°C
Winding temperature rise: 120°C
Motor in natural convection mounted on a 200 flange

(2) Cold motor at 20°C

(3) Overload characteristics on a 540VDC bus
Peak torque is available up to:
- 300rpm for 500rpm version
- 1 000rpm for 1 500rpm version

At nominal speed, peak torque is limited to the value of continuous torque at stall.

See torque vs speed characteristics on:
(Direct Drives ⇨ Torque motor)

(4) Consider a 7% derating with position feedback codes '2' and '7'.

(5) Housing – Ambient

(6) B14 flange: +0.4kg

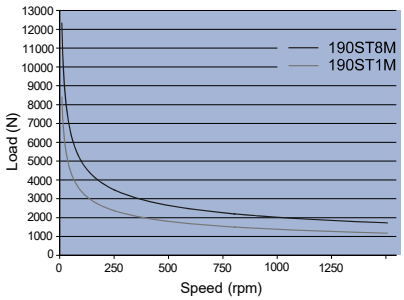
(7) Position feedback options
1*: +1.5kg
2*, 7*: +1.2kg
3*: +0.34kg
5*, 8*, 9*: +0.25kg
6*: +0.1kg

(8) Position feedback options
1*: 1 500kg · mm²
2*,7*: 340kg · mm²
3*: 150kg · mm²
5*, 8*, 9*: 2 600kg · mm²
6*: 2 500kg · mm²

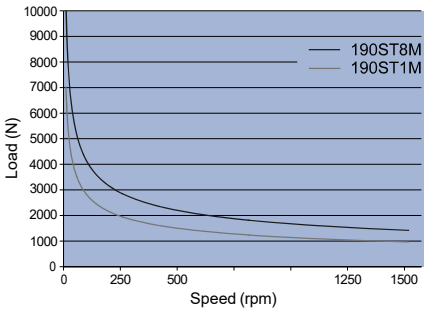
* The numbers refer to the order code on page 24.

Maximum load for a 20 000h life time and axial load < 30% of radial load

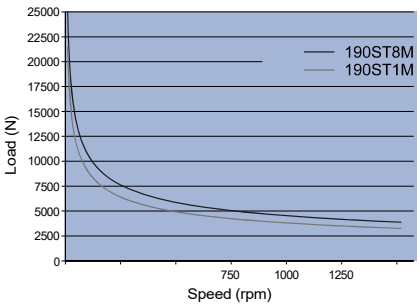
190ST with solid shaft



190ST with hollow shaft Ø40



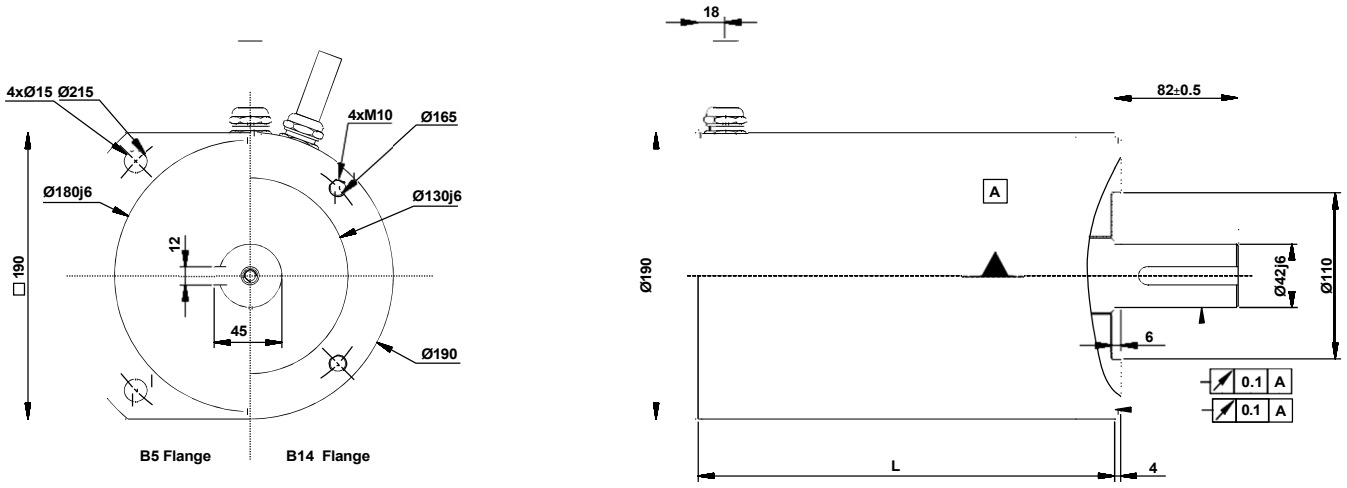
190ST with hollow shaft Ø72 & Ø75



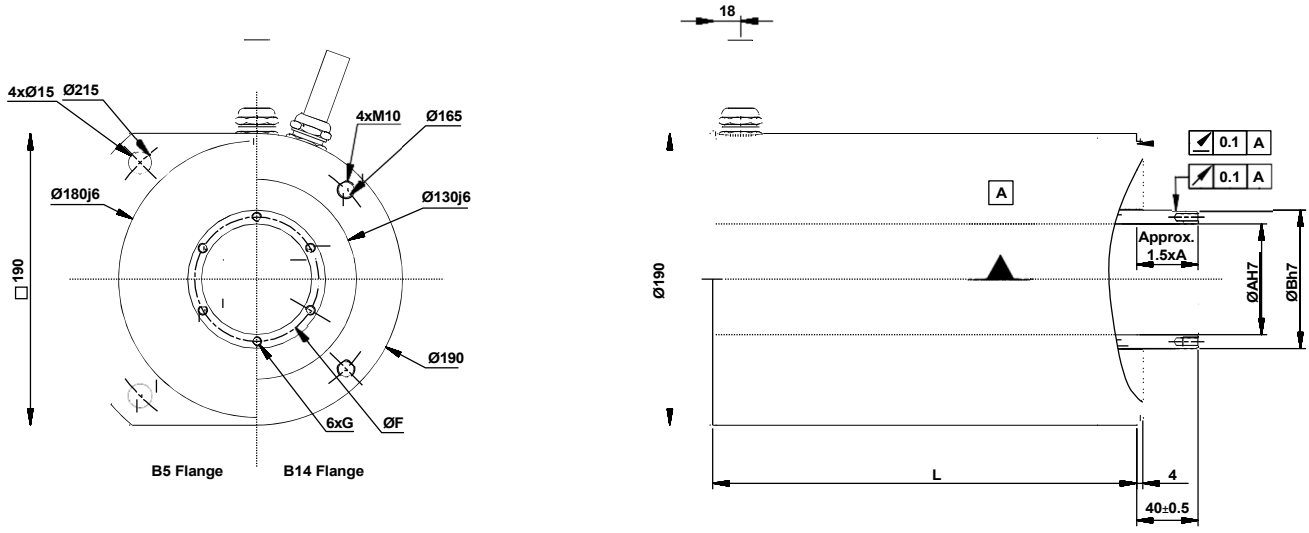
Load graphs are accurate if:
- Loads are gradual with no shock loading
- The motor is operating within its designed operating envelope
- Loads are applied to the midpoint of the shaft (no incurring large moments loads)

For irregular operating conditions (e. g. shocks, vibratios, cyclic loading, temperature, enviroment) please contact us.

Motor Dimension: 190ST with solid shaft



Motor Dimension: 190ST with hollow shaft



	Solid Shaft		Hollow Shaft Ø40		Hollow Shaft Ø72	Hollow Shaft Ø75
			G=M5, F=67,5, A=40, B=55		G=M6, F=81, A=72, B=90	No threads A=75, B=90
	L		L		L	*Same length dimensions as Ø72 hollow shaft motor*
Position Feedback	**1*, 3*, 6***	**5*, 8*, 9***	**1*, 3***	**2*, 7***	**1***	
190ST2M	204.00	215.00	204.00	242.00	235.00	
190ST4M	276.50	287.50	276.50	314.50	307.50	
190ST6M	349.00	360.00	349.00	387.00	380.00	
190ST8M	421.50	432.50	421.50	459.50	452.50	

* The numbers refer to the order code on page 24.

Motor type 300ST

400/460VAC Version

		300ST2M		300ST4M		300ST6M	
Rated speed	**rpm**	200	800	200	800	200	800
Continuous torque at stall	**Nm**	98		170		235	
Current at continuous torque (1)	**A**	7.3	18.3	11.8	39.9	16.3	55.5
Peak torque (2)(3)	**Nm**	387		774		1 161	
Current at peak torque (2)	**A**	36.7	92.6	66.5	212.9	96.8	304.1
Rated Power (1)	**kW**	1.89	7.06	3.05	10.92	4.2	13.86
Inertia without position feedback (6)	**10^{-3}kg · m²**	87		140.8		194.7	
Weight without position feedback(5)	**kg**	38		51		64.1	
Thermal time constant (1)(4)	**s**	669		1 145		1 621	
Thermal resistance (1)(4)	**°C/W**	0.164		0.135		0.115	
Phase resistance at 20°C (2)	**Ω**	2.82	0.44	1.286	0.126	0.808	0.082
Inductance (phase-to-phase) at I continous	**mH**	17.7	2.8	11.1	1.1	5.5	0.53
Electrical time constant (2)	**ms**	6.3		8.6		9.7	
Motor Voltage Constant (phase-to-phase)	**V/1000rpm**	902	283	968	286	968	285
Number of Poles		24					

(1) Ambient temperature: 20°C
Winding temperature rise: 120°C
(2) Cold motor at 20°C
(3) See torque vs speed characteristics on:

(Direct Drives ⇨ Torque motor)

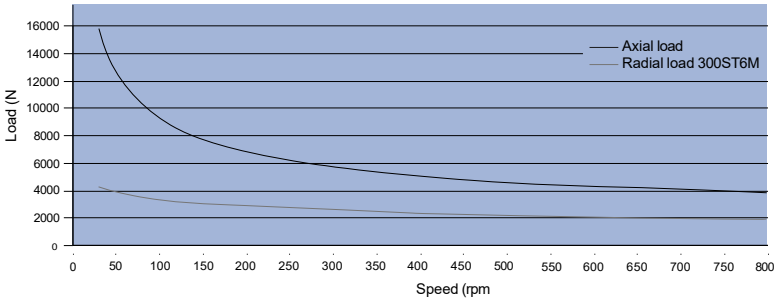
(4) Housing – Ambient
(5) Position feedback options
1*: +0.8kg
2*: +1.1kg
3*: +1.1kg

(6) Position feedback options
1*: $2.03 \cdot 10^{-3}$kg · mm²
2*, 7*: $0.32 \cdot 10^{-3}$ kg · mm²
3*: $0.55 \cdot 10^{-3}$ kg · mm²

* The numbers refer to the order code on page 24.

Maximum load for a 20 000h life time and axial load < 30% of radial load

300ST with solid shaft

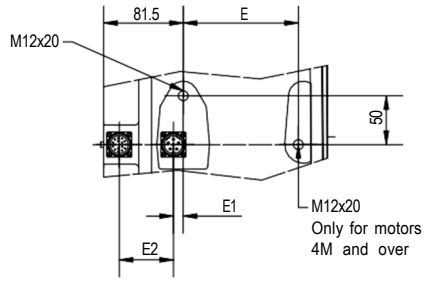


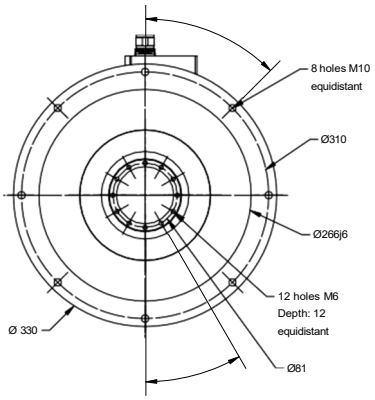
Load graphs are accurate if:
- Loads are gradual with no shock loading
- The motor is operating within its designed operating envelope
- Loads are applied to the midpoint of the shaft (no incurring large moments loads)

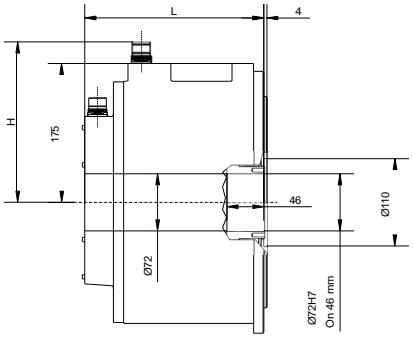
For irregular operating conditions (e. g. shocks, vibrations, cyclic loading, temperature, enviroment) please contact us.

Motor Dimension: 300ST

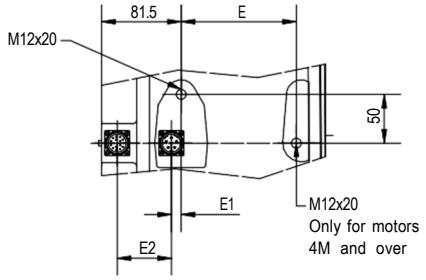
with Feedback 1 [Shaft 1 (Ø72)]

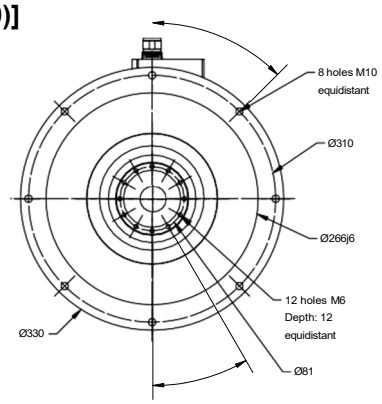


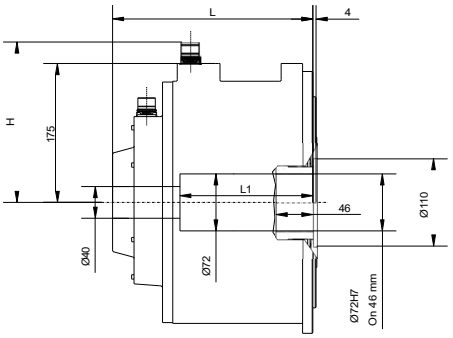




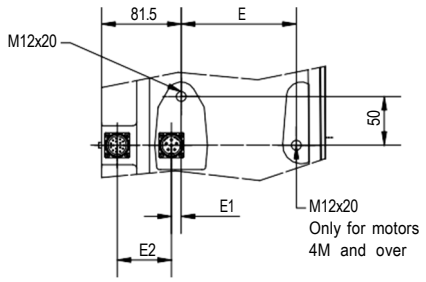
with Feedback 2 or 7 [Shaft 8 (Ø72/Ø40)]

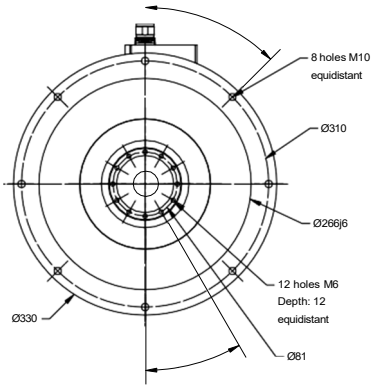


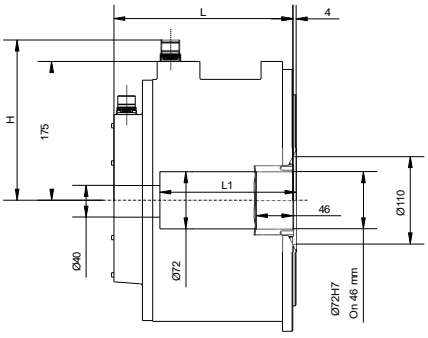




with Feedback 3 [Shaft 8 (Ø72/Ø40)]







	Hollow Shaft Ø72	Hollow Shaft Ø72 / Ø40				All Current at continous torque <25A (Current at continous torque >25A)			
	L	L	L1	L	L1	H	E1	E2	E
Position Feedback	**1***	**2, 7***		**3***		**All**			
300ST2M	201	225	150.5	201	150.5	202 (217)	10 (2)	55.5 (63.5)	
300ST4M	256	280	205.5	256	205.5	202 (217)	10 (2)	55.5 (63.5)	123
300ST6M	311	335	260.5	311	260.5	202 (217)	10 (2)	55.5 (63.5)	

* The numbers refer to the order code on page 24.

STK series

Frameless brushless torque motor as kit version





With the STK range, Parker offers a solution for direct drive applications. Examples include:

- Applications needing total integration of the motor within the servomechanism due to volume and/or weight considerations
- Applications needing a large-diameter hollow shaft demanding a ring-type technology

Main characteristics

- Continuous torque from 14Nm to 2 700Nm with natural convection (according to size), and up to 6 100Nm with fluid cooling.
- Six external diameters from 145mm to 800mm.
- Internal diameters from 56mm to 630mm.
- Various windings available from 30rpm to 1 500rpm according to size.

Parker's STK range of permanent magnet brushless motors has been specially designed for direct drive (without a gearbox), particularly in applications needing very low volume and weight in relation to the torque and power requirements.

Electromagnetic and thermal optimisation has permitted continuous torque-to-weight ratios up to 14Nm/Kg to be achieved with natural convection and up to 31Nm/Kg with fluid cooling.
The Parker STK range of frameless motors addresses very demanding industrial applications, not only in terms of performance (dynamic performance, torque capability and precise rotation at low speed) but also in terms of cost. Particular attention has therefore been paid in the design to the combination of technical and economic optimisation.

Industrial users can sometimes be dissatisfied with direct drive servo systems because they are frequently based on torque motors with limited power and speed capability. With the STK range, Parker set out to counter this objection by creating motors that could not only satisfy low-speed applications with their associated speed regulation, but could also address direct drive applications up to 30KW in natural convection at speeds up to 1 500rpm.

The various speed ratings are achieved by having a range of available windings. Some of these are illustrated in the catalogue, but numerous winding variations are possible to allow the drive system to be optimised.

Motor Constitution

STATOR: this consists of iron laminations incorporating the windings and attached to the external aluminium housing. The windings are encapsulated in resin. The housing may incoporate a cooling circuit when fluid cooling is required.

- Winding class: H.
- Power cable: class 6 with 4 shielded wires for power.

ROTOR: rare earth magnets protected against corrosion are attached to the periphery of a magnetic iron ring.

STAToR AND RoToR MouNTING: STK armatures and rotors can be optionally shipped mounted on a centering and positioning flange which eliminates the need to mount and centre the rotor inside the stator.

Natural convection

The stator is the source of copper losses as well as hysteresis and eddy current losses. It is necessary to take this into account when incorporating the motor. Here are the main points to be taken in consideration:

- Continuous torque ratings are indicated for a copper temperature rise of 120°C for housings in contact with ambient air, or in contact over the full peripheral area with a metal component in contact with ambient air. In addition, the motor housing must be fixed on a metal flange having an area equal to at least twice the housing area.
- For example, for a 400mm diameter motor, the minimum flange area will be equal to $2 \cdot \frac{\pi \cdot 0{,}4^2}{4} = > 0{,}25 m^2$
- Avoid an enclosed environment, or if this is unavoidable, consult us for calculation of the motor derating.
- Be sure that the materials located in the vicinity of the motor can withstand high temperatures. If this is not the case, consult us for recommendations on derating the motor.

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