

Torque Motors

TM Series

Technical Manual

PVD 3622





EU DECLARATION OF CONFORMITY

We ,

Parker Hannifin Manufacturing France SAS
Electromechanical & Drives Division Europe
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manufacturer, with brand name **Parker**, declare under our sole responsibility that the products

SERVOMOTORS TYPE TMW

satisfy the arrangements of the directives :

Directive 2014/35/EU : “Low Voltage Directive”, LVD

Directive 2011/65/EU : “Restriction of Hazardous Substances”, RoHS

Directive 2014/30/EU : “Electromagnetic Compatibility”, EMC

and meet standards or normative document according to :

EN 60034-1:2010/AC:2010 : Rotating electrical machines - Part 1 : Rating and performance.

EN 60034-5:2001/A1:2007 : Rotating electrical machines - Part 5 : Degrees of protection provided by the integral design of rotating electrical machines (IP code) - Classification.

EN 60204-1:2006/AC:2010 : Safety of machinery – Electrical equipment of machines – Part 1 : General requirements.

The product itself is not impacted by the modifications made on the latest directives.

The undersigned certify that the above mentioned model is procured in accordance with the above directives and standards.

Further information :

SERVOMOTORS shall be mounted on a mechanical support providing good heat conduction and not exceeding 40° C in the vicinity of the motor flange.

The product must be installed in accordance with the instructions and recommendations contained in the operating instructions supplied with the product.

TMW15x C.E. Marking : July 24th 2012
TMW20x C.E. Marking : June 19th 2006

TMW30x C.E. Marking : June 19th 2006
TMW40x C.E. Marking : June 19th 2006

Longvic, November 18th 2016

In the name of Parker
A. ANDRIOT
Quality Manager

Ref : DCE-TMW-001rev0

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1. INTRODUCTION

1.1. Purpose and intended audience

This manual contains information that must be observed to select, install, operate and maintain PARKER TM Torque Motors.

Installation, operation and maintenance of the equipment should be carried out by qualified personnel. A qualified person is someone who is technically competent and familiar with all safety information and established safety practices; with the installation process, operation and maintenance of this equipment; and with all the hazards involved.

Reading and understanding the information described in this document is mandatory before carrying out any operation on the motors. If any malfunction or technical problem occurs, that has not been dealt with in this manual, please contact PARKER for technical assistance. In case of missing information or doubts regarding the installation procedures, safety instructions or any other issue tackled in this manual, please contact PARKER as well.

PARKER's responsibility is limited to its torque motors and does not encompass the whole user's system. Data provided in this manual are for product description only and may not be guaranteed, unless expressly mentioned in a contract.



DANGER: PARKER declines responsibility for any accident or material damage that may arise, if the procedures and safety instructions described in this manual are not scrupulously followed.

1.2. Safety

1.2.1. Principle

To operate safely, this equipment must be transported, stored, handled, installed and serviced correctly. Following the safety instructions described in each section of this document is mandatory. Torque Motors usage must also comply with all applicable standards, national directives and factory instructions in force.



DANGER: Non-compliance with safety instructions, legal and technical regulations in force may lead to physical injuries or death, as well as damages to the property and the environment.

1.2.2. General Safety Rules

	Generality DANGER: The installation, commission and operation must be performed by qualified personnel, in conjunction with this documentation. The qualified personnel must know the safety (C18510 authorization, standard VDE 0105 or IEC 0364) and local regulations. They must be authorized to install, commission and operate in accordance with established practices and standards.
	Electrical hazard Servo drives may contain non-insulated live AC or DC components. Respect the drives commissioning manual. Users are advised to guard against access to live parts before installing the equipment. Some parts of the motor or installation elements can be subjected to dangerous voltages, when the motor is driven by the inverter , when the motor rotor is manually rotated, when the motor is driven by its load, when the motor is at standstill or stopped. For measurements use only a meter to IEC 61010 (CAT III or higher). Always begin using the highest range. CAT I and CAT II meters must not be used on this product. Allow at least 5 minutes for the drive's capacitors to discharge to safe voltage levels (<50V). Use the specified meter capable of measuring up to 1000V dc & ac rms to confirm that less than 50V is present between all power terminals and between power terminals and earth. Check the drive recommendations. The motor must be permanently connected to an appropriate safety earth. To prevent any accidental contact with live components, it is necessary to check that cables are not damaged, stripped or not in contact with a rotating part of the machine. The work place must be clean, dry. General recommendations : - Check the wiring circuit - Lock the electrical cabinets - Use standardized equipment
	Mechanical hazard Servomotors can accelerate in milliseconds. Running the motor can lead to other sections of the machine moving dangerously. Moving parts must be screened off to prevent operators coming into contact with them. The working procedure must allow the operator to keep well clear of the danger area.
	Burning Hazard Always bear in mind that some parts of the surface of the motor can reach temperatures exceeding 100°C.

2. PRODUCT DESCRIPTION

2.1. Quick URL

All informations and datas are available on :

<http://www.parker.com/eme/tmw>

2.2. Overview

TM Torque Motors Series from PARKER is an innovative direct drive solution designed for industrial applications requiring high torque at low speed.

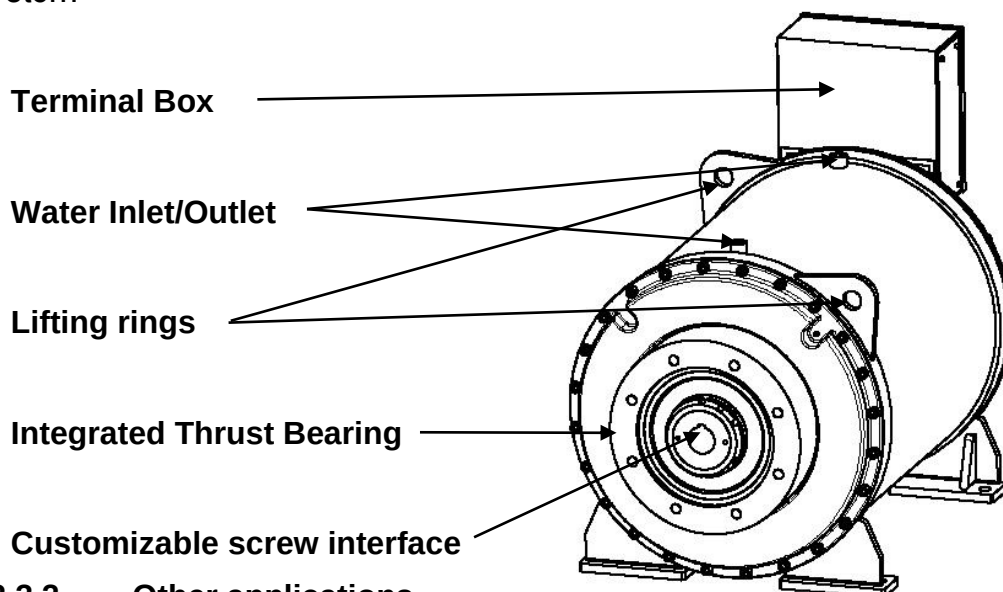
TM Torque Motors from PARKER are permanent magnet based servomotors with a high number of poles, able to deliver torques up to 22,000 Nm at speeds up to 500 rpm. Based on brushless technology, they offer the following decisive advantages: high torque densities for a maximum compactness, high power efficiencies and almost no maintenance.

TM Torque Motors deliver their full performance in association with the AC890 PARKER Drives family. These drives run induction motors, torque motors and permanent magnets servo motors in control modes from simple Volts/Hz to precision closed loop vector with positioning.

2.3. Applications

2.3.1. Extruders

PARKER Torque Motors have been especially designed to replace traditional motor + gearbox sets on **single screw extruders** with power up to 400 kW. More than just motors, TM Torque Motors offer extruder specific features such as built-in thrust bearing or patent pending screw extraction mechanisms, making them particularly suitable for applications in segments such as plastics and rubber extrusion, injection molding, etc...



2.3.2. Other applications

Basic versions of TM Torque Motors can also be used in many other similar applications such as winders, crushers, mixers, and more generally in all application segments requiring **framed** torque motors operated in **speed control** and requiring **torque up to 22,000 Nm**.



2.4. General Technical Data

Motor type	Permanent-magnet synchronous motor							
Magnet material	Nd-Fe-B (Neodymium Iron Boron)							
Number of poles	Size:		TMW200		TMW300		TMW400	
	Polarity:		Low	High	Low	High	Low	High
	Nbr of poles:		24	60	36	90	48	120
Type of construction	IMB3 or IMB34 (IEC60034-7)							
Shaft heights	200 mm							
	315 mm							
	400 mm							
Degree of protection	Plain shaft : IP54							
	Hollow shaft : IP54 with extrusion screw.							
	Hollow shaft : IP00 without extrusion screw.							
	Hollow shaft : on request IP54 without extrusion screw							
Cooling	Natural or Water cooling							
Cooling water temperature	5°C to 25°C (IEC 60034-1) – to avoid condensation see §3.6							
Altitude	Up to 1000m (IEC 60034-1)							
	(for higher altitude see §3.1.1 for derating)							
Rated voltage	400 VAC and 480 VAC							
Connections	Terminal box for power cable, PTC probes and KTY sensors, connector for encoder signals							
Insulation of the stator winding	Class F according to IEC 60034-1 with potting							
Thermal protection	2 PTC probes and 1 KTY sensor							
Ambiant temperature	-15°C to +40°C for natural cooling version (IEC 60034-1)							
	0°C to 40°C for water cooled version (IEC 60034-1) - to avoid condensation see §3.6							
Storage temperature	-20... +60°C							
Vibration severity	Grade A according to IEC 60034-14							
Shaft End	Hollow shaft with keyway as standard							
	Customized interface on request							
Thrust Bearings	SKF 294__E							
Bearings	Ball bearing version							
	Size:		TMW200		TMW300		TMW400	
	Front bearing		6024		6030		6040	
	Rear bearing		6024		6030		6040	
	Roller bearing version							
	Size:		TMW200		TMW300		TMW400	
	Front bearing		NU220		NU226		NU234	
	Rear bearing		6024		6030		6040	
Encoder systems	EnDat Encoder							
	Resolver on request (not recommended for accurate motion control)							
Terminal Box Position	At the rear on the top of the motor as standard							
Paint finish	Black RAL 9005							
Marking	CE							



2.5. Product Code

Code	T	M	W	2	0	4	L	X	C	2	0	U	F	R	0	0	0	3
Product Series																		
Cooling Method																		
W = Water cooling A = Natural ventilation																		
Shaft Height																		
20 = 200 mm 30 = 315 mm 40 = 400 mm																		
Torque / Speed Characteristics																		
See motor data.																		
Feedback Sensor																		
A = remote Resolver B = direct EnDat Encoder C = remote EnDat Pulleys-belt ratio with remote encoder or resolver TM20_ : ratio=6 TM30_ : ratio=9 TM40_ : ratio=6																		
Thrust Bearing																		
XX = SKF 294XX 00 = without thrust bearings, with ball bearings 01 = without thrust bearings, with roller bearings																		
Terminal Box Position																		
U = At the rear on the top R = At the rear on the right (front view) L = At the rear on the left (front view)																		
Extruder screw extraction / cooling																		
F = Front side extrusion screw extraction P = Front side extrusion screw extraction with screw cooling R = Back side extrusion screw extraction with screw cooling Z = No screw extraction / no screw cooling																		
Unused character																		
Shaft End																		
0 = Hollow shaft with keyway																		
Mechanical Interface																		

3. TECHNICAL DATA

3.1. Motor selection

3.1.1. Altitude derating

From 0 to 1000 m : no derating

From 1000 to 4000 m : torque derating of 5% for each step of 1000 m for TMW

From 1000 to 4000 m : torque derating of 10% for each step of 1000 m for TMA

3.1.2. Temperature derating

3.1.2.1. Natural cooled motor

The maximal temperature for natural cooling is 40°C. But, it is possible to increase a little bit the ambient temperature above 40°C, with a torque reduction. The following formula gives an indicative about the torque derating at low speed. But in any case refer to PARKER technical department to know the exact values

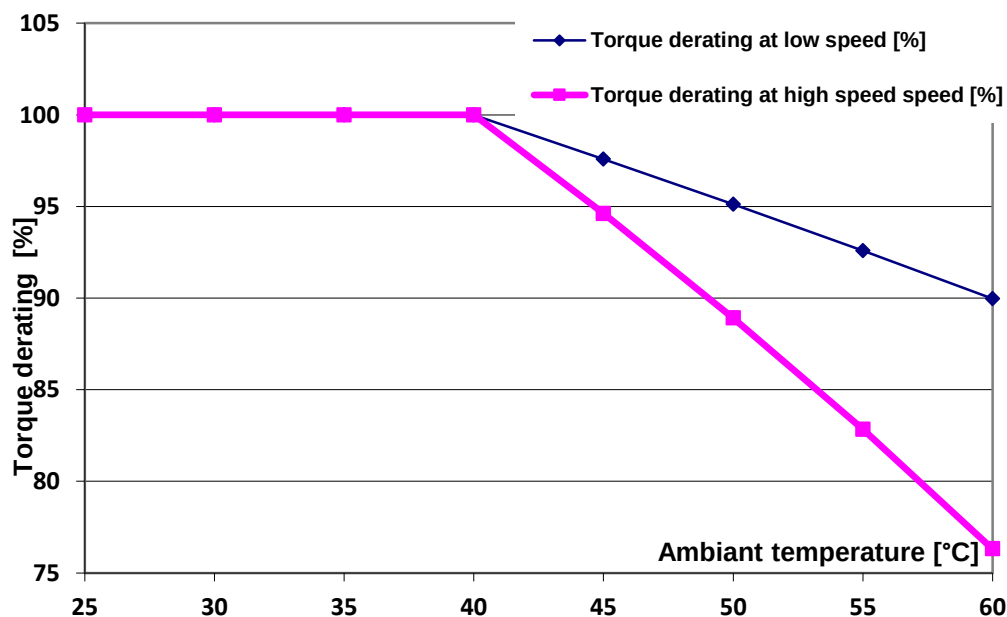
At low speed the torque derating is given by the following formula for an ambient temperature > 40°C.

$$\text{Torque_derating}[\%] = 100 * \sqrt{\frac{(145^{\circ}\text{C} - \text{Ambient_temperature}^{\circ}\text{C})}{105^{\circ}\text{C}}}$$



At high speed, the calculation is more complex, and the derating is much more important.
Please refer to PARKER to know the precise data of Torque derating according to ambient temperature at high speed for a specific motor.

Illustration: Only for example given for the TMA208L :

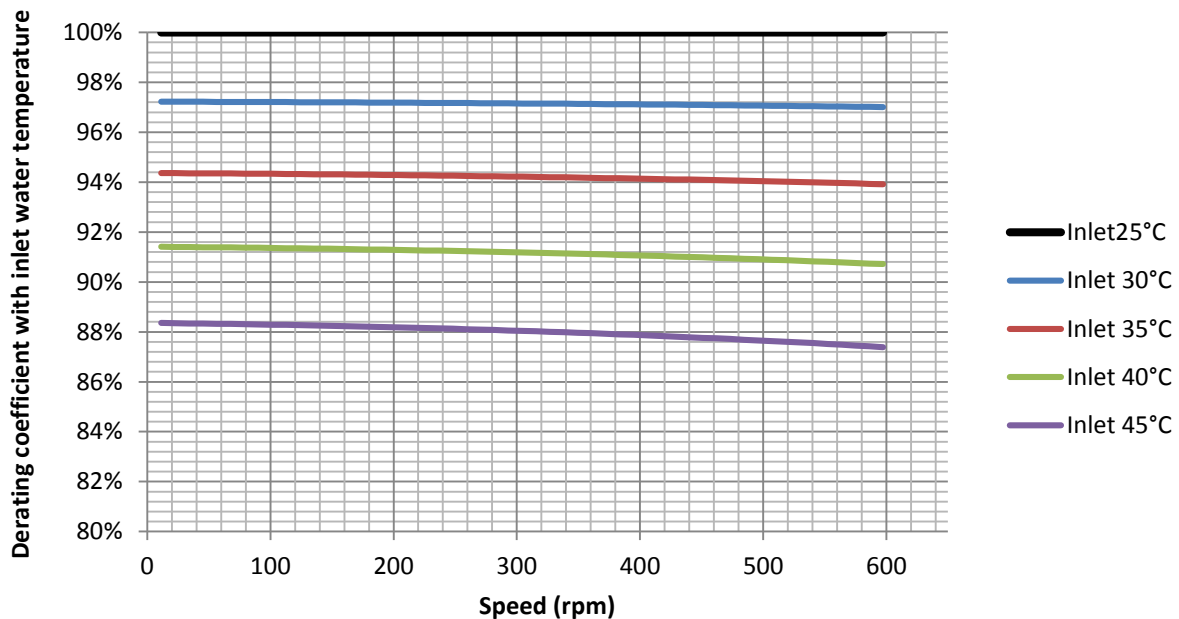


3.1.2.2. Water cooled motor

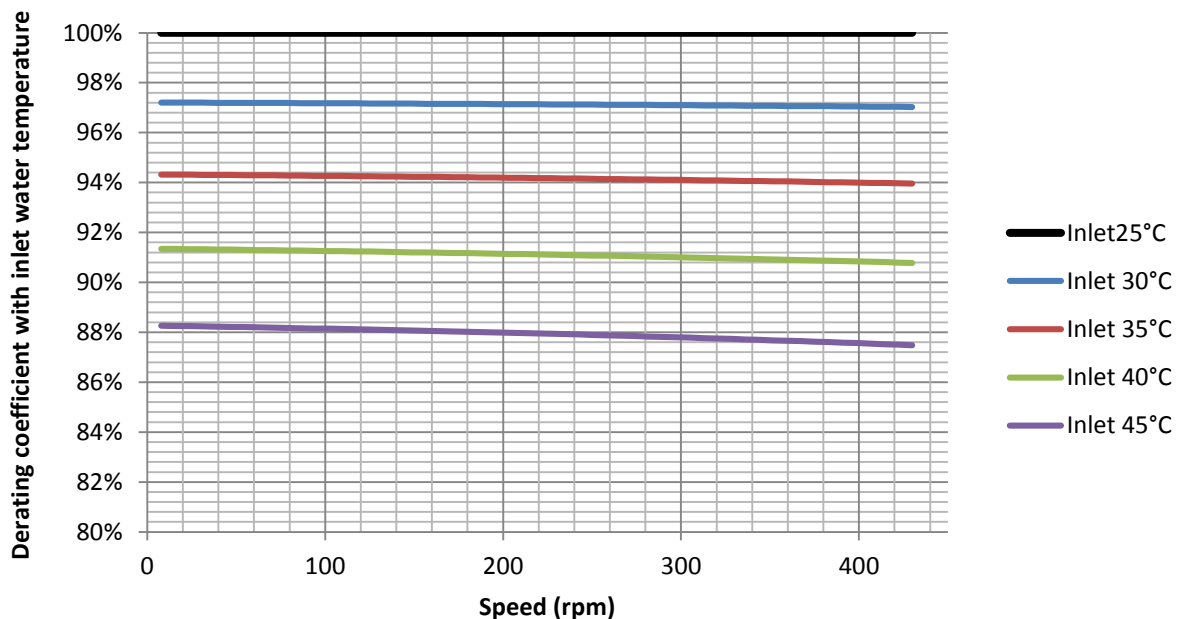
Typical values are given with a water inlet temperature of 25°C and a temperature gradient Inlet-Outlet of 10°C. These references lead to a winding overheating of 95°C corresponding to a winding temperature of 120°C. Recommendations regarding condensation issues are given at § 3.5

It is possible to increase a little bit the Inlet temperature up to 45°C, but the torque must be reduced. The following curves give an indicative of the derating versus the speed for different temperature.

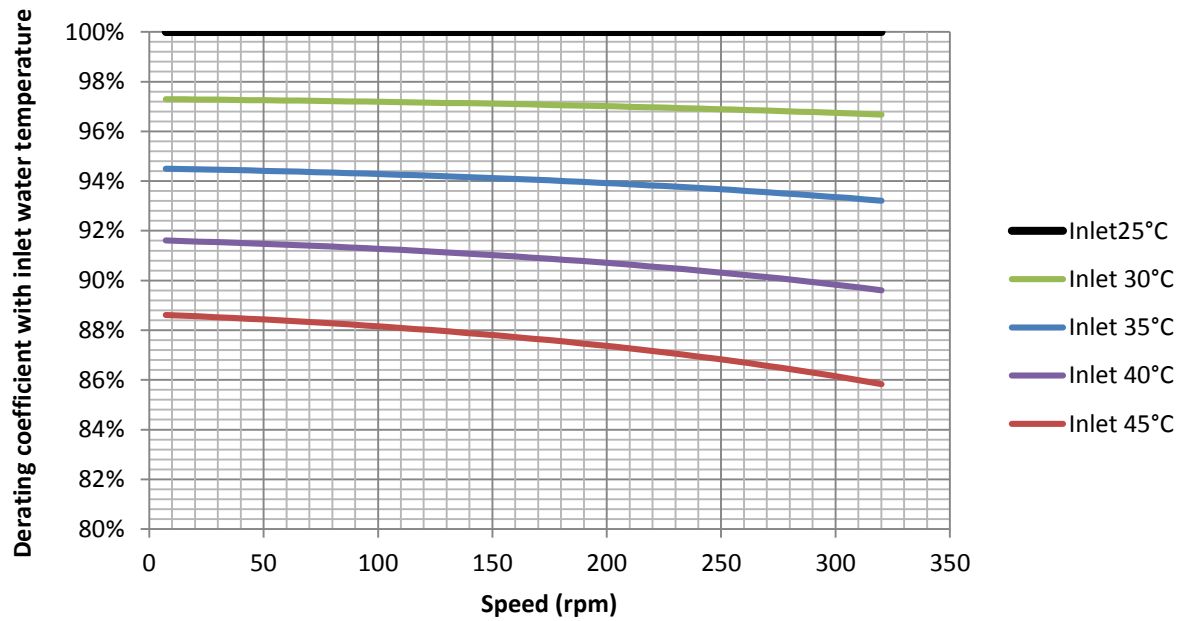
Derating curve vs speed for TMW2xx at nominal water flow (50%glycol)



Derating curve vs speed for TMW3xx at nominal water flow (50%glycol)



Derating curve vs speed for TMW4xx at nominal water flow (50%glycol)



3.1.3. Thermal equivalent torque (rms torque)

The selection of the right motor can be made through the calculation of the rms torque M_{rms} (i.e. root mean squared torque) (sometimes called equivalent torque).

This calculation does not take into account the thermal time constant. It can be used only if the overload time is much shorter than the copper thermal time constant.

The rms torque M_{rms} reflects the heating of the motor during its duty cycle.

Let us consider:

- the period of the cycle T [s],
- the successively samples of movements i characterized each ones by the maximal torque M_i [Nm] reached during the duration Δt_i [s].

So, the rms torque M_{rms} can be calculated through the following basic formula:

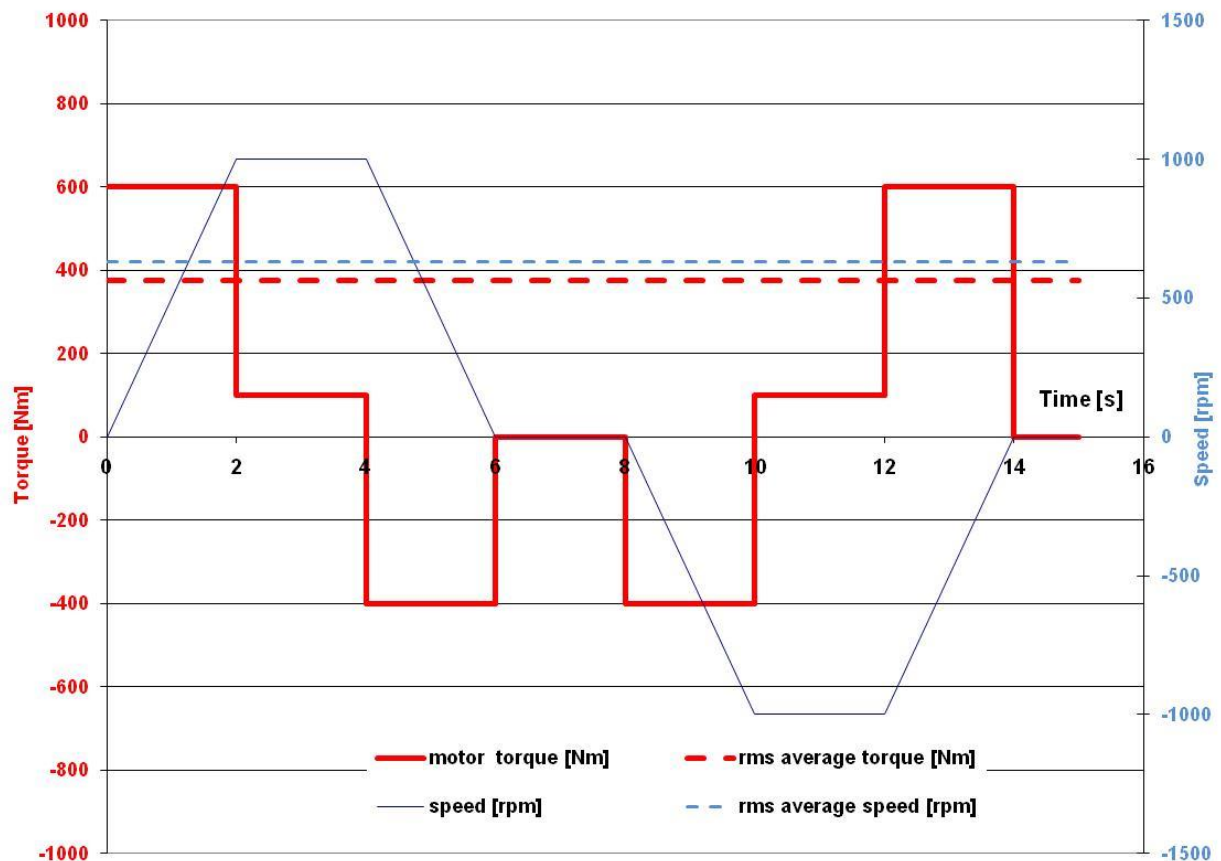
$$M_{rms} = \sqrt{\frac{1}{T} * \sum_{i=1}^n M_i^2 \Delta t_i}$$

Example:

For a cycle of 2s at 0 Nm and 2s at 100Nm, the rms torque is

$$M_{rms} = \sqrt{\frac{1}{4} * 100^2 * 2} = 70,7Nm$$

Illustration :



The maximal torque M_i delivered by the motor at each segment i of movement is obtained by the algebraic sum of the acceleration-deceleration torque and the resistant torque.

Therefore, M_{max} corresponds to the maximal value of M_i .

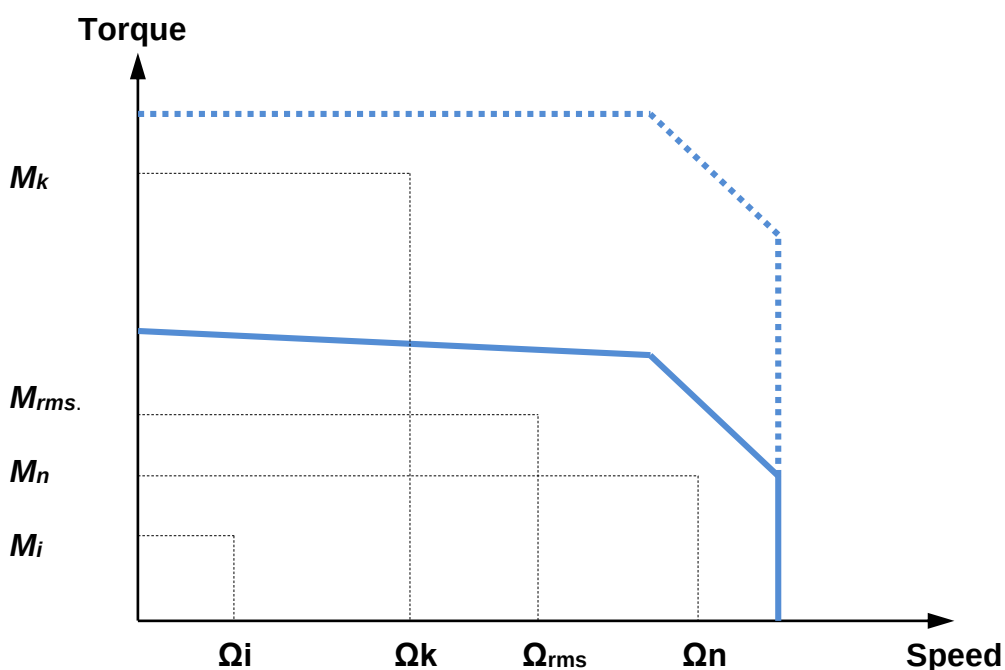
Selection of the motor :

The motor adapted to the duty cycle has to provide the rms torque M_{rms} at the rms speed(*) without extra heating. This means that the permanent torque M_n available at the average speed presents a sufficient margin regarding the rms torque M_{rms} .

$$\Omega_{rms} = \sqrt{\frac{1}{T} * \sum_{i=1}^n \Omega_i^2 \Delta t_i}$$

(*) rms speed is calculated thanks to the same formula as that used for the rms torque. The mean speed cannot be used (in general mean speed is equal to zero). Only use the rms speed.

Furthermore, each M_i and speed associated Ω_i of the duty cycle has to be located in the operational area of the torque vs speed curve.



3.1.4. Drive selection

Drive selection depends on its rated power and its mode selection which leads to the maximal current duration.



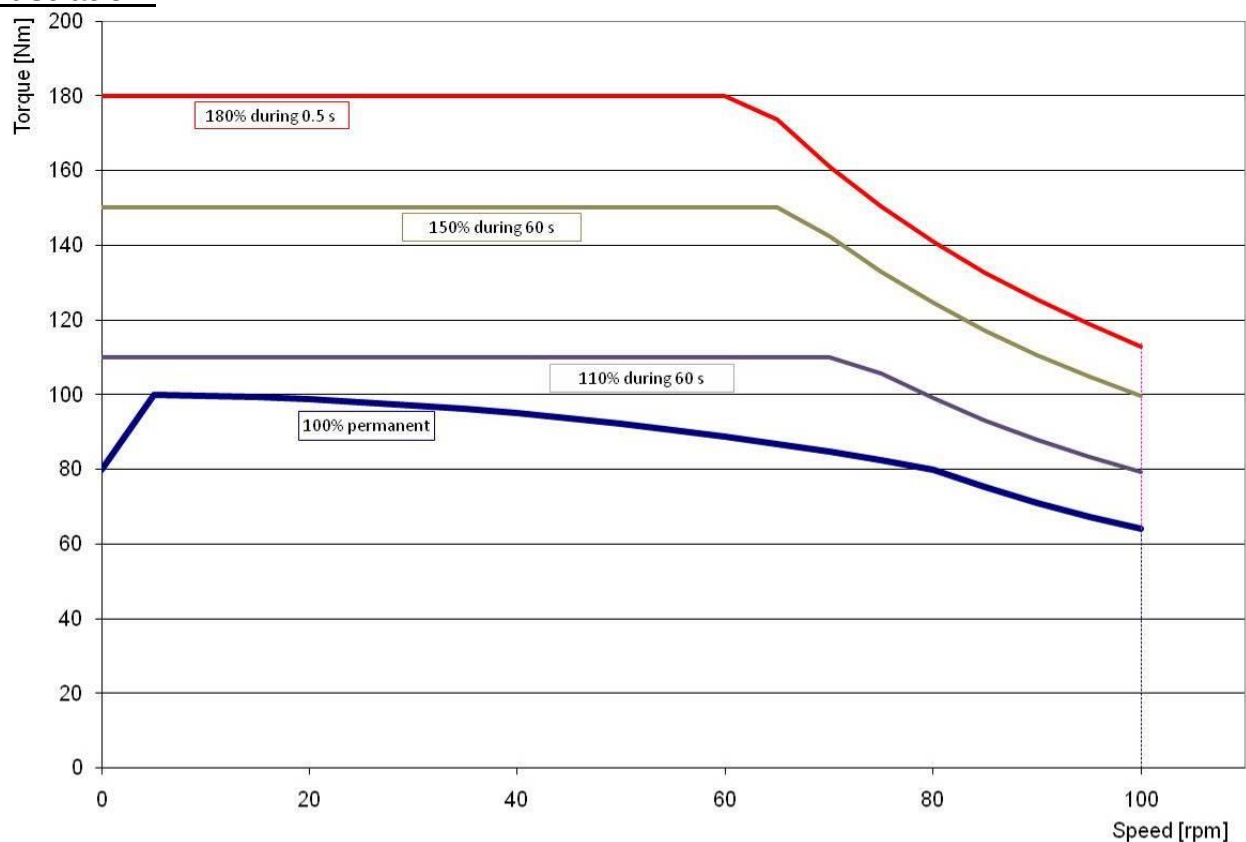
Please refer to the drive technical documentation for any further information and to select the best motor and drive association.

AC890 PARKER Parker drive example:

The rated current provided by the AC890 Parker drive depends on its rated power and its mode selection. Vectorial mode or Servo mode for a power < 37 kW, Constant torque or Quadratic torque for a power > 37 kW.
Once the mode selection set, the rated current corresponds to 100%.
(The rated current with the Quadratic mode selection is greater than with the Constant torque mode selection.)

Power of Drive AC890 [kW]	<37 kW		>37 kW		
Mode	vectoriel mode	servo mode	constant torque		quadratic torque
Overload capability [%]	150% during 60 s	200% during 4 s	150% during 60 s	180% during 0.5 s	110% during 60 s

Illustration:





Example n°1 :

The application needs:

- A rms torque of **4000 Nm** at the rms speed of **100 rpm**,
- An acceleration torque of **7000 Nm**,
- A maximal speed of **140 rpm**.

Selection of the motor:

The selected motor is the type **TMW306LR**.

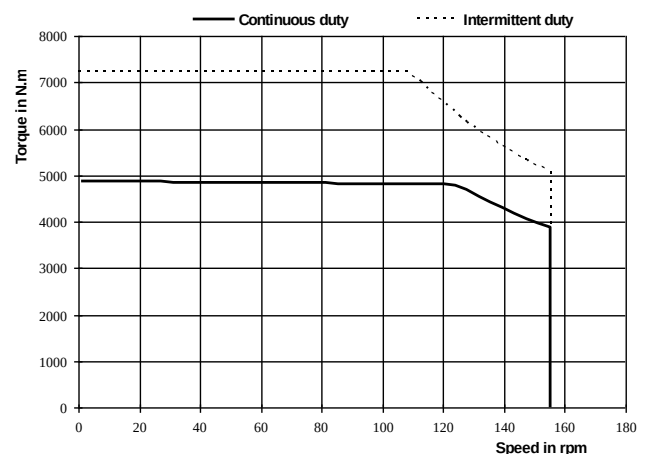
The nominal speed is equal to 125 rpm.

The maximal speed is equal to 155 rpm.

The torque sensitivity is equal to 37.5 Nm/Arms.

BRUSHLESS MOTOR	
TMW306LR	
ELECTRONIC DRIVE	
AC890SD-43 3156 F	

Pn	Rated power	62.8	kW	Cooling : water cooling Cooling : IC 97 W Minimum flow : 21 l / min Maximum temperature : 25 °C Maximum pressure : 5 bars
Mn	Rated torque	4800	Nm	
Nn	Rated speed	125	rpm	
In	Rated current	129	A _{rms}	
UR	Voltage of the mains	400	V _{rms}	Ambient temperature : 40°C max Altitude : < 1.000 m Thermal class : F (according to CEI 34-1) Number of poles : 36
U	DC voltage supply when motor is loaded	540	V	
M ₀	Low speed torque	4870	Nm	
I ₀	Permanent current at low speed	130	A _{rms}	
M _p	Max. torque	7200	Nm	Efficiency : at rated torque ** : 81.8 % at 75 % of the rated torque ** : 86.8 %
I _p	Max. current	195	A _{rms}	
N _p	Max. speed	155	rpm	
J	Rotor inertia	4.55	kg.m ²	
Ke	Back emf constant at 1000 rpm (25°C)*	2350	V _{rms}	
Kt	Torque sensitivity	37.5	Nm/A _{rms}	
Rb	Winding resistance(25°C) *	0.398	Ω	
L	Winding inductance *	4.92	mH	



The permanent current I_0 of the motor is **130 Arms** for **4870 Nm** at low speed.

The nominal current I_n of the motor is **129 Arms** for **4800 Nm** at the nominal speed.

Selection of the drive:

The drive has to provide at least a permanent current equal to I_0 (130 Arms).

In order to obtain an acceleration torque of **7000 Nm**, the current will be about 190 Arms

(the motor data sheet shows 7200 Nm with 195 Arms). This means that the drive has to provide at least 190 Arms as transient current.

→ Therefore, we can select the drive **AC890 PARKERSD-43 3156 F** which delivers under 400 VAC:

135 Arms as permanent current and

135*150%=202 Arms as maximal transient current during 60 s.

Under these conditions, the drive must run with **“Constant as Servo Mode”**.



Example n°2 :

This time; the application needs:

- A rms torque of **4000 Nm** at the rms speed of **100 rpm**,
- An acceleration torque of **5500 Nm**,
- A maximal speed of **140 rpm**.

Selection of the motor:

The selected motor is the type **TMW306LR**.

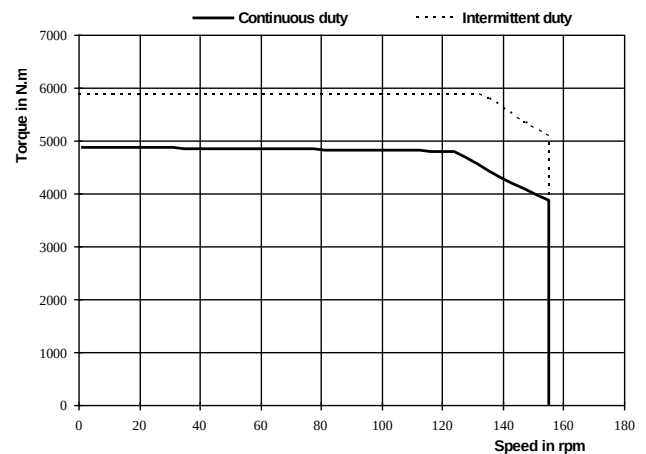
The nominal speed is equal to 125 rpm.

The maximal speed is equal to 155 rpm.

The torque sensitivity is equal to 37.5 Nm/Arms.

BRUSHLESS MOTOR		
TMW306LR		
ELECTRONIC DRIVE		
AC890SD-43 3145 F		

P _n	Rated power	62.8	kW	Cooling : water cooling Cooling : IC 97 W Minimum flow : 21 l / min Maximum temperature : 25 °C Maximum pressure : 5 bars
M _n	Rated torque	4800	Nm	
N _n	Rated speed	125	rpm	
I _n	Rated current	129	A _{rms}	
U _R	Voltage of the mains	400	V _{rms}	Ambient temperature : 40°C max Altitude : < 1.000 m Thermal class : F (according to CEI 34-1)
U	DC voltage supply when motor is loaded	540	V	
M ₀	Low speed torque	4870	Nm	
I ₀	Permanent current at low speed	130	A _{rms}	
M _p	Max. torque	5870	Nm	Number of poles : 36 Efficiency : at rated torque ** : 81.8 % at 75 % of the rated torque ** : 86.8 %
I _p	Max. current	157	A _{rms}	
N _p	Max. speed	155	rpm	
J	Rotor inertia	4.55	kg.m ²	
K _e	Back emf constant at 1000 rpm (25°C)*	2350	V _{rms}	
K _t	Torque sensitivity	37.5	Nm/A _{rms}	
R _b	Winding resistance(25°C) *	0.398	Ω	
L	Winding inductance *	4.92	mH	



The permanent current I₀ of the motor is **130 Arms** for **4870 Nm** at low speed.

The nominal current I_n of the motor is **129 Arms** for **4800 Nm** at the nominal speed.

Selection of the drive:

The drive has to provide at least a permanent current equal to I₀ (130 Arms).

In order to obtain an acceleration torque of **5500 Nm**, the current will be of about 150 Arms

(the motor data sheet shows 5870 Nm with 157 Arms). This means that the drive has to provide at least 150 Arms as transient current.

→ Therefore, we can select the drive **AC890 PARKERSD-43 3145 F** which delivers under 400 VAC:

143 Arms as permanent current and

143*110%=157 Arms as maximal transient current during 60 s.

Under these conditions, the drive must run with **“Quadratic as Servo Mode”**.

The maximal transient torque will be equal to 5870 Nm during 60 s.



Example n°3 :

This time, the application needs :

- a rms torque of **4500 Nm** at the rms speed of **100 rpm**,
- an acceleration torque of **5000 Nm**,
- a maximal speed of **120 rpm**.

Selection of the motor:

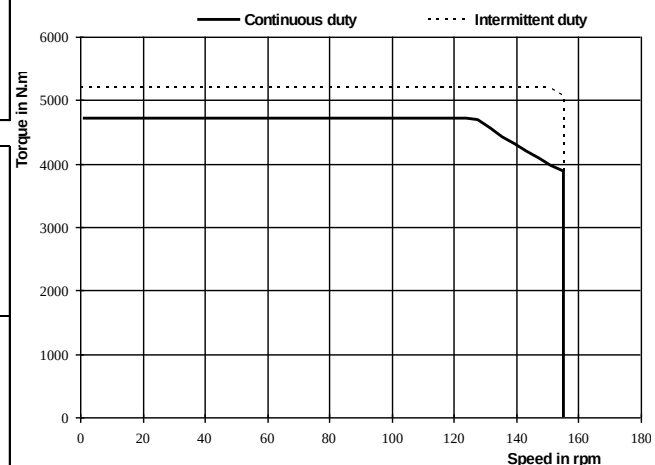
The selected motor is the type **TMW306LR**.

The nominal speed is equal to 125 rpm.

The maximal speed is equal to 155 rpm.

The torque sensitivity is equal to 37.5 Nm/Arms.

BRUSHLESS MOTOR			Parker	
TMW306LR			SSD	
ELECTRONIC DRIVE			PARVEX	
AC890SD-43 3105 F				
Pn	Rated power	62.8 kW	Cooling : water cooling Cooling : IC 97 W Minimum flow : 21 l / min Maximum temperature : 25 °C Maximum pressure : 5 bars	
Mn	Rated torque	4720 Nm		
Nn	Rated speed	127 rpm		
In	Rated current	126 Arms		
UR	Voltage of the mains	400 Vrms	Ambient temperature : 40°C max Altitude : < 1.000 m Thermal class : F (according to CEI 34-1)	
U	DC voltage supply when motor is loaded	540 V		
M ₀	Low speed torque	4720 Nm		
I ₀	Permanent current at low speed	126 Arms		
M _p	Max. torque	5190 Nm	Number of poles : 36 Efficiency : at rated torque ** : 82.3 % at 75 % of the rated torque ** : 87.1 %	
I _p	Max. current	139 Arms		
N _p	Max. speed	155 rpm		
J	Rotor inertia	4.55 kg.m ²		
Ke	Back emf constant at 1000 rpm (25°C)*	2350 Vrms		
Kt	Torque sensitivity	37.5 Nm/Arms		
Rb	Winding resistance(25°C) *	0.398 Ω		
L	Winding inductance *	4.92 mH		



The permanent current I₀ of the motor is **126 Arms** for **4720Nm** at low speed.

The nominal current I_n of the motor is **126 Arms** for **4720 Nm** at the nominal speed.

Selection of the drive:

The datasheet shows a torque sensitivity of 37.5 Nm/Arms. This means that the drive has to provide at least 4500/37.5=106 Arms.

In order to obtain an acceleration torque of **5000 Nm**, the current will be of about 133 Arms

(the motor data sheet shows 5190 Nm with 139 Arms). This means that the drive has to provide at least 133 Arms as transient current.

→ Therefore, we can select the drive **AC890 PARKERSD-43 3105 F** which delivers under 400Vac:

126 Arms as permanent current and

126*110%=138 Arms as maximal transient current during 60 s.

Under these conditions, the drive must run with “**Quadratic as Servo Mode**”.

The example n°3 illustrates the situation where the motor observes a “derating” mode due to the current limitation set by the drive.

- the permanent torque authorized will be equal to 4720 Nm,
- the maximal transient torque will be equal to 5185 Nm during 60 s.

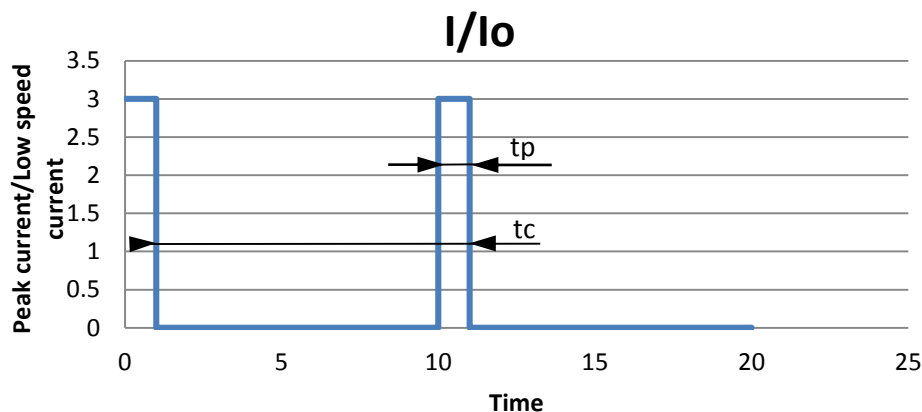
3.1.5. Current limitation at stall conditions (i.e. speed < 3 rpm)

Recommended reduced current at speed < 3 rpm:

	<u>Warning:</u> The current must be limited to the prescribed values. If the nominal torque has to be maintained at stop or low speed (< 3 rpm), imperatively limit the current to 80% of I_0 (permanent current at low speed), in order to avoid an excessive overheating of the motor.
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	Please refer to the drive technical documentation for any further information and to choose functions to program the drive.
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3.1.6. Peak current limitations



It is possible to use the TM motor with a current higher than the permanent current. But, to avoid any overheating, the following rules must be respected.

- 1) The peak currents and peak torques given in the data sheet must never be exceeded
- 2) The thermal equivalent torque must be respected (§3.1.3)
- 3) If 1) and 2) are respected (it can limit the peak current value or duration), the peak current duration (t_p) must be limited, in addition, accordingly to the following table (I_0 is the permanent current at low speed):

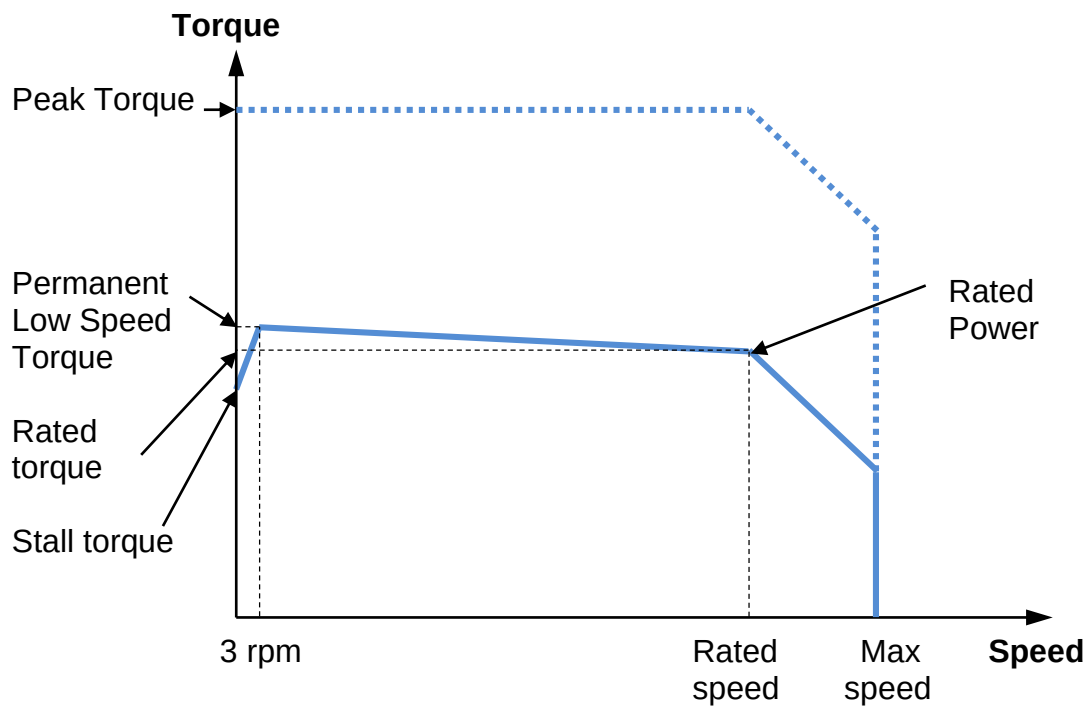
	$I_p/I_0 = 2$	$I_p/I_0 = 3$	$I_p/I_0 = 4$	$I_p/I_0 = 5$
TMA	$T_{peak} < 4s$	$T_{peak} < 1.7s$	$T_{peak} < 0.9s$	$T_{peak} < 0.5s$

	$I_p/I_0 = 1.5$	$I_p/I_0 = 2$	$I_p/I_0 = 2.5$	$I_p/I_0 > 2.5$
TMW	$T_{peak} < 2s$	$T_{peak} < 0.8$	$T_{peak} < 0.5s$	Not allowed

The peak current duration is calculated for a temperature rise of 3°C
Consult us for more demanding applications.

3.2. TM Characteristics: Torque, speed, current, power...

The torque vs speed graph below explains different intrinsic values of the next tables.



3.2.1. TMA204...208 (Natural Cooled) data - Mains voltage 400 V

Model	Nominal Torque Mn (Nm)	Nominal Speed Nn (rpm)	Nominal Power Pn (kW)	Peak Torque Mmax (Nm)	Max speed Nmax (rpm)	Inertia (kgm ²)	Nominal current In (Arms)	Low speed Torque (Nm)	Current at low speed (Arms)
TMA204LX	445	105	4,89	1810	105	0,75	9,86	468	10,3
TMA204LV	437	130	5,95	1810	130	0,75	11,4	468	12,1
TMA204LU	432	145	6,56	1810	145	0,75	12,1	468	13
TMA204LR	413	195	8,44	1810	195	0,75	15,6	468	17,6
TMA204LP	365	300	11,5	1810	300	0,75	20,6	468	26
TMA204LM	319	380	12,7	1810	380	0,75	22,2	468	32
TMA205LY	544	80	4,56	2320	80	0,78	9,12	569	9,51
TMA205LX	537	100	5,62	2320	100	0,78	10,8	569	11,4
TMA205LT	514	150	8,08	2320	150	0,78	14,8	569	16,3
TMA205LQ	470	230	11,3	2320	230	0,78	20,4	569	24,4
TMA205LP	434	285	12,9	2320	285	0,78	23	569	29,8
TMA205LL	351	390	14,3	2320	390	0,78	25,5	569	40,3
TMA206LY	637	75	5	2850	75	0,81	9,99	664	10,4
TMA206LV	616	115	7,42	2850	115	0,81	14,1	664	15,1
TMA206LR	568	190	11,3	2850	190	0,81	20,5	664	23,8
TMA206LQ	541	225	12,7	2850	225	0,81	22,8	664	27,7
TMA206LM	448	325	15,2	2850	325	0,81	26,9	664	39,1
TMA206LL	399	370	15,4	2850	370	0,81	27,3	664	44,4
TMA207LY	726	70	5,32	3380	70	1	10,8	760	11,3
TMA207LW	711	95	7,07	3380	95	1	14	760	14,9
TMA207LS	667	155	10,8	3380	155	1	19,9	760	22,6
TMA207LR	637	190	12,7	3380	190	1	23,1	760	27,3
TMA207LN	544	280	15,9	3380	280	1	28	760	38,5
TMA207LM	502	315	16,6	3380	315	1	29,4	760	43,6
TMA208LY	804	80	6,74	3910	80	1,03	13,2	850	13,9
TMA208LU	759	135	10,7	3910	135	1,03	19,8	850	22,1
TMA208LT	730	165	12,6	3910	165	1,03	23,1	850	26,7
TMA208LQ	662	225	15,6	3910	225	1,03	28	850	35,6
TMA208LP	617	260	16,8	3910	260	1,03	29,5	850	40
TMA208LL	506	335	17,7	3910	335	1,03	31,3	850	51,2

3.2.2. TMA304...30A (Natural Cooled) data - Mains voltage 400 V

Model	Nominal Torque Mn (Nm)	Nominal Speed Nn (rpm)	Nominal Power Pn (kW)	Peak Torque Mmax (Nm)	Max speed Nmax (rpm)	Inertia (kgm ²)	Nominal current In (Arms)	Low speed Torque (Nm)	Current at low speed (Arms)
TMA304LV	1070	70	7,86	4550	70	3,45	15,9	1150	16,9
TMA304LR	979	120	12,3	4550	120	3,45	23	1150	26,5
TMA304LQ	921	145	14	4550	145	3,45	25,4	1150	31
TMA304LM	731	210	16,1	4550	210	3,45	29	1150	43,7
TMA305LU	1230	90	11,6	5880	90	4,4	21,6	1390	24
TMA305LT	1160	115	14	5880	115	4,4	25,6	1390	30
TMA305LP	991	165	17,1	5880	165	4,4	31,1	1390	42,3
TMA305LN	888	190	17,7	5880	190	4,4	31,9	1390	48
TMA306LX	1470	70	10,8	7200	70	4,55	21,5	1620	23,3
TMA306LV	1400	95	13,9	7200	95	4,55	25,5	1620	29,1
TMA306LS	1260	130	17,2	7200	130	4,55	30,9	1620	38,9
TMA306LR	1190	145	18,1	7200	145	4,55	33,1	1620	43,7
TMA306LN	963	190	19,2	7200	190	4,55	34,3	1620	55,2
TMA308LY	1890	60	11,9	9870	60	6,5	22,9	2060	24,8
TMA308LV	1720	95	17,2	9870	95	6,5	31,6	2060	37,2
TMA308LU	1640	110	18,9	9870	110	6,5	34	2060	41,8
TMA308LQ	1450	140	21,2	9870	140	6,5	38,2	2060	52,8
TMA308LN	1220	170	21,6	9870	170	6,5	38,6	2060	62,7
TMA30ALY	2190	70	16	12500	70	6,8	30,3	2480	34
TMA30ALX	2120	80	17,8	12500	80	6,8	33	2480	38
TMA30ALU	1940	105	21,4	12500	105	6,8	38,7	2480	48,4
TMA30ALS	1780	125	23,3	12500	125	6,8	41,9	2480	56,9
TMA30ALQ	1640	140	24	12500	140	6,8	44,1	2480	64,5

3.2.3. TMA406...40C (Natural Cooled) data - Mains voltage 400 V

Model	Nominal Torque Mn (Nm)	Nominal Speed Nn (rpm)	Nominal Power Pn (kW)	Peak Torque Mmax (Nm)	Max speed Nmax (rpm)	Inertia (kgm ²)	Nominal current In (Arms)	Low speed Torque (Nm)	Current at low speed (Arms)
TMA406LY	3290	55	18,9	15300	55	16,2	36,7	3610	40
TMA406LX	3210	65	21,8	15300	65	16,2	42,2	3610	47,1
TMA406LV	3020	85	26,9	15300	85	16,2	50,2	3610	59,3
TMA406LT	2800	105	30,8	15300	105	16,2	54,9	3610	69,6
TMA406LS	2680	115	32,3	15300	115	16,2	57,7	3610	76,2
TMA406LP	2280	145	34,7	15300	145	16,2	61,2	3610	94,2
TMA408LY	4100	55	23,6	21000	55	19,4	45,9	4570	50,8
TMA408LW	3830	75	30,1	21000	75	19,4	53,8	4570	63,6
TMA408LV	3680	85	32,8	21000	85	19,4	59,2	4570	72,6
TMA408LS	3430	100	35,9	21000	100	19,4	64,7	4570	84,7
TMA408LP	3060	120	38,4	21000	120	19,4	68,1	4570	99,5
TMA408LN	2640	140	38,7	21000	140	19,4	68,1	4570	114
TMA40ALW	4660	65	31,7	26800	65	25,1	57,2	5500	66,8
TMA40ALT	4370	80	36,6	26800	80	25,1	65,7	5500	81,7
TMA40ALQ	4030	95	40,1	26800	95	25,1	71,5	5500	95,9
TMA40ALN	3660	110	42,2	26800	110	25,1	75,1	5500	110
TMA40ALM	3260	125	42,6	26800	125	25,1	74,7	5500	123
TMA40CLW	5290	65	36	32500	65	25,9	66,4	6400	79,4
TMA40CLU	5040	75	39,6	32500	75	25,9	71,3	6400	89,3
TMA40CLS	4770	85	42,5	32500	85	25,9	77,4	6400	102
TMA40CLP	4330	100	45,3	32500	100	25,9	82,3	6400	119
TMA40CLK	4010	110	46,2	32500	110	25,9	81	6400	126



3.2.4. TMW204...208 (Water Cooled) data

3.2.4.1. Mains voltage 3 AC 400 V

Model	Nominal Torque Mn (Nm)	Nominal Speed Nn (rpm)	Nominal Power Pn (kW)	Peak Torque Mmax (Nm)	Max Speed Nmax (rpm)	Inertia (kgm²)	Water Flow Rate (l/min)	Nominal current In (Arms)
TMW204LX	1220	85	10,8	1810	95	0,75	8,8	28
TMW204LV	1220	105	13,4	1810	130	0,75	8,8	32,8
TMW204LU	1220	120	15,3	1810	140	0,75	8,8	35,2
TMW204LR	1210	175	22,2	1810	215	0,75	8,9	47,3
TMW204LP	1200	280	35,2	1810	350	0,75	9	69,7
TMW204LM	1200	355	44,5	1810	440	0,75	9,1	85
TMW205LY	1570	50	8,22	2320	50	0,78	11	27,2
TMW205LX	1570	75	12,3	2320	85	0,78	11	32,7
TMW205LW	1570	80	13,2	2320	95	0,78	11	35
TMW205LT	1570	125	20,6	2320	155	0,78	11	46,6
TMW205LQ	1560	205	33,5	2320	255	0,78	11	69,6
TMW205LP	1550	260	42,2	2320	325	0,78	11	84,5
TMW205LL	1540	370	59,7	2320	460	0,78	11	113
TMW205LK	1530	400	64,3	2320	500	0,78	11	128
TMW206LY	1930	45	9,09	2850	45	0,81	13	31,4
TMW206LX	1930	60	12,1	2850	65	0,81	13	35,8
TMW206LV	1920	90	18,1	2850	110	0,81	13	45,5
TMW206LR	1920	165	33,2	2850	205	0,81	13	71,3
TMW206LQ	1910	200	40	2850	250	0,81	13	83
TMW206LM	1900	300	59,7	2850	375	0,81	14	116
TMW206LL	1890	350	69,3	2850	435	0,81	14	131
TMW206LJ	1880	400	78,7	2850	500	0,81	14	151
TMW207LY	2290	40	9,58	3380	40	1	15	35,2
TMW207LW	2280	70	16,7	3380	85	1	15	46,3
TMW207LS	2280	130	31	3380	160	1	15	70,1
TMW207LR	2270	165	39,2	3380	205	1	16	84,6
TMW207LN	2260	250	59,2	3380	310	1	16	119
TMW207LM	2250	290	68,3	3380	360	1	16	134
TMW207LJ	2240	375	87,7	3380	465	1	16	167
TMW207LI	2230	400	93,4	3380	500	1	16	181
TMW208LY	2640	50	13,8	3910	50	1,03	18	44,9
TMW208LU	2640	110	30,4	3910	125	1,03	18	71
TMW208LT	2630	140	38,6	3910	175	1,03	18	85,7
TMW208LQ	2620	200	54,9	3910	250	1,03	18	114
TMW208LP	2620	230	63,1	3910	280	1,03	18	128
TMW208LL	2600	310	84,4	3910	385	1,03	18	163
TMW208LJ	2580	375	102	3910	465	1,03	18	193
TMW208LH	2580	400	108	3910	500	1,03	18	213

3.2.4.2. Mains voltage 3 AC 480 V

Model	Nominal Torque Mn (Nm)	Nominal Speed Nn (rpm)	Nominal Power Pn (kW)	Peak Torque Mmax (Nm)	Max Speed Nmax (rpm)	Inertia (kgm ²)	Water Flow Rate (l/min)	Nominal current In (Arms)
TMW204LX	1220	110	14	1810	120	0,75	8,8	27,9
TMW204LV	1210	135	17,2	1810	165	0,75	8,8	32,7
TMW204LU	1210	150	19,1	1810	170	0,75	8,8	35,1
TMW204LR	1210	215	27,2	1810	260	0,75	8,9	47,2
TMW204LP	1200	345	43,2	1810	430	0,75	9	69,3
TMW204LM	1190	435	54	1810	535	0,75	9,1	84,5
TMW205LY	1570	70	11,5	2320	70	0,78	11	27,2
TMW205LX	1570	95	15,6	2320	105	0,78	11	32,7
TMW205LW	1570	100	16,4	2320	120	0,78	11	35
TMW205LT	1560	155	25,4	2320	190	0,78	11	46,5
TMW205LQ	1550	255	41,5	2320	315	0,78	11	69,4
TMW205LP	1550	320	51,8	2320	400	0,78	11	84,1
TMW205LL	1530	450	72	2320	555	0,78	11	113
TMW205LK	1520	511	81,2	2320	630	0,78	11	127
TMW206LY	1930	60	12,1	2850	60	0,81	13	31,4
TMW206LX	1920	85	17,1	2850	90	0,81	13	35,8
TMW206LV	1920	115	23,1	2850	140	0,81	13	45,5
TMW206LR	1910	205	41	2850	250	0,81	13	71,1
TMW206LQ	1900	250	49,9	2850	310	0,81	13	82,8
TMW206LM	1890	365	72,1	2850	455	0,81	14	116
TMW206LL	1880	420	82,6	2850	520	0,81	14	131
TMW206LJ	1860	495	96,6	2850	615	0,81	14	150
TMW207LY	2290	55	13,2	3380	55	1	15	35,2
TMW207LW	2280	95	22,7	3380	115	1	15	46,3
TMW207LS	2270	160	38,1	3380	195	1	15	70
TMW207LR	2270	205	48,6	3380	250	1	16	84,4
TMW207LN	2250	310	73	3380	380	1	16	118
TMW207LM	2240	355	83,2	3380	440	1	16	134
TMW207LJ	2220	455	106	3380	560	1	16	166
TMW207LI	2210	500	116	3380	625	1	16	180
TMW208LY	2640	70	19,4	3910	70	1,03	18	44,9
TMW208LU	2630	135	37,2	3910	150	1,03	18	70,9
TMW208LT	2630	175	48,1	3910	215	1,03	18	85,5
TMW208LQ	2610	250	68,4	3910	310	1,03	18	114
TMW208LP	2600	285	77,7	3910	345	1,03	18	127
TMW208LL	2590	375	102	3910	465	1,03	18	162
TMW208LJ	2570	455	122	3910	560	1,03	18	192
TMW208LH	2550	510	136	3910	635	1,03	18	211



3.2.5. TMW304...30A (Water Cooled) data

3.2.5.1. Mains voltage 3 AC 400 V

Model	Nominal Torque Mn (Nm)	Nominal Speed Nn (rpm)	Nominal Power Pn (kW)	Peak Torque Mmax (Nm)	Max Speed Nmax (rpm)	Inertia (kgm²)	Water Flow Rate (l/min)	Nominal current In (Arms)
TMW304LV	3060	55	17,6	4550	55	3,45	14	44,6
TMW304LR	3040	100	32	4550	115	3,45	14	69,8
TMW304LQ	3030	125	39,7	4550	150	3,45	14	81,2
TMW304LM	3000	185	58,1	4550	230	3,45	14	114
TMW304LL	2980	215	67,1	4550	265	3,45	14	128
TMW304LH	2920	295	90,2	4550	350	3,45	15	167
TMW304LE	2860	365	109	4550	425	3,45	15	199
TMW304LC	2830	400	119	4550	475	3,45	15	220
TMW305LU	3940	70	28,9	5880	80	4,4	17	67,5
TMW305LT	3930	95	39,1	5880	115	4,4	17	84,1
TMW305LP	3900	145	59,2	5880	180	4,4	17	118
TMW305LN	3880	165	67	5880	205	4,4	17	133
TMW305LK	3840	215	86,5	5880	265	4,4	18	165
TMW305LH	3800	265	105	5880	325	4,4	18	196
TMW305LF	3770	295	116	5880	365	4,4	18	217
TMW305LC	3660	390	149	5880	450	4,4	19	271
TMW306LX	4840	55	27,9	7200	55	4,55	20	69,1
TMW306LV	4830	75	37,9	7200	85	4,55	20	86,2
TMW306LS	4810	105	52,9	7200	130	4,55	21	115
TMW306LR	4800	125	62,8	7200	155	4,55	21	129
TMW306LN	4760	165	82,2	7200	205	4,55	21	161
TMW306LL	4730	200	99,1	7200	240	4,55	21	191
TMW306LI	4690	240	118	7200	300	4,55	21	224
TMW306LG	4610	305	147	7200	370	4,55	22	271
TMW306LF	4590	320	154	7200	385	4,55	22	283
TMW308LY	6660	40	27,9	9870	40	6,5	27	79,1
TMW308LV	6630	75	52,1	9870	85	6,5	27	118
TMW308LU	6620	85	58,9	9870	105	6,5	27	133
TMW308LQ	6590	115	79,4	9870	140	6,5	28	167
TMW308LN	6560	145	99,6	9870	180	6,5	28	198
TMW308LM	6530	170	116	9870	210	6,5	28	225
TMW308LK	6490	200	136	9870	250	6,5	28	261
TMW308LH	6420	245	165	9870	305	6,5	29	311
TMW308LG	6370	275	183	9870	340	6,5	29	343
TMW30ALY	8460	50	44,3	12500	50	6,8	34	114
TMW30ALX	8450	60	53,1	12500	70	6,8	34	128
TMW30ALU	8430	80	70,6	12500	95	6,8	34	163
TMW30ALS	8410	100	88,1	12500	125	6,8	34	191
TMW30ALQ	8380	120	105	12500	150	6,8	34	216
TMW30ALN	8330	155	135	12500	190	6,8	35	268
TMW30ALL	8290	180	156	12500	225	6,8	35	305
TMW30ALJ	8230	215	185	12500	265	6,8	35	354
TMW30ALH	8170	245	210	12500	305	6,8	36	396



3.2.5.2. Mains voltage 3 AC 480 V

Model	Nominal Torque Mn (Nm)	Nominal Speed Nn (rpm)	Nominal Power Pn (kW)	Peak Torque Mmax (Nm)	Max Speed Nmax (rpm)	Inertia (kgm ²)	Water Flow Rate (l/min)	Nominal current In (Arms)
TMW304LV	3060	70	22,4	4550	70	3,45	14	44,6
TMW304LR	3030	125	39,7	4550	140	3,45	14	69,6
TMW304LQ	3020	150	47,4	4550	180	3,45	14	81
TMW304LM	2970	225	70,1	4550	275	3,45	14	113
TMW304LL	2950	260	80,3	4550	320	3,45	14	127
TMW304LH	2870	355	107	4550	420	3,45	15	164
TMW304LE	2790	440	129	4550	510	3,45	15	194
TMW304LC	2720	500	143	4550	590	3,45	15	213
TMW305LU	3930	85	35	5880	95	4,4	17	67,4
TMW305LT	3920	115	47,2	5880	135	4,4	17	83,9
TMW305LP	3880	175	71	5880	215	4,4	17	117
TMW305LN	3850	205	82,7	5880	250	4,4	17	132
TMW305LK	3800	260	104	5880	320	4,4	18	164
TMW305LH	3740	320	125	5880	390	4,4	18	194
TMW305LF	3700	360	139	5880	445	4,4	18	213
TMW305LC	3550	470	175	5880	540	4,4	19	264
TMW306LX	4840	65	32,9	7200	65	4,55	20	69
TMW306LV	4820	90	45,4	7200	100	4,55	20	86
TMW306LS	4790	135	67,7	7200	165	4,55	21	114
TMW306LR	4770	155	77,4	7200	190	4,55	21	128
TMW306LN	4730	200	99	7200	245	4,55	21	160
TMW306LL	4680	245	120	7200	290	4,55	21	189
TMW306LI	4620	295	143	7200	365	4,55	21	221
TMW306LG	4520	370	175	7200	445	4,55	22	266
TMW306LF	4500	385	181	7200	460	4,55	22	278
TMW308LY	6650	50	34,8	9870	50	6,5	27	79,1
TMW308LV	6610	95	65,8	9870	105	6,5	27	118
TMW308LU	6600	110	76	9870	135	6,5	27	133
TMW308LQ	6560	145	99,6	9870	175	6,5	28	167
TMW308LN	6520	175	120	9870	215	6,5	28	197
TMW308LM	6480	205	139	9870	250	6,5	28	224
TMW308LK	6430	240	162	9870	300	6,5	28	259
TMW308LH	6330	300	199	9870	370	6,5	29	307
TMW308LG	6270	335	220	9870	410	6,5	29	338
TMW30ALY	8450	65	57,5	12500	65	6,8	34	114
TMW30ALX	8440	75	66,3	12500	85	6,8	34	128
TMW30ALU	8410	100	88,1	12500	120	6,8	34	162
TMW30ALS	8370	125	110	12500	155	6,8	34	190
TMW30ALQ	8350	145	127	12500	180	6,8	34	215
TMW30ALN	8270	190	165	12500	230	6,8	35	267
TMW30ALL	8220	220	189	12500	275	6,8	35	303
TMW30ALJ	8140	260	222	12500	320	6,8	35	351
TMW30ALH	8060	300	253	12500	370	6,8	36	391



3.2.6. TMW406...40C (Water Cooled) data

3.2.6.1. Mains voltage 3 AC 400 V

Model	Nominal Torque Mn (Nm)	Nominal Speed Nn (rpm)	Nominal Power Pn (kW)	Peak Torque Mmax (Nm)	Max Speed Nmax (rpm)	Inertia (kgm²)	Water Flow Rate (l/min)	Nominal current In (Arms)
TMW406LY	10400	45	49	15300	50	16,2	28	115
TMW406LX	10400	55	59,7	15300	65	16,2	28	135
TMW406LV	10300	75	81,1	15300	90	16,2	28	169
TMW406LT	10300	90	97,1	15300	110	16,2	28	198
TMW406LS	10300	100	108	15300	125	16,2	28	216
TMW406LP	10200	125	134	15300	155	16,2	29	266
TMW406LJ	10200	150	160	15300	180	16,2	29	306
TMW406LI	10100	175	185	15300	215	16,2	29	353
TMW406LH	10000	200	209	15300	250	16,2	29	391
TMW406LG	9930	230	239	15300	285	16,2	30	440
TMW408LY	14300	45	67,2	21000	50	19,4	37	158
TMW408LW	14200	60	89,5	21000	75	19,4	37	197
TMW408LV	14200	70	104	21000	85	19,4	38	224
TMW408LS	14200	85	126	21000	105	19,4	38	261
TMW408LP	14100	100	148	21000	120	19,4	38	306
TMW408LN	14100	120	177	21000	150	19,4	38	350
TMW408LL	14000	135	198	21000	165	19,4	38	388
TMW408LJ	13900	155	226	21000	190	19,4	38	434
TMW408LF	13800	200	289	21000	250	19,4	39	538
TMW40ALW	18200	50	95,1	26800	60	25,1	47	219
TMW40ALT	18100	65	123	26800	80	25,1	47	267
TMW40ALQ	18100	80	151	26800	100	25,1	47	313
TMW40ALN	18000	90	170	26800	110	25,1	47	359
TMW40ALM	18000	105	198	26800	130	25,1	47	398
TMW40ALL	18000	110	207	26800	135	25,1	47	421
TMW40ALK	17900	120	225	26800	150	25,1	48	446
TMW40ALH	17800	145	270	26800	180	25,1	48	526
TMW40ALE	17700	175	324	26800	205	25,1	48	626
TMW40CLW	22100	50	116	32500	60	25,9	56	271
TMW40CLU	22100	60	139	32500	75	25,9	56	305
TMW40CLS	22000	70	161	32500	85	25,9	56	348
TMW40CLP	22000	85	195	32500	105	25,9	57	405
TMW40CLK	21900	90	207	32500	110	25,9	57	428
TMW40CLI	21800	120	274	32500	150	25,9	57	536
TMW40CLG	21700	140	318	32500	175	25,9	57	626

3.2.6.2. Mains voltage 3 AC 480 V

Model	Nominal Torque Mn (Nm)	Nominal Speed Nn (rpm)	Nominal Power Pn (kW)	Peak Torque Mmax (Nm)	Max Speed Nmax (rpm)	Inertia (kgm ²)	Water Flow Rate (l/min)	Nominal current In (Arms)
TMW406LY	10400	55	59,7	15300	60	16,2	28	114
TMW406LX	10400	65	70,5	15300	75	16,2	28	134
TMW406LV	10300	90	97,1	15300	105	16,2	28	169
TMW406LT	10300	110	118	15300	130	16,2	28	197
TMW406LS	10200	120	129	15300	145	16,2	28	215
TMW406LP	10100	155	165	15300	190	16,2	29	264
TMW406LJ	10100	180	190	15300	215	16,2	29	304
TMW406LI	9970	215	225	15300	260	16,2	29	349
TMW406LH	9890	240	249	15300	300	16,2	29	387
TMW406LG	9770	275	281	15300	340	16,2	30	433
TMW408LY	14300	55	82,1	21000	60	19,4	37	157
TMW408LW	14200	75	112	21000	90	19,4	37	196
TMW408LV	14200	85	126	21000	100	19,4	38	224
TMW408LS	14100	105	155	21000	125	19,4	38	260
TMW408LP	14100	125	184	21000	145	19,4	38	304
TMW408LN	14000	145	212	21000	180	19,4	38	348
TMW408LL	13900	165	240	21000	200	19,4	38	385
TMW408LJ	13800	185	268	21000	225	19,4	38	431
TMW408LF	13600	240	342	21000	295	19,4	39	532
TMW40ALW	18100	60	114	26800	70	25,1	47	219
TMW40ALT	18100	80	151	26800	95	25,1	47	267
TMW40ALQ	18000	95	179	26800	115	25,1	47	312
TMW40ALN	17900	115	216	26800	140	25,1	47	357
TMW40ALM	17900	130	243	26800	160	25,1	47	396
TMW40ALL	17900	135	252	26800	165	25,1	47	419
TMW40ALK	17800	145	271	26800	180	25,1	48	444
TMW40ALH	17700	175	324	26800	215	25,1	48	522
TMW40ALE	17500	215	393	26800	250	25,1	48	619
TMW40CLW	22000	65	150	32500	75	25,9	56	271
TMW40CLU	22000	75	173	32500	90	25,9	56	304
TMW40CLS	22000	85	195	32500	100	25,9	56	347
TMW40CLP	21900	105	240	32500	125	25,9	57	403
TMW40CLK	21800	110	252	32500	130	25,9	57	426
TMW40CLI	21700	145	329	32500	180	25,9	57	533
TMW40CLG	21500	175	394	32500	215	25,9	57	621

3.2.7. Efficiency curves



Caution: The efficiency curves are typical values. They may vary from one motor to an other



Caution: The efficiency curves are given for an optimal motor control (no voltage saturation and optimal phase between current and EMF)

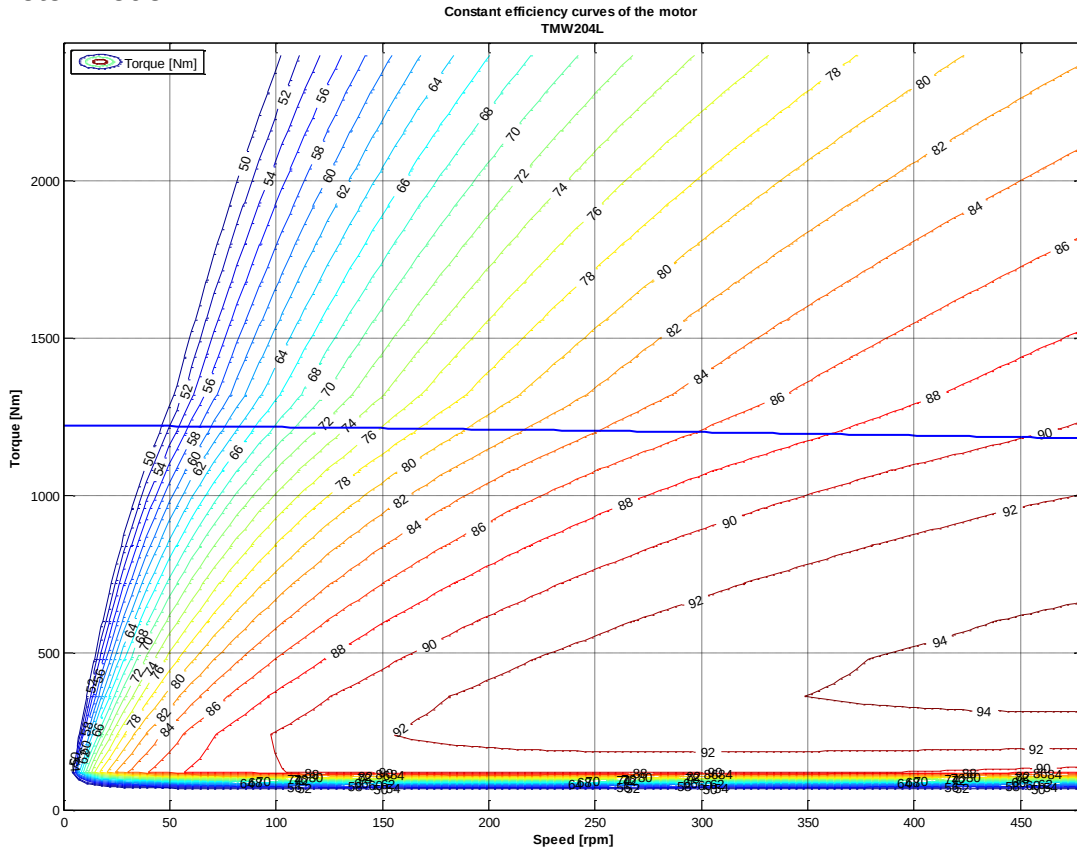


Caution: The efficiency curves do not include the losses due to the switching frequency.

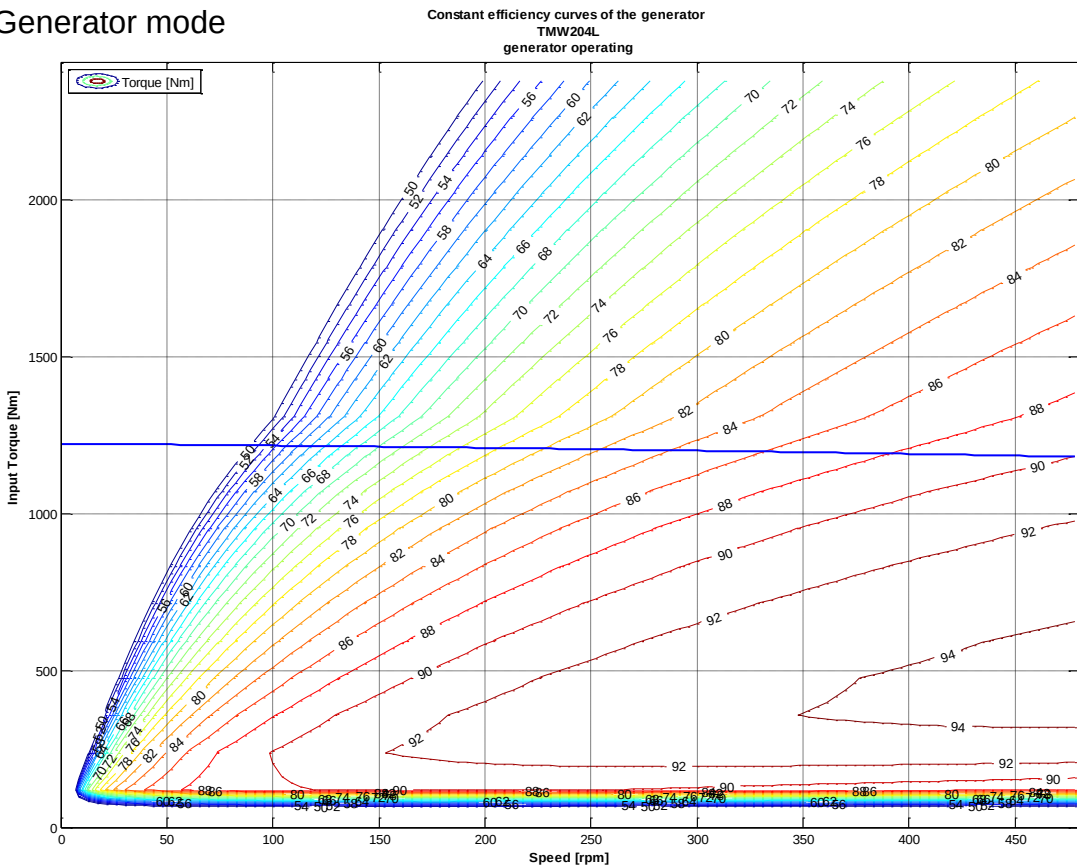


3.2.7.1. Series TMW204L

Motor mode



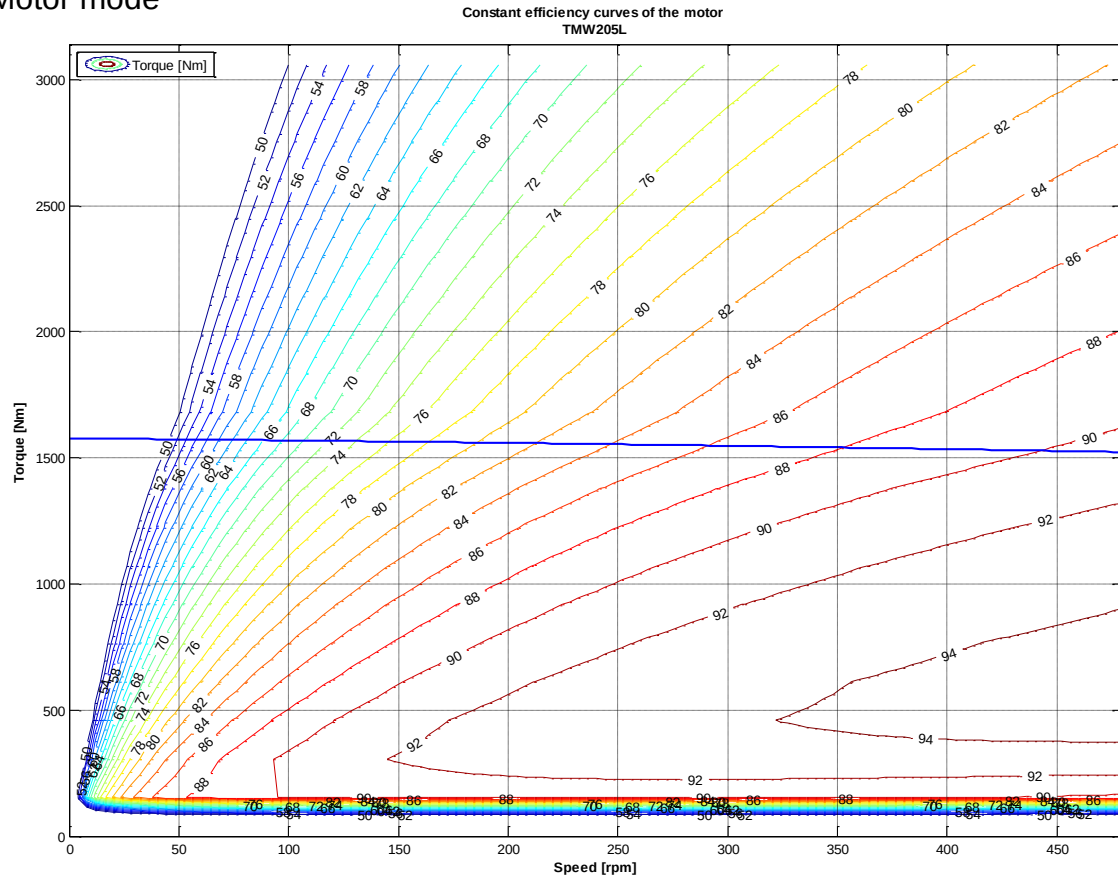
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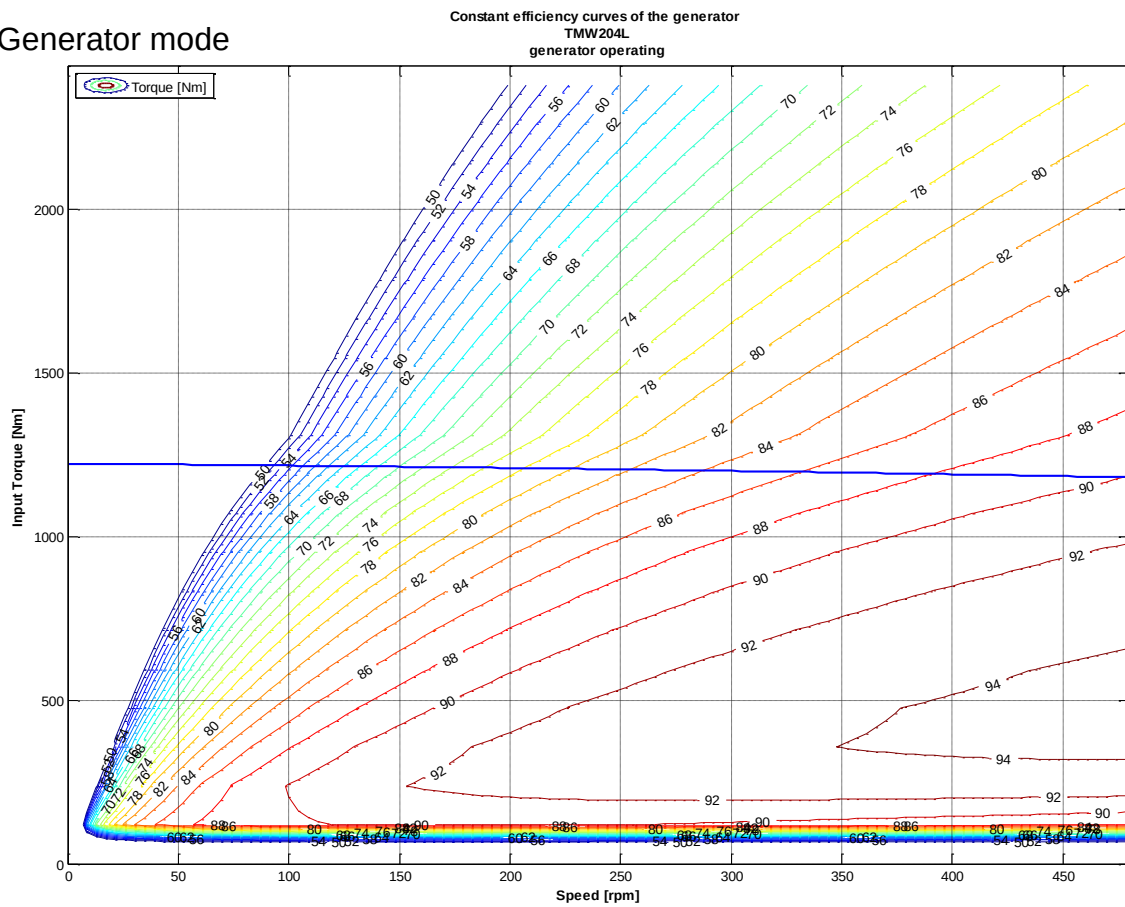


3.2.7.2. Series TMW205L

Motor mode



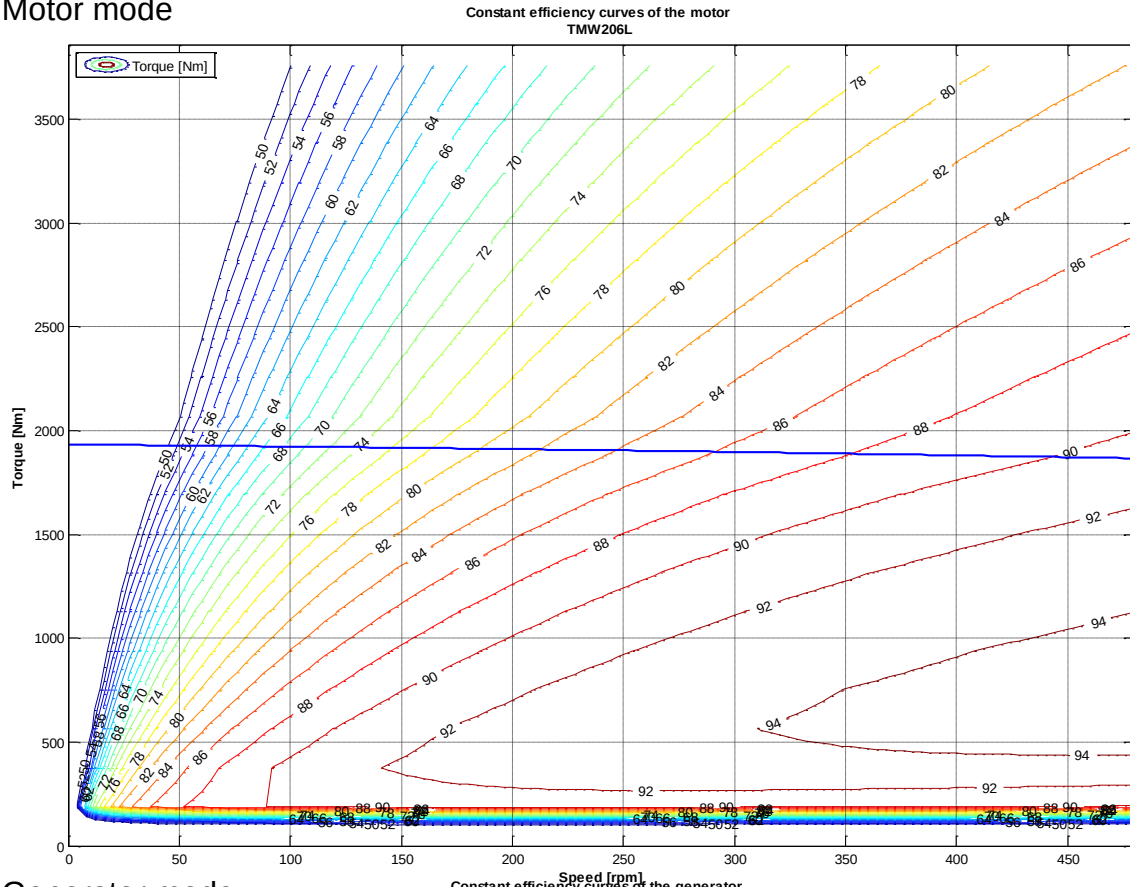
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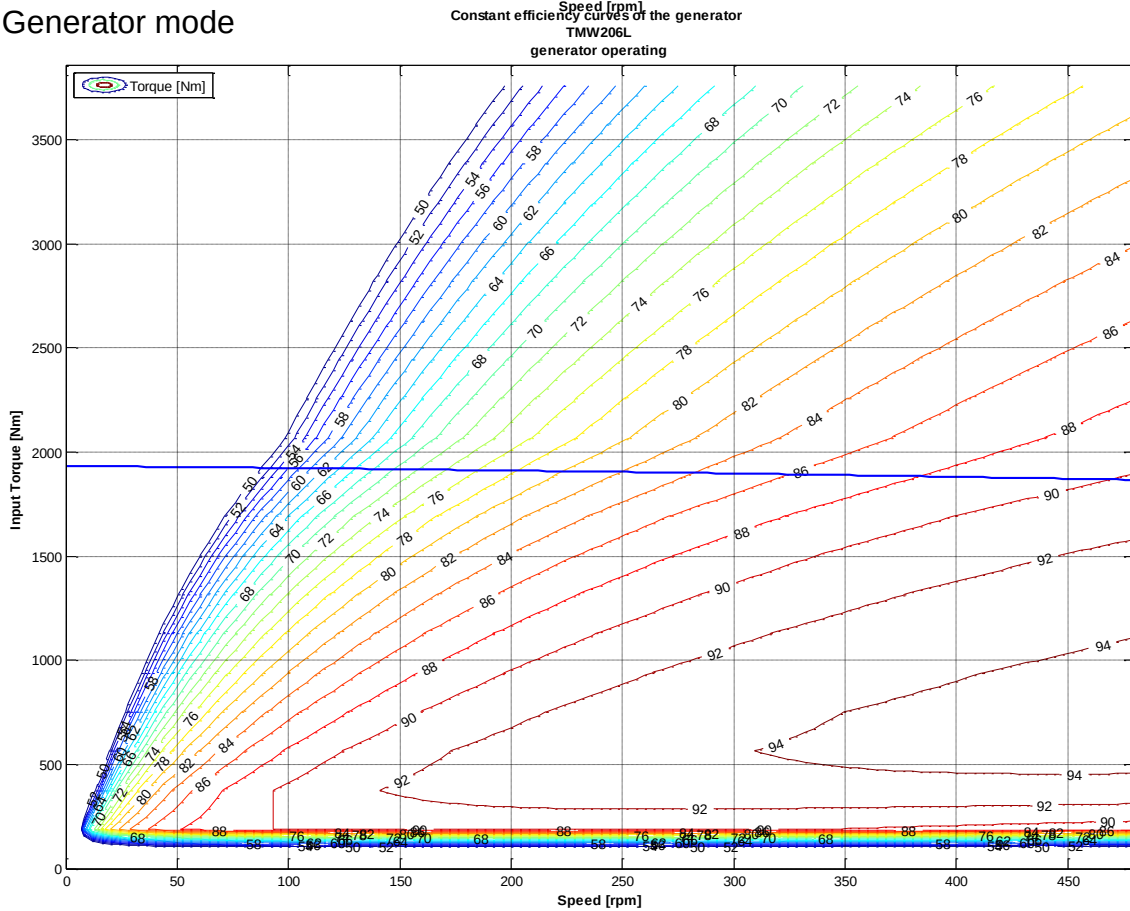


3.2.7.3. Series TMW206L

Motor mode



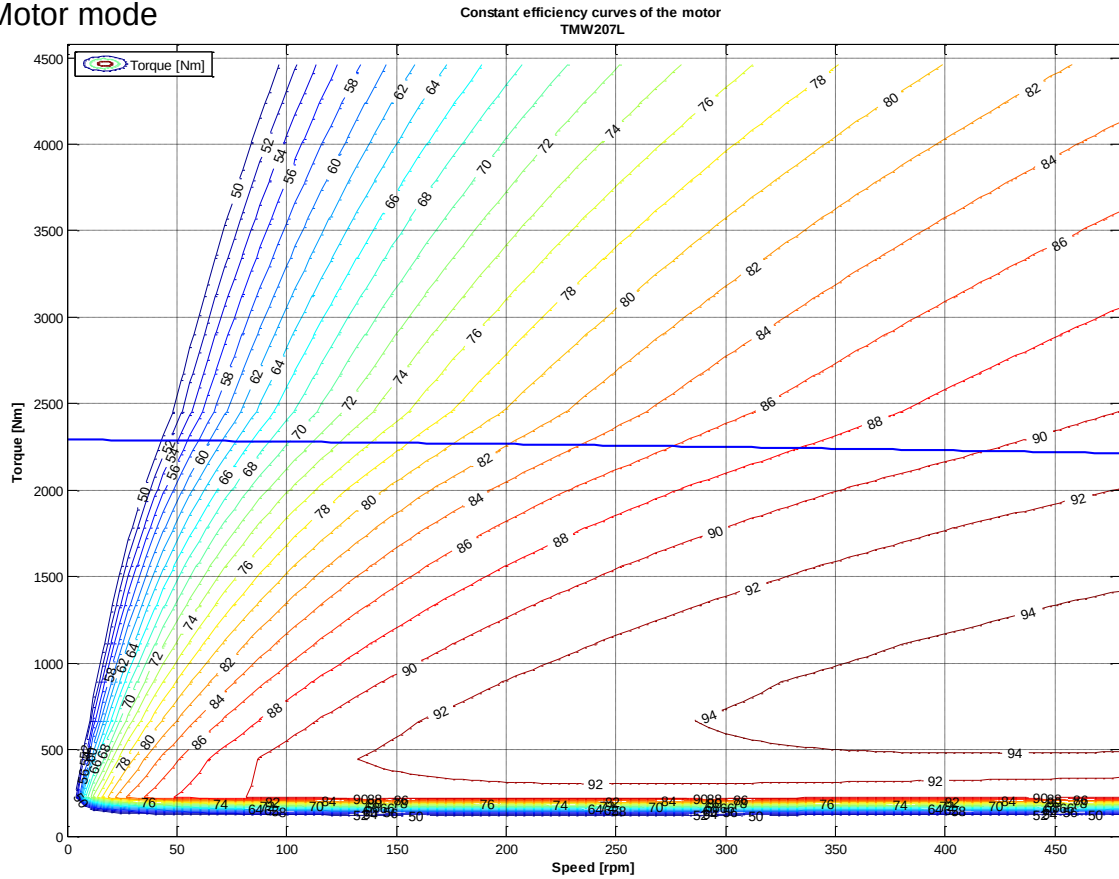
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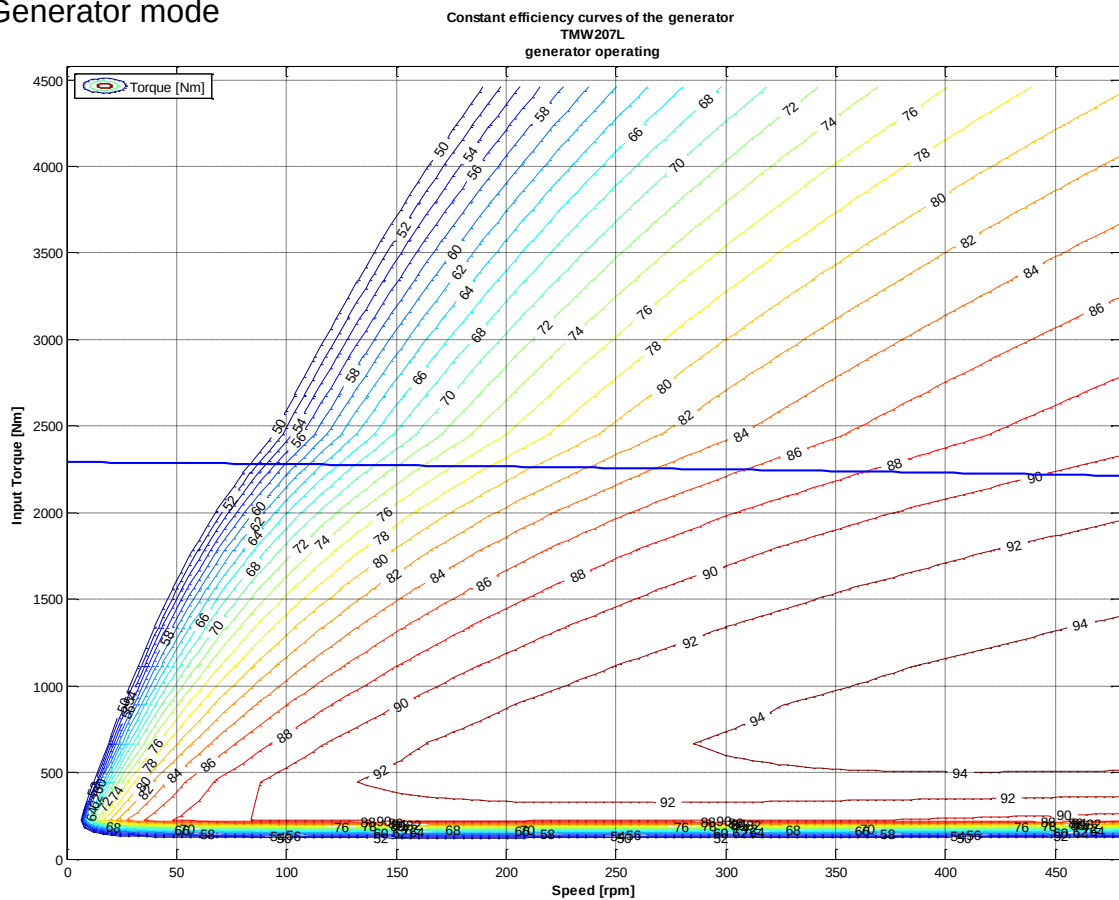


3.2.7.4. Series TMW207L

Motor mode



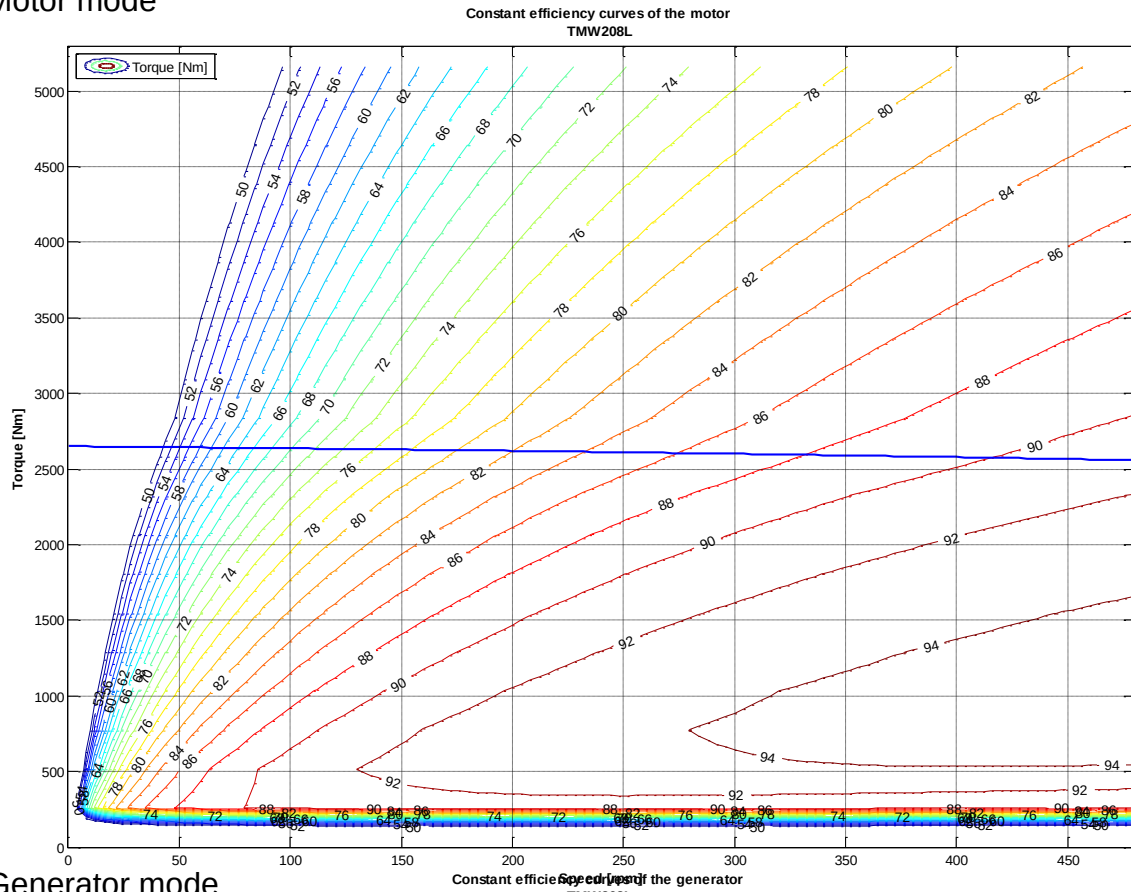
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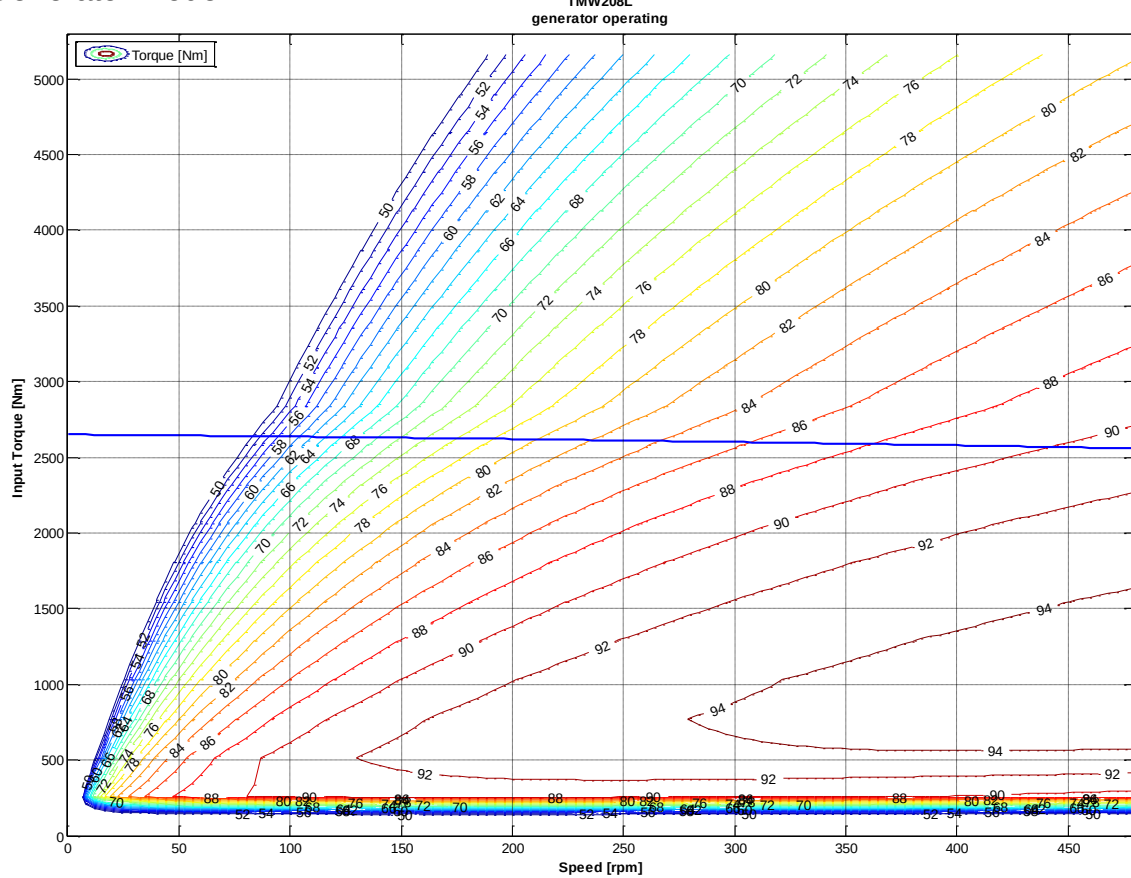


3.2.7.5. Series TMW208L

Motor mode



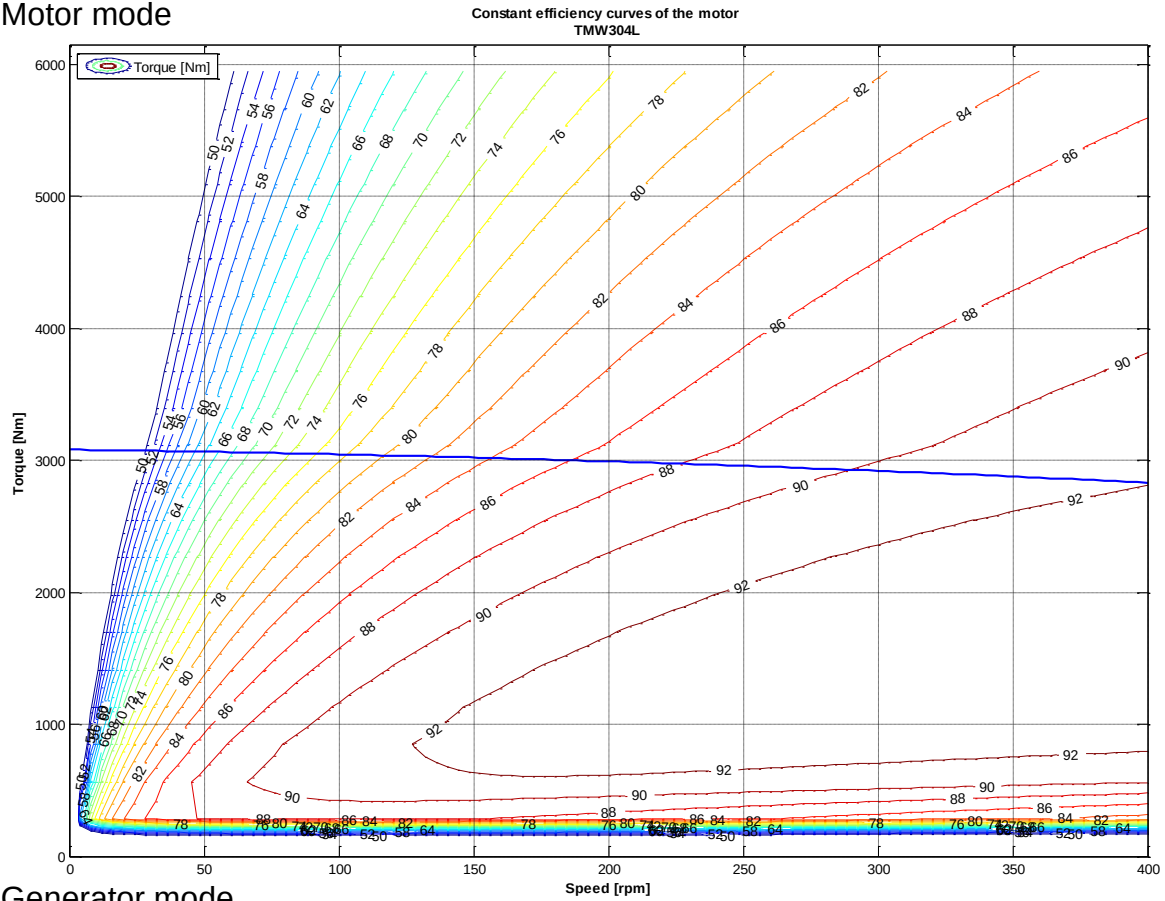
Generator mode



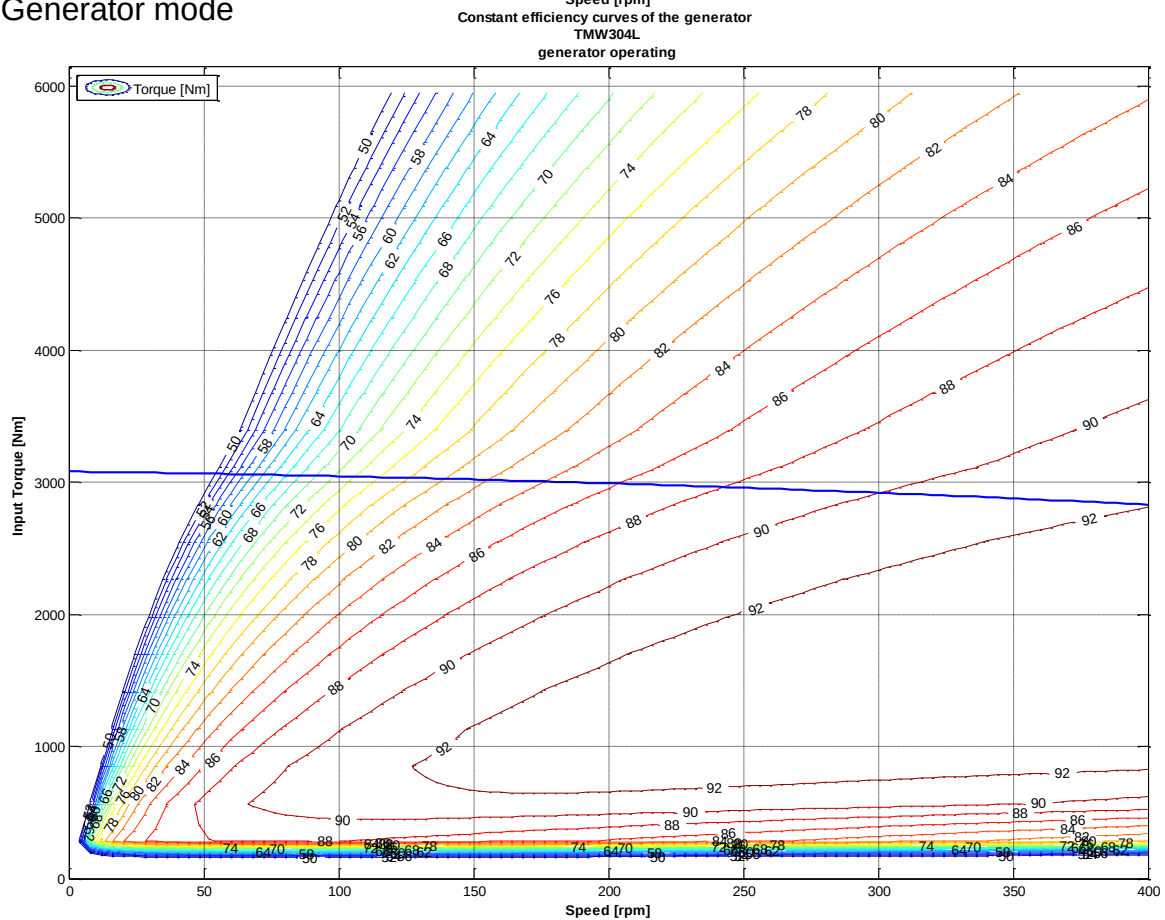


3.2.7.6. Series TMW304L

Motor mode



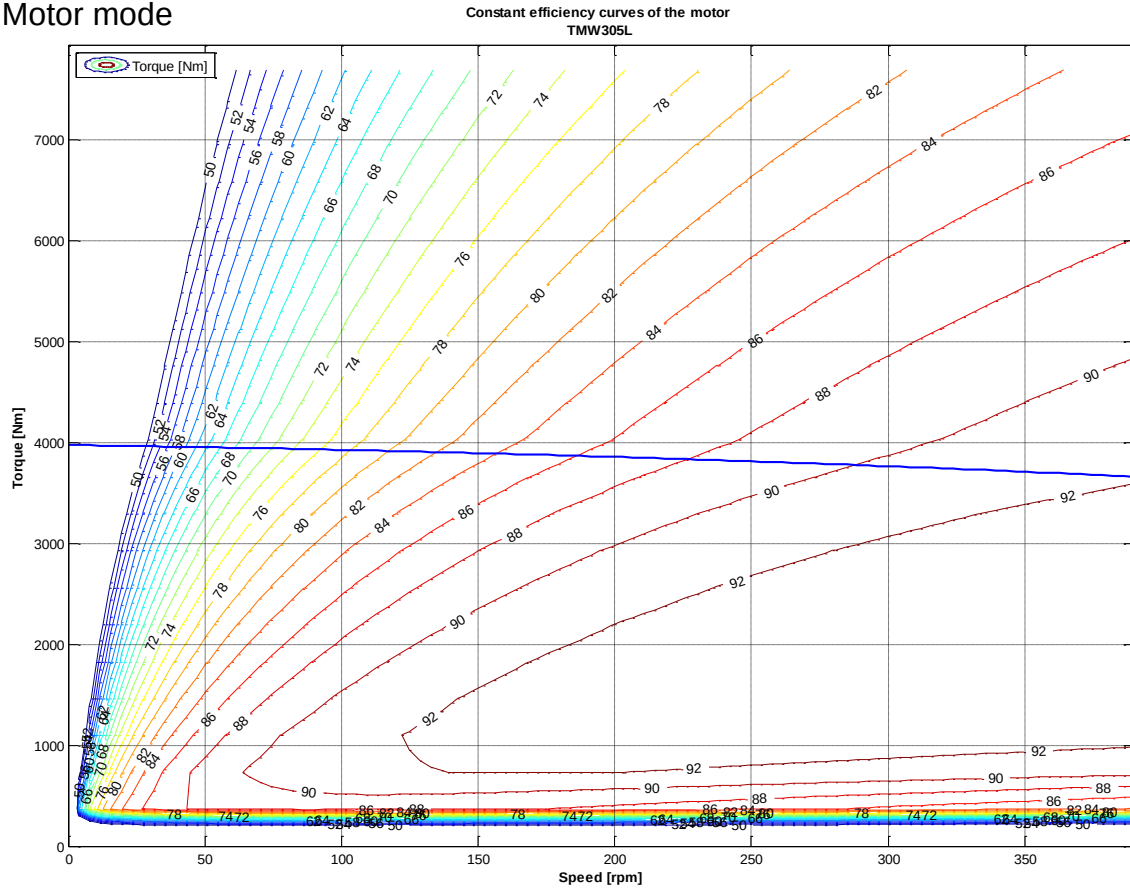
Generator mode



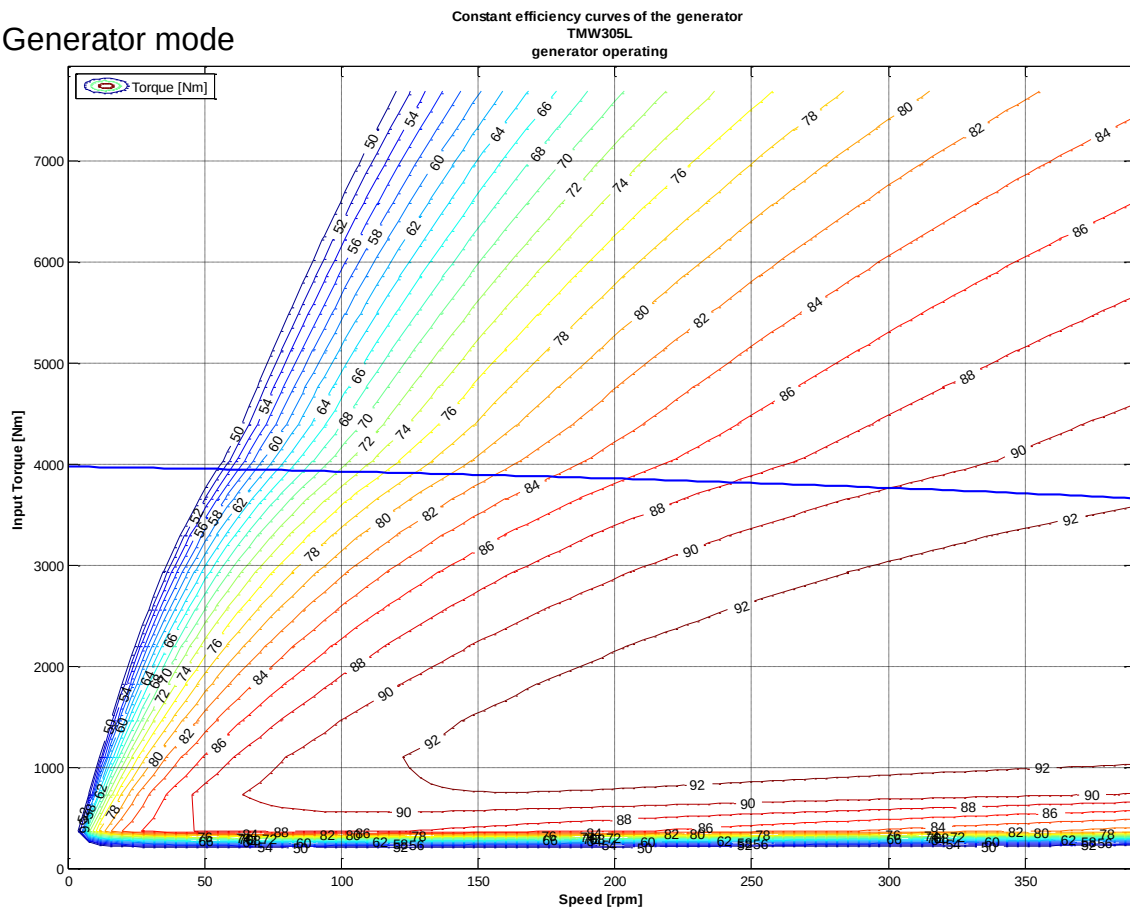


3.2.7.7. Series TMW305L

Motor mode



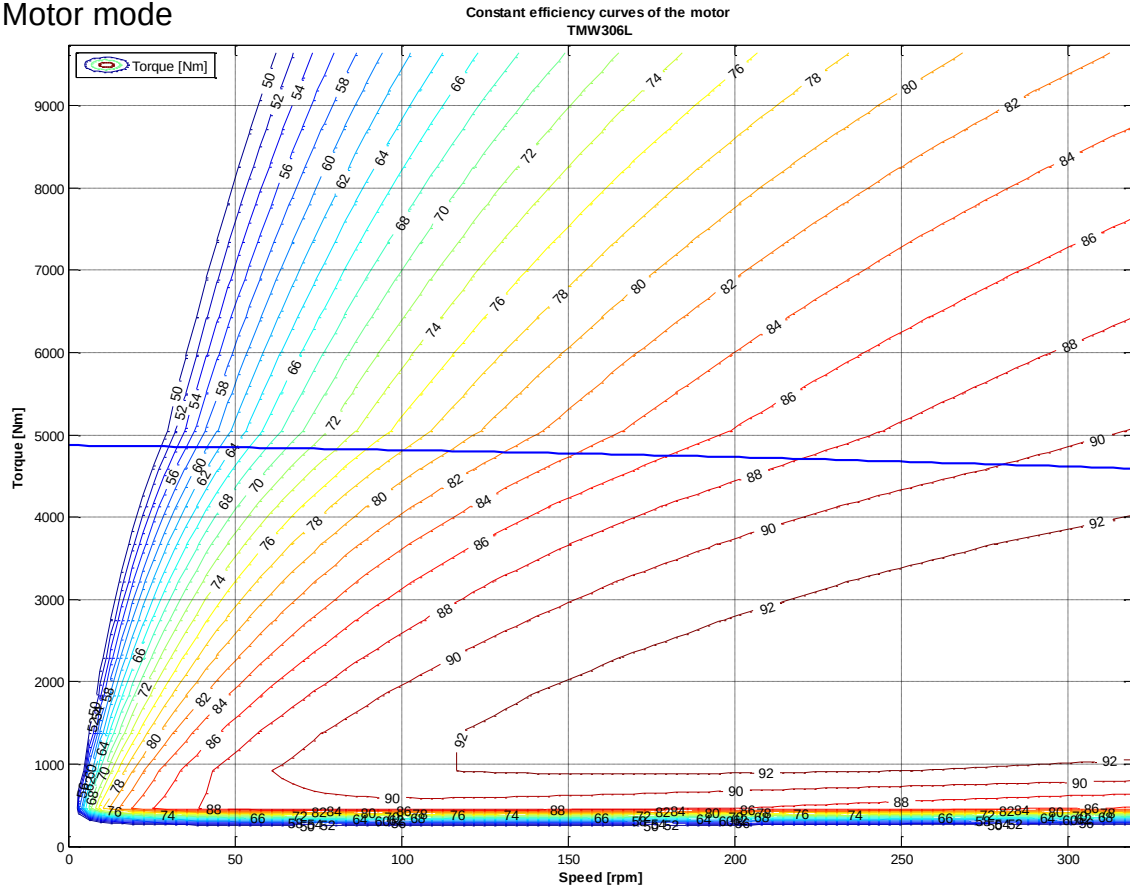
Generator mode



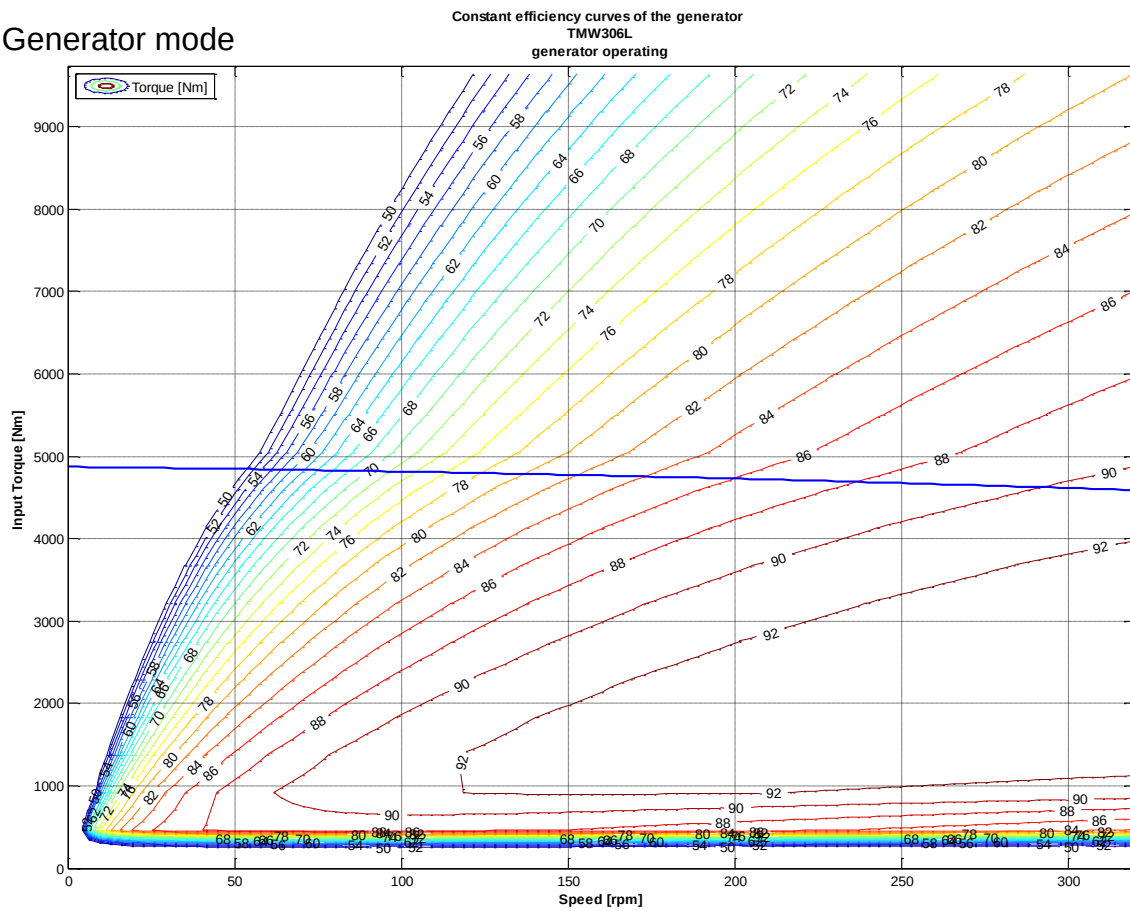


3.2.7.8. Series TMW306L

Motor mode



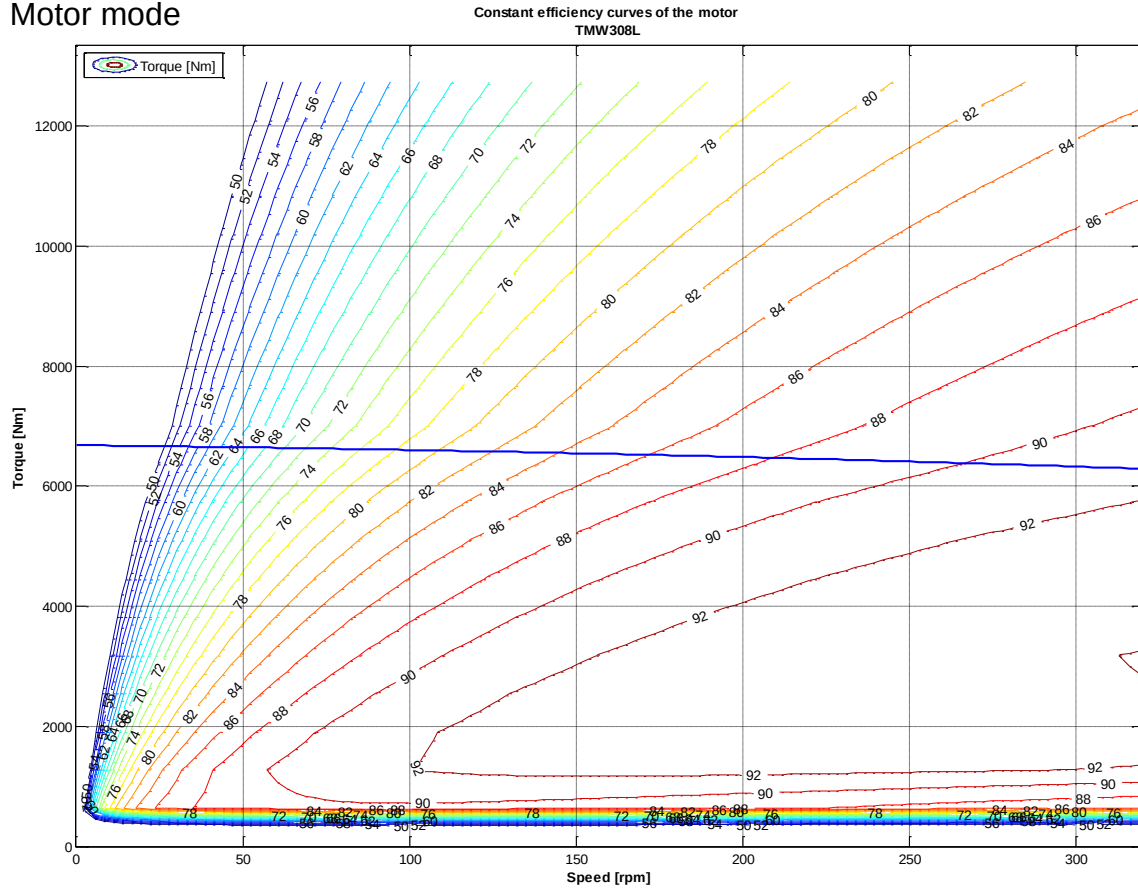
Generator mode



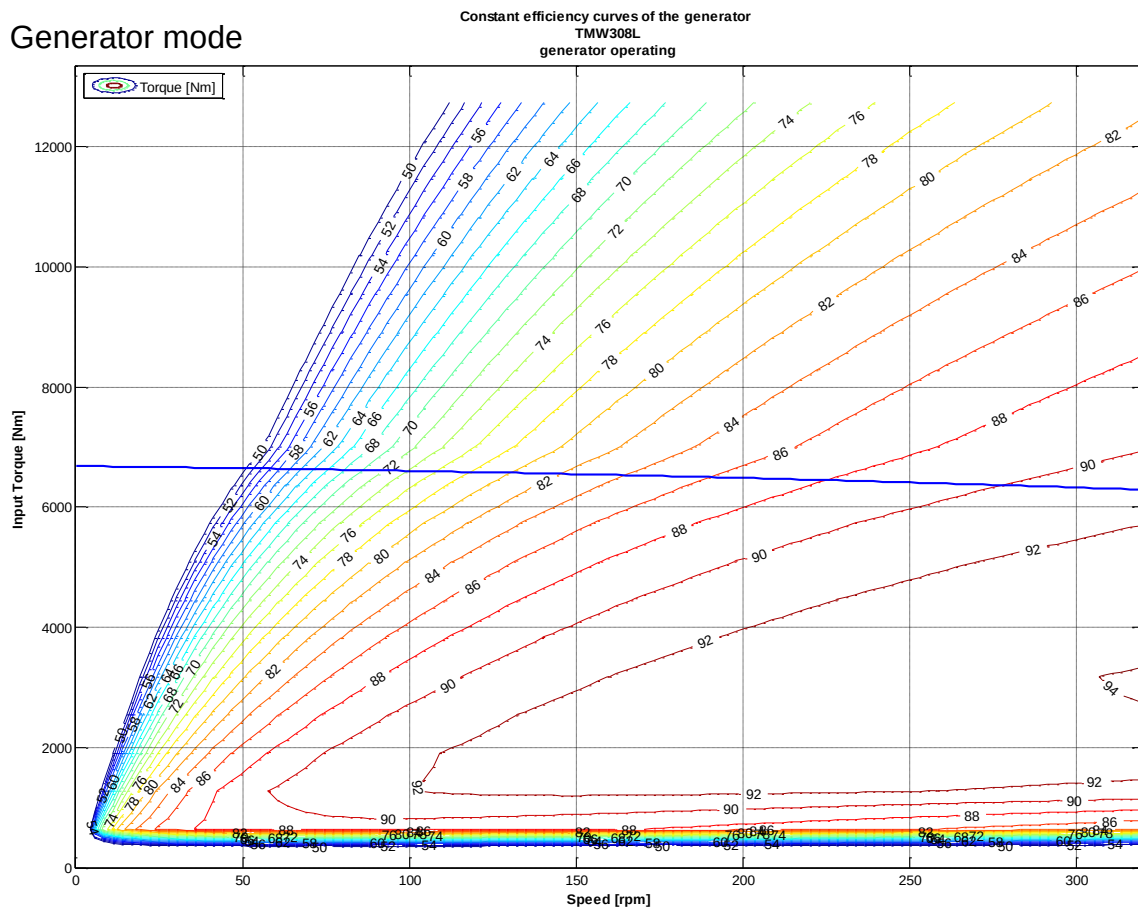


3.2.7.9. Series TMW308L

Motor mode



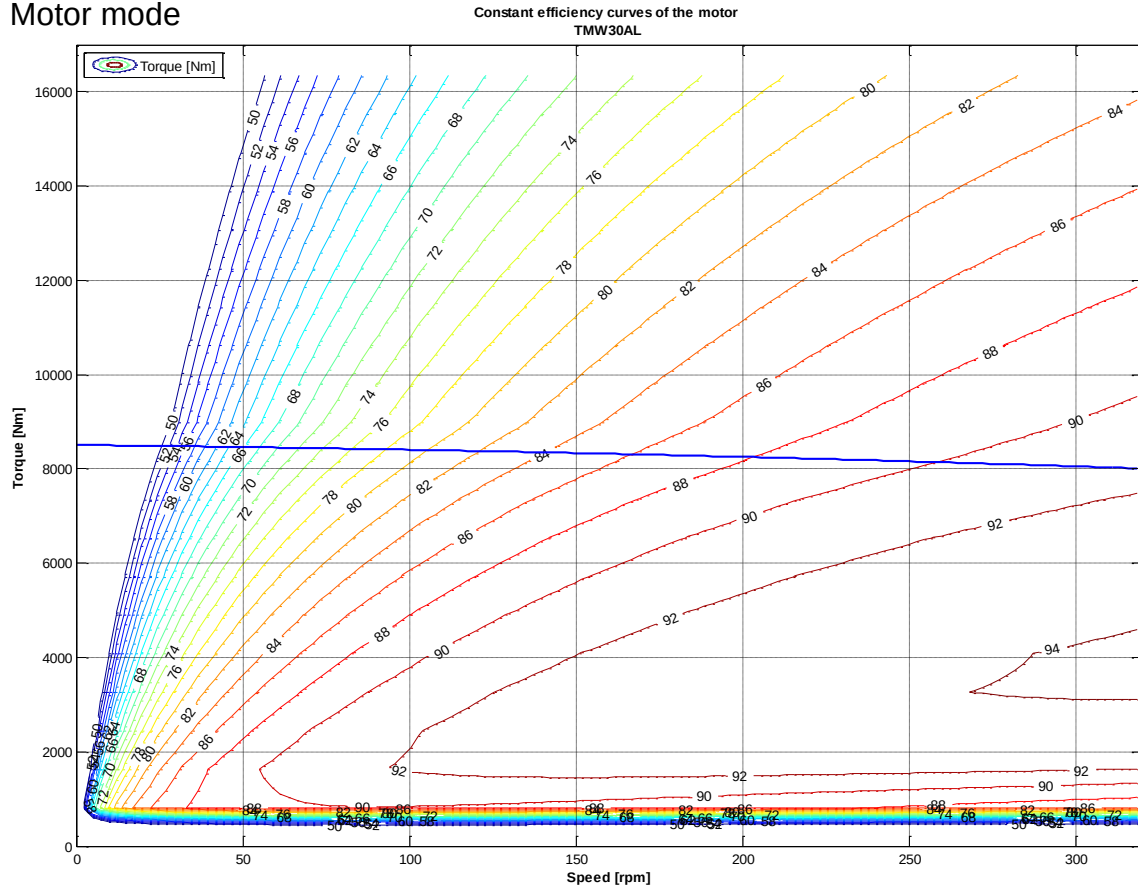
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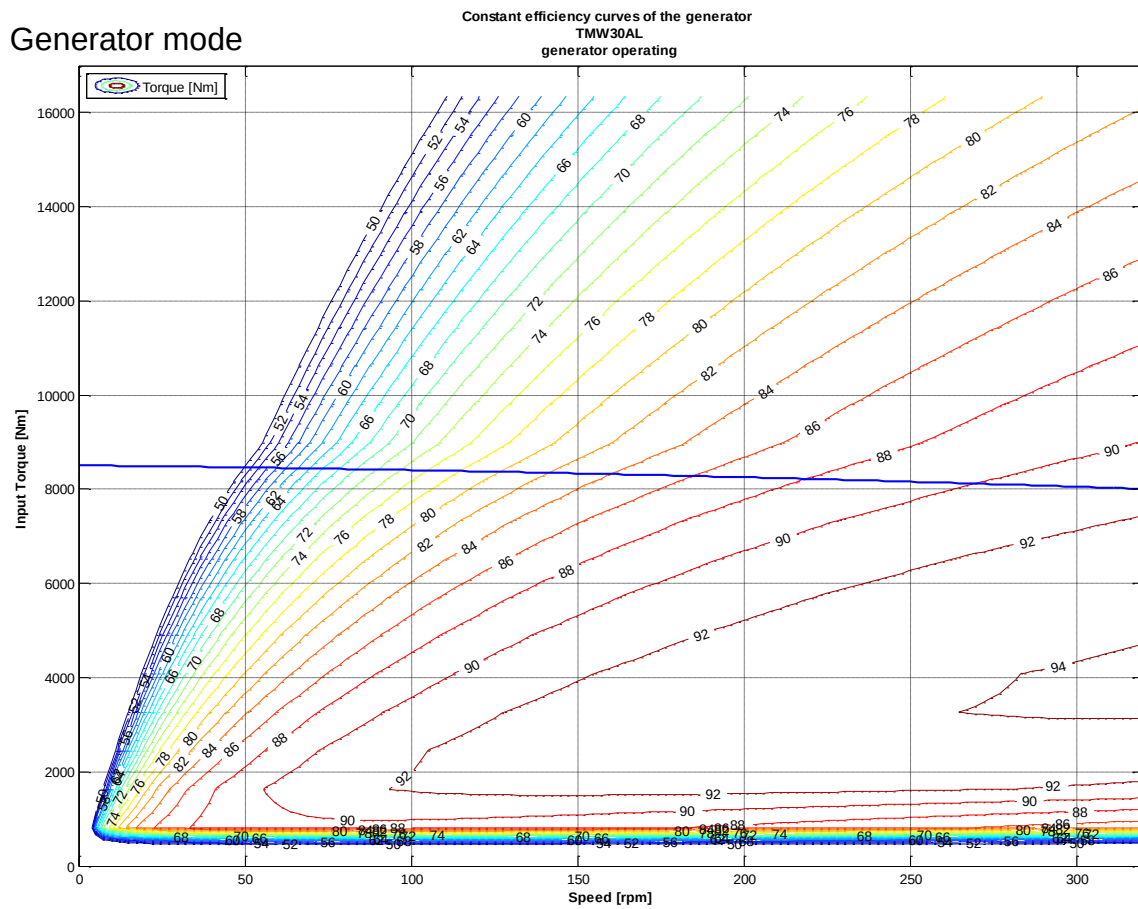


3.2.7.10. Series TMW30AL

Motor mode



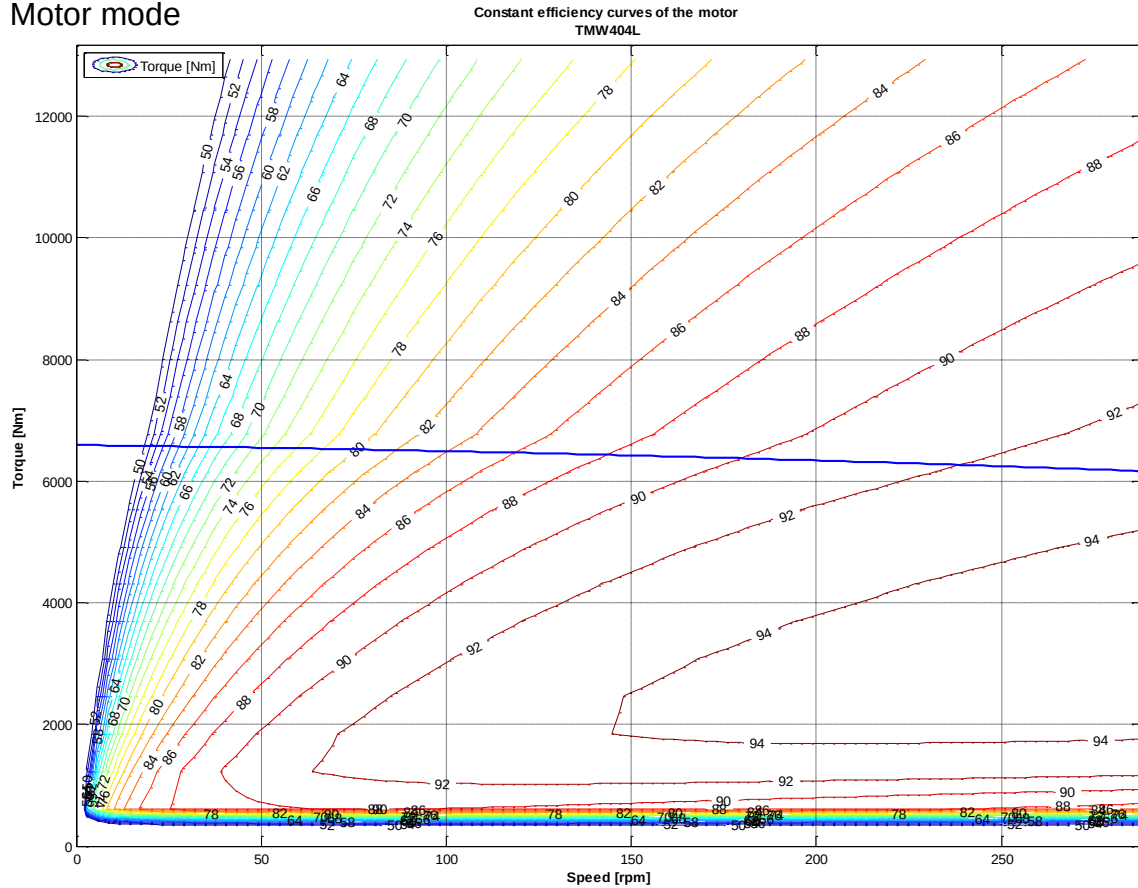
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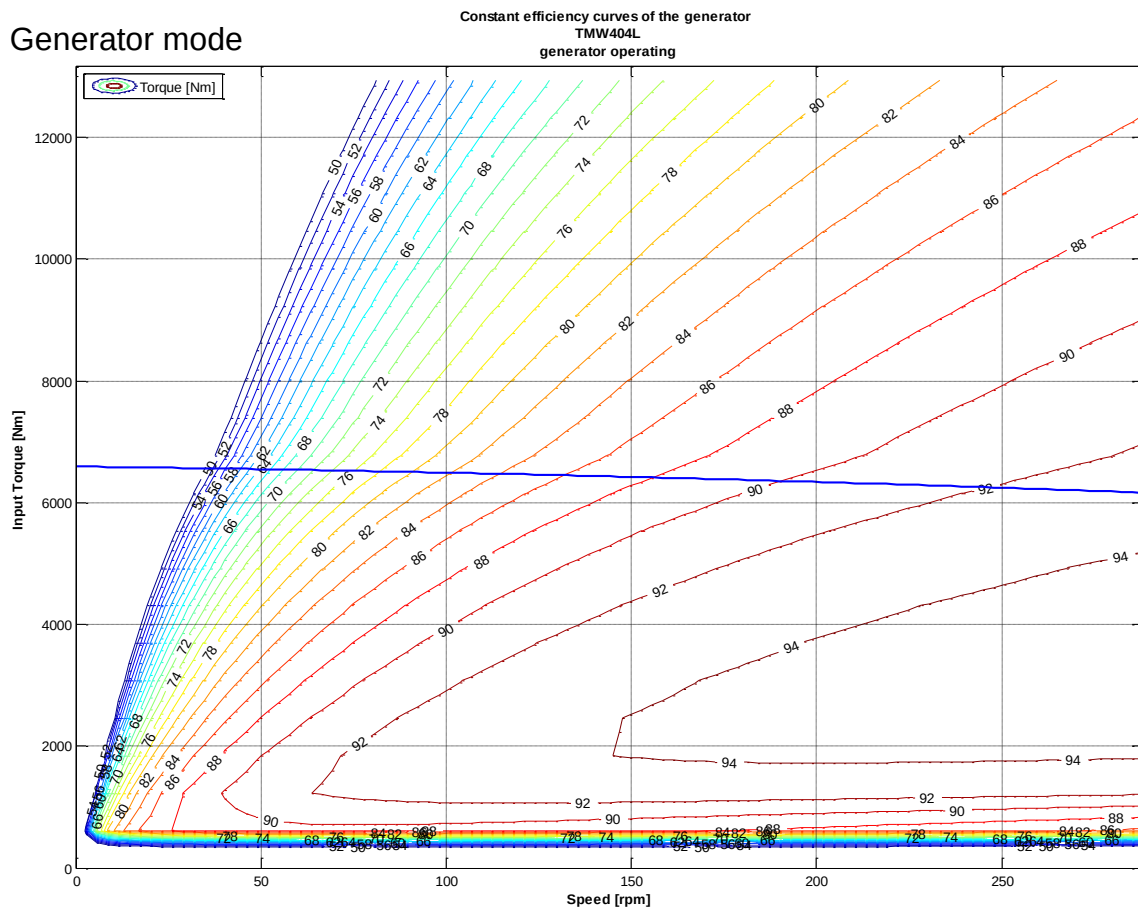


3.2.7.11. Series TMW404L

Motor mode



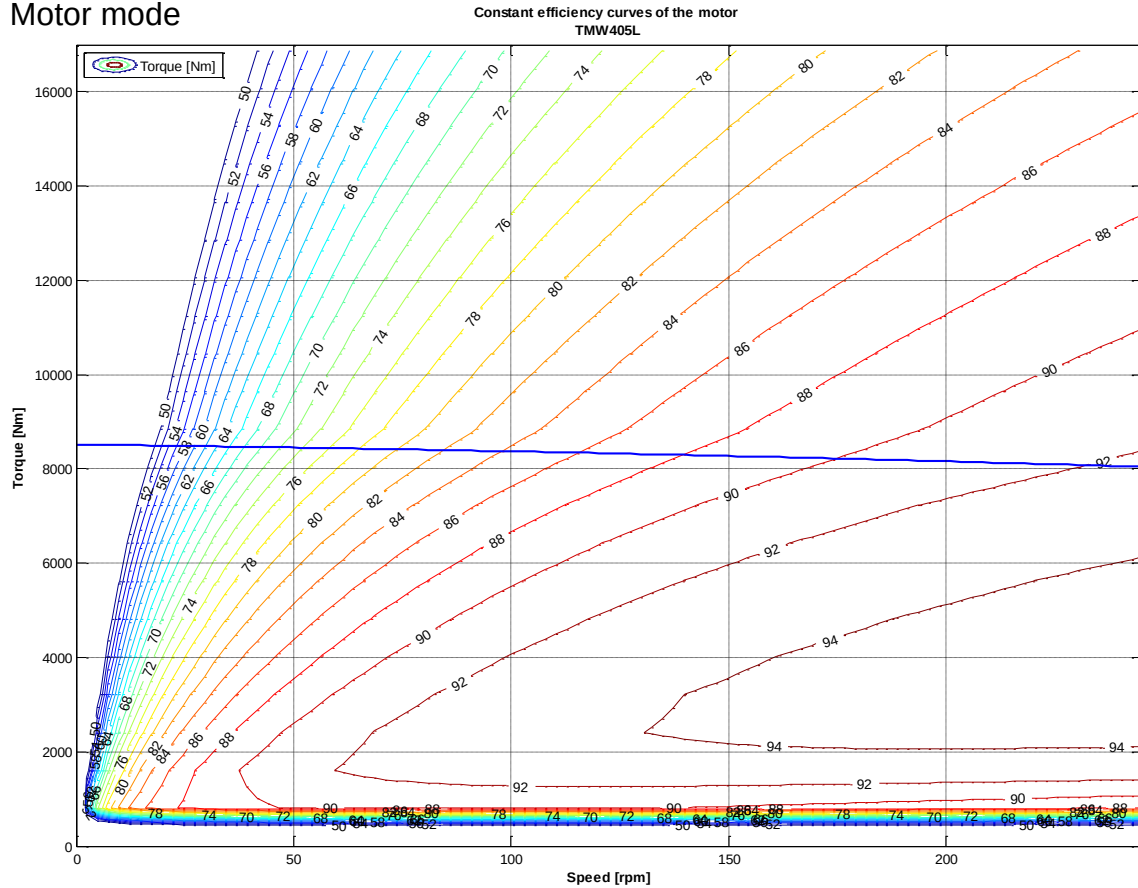
Generator mode



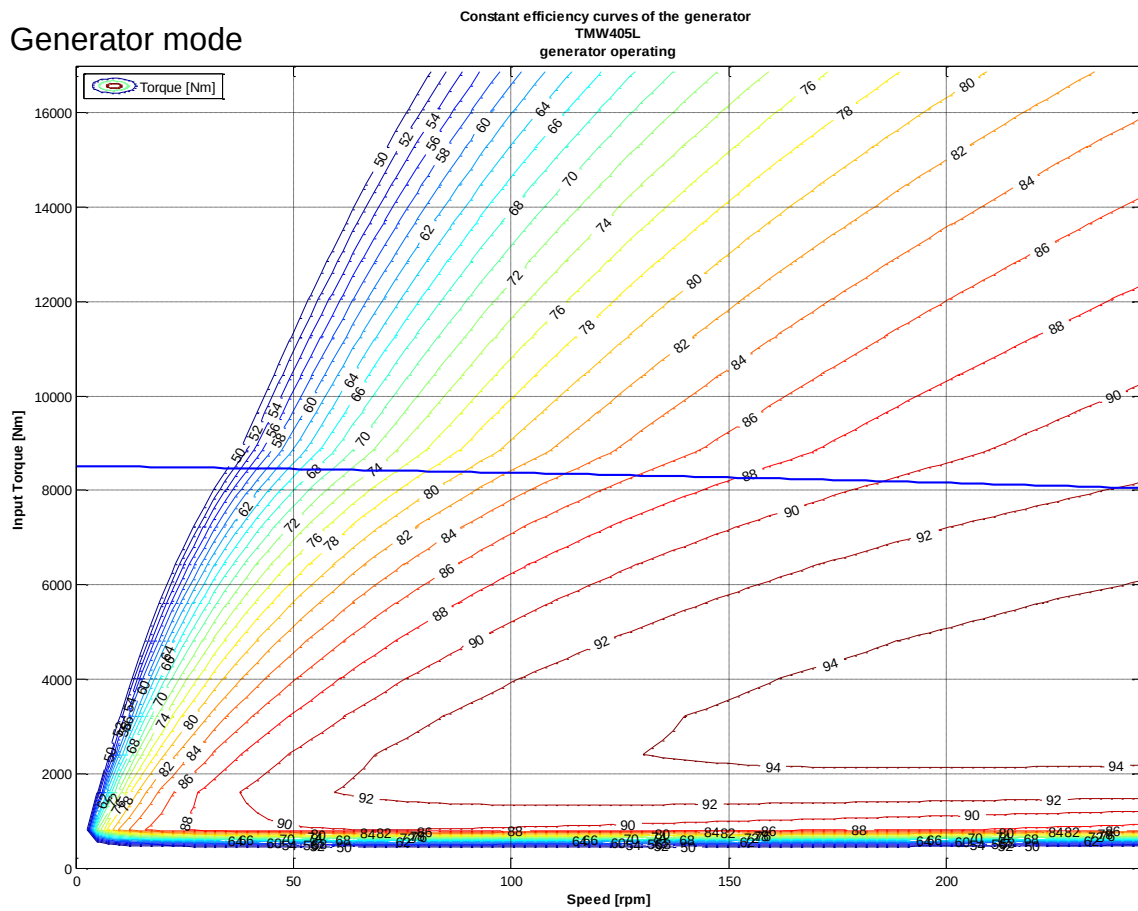


3.2.7.12. Series TMW405L

Motor mode



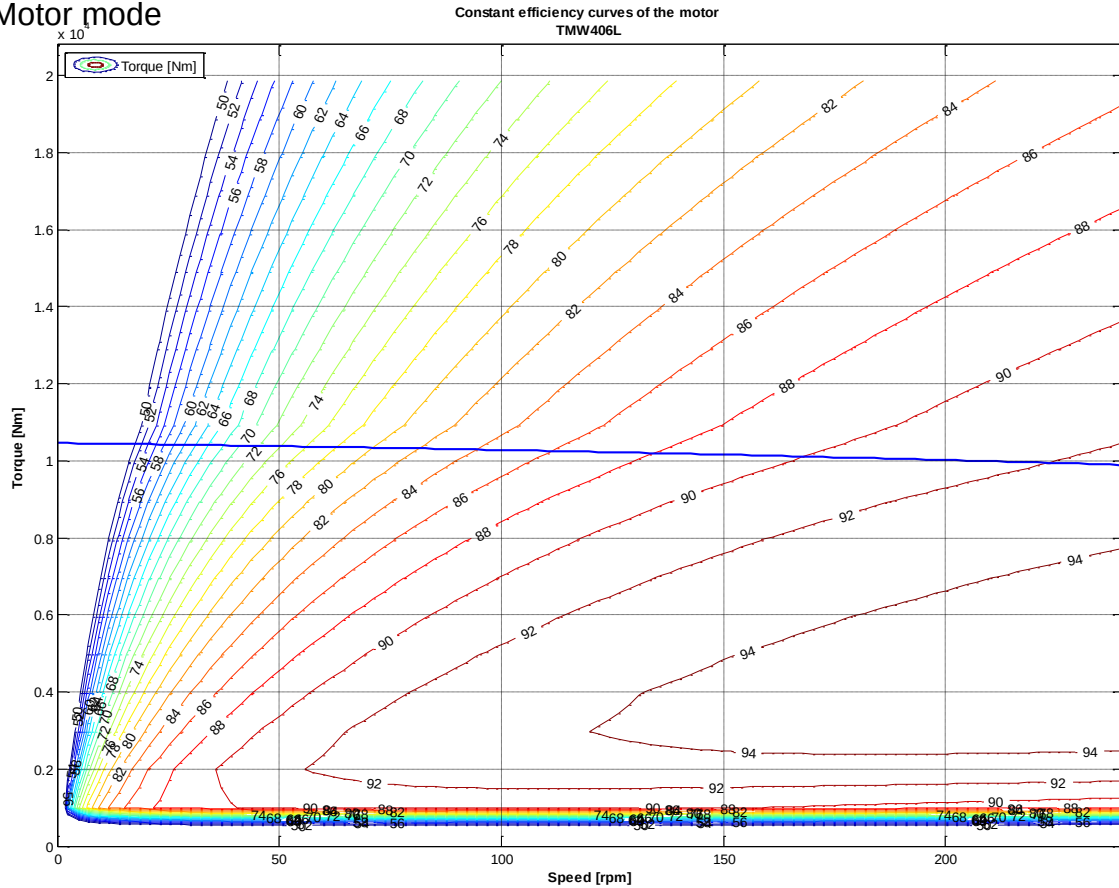
Generator mode



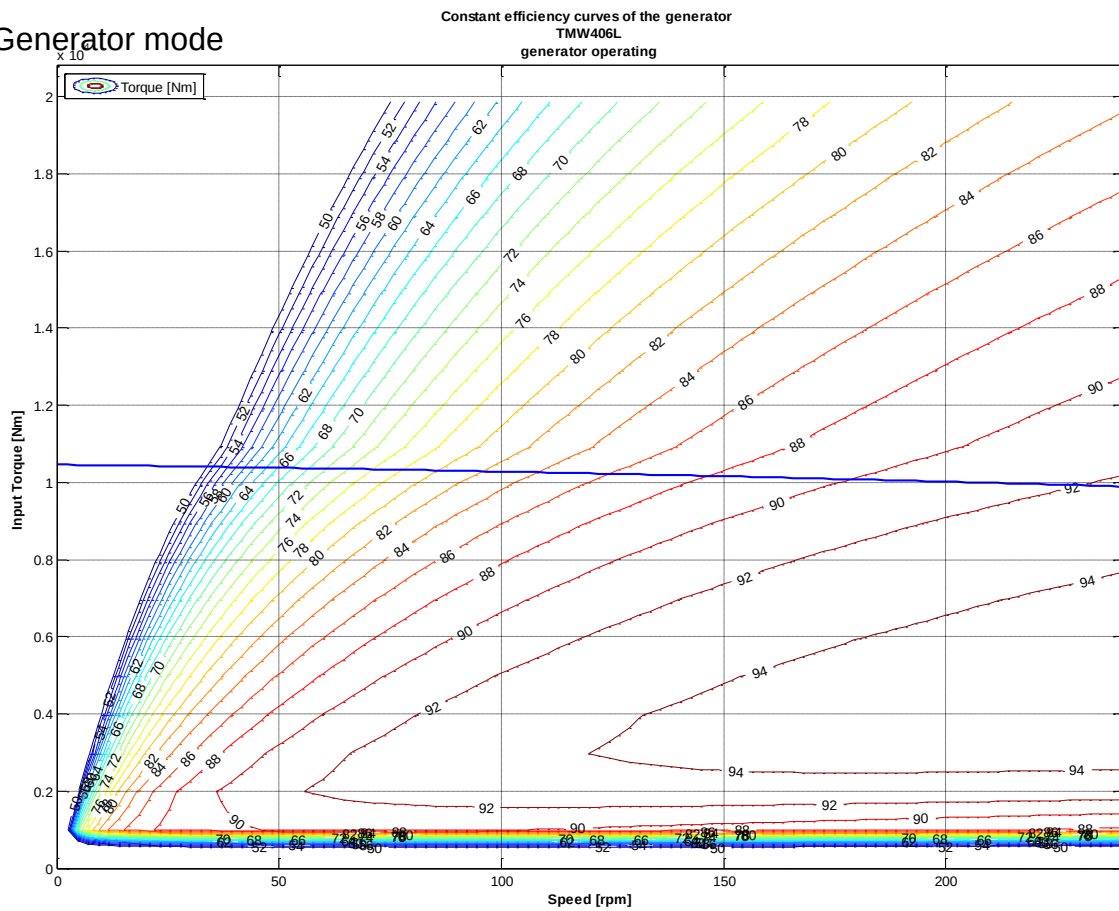


3.2.7.13. Series TMW406L

Motor mode



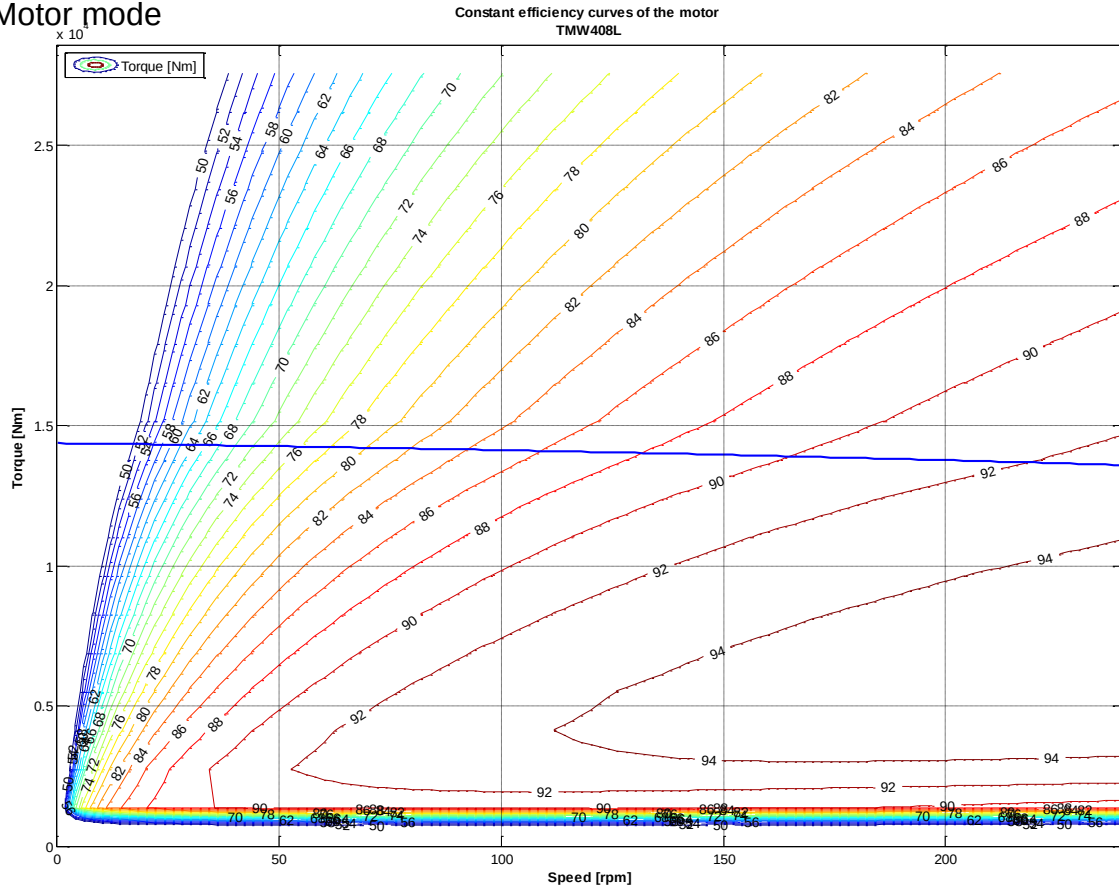
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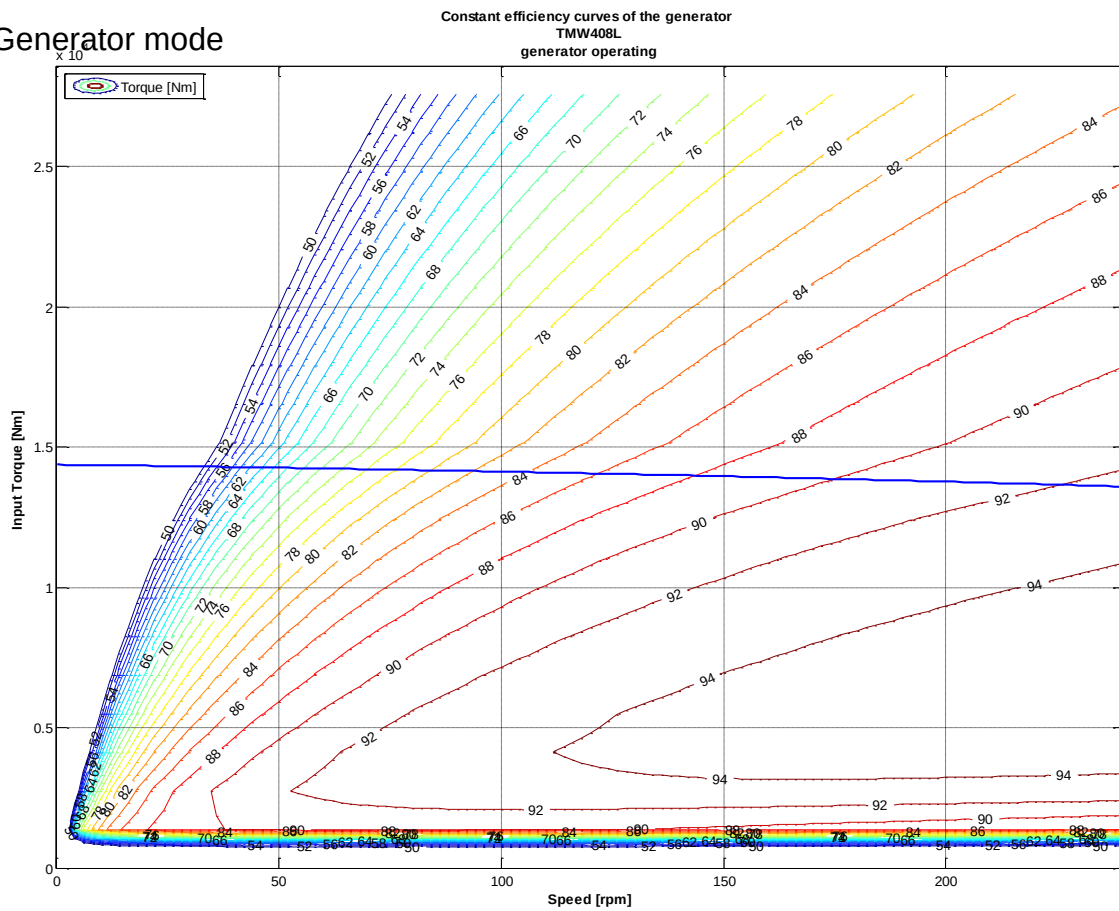


3.2.7.14. Series TMW408L

Motor mode



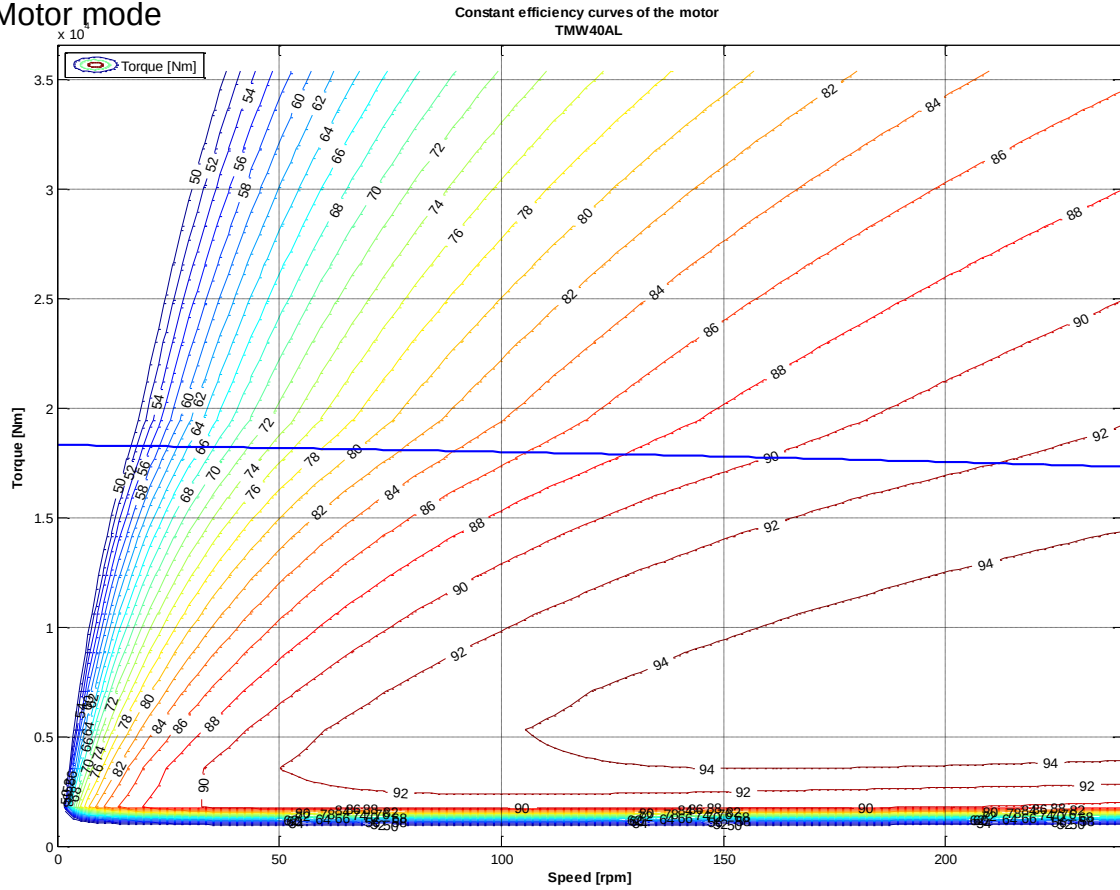
Generator mode



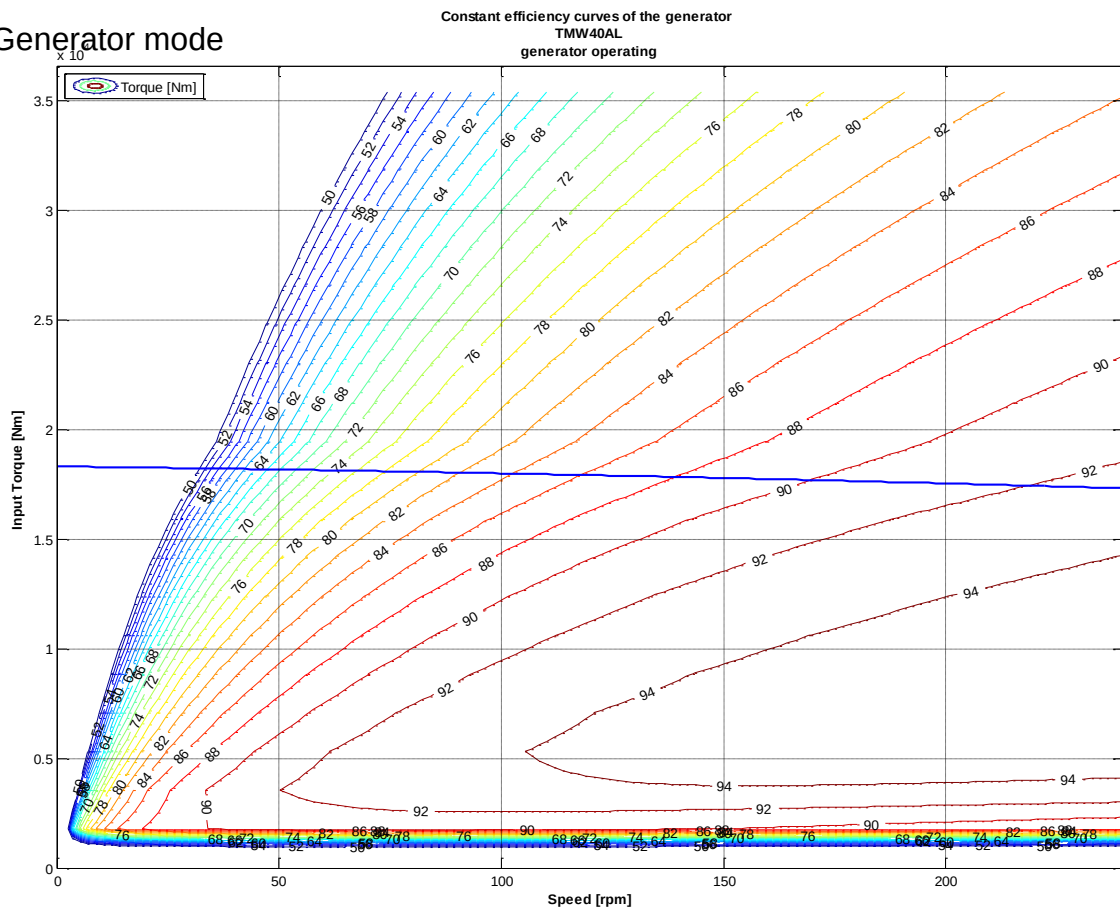


3.2.7.15. Series TMW40AL

Motor mode



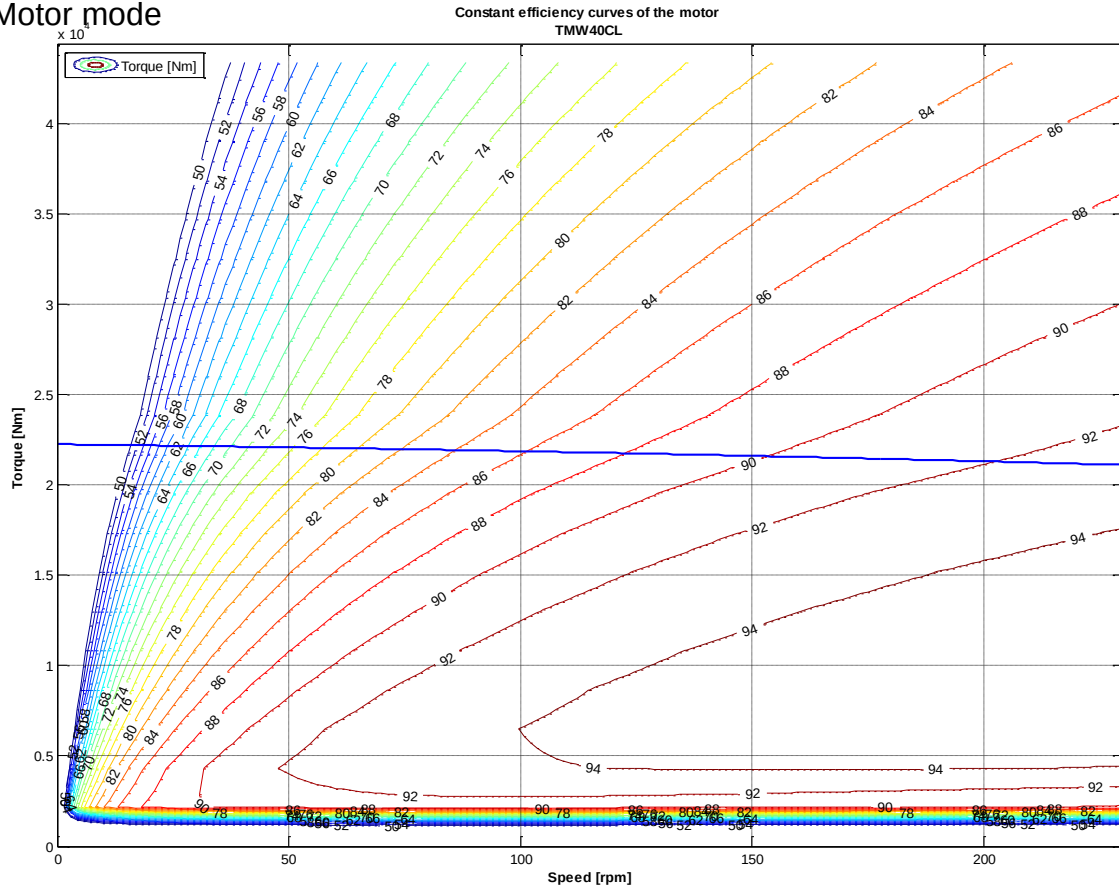
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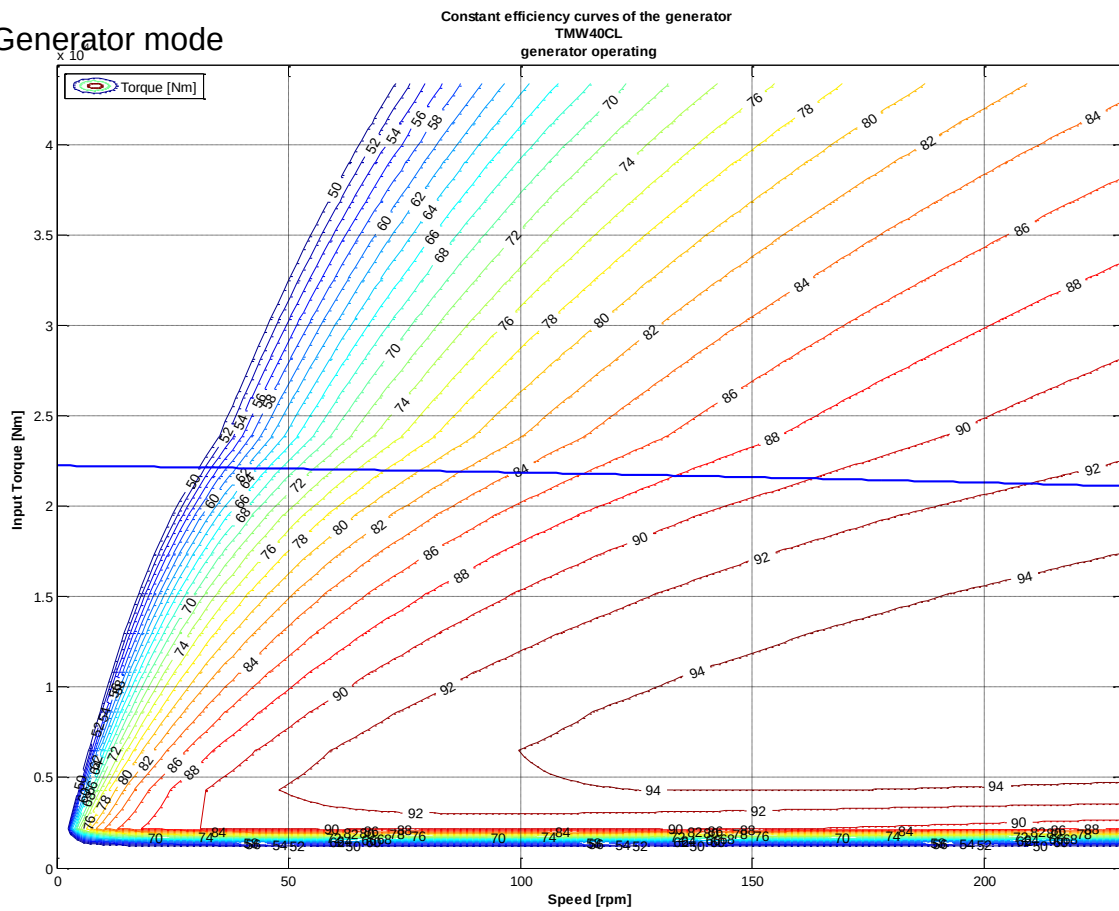


3.2.7.16. Series TMW40CL

Motor mode



Generator mode



3.2.8. Electromagnetic losses



Caution: Following data result from our best estimations but are indicative. They can vary from one motor to another and with temperature. No responsibility will be accepted for direct or indirect losses or damages due to the use of these data.

(Following data are indicative)

Type	Tf [Nm]	Kd [Nm/1000rpm]
TMW204L	9	11
TMW205L	11	15
TMW206L	13	17
TMW207L	15	20
TMW208L	17	23
TMW304L	22	95
TMW305L	27	122
TMW306L	33	148
TMW308L	44	202
TMW30AL	55	253
TMW404L	48	147
TMW405L	61	186
TMW406L	74	225
TMW408L	99	304
TMW40AL	124	383
TMW40CL	150	463

Torque losses = Tf + Kd x speed/1000

3.2.9. Total torque losses

Total torque losses (including mechanical and electromagnetical losses) With thrust bearings and with axial load (N.m)				
Speed [rpm]	1	100	200	250
TMW204L	17	26	27	27
TMW205L	20	28	30	30
TMW206L	22	31	32	33
TMW207L	24	33	35	36
TMW208L	26	36	38	39
TMW304L	35	64	72	78
TMW305L	41	73	83	90
TMW306L	46	81	94	102
TMW308L	58	98	116	127
TMW30AL	69	114	137	151
TMW404L	75	124	138	146
TMW405L	87	141	158	169
TMW406L	100	157	179	191
TMW408L	126	190	220	236
TMW40AL	151	224	261	281
TMW40CL	177	257	303	327

Total torque losses (including mechanical and electromagnetical losses) With ball bearings and radial load (N.m)				
Speed [rpm]	1	100	200	250
TMW204L	17	19	20	20
TMW205L	19	21	22	23
TMW206L	21	24	25	26
TMW207L	23	26	28	29
TMW208L	25	29	31	32
TMW304L	34	45	54	59
TMW305L	40	53	65	71
TMW306L	46	62	76	84
TMW308L	57	78	98	108
TMW30AL	68	94	120	132
TMW404L	73	90	105	113
TMW405L	86	107	126	135
TMW406L	98	123	146	157
TMW408L	124	156	187	202
TMW40AL	149	190	228	248
TMW40CL	175	224	270	293

3.2.10. Time constants of the motor

3.2.10.1. Electric time constant:

$$\tau_{elec} = \frac{L_{ph_ph}}{R_{ph_ph}}$$

With following values given in the motor data sheet

L_{ph_ph} inductance of the motor phase to phase [H],

R_{ph_ph} resistance of the motor phase to phase at 25°C [Ohm].

Example:

Motor series TMW306LF

$L_{ph_ph} = 0.942 \text{ mH}$ or $0.942 \cdot 10^{-3} \text{ H}$

R_{ph_ph} at 25°C = 0.0778 Ohm

→ $\sigma_{elec} = 0.942 \cdot 10^{-3} / 0.0778 = 12.1 \text{ ms}$

An overall summary of motor time constants is given a little further.

3.2.10.2. Mechanical time constant:

$$\tau_{mech} = \frac{R_{ph_ph} * J}{Kt * Ke_{ph_ph}} = \frac{0.5 * R_{ph_ph} * J}{(3 * \frac{Ke_{ph_ph}}{\sqrt{3}}) * \frac{Ke_{ph_ph}}{\sqrt{3}}}$$

$$\tau_{mech} = \frac{0.5 * R_{ph_ph} * J}{(Ke_{ph_ph})^2}$$

With following values obtained from the motor data sheet:

R_{ph_ph} resistance of the motor phase to phase at 25°C [Ohm],

J inertia of the rotor [kgm²],

Ke_{ph_ph} back emf coefficient phase to phase [V_{rms}/rad/s].

The coefficient Ke_{ph_ph} in the formula above is given in [V_{rms}/rad/s]

To calculate this coefficient from the datasheet, use the following relation:

$$Ke_{ph_ph} [V_{rms}/rad/s] = \frac{Ke_{ph_ph} [V_{rms}/1000rpm]}{\frac{2 * \pi * 1000}{60}}$$

Example:

Motor series TMW306LF

R_{ph_ph} at 25°C = 0.0778 Ohm

$J = 4.55 \text{ kgm}^2$

$Ke_{ph_ph} [V_{rms}/1000rpm] = 1030 [V_{rms}/1000rpm]$

→ $Ke_{ph_ph} [V_{rms}/rad/s] = 1030 / (2 * \pi * 1000 / 60) = 9.835 [V_{rms}/rad/s]$

→ $\sigma_{mech} = 0.5 * 0.0778 * 4.55 / (9.835^2) = 1.8 \text{ ms}$

Remarks:

For a DC motor, the mechanical time constant σ_{mech} represents the duration needed to reach 63% of the final speed when applying a voltage step without any resistant torque, if the electrical time constant is much smaller than the mechanical time constant.

An overall summary of motor time constants is given a little further.

3.2.10.3. Thermal time constant of the copper:

$$\tau_{\text{therm}} = Rth_{\text{copper_iron}} * Cth_{\text{copper}}$$

$$Cth_{\text{copper}[J/^{\circ}K]} = Mass_{\text{copper}[Kg]} * 389_{[J/kg^{\circ}K]}$$

With:

$Rth_{\text{copper_iron}}$ thermal resistance between copper and iron [$^{\circ}K/W$]

Cth_{copper} thermal capacity of the copper [$J/^{\circ}K$]

$Mass_{\text{copper}}$ mass of the copper (winding) [kg]

Hereunder is given an overall summary of motor time constants:

Type	Electric time constant [ms]	Mechanical time constant [ms]	Thermal time constant of copper [s]
TMW204L	11	2,1	41
TMW205L	12	1,6	38
TMW206L	12	1,4	36
TMW207L	13	1,4	36
TMW208L	13	1,2	35
TMW304L	11	2,3	43
TMW305L	12	2,2	40
TMW306L	12	1,8	38
TMW308L	13	1,8	36
TMW30AL	14	1,5	35
TMW404L	15	3,0	43
TMW405L	16	2,4	40
TMW406L	17	1,9	38
TMW408L	18	1,6	36
TMW40AL	18	1,6	34
TMW40CL	19	1,3	34



3.2.11. Speed ripple

Following values are given as indicative data because depending on the settings of the drive (gains of both speed and current regulation loops, presence of filtering or not, load inertia, resistant torque and type of sensor in use). The data below correspond to a motor type TMW206HS without external load (neither external inertia nor resistant torque).

(Following data are indicatives)

Sensor	Speed ripple peak to peak [%]
Resolver + pulleys-belt ratio=6	4% ... 30% or higher depending on the max speed
EnDat encoder + pulleys-belt ratio=6	3.4% ... 4% or higher depending on the max speed
Endat in direct	1% or higher depending on the max speed

3.2.12. PWM frequencies – Noise according to PWM frequency

The converter supplies the motor with series of PWM voltage pulses occurring at the switching frequency.

Following values of PWM frequency are given for AC890 Parker drives:

AC890 Parker Drives

Frame B, C & D : 4 and 8 kHz

All others frames: only 4 kHz, either standard or PX frames.

Noise according to EN ISO 1680 :

For a switching PWM frequency of 8 kHz: <70dBA @ 200 rpm max

For a switching PWM frequency of 4 kHz: <80dBA @ 200 rpm max

N.B. As the noise level increases when the PWM frequency decreases, the current ripple has to be limited to 10% to 15% of the nominal current in order to reduce the torque ripple.



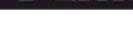
3.2.13. Rated data according to rated voltage variation

The nominal characteristics and especially the rated speed, maximal speed, rated power, rated torque, depend on the nominal voltage supplying the motor considered as the rated voltage. The rated data mentioned in the data sheet are given for each association of motor and drive. Therefore, if the supply voltage changes, the rated values will also change. As long as the variation of the rated voltage remains limited, for instance $\pm 10\%$ of the nominal value, it is possible to correctly evaluate the new rated values as illustrated below.

Example:

Extract of TMW40CLG datasheet

BRUSHLESS MOTOR		
TMW40CLG		
ELECTRONIC DRIVE		
AC890SD/4/0798K		

		
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P _n	Rated power	318	kW	Cooling : water cooling Cooling : 1C 97 W Minimum flow : 57 l / min Maximum temperature : 25 °C Maximum pressure : 5 bars
M _n	Rated torque	21700	Nm	
N _n	Rated speed	140	rpm	
I _n	Rated current	626	A _{rms}	
U _n	Rated voltage	347	V _{rms}	
U _R	Voltage of the mains	400	V _{rms}	
U	DC voltage supply when motor is loaded	540	V	
M ₀	Low speed torque	22200	Nm	Ambient temperature : 40°C max Altitude : < 1.000 m Thermal class : F (according to CEI 34-1) Number of poles : 48 Efficiency : at rated torque ** : 89.3 % at 75 % of the rated torque ** : 92.2 %
I ₀	Permanent current at low speed	640	A _{rms}	
M _p	Max. torque	32500	Nm	
I _p	Max. current	959	A _{rms}	
N _p	Max. speed	175	rpm	
J	Rotor inertia	25.9	kg.m ² x 10	
K _e	Back emf constant at 1000 rpm (25°C)*	2180	V _{rms}	
K _t	Torque sensitivity	34.7	Nm/A _{rms}	
R _b	Winding resistance(25°C) *	0.0443	Ω	
L	Winding inductance *	0.86	mH	

All data are given in typical values under standard conditions

* Phase to phase **without thrust-bearing

If we suppose that the rated voltage $U_n=347 \text{ V}_{\text{rms}}$ decreases of **10%** ; this means that the new rated voltage becomes $U_{n2}=312 \text{ V}_{\text{rms}}$.

Rated speed:

The former rated speed $N_n=140 \text{ rpm}$ obtained with a rated voltage $U_n=347 \text{ V}_{\text{rms}}$ and an efficiency of $\eta=89.3\%$ leads to the new rated speed N_{n2} given as follows:

$$N_{n2} = N_n * \frac{\frac{U_{n2}}{U_n} - 1 + \eta}{\eta} \qquad N_{n2} = 140 * \frac{\frac{312}{347} - 1 + 0.893}{0.893} = 124 \text{ rpm}$$

Maximum speed:

The former maximum speed $N_{\text{max}} = 175 \text{ rpm}$ obtained with $U_n = 347 \text{ V}_{\text{rms}}$ and $N_n = 140 \text{ rpm}$ leads to the new maximum speed $N_{\text{max}2}$ given as follows:

$$N_{\text{max}2} = N_{\text{max}} * \frac{N_{n2}}{N_n} \qquad N_{\text{max}2} = 175 * \frac{124}{140} = 155 \text{ rpm}$$

N.B.

□ If the rated voltage increases ($U_{n2} > U_n$), the new rated speed N_{n2} and the new maximum speed $N_{\text{max}2}$ will be greater than the former ones N_n and N_{max} . Moreover you will have to check that the drive still shows able to deal with the new maximum electric frequency.

	<u>Warning:</u> If the mains supply decreases, you must reduce the maximum speed accordingly in order not to damage the motor. In case of doubt, consult us.
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Rated power:

The former rated power $P_n=318 \text{ kW}$ obtained with $U_n = 347 \text{ V}_{\text{rms}}$ leads to the new rated power P_{n2} given as follows:

$$P_{n2} = P_n * \frac{U_{n2}}{U_n} \qquad P_{n2} = 318 * \frac{312}{347} = 285 \text{ kW}$$

Rated torque:

The former rated torque $M_n = 21700 \text{ Nm}$ obtained with $U_n = 347 \text{ V}_{\text{rms}}$ leads to the new rated torque M_{n2} given as follows:

$$M_{n2} = \frac{P_{n2}}{\frac{2 * \pi * N_{n2}}{60}} \qquad M_{n2} = \frac{285000}{\frac{2 * \pi * 124}{60}} = 21947 \text{ Nm}$$

3.2.14. Voltage withstand characteristics of TM series

The motors fed by converters are subject to higher stresses than in case of sinusoidal power supply. The combination of fast switching inverters with cables will cause overvoltage due to the transmission line effects. The peak voltage is determined by the voltage supply, the length of the cables and the voltage rise time. As an example, with a rise time of 200 ns and a 30 m (100 ft) cable, the voltage at the motor terminals is twice the inverter voltage.

The insulation system of the torque motors TM is designed to withstand high repetitive pulse voltages and largely exceeds the recommendations of the IEC/TS 60034-25 ed 2.0 2007-03-12 for motors without filters up to 690V AC (See figure 1).

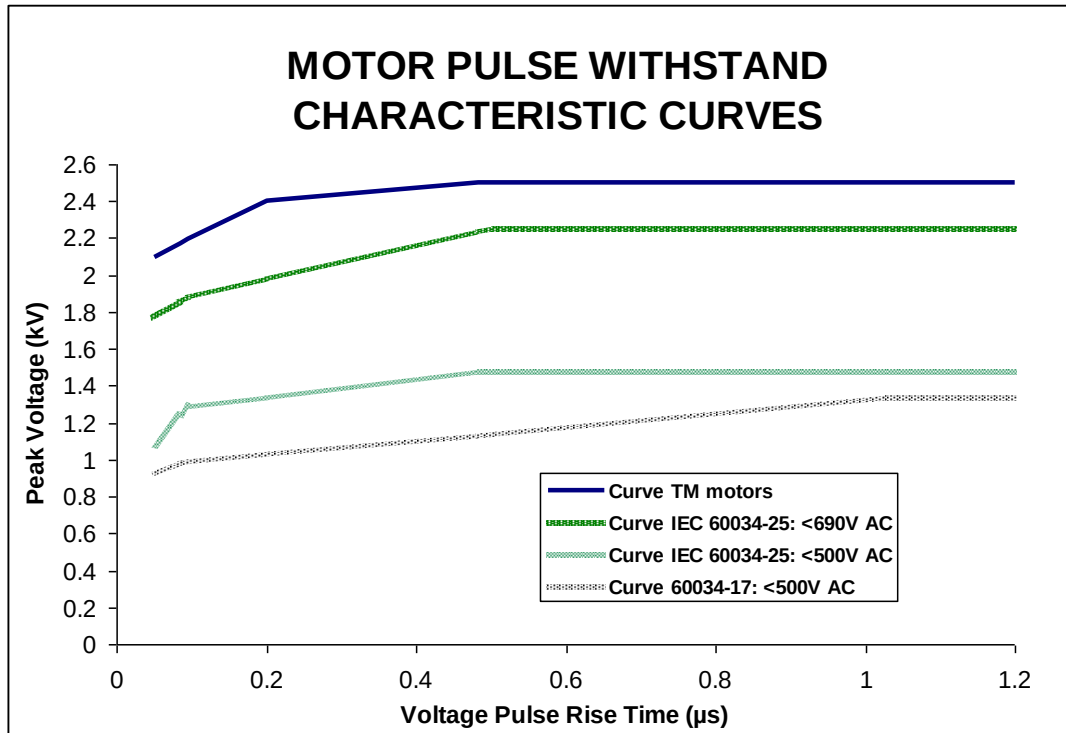


Figure 1: Minimum Voltage withstands characteristics for motors insulations according to IEC standards. At the top are the typical capabilities for the TM motors.

Note: The pulse rise times are defined in accordance with the IEC/TS 60034-17 ed4.0 2006-05-09.

The TM motors can be used with a supply voltage up to 690 V under the following conditions:

- The pulse rise times must be longer than 50 ns.
- The repetitive pulse voltages must not exceed the values given in figure 1, "Curve TM motors" in dark blue.

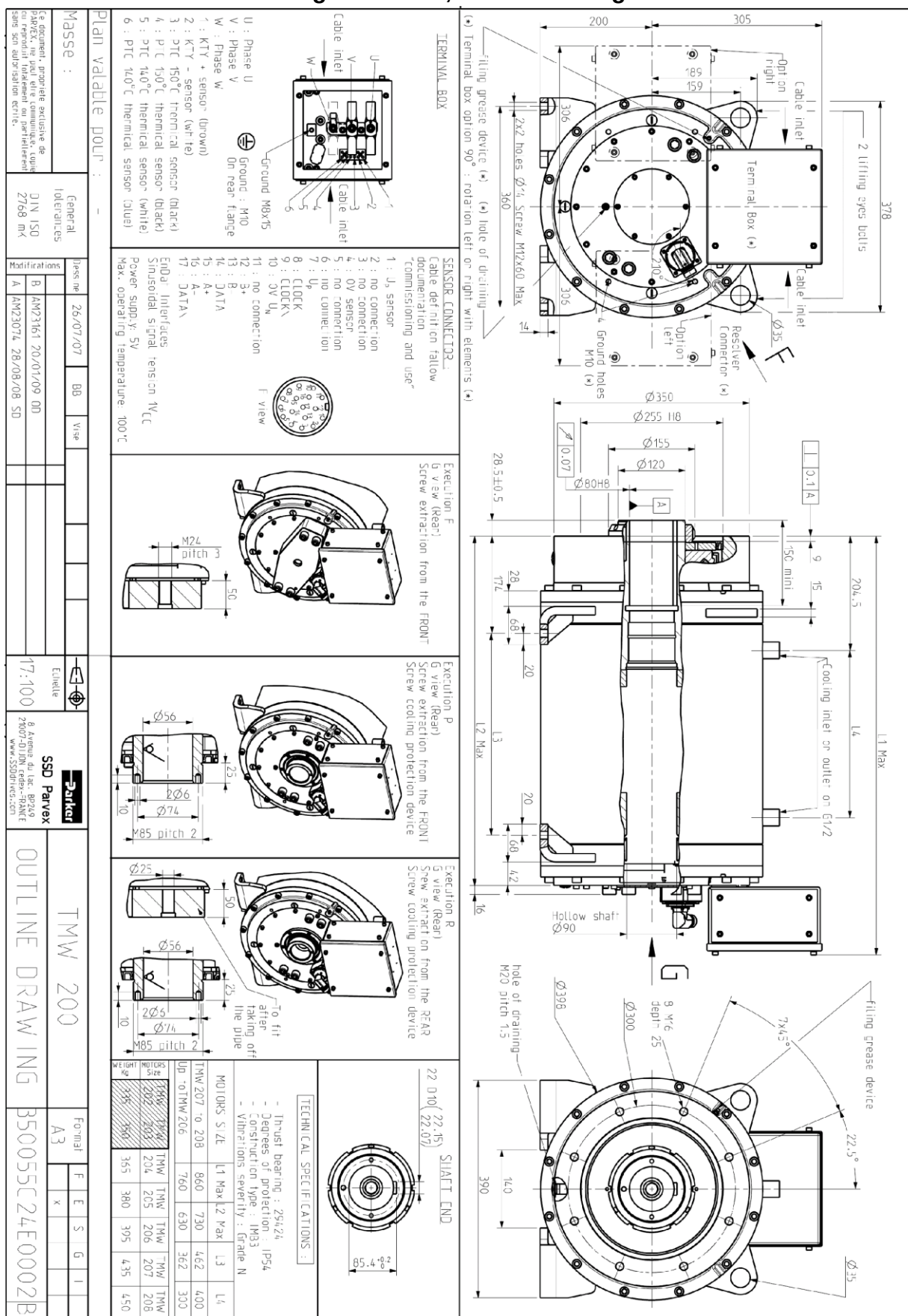
3.3. Dimension drawings

3.3.1. TMW200 standard configurations

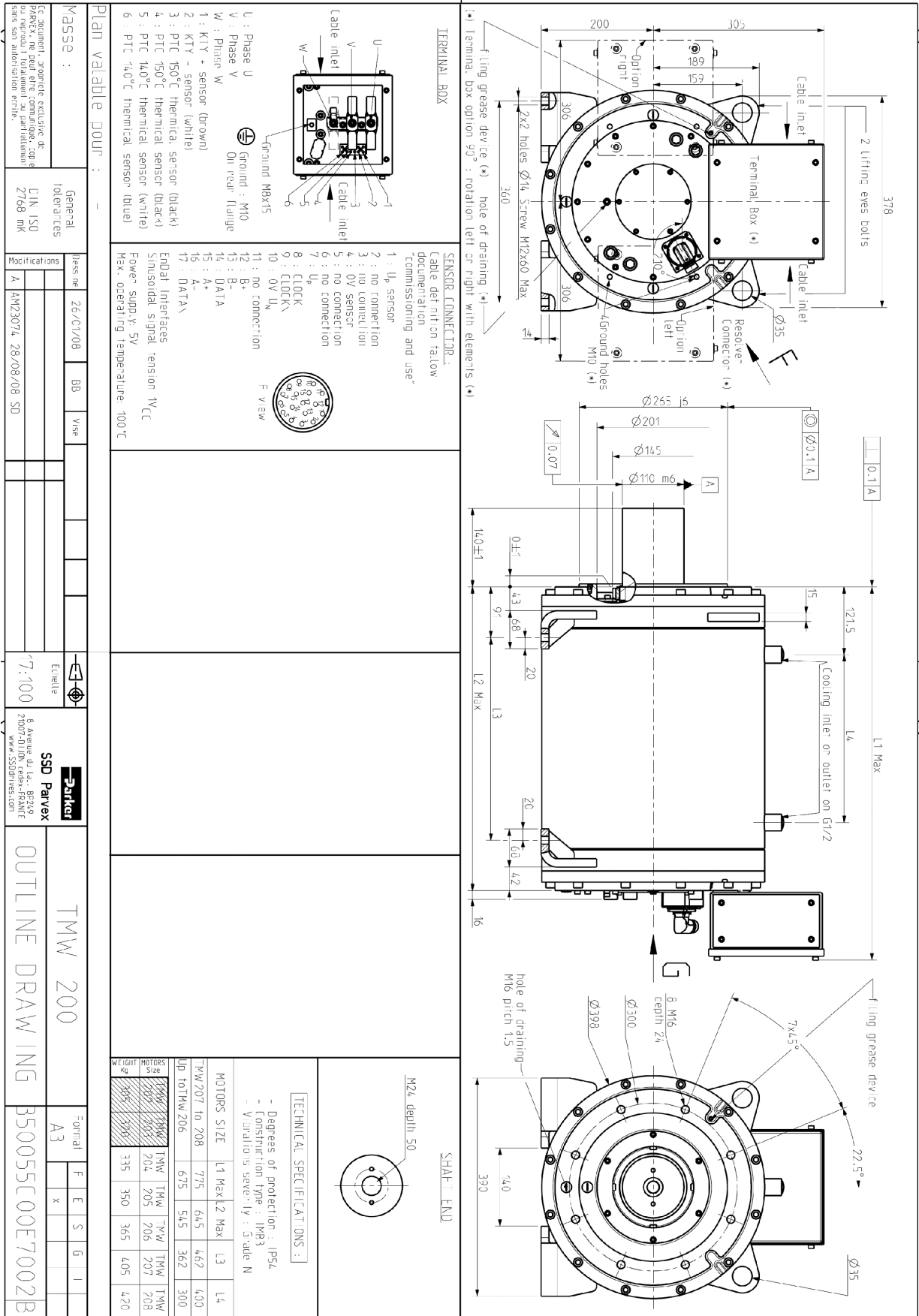
3.3.1.1. Shaft Height 200 mm, Thrust bearing 29420

[illegible]

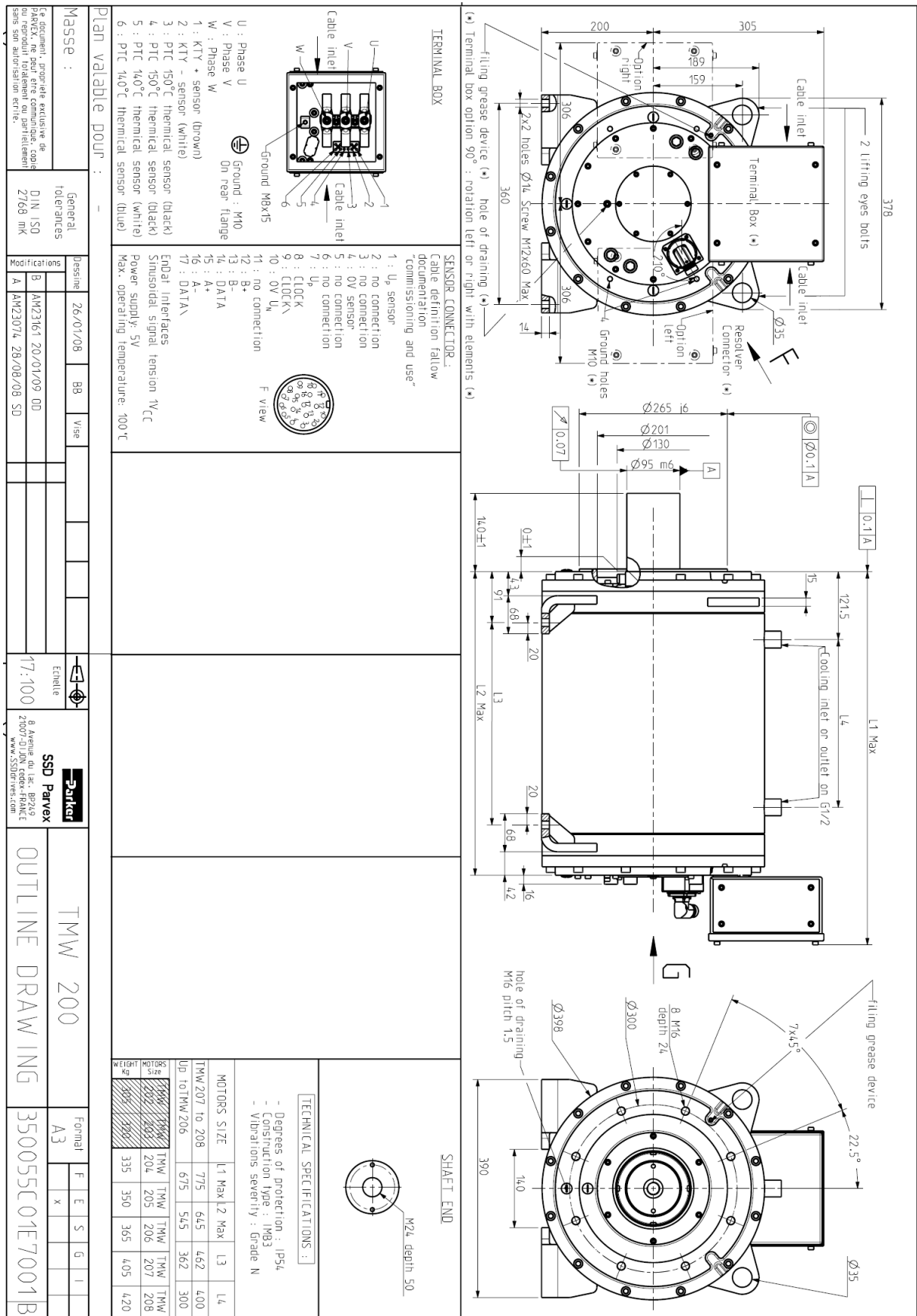
3.3.1.2. Shaft Height 200 mm, Thrust bearing 29424



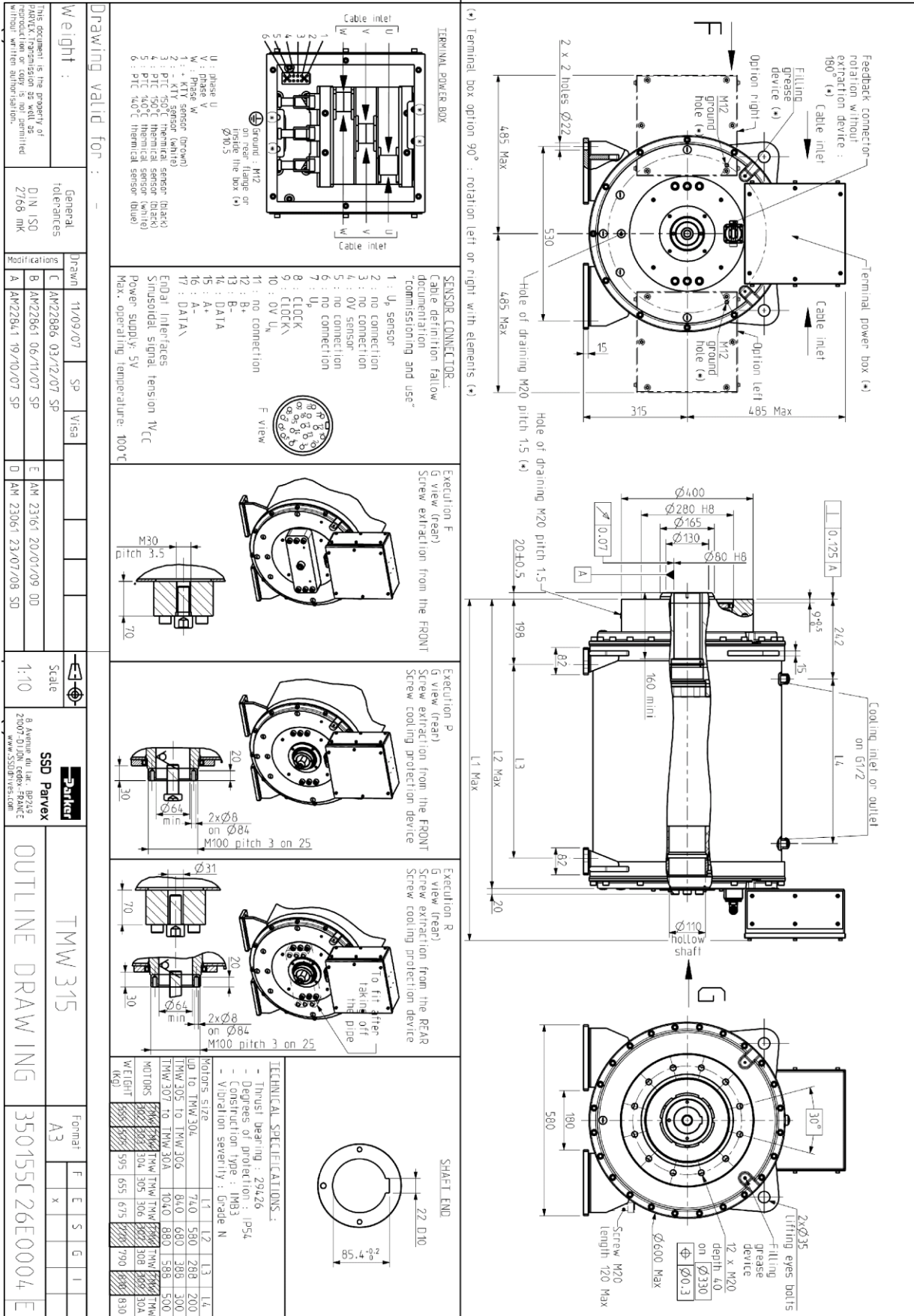
3.3.1.3. Shaft Height 200 mm, Without Thrust Bearing, With Ball Bearing



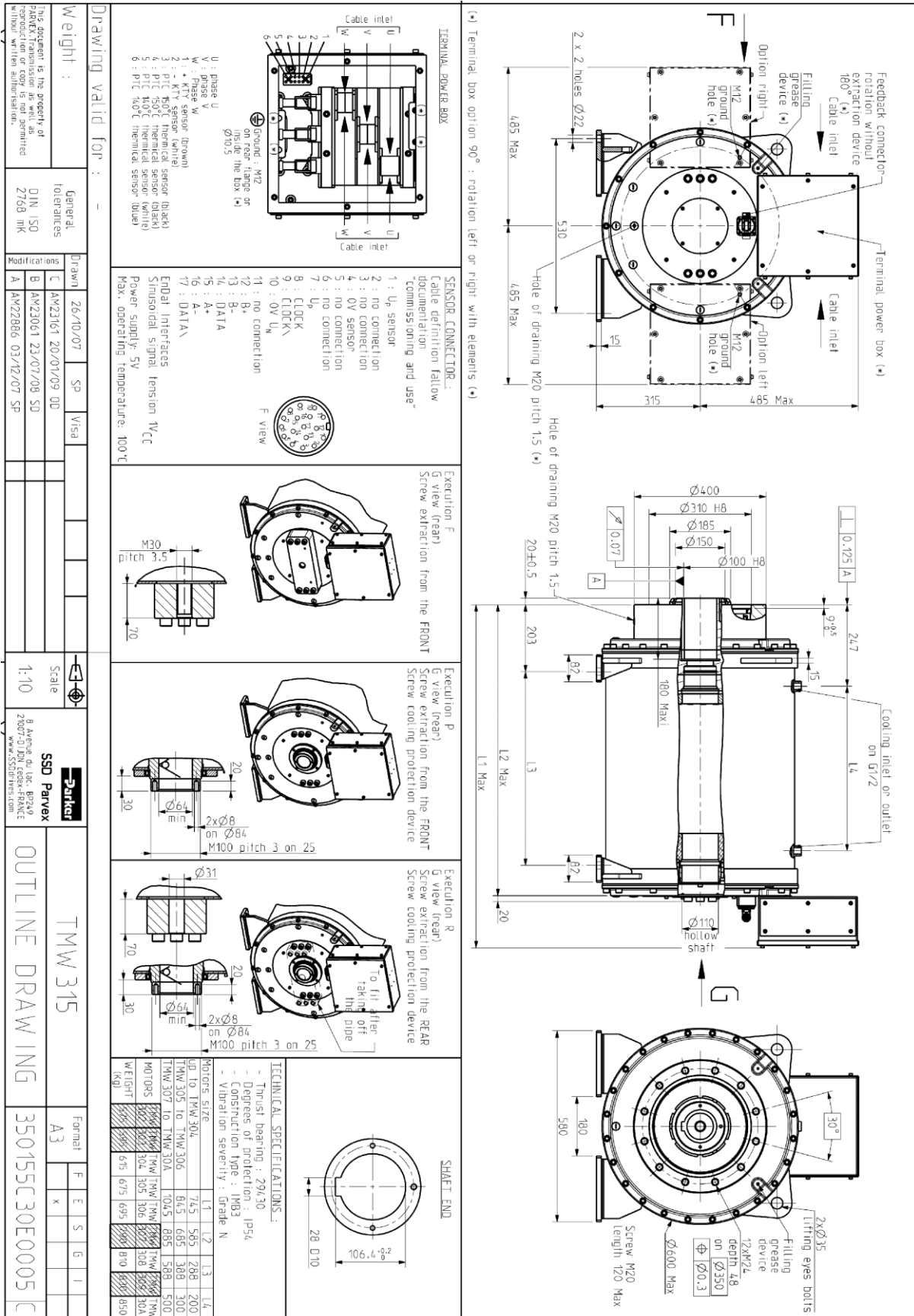
3.3.1.4. Shaft Height 200 mm, Without Thrust Bearing, With Roller Bearing



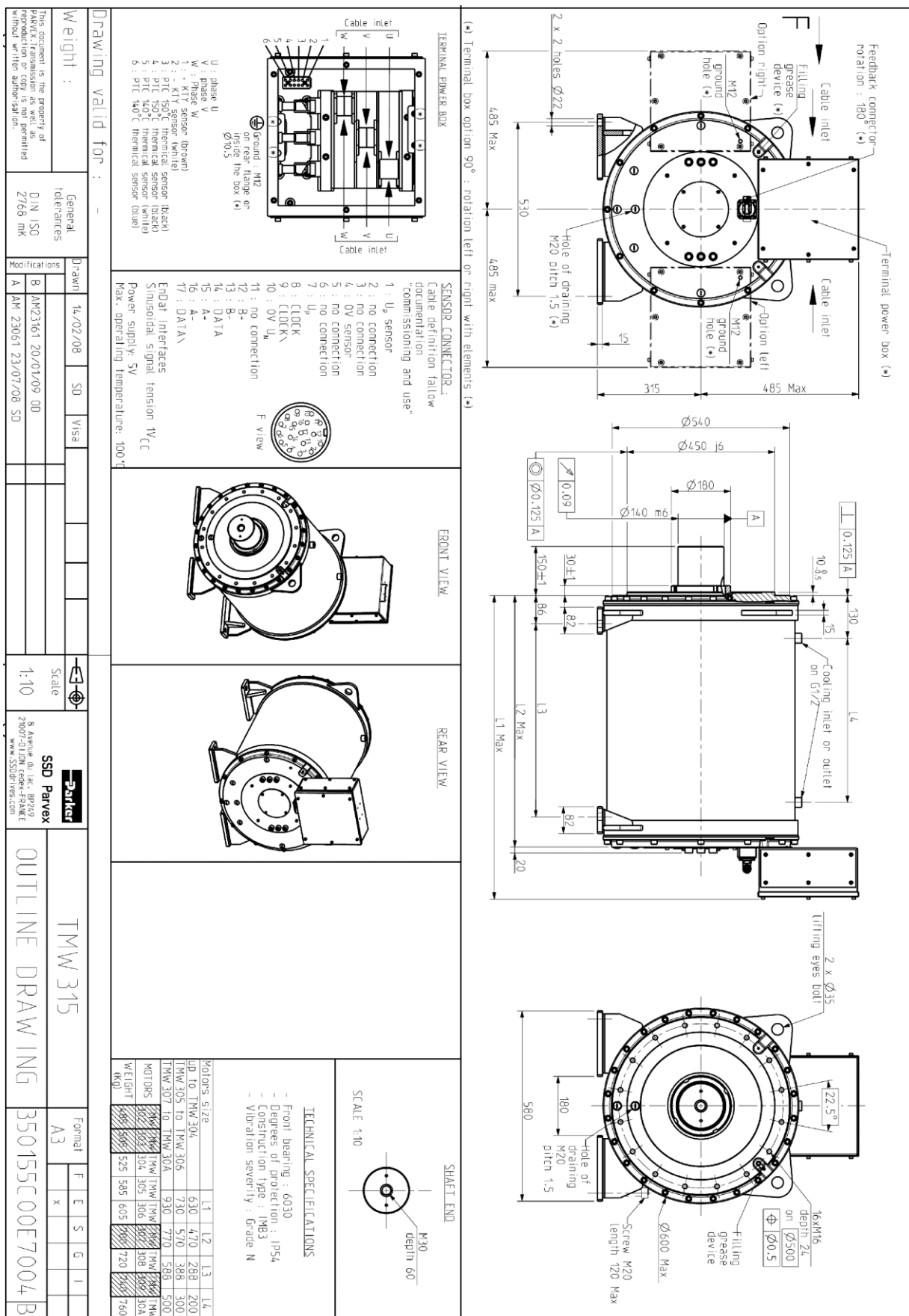
3.3.2.2. Shaft Height 315 mm, Thrust Bearing 29426



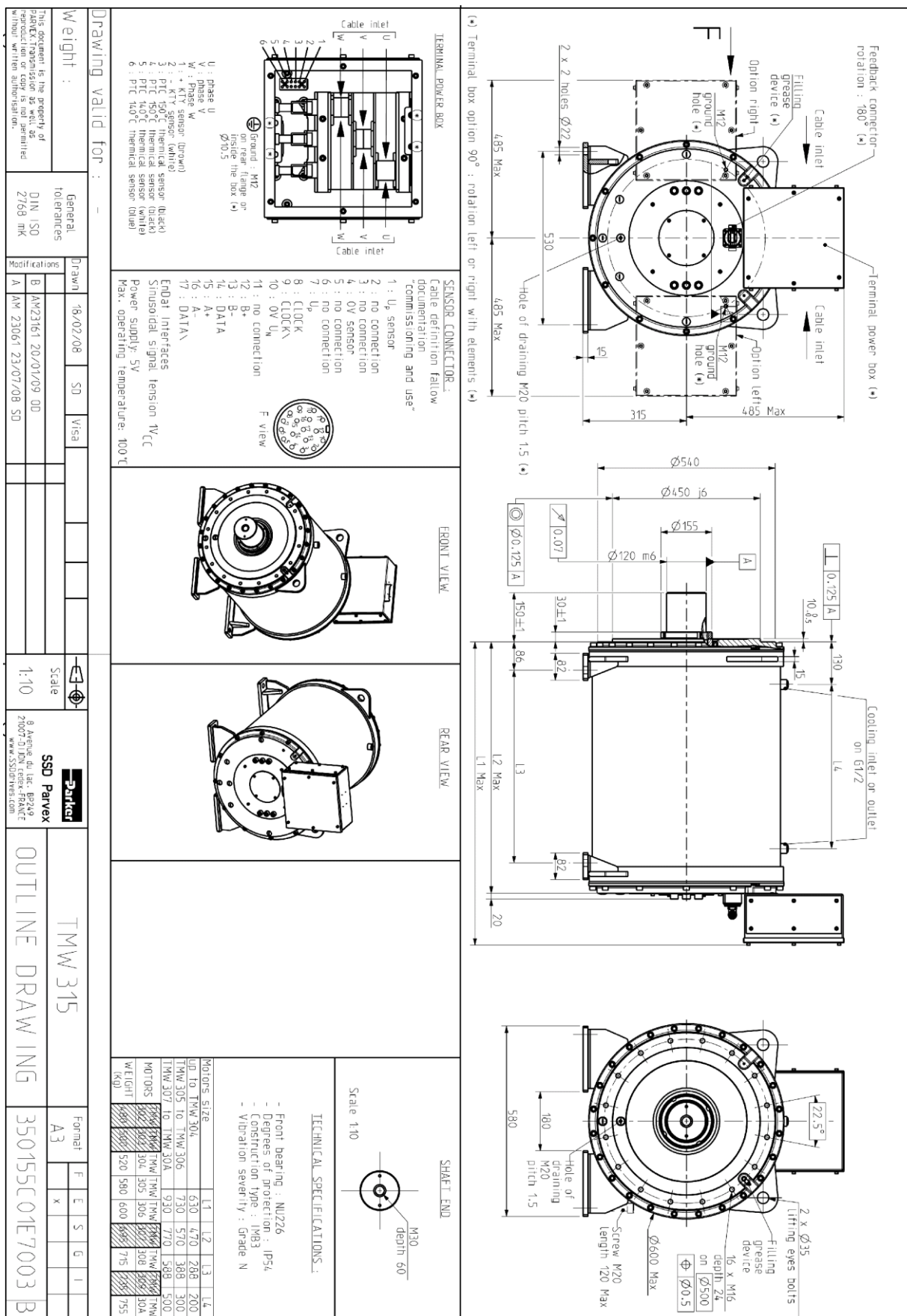
3.3.2.3. Shaft Height 315 mm, Thrust Bearing 29430



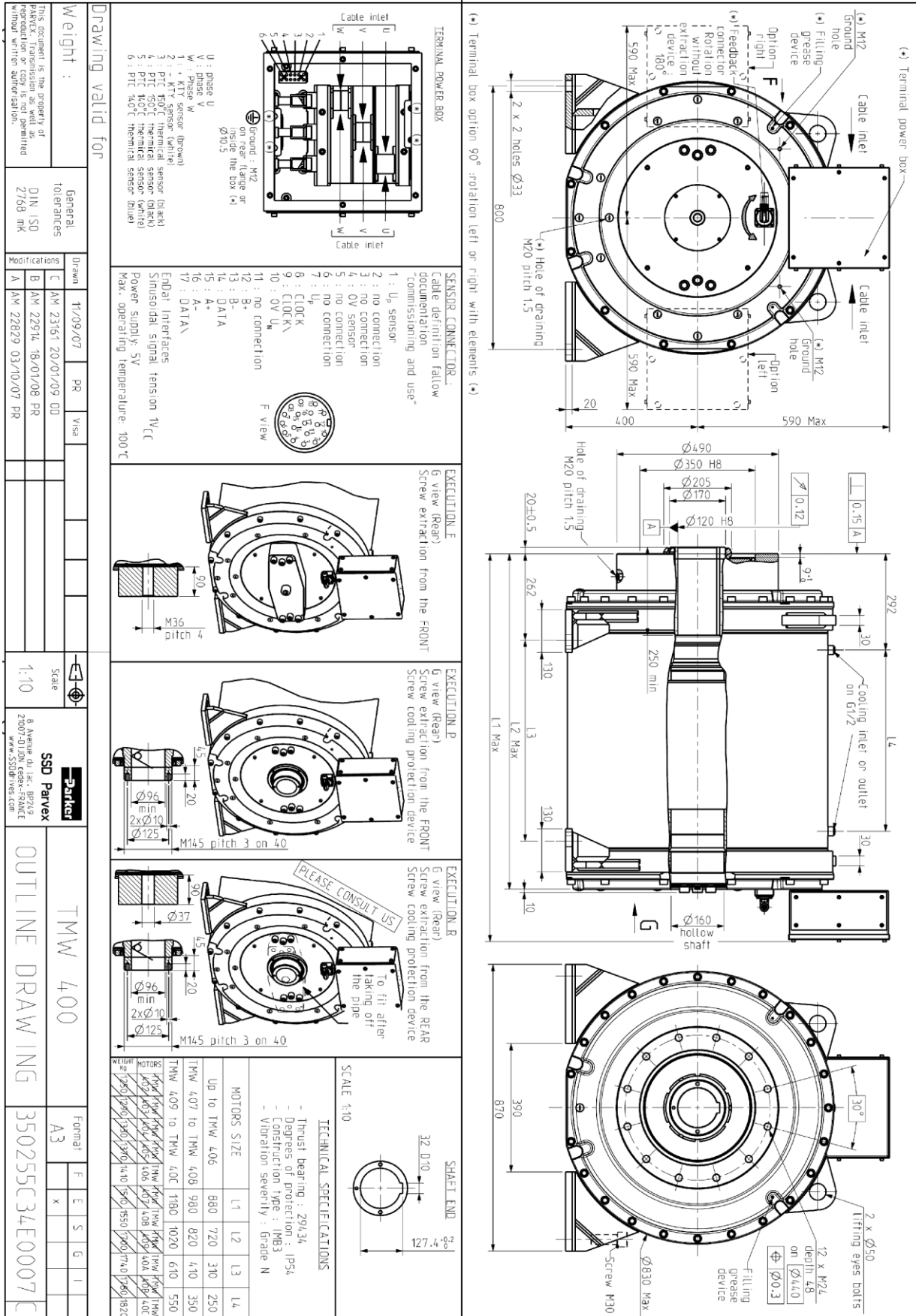
3.3.2.4. Shaft Height 315 mm, Without Thrust Bearing, With Ball Bearing



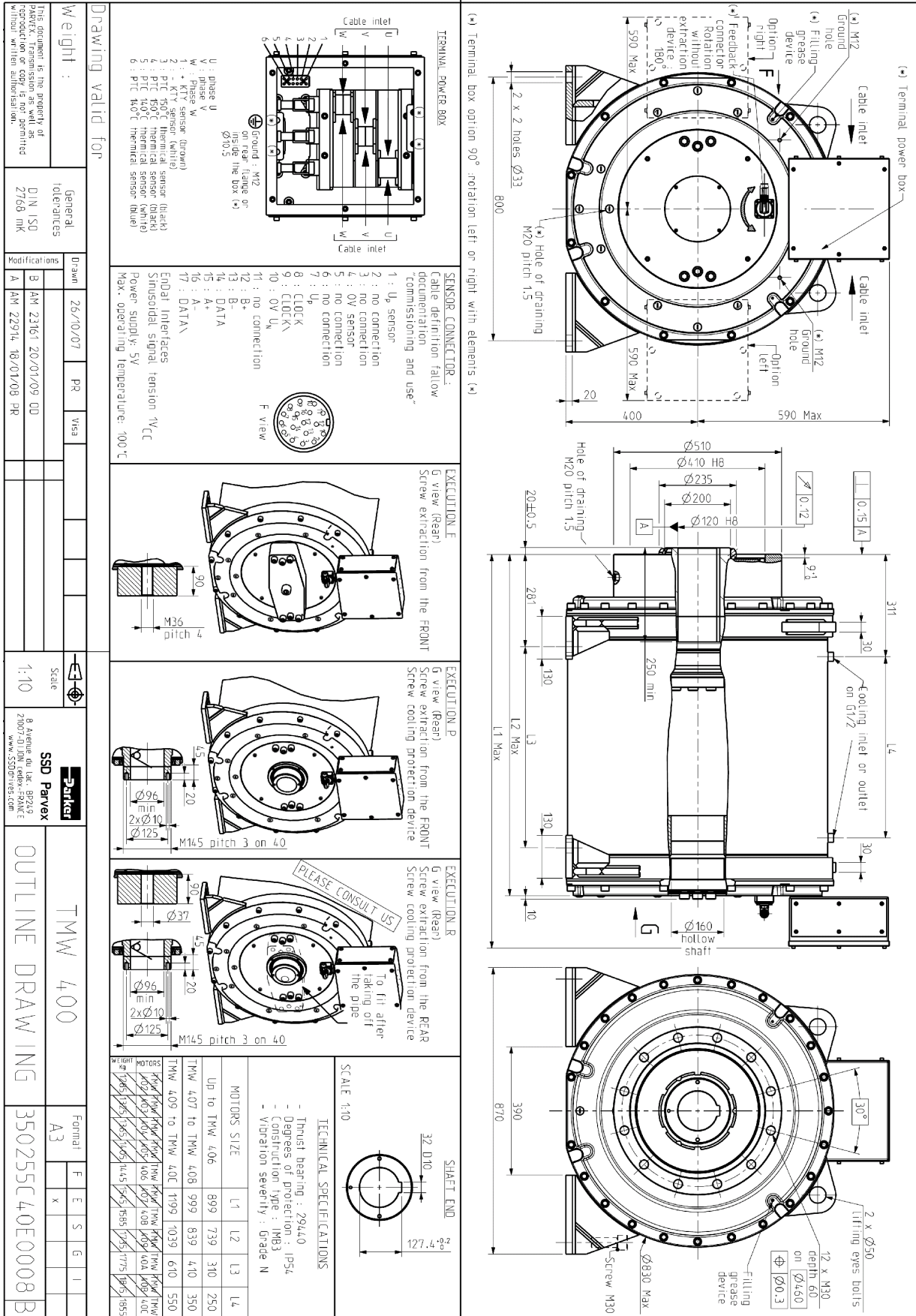
3.3.2.5. Shaft Height 315 mm, Without Thrust Bearing, With Roller Bearing



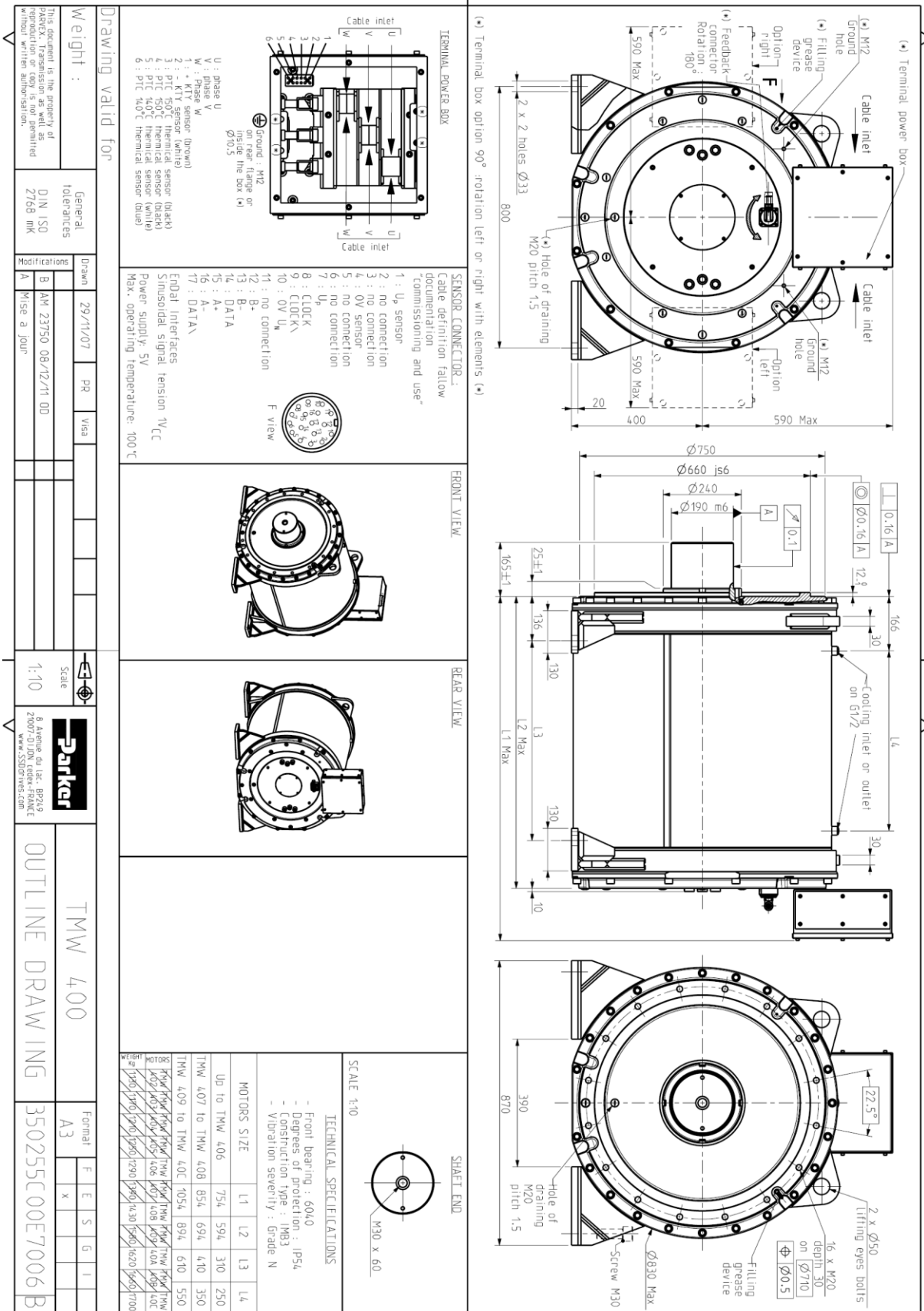
3.3.3.2. Shaft Height 400 mm, Thrust Bearing 29434



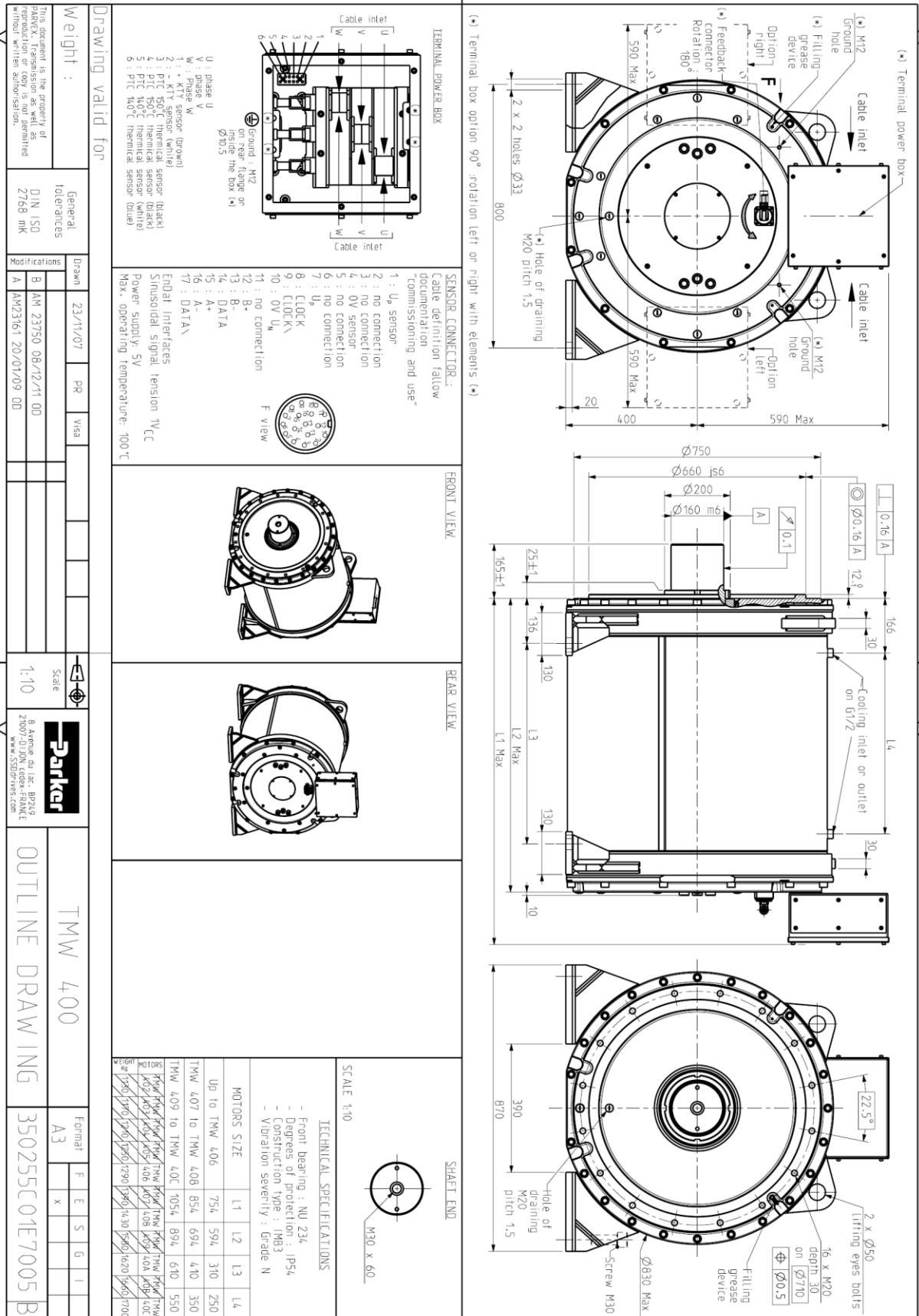
3.3.3.3. Shaft Height 400 mm, Thrust Bearing 29440



3.3.3.4. Shaft Height 400 mm, Without Thrust Bearing, With Ball Bearing



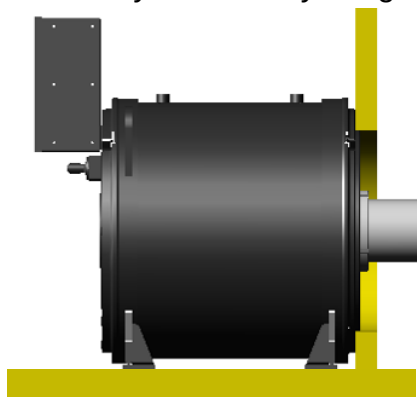
3.3.3.5. Shaft Height 400 mm, Without Thrust Bearing, With Roller Bearing



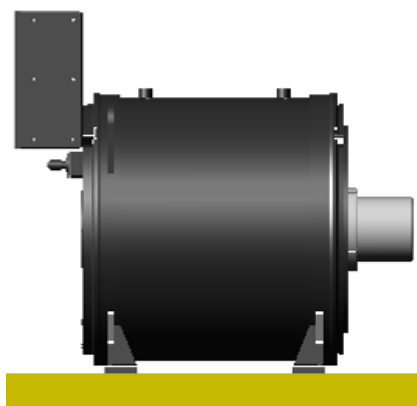
3.4. Motor Mounting

3.4.1. Motor mounting

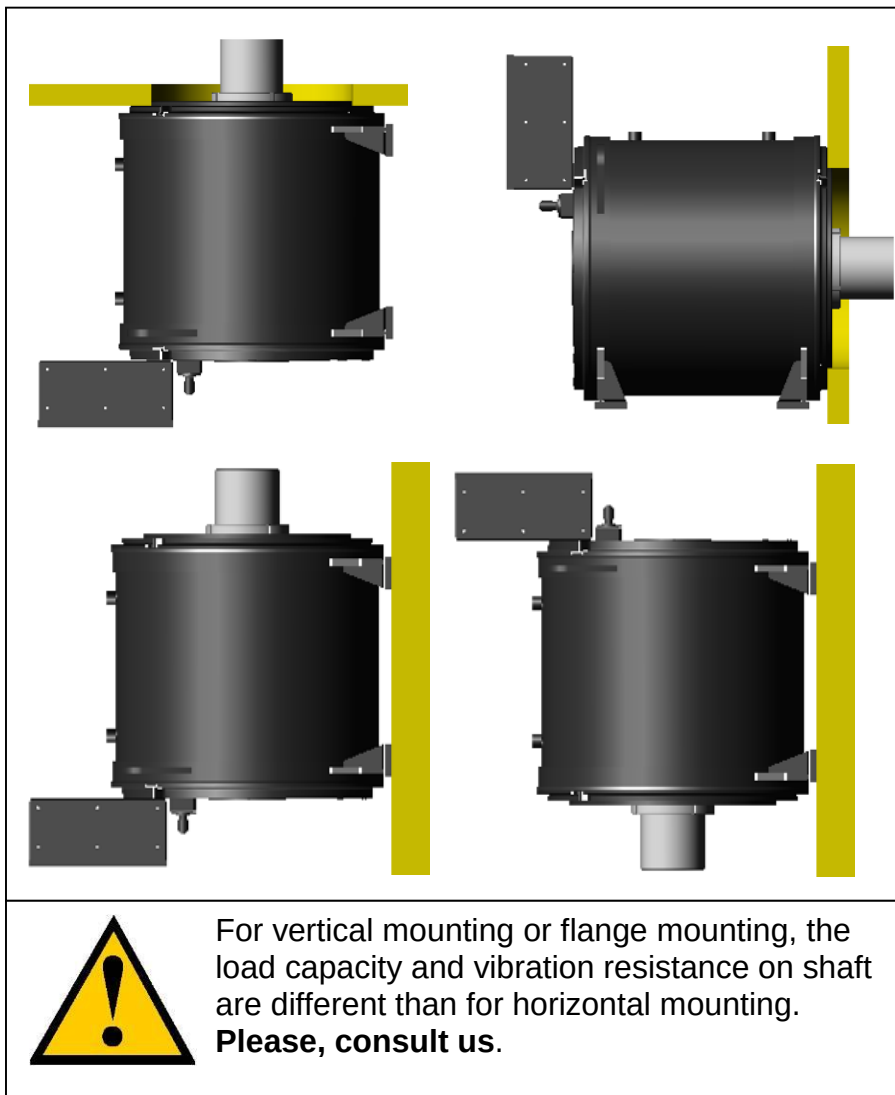
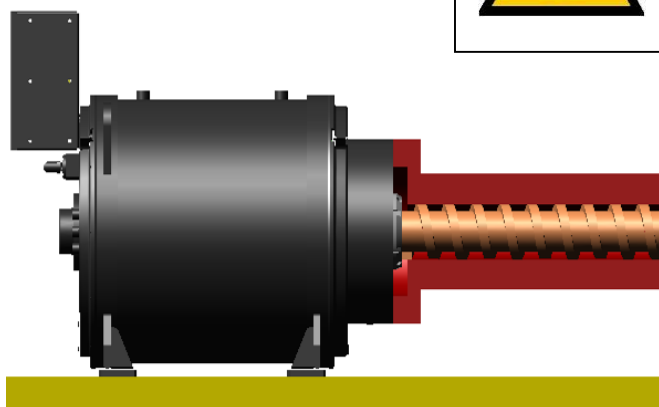
By feet and by flange



By feet



Extruder mounting



	<u>Caution:</u> For other mounting position, consult us and specify the position on the order for the drain holes location.
---	--

3.4.2. Frame recommendation

	<u>Warning</u> : The user has the entire responsibility to design and prepare the support, the coupling device, shaft line alignment, and shaft line balancing.
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Foundation must be even, sufficiently rigid and shall be dimensioned in order to avoid vibrations due to resonances.

The torque motors need a rigid support, machined and of good quality.

The maximum flatness of the support has to be lower than 0.1mm.

The motor vibration magnitudes in rms value are in accordance with IEC 60034-14 – grade A:

- maximum rms vibration velocity for TM200 is 1.8mm/s for rigid mounting
- maximum rms vibration velocity for TM300/TM400 is 2.3mm/s for rigid mounting

	<u>Warning</u> : A grade A motor (according to IEC 60034-14) well-balanced, may exhibit large vibrations when installed in-situ arising from various causes, such as unsuitable foundations, reaction of the driven motor, current ripple from the power supply, etc. Vibration may also be caused by driving elements with a natural oscillation frequency very close to the excitation due to the small residual unbalance of the rotating masses of the motor. In such cases, checks should be carried out not only on the machine, but also on each element of the installation. (See ISO 10816-3).
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	<u>Warning</u> : A bad setting of the electronic control of the close loop (gain too high, incorrect filtering ...) can occur an instability of the shaft line, vibration or/and breakdown - . Please consult us
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3.5. Shaft Loads

3.5.1. Extra protection against bearings currents

An extra protection against bearings currents is available under request. That can reduce the shaft voltages by a factor 10, reduce the bearings currents and extend the bearings life time as well.

3.5.2. Vibration resistance to shaft end

Frequency domain :10 to 55 Hz according to EN 60068 -2-6

Vibration resistance to the shaft end :

- radial 3 g

- axial 1 g

3.5.3. Motors with Thrust Bearings

As standard, TM Torque Motors are equipped with integrated spherical roller thrust bearings from SKF Explorer range.

The following tables give expected bearing lifetimes and regreasing intervals at 70°C and at various speeds for different axial dynamic bearing load, calculated using the following formula according to ISO281 and SKF recommendations:

$$Ln = \frac{10^6}{60n} \left(\frac{C}{P} \right)^{\frac{10}{3}}$$

Ln = Thrust bearing life time, **hours**

n = Rotational speed, **r/min**

C = Basic dynamic load rating, **kN**

P = Equivalent dynamic bearing load, **kN**

Thrust Bearing	Availability													Basic dynamic load (kN)
	TMW20													
	1	2	3	4	5	6	7	8	9	A	B	C		
29420				S	S	S	S	S						980
29424				O	O	O	O	O						1370
	TMW30													
	1	2	3	4	5	6	7	8	9	A	B	C		
29422				S	O	O	O	O		O				1180
29426				O	S	S	S	S		S				1560
29430				O	O	O	O	O		O				1860
	TMW40													
	1	2	3	4	5	6	7	8	9	A	B	C		
29430						S		O		O		O		1860
29434						O		S		S		S		2360
29440						O		O		O		O		3200

S = Standard, O = Optional

For extruder application, a raw estimation of axial load can be calculated with following formula

$$F_A = P_e \cdot \frac{\pi \cdot D^2}{40}$$

F_A : Axial Load, **N**

D : Extruder screw diameter, **mm**

P_e : Pressure on extruder screw, **Bar**

Example : For a pressure of 300bars and an extruder diameter of 50mm, the axial load is 58.9kN

3.5.3.1. 29420 Thrust Bearings lifetime and regreasing interval vs speed and load

Axis load (kN)	Rotation speed (rpm)	50	100	150	200	250	300	350	400	450	500	550	600
		50	100	150	200	250	300	350	400	450	500	550	600
60	Thrust bearing service life (h)	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000
	Re-greasing interval (h)	7000	7000	7000	7000	7000	7000	7000	7000	6200	5200	4400	3700
80	Thrust bearing service life (h)	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000
	Re-greasing interval (h)	7000	7000	7000	7000	7000	7000	7000	6300	5300	4400	3700	3100
100	Thrust bearing service life (h)	>100000	>100000	>100000	>100000	>100000	>100000	95900	83900	74600	67100	61000	55900
	Re-greasing interval (h)	7000	7000	7000	7000	7000	6800	5700	4800	4000	3300	2800	2400
120	Thrust bearing service life (h)	>100000	>100000	>100000	91400	73100	60900	52200	45700	40600	36600	33200	30500
	Re-greasing interval (h)	7000	7000	7000	7000	6200	5200	4400	3700	3100	2600	2200	1800
140	Thrust bearing service life (h)	>100000	>100000	72900	54700	43700	36500	31200	27300	24300	21900	19900	18200
	Re-greasing interval (h)	7000	7000	7000	6000	5000	4200	3500	3000	2500	2100	1700	1500
160	Thrust bearing service life (h)	>100000	70100	46700	35000	28000	23400	20000	17500	15600	14000	12700	N/A
	Re-greasing interval (h)	7000	7000	5900	5000	4200	3500	2900	2500	2100	1700	1500	N/A
180	Thrust bearing service life (h)	94600	47300	31500	23700	18900	15800	13500	11800	10500	9500	N/A	N/A
	Re-greasing interval (h)	7000	6000	5100	4300	3600	3000	2500	2100	1800	1500	N/A	N/A
200	Thrust bearing service life (h)	66600	33300	22200	16700	13300	11100	9500	8300	7400	N/A	N/A	N/A
	Re-greasing interval (h)	6300	5300	4500	3700	3100	2600	2200	1900	1600	N/A	N/A	N/A
220	Thrust bearing service life (h)	48500	24200	16200	12100	9700	8100	6900	6100	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	5700	4800	4000	3300	2800	2400	2000	1700	N/A	N/A	N/A	N/A
240	Thrust bearing service life (h)	36300	18100	12100	9100	7300	6000	5200	N/A	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	5100	4300	3600	3000	2600	2100	1800	N/A	N/A	N/A	N/A	N/A

3.5.3.1. 29422 Thrust Bearings lifetime and regreasing interval vs speed and load

Axis load (kN)	Rotation speed (rpm)	50	100	150	200	250	300	350	400	450	500	550	600
70	Thrust bearing service life (h)	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000
	Re-greasing interval (h)	7000	7000	7000	7000	7000	7000	7000	6400	5300	4400	3600	3000
90	Thrust bearing service life (h)	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000
	Re-greasing interval (h)	7000	7000	7000	7000	7000	7000	7000	5900	4800	4000	3300	2700
110	Thrust bearing service life (h)	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	90700	82500	75600
	Re-greasing interval (h)	7000	7000	7000	7000	7000	6900	5700	4700	3900	3200	2600	2200
130	Thrust bearing service life (h)	>100000	>100000	>100000	>100000	>100000	86700	74300	65000	57800	52000	47300	43300
	Re-greasing interval (h)	7000	7000	7000	7000	6600	5500	4500	3700	3100	2500	2100	1700
150	Thrust bearing service life (h)	>100000	>100000	>100000	80700	64500	53800	46100	40300	35900	32300	29300	26900
	Re-greasing interval (h)	7000	7000	7000	6600	5400	4500	3700	3000	2500	2100	1700	1400
170	Thrust bearing service life (h)	>100000	>100000	70900	53200	42500	35400	30400	26600	23600	21300	19300	17700
	Re-greasing interval (h)	7000	7000	6700	5500	4500	3700	3100	2500	2100	1700	1400	1200
190	Thrust bearing service life (h)	>100000	73400	48900	36700	29400	24500	21000	18300	16300	14700	13300	N/A
	Re-greasing interval (h)	7000	6900	5700	4700	3900	3200	2700	2200	1800	1500	1200	
210	Thrust bearing service life (h)	>100000	52600	35000	26300	21000	17500	15000	13100	11700	10500	N/A	N/A
	Re-greasing interval (h)	7000	6100	5000	4100	3400	2800	2300	1900	1600	1300		
230	Thrust bearing service life (h)	77600	38800	25900	19400	15500	12900	11100	9700	8600	N/A	N/A	N/A
	Re-greasing interval (h)	6600	5400	4500	3700	3000	2500	2100	1700	1400			
250	Thrust bearing service life (h)	58800	29400	19600	14700	11800	9800	8400	7300	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	6000	4900	4100	3300	2800	2300	1900	1500				
270	Thrust bearing service life (h)	45500	22700	15200	11400	9100	7600	6500	N/A	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	5400	4500	3700	3100	2500	2100	1700					
290	Thrust bearing service life (h)	35900	17900	12000	9000	7200	6000	5100	N/A	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	5000	4200	3400	2800	2300	1900	1600					

3.5.3.2. 29424 Thrust Bearings lifetime and regreasing interval vs speed and load

Axis load (kN)	Rotation speed (rpm)	50	100	150	200	250	300	350	400	450	500	550	600
90	Thrust bearing service life (h)	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000
	Re-greasing interval (h)	7000	7000	7000	7000	7000	7000	6900	5600	4600	3700	3000	2400
110	Thrust bearing service life (h)	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000
	Re-greasing interval (h)	7000	7000	7000	7000	7000	7000	6000	4900	4000	3200	2600	2100
130	Thrust bearing service life (h)	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	95000	85500	77800	71300
	Re-greasing interval (h)	7000	7000	7000	7000	7000	6100	4900	4000	3200	2600	2100	1700
150	Thrust bearing service life (h)	>100000	>100000	>100000	>100000	>100000	88500	75800	66400	59000	53100	48300	44200
	Re-greasing interval (h)	7000	7000	7000	7000	6200	5000	4100	3300	2700	2200	1800	1400
170	Thrust bearing service life (h)	>100000	>100000	>100000	87400	70000	58300	50000	43700	38900	35000	31800	29100
	Re-greasing interval (h)	7000	7000	7000	6400	5200	4200	3400	2700	2200	1800	1500	1200
190	Thrust bearing service life (h)	>100000	>100000	80500	60400	48300	40200	34500	30200	26800	24100	21900	N/A
	Re-greasing interval (h)	7000	7000	6700	5400	4400	3600	2900	2300	1900	1500	1300	
210	Thrust bearing service life (h)	>100000	86500	57600	43200	34600	28800	24700	21600	19200	17300	N/A	N/A
	Re-greasing interval (h)	7000	7000	5800	4700	3800	3100	2500	2000	1700	1300		
230	Thrust bearing service life (h)	>100000	63800	42600	31900	25500	21300	18200	16000	14200	N/A	N/A	N/A
	Re-greasing interval (h)	7000	6300	5100	4200	3400	2700	2200	1800	1500			
250	Thrust bearing service life (h)	96700	48400	32200	24200	19300	16100	13800	12100	10700	N/A	N/A	N/A
	Re-greasing interval (h)	7000	5700	4600	3700	3000	2500	2000	1600	1300			
270	Thrust bearing service life (h)	74800	37400	24900	18700	15000	12500	10700	9400	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	6400	5200	4200	3400	2800	2200	1800	1500				
290	Thrust bearing service life (h)	59000	29500	19700	14700	11800	9800	8400	N/A	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	5900	4800	3900	3100	2500	2100	1700					
310	Thrust bearing service life (h)	47200	23600	15700	11800	9400	7900	6700	N/A	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	5400	4400	3600	2900	2300	1900	1500					
330	Thrust bearing service life (h)	38300	19200	12800	9600	7700	6400	N/A	N/A	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	5100	4100	3300	2700	2200	1800						
350	Thrust bearing service life (h)	31500	15800	10500	7900	6300	5300	N/A	N/A	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	4800	3900	3100	2500	2100	1700						

3.5.3.3. 29426 Thrust Bearings lifetime and regreasing interval vs speed and load

Axis load (kN)	Rotation speed (rpm)	50	100	150	200	250	300	350	400	450	500	550	600
100	Thrust bearing service life (h)	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000
	Re-greasing interval (h)	7000	7000	7000	7000	7000	7000	6200	4900	3900	3100	2500	2000
120	Thrust bearing service life (h)	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000
	Re-greasing interval (h)	7000	7000	7000	7000	7000	7000	5600	4400	3500	2800	2300	1800
140	Thrust bearing service life (h)	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	93600	85800
	Re-greasing interval (h)	7000	7000	7000	7000	7000	5900	4700	3700	3000	2400	1900	1500
160	Thrust bearing service life (h)	>100000	>100000	>100000	>100000	>100000	>100000	94300	82500	73300	66000	60000	55000
	Re-greasing interval (h)	7000	7000	7000	7000	6200	4900	3900	3100	2500	2000	1600	1300
180	Thrust bearing service life (h)	>100000	>100000	>100000	>100000	89100	74300	63700	55700	49500	44600	40500	37100
	Re-greasing interval (h)	7000	7000	7000	6600	5300	4200	3300	2700	2100	1700	1400	1100
200	Thrust bearing service life (h)	>100000	>100000	>100000	78400	62700	52300	44800	39200	34900	31400	28500	N/A
	Re-greasing interval (h)	7000	7000	7000	5700	4500	3600	2900	2300	1800	1500	1200	
220	Thrust bearing service life (h)	>100000	>100000	76100	57100	45700	38100	32600	28500	25400	22800	N/A	N/A
	Re-greasing interval (h)	7000	7000	6200	5000	3900	3100	2500	2000	1600	1300		
240	Thrust bearing service life (h)	>100000	85400	56900	42700	34200	28500	24400	21400	19000	N/A	N/A	N/A
	Re-greasing interval (h)	7000	6900	5500	4400	3500	2800	2200	1800	1400			
260	Thrust bearing service life (h)	>100000	65400	43600	32700	26200	21800	18700	16400	14500	N/A	N/A	N/A
	Re-greasing interval (h)	7000	6200	4900	3900	3100	2500	2000	1600	1300			
280	Thrust bearing service life (h)	>100000	51100	34100	25500	20400	17000	14600	12800	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	7000	5600	4500	3600	2900	2300	1800	1400				
300	Thrust bearing service life (h)	81200	40600	27100	20300	16200	13500	11600	N/A	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	6500	5200	4100	3300	2600	2100	1700					
320	Thrust bearing service life (h)	65500	32700	21800	16400	13100	10900	9400	N/A	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	6000	4800	3800	3000	2400	1900	1500					
340	Thrust bearing service life (h)	53500	26800	17800	13400	10700	8900	N/A	N/A	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	5600	4400	3500	2800	2300	1800						
360	Thrust bearing service life (h)	44200	22100	14700	11100	8800	7400	N/A	N/A	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	5200	4200	3300	2600	2100	1700						
380	Thrust bearing service life (h)	36900	18500	12300	9200	7400	6200	N/A	N/A	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	4900	3900	3100	2500	2000	1600						

3.5.3.4. 29430 Thrust Bearings lifetime and regreasing interval vs speed and load

Axis load (kN)	Rotation speed (rpm)	50	100	150	200	250	300	350	400	450	500	550	600
120	Thrust bearing service life (h)	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000
	Re-greasing interval (h)	7000	7000	7000	7000	7000	6500	5000	3900	3000	2400	1800	1400
150	Thrust bearing service life (h)	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000
	Re-greasing interval (h)	7000	7000	7000	7000	7000	5600	4400	3400	2600	2000	1600	1200
180	Thrust bearing service life (h)	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	89000	80100	72800	66800
	Re-greasing interval (h)	7000	7000	7000	7000	5800	4500	3500	2700	2100	1600	1300	1000
210	Thrust bearing service life (h)	>100000	>100000	>100000	>100000	95800	79900	68500	59900	53200	47900	43600	N/A
	Re-greasing interval (h)	7000	7000	7000	6100	4700	3600	2800	2200	1700	1300	1000	N/A
240	Thrust bearing service life (h)	>100000	>100000	>100000	76800	61400	51200	43900	38400	34100	30700	N/A	N/A
	Re-greasing interval (h)	7000	7000	6500	5000	3900	3000	2300	1800	1400	1100	N/A	N/A
270	Thrust bearing service life (h)	>100000	>100000	69100	51800	41500	34600	29600	25900	23000	N/A	N/A	N/A
	Re-greasing interval (h)	7000	7000	5500	4200	3300	2600	2000	1500	1200	N/A	N/A	N/A
300	Thrust bearing service life (h)	>100000	73000	48600	36500	29200	24300	20800	18200	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	7000	6100	4700	3700	2800	2200	1700	1300	N/A	N/A	N/A	N/A
330	Thrust bearing service life (h)	>100000	53100	35400	26600	21200	17700	15200	N/A	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	7000	5400	4200	3200	2500	1900	1500	N/A	N/A	N/A	N/A	N/A
360	Thrust bearing service life (h)	79500	39700	26500	19900	15900	13200	11400	N/A	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	6200	4800	3700	2900	2300	1700	1400	N/A	N/A	N/A	N/A	N/A
390	Thrust bearing service life (h)	60900	30400	20300	15200	12200	10100	N/A	N/A	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	5700	4400	3400	2600	2000	1600	N/A	N/A	N/A	N/A	N/A	N/A
420	Thrust bearing service life (h)	47500	23800	15800	11900	9500	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	5200	4000	3100	2400	1900	N/A	N/A	N/A	N/A	N/A	N/A	N/A
450	Thrust bearing service life (h)	37800	18900	12600	9400	7600	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	4800	3700	2900	2200	1700	N/A	N/A	N/A	N/A	N/A	N/A	N/A

3.5.3.5. 29434 Thrust Bearings lifetime and regreasing interval vs speed and load

Axis load (kN)	Rotation speed (rpm)	50	100	150	200	250	300	350	400	450	500	550	600
150	Thrust bearing service life (h)	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000
	Re-greasing interval (h)	7000	7000	7000	7000	7000	5300	4000	3000	2200	1700	1300	900
180	Thrust bearing service life (h)	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000
	Re-greasing interval (h)	7000	7000	7000	7000	6500	4800	3600	2700	2000	1500	1100	900
210	Thrust bearing service life (h)	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	96300	88300
	Re-greasing interval (h)	7000	7000	7000	7000	5500	4100	3100	2300	1700	1300	1000	700
240	Thrust bearing service life (h)	>100000	>100000	>100000	>100000	>100000	>100000	97000	84900	75400	67900	61700	N/A
	Re-greasing interval (h)	7000	7000	7000	6100	4600	3400	2600	1900	1400	1100	800	
270	Thrust bearing service life (h)	>100000	>100000	>100000	>100000	91700	76400	65500	57300	50900	45900	N/A	N/A
	Re-greasing interval (h)	7000	7000	6900	5200	3900	2900	2200	1600	1200	900		
300	Thrust bearing service life (h)	>100000	>100000	>100000	80700	64500	53800	46100	40300	35900	N/A	N/A	N/A
	Re-greasing interval (h)	7000	7000	6000	4500	3400	2500	1900	1400	1100			
330	Thrust bearing service life (h)	>100000	>100000	78300	58700	47000	39100	33600	29400	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	7000	7000	5200	3900	2900	2200	1600	1200				
360	Thrust bearing service life (h)	>100000	87900	58600	43900	35200	29300	25100	N/A	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	7000	6200	4600	3500	2600	1900	1500					
390	Thrust bearing service life (h)	>100000	67300	44900	33600	26900	22400	19200	N/A	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	7000	5500	4100	3100	2300	1700	1300					
420	Thrust bearing service life (h)	>100000	52600	35000	26300	21000	17500	N/A	N/A	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	6700	5000	3800	2800	2100	1600						
450	Thrust bearing service life (h)	83500	41800	27800	20900	16700	13900	N/A	N/A	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	6100	4600	3400	2600	1900	1500						
480	Thrust bearing service life (h)	67400	33700	22500	16800	13500	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	5700	4300	3200	2400	1800							
510	Thrust bearing service life (h)	55000	27500	18300	13800	11000	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	5300	4000	3000	2200	1700							
540	Thrust bearing service life (h)	45500	22700	15200	11400	9100	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	4900	3700	2800	2100	1600							
570	Thrust bearing service life (h)	38000	19000	12700	9500	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	4700	3500	2600	2000								

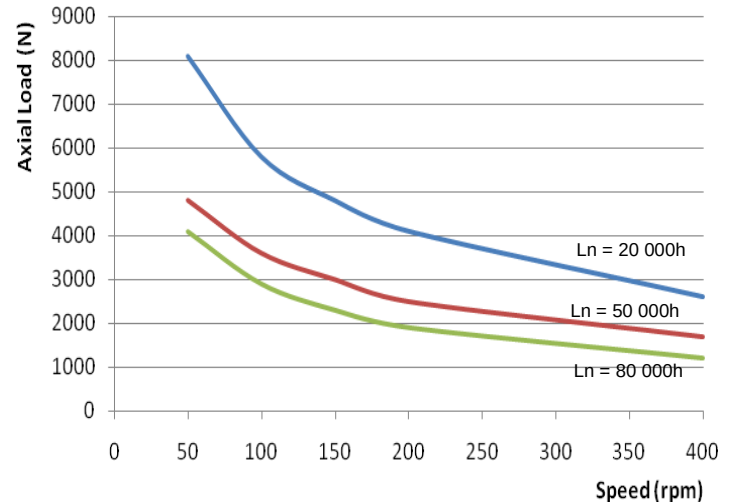
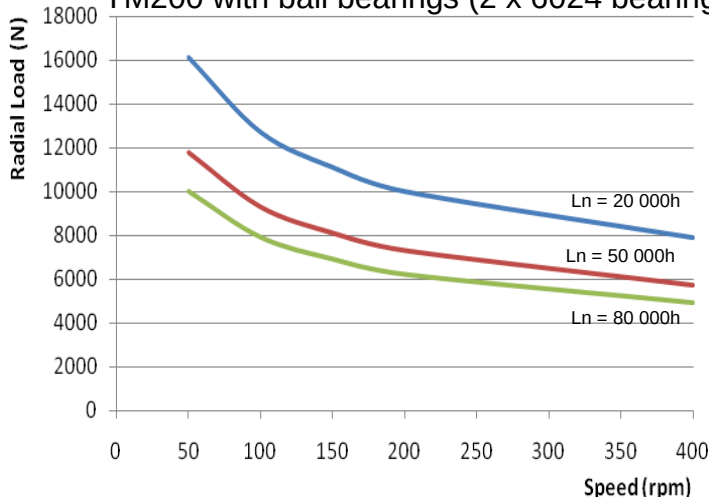
3.5.3.6. 29440 Thrust Bearings lifetime and regreasing interval vs speed and load

Axis load (kN)	Rotation speed (rpm)	50	100	150	200	250	300	350	400	450	500	550	600
280	Thrust bearing service life (h)	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	>100000	N/A	N/A
	Re-greasing interval (h)	7000	7000	7000	6100	4300	3100	2200	1600	1100	800		
320	Thrust bearing service life (h)	>100000	>100000	>100000	>100000	>100000	>100000	>100000	89800	79800	N/A	N/A	N/A
	Re-greasing interval (h)	7000	7000	7000	5100	3600	2600	1800	1300	900			
360	Thrust bearing service life (h)	>100000	>100000	>100000	>100000	97000	80800	69300	60600	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	7000	7000	6100	4300	3100	2200	1600	1100				
400	Thrust bearing service life (h)	>100000	>100000	>100000	85300	68300	56900	48800	42700	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	7000	7000	5200	3700	2700	1900	1300	1000				
440	Thrust bearing service life (h)	>100000	>100000	82800	62100	49700	41400	35500	N/A	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	7000	6400	4600	3300	2300	1700	1200					
480	Thrust bearing service life (h)	>100000	92900	62000	46500	37200	31000	N/A	N/A	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	7000	5700	4100	2900	2100	1500						
520	Thrust bearing service life (h)	>100000	71200	47500	35600	28500	23700	N/A	N/A	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	7000	5100	3600	2600	1800	1300						
560	Thrust bearing service life (h)	>100000	55600	37100	27800	22200	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	6500	4600	3300	2300	1700							
600	Thrust bearing service life (h)	88400	44200	29500	22100	17700	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	6000	4200	3000	2200	1500							
640	Thrust bearing service life (h)	71200	35600	23700	17800	14200	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	5500	3900	2800	2000	1400							
680	Thrust bearing service life (h)	58200	29100	19400	14600	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	5100	3600	2600	1800								
720	Thrust bearing service life (h)	48100	24100	16000	12000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	4800	3400	2400	1700								
760	Thrust bearing service life (h)	40200	20100	13400	10000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	4500	3200	2300	1600								
800	Thrust bearing service life (h)	33900	16900	11300	8500	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Re-greasing interval (h)	4300	3000	2200	1500								

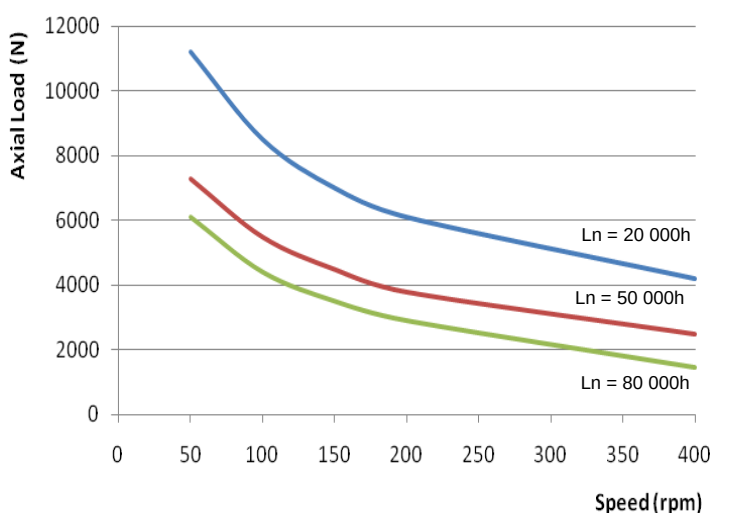
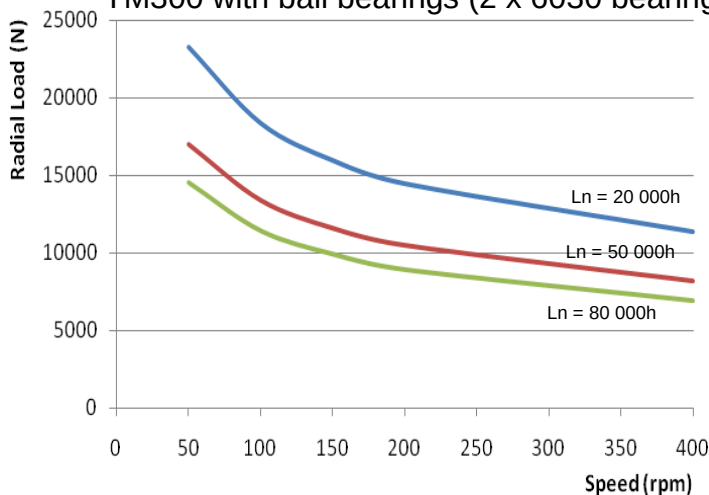
3.5.4. Motors without Thrust Bearings

As an option, TM Torque Motors are also available without thrust bearings, with either ball bearings or roller bearings. The following curves give indicative values of maximum admissible radial (in the middle of the shaft) and axial cumulative loads for both configurations. Those values are given for a bearing lifetime of 200000h, 50000h and 80000h in horizontal mounting.

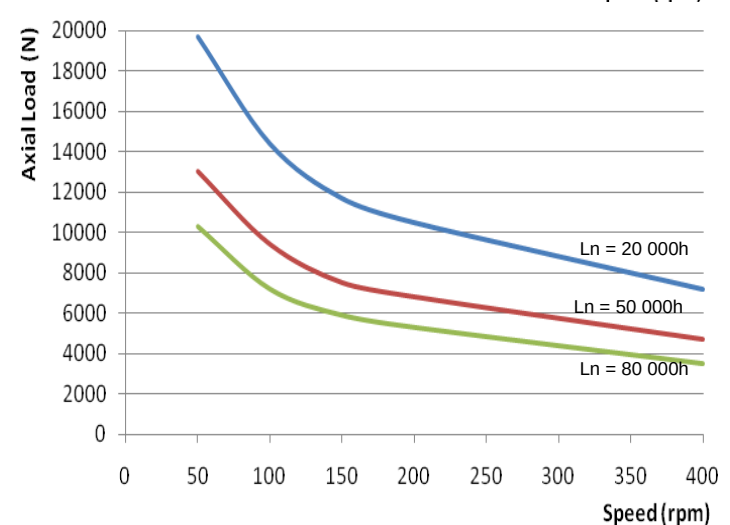
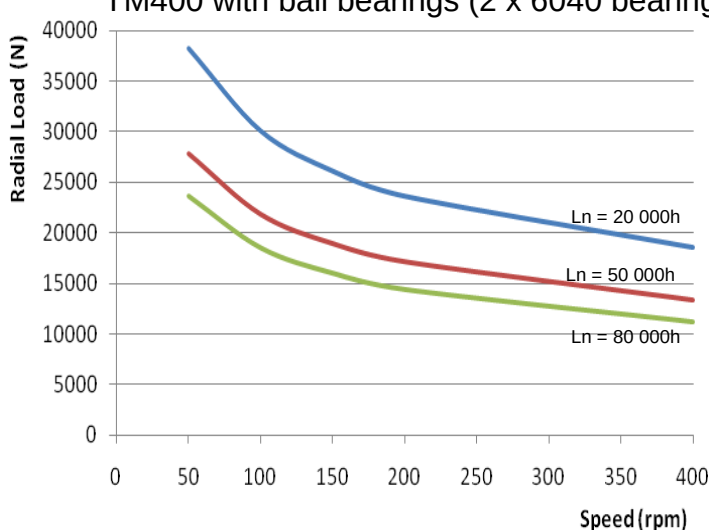
TM200 with ball bearings (2 x 6024 bearing)



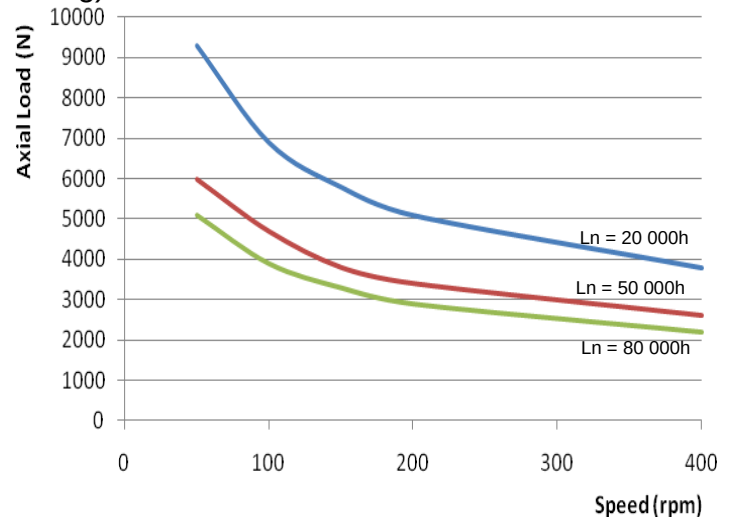
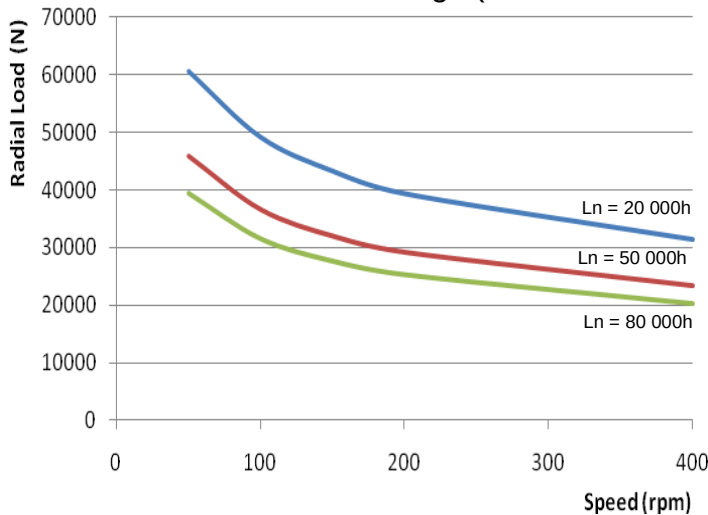
TM300 with ball bearings (2 x 6030 bearing)



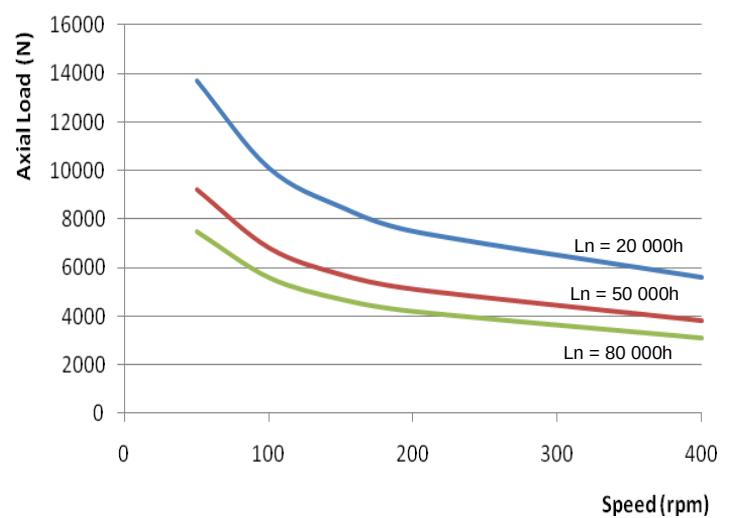
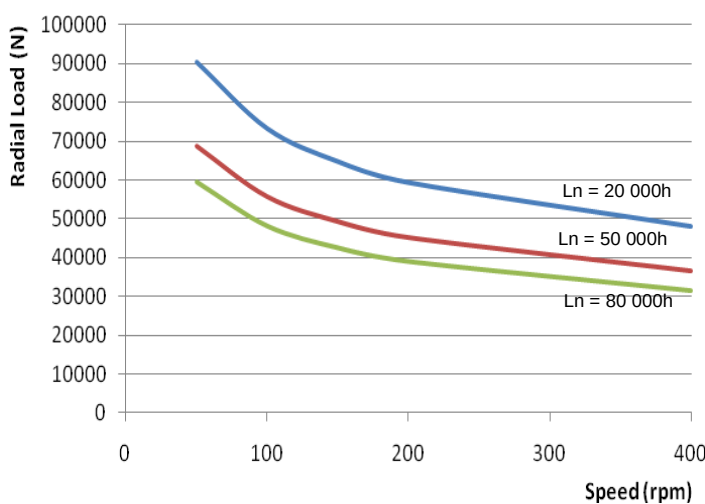
TM400 with ball bearings (2 x 6040 bearing)



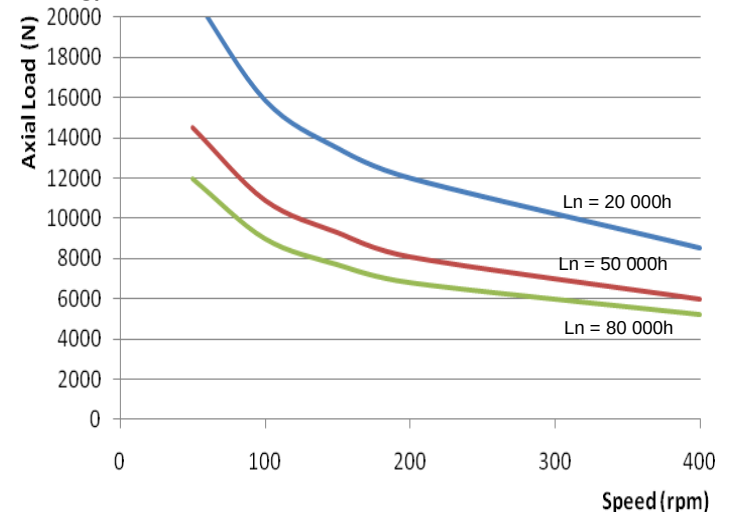
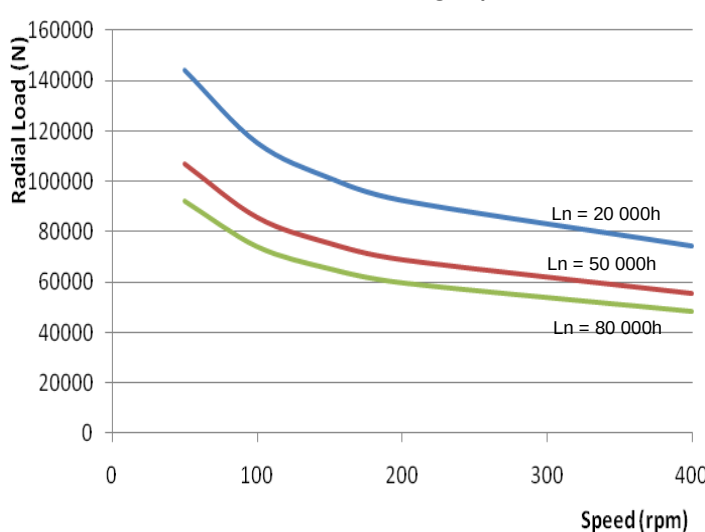
TM200 with roller bearings (NU220 + 6024 bearing)



TM300 with roller bearings (NU226 + 6030 bearing)



TM400 with roller bearings (NU234 + 6040 bearing)



For the roller bearing arrangement, the second bearing on the rear is a ball bearing. This rear bearing is blocked in axial translation and the roller bearing is free in translation to avoid any stress from the shaft thermal expansion during the running. So, it is important not to block in translation the shaft expansion by any extra bearing or similar device.

3.6. Cooling

In compliance with the IEC 60034-1 standards:

3.6.1. Natural cooled motor – TMA series

The ambient air temperature shall not be less than **-15°C** and more than **40°C**.

	It is possible to use the motors in an higher ambient temperature but with an associated derating to the motor performances.
	<u>Caution:</u> the ambient air temperature shall not exceed 40°C in the vicinity of the motor flange
	<u>Warning:</u> A significant part of the heat produced by the motor is evacuated through the flange. • if the air is not able to circulate freely around the motor, • if the motor is mounted on a surface that dissipates not well the heating (surface with little dimensions for instance), • if the motor is thermally isolated, • if the motor is mounted on a warm surface (mounted on a gearbox for instance), then the motor has to be used at a torque less than the rated torque.

3.6.2. Water cooled motor – TMW series

	<u>Danger:</u> The cooling system has to be operational when the motor is running or energized.
	<u>Danger:</u> The Inlet temperature and the water flow have to be monitored to avoid any exceeding values.
	<u>Caution:</u> When motor is not running, the cooling system has to be stopped 10 minutes after motor shut down.
	<u>Caution:</u> Condensation and risk of rust may occur when the temperature gradient between the air and the water becomes significant. Condensation is also linked to hygrometry rate. To avoid any issue, we recommend: $T_{\text{water}} > T_{\text{air}} - 2^{\circ}\text{C}$. The motor can be used with an ambient temperature between 27°C to 40°C with a high water temperature but with derating. If inlet water temperature becomes higher than 25°C, derating factor must be applied according to §3.1.2 Temperature Derating
	<u>Caution:</u> the ambient air temperature shall not exceed 40°C in the vicinity of the motor flange
	<u>Danger:</u> If the water flow stops, the motor can be damaged or destroyed causing accidents.

3.6.3. Additives for water as cooling media

Please refer to motor technical data for coolant flow rates.

The water inlet temperature must not exceed **25°C** without torque derating.
The water inlet temperature must not be below **5°C**.

The inner pressure of the cooling liquid must not exceed **5 bars**.



Caution: To avoid the appearance of rust on the steel of the motor cooling system, the water must have anti-corrosion additive.

The torque motors are water cooled. Corrosion inhibitors must be added to the water to avoid the corrosion. The complete cooling system must be taken into account to choose the right additive, this includes: the different materials in the cooling circuit, the chiller manufacturer recommendations, the quality of the water...

The right additive solution is under the responsibility of the user. Some additives like TYFOCOR or GLYSANTIN G48 correctly used have demonstrated their ability to prevent corrosion in a closed cooling circuit.

For example: Glysantin G48 recommendations are :

- Water hardness: 0 to 20°dH (0 – 3.6 mmol/l)
- Chloride content: max. 100ppm
- Sulphate content: max. 100ppm



Caution: The water quality is very important and must comply with supplier recommendations. The additive quantity and periodic replacement must respect the same supplier recommendations.



Caution: The additive choice must take into account the global cooling system (chiller or water exchanger recommendations...).



Select carefully the materials of all the cooling system parts (chiller, exchanger, hoses, adapters and fittings) because the difference between material galvanic potential can make corrosion.

3.6.4. Motor cooling circuit drop pressure

The tab below describes the drop pressure at the water flow rate from the motor data:

Motor type	Drop pressure @ nominal water flow
All TMW200	0.1 to 0.4 bar
Up to TMW304	0.1 to 0.4 bar
TMW305 to TMW306	0.2 to 0.8 bar
TMW306 to TMW30A	1 to 2 bar
Up to TMW406	0.1 to 0.4 bar
TMW407 to TMW408	0.2 to 1.5 bar
TMW409 to TMW40C	1 to 2.5 bar

Note : all motors drop pressure are checked before shipping.

3.6.5. Chiller selection

This section describes how to choose the chiller. The chiller is able to evacuate the heat from the motor losses with the water circulation.

The motor losses (= power to evacuate by the chiller) depend on the efficiency and motor power:

$$P_c = \left(\frac{1}{\rho} - 1 \right) \cdot P_n$$

With P_c : Power to evacuate by the chiller (kW)
 P_n : Nominal motor power (kW)
 ρ : motor efficiency at nominal power (%)

Refer to the respective torque motor data sheet for nominal power, efficiency and water flow.

Chiller pump must provide water flow through motor and pipe pressure drop. Inlet temperature must be inferior to **25°C**.

Example

Motor : TMW30ALN (see §3.2)

Nominal power = 135kW

Efficiency = 84.6%

Water flow = 35 l/min

$$P_c = \left(\frac{1}{0.846} - 1 \right) \cdot 135 = \mathbf{25 \text{ kW}}$$

So, the chiller must evacuate 25 kW and has a water flow of 35 l/min for a TMW30ALN

3.6.6. Parker Hiross Chiller selection vs TMW series

You can find various chillers solutions in Parker Hiross - <http://www.dh-hiross.com/>

Table of chiller selection with water + 25% glycol

			Series Hyperchill type ICE		
Motor Type	Power dissipation [kW]	Flow rate [l/min]	Chiller	Power dissipation capability [kW]	Flowrate capability [l/min]
TMW204L	6,2	10	ICE010	7.40	10.5
TMW205L	7,9	13	ICE015	11.1	31.5
TMW206L	9,7	15			
TMW207L	11,0	17			
TMW208L	12,6	20	ICE022	17,8	51,1
TMW304L	10,9	17	ICE015	11.1	31.5
TMW305L	13,7	22	ICE022	17,8	51,1
TMW306L	15,8	25			
TMW308L	20,3	32	ICE029	23,0	66,1
TMW30AL	24,9	39	ICE039	31,6	90.3
TMW404L	14,3	23	ICE022	17,8	51,1
TMW405L	17,5	28			
TMW406L	20,6	33	ICE029	23,0	66,1
TMW408L	27,4	43	ICE039	31,6	90,3
TMW40AL	33,6	53	ICE046	37,1	106,5
TMW40CL	38,7	61	ICE057	45,8	130,8

3.6.7. Flow derating according to glycol concentration

	Glycol concentration [%]					
	0	10	20	30	40	50
Flow rate [l/min]	5	5.1	5.3	5.6	5.9	6.2
	10	10.2	10.6	11.1	11.8	12.4
	15	15.3	15.9	16.7	17.6	18.7
	20	20.4	21.2	22.2	23.5	24.9
	25	25.5	26.5	27.8	29.4	31.1
	30	30.6	31.8	33.4	35.3	37.3
	35	35.7	37.1	38.9	41.1	43.6
	40	40.8	42.4	44.5	47.0	49.8
	45	45.9	47.7	50.0	52.9	56.0
	50	51.0	53.0	55.6	58.8	62.2
	55	56.1	58.3	61.2	64.7	68.4
	60	61.2	63.5	66.7	70.5	74.7
	65	66.4	68.8	72.3	76.4	80.9
	70	71.5	74.1	77.8	82.3	87.1
	75	76.6	79.4	83.4	88.2	93.3
	80	81.7	84.7	89.0	94.1	99.5
	85	86.8	90.0	94.5	99.9	105.8
	90	91.9	95.3	100.1	105.8	112.0
	95	97.0	100.6	105.6	111.7	118.2
	100	102.1	105.9	111.2	117.6	124.4
	110	112.3	116.5	122.3	129.3	136.9
	120	122.5	127.1	133.4	141.1	149.3
	130	132.7	137.7	144.6	152.8	161.8
	140	142.9	148.3	155.7	164.6	174.2
	150	153.1	158.9	166.8	176.3	186.6
	160	163.3	169.5	177.9	188.1	199.1
	170	173.5	180.1	189.0	199.9	211.5
	180	183.7	190.6	200.2	211.6	224.0
	190	194.0	201.2	211.3	223.4	236.4
	200	204.2	211.8	222.4	235.1	248.9

Use of the table above - Example

If the motor needs **25 l/min** with **0%** glycol,

If application needs **20%** glycol, the water flow must be **26.5 l/min**,

If application needs **40%** glycol, the water flow must be **29.4 l/min**.



According to the table “Parker Hiross Chiller selection vs TMW series” given

The motor needs a chiller:

ICE022 with **0%** glycol,

ICE029 with **20%** glycol,

ICE029 with **40%** glycol.

<u>Glycol concentration</u>	0%	20%	40%
Flow rate requested [l/min]	25	26.5	29.4
Chiller type:	ICE022	ICE029	ICE029
Flow rate capability [l/min]	25.5	33.1	33.1

Main formulas

$$Flow_rate = \frac{Power_dissipation * 60}{\Delta\theta * C_p}$$

With: *Flow rate* [l/min]

Power_dissipation [W]

$\Delta\theta$ Gradient inlet-outlet [°C]

C_p thermal specific capacity of the water as coolant [J/kg°K]

(**C_p** depends on the % glycol concentration please see below)

Thermal specific capacity C_p according to % glycol concentration and temperature

We have considered an average temperature of the coolant of 30°C.

Glycol concentration [%]	Average temperature of the water as coolant [°C]	Thermal specific capacity of the water C_p [J/kg°K]
0	30	4176
30	30	3755
40	30	3551
50	30	3354

3.6.8. Water circuit capacity

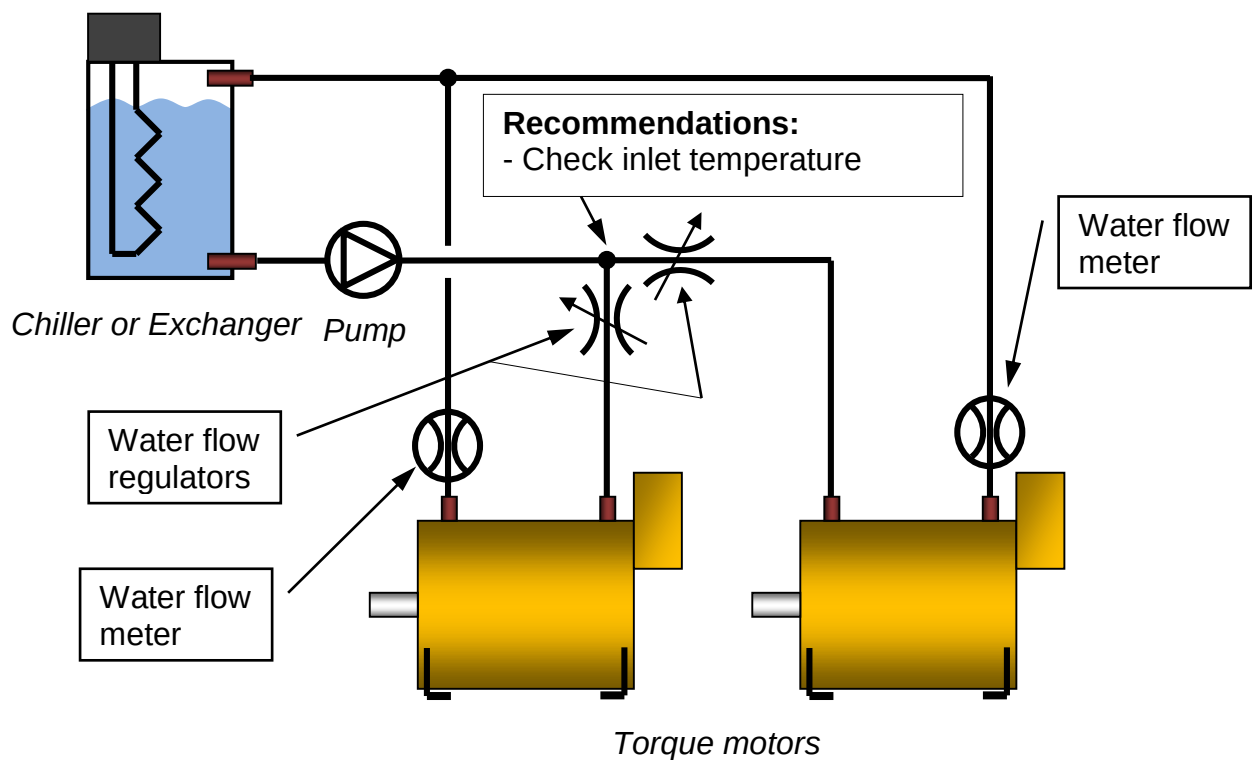
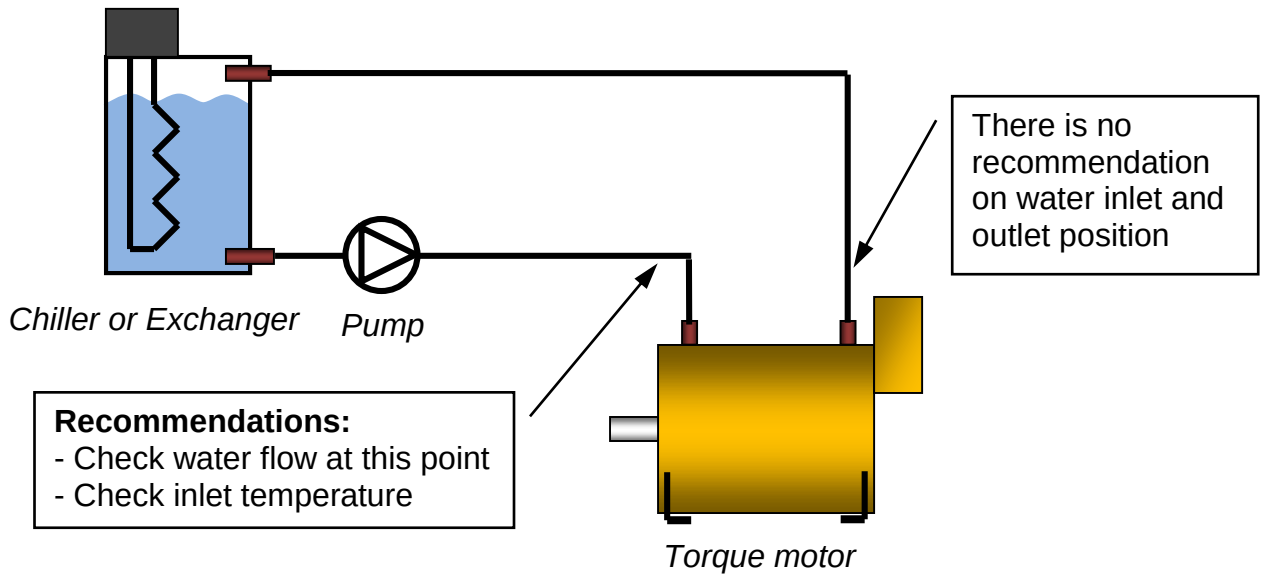
This tab describes the water volume inside the cooling circuit

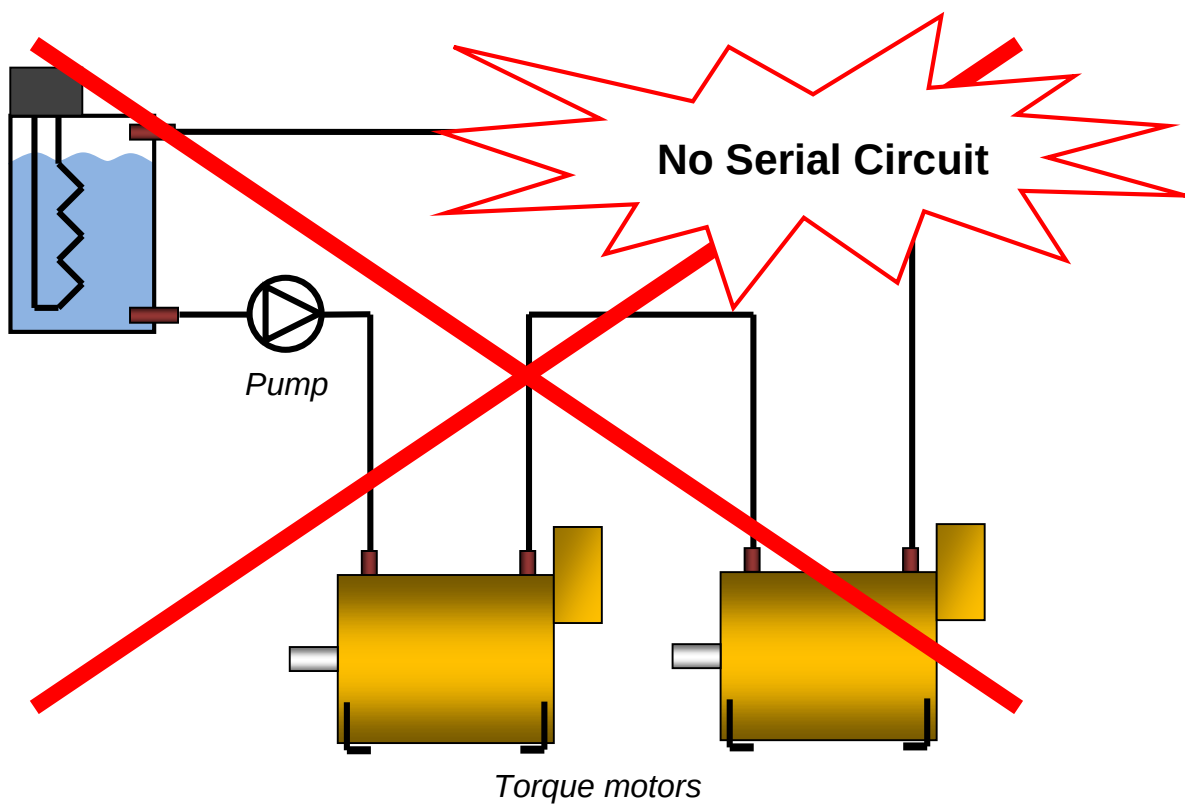
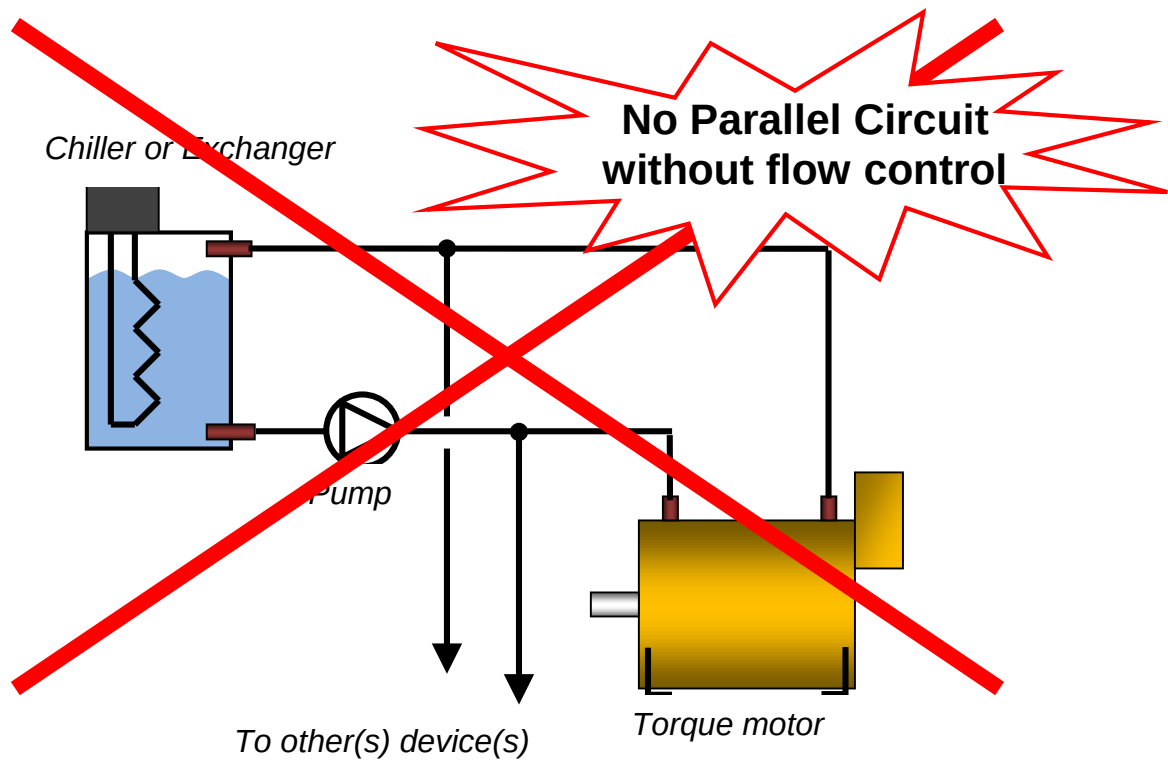
Motor	Volume [liter]
Up to TMW206	2,6
TMW207 to TMW208	3,3
Up to TMW304	2,5
TMW305 to TMW306	3,6
TMW307 to TMW30A	5,7
Up to TMW406	4,8
TMW407 to TMW408	6,3
TMW40A to TMW40C	9,2

3.6.9. Water cooling diagram

	<u>Recommendation:</u> The use of a filter allows to reduce the presence of impurities or chips in the water circuit in order to prevent its obstruction. We recommend 0.1mm filter.
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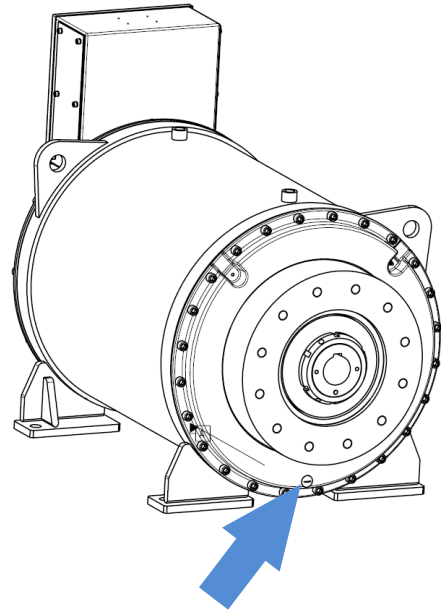
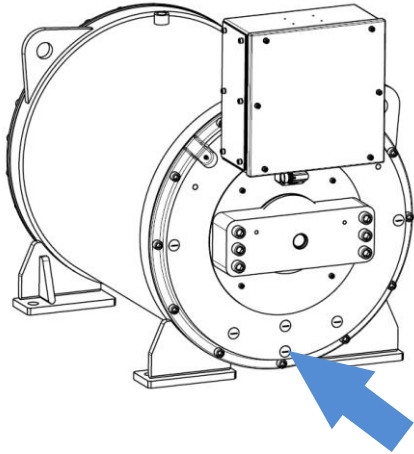
This section shows typical water cooling diagram :





3.6.10. Condensation water drain hole

If condensation water builds up in the motor it can be drained through holes positioned at the lowest point in the motor housing. Condensation water drain holes must be checked at least once a year, the presence of oil is not abnormal.



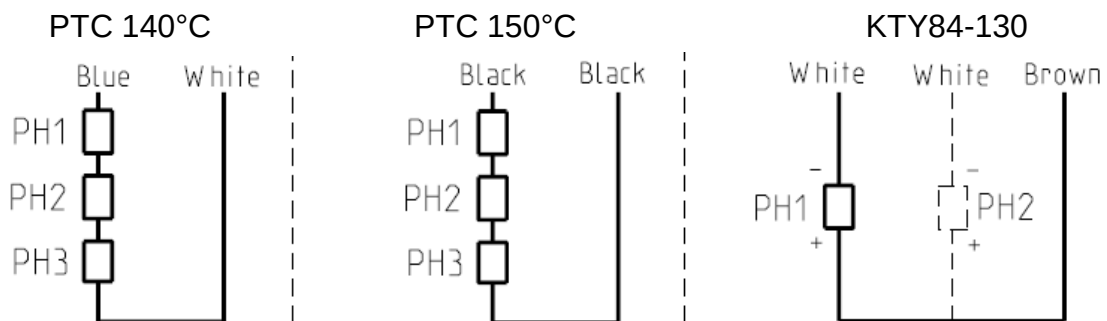
3.7. Thermal Protection

Protection against thermal overloading of the motor is provided by 2 x 3 PTC thermistors and one KTY temperature sensor (and one more in case of KTY failure) built into the stator winding as standard. The thermal sensors, due to their thermal inertia, are unable to follow very fast winding temperature variations. They achieve their thermal steady state after a few minutes.



Warning: To protect correctly the motor against very fast overload, please refer to 3.1.6. Peak current limitations

Both PTC thermistors and KTY sensor are connected through the terminal box, according to the electrical connection diagrams.

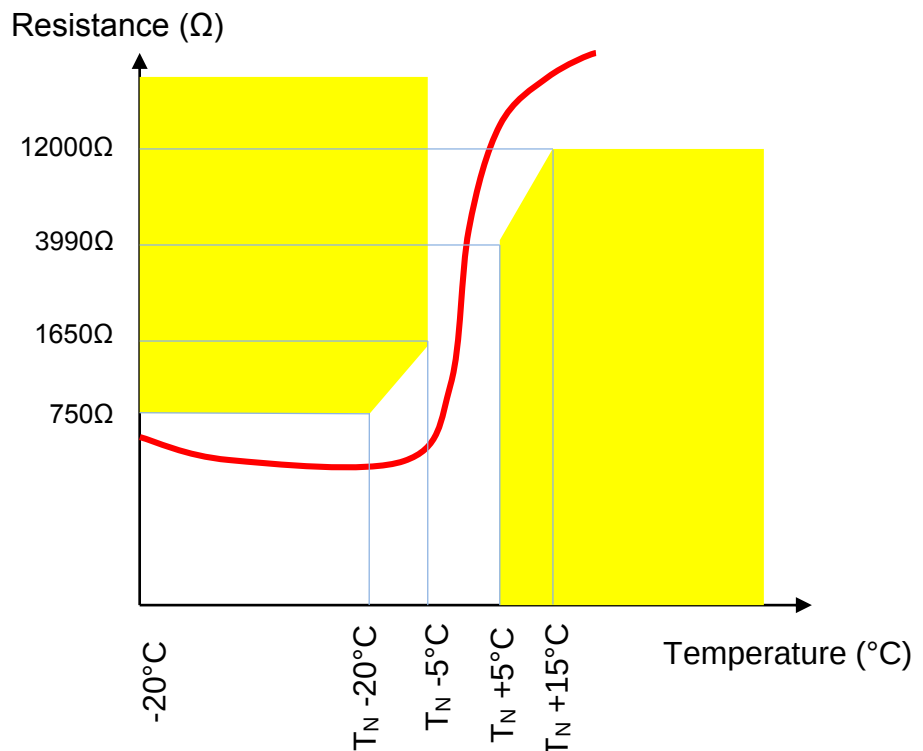


3.7.1. Alarm tripping with PTC thermistors :

Two thermal probes (PTC thermistors) fitted in the servomotor winding trip the electronic system at **140° and 150° ± 5° C**. When the rated tripping temperature is reached, the PTC thermistor undergoes a step change in resistance. This means that a limit can be easily and reliably detected by the drive.

The graph and tab below shows PTC sensor resistance as a function of temperature (T_N is nominal temperature)

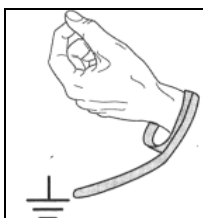
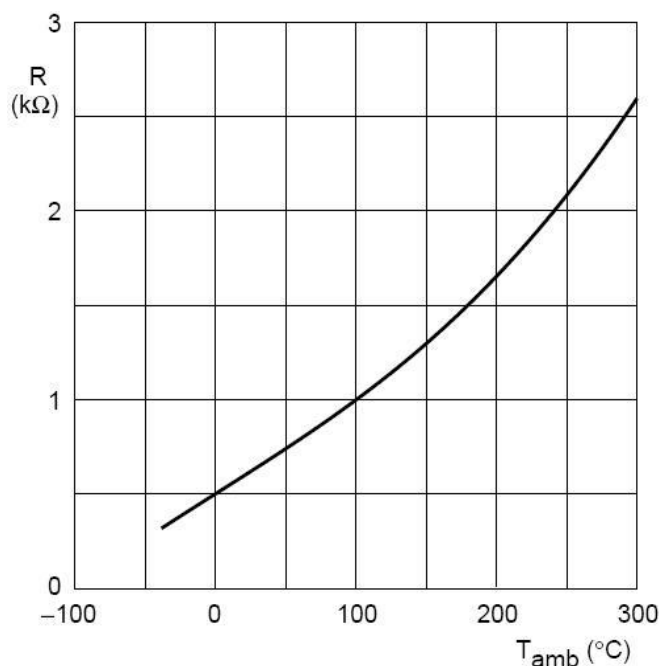
Temperature	Resistance value
-20°C up to $T_N - 20^\circ\text{C}$	$R \leq 750\Omega$
$T_N - 5^\circ\text{C}$	$R \leq 1650\Omega$
$T_N + 5^\circ\text{C}$	$R \geq 3990\Omega$
$T_N + 15^\circ\text{C}$	$R \geq 12000\Omega$



3.7.2. Temperature measurement with KTY sensors:

Motor temperature can also be continuously monitored by the drive using a KTY 84-130 thermal sensor built in to the stator winding. KTY sensors are semiconductor sensors that change their resistance according to an approximately linear characteristic. The required temperature limits for alarm and tripping can be set in the drive.

The graph below shows KTY sensor resistance vs temperature, for a measuring current of 2 mA:



Warning: KTY sensor is sensitive to electrostatic discharge. So, always wear an antistatic wrist strap during KTY handling.



Warning: KTY sensor is polarized. Do not invert the wires.



Warning: KTY sensor is sensitive. Do not check it with an Ohmmeter or any measuring or testing device.

3.8. Power Electrical Connections

3.8.1. Wires sizes

	In every country, you must respect all the local electrical installation regulations and standards.
---	--

Not limiting example in France: NFC 15-100 or IEC 60364 as well in Europe.

	Cable selection depends on the cable construction, so refer to the cable technical documentation to choose wire sizes
---	--

	Some drives have cable limitations or recommendations; please refer to the drive technical documentation for any further information.
---	--

Cable selection

	At standstill, the current must be limited at 80% of the low speed current I_0 and cable has to support peak current for a long period. So, if the motor works at standstill, the current to select wire size is $\sqrt{2} \times 0.8 I_0 \cong 1,13 \times I_0$.
---	--

Sizes for H07 RN-F cable, for a 3 cores in a cable tray at 30°C max

Section [mm ²]	I _{max} [A _{rms}]
1.5	17
2.5	23
4	31
6	42
10	55
16	74
25	97
35	120
50	146
70	185
95	224
120	260
150	299
185	341
240	401
300	461



Example of sizes for H07 RN-F cable :

Conditions of use:

Case of 3 conductors type H07 RN-F: **60°C maximum**

Ambient temperature: 30°C

Cable runs on dedicated cables ways

Current limited to 80%*I₀ at low speed or at motor stall.

Example:

I₀=100 Arms

Permanent current at standstill : 80 Arms

Max permanent current in the cable = 113 Arms

Cable section selection = 35mm² for a 3 cores in a cable tray at 30°C max.

You also have to respect the Drive commissioning manual and the cables current densities or voltage specifications

3.8.2. Conversion Awg/kcmil/mm²:

Awg	kcmil	mm ²
	500	253
	400	203
	350	177
	300	152
	250	127
0000 (4/0)	212	107
000 (3/0)	168	85
00 (2/0)	133	67.4
0 (1/0)	106	53.5
1	83.7	42.4
2	66.4	33.6
3	52.6	26.7
4	41.7	21.2
5	33.1	16.8
6	26.3	13.3
7	20.8	10.5
8	16.5	8.37
9	13.1	6.63
10	10.4	5.26
11	8.23	4.17
12	6.53	3.31
14	4.10	2.08
16	2.58	1.31
18	1.62	0.82
20	1.03	0.52
22	0.63	0.32
24	0.39	0.20
26	0.26	0.13

3.8.3. Motor cable length

For motors windings which present low inductance values or low resistance values, the own cable inductance, respectively own resistance, in case of large cable length can greatly reduce the maximum speed of the motor. Please contact PARKER for further information.



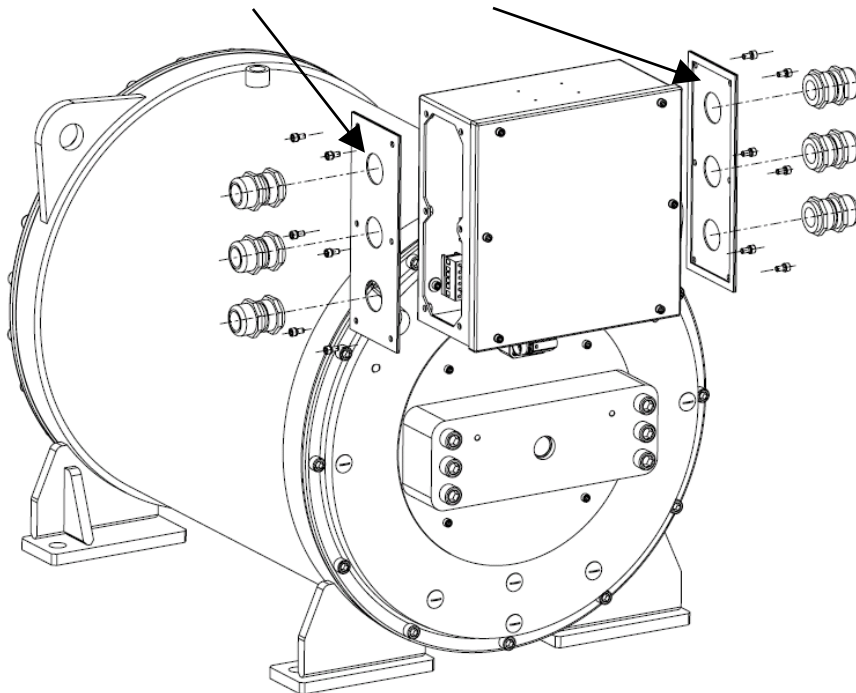
Caution: It might be necessary to fit a filter at the servo-drive output if the length of the cable exceeds 25 m. Consult us.

3.8.4. Mains supply connection diagrams

The side plates can be removed and drilled to install the cables glands (not provided).

The plate useful area to drill is:

- for TM200 : 170mm x 75mm
- for TM300 and TM400: 270mm x 95mm



Caution: A bad tightening on the cable or a too small cable section can generate an overheating and burn the terminals box

3.8.4.1. Ground connection



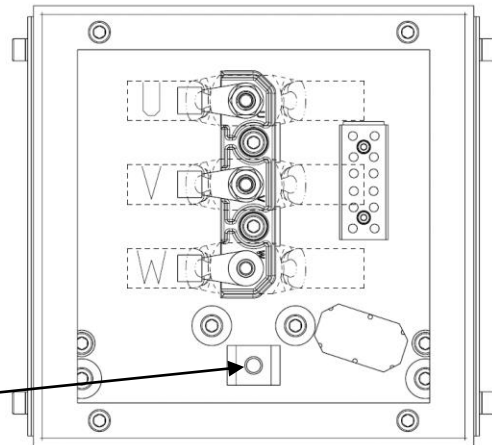
DANGER: For safety reasons, you need to connect motor to the ground.
Consult the local regulations to choose the right cross section and to know the resistance limits to check ground continuity between frame and ground wire.

3.8.4.2. Shaft Height 200 mm

U, V, W : M8 pins for Power Connection

- 1: KTY Sensor + (Brown)
- 2: KTY Sensor – (White)
- 3: PTC 150°C Thermal Probe (Black)
- 4: PTC 150°C Thermal Probe (Black)
- 5: PTC 140°C Thermal Probe (White)
- 6: PTC 140°C Thermal Probe (Blue)

GND: M8x15 screw on terminal box
And M10 on rear flange



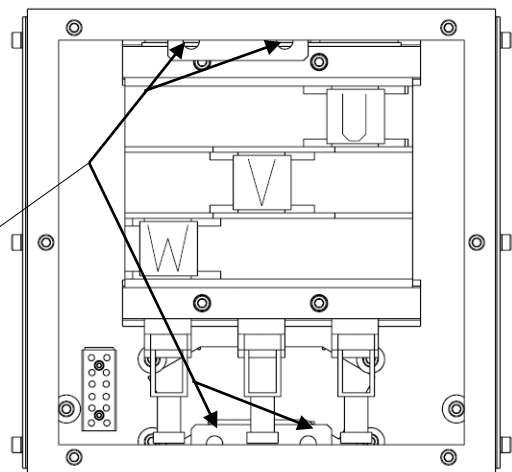
	Power	Accessories
Tightening torque	17 N.m	0,6 – 0,8 N.m
Cables section capacity	35 to 95 mm ²	0,2 to 4 mm ²

3.8.4.3. Shaft Heights 315 and 400 mm with current < 320A – cable cross section: 95 to 185mm² max and 320 < current < 560A – cable cross section: 150 to 300mm²

U, V, W : Clamp Power Connection

- 1: KTY Sensor + (Brown)
- 2: KTY Sensor – (White)
- 3: PTC 150°C Thermal Probe (Black)
- 4: PTC 150°C Thermal Probe (Black)
- 5: PTC 140°C Thermal Probe (White)
- 6: PTC 140°C Thermal Probe (Blue)

GND: 4 holes Ø10.5mm on terminal box
And M8 on rear flange (TM 315)
M12 on rear flange (TM 400)



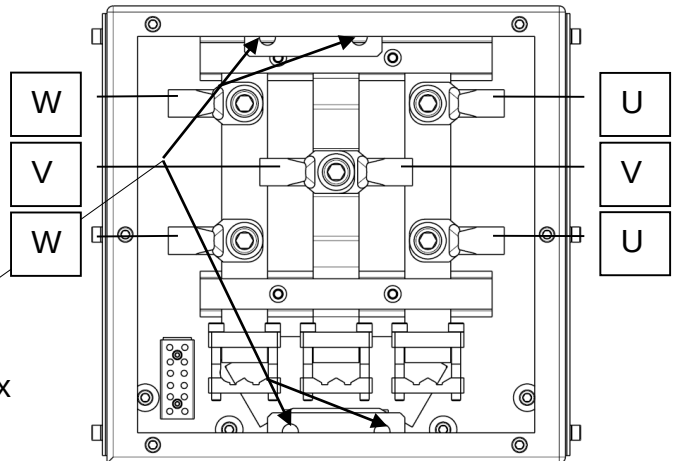
	Power	Accessories
Tightening torque	30 N.m	0,6 – 0,8 N.m
Cables section capacity	95 to 185 mm ² (320 A) 150 to 300 mm ² (450 and 560 A)	0,2 to 4 mm ²

3.8.4.1. Shaft Heights 315 and 400 mm with 560 < current < 630A – cable cross section: 2x120mm² max

U, V, W : Ø12.5 for Power Connection

- 1: KTY Sensor + (Brown)
- 2: KTY Sensor – (White)
- 3: PTC 150°C Thermal Probe (Black)
- 4: PTC 150°C Thermal Probe (Black)
- 5: PTC 140°C Thermal Probe (White)
- 6: PTC 140°C Thermal Probe (Blue)

GND: 4 holes Ø10.5mm on terminal box
And M8 on rear flange (TM 315)
M12 on rear flange (TM 400)



	Power	Accessories
Tightening torque	30 N.m	0,6 – 0,8 N.m
Cables section capacity	2 x 120mm ² ring terminal per phase	0,2 to 4 mm ²



This terminal box is limited to a 120mm² cross section.



For higher current than 630 Arms or higher cable cross section, please consult us.

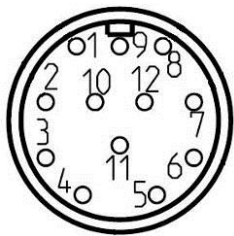
3.9. Feedback system

3.9.1. Resolver



We do not recommend resolver for TM series due to the low accurate speed control

Parker part number	220005P1001
Electrical specification	Values @ 8 kHz
Mounting	Remote system with belt and pulley
Ordering designation	A
Reduction ratio	6 (TM_200) 9 (TM_300) 6 (TM_400)
Polarity	2 poles
Input voltage	7 Vrms
Input current	86mA maximum
Zero voltage	20mV maximum
Encoder accuracy (without belt & pulley)	$\pm 10'$ maxi
Ratio	$0,5 \pm 5 \%$
Input impedance	Mini $48 + 66j \Omega$ Typical $56 + 80j \Omega$
Output impedance (primary in short circuit whatever the position of the rotor)	Typical $120 + 200j \Omega$
Dielectric rigidity (50 – 60 Hz)	500 V – 1 min
Insulation resistance	$\geq 100M\Omega$
Rotor inertia	$\sim 30 \text{ g.cm}^2$
Operating temperature range	$-55 - +155 \text{ }^\circ\text{C}$

Resolver connection	PIN	Signal
	1	Output voltage S3 (cos-)
	2	Output voltage S1 (cos+)
	3	
	4	
	5	
	6	
	7	Output voltage S2 (sin+)
	8	Output voltage S4 (sin-)
	9	
	10	Input voltage R1
	11	
	12	Input voltage R2

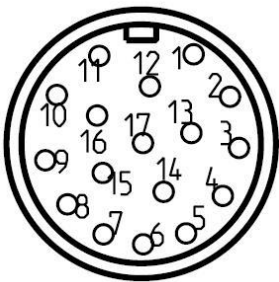
3.9.2. Absolute EnDat Encoder systems

Very good performances for low speed control and accurate speed control.

Model	ECN 113 (Heidenhain)
Type	Absolute single turn encoder
Mounting	Direct mounting on motor's shaft
Parker part number	220165P0005
Ordering designation	B
Incremental signals	Sinusoidal
Line count / System accuracy	2048
Cutoff frequency – 3 dB	≥ 200kHz typical
Absolute position values	EnDat 2.2
Position values per revolution	8192 (13 bits)
Electrical Permissible speed/ at accuracy	600 rpm / ± 1 LSB - N _{max} / ± 50 LSB
Calculation time	≤ 0,25μs
Encoder accuracy	± 20"
Power Supply	5VDC ± 5 %
Current consumption (without load)	≤ 180mA
Electrical connection	17-pin flange socket
Maximum operating temp.	100 °C



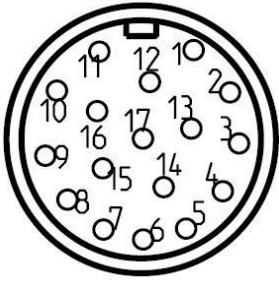
With unregulated power supply (AC890 Parker drive for instance), the max cable length is **30m** with 1mm² power supply wire or twin 0.5mm² cables on power supply, due to the voltage drop into the cable itself.

Encoder connection	PIN	Signal
	1	U _p sensor
	2	No connection
	3	No connection
	4	0 V sensor
	5	No connection
	6	No connection
	7	U _p
	8	Clock
	9	Clock\
	10	0 V U _N
	11	No connection
	12	B+
	13	B-
	14	Data
	15	A+
	16	A-
	17	Data\

Model	ECN 1113 (Heidenhain)
Type	Absolute single turn encoder
Mounting	Remote system with belt and pulley
Parker part number	220165P0002
Ordering designation	C
Reduction ratio	6 (TM_200) 9 (TM_300) 6 (TM_400)
Incremental signals	Sinusoidal
Line count / System accuracy	512 / $\pm 60''$
Cutoff frequency – 3 dB	$\geq 190\text{kHz}$ typical
Absolute position values	EnDat 2.2
Position values per revolution	8192 (13 bits)
Calculation time	$\leq 5\mu\text{s}$
Power Supply	3.6 to 14V
Electrical connection	17-pin flange socket
Maximum operating temp.	115 °C (239°F)

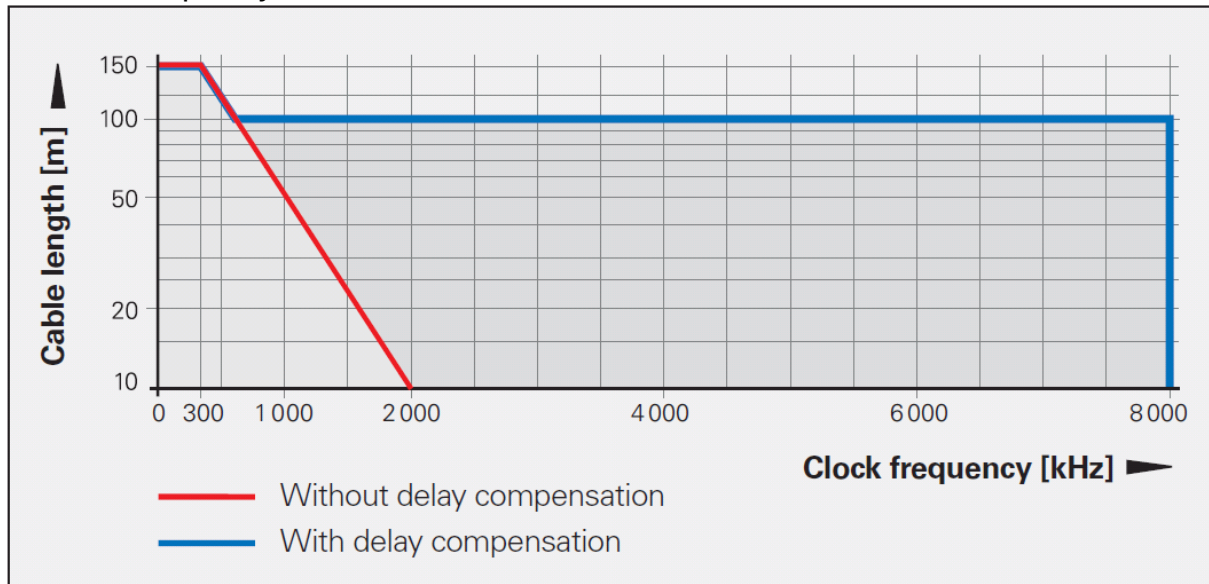


With unregulated power supply (AC890 PARKER drive for instance), the max cable length is **65m** with 0.25mm² power supply wire due to the voltage drop into the cable itself.

Encoder connection	PIN	Signal
	1	U _p sensor
	2	No connection
	3	No connection
	4	0 V sensor
	5	No connection
	6	No connection
	7	U _p
	8	Clock
	9	Clock\
	10	0 V U _N
	11	No connection
	12	B+
	13	B-
	14	Data
	15	A+
	16	A-
	17	Data\

Maximum Endat cable length

Please refer to the following curve to calculate the max cable length depending on the clock frequency



AC890 PARKER Wiring – EnDat encoder

From Heidenhain

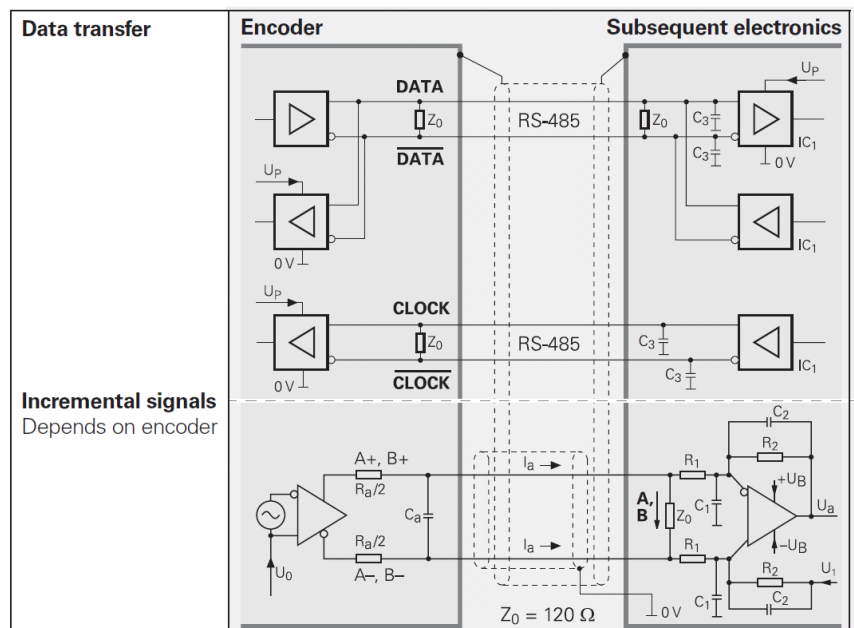
Data (measured values or parameters) can be transferred bidirectionally between position encoders and subsequent electronics with transceiver components in accordance with RS-485 (differential signals), in synchronism with the clock signal produced by the subsequent electronics.

Dimensioning

IC₁ = RS 485 differential line receiver and driver

C₃ = 330 pF

Z₀ = 120 Ω



3.9.3. Sin-Cos Encoder (on request)

1V~, 250Khz max

Restriction: Need for homing equivalent function at each power ON for synchronizing the incremental signals to the motor position or keep alive the low power supplies. Very good performances for low speed control and accurate speed control



3.9.4. Signal cables

To connect feedback signal to AC890 PARKER drive or COMPAX3, you can use complete cable with part number on the tab below.

The "xxx" in the part number must be replaced by the length in meter.

Ex : for 20m cable, "xxx" = 020.

Feedback Sensor	Cable reference for AC890	Cable reference for COMPAX3
EnDat Encoder	CS4UV1F3R0xxx	CC3UV1F3R0xxx
Resolver	CS4UA1F1R0xxx	CC3UA1F1R0xxx

For other drive, you can assembly cable and plug by soldering with part number on the tab below:

Feedback Sensor	Cable reference	Plug reference
EnDat Encoder	6537P0055	220132R4641
Resolver	6537P0047	220065R4621

4. COMMISSIONING, USE AND MAINTENANCE

4.1. Instructions for commissioning, use and maintenance

4.1.1. Equipment delivery

All torque motors are strictly controlled during manufacturing, before shipping. While receiving it, it is necessary to verify motor condition and if it has not been damaged in transit. Remove it carefully from its packaging. Verify that the data written on the label are the same as the ones on the acknowledgement of order, and that all documents or needed accessories for user are present in the packaging.



Warning: In case of damaged material during the transport, the recipient must **immediately** make reservations to the carrier through a registered mail within 24 h..

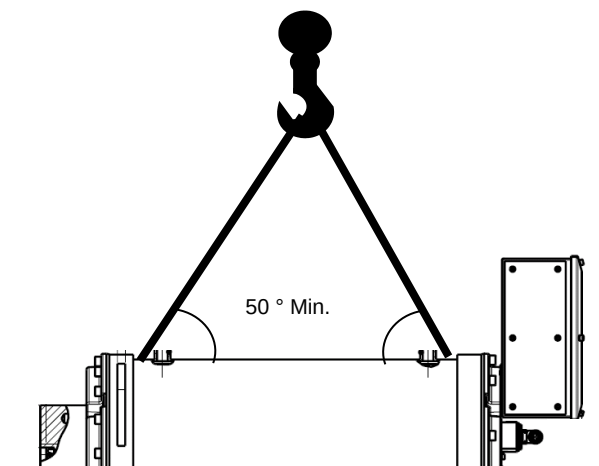
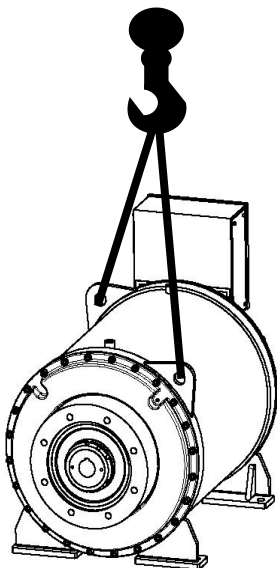
4.1.2. Handling

Torque Motors are equipped with two lifting rings intended for handling.



Caution: Use Torque Motors lifting rings only to handle the motor. Do not handle the motor with the help of electrical cables, connectors and water inputs/outputs, or use any other inappropriate method.

The drawings below show the correct handling procedure.



DANGER: Choose the correct slings for the motor weight. The two slings must be the same length and a minimum angle of 50° has to be respected between the motor axis and the slings.

4.1.3. Storage

Before being mounted, the torque motor has to be stored in a dry place, without rapid or important temperature variations in order to avoid condensation.

During storage, the ambient temperature must be kept between -20 and +60°C.

If the torque motor has to be stored for a long time, verify that the shaft end, feet and the flange are coated with corrosion proof product.

After a long storage duration (more than 3 month), run the motor at low speed in both directions, in order to blend the bearing grease spreading.

The motor is delivered with caps for the water inlet and outlet to protect the cooling circuit. Keep them on place until the motor commissioning.

4.2. Installation

4.2.1. Mounting

Foundation must be even, sufficiently rigid and shall be dimensioned in order to avoid vibrations due to resonance. Before bolting the motor's feet, the foundation surface must be cleaned and checked in order to detect any excessive height difference between the foot locations. The variation from one foot to any other shall not exceed 0,1 mm. In any case we recommend using shims to compensate small irregularities.



Caution: The user bears the entire responsibility for the preparation of the foundation.

The table below gives the average tightening torques required regarding the fixing screw diameter. These values are valid for both motor's feet and flange bolting.

Screw diameter	Tightening torque
M2 x 0.35	0.35 N.m
M2.5 x 0.4	0.6 N.m
M3 x 0.5	1.1 N.m
M3.5 x 0.6	1.7 N.m
M4 x 0.7	2.5 N.m
M5 x 0.8	5 N.m
M6 x1	8.5 N.m
M7 x 1	14 N.m
M8 x 1.25	20 N.m

Screw diameter	Tightening torque
M9 x 1.25	31 N.m
M10 x 1.5	40 N.m
M11 x 1.5	56 N.m
M12 x 1.75	70 N.m
M14 x 2	111 N.m
M16 x 2	167 N.m
M18 x 2.5	228 N.m
M20 x 2.5	329 N.m
M22 x 2.5	437 N.m
M24 x 3	564 N.m



Warning: After 15 days, check all tightening torques on all screw and nuts.

4.2.2. Preparation

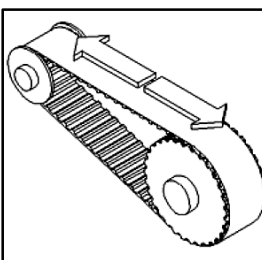
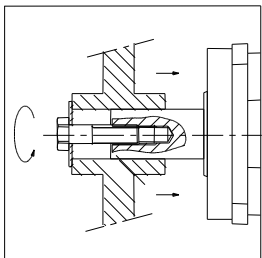
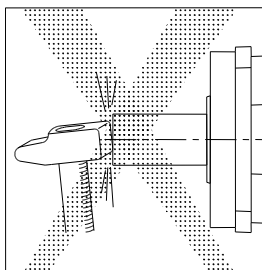
Once the motor is installed, it must be possible to access the wiring, and read the manufacturer's plate. Air must be able to circulate around the motor for cooling purposes.

Clean the shaft using a cloth soaked in white spirit or alcohol. Pay attention that the cleaning solution does not get on to the bearings.

The motor must be in a horizontal position during cleaning or running.

	<u>Caution:</u> Do not step on the motor, the connector or the terminal box
	<u>Caution:</u> Always bear in mind that some parts of the surface of the motor can reach temperatures exceeding 100°C

4.2.3. Mechanical installation



The operation life of servomotor bearings depends largely on the care and attention given to this operation.

- In the event that the servomotor shaft has a cotter pin, make sure that the coupling components have been balanced correctly without the cotter pin, the servomotor having been balanced with its cotter pin.
- Prohibit any impact on the shaft and avoid press fittings which could mark the bearing tracks. If press fitting cannot be avoided, it is advisable to immobilize the shaft in motion; this solution is nevertheless dangerous as it puts the resolver at risk.
- Use the thread at the end of the shaft in accordance with the diagram for fitting pulleys or accessories. It is possible to put pressure on the shoulder of the shaft located in front of the bearing.
- In the event that the front bearing block is sealed by a lip seal which rubs on the rotating section (version IP 65), we recommended that you lubricate the seal with grease thus prolonging its operational life.
- In the event that the drive system uses a pulley and belt, the drive pulley must be fixed as close as possible to the flange. The pulley diameter is to be selected so that the radial load does not exceed the limits given in the catalog.

	We cannot be held responsible for wear on the drive shaft resulting from excessive strain.
	CAUTION: In general, pay attention that no particles go into motor during commissioning, operation and maintenance. In particular, for extruder application, take care that plastic particles cannot go into the motor during commissioning, operation or extruder screw replacement. Else, the motor can be damaged.

4.3. Electrical connections

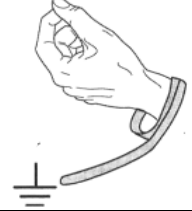
	<u>Danger:</u> Check that the power to the electrical cabinet is off prior to making any connections.
	<u>Caution:</u> The wiring must comply with the drive commissioning manual and with recommended cables.
	<u>Danger:</u> The torque motor must be earthed by connecting to an unpainted section of the motor.
	<u>Caution:</u> After 15 days, check all tightening torques on cable connection.

4.3.1. Cable connection

Please, read §3.7 "Electrical connection" to have information about cable and terminal box.

Many useful information are already available in the drive documentations.

4.3.2. Encoder cable handling

	<u>Danger:</u> before any intervention the drive must be stopped in accordance with the procedure.
	<u>Caution:</u> It is forbidden to disconnect the Encoder cable under voltage (high risk of damage and sensor destruction).
	<u>Warning:</u> Always wear an antistatic wrist strap during encoder handling.
	<u>Warning:</u> Do not touch encoder contacts (risk of damage due to electrostatic discharges ESD).

4.4. Maintenance Operations

4.4.1. Summary maintenance operations

	Generality <u>DANGER</u>: The installation, commission and maintenance operations must be performed by qualified personnel, in conjunction with this documentation. The qualified personnel must know the safety (C18510 authorization, standard VDE 0105 or IEC 0364) and local regulations. They must be authorized to install, commission and operate in accordance with established practices and standards. Please contact PARKER for technical assistance.
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Operation	Periodicity	Section number
Thrust bearing re-greasing	See §3.5.3	§4.4.2
Bearing re-greasing	Every 7000h @ 70°C	§4.4.2
Belt replacement	Every 15000h	§4.4.4
Belt tension checking	Every year	§4.4.4
No water condensation checking	Every year	§3.6.9
Cooling water quality inspection	Every year	§3.6.3

4.4.2. Bearings re-greasing intervals

Proper lubrication of ball or roller bearings requires re-greasing at regular intervals. The re-greasing procedure described below should be undertaken every 7000 hours. For thrust bearing, re-greasing interval is describes in §3.5.3.

This is an estimated re-greasing interval value, valid for an operating temperature of 70°C, using SKF LGEP2 (up to 100°C - ref Parker 4121P0014), LGHB2 (up to 150°C - ref Parker 4121P0016) or equivalent grease.

To take into account the accelerated ageing of the grease with increasing temperature, we recommend halving the re-greasing interval for every 15°C increase of the bearing temperature, between 70°C and the maximal grease operating temperature. It is not recommended to prolong the re-greasing interval for temperatures below 70°C.

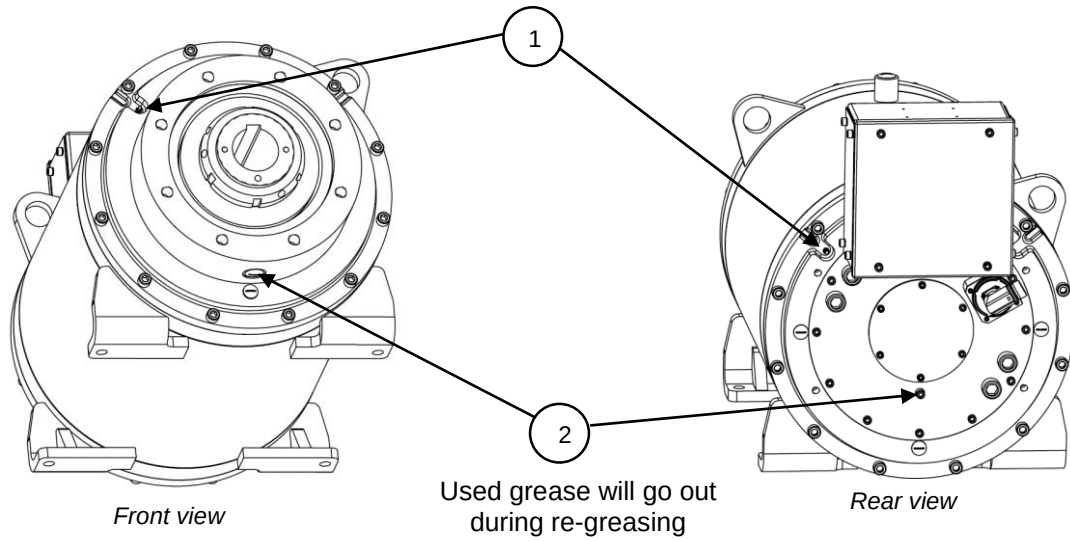
	<u>Caution:</u> Grease temperature should never exceed 100°C. Otherwise, use a different grease.
	ATTENTION: For thrust bearing , re-greasing intervals depend on load and decrease with high load – see §3.5.3.
	<u>Caution:</u> Run the motor slowly during the regreasing operation..
	An oil leakage could appear on the front and rear of the motor, it has no impact on the bearings and motor lifetime.

When re-greasing, remove the lower plugs (2) from the front and rear flange, introduce the quantity of grease required (see table below) into the front and rear grease fittings (1) so that the used grease is pushed out. Do not forget to replace the grease drain plugs (2) when the operation is finished.

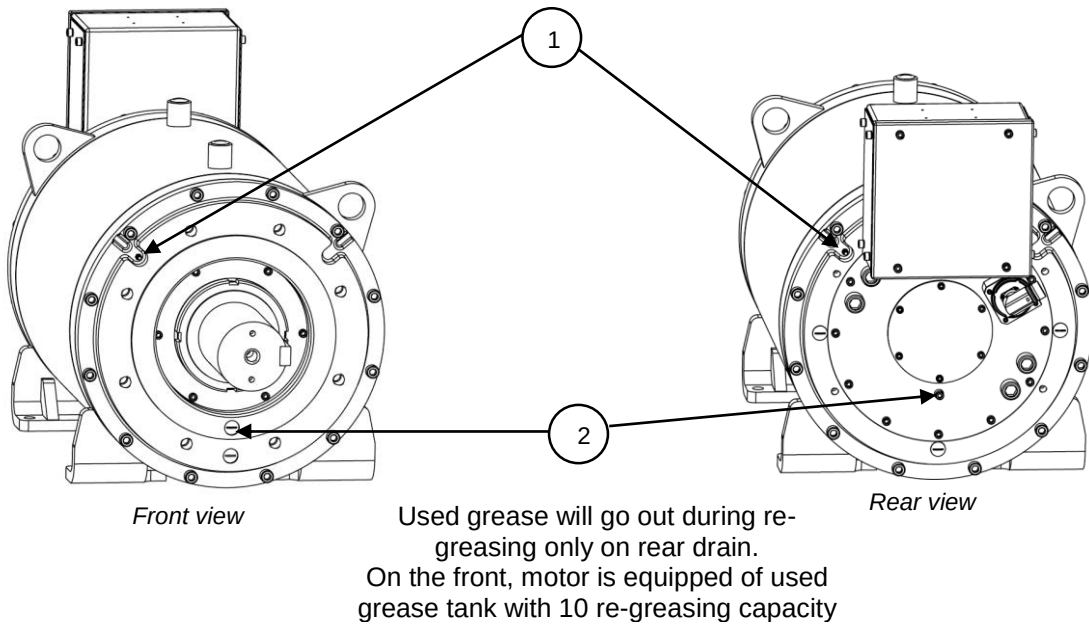
The following table gives the grease quantities (in grams), that have to be introduced into the front and rear fittings depending on Thrust Bearing size:

Thrust Bearing	Shaft Heights					
	200 mm		315 mm		400 mm	
	Front	Rear	Front	Rear	Front	Rear
29420	96 g	25 g				
29422			123 g	39 g		
29424	123 g	25 g				
29426			154 g	39 g		
29430			174 g	39 g	214 g	79 g
29434					254 g	79 g
29440					323 g	79 g
No thrust bearing	25 g	25 g	39 g	39 g	79 g	79 g

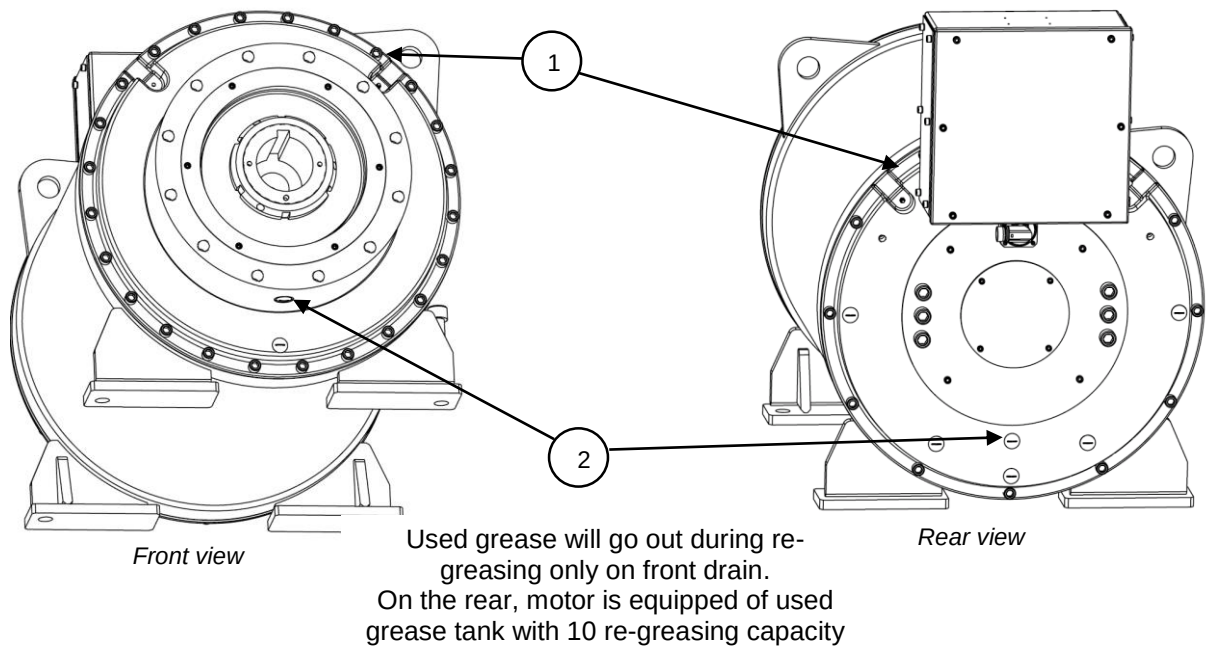
4.4.2.1. TM_200 Motor with thrust bearing



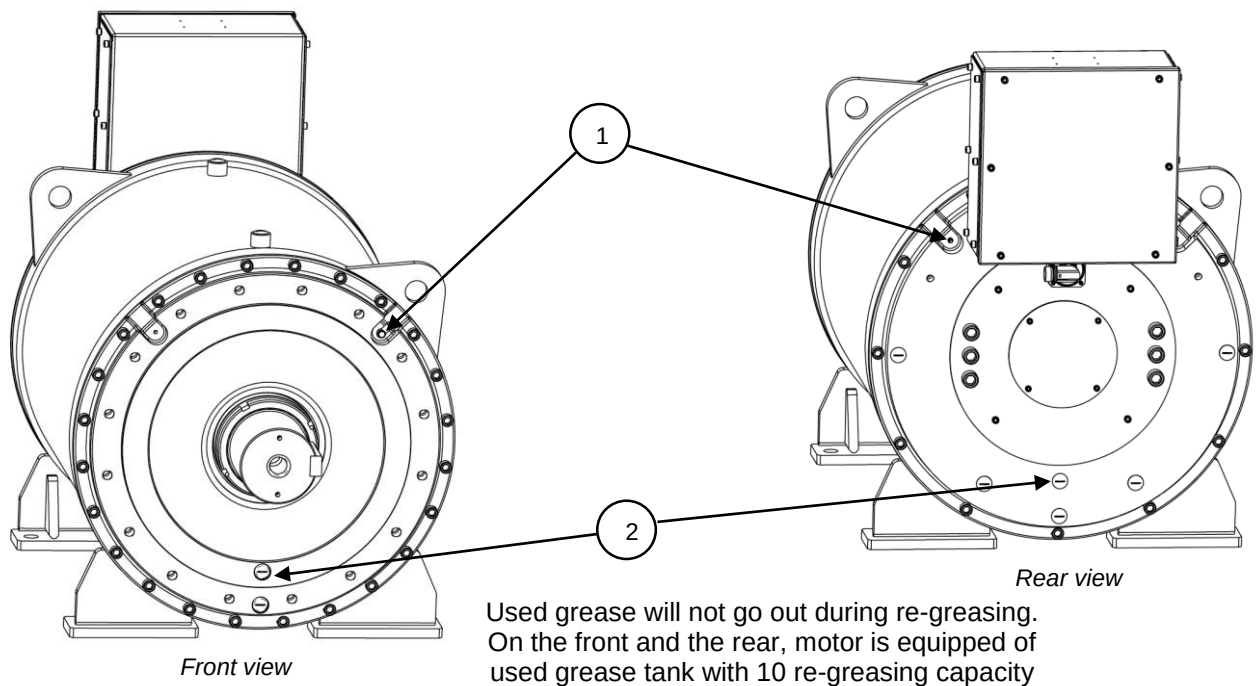
4.4.2.2. TM_200 Motor without thrust bearing



4.4.2.3. TM_300 and TM_400 Motor with thrust bearing



4.4.2.4. TM_300 and TM_400 Motor without thrust bearing



4.4.3. Thrust-Bearing Disassembly / Reassembly

	<u>Caution:</u> The work must be performed by a qualified person
	<u>Caution:</u> Comply with the security procedures of the factory.
	<u>Caution:</u> Read the technical manual of the drive and respect it

The procedure below shows how to remove the thrust-bearing from Torque Motors.

- Steps 2 and 3 have to be executed if the Torque Motor is equipped with a Direct EnDat Encoder (option B)
- Steps 4 to 7 are mandatory for all Torque Motors

Step 1: Motor rotation blocking



1 – Shut down the drive

Switch off main power supply. After removal of power supply main switch off **wait at least 5 minutes before working on motors** or on any part of the system.

2 – Disconnect signal connector (2)

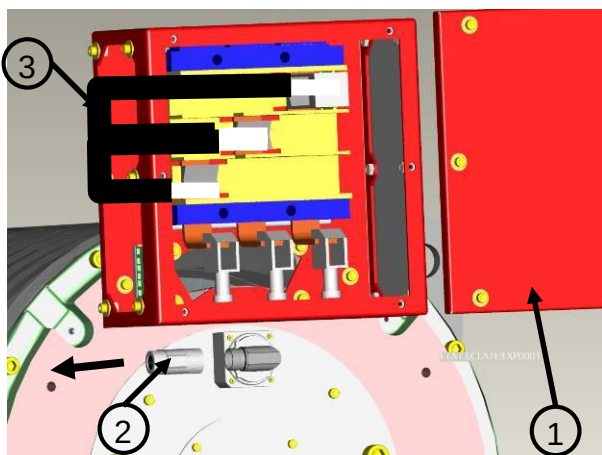
3 – Remove terminal box cover (1)

4 - **Ensure that no tension is present** between phases with an appropriate device

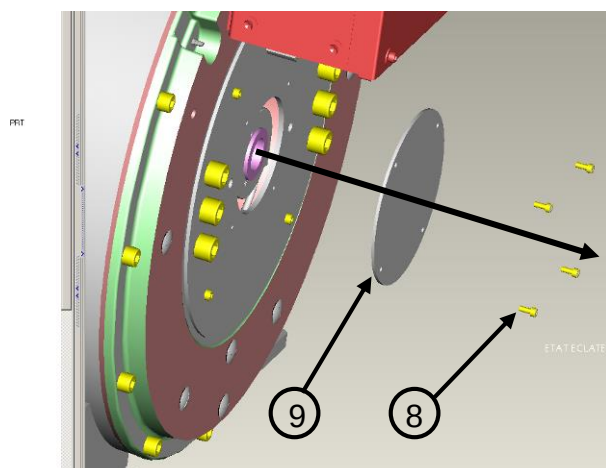
5 – Disconnect motor phases on the terminal box

6 – Short-circuit the phases

Put two bridges (3) between the phases with a wire of the same gauge as the supply wire and keep the short-circuit until the end of the reassembly



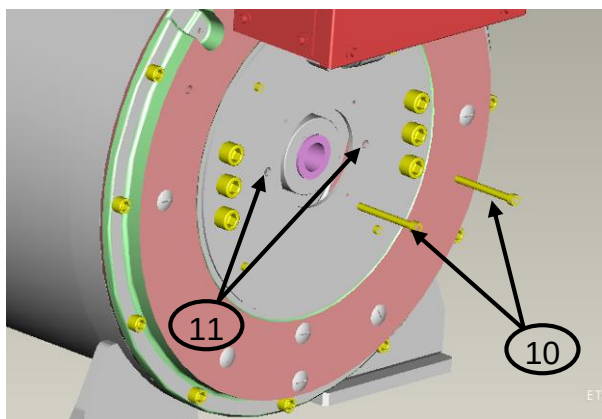
Step 2: Rear cover removal (for TM with Direct EnDat Encoder only)



1 – Unscrew and remove (8)

2 – Remove the rear cover (9)

Step 3 : Shaft blocking (for TM with Direct EnDat Encoder only)

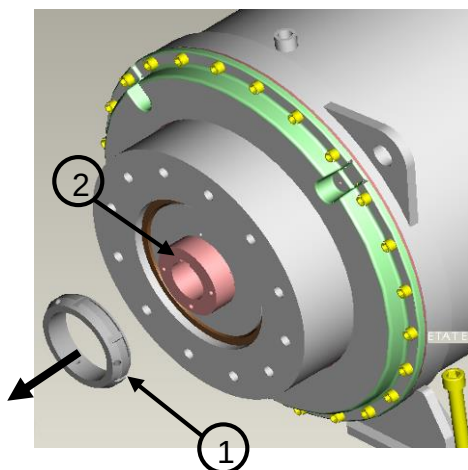


3 – **Screw down (10) in holes (11)**

Screws have to be tightened until contact is certain

Screw type : CHC M8*80

Step 4 : Thrust-Bearing release (for all Torque Motors)



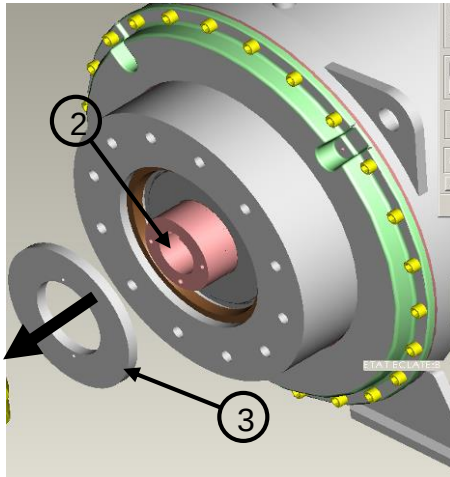
1 – **Remove the locking screws of the KMT nut**

2 – **Unscrew and remove the KMT nut (1) from the motor's shaft (2)**

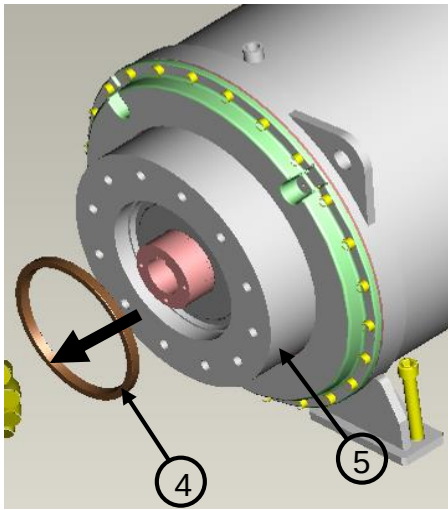
KMT nut reference :

Thrust Bearing Ref.	29420	29422	29424	29426	29430	29434	29440
Nut Ref.	KMT20	KMT22	KMT24	KMT26	KMT30	KMT34	KMT40

Step 5 : Shutting collar removal (for all Torque Motors)

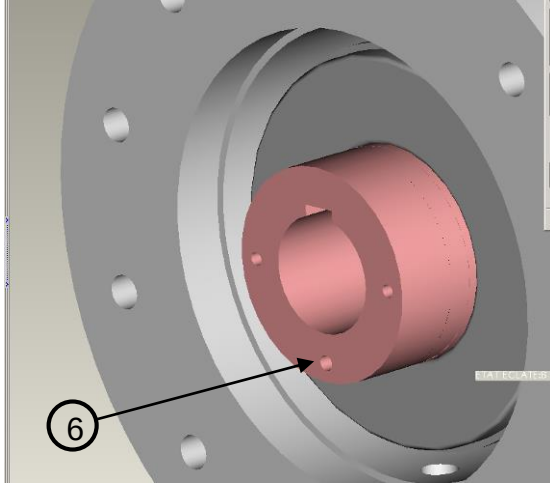


1 – **Remove the shutting collar** (3) from the shaft (2) using the two tapped holes.



2 – **Remove the seal** (4) from the thrust bearing nose (5)

Step 6 : Hydraulic Disassembly (for all Torque Motors)

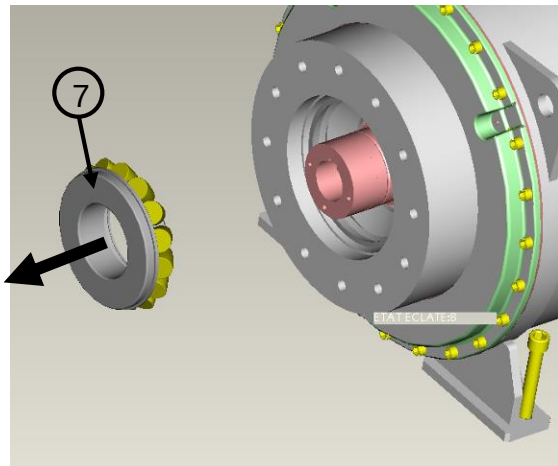


take necessary precautions in relation to oil pressure.

1 – **Inject oil** into the tapped hole (6) (G1/8) at 300 bars (4350 psi)

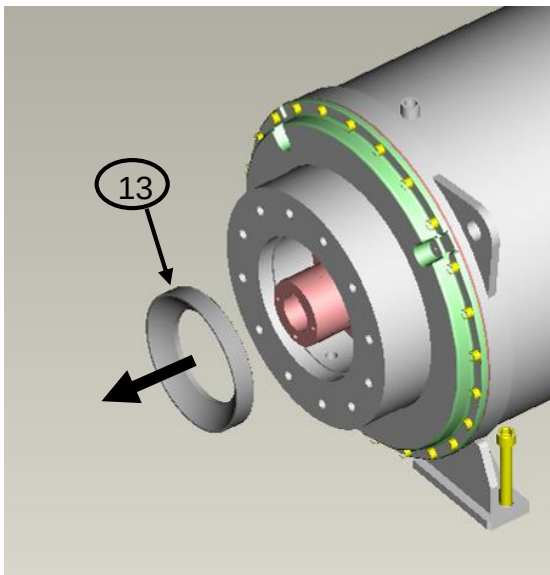
Reference of the pump recommended by SKF : 729101B or TMJE300/400

Reference of the oil recommended by SKF : SKF LHDF 900/5



3 – As soon as the Thrust-Bearing is dilated, the inner ring has to be **removed rapidly** before jamming.

It is possible to use the 3 notches in the rollers cage to grab the Thrust-Bearing.



4 – Remove the old external ring (13)

Step 7 : Assembly (for all Torque Motors)

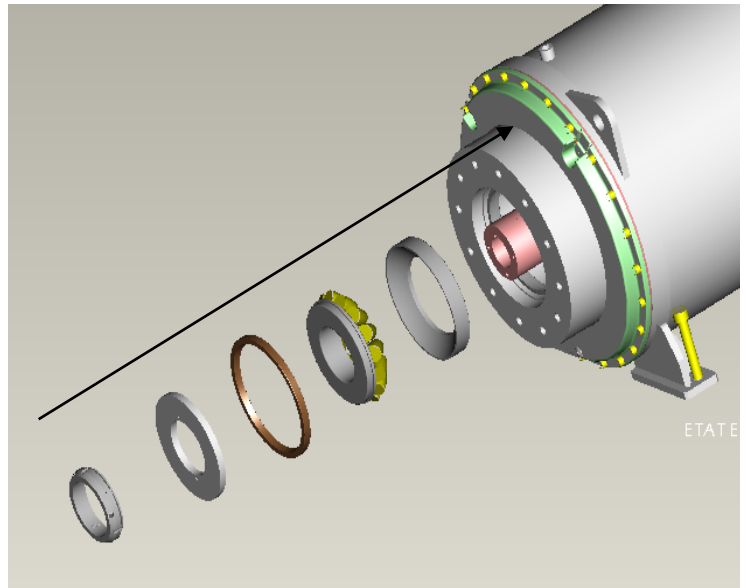
Precautions:

- 1 – Wait until last moment before removing the Thrust-Bearing from it's original packaging to avoid dirt.
- 2 – **Check the shaft and other parts of the system. Everything has to be clean.**
- 3 – Clean the oil injection canals
- 4 – The following table gives the approximate amount of grease required for Thrust-Bearings assembly :

Thrust Bearing	29420	29422	29424	29426	29430	29434	29440
Amount of Grease	1100 g	1400g	1450g	1700g	2500g	3500g	4000g

Procedure:

- 1 – **Uniformly grease** the area between the external ring and the flange.
- 2 – Make sure **all springs** are in position.
- 3 – Insert the new Thrust Bearing **external ring**.
- 4 – **Uniformly grease** the **contact surface** between the rollers and the external ring.
- 5 – Wipe off the preservative agent from the thrust bearing's internal ring bore.



Caution: Risk of burns

- 6 – **Heat up** the **internal ring** and the **rolling parts** up to **90°C ±10°C**, given a shaft temperature of **20 °C**.

- 7 – **Slip on protective gloves** for handling.

- 8 – **Mount the heated internal ring and rolling parts on the shaft.**

- 9 – **Immediately install the shutting collar** **(3)** **and screw down a KMT nut until it locks on the shaft** in order to push the internal ring and rolling parts down to the shoulder of the thrust bearing nose.

10 – **Keep the nut tightened until the internal ring cools and shrinks.**

11 – **Unscrew and remove the KMT nut and the shutting collar.**

12 – Mount a **new lip seal (alcohol mounting)** :

The following table gives the recommended lip seal references (Techne) :

Thrust Bearing Ref	29420	29422	29424	29426	29430	29434	29440
Techne seal ref.	A180*215*16 NBR	A210*240*15 NBR	A230*255*15 NBR	A250*280*15 NBR	A280*310*15 NBR	A320*350*15 NBR	A370*410*15 NBR
Parker seal ref.	5320P0058	5320P0052	5320P0059	5320P0054	5320P0064	5320P0063	5320P0065

13 – Re-insert **the shutting collar**

14 – Re-insert and screw down **the KMT nut.**

Tightening torque : 300 to 400 Nm

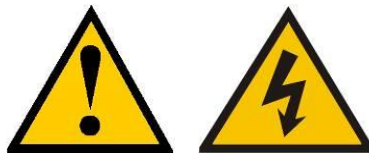
15 – **Screw down the locking screws of the KMT nut.**

Tightening torque: 35Nm

16 – **Remove the bridges** on the terminal box and **connect motor phases to the terminal box.** Put back the terminal box cover

17 – **Connect control cable to the encoder connector**

18 – **Before applying power:**

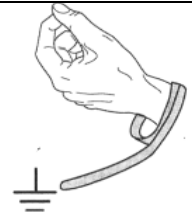


- * Read the safety section at the beginning of the manual
- * Check for damage to equipment
- * Check all external wiring circuits of the system – power, control, motor and earth connections.
- * Ensure that nobody is working on another part of the system who will be affected by powering up
- * Ensure that other equipment will not be adversely affected by powering up.

4.4.4. Encoder and belt Disassembly / Reassembly

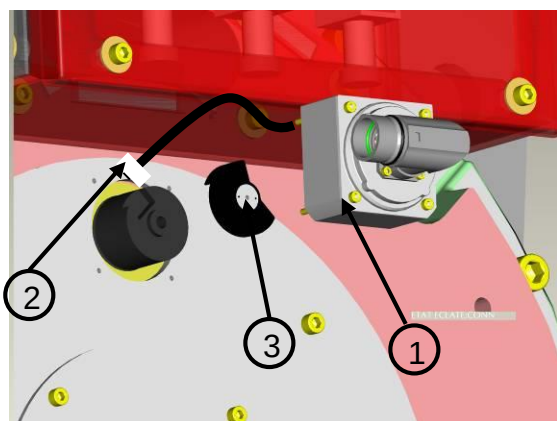
	<u>Caution:</u> The belt has to be changed every 15000 hours. <u>Caution:</u> The belt tension has to be checked every year.
---	--

	<u>Caution:</u> before any intervention the drive must be stopped in accordance with the procedure
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	<u>Warning:</u> Always wear an antistatic wrist strap during encoder handling.
	<u>Warning:</u> Do not touch encoder contacts.

REAR COVER DISASSEMBLY

First Step : release the encoder cable



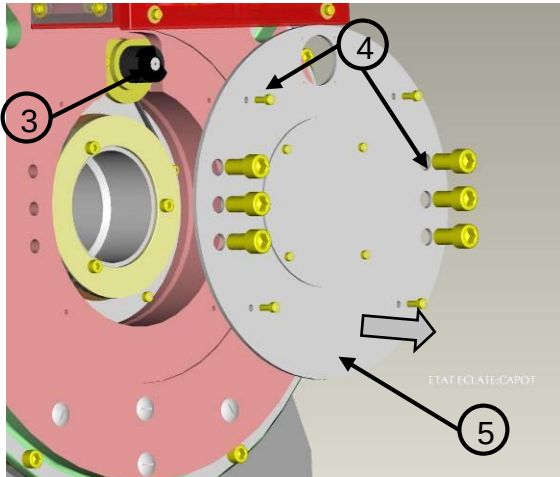
1 – Remove plug base (1) from the rear flange by removing the 4 M3 screws.

2 – Remove encoder rear cap (3) and disconnect encoder cable (2)



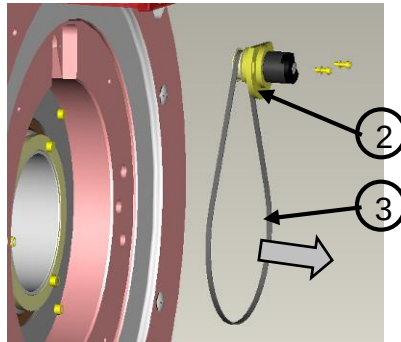
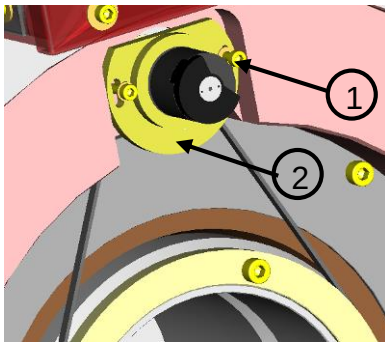
Warning: Do not touch encoder contacts.

Step 2 : remove the rear cover



- 1 – Put back encoder rear cap (3)
- 2 – Remove all fixing screws (4).
- 3 – Remove the rear cover (5).

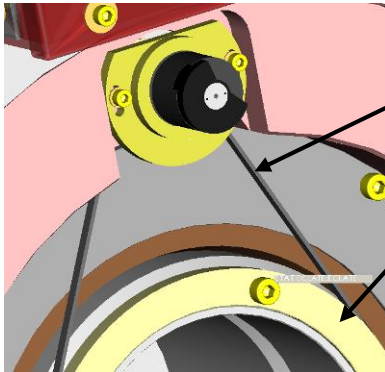
Step 3 : Remove the encoder support



- 1 – Remove the two holding screws (1).

- 2 – Remove the encoder support (2), the belt (3) will also be removed.

Step 4 : Belt replacement and positioning



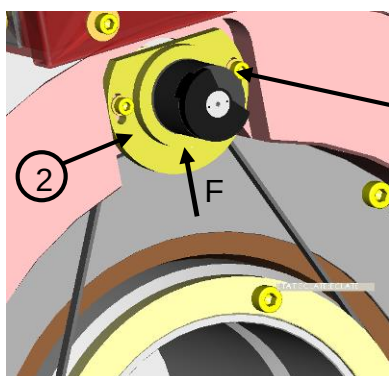
- 1 – Replace the worn belt (3) by a new one.

Belt reference :

See Table 1 below

- 2 – Place the new belt (3) on the gear wheel (4) and the encoder support on the rear flange for positioning.

Step 5 : Belt tension adjustment.



1 – Adjust the belt tension by moving the encoder support (2) in the direction specified by (F)

Effort : $F = 50N (\pm 10N)$

Tighten screws (1) at 5 Nm

Control frequency : **see Table 1 below**

(BINDER accessory : SM4 tension controller)

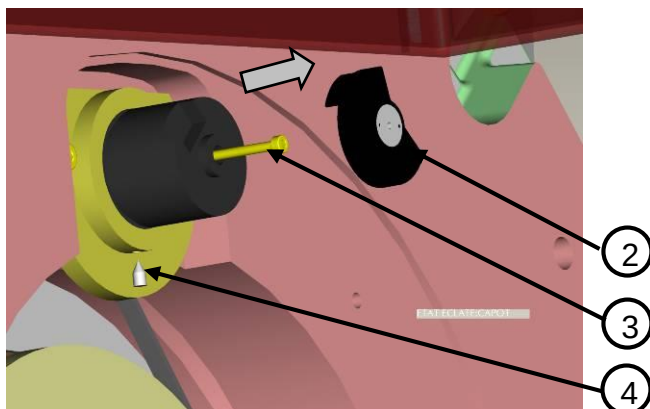
2 - Execute the encoder calibration procedure : adjustment of the encoder position to the rotor position done from the drive.

Table1 : Belt references and control frequencies

	BINDER references	PARKER references	Frequency :
TMW 40	6AT3 / 816	350012P0001	194 to 215 Hz
TMW 30	6AT3 / 639	350112P0001	307 to 340 Hz
TMW 20	6AT3 / 450	350212P0001	358 to 403 Hz

ENCODER REPLACEMENT

Step 1 : Encoder Disassembly

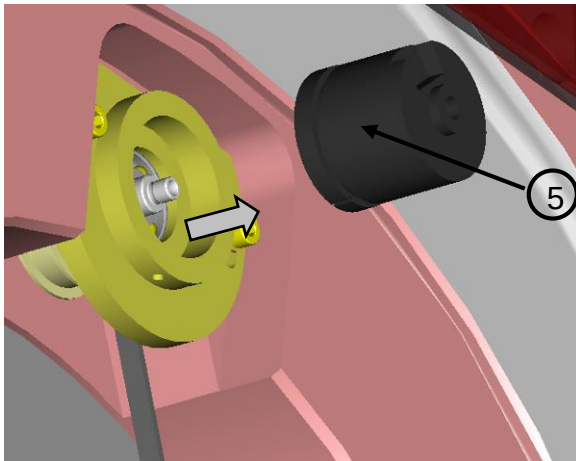


1 – Remove the rear cover (2) .

2 – Remove the encoder axial holding screw (3) .

3 – Unscrew the pointed (4) screw (encoder radial positioning).

Step 2 : New encoder assembly



1 – Remove and replace the encoder (5)

Encoder reference :

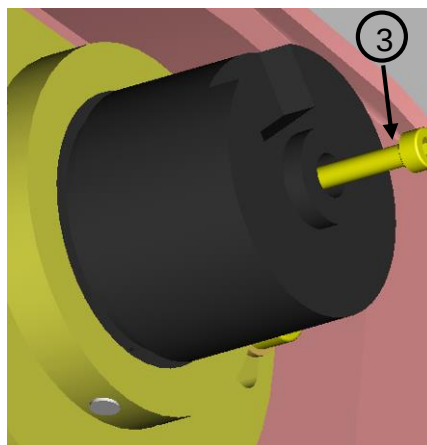
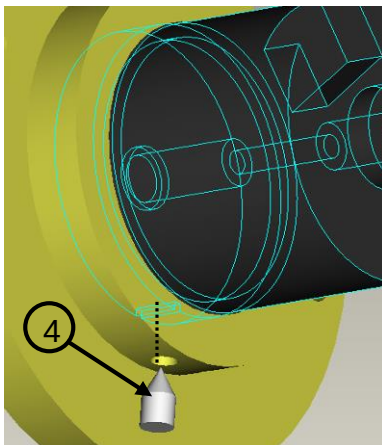
HEIDENHAIN

ECN 1113 512 lines

(ID 606684-04+605090-01)

PARKER ref : 220165P0002

Step 3 :



3 – Assemble the new encoder on the support by aligning the pointed screw with the encoder coupling ring key. (4)

Tightening torque :
0.45±0.05 Nm

4 – Assemble the encoder axial holding screw (3).

Tightening torque :
1.2±0.1 Nm

Final Step : Reassembly

1 – Screw-down the rear cover (standard screw tightening torque).

2 – Connect the encoder cable to the encoder, block the cable on the rear of the encoder and place the rear cap of the encoder.

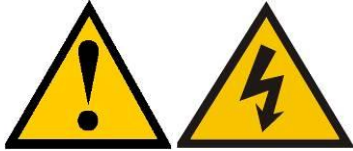
3 – Put back the plug base with the 4 M3 screws.

4 – Execute the encoder calibration procedure : adjustment of the encoder position to the rotor position done from the drive.

4.5. Extruder screw cooling / extraction

Before any extraction block motor rotation by putting the phases in short-circuit on the terminal box as described. Once operations are finished do not forget to remove the short circuit to free motor rotation.

Motor rotation blocking



1 – Shut down the drive

Switch off main power supply. After removal of power supply main switch off **wait at least 5 minutes before working on motors** or on any part of the system.

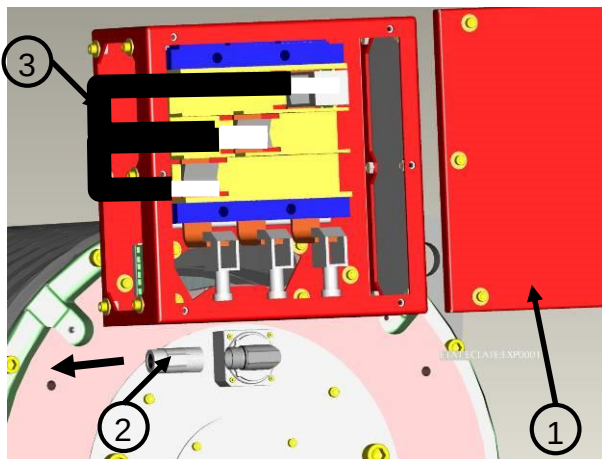
2 – disconnect signal connector (2)

3 – Remove terminal box cover (1)

4 – Disconnect motor phases on the terminal box

5 – Short-circuit the phases

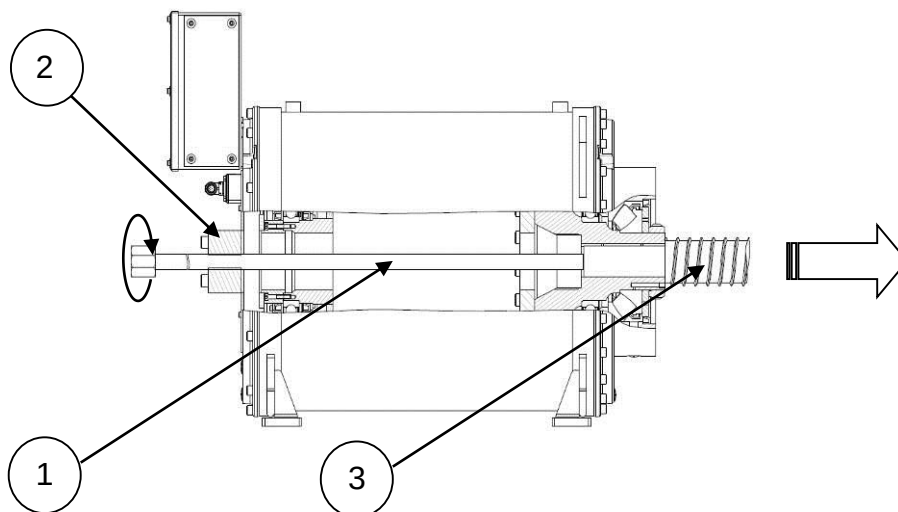
Put two bridges (3) between the phases with a wire of the same gauge as the supply wire and keep the short-circuit until the end of the reassembly



4.5.1. Front side screw extraction (Execution F)

In execution F, torque motors are delivered with a removable mechanical part fixed at the rear of the motor, allowing to easily extract the extrusion screw from the front of the motor, by simply pushing it with a threaded steel rod (not provided).

The drawing below shows how to proceed :



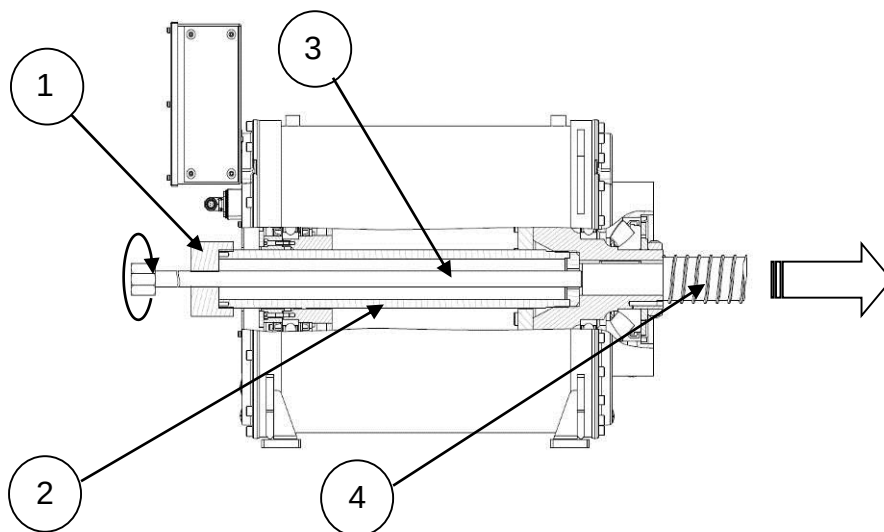
Insert a threaded steel rod (1) from the rear of the motor through the threaded hole intended for this operation (2). Rotate the threaded steel rod until it reaches the extrusion screw (3). Continue to rotate the rod in order to push the screw out of the front of the motor.

4.5.2. Front side screw extraction with screw cooling (Execution P)

In execution P, torque motors are equipped with an internal sealed protection pipe (1) allowing the passage of an external water conduit for the cooling of the extrusion screw through the motor.

	<u>Warning:</u> The protection pipe is only intended to isolate the motor in case of coolant leakage. It shall not be used directly as a coolant conduit. Use an external system to convey the coolant to the screw.
---	--

The drawing below shows how to remove the screw from the front of the motor when the motor is equipped with a screw cooling protection pipe.



Having removed the screw cooling conduit, mount the screw extraction mechanical part (1) at the end of the protection pipe (2), using the threading intended for this operation. Then insert a threaded steel rod (3) from the rear of the motor. Rotate the threaded steel rod until it reaches the extrusion screw (4). Continue to rotate the rod in order to push the screw out of the front of the motor.

4.5.3. Rear side screw extraction with screw cooling (Execution R)

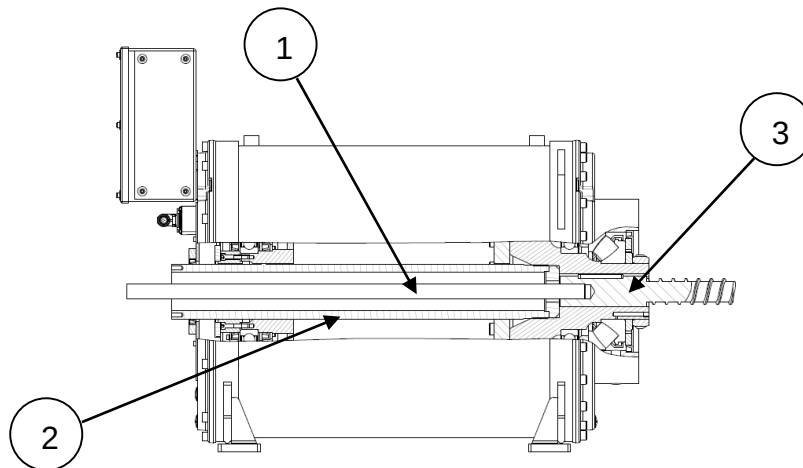
In execution R, torque motors are equipped with a patent pending mechanism allowing the extraction of the extrusion screw from the rear of the motor. An internal sealed protection pipe also allows the passage of an external water conduit for the cooling of the extrusion screw through the motor.

	Warning: The protection pipe is only intended to isolate the motor in case of coolant leakage. It shall not be used directly as a coolant conduit. Use an external system to convey the coolant to the screw.
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	Warning: When removing the extrusion screw from the rear of the motor, the extrusion screw has to be clean to avoid material deposit inside the motor.
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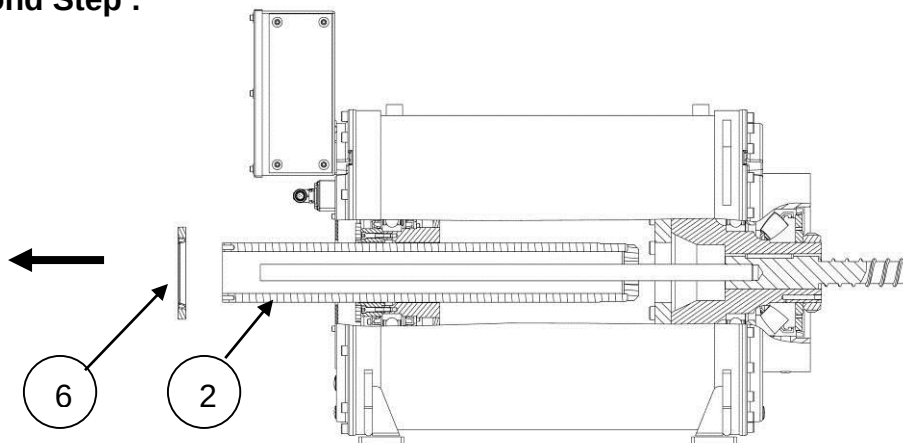
The drawings below show how to remove the screw from the rear of the motor:

First Step :



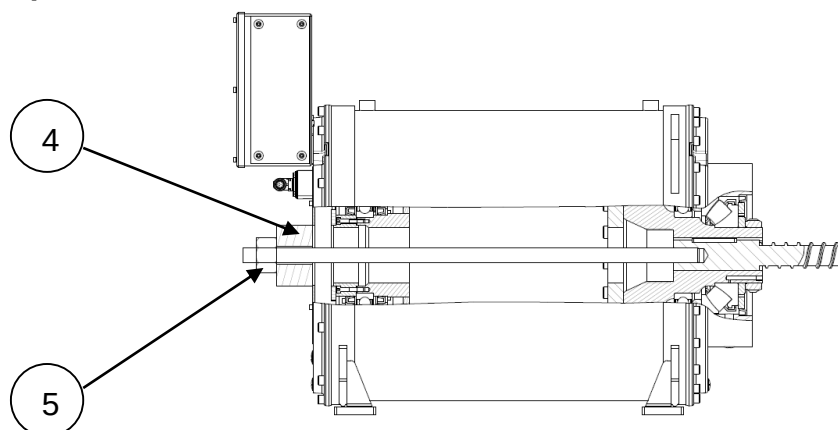
Insert a threaded steel rod (1) into the protection pipe (2) and fix it to the screw end (3).

Second Step :



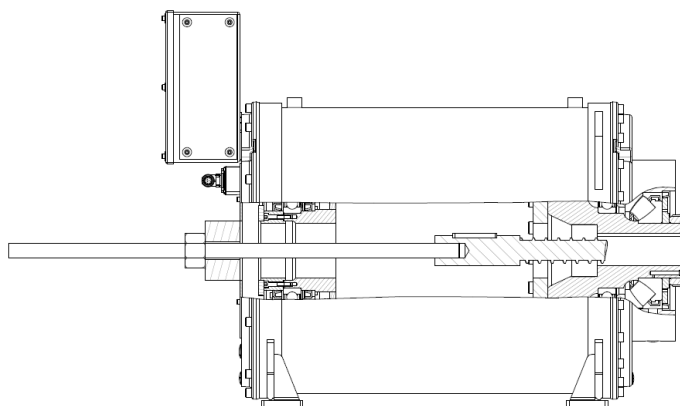
Remove the lip seal mounting (6) by unscrewing the screws on its rear then remove the protection pipe (2).

Third Step :



Having removed the protection pipe (2), fix the screw extraction mechanical part (4) on the rear flange, and screw-down a nut (5) on the threaded steel rod.

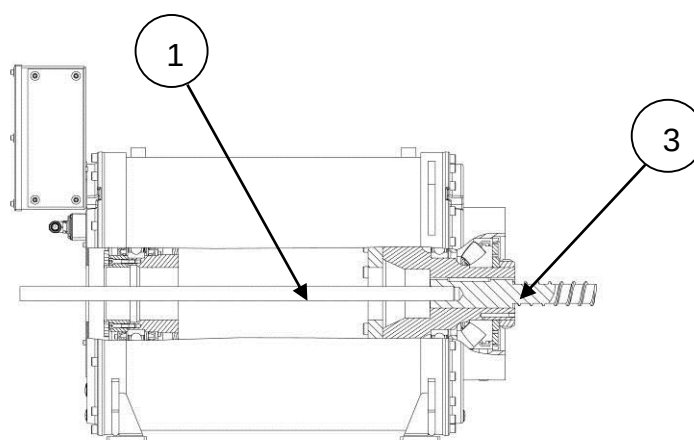
fourth Step :



Pull the extrusion screw by screwing-down the nut on the threaded steel rod.

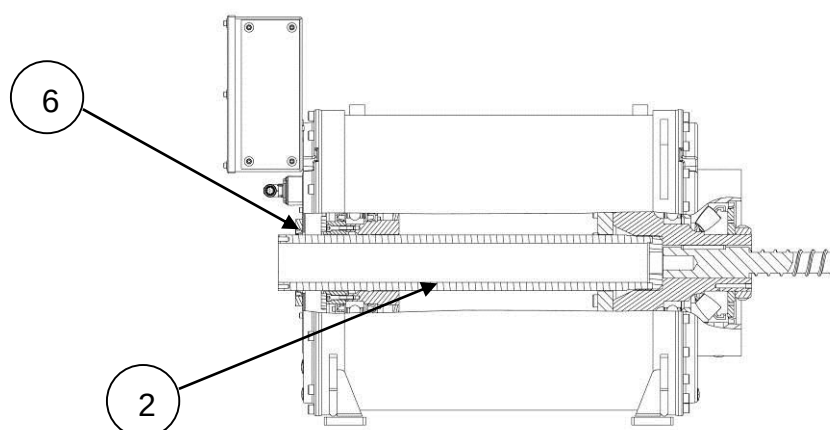
Reassembly:

First Step :



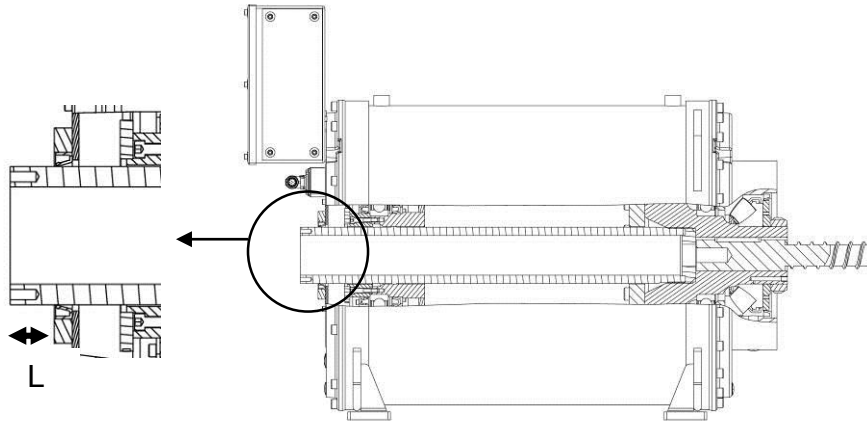
Insert the threaded steel rod (1) with the screw (3) into the shaft. Put the screw near its final position.

Second Step :



Remove the threaded steel rod (1), insert and screw the protection pipe (2) then mount the lip seal mounting (6).

Third Step :



Adjust the distance (L) between the protection pipe (2) and the lip seal mounting (6) as indicated on the outline drawing to guaranty the position of the screw.

Last step:

Remove the bridges on the terminal box and **connect motor phases to the terminal box**. Put back the terminal box cover.



Before applying power:

- * Read the safety section at the beginning of the manual
- * Check for damage to equipment
- * Check all external wiring circuits of the system – power, control, motor and earth connections.
- * Ensure that nobody is working on another part of the system who will be affected by powering up
- * Ensure that other equipment will not be adversely affected by powering up.

4.6. Troubleshooting

Some symptoms and their possible causes are listed below. This list is not comprehensive. Whenever an operating incident occurs, consult the relevant servo drive installation instructions (the troubleshooting display indications will help you in your investigation) or contact us at: <http://www.parker.com/eme/repairservice>.

You note that the motor does not turn by hand when the motor is not connected to the drive.	Check there is no mechanical blockage or if the motor terminals are not short-circuited.
You have difficulty starting the motor or making it run	- Check on the fuses, the voltage at the terminals (there could be an overload or the bearings could be jammed), also checks on the load current. - Check on any thermal protection, its connection and how it is set in the drive. - Check on the servomotor insulation (if in doubt, carry out hot and cold measurements). The minimum insulation resistance value measured under a max. 50V DC is 50 MΩ: - Between the phase and the casing - Between the thermal protection and the casing - Between the brake coil and the casing - Between the resolver coils and the casing.
You find that the motor speed is drifting	Reset the offset of the servoamplifier after having given a zero instruction to the speed setpoint input.
You notice that the motor is racing	- Check the speed setpoint of the servo drive. - Check you are well and truly in speed regulation (and not in torque regulation). - Check the encoder setting - Check on the servomotor phase order: U, V, W
You notice vibrations	- Check the encoder and tachometer connections, the earth connections (carefully) and the earthing of the earth wire, the setting of the servo drive speed loop, tachometer screening and filtering. - Check the stability of the secondary voltages. - Check the rigidity of the frame and motor support..
You think the motor is becoming unusually hot	- It may be overloaded or the rotation speed is too low : check the current and the operating cycle of the motor. - Check if the mounting surface is enough or if this surface is not a heat source – see §3.6 cooling. - Friction in the machine may be too high : - Test the motor current with and without a load. - Check the motor does not have thermal insulation. - Check that there is no friction from the brake when the brake power is on. - Check the cooling circuit

You find that the motor is too noisy	Several possible explanations : • Unsatisfactory mechanical balancing • There is friction from the brake: mechanical jamming. • Defective coupling • Loosening of several pieces • Poor adjustment of servo drive or position loop : check rotation in open loop
The motor is warmer on its top	Air bubbles can be stocked in the water cooling circuit. You need to purge the circuit or to double the water flow rate during 10 minutes to remove the air bubbles.
You hear some noise on bearing like "clac"	Too many grease on the bearing, you did not open the drain hole during re-greasing operation. Open grease drain plugs for 1 hour (see §4.4.1).
Some leakage on the front or rear flange	Too many grease on the bearing, you need to drain a part of grease. Open grease drain plugs for 1 hour (see §4.4.1).