Servomotors

NK Series

Technical Manual

PVD 3664_GB

DECLARATION CE OF CONFORMITY

We,

Parker Hannifin Manufacturing France SAS
Etablissement de Dijon
8 Avenue du Lac CS 30749
21007 DIJON CEDEX

Certify that the product

SERVOMOTORS TYPE NK

Satisfy the arrangements of the directives:

Directive 2006/95/EC: “Low Voltage Directive”
Directive 2011/65/EU: “Restriction of hazardous substances”

and meet standards or normative document according to :

EN 60034-1:2010 : “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 machine.

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.

As NK is a kit motor, final conformance of the complete motor is under the responsibility of the integrator.

The instructions and recommendations of the user manual supplied with the product, together with the servo amplifier commissioning manual instructions must be applied.

NK1 C.E. Marking in : March 2005
NK2 C.E. Marking in : October 2003
NK3 C.E. Marking in : November 2001

NK4 C.E. Marking in : September 2002
NK6 C.E. Marking in : July 2002
NK8 C.E. Marking in : April 2004

DIJON, July 1st 2014

QUALITY MANAGER
S. POIZOT

Table of Content

1. INTRODUCTION

1.1. Purpose and intended audience

This manual contains information that must be observed to select, install, operate and maintain PARKER NK servomotors.

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 servomotors 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 industrial 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. Servomotors 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 avaible on :

http://www.parker.com/eme/nk

2.2. Overview

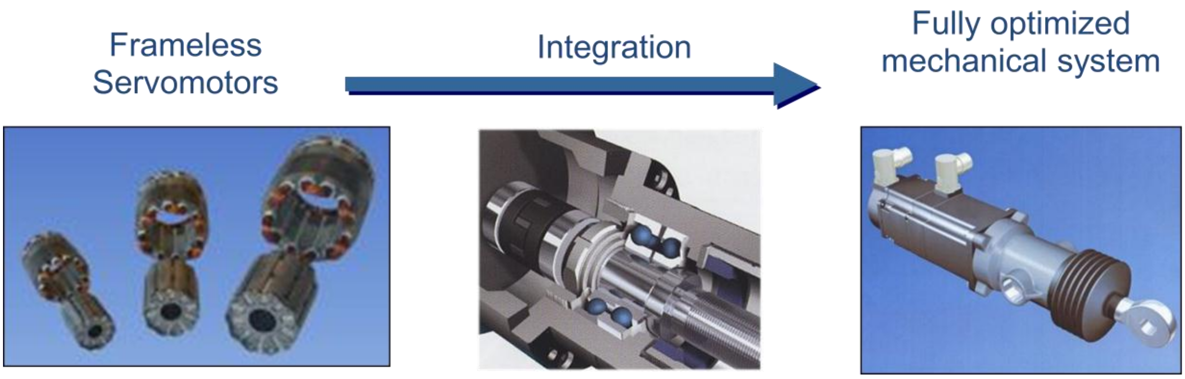
NK servomotors Series from PARKER is an innovative direct drive solution designed for industrial applications. NK Series brushless servomotors from Parker SSD Parvex combine exceptional precision and motion quality, high dynamic performances and very compact dimensions.
A large set of torque / speed characteristics, options and customization possibilities are available, making NK Series servomotors the ideal solution for most servosystems applications.

Advantages

- High precision
- High motion quality
- High dynamic performances
- Compact dimensions and robustness
- Hiher stiffness of the system
- no coupling systems needed

2.3. Applications

Medical: Blood pumps, air pump, radiology tables,…
Machine tools: Ancillary axis, spindle, axis…
Semiconductor
Hand tool: screwdriver,…
Packaging machinery
Robot applications
Special machines



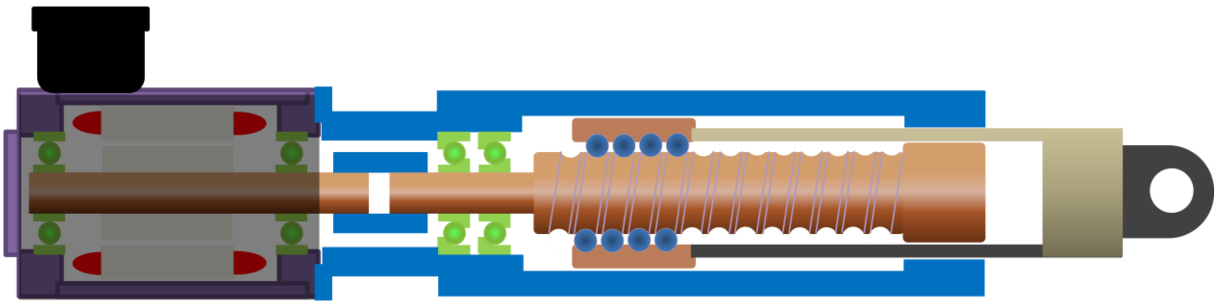
Partner of your integration :

- ✓ Flexible organization and technical know-how
- ✓ Assistance during mechanical integration

- ✓ Assistance during mechanical system tuning

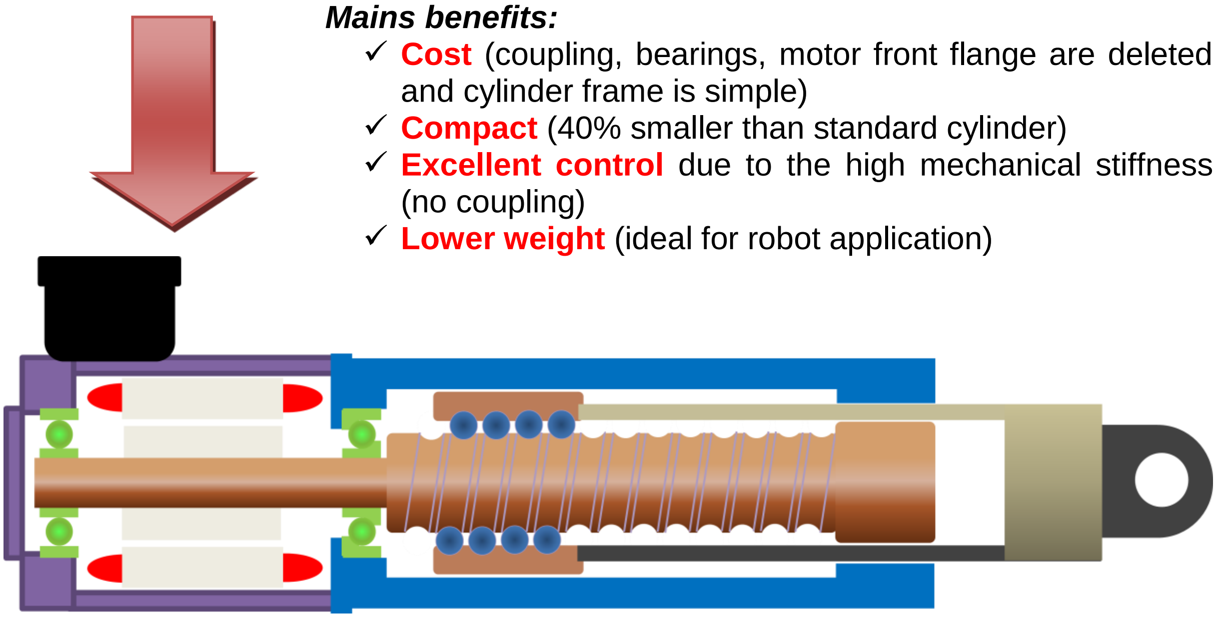
Examples

Electric cylinder

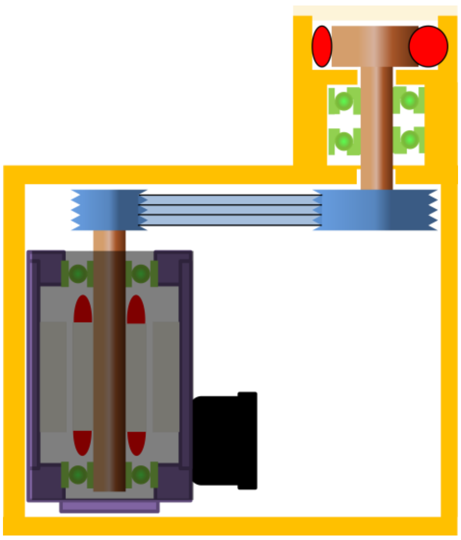


Mains benefits:

- ✓ **Cost** (coupling, bearings, motor front flange are deleted and cylinder frame is simple)
- ✓ **Compact** (40% smaller than standard cylinder)
- ✓ **Excellent control** due to the high mechanical stiffness (no coupling)
- ✓ **Lower weight** (ideal for robot application)

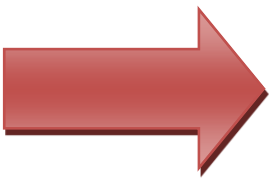


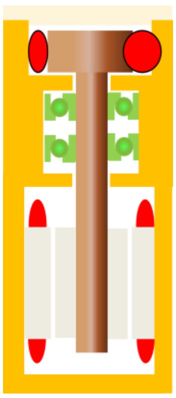
Pump



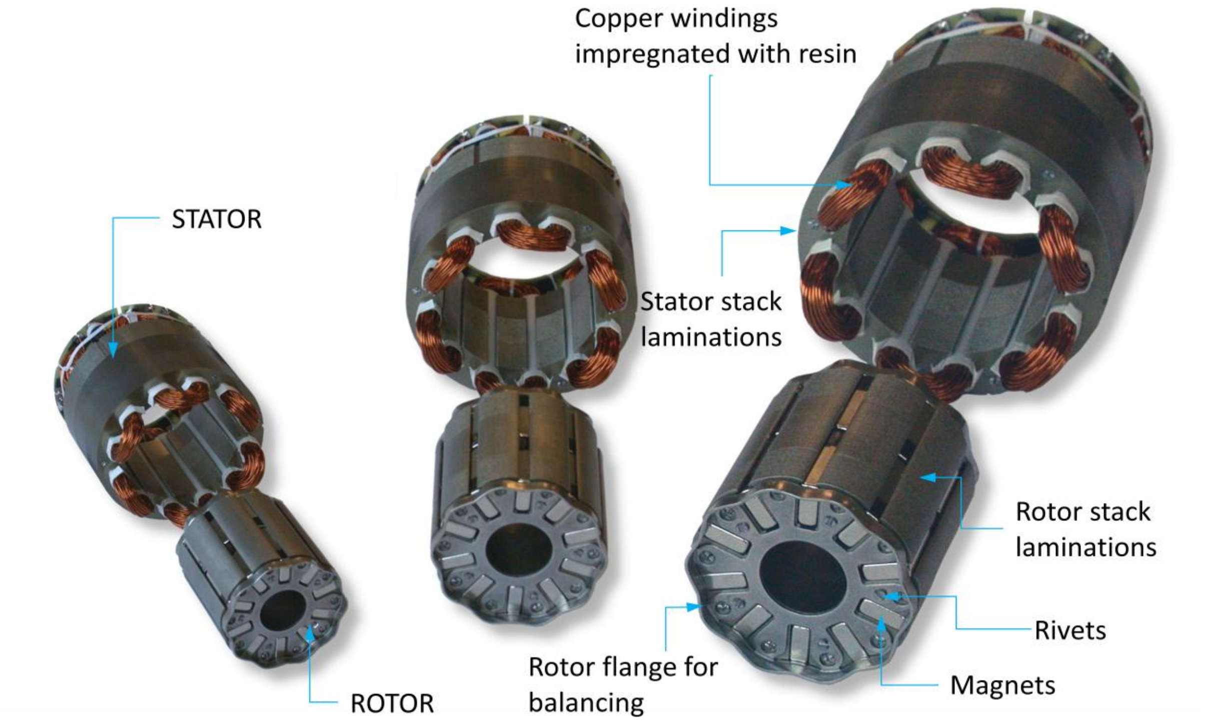
Mains benefits:

- ✓ **Low cost**
- ✓ **Compact**
- ✓ **Simplified design**
- ✓ **Low temperature rise**





2.4. Motor description



2.5. General Technical Data

	NK1	NK2	NK3, NK4,NK6	NK8
Motor type	Permanent-magnet synchronous motor			
Magnets material	Neodymium Iron Boron			
Number of poles	10			
Type of construction	IMB3 (EN60034-7)			
Degree of protection	IP00			
Cooling	• Natural cooling		• Natural cooling, • Water cooled	
Rated voltage	230VAC	230VAC, 400 VAC and 480 VAC		
Insulation of the stator winding	Class F according to IEC 60034-1 with potting		Class F according to IEC 60034-1	Class F according to IEC 60034-1 with potting
Altitude	Up to 1000m (IEC 60034-1) (for higher altitude see §3.1.1 for derating)			
Ambiant temperature	•-15°C to +40°C (IEC 60034-1) •-40°C on request •0°C to 40°C for water cooled version (IEC 60034-1) to avoid condensation see §3.5			
Storage temperature	-20… +60°C			
Connection	Cable			

2.6. Product Code

Code	N	K	3	1	0	E	A	K	R	1	0	0	0

Product Series

Motor size

1, 2, 3, 4, 6 or 8 in relation with the motor diameter

Motor length

up to 60 depend on size

Windings variant

E: standard serial windings class F
W: serial windings class F water cooled

Feedback Sensor

A: resolver 2 poles transformation ratio = 0.5
K: without sensor
R: Hiperface encoder singleturn SKS36 (128pulses)
S: Hiperface encoder mutiturn SKM36 (128pulses)
T: Hiperface encoder singleturn SRS50 (1024pulses)
U: Hiperface encoder mutiturn SRM50 (1024pulses)
V: Endat encoder singleturn ECN1113
W: Endat encoder multiturn ECN1125
X: Commuted lines 10 poles – 2048pulses
Y: sensorless series for 650S drive
Z : Special encoder

Torque / Speed Characteristics

See motor data

Unused character

Electric connection

1: flying wires

Mechanical Interface

000: Standard motor
Other: custom code

3. TECHNICAL DATA

3.1. Motor selection

3.1.1. Altitude derating

From 0 to 1000 m : no derating
1000 to 4000 m: torque derating of 5% for each step of 1000 m for water cooled
1000 to 4000 m: torque derating of 10% for each step of 1000 m for air cooled

3.1.2. Temperature derating

3.1.2.1. Natural cooled motor

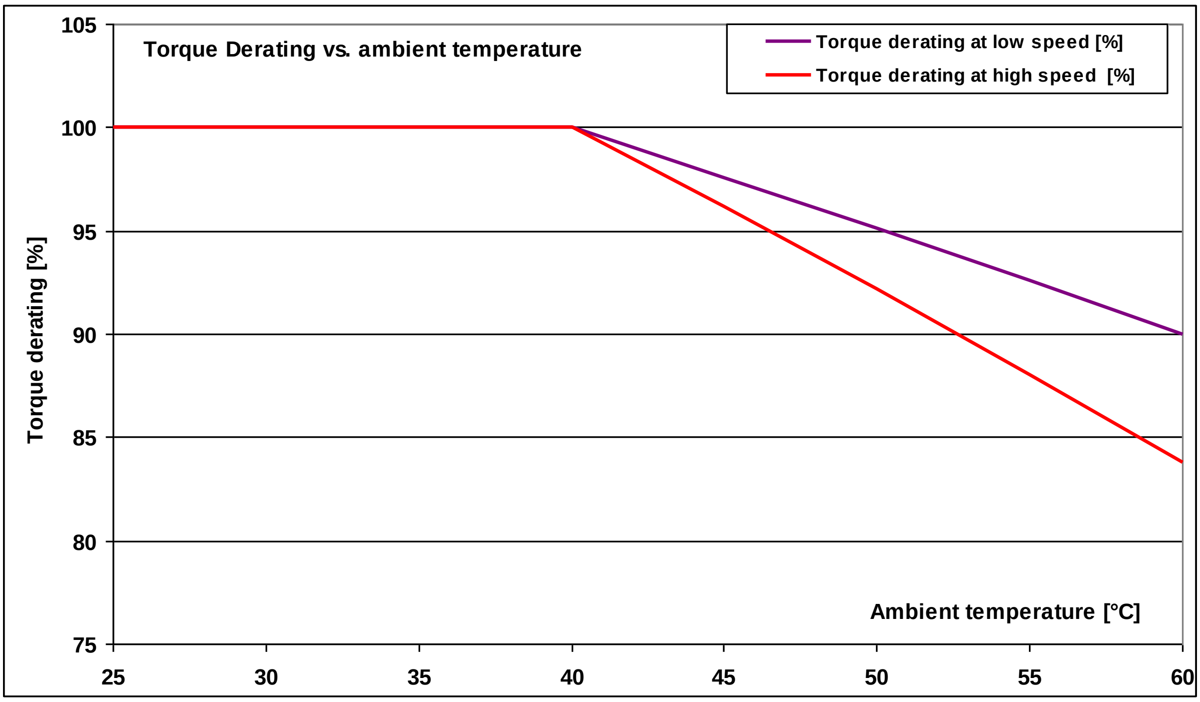
The maximal temperature for natural cooling is 40°C. But, it is possible to increase a little bit the ambient temperature above 40°C, with a torque reduction. The following formula gives an indicative about the torque derating at low speed. But in any case refer to PARKER technical department to know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

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

$$Torque\_derating[\%] = 100 * \sqrt{\frac{(145°C - Ambient\_temperature°C)}{105°C}}$$

⚠	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 NK620EAR :



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

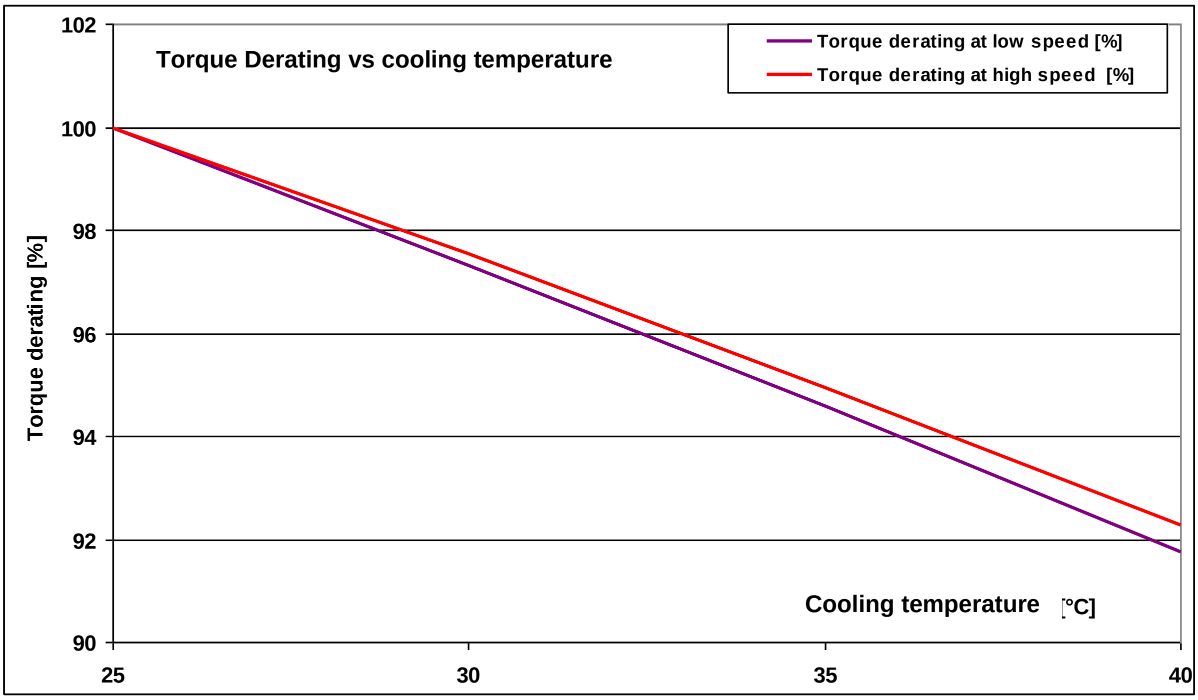
It is possible to increase a little bit the Inlet temperature up to 40°C, but the torque must be reduced. The following formula gives an indicative of the torque derating at low speed. But in any case refer to PARKER technical department to know the exact values

<u>At low speed</u> the torque derating is given by the following formula for an water Inlet temperature > 25°C.

$$Torque\_derating[\%] = 100 * \sqrt{\frac{(120°C - Inlet\_temperature°C)}{95°C}}$$

	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 water inlet temperature at high speed for a specific motor.

Illustration: Only for example given for the NK860WAF



3.1.3. Thermal equivalent torque (rms torque)

The selection of the right motor can be made through the calculation of the rms torque $\boldsymbol{M_{rms}}$ (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 $\boldsymbol{M_{rms}}$ 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 $\boldsymbol{M_i}$ *[Nm]* reached during the duration $\boldsymbol{\Delta t_i}$ *[s]*.

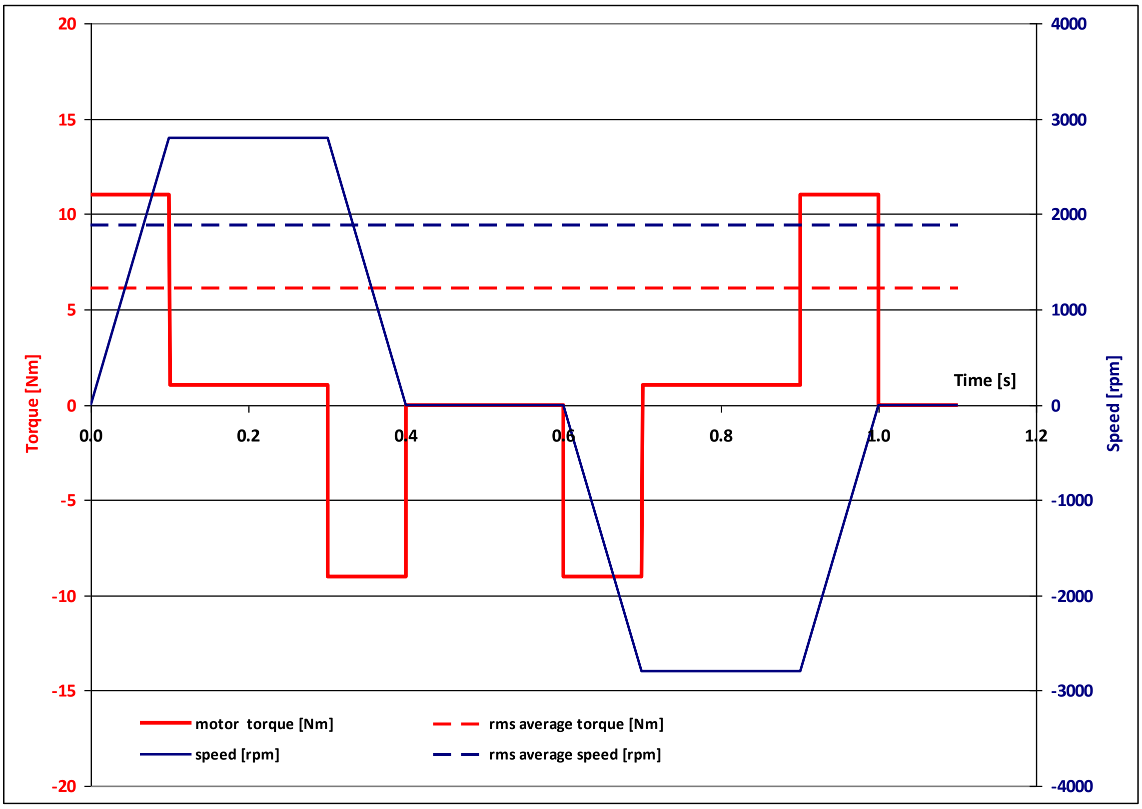
So, the rms torque $\boldsymbol{M_{rms}}$ can be calculated through the following basic formula:

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

Example:
For a cycle of 2s at 0 Nm and 2s at 10Nm and a period of 4 s, the rms torque is

$$M_{rms} = \sqrt{\frac{1}{4} * 10^2 * 2} = 7{,}07 Nm$$

Illustration :
Acceleration-deceleration torque:10 Nm during 0.1 s. Resistant torque: 1 Nm during the movement.
Max-min speed: ± 2800 rpm during 0.2 s. Max torque provided by the motor 11 Nm. rms torque: 6 Nm.



The maximal torque $\boldsymbol{M_i}$ delivered by the motor at each segment ***i*** of movement is obtained by the algebric sum of the acceleration-deceleration torque and the resistant torque. Therefore, $\boldsymbol{M_{max}}$ corresponds to the maximal value of $\boldsymbol{M_i}$.

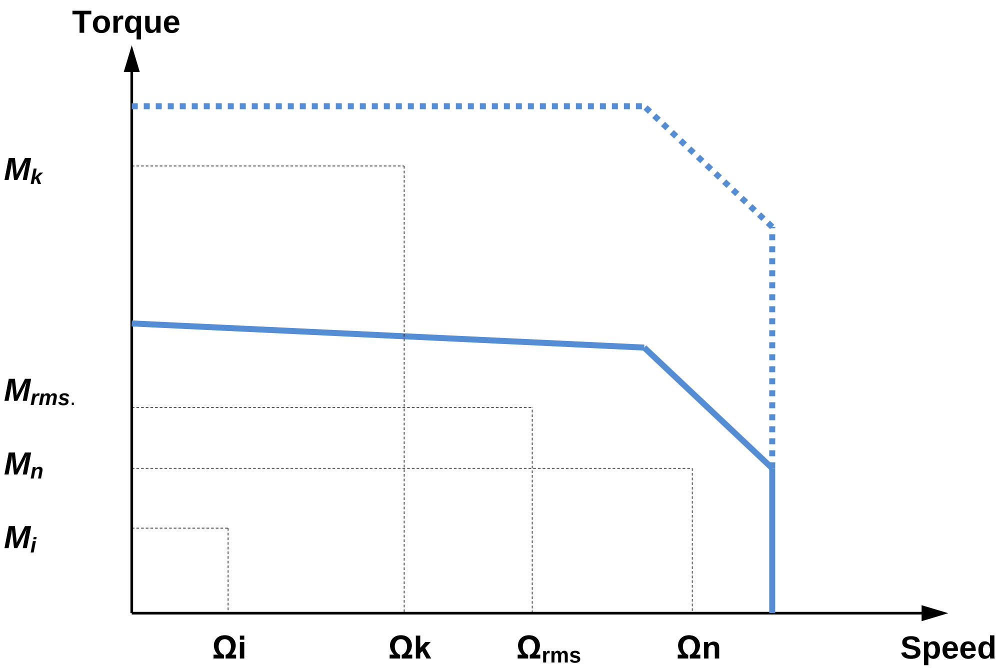
Selection of the motor :

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 Mi and speed associated Ωi 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.

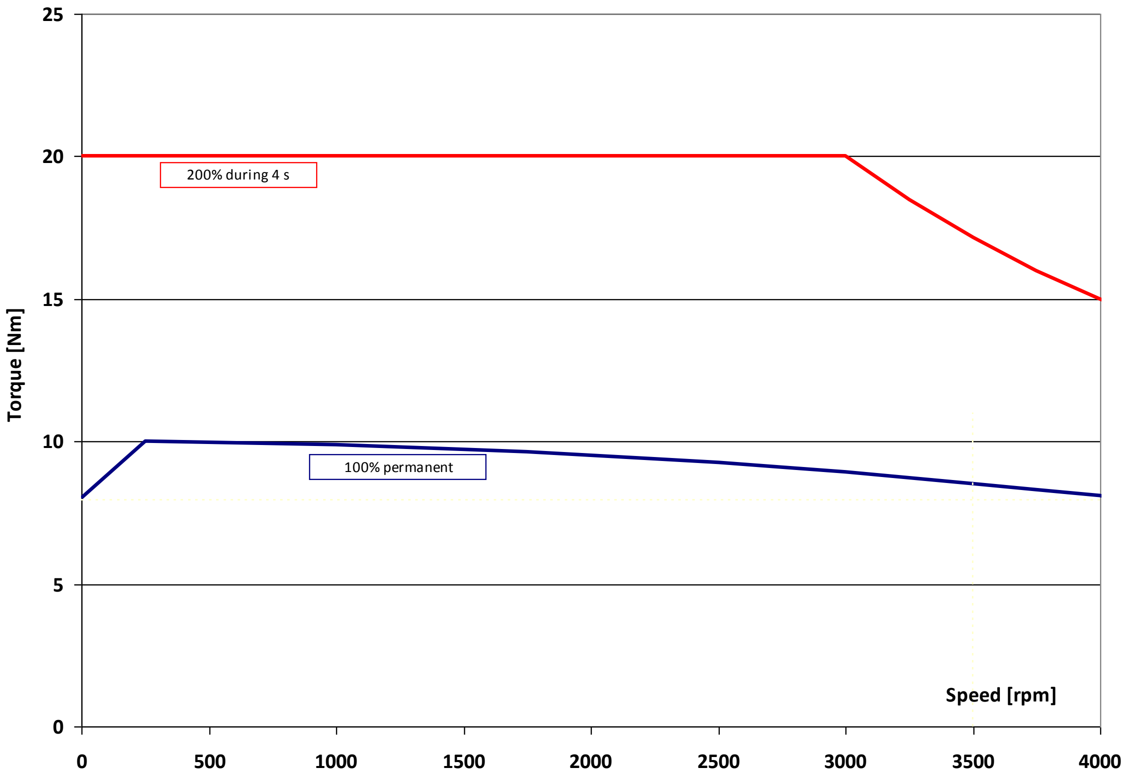
⚠	Please refer to the drive technical documentation for any further information and to select the best motor and drive association.

AC890 PARKER drive example:

The rated current provided by the AC890 drive depends on its rated power and its mode selection. “Vector mode” is used for induction motors while “Servo mode” is used for brushless AC motors. With NK motors the power is usually < 37 kW, the rated current corresponds to 100 %.

Power of Drive AC890 [kW]	**< 37 kW**	
Mode	Vector mode	Servo mode
Overload capability [%]	150 % during 60 s	200 % during 4 s

Illustration:



![Parker logo]

<u>Example n°1 :</u>

The application needs:
- a rms torque of **7 Nm** at the rms speed of **2000 rpm**,
- an acceleration torque of **12 Nm**,
- a maximal speed of **2800 rpm**.

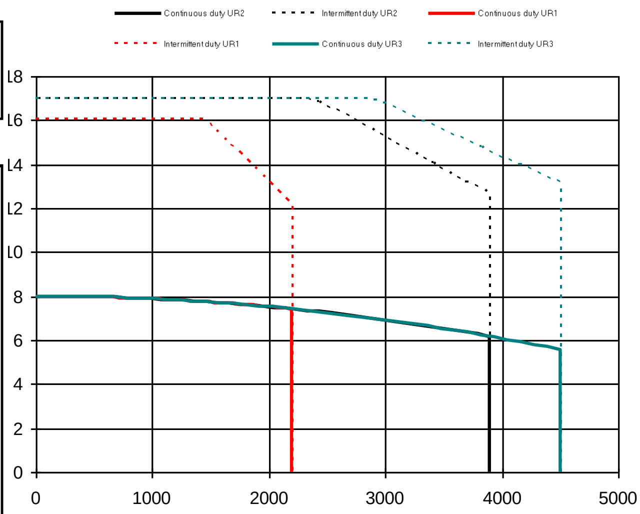
Selection of the motor:

The selected motor is the type **NK620EAR**.
The nominal speed is equals to 3900 rpm.
The maximal speed is equals to 3900 rpm.
The torque sensitivity is equals to 1.47 Nm/Arms.

BRUSHLESS MOTORS
NK620EAR
ELECTRONIC DRIVE
DIGIVEX 8/16
(400V)

No UL certification

Torque at low speed	M_o	Nm		8	
Permanent current at low speed	I_o	A_{rms}		5.31	
Peak torque	M_p	Nm		26.7	--
Current for the peak torque	I_p	A_{rms}		21.2	--
Back emf constant at 1000 rpm (25°C)*	Ke	V_{rms}		95.7	
Torque sensitivity	Kt	Nm/A_{rms}		1.51	
Winding resistance (25°C)*	Rb	Ω		2.24	
Winding inductance*	L	mH		19.2	
Rotor inertia	J	kgm^2x10^{-5}		98	
Thermal time constant	Tth	min		27	
Motor mass	M	kg		7	
Voltage of the mains	UR1 UR2 UR3	V_{rms}	400	-	-
Rated speed	Nn1 Nn2 Nn3	rpm	3900	-	-
Rated torque	Mn1 Mn2 Mn3	Nm	6.17	-	-
Rated current	In1 In2 In3	A_{rms}	4.25	-	-
Rated power	Pn1 Pn2 Pn3	W	2520	-	-



The permanent current I_0 of the motor is **5.31 Arms** for M_0**=8 Nm** at low speed.
The nominal current I_n of the motor is **4.25 Arms** for M_n**=6.17 Nm** at the nominal speed.

Selection of the drive:

The drive has to provide at least a permanent current equals to I_0 (5.31 Arms).
In order to obtain an acceleration torque of **12 Nm**, the current will be about 8 Arms (the motor data sheet shows 17 Nm with 11.3 Arms). This means that the drive has to provide at least 8 Arms as transient current.

→ Therefore, we can select the drive **AC890SD-53 2100 B** which delivers under 400 VAC:
6 Arms as permanent current and
6***200%**=12 Arms as maximal transient current during 4 s.
The drive is set with **"Servo Mode"**.

→ We also can select the drive **DIGIVEX 8/16 Â** which delivers under 400 VAC:
5.6 Arms as permanent current and
5.6***200%**=11.3 Arms as maximal transient current during 2 s.

Example n°2 :

This times; the application needs :

- a permanent torque of **5.8 Nm** at low speed,
- a rms torque of **5.8 Nm** at the rms speed of **1890 rpm**,
- an acceleration torque of **8.8 Nm,**
- a maximal speed of **2800 rpm**.

Selection of the motor:

The selected motor is the type **NK620EAR**.
The nominal speed is equals to 3900 rpm.
The maximal speed is equals to 3900 rpm.
The torque sensitivity is equals to 1.47 Nm/Arms.

Selection of the drive:

The drive has to provide a permanent current equals to 4 Arms to obtain 5.8 Nm.
In order to obtain an acceleration torque of **8.8 Nm**, the current will be of about 6 Arms
This means that the drive has to provide at less 6 Arms as transient current.

Compared to the previous example n°1, it is now possible to decrease the size of drive.
→ Therefore, we can select the drive **AC890SD-53 1600 B** which delivers under 400 VAC:
4 Arms as permanent current and
4***200%**=**8 Arms** as maximal transient current during 4 s.
The drive is set with **"Servo Mode"**.

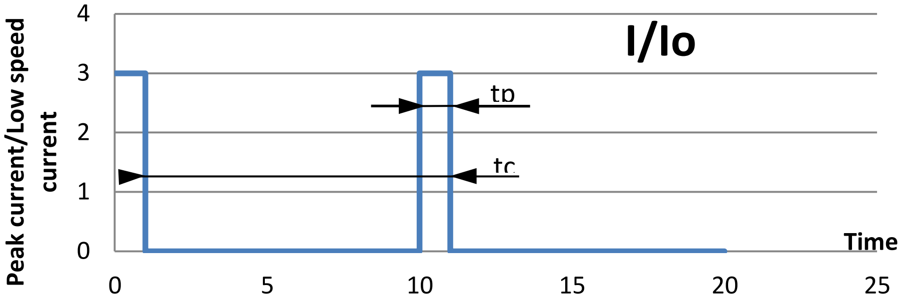
3.1.5. Current limitation at stall conditions (i.e. speed < 3 rpm)

Recommended reduced current at speed < 3 rpm:

$$I_{reduced} = \frac{1}{\sqrt{2}} * I_0 \cong 0.7 * I_0$$

<table>
<tr><td></td><td><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 70% of I_0 (permanent current at low speed), in order to avoid an excessive overheating of the motor.</td></tr>
<tr><td></td><td>Please refer to the drive technical documentation for any further information and to choose functions to program the drive.</td></tr>
</table>

3.1.6. Peak current limitations



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

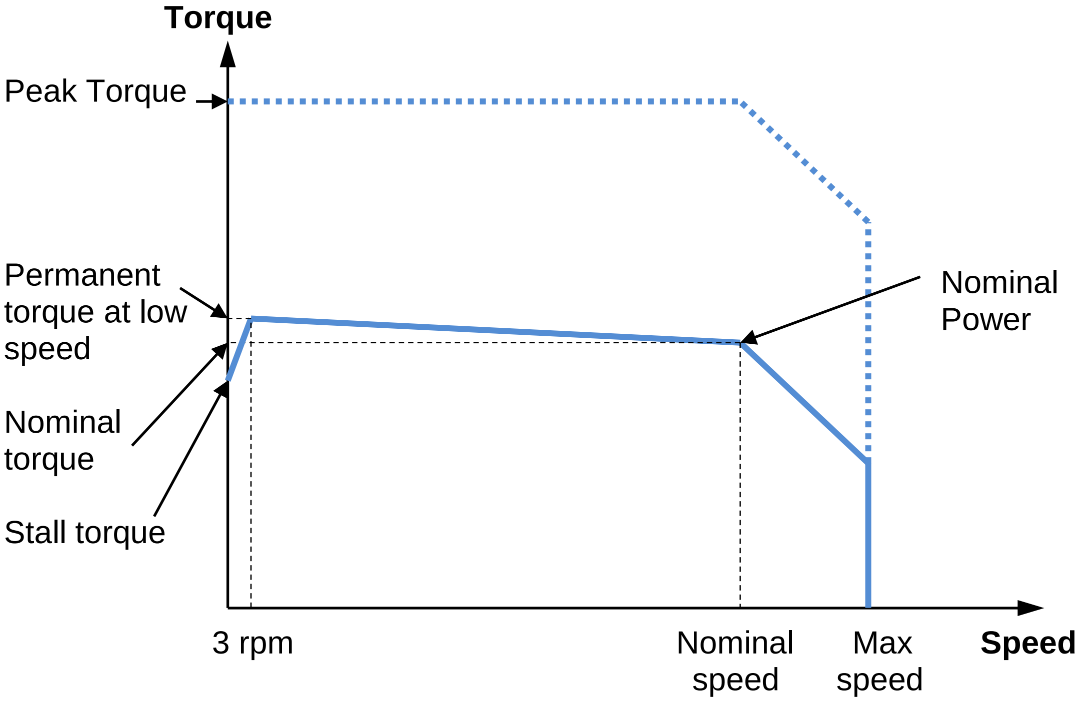
1) The peak currents and peak torques given in the data sheet must never be exceeded
2) The thermal equivalent torque must be respected (§3.1.3)
3) If 1) and 2) are respected (it can limit the peak current value or duration), the peak current duration (tp) must be limited, in addition, accordingly to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

<table>
<tr><th>Ipeak/In</th><th>Ip/Io =2</th><th>Ip/Io = 3</th><th>Ip/Io =4</th><th>Ip/Io >5</th></tr>
<tr><td>NK110</td><td rowspan="5">tp<0.8 s</td><td rowspan="5">tp<0.3s</td><td rowspan="5">tp<0.15s</td><td rowspan="5">tp<0.1s</td></tr>
<tr><td>NK210</td></tr>
<tr><td>NK310</td></tr>
<tr><td>NK420</td></tr>
<tr><td>NK430</td></tr>
<tr><td>NK620</td><td rowspan="5">tp<1.5s</td><td rowspan="5">tp<0.6s</td><td rowspan="5">tp<0.3s</td><td rowspan="5">tp<0.2s</td></tr>
<tr><td>NK630</td></tr>
<tr><td>NK820</td></tr>
<tr><td>NK840</td></tr>
<tr><td>NK860</td></tr>
<tr><td>NK860V</td><td rowspan="2">tp<3s</td><td rowspan="2">tp<1.5s</td><td rowspan="2" colspan="2">not allowed</td></tr>
<tr><td>NK860W</td></tr>
</table>

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

3.2. NK Characteristics: Torque, speed, current, power…

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



Motor	Electronic Drive	Torque at low speed	Current at low speed	Peak Torque	Peak current	Back emf constant at 1000rpm	Torque sensitivity	Winding resistance	Winding inductance	Rotor inertia	Voltage of the mains	Rated speed and max speed	Rated torque	Rated current	Rated power
Name	**Type**	**Mo (Nm)**	**Io (Arms)**	**Mp (Nm)**	**Ip (Arms)**	**Ke (V)**	**Kt (Nm/A)**	**Rb (Ω)**	**L (mH)**	**J (10^{-5}.kg.m²)**	**UR (V)**	**Nn (rpm)**	**Mn (Nm)**	**In (Arms)**	**Pn (W)**
NK110EAP	DRIVE 1 / 4 Arms	0,45	0,989	1,72	3,96	29,9	0,46	22,6	26,5	1,3	230	6000	0,33	0,78	210
NK205EAV	DRIVE 1.5 / 6 Arms	0,45	1,01	2	5,08	30,2	0,44	17,6	46,4	2,1	400	7500	0,29	0,69	230
NK205EAS	DRIVE 1.5 / 7.5 Arms	0,45	1,4	2	7,01	21,9	0,32	8,9	24,3	2,1	400	8900	0,23	0,80	210
NK210EAT	DRIVE 1.5 / 6 Arms	1	1,33	3,4	5,35	48,6	0,75	16,3	35,0	3,8	400	6000	0,61	0,89	390
NK210EAP	DRIVE 2 / 8 Arms	1	1,99	3,4	7,96	32,6	0,50	7,7	15,8	3,8	400	7000	0,50	1,11	370
NK210EAG	DRIVE 3 / 11 Arms	1	2,75	3,4	11	23,6	0,36	3,9	8,3	3,8	400	7000	0,50	1,53	370
NK310EAP	DRIVE 1.5 / 6 Arms	2	1,39	6,6	5,56	88,9	1,44	20,7	62,0	7,9	400	4000	1,65	1,18	690
NK310EAI	DRIVE 3.5 / 14 Arms	2	3,38	6,6	13,5	36,5	0,59	3,4	10,5	7,9	230	5600	1,48	2,61	870
NK310EAK	DRIVE 2.5 / 10 Arms	2	2,43	6,6	9,71	50,9	0,82	6,6	20,3	7,9	400	7000	1,36	1,76	1000
NK310EAX	DRIVE 4 / 16 Arms	2	3,85	6,6	15,4	32,1	0,52	2,7	8,1	7,9	230	6600	1,32	2,71	910
NK420EAP	DRIVE 3 / 11 Arms	4	2,71	13,4	10,9	89,9	1,48	7,2	33,0	29	400	4000	3,14	2,16	1310
NK420EAV	DRIVE 1.5 / 6 Arms	4	1,36	13,4	5,47	179	2,94	28,4	131,0	29	400	2000	3,60	1,23	750
NK420EAX	DRIVE 6 / 22 Arms	4	5,42	13,4	21,8	44,9	0,74	1,8	8,2	29	400	7500	1,89	2,72	1490
NK420EAJ	DRIVE 5 / 20 Arms	4	4,69	13,4	18,8	51,9	0,85	2,3	11,0	29	400	6000	2,62	3,17	1650
NK430EAV	DRIVE 1.5 / 6 Arms	5,5	1,41	18,8	5,64	244	3,90	29,0	151,0	42,6	400	1000	5,38	1,38	560
NK430EAP	DRIVE 3 / 12 Arms	5,5	2,82	18,8	11,3	122	1,95	7,3	37,8	42,6	400	3000	4,77	2,48	1500
NK430EAL	DRIVE 4 / 16 Arms	5,5	3,78	18,8	15,1	90,9	1,45	4,2	21,0	42,6	400	4000	4,29	3,01	1800
NK430EAF	DRIVE 7 / 27 Arms	5,5	6,64	18,8	26,5	51,8	0,83	1,4	6,8	42,6	400	6000	2,98	3,76	1870
NK430EAJ	DRIVE 6 / 22 Arms	5,5	5,24	18,8	21	65,6	1,05	2,2	10,9	42,6	400	5500	3,35	3,31	1930
NK430EAH	DRIVE 6 / 23 Arms	5,5	5,64	18,8	22,5	61	0,98	1,8	9,4	42,6	400	6000	2,98	3,19	1870

Motor	Electronic Drive	Torque at low speed	Current at low speed	Peak Torque	Peak current	Back emf constant at 1000rpm	Torque sensitivity	Winding resistance	Winding inductance	Rotor inertia	Voltage of the mains	Rated speed and max speed	Rated torque	Rated current	Rated power
Name	Type	Mo (Nm)	Io (Arms)	Mp (Nm)	Ip (Arms)	Ke (V)	Kt (Nm/A)	Rb (Ω)	L (mH)	J (10-5.kg.m^2)	UR (V)	Nn (rpm)	Mn (Nm)	In (Arms)	Pn (W)
NK620EAR	DRIVE 6 / 22 Arms	8	5,31	26,7	21,2	95,7	1,51	2,2	19,2	98	400	3900	6,17	4,25	2520
NK620EAJ	DRIVE 10 / 40 Arms	8	9,89	26,7	39,5	51,3	0,81	0,6	5,5	98	400	5700	4,10	5,56	2450
NK620EAV	DRIVE 3 / 12 Arms	8	2,83	26,7	11,3	180	2,83	7,9	67,6	98	400	2000	7,52	2,69	1570
NK620EAD	DRIVE 13 / 50 Arms	8	12,1	26,7	48,3	42	0,66	0,4	3,7	98	400	6000	3,68	6,19	2310
NK630EAR	DRIVE 6 / 22 Arms	12	5,25	40	21	138	2,29	2,4	24,9	147	400	2700	9,34	4,20	2640
NK630EAN	DRIVE 8 / 32 Arms	12	7,93	40	31,6	91,6	1,51	1,1	10,9	147	400	4000	7,60	5,30	3180
NK630EAV	DRIVE 3 / 11 Arms	12	2,62	40	10,5	277	4,57	9,2	99,6	147	400	1350	10,83	2,40	1530
NK630EAK	DRIVE 10 / 40 Arms	12	9,86	40	39,4	73,6	1,22	0,7	7,1	147	400	4900	6,23	5,53	3190
NK630EAG	DRIVE 14 / 56 Arms	12	13,9	40	55,6	52,1	0,86	0,3	3,5	147	230	4000	8,31	10,1	3480
NK820EAX	DRIVE 6 / 21 Arms	16	5,16	50	20,3	193	3,10	4,5	38,7	320	400	1900	14,72	4,79	2930
NK820EAR	DRIVE 12 / 44 Arms	16	11	50	43,2	91	1,46	1,0	8,6	320	400	3900	12,94	9,07	5290
NK820EAL	DRIVE 18 / 70 Arms	16	17,6	50	69,1	56,9	0,91	0,4	3,4	320	400	6200	10,35	11,90	6720
NK840EAQ	DRIVE 11 / 40 Arms	28	10,1	92	39,9	174	2,78	1,4	15,1	620	400	2100	23,17	8,47	5090
NK840EAL	DRIVE 16 / 60 Arms	28	15,1	92	59,8	116	1,85	0,6	6,7	620	400	3100	19,99	11,09	6490
NK840EAK	DRIVE 17 / 67 Arms	28	16,8	92	66,5	104	1,67	0,5	5,4	620	400	3500	18,56	11,51	6800
NK840EAJ	DRIVE 20 / 75 Arms	28	18,9	92	74,8	92,8	1,48	0,4	4,3	620	400	3900	17,04	11,99	6960
NK860EAJ	DRIVE 20 / 75 Arms	41	18,5	137	74	140	2,21	0,5	6,4	920	400	2600	27,47	12,66	7480
NK860EAD	DRIVE 35 / 135 Arms	41	33	137	132	78,7	1,24	0,2	2,0	920	400	3200	21,89	18,19	7340
NK860EAF	DRIVE 28 / 110 Arms	41	27	137	108	96,1	1,52	0,2	3,0	920	400	3200	21,89	14,88	7340
NK860VAJ	DRIVE 30 / 75 Arms	64	29,3	137	74	140	2,18	0,5	6,4	920	400	2600	52,57	24,06	14310
NK860VAF	DRIVE 45 / 110 Arms	64	42,7	137	108	96,1	1,50	0,2	3,0	920	400	3750	43,38	28,93	17030

Motor	Electronic Drive	Torque at low speed	Current at low speed	Peak Torque	Peak current	Back emf constant at 1000rpm	Torque sensitivity	Winding resistance	Winding inductance	Rotor inertia	Voltage of the mains	Rated speed and max speed	Rated torque	Rated current	Rated power	Water flow
Name	Type	Mo (Nm)	Io (Arms)	Mp (Nm)	Ip (Arms)	Ke (V)	Kt (Nm/A)	Rb (Ω)	L (mH)	J (10-5.kg.m²)	UR (V)	Nn (rpm)	Mn (Nm)	In (Arms)	Pn (W)	l/min
NK310WAK	DRIVE 5 / 10 Arms	3.8	4.7	6.6	9.71	50,9	0,82	6,6	20,3	7,9	400	7000	3.2	4.6	2400	1
NK420WAJ	DRIVE 7 / 20 Arms	5.2	6.7	13.4	18.8	51,9	0,85	2,3	11,0	29	400	7000	4.9	6.3	3700	1
NK430WAF	DRIVE 10 / 27 Arms	7.7	9.5	18.8	26.5	51,8	0,83	1,4	6,8	42,6	400	7000	9.0	7.2	5300	1
NK620WAD	DRIVE 20 / 50 Arms	11	17	26.7	48.3	42	0,66	0,4	3,7	98	400	7000	10.2	15.5	7500	1
NK630WAG	DRIVE 23 / 56 Arms	19	22.6	40	55.6	52,1	0,86	0,3	3,5	147	400	6000	18.2	21.6	11 500	1.5
NK820WAL	DRIVE 25 / 70 Arms	22	25	50	69.1	56,9	0,91	0,4	3,4	320	400	6200	20	22.8	12 700	2
NK840WAJ	DRIVE 40 / 75 Arms	50	36	92	74.8	92,8	1,48	0,4	4,3	620	400	4000	47	34	19 500	3.5
NK860WAF	Drive 73 / 110 Arms	90	62,6	137	108	96,1	1,50	0,2	3,0	920	400	3750	84	59,1	33 000	5

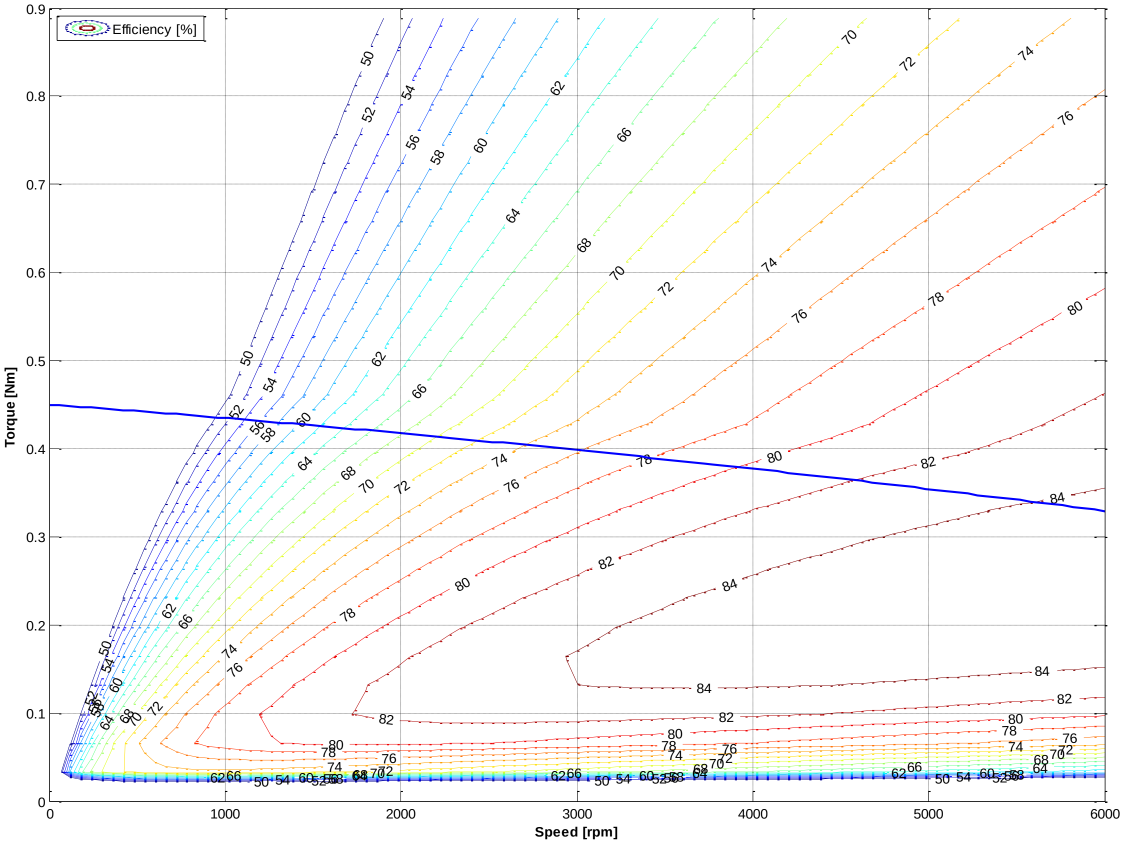
3.2.1. Efficiency curves

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

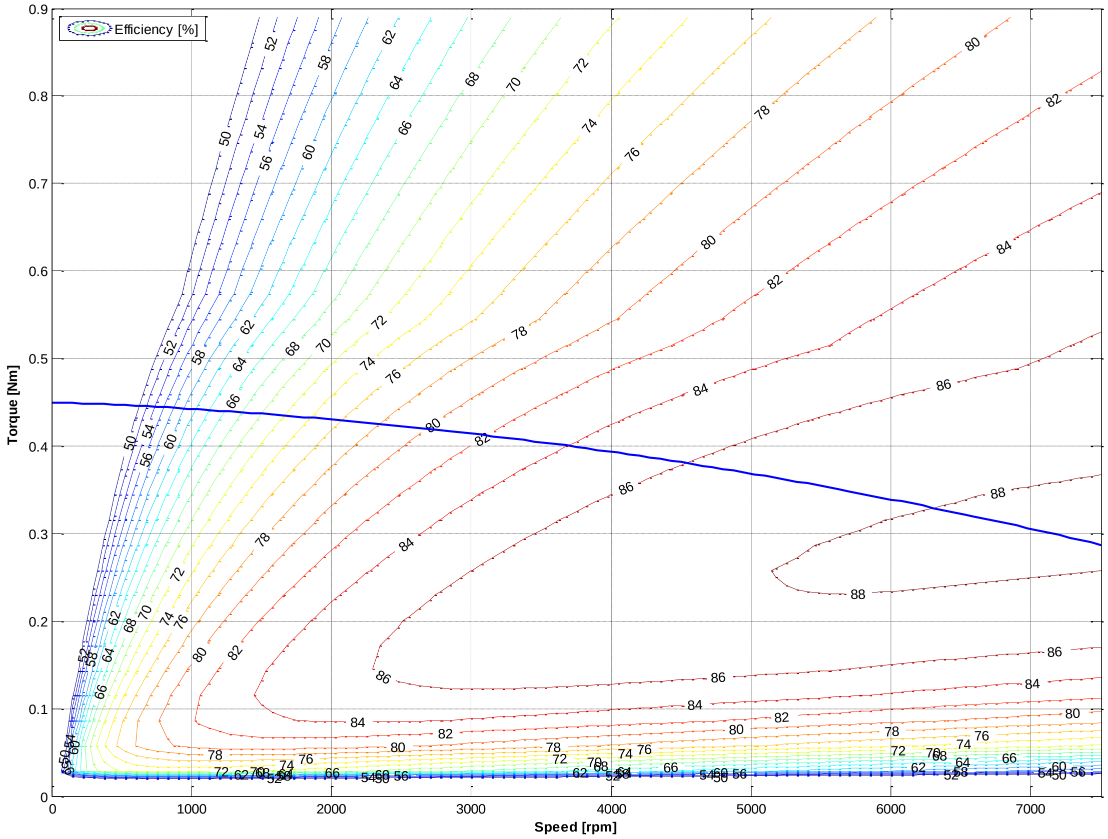
⚠	Caution: The efficiency curves are given for an optimal motor control (no voltage saturation and optimal phase between current and EMF)

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

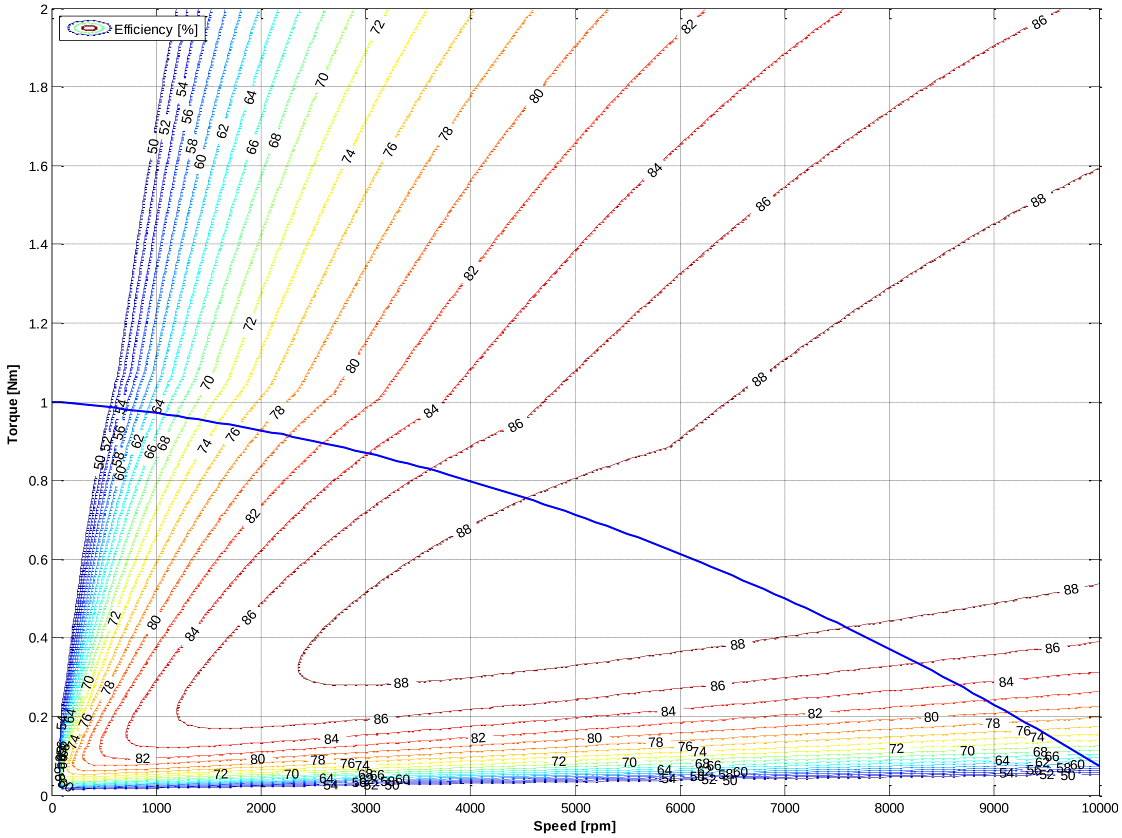
3.2.1.1. Series NK110E



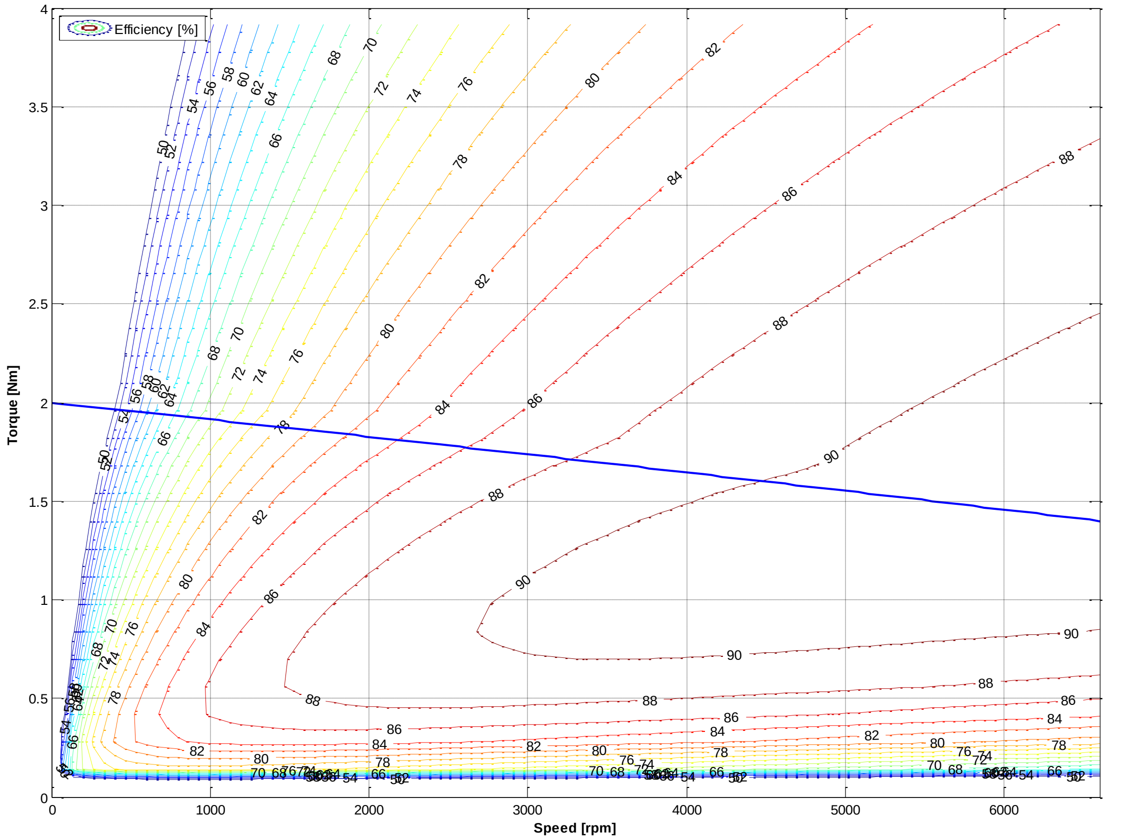
3.2.1.2. Series NK205E



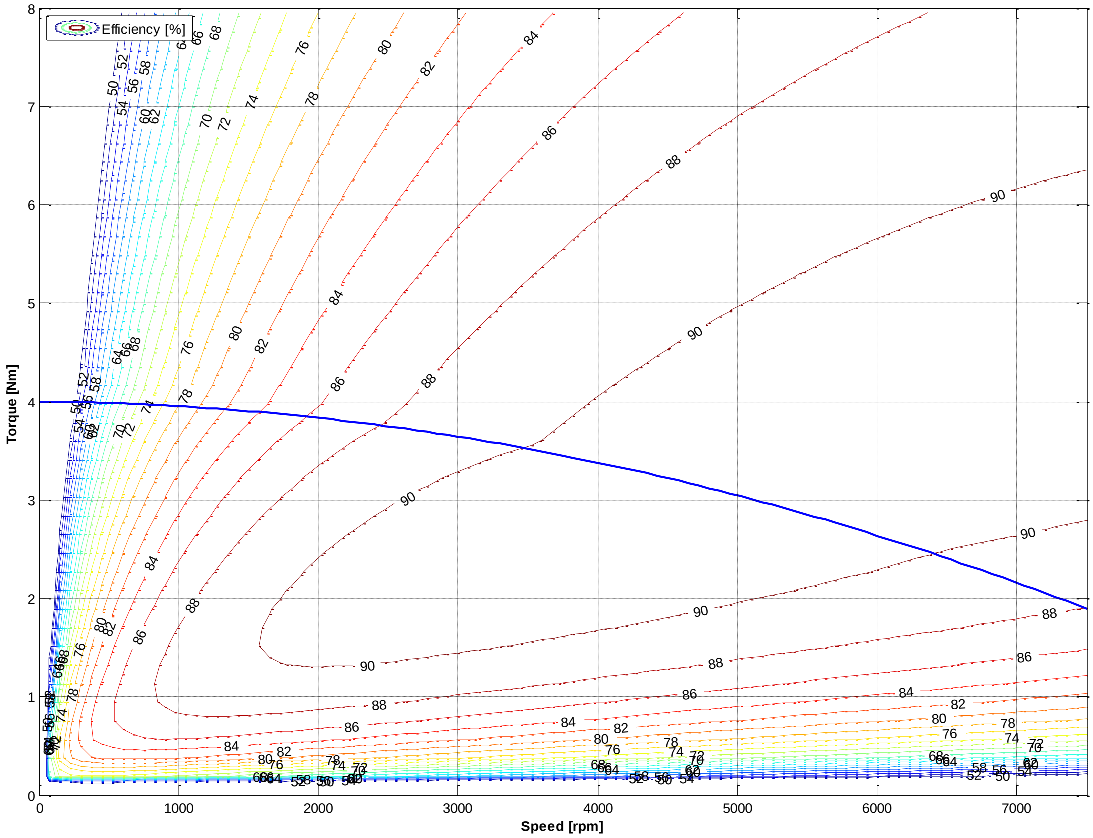
3.2.1.3. Series NK210E



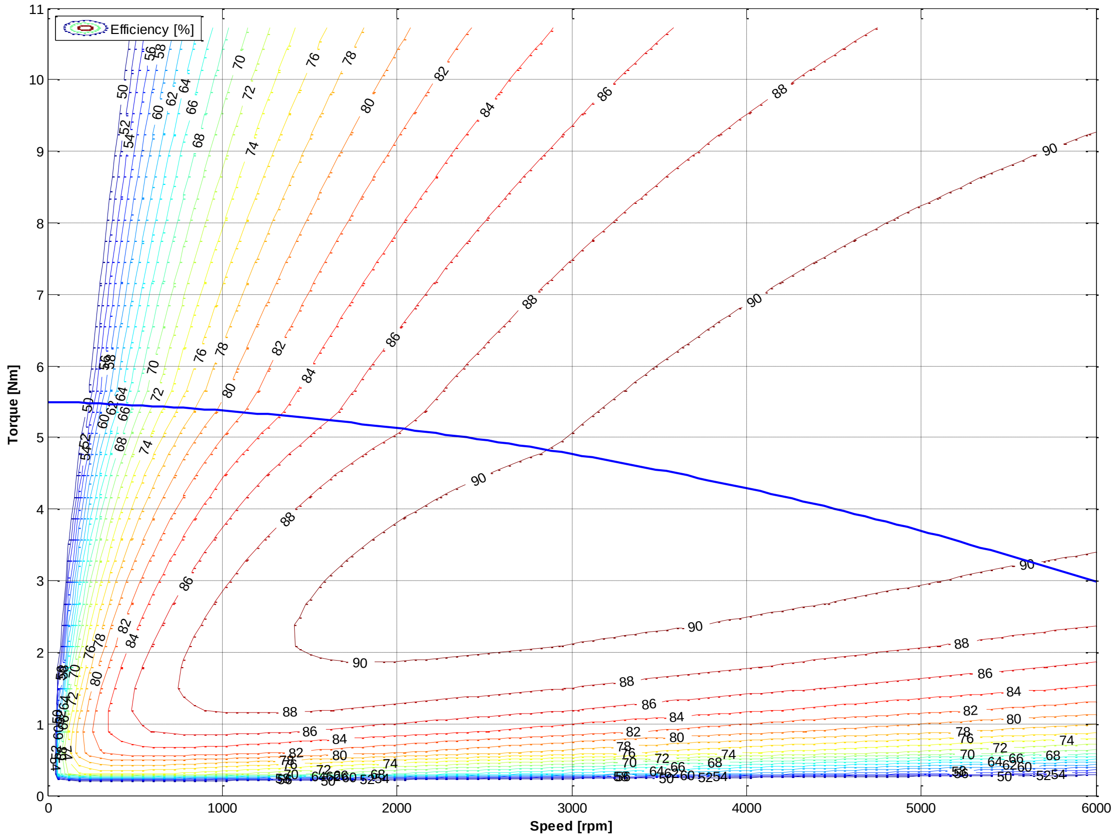
3.2.1.4. Series NK310E



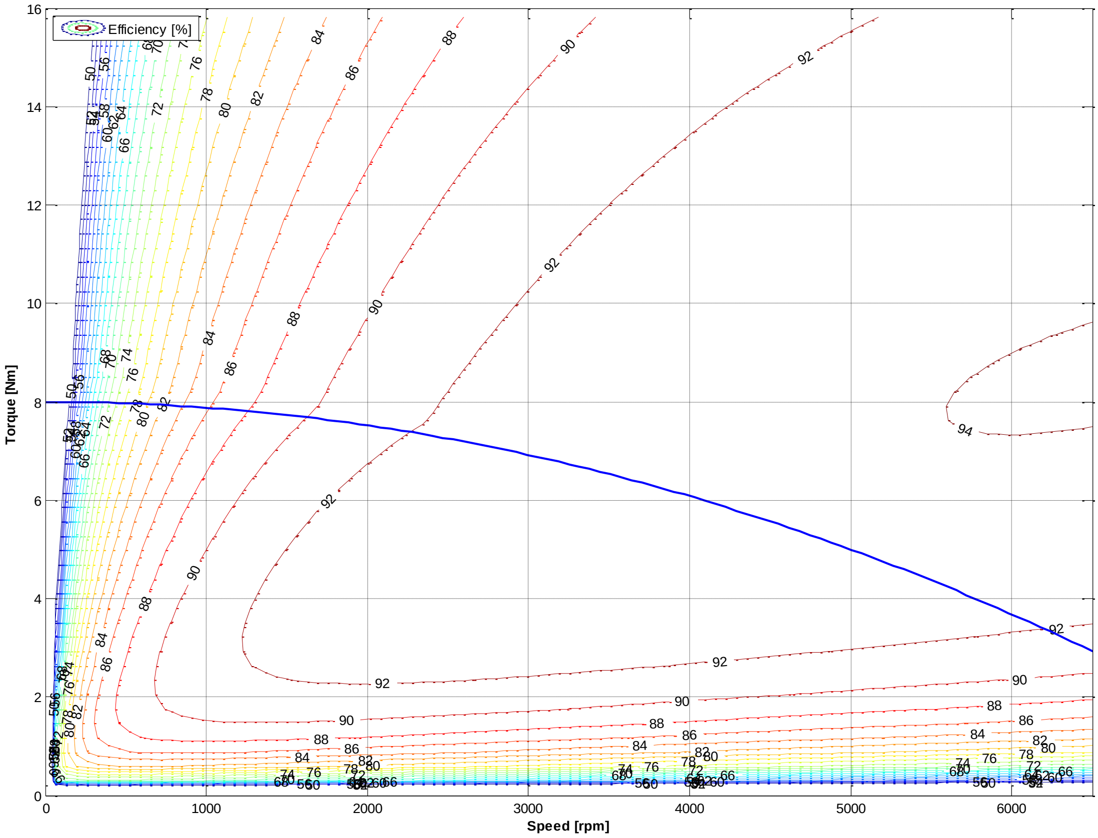
3.2.1.5. Series NK420E



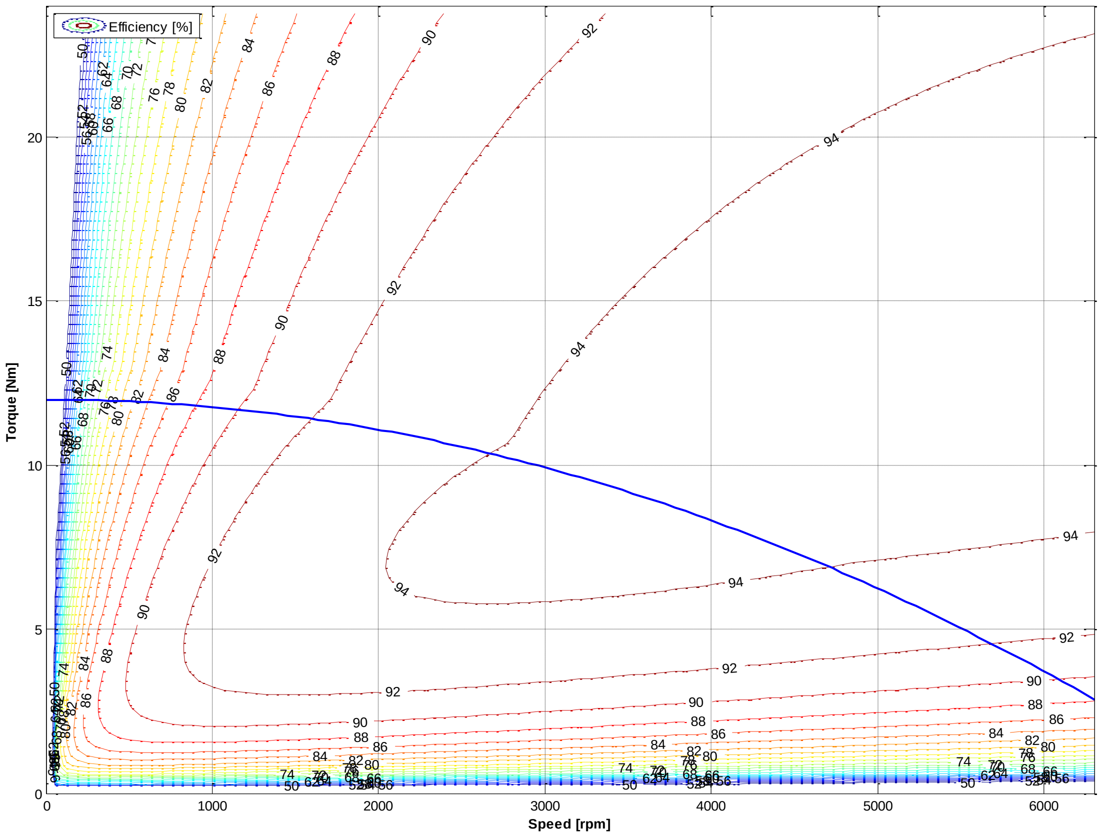
3.2.1.6. Series NK430E



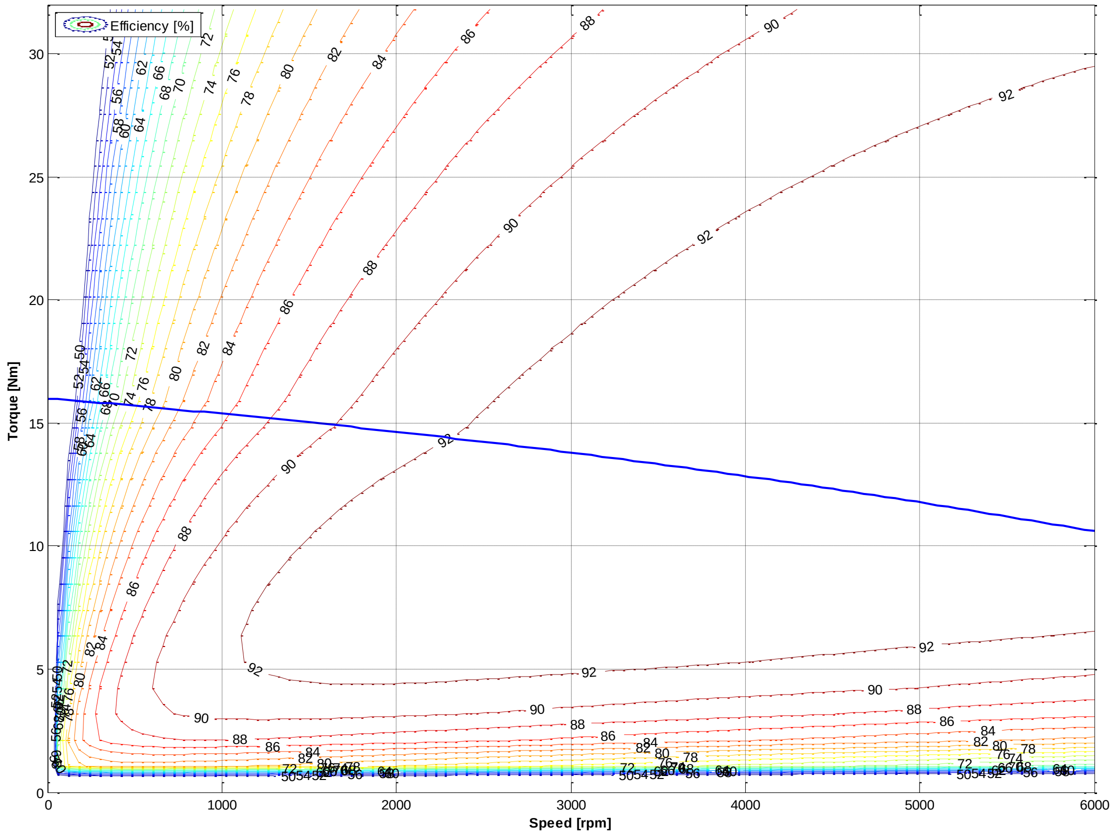
3.2.1.7. Series NK620E



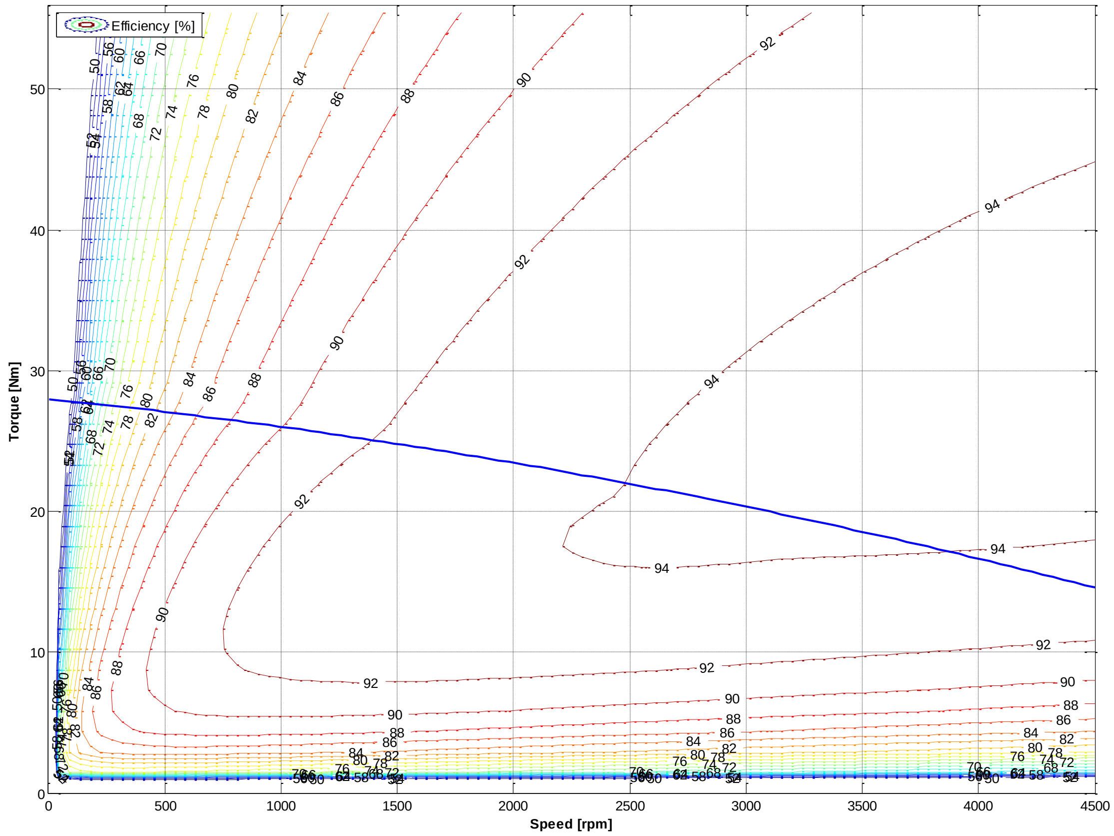
3.2.1.8. Series NK630E



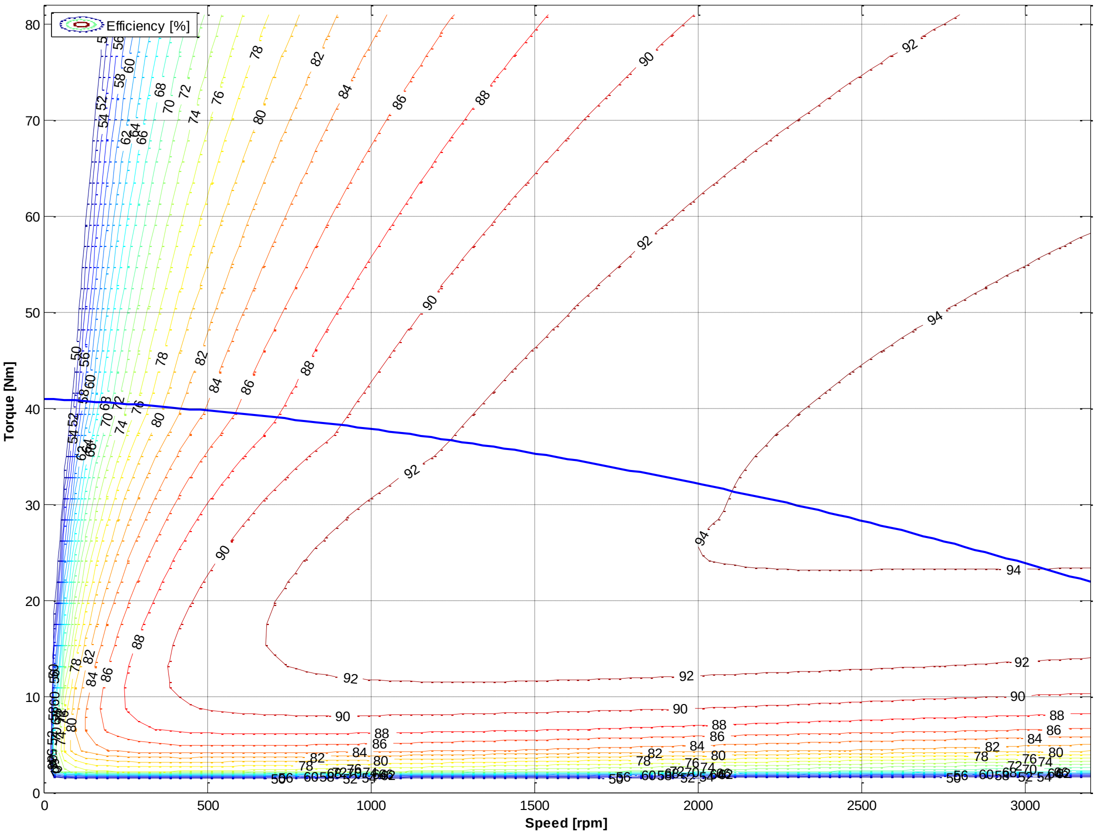
3.2.1.9. Series NK820E



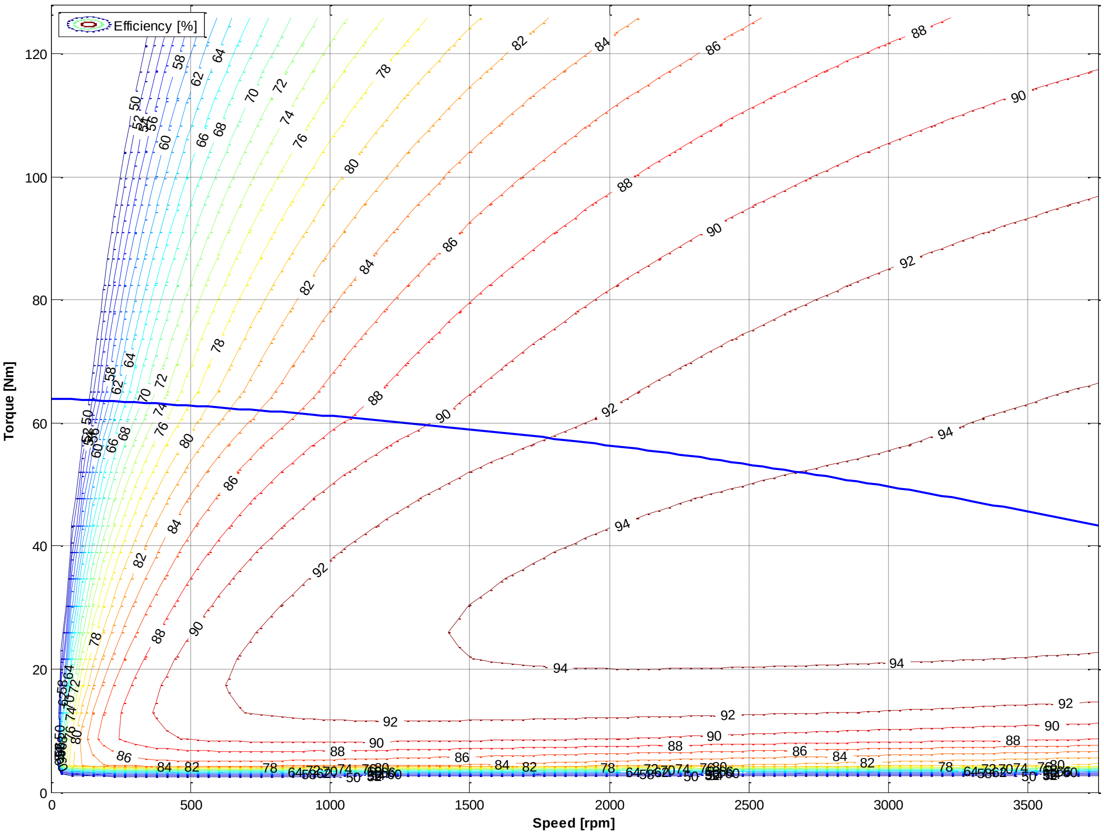
3.2.1.10. Series NK840E



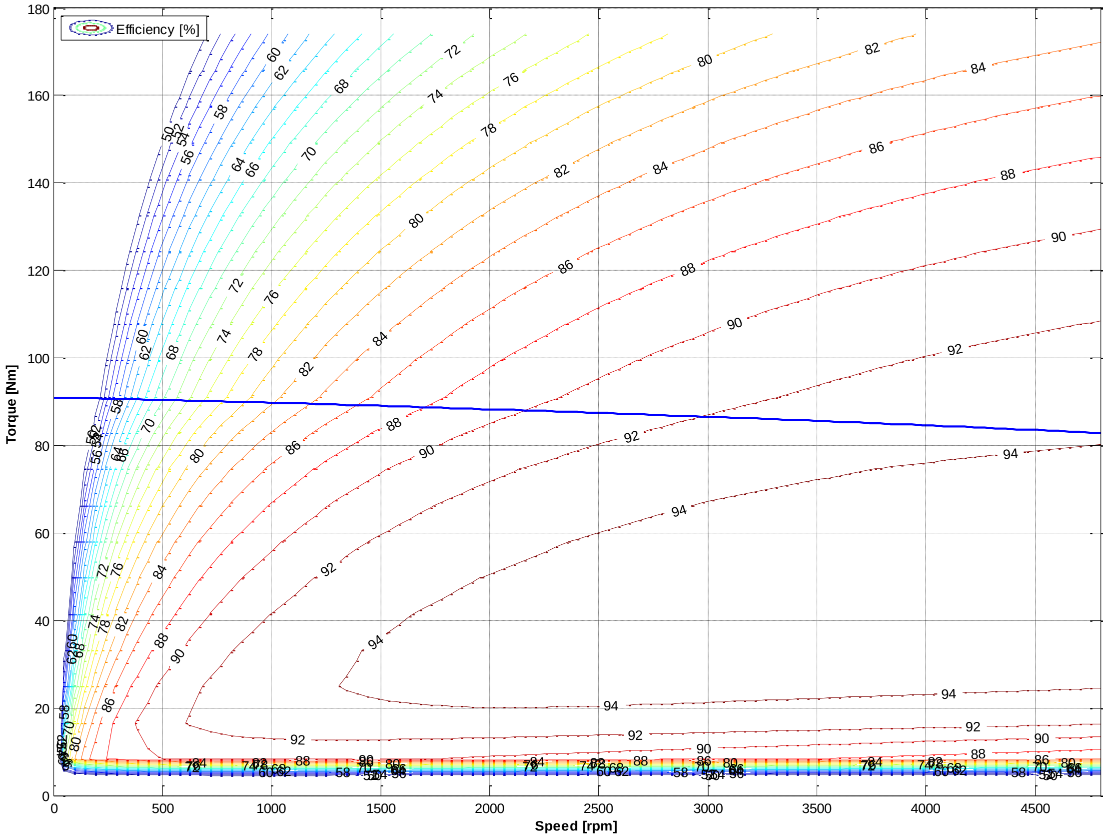
3.2.1.11. Series NK860E



3.2.1.12. Series NK860V



3.2.1.13. Series NK860W



3.2.2. 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]
NK110EAP	0.010	0.004
NK205EAV	0.028	0.002
NK210EAP	0.013	0.007
NK310EAP	0.024	0.012
NK420EAP	0.045	0.013
NK430EAP	0.059	0.020
NK620EAR	0.080	0.034
NK630EAR	0.120	0.040
NK820EAR	0.104	0.083
NK840EAK	0.208	0.166
NK860EAJ	0.485	0.160
NK860VAJ	0.485	0.160

Torque losses = Tf + Kd x speed/1000

3.2.3. Time constants of the motor

3.2.3.1. 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 NK620EAR
L_{ph_ph} = 19.2 mH or 19.2.10^{-3} H
R_{ph_ph} at 25°C = 2.24 Ohm
→ σ_{elec} = 19.2.10^{-3}/2.24=**8.6 ms**

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

3.2.3.2. Mechanical time constant:

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

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

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 NK620EAR
R_{ph_ph} at 25°C = 2.24 Ohm
J = 98.10^{-5} kgm²
Ke_{ph_ph} [V_{rms}/$_{1000rpm}$] = 95.7 [V_{rms}/$_{1000rpm}$]
→ Ke_{ph_ph} [$V_{rms/rad/s}$] = 95.7/(2*π*1000/60) = 0.9139 [$V_{rms/rad/s}$]
→ σ_{mech}=0.5*2.24*98.10^{-5} /(0.9139²) = **1.2 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. However this value makes sense only if the electric time constant σ_{elec} is much smaller than the mechanical time constant σ_{mech} (for the motor NK620EAR taken as illustration, it is not the case because we obtain $\sigma_{mech} < \sigma_{elec}$.).

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

3.2.3.3. Thermal time constant of the copper:

$$\tau_{therm} = Rth_{copper\_iron} * Cth_{copper}$$

$$Cth_{copper[J/°K]} = Mass_{copper[Kg]} * 389_{[J/kg°K]}$$

With:

Rth*copper_iron* thermal resistance between copper and iron [°K/W]
Cth*copper* thermal capacity of the copper [J/°K]
Mass*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]
NK110EAP	1.2	0.5	3.0
NK205EAV	2.6	0.6	7.9
NK210EAP	2.0	0.5	5.6
NK310EAP	3.0	1.0	11.6
NK420EAP	4.6	1.2	31.1
NK430EAP	5.2	1.3	32.6
NK620EAR	8.6	1.2	59.5
NK630EAR	10.2	1.3	53.9
NK820EAR	8.5	1.9	67.3
NK840EAK	11.0	1.5	29.9
NK860EAJ	12.9	1.7	28.1
NK860VAJ	12.9	1.7	28.1

3.2.4. Speed ripple

The typical speed ripple for a NK motor with a resolver at 4000rpm is 3% peak to peak.

This value is 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), without external load (neither external inertia nor resistant torque).

3.2.5. 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 ±**10%** of the nominal value, it is possible to correctly evaluate the new rated values as illustrated below.

Example:

Extract of NK620EAR datasheet

BRUSHLESS MOTORS
NK620EAR
ELECTRONIC DRIVE
DIGIVEX 8/16
(400V)

No UL certification

Torque at low speed	M_o	Nm		8	
Permanent current at low speed	I_o	A_{rms}		5.31	
Peak torque	M_p	Nm		26.7	--
Current for the peak torque	I_p	A_{rms}		21.2	--
Back emf constant at 1000 rpm (25°C)*	Ke	V_{rms}		95.7	
Torque sensitivity	Kt	Nm/A_{rms}		1.51	
Winding resistance (25°C)*	Rb	Ω		2.24	
Winding inductance*	L	mH		19.2	
Rotor inertia	J	kgm^2x10^{-5}		98	
Thermal time constant	Tth	min		27	
Motor mass	M	kg		7	
Voltage of the mains	UR1 UR2 UR3	V_{rms}	400	-	-
Rated speed	Nn1 Nn2 Nn3	rpm	3900	-	-
Rated torque	Mn1 Mn2 Mn3	Nm	6.17	-	-
Rated current	In1 In2 In3	A_{rms}	4.25	-	-
Rated power	Pn1 Pn2 Pn3	W	2520	-	-

- If we suppose that the rated voltage U_n=400 V_{rms} decreases of **10%** ; this means that the new rated voltage becomes U_{n2}=360 V_{rms}.

Rated speed:

The former rated speed N_n=3900 rpm obtained with a rated voltage U_n=400 V_{rms} and an efficiency of η=92% leads to the new rated speed N_{n2} given as follows:

$$N_{n2} = N_n * \frac{\frac{U_{n2}}{U_n} - 1 + \eta}{\eta}$$

$$N_{n2} = 3900 * \frac{\frac{360}{400} - 1 + 0.92}{0.92} = 3476 rpm$$

Maximum speed:

The former maximum speed N_{max} = 3900 rpm obtained with U_n =400 V_{rms} and N_n =3900 rpm leads to the new maximum speed N_{max2} given as follows:

$$N_{max\,2} = N_{max} * \frac{N_{n2}}{N_n} \qquad N_{max\,2} = 3900 * \frac{3476}{3900} = 3476 rpm$$

N.B.

- If the rated voltage increases ($U_{n2} > U_n$), the new rated speed N_{n2} and the new maximum speed N_{max2} 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.

Warning: If the main supply decreases, you must reduce the maximum speed accordingly in order not damage the motor.
In case of doubt, consult us.

Rated power:

The former rated power P_n=2520 W obtained with U_n =400 V_{rms} leads to the new rated power P_{n2} given as follows:

$$P_{n2} = P_n * \frac{U_{n2}}{U_n} \qquad P_{n2} = 2520 * \frac{360}{400} = 2268 W$$

Rated torque:

The former rated torque M_n = 6.17 Nm obtained with U_n =400 V_{rms} leads to the new rated torque M_{n2} given as follows:

$$M_{n2} = \frac{P_{n2}}{\frac{2 * \pi * N_{n2}}{60}} \qquad M_{n2} = \frac{2268}{\frac{2 * \pi * 3476}{60}} = 6.23 Nm$$

3.2.6. Voltage withstand characteristics of NK 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 servomotors NK 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 500V AC (See figure 1).

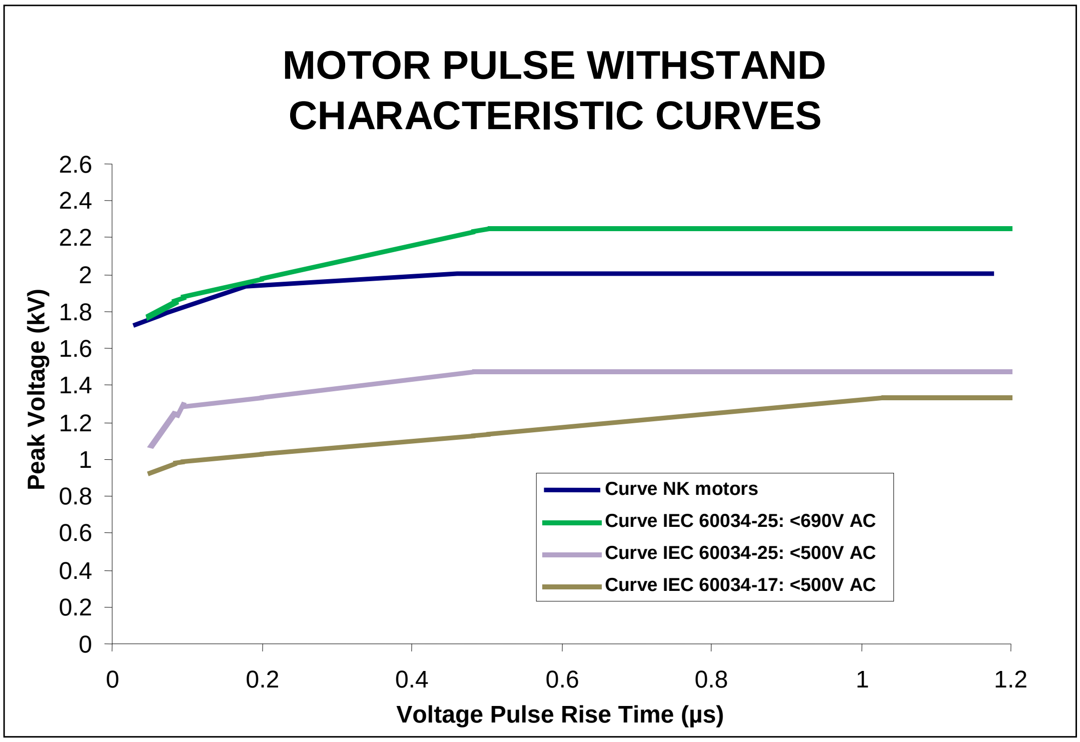


Figure 1: Minimum Voltage withstands characteristics for motors insulations according to IEC standards. At the top are the typical capabilities for the NK motors.

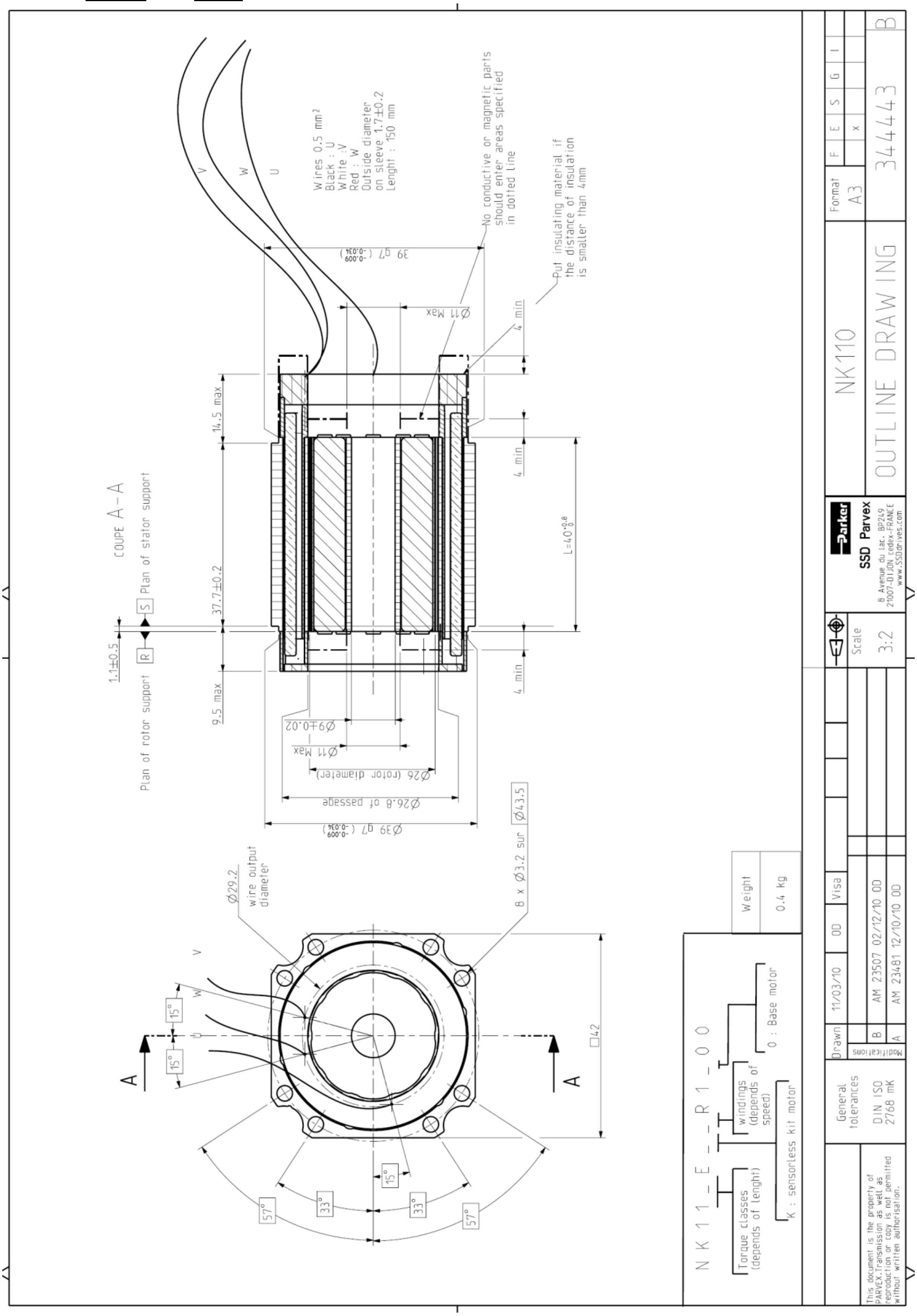
Note: The pulse rise times are defined in accordance with the IEC/TS 60034-17 ed4.0 2006-05-09.

The NK motors can be used with a supply voltage up to 500 V under the following conditions:

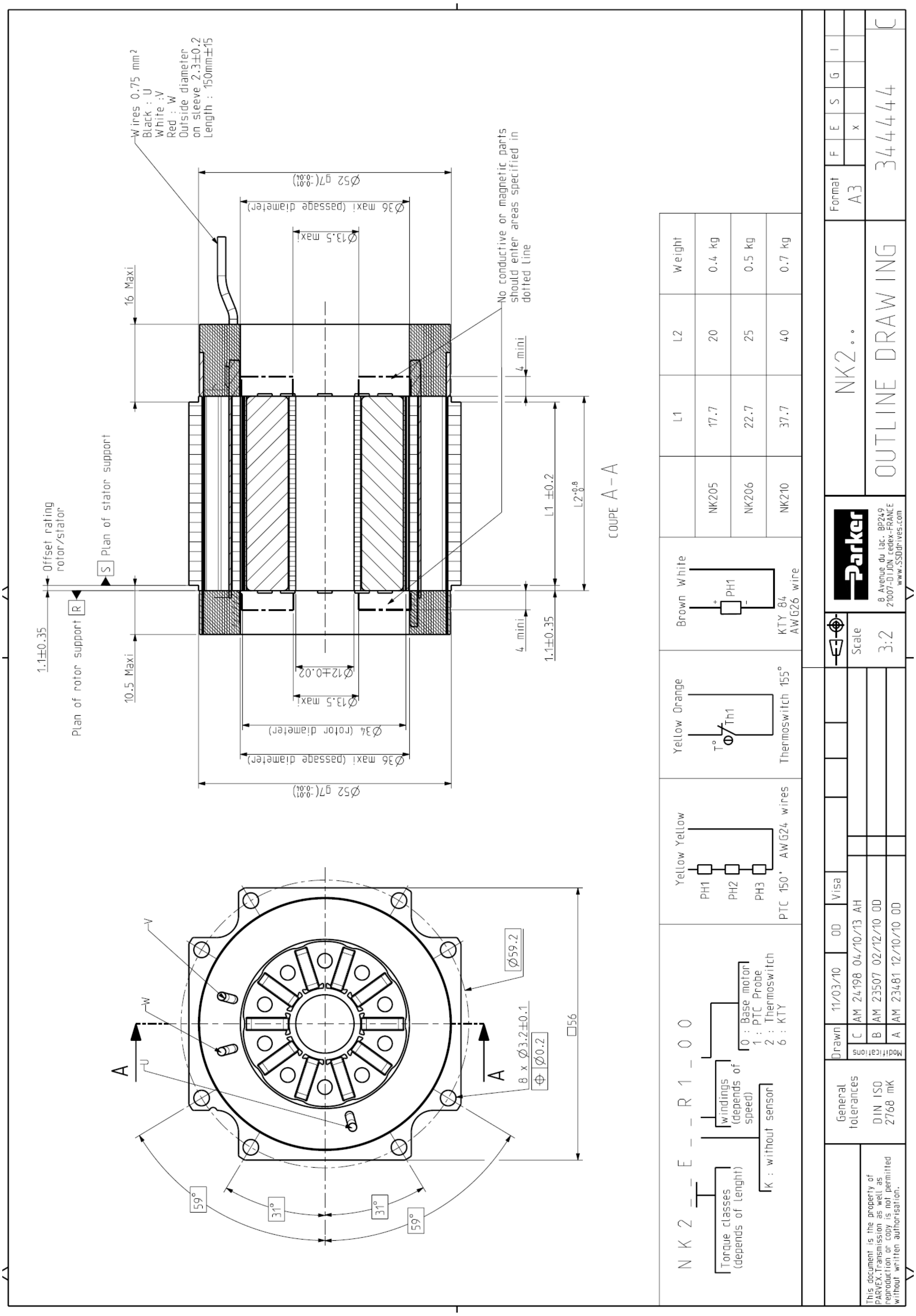
- The pulse rise times must be longer than 50 ns.
- The repetitive pulse voltages must not exceed the values given in figure 1, "*Curve NK motors*" in dark blue.

3.3. Dimension drawings

3.3.1. NK1



3.3.2. NK2



Wires 0.75 mm²
Black : U
White : V
Red : W
Outside diameter on sleeve 2.3±0.2
Length : 150mm±15
No conductive or magnetic parts should enter areas specified in dotted line
16 Maxi
10.5 Maxi
4 mini
L1 ±0.2
1.1±0.35
Offset rating rotor/stator
Plan of stator support
Plan of rotor support
COUPE A-A
Ø52 g7
Ø36 maxi (passage diameter)
Ø13.5 maxi
Ø12+0.02
Ø34 (rotor diameter)
Ø59.2
8 x Ø3.2±0.1
Ø0.2
□56
59°
31°
A
U
V
W
Weight
L1
L2
NK205
17.7
20
0.4 kg
NK206
22.7
25
0.5 kg
NK210
37.7
40
0.7 kg
Brown White
PH1
KTY 84
AWG26 wire
Yellow Orange
Th1
Thermoswitch 155°
Yellow Yellow
PH1
PH2
PH3
PTC 150° AWG24 wires
N K 2 _ _ E _ _ R 1 _ 0 0
Torque classes (depends of lenght)
K : without sensor
windings (depends of speed)
0 : Base motor
1 : PTC Probe
2 : Thermoswitch
6 : KTY
Format
A3
F E S G I
NK2..
OUTLINE DRAWING
344444
C
8 Avenue du lac, BP249
21007-DIJON cedex-FRANCE
www.SSDdrives.com
Scale
3:2
Drawn 11/03/10 OD Visa
C AM 24198 04/10/13 AH
B AM 23507 02/12/10 OD
A AM 23481 12/10/10 OD
Modifications
General tolerances
DIN ISO 2768 mK
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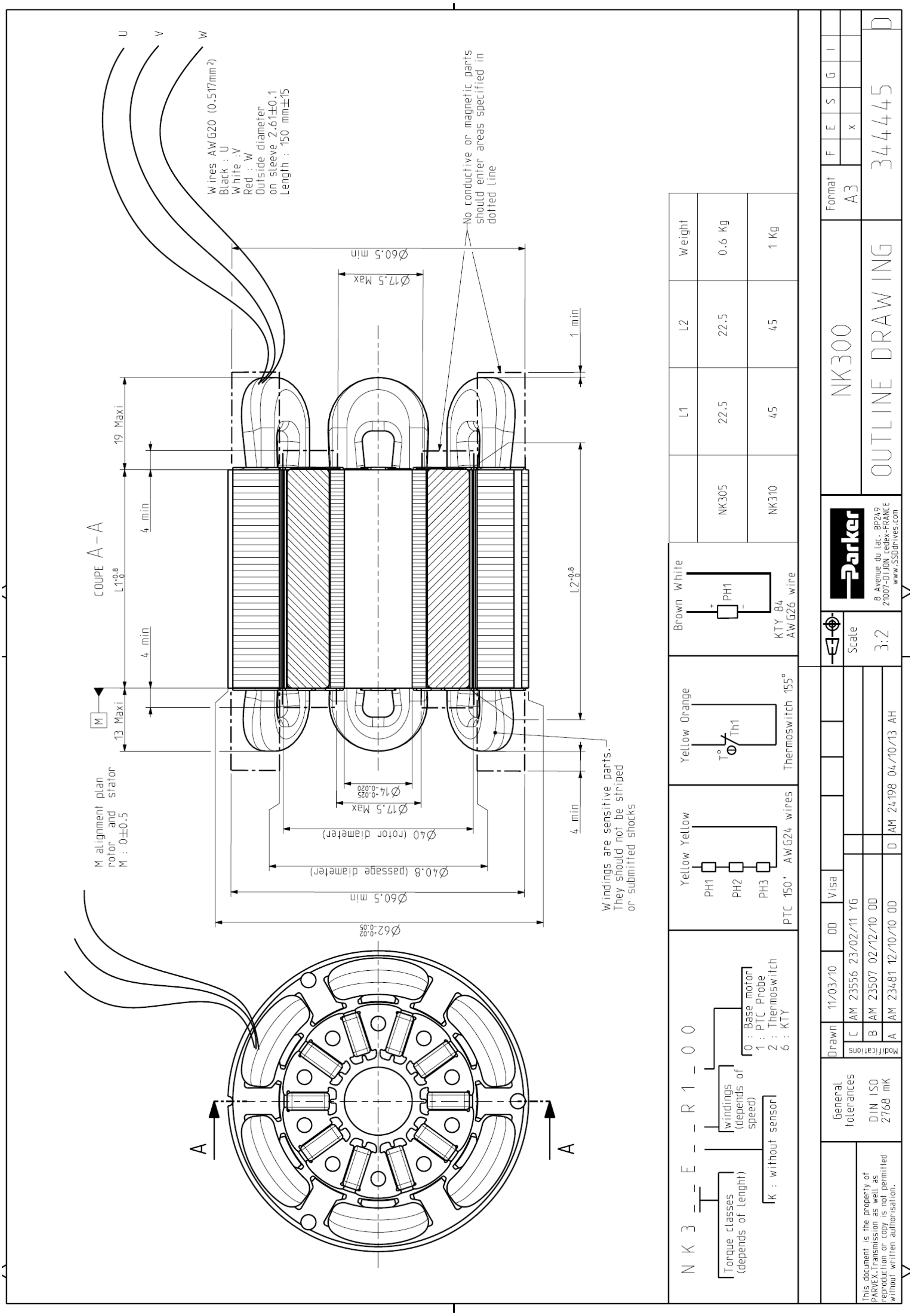
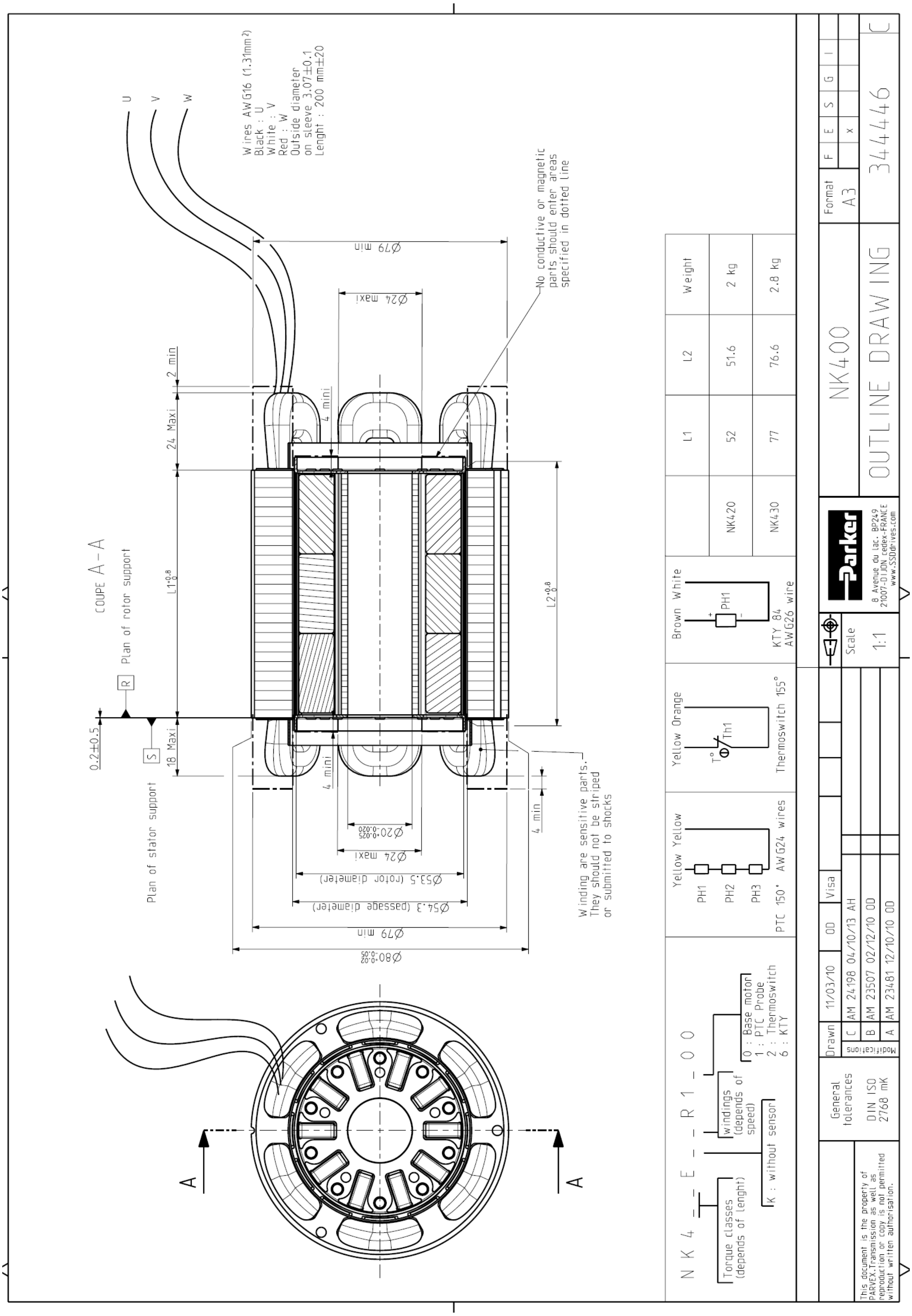
3.3.3. NK3


Wires AWG20 (0.517mm²)
Black : U
White : V
Red : W
Outside diameter on sleeve 2.61±0.1
Length : 150 mm±15
No conductive or magnetic parts should enter areas specified in dotted line
COUPE A-A
Windings are sensitive parts. They should not be striped or submitted shocks
M alignment plan rotor and stator M : 0±0.5
Ø40 (rotor diameter)
Ø40.8 (passage diameter)
Torque classes (depends of lenght)
windings (depends of speed)
K : without sensor
0 : Base motor
1 : PTC Probe
2 : Thermoswitch
6 : KTY
PTC 150° AWG24 wires
Thermoswitch 155°
KTY 84 AWG26 wire
NK305
NK310
NK300
OUTLINE DRAWING
344445

3.3.4. NK4



Wires AWG16 (1.31mm²)
Black : U
White : V
Red : W
Outside diameter on sleeve 3.07±0.1
Lenght : 200 mm±20
No conductive or magnetic parts should enter areas specified in dotted line
Winding are sensitive parts. They should not be striped or submitted to shocks
COUPE A-A
Plan of rotor support
Plan of stator support
Ø79 min
Ø24 maxi
Ø20
Ø53.5 (rotor diameter)
Ø54.3 (passage diameter)
Ø80
24 Maxi
18 Maxi
2 min
4 mini
4 min
0.2±0.5
Weight
L1
L2
NK420
52
51.6
2 kg
NK430
77
76.6
2.8 kg
Brown White
PH1
KTY 84 AWG26 wire
Yellow Orange
Th1
Thermoswitch 155°
Yellow Yellow
PH1
PH2
PH3
PTC 150° AWG24 wires
N K 4 _ _ E _ _ R 1 _ 0 0
Torque classes (depends of lenght)
K : without sensor
windings (depends of speed)
0 : Base motor
1 : PTC Probe
2 : Thermoswitch
6 : KTY
NK400
OUTLINE DRAWING
Format A3
Scale 1:1
344446
8 Avenue du lac. BP249
21007-DIJON cedex-FRANCE
www.SSDdrives.com
General tolerances DIN ISO 2768 mK
Drawn 11/03/10 OD
Visa
C AM 24198 04/10/13 AH
B AM 23507 02/12/10 OD
A AM 23481 12/10/10 OD
Modifications
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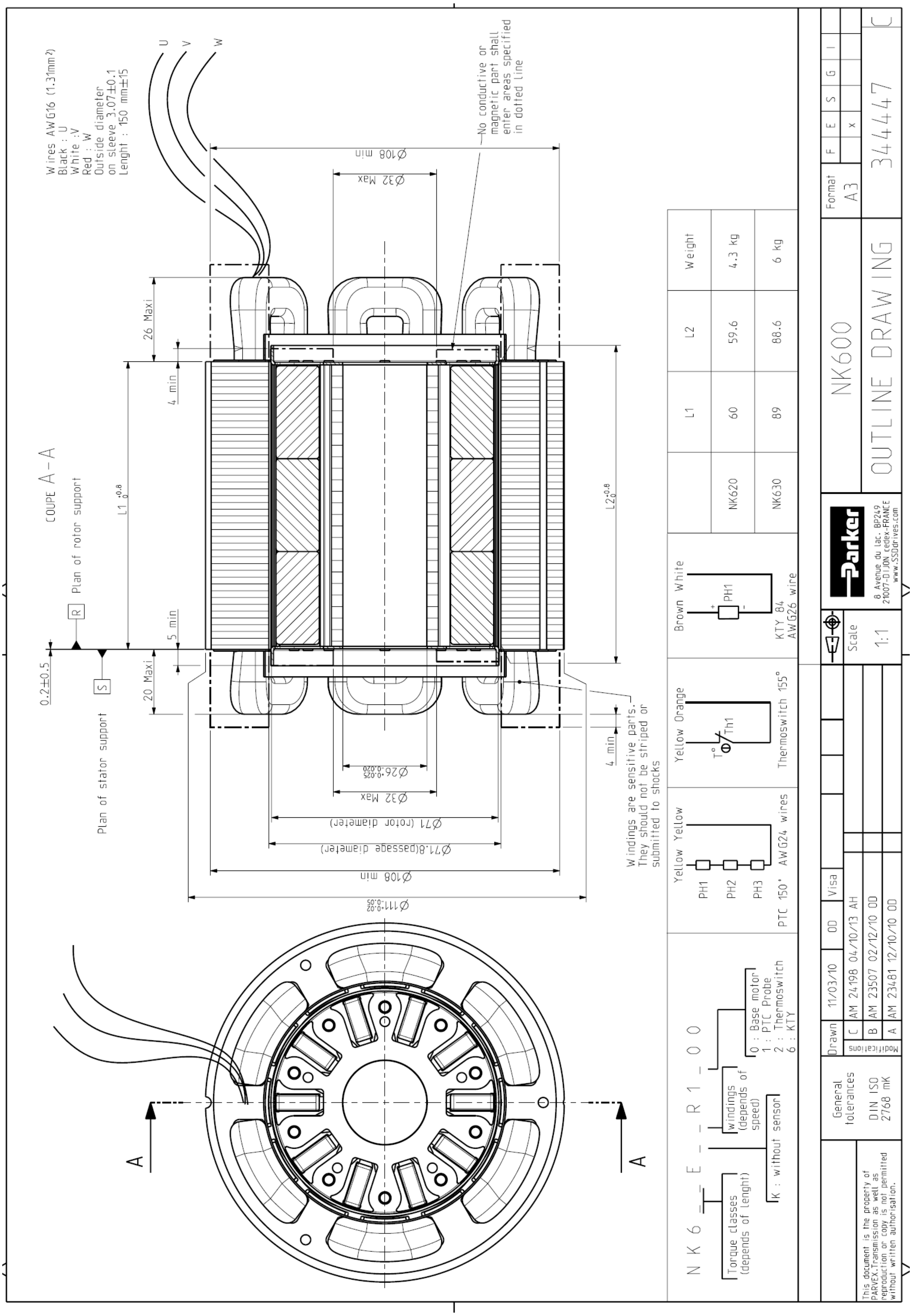
3.3.5. NK6


Wires AWG16 (1.31mm²)
Black : U
White : V
Red : W
Outside diameter on sleeve 3.07±0.1
Lenght : 150 mm±15
U
V
W
No conductive or magnetic part shall enter areas specified in dotted line
Ø108 min
Ø32 Max
26 Maxi
4 min
COUPE A-A
L1 0 +0.8
L2 0 +0.8
R Plan of rotor support
0.2±0.5
S Plan of stator support
5 min
20 Maxi
4 min
Ø26 -0.020 -0.025
Ø32 Max
Ø71 (rotor diameter)
Ø71.8(passage diameter)
Ø108 min
Ø111 -0.02 -0.05
Windings are sensitive parts. They should not be striped or submitted to shocks
A
A
N K 6 _ _ E _ _ R 1 _ 0 0
Torque classes (depends of lenght)
K : without sensor
windings (depends of speed)
0 : Base motor
1 : PTC Probe
2 : Thermoswitch
6 : KTY
Weight
L2
L1
NK620
60
59.6
4.3 kg
NK630
89
88.6
6 kg
Brown White
PH1
KTY 84 AWG26 wire
Yellow Orange
T°
Th1
Thermoswitch 155°
Yellow Yellow
PH1
PH2
PH3
PTC 150° AWG24 wires
General tolerances
DIN ISO 2768 mK
Drawn 11/03/10 OD
C AM 24198 04/10/13 AH
B AM 23507 02/12/10 OD
A AM 23481 12/10/10 OD
Modifications
Visa
Scale 1:1
8 Avenue du lac. BP249
21007-DIJON cedex-FRANCE
www.SSDdrives.com
NK600
OUTLINE DRAWING
Format A3
F E S G I
x
344447
C
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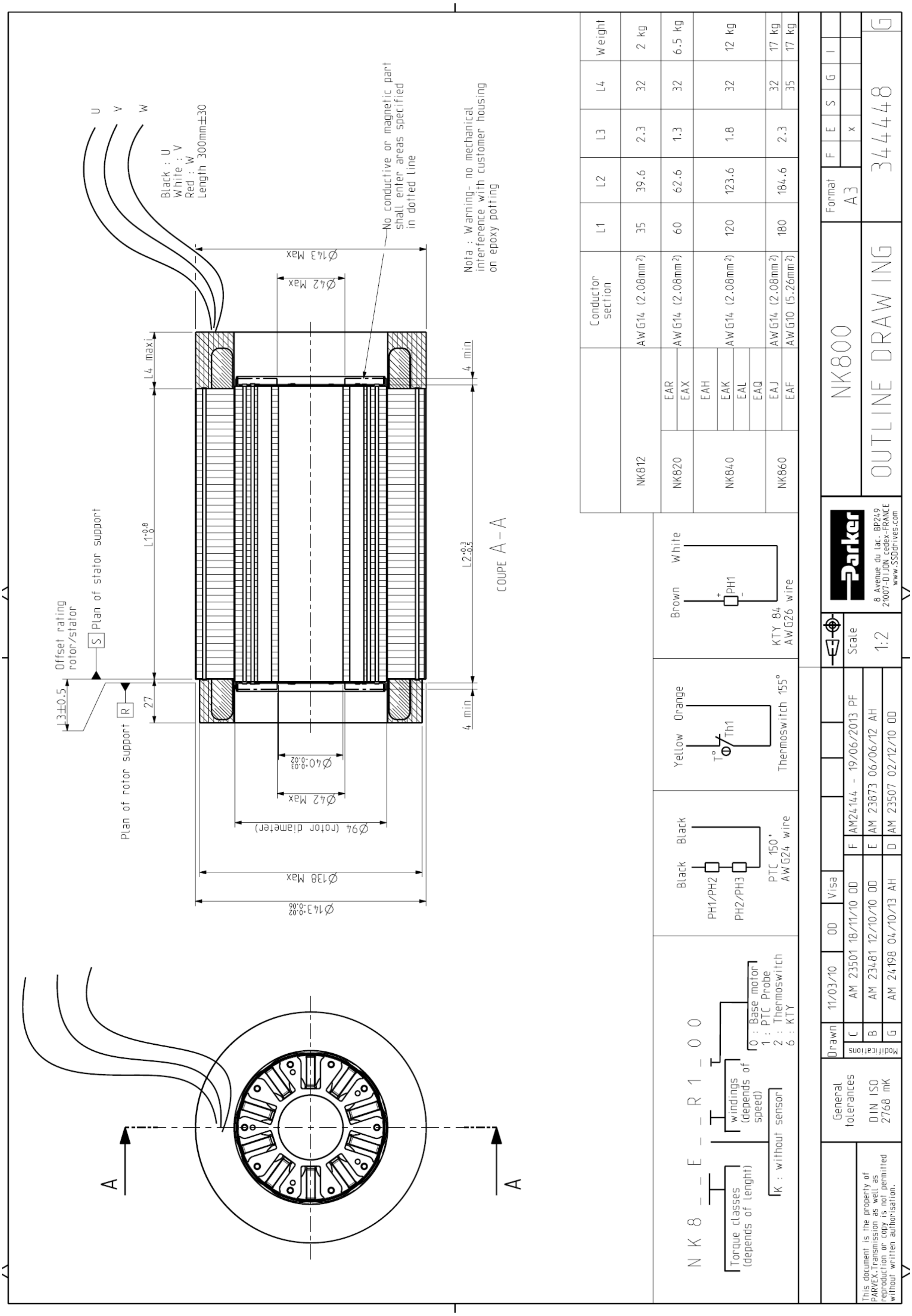
3.3.6. NK8


NK800
OUTLINE DRAWING
344448
COUPE A-A
Black : U
White : V
Red : W
Length 300mm±30
No conductive or magnetic part shall enter areas specified in dotted line
Nota : Warning- no mechanical interference with customer housing on epoxy potting
Plan of stator support
Plan of rotor support
Offset rating rotor/stator
Ø143 Max
Ø42 Max
Ø138 Max
Ø94 (rotor diameter)
4 min
Torque classes (depends of lenght)
windings (depends of speed)
K : without sensor
0 : Base motor
1 : PTC Probe
2 : Thermoswitch
6 : KTY
PTC 150° AWG24 wire
Thermoswitch 155°
KTY 84 AWG26 wire
Conductor section
Weight
NK812
NK820
NK840
NK860
8 Avenue du lac. BP249 21007-DIJON cedex-FRANCE www.SSDdrives.com
Scale 1:2
Format A3
General tolerances DIN ISO 2768 mK
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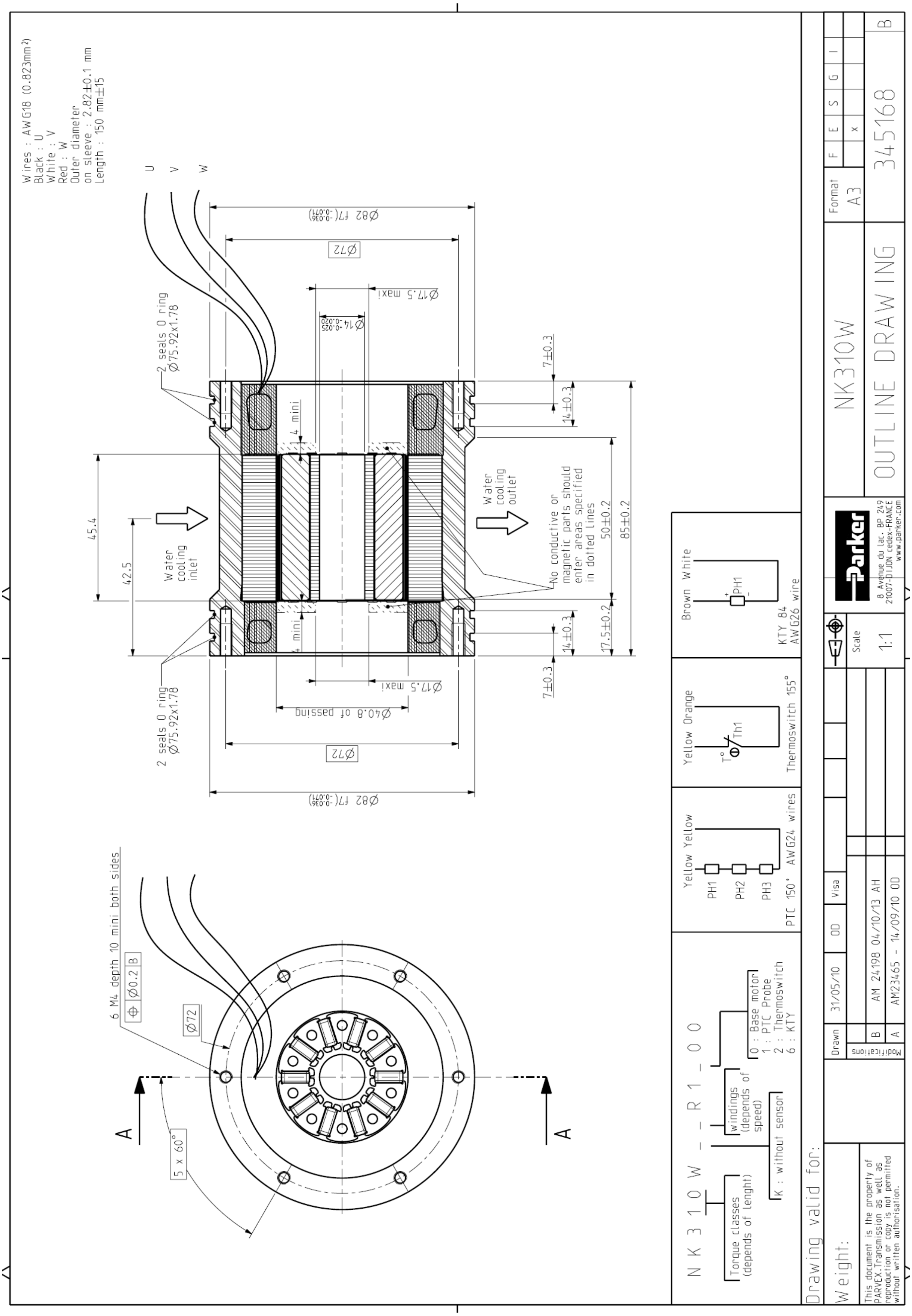
3.3.1. NK3..W


Wires : AWG18 (0.823mm²)
Black : U
White : V
Red : W
Outer diameter
on sleeve : 2.82±0.1 mm
Length : 150 mm±15
U
V
W
Ø82 f7(-0.036/-0.071)
Ø72
Ø17.5 maxi
Ø14 -0.020/-0.025
2 seals O ring
Ø75.92x1.78
4 mini
7±0.3
14±0.3
45.4
42.5
Water cooling inlet
Water cooling outlet
No conductive or magnetic parts should enter areas specified in dotted lines
50±0.2
85±0.2
17.5±0.2
Ø40.8 of passing
6 M4 depth 10 mini both sides
Ø0.2 B
5 x 60°
A
A
Brown White
PH1
KTY 84
AWG26 wire
Yellow Orange
T°
Th1
Thermoswitch 155°
Yellow Yellow
PH1
PH2
PH3
PTC 150° AWG24 wires
N K 3 1 0 W _ _ R 1 _ 0 0
Torque classes (depends of lenght)
K : without sensor
windings (depends of speed)
0 : Base motor
1 : PTC Probe
2 : Thermoswitch
6 : KTY
Drawing valid for:
Weight:
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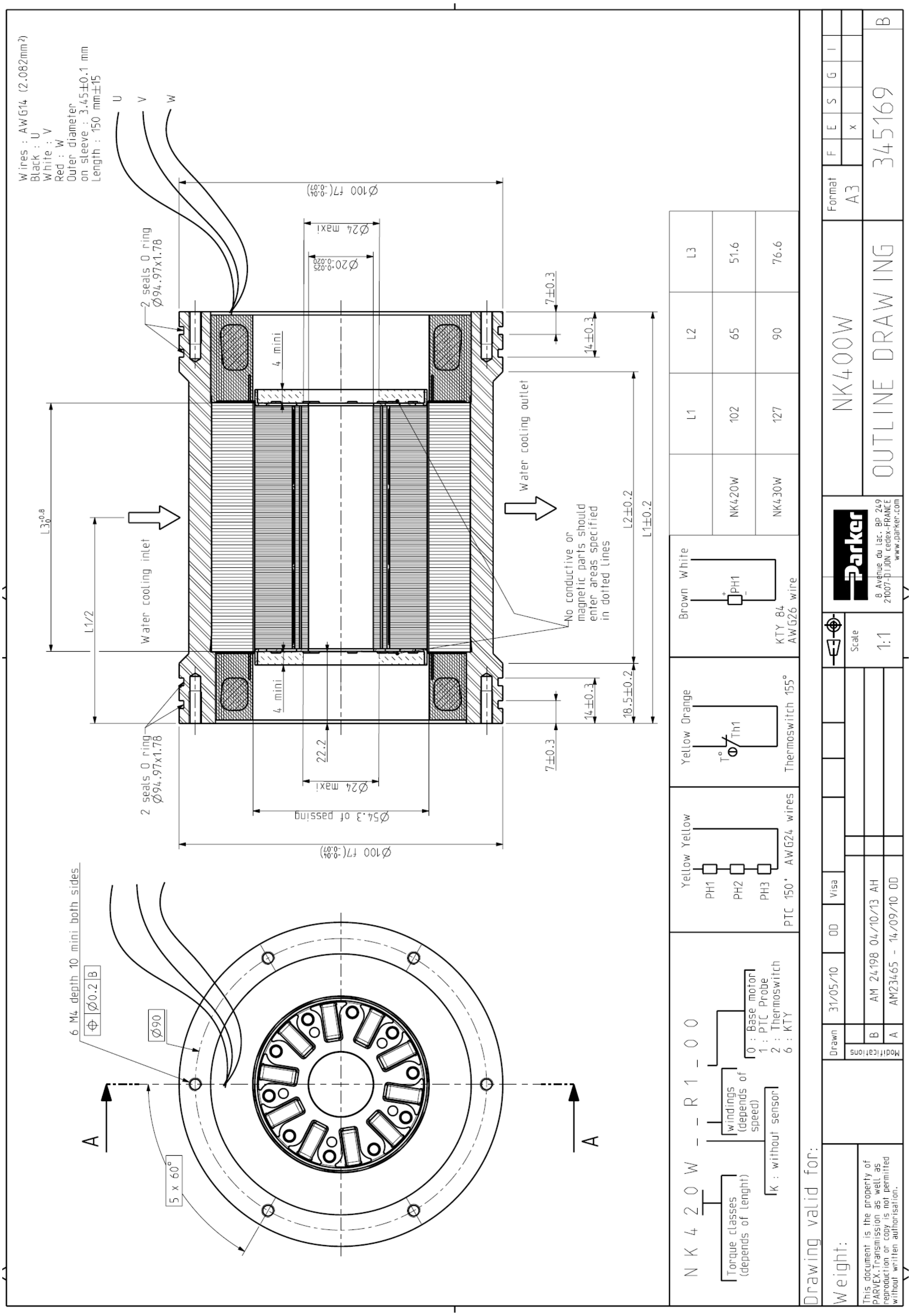
Drawn 31/05/10 OD Visa
Modifications
B AM 24198 04/10/13 AH
A AM23465 - 14/09/10 OD
Scale 1:1
8 Avenue du lac. BP 249
21007-DIJON cedex-FRANCE
www.parker.com
NK310W
OUTLINE DRAWING
Format A3
F E S G I
345168
B

3.3.2. NK4..W



Wires : AWG14 (2.082mm²)
Black : U
White : V
Red : W
Outer diameter on sleeve : 3.45±0.1 mm
Length : 150 mm±15
U
V
W
2 seals O ring Ø94.97x1.78
Water cooling inlet
Water cooling outlet
No conductive or magnetic parts should enter areas specified in dotted lines
L1/2
L1±0.2
L2±0.2
7±0.3
14±0.3
18.5±0.2
4 mini
22.2
Ø24 maxi
Ø54.3 of passing
6 M4 depth 10 mini both sides
Ø0.2 B
Ø90
5 x 60°
A
L1
L2
L3
NK420W
102
65
51.6
NK430W
127
90
76.6
Brown White
PH1
KTY 84 AWG26 wire
Yellow Orange
Th1
Thermoswitch 155°
Yellow Yellow
PH1 PH2 PH3
PTC 150° AWG24 wires
N K 4 2 0 W _ _ R 1 _ 0 0
Torque classes (depends of lenght)
windings (depends of speed)
K : without sensor
0 : Base motor
1 : PTC Probe
2 : Thermoswitch
6 : KTY
Drawing valid for:
Weight:
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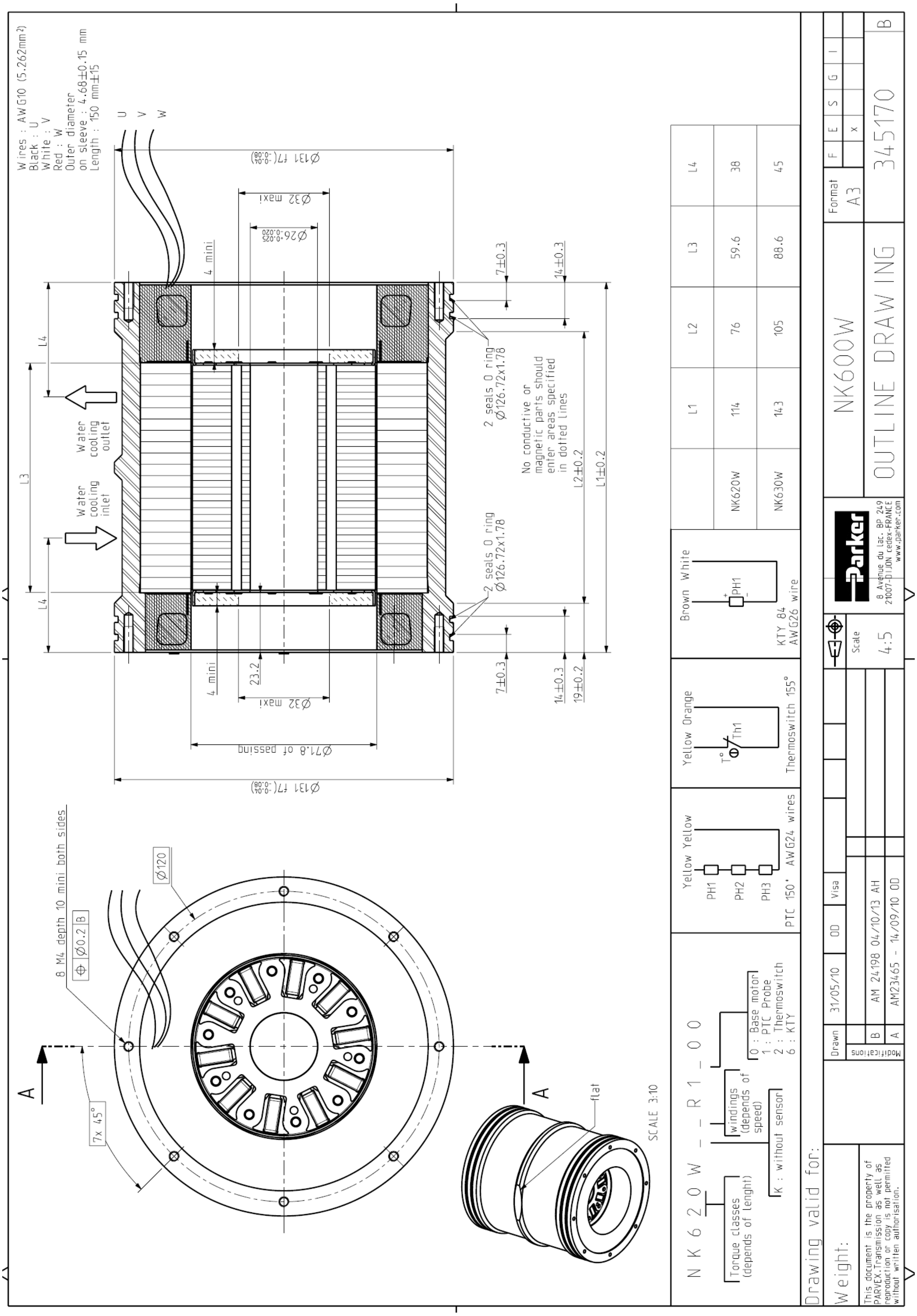
Drawn 31/05/10 OD
Visa
B AM 24198 04/10/13 AH
A AM23465 - 14/09/10 OD
Modifications
Scale 1:1
8 Avenue du lac. BP 249 21007-DIJON cedex-FRANCE www.parker.com
NK400W
OUTLINE DRAWING
Format A3
345169
B

3.3.3. NK6..W


Wires : AWG10 (5.262mm²)
Black : U
White : V
Red : W
Outer diameter on sleeve : 4.68±0.15 mm
Length : 150 mm±15
U V W
Ø131 f7(-0.043/-0.083)
Ø32 maxi
Ø26+0.025/-0.020
4 mini
7±0.3
14±0.3
2 seals O ring Ø126.72x1.78
No conductive or magnetic parts should enter areas specified in dotted lines
L2±0.2
L1±0.2
L4
L3
Water cooling outlet
Water cooling inlet
23.2
19±0.2
Ø71.8 of passing
8 M4 depth 10 mini both sides
Ø0.2 B
Ø120
7x 45°
A
flat
SCALE 3:10
L4 L3 L2 L1
NK620W 38 59.6 76 114
NK630W 45 88.6 105 143
Brown White
PH1
KTY 84 AWG26 wire
Yellow Orange
Th1
Thermoswitch 155°
Yellow Yellow
PH1 PH2 PH3
PTC 150° AWG24 wires
N K 6 2 0 W _ _ R 1 _ 0 0
Torque classes (depends of lenght)
windings (depends of speed)
K : without sensor
0 : Base motor
1 : PTC Probe
2 : Thermoswitch
6 : KTY
Drawing valid for:
Weight:
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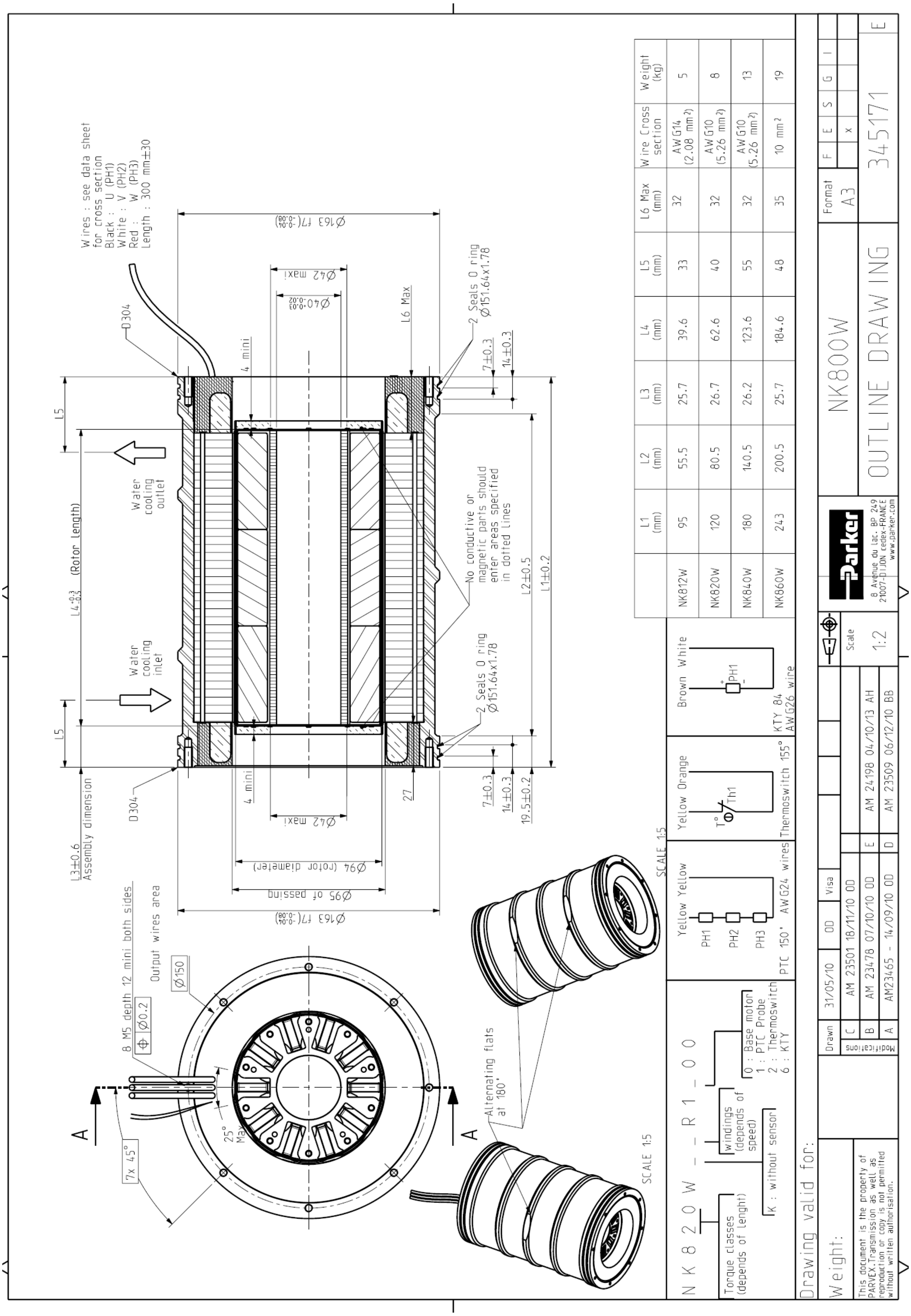
Drawn 31/05/10 OD Visa
B AM 24198 04/10/13 AH
A AM23465 - 14/09/10 OD
Modifications
Scale 4:5
Parker
8 Avenue du lac. BP 249 21007-DIJON cedex-FRANCE www.parker.com
NK600W
OUTLINE DRAWING
Format A3
F E S G I
345170 B

3.3.4. NK8..W



	L1 (mm)	L2 (mm)	L3 (mm)	L4 (mm)	L5 (mm)	L6 Max (mm)	Wire Cross section	Weight (kg)
NK812W	95	55.5	25.7	39.6	33	32	AWG14 (2.08 mm²)	5
NK820W	120	80.5	26.7	62.6	40	32	AWG10 (5.26 mm²)	8
NK840W	180	140.5	26.2	123.6	55	32	AWG10 (5.26 mm²)	13
NK860W	243	200.5	25.7	184.6	48	35	10 mm²	19

3.4. Motor mounting recommendations

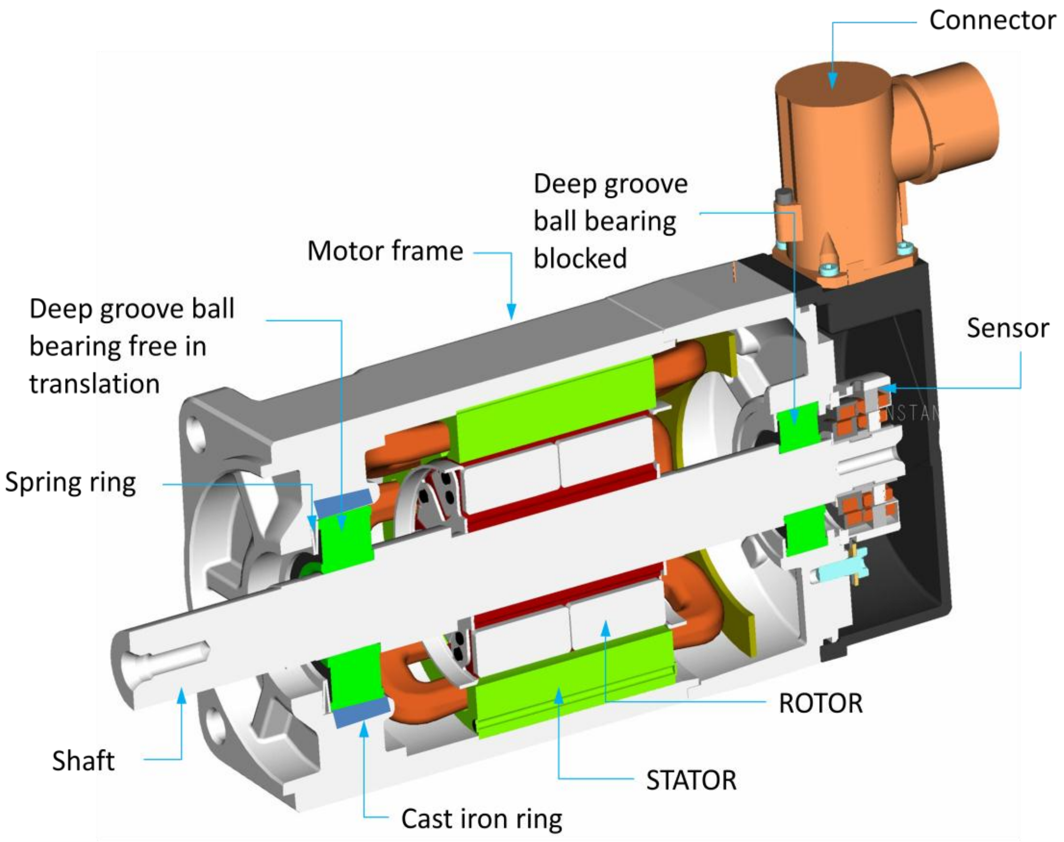
3.4.1. Frame recommendation

	Warning : The user has the entire responsibility to design and prepare the housing, the shaft, connection box, the support, the coupling device, shaft line alignment, and shaft line balancing.

Machine design must be even, sufficiently rigid, precise and shall be dimensioned as to avoid vibrations due to resonances. Integrator bears the entire responsibility for choice of the key components, such as bearing, encoder, electric connection and mechanical parts design.

	Warning : 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).

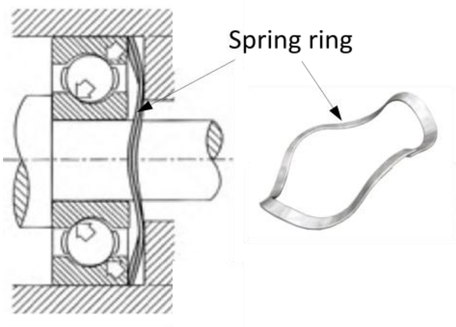
3.4.2. Servomotor typical construction



3.4.3. Bearings recommendation

The arrangement bearings choice is a key point fot the motor design. It depend on speed, load and life time needed. We recommend to contact bearing supplier technical department to check the arrangement.

Warning : When motor runs, the temperature increases (up to 120°C on the rotor), so use springs or spring rings on one bearing to accept shaft dilatation and to create a preload..



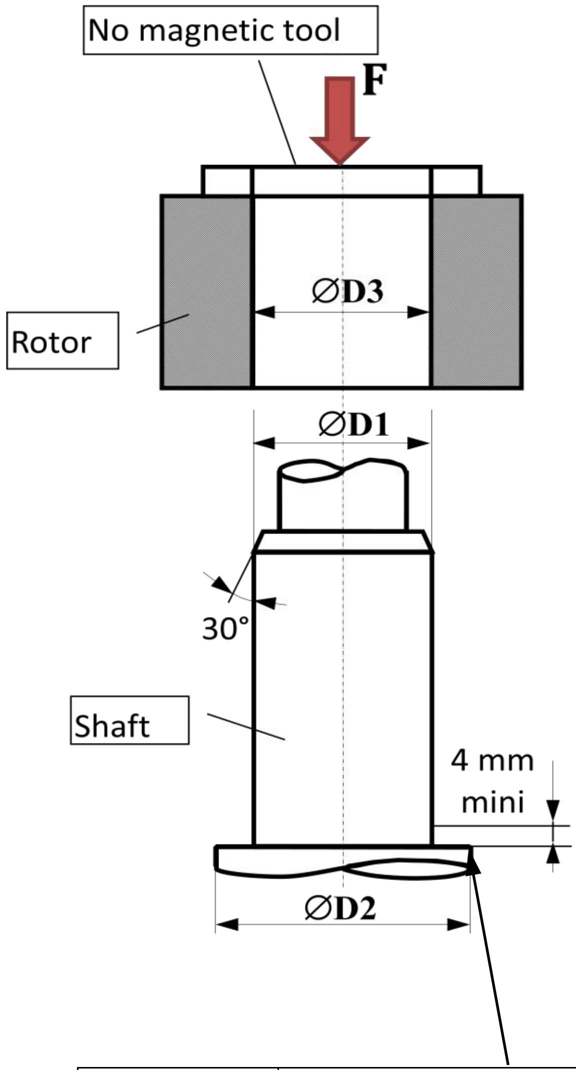
Warning : When motor runs, temperature increases (up to 120°C on the rotor), so we recommend to use bearings with C3 clearance..

3.4.4. Mechanical interfaces

The mechanical interfaces requirements for the user structure must comply with the following drawings and values.

3.4.4.1. Rotor interfaces

To fit the rotor on the shaft, apply a force (Fmaxi from the following tab) with a press near the center with a no magnetic part.
To decrease the force applied, it is possible to heat the rotor up to 130°C maxi.



Moteur	D1	D2 max	D3	F maxi (kN)
NK110	9 s6	11	$9^{+0.02}_{-0.02}$	38
NK210	12 s6	13.5	$12^{+0.02}_{-0.02}$	40
NK310	14 s6	17.5	$14^{+0.025}_{-0.02}$	13
NK420	20 s6	24	$20^{+0.025}_{-0.02}$	53
NK430	20 s6	24	$20^{+0.025}_{-0.02}$	80
NK620	26 s6	32	$26^{+0.025}_{-0.02}$	75
NK630	26 s6	32	$26^{+0.025}_{-0.02}$	113
NK820	40 t6	48	$40^{+0.03}_{-0.02}$	54
NK840	40 t6	48	$40^{+0.03}_{-0.02}$	110
NK860	40 t6	48	$40^{+0.03}_{-0.02}$	165

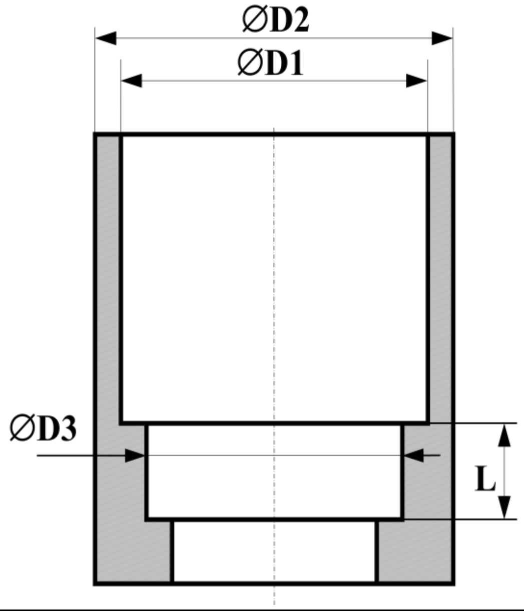
Warning : Te rotor must not touch the step D2 to avoid shaft flexion

3.4.4.2. Natural cooled stator interfaces

The stator can be shrink fitted inside an aluminium housing (with a yield strength >160 Mpa), or a steel housing (with a yield strength > 350Mpa), or stainless steel housing (with a yield strength > 290Mpa).
The housing has to be heated at 250°C to 300°C and the stator inserted in the housing.

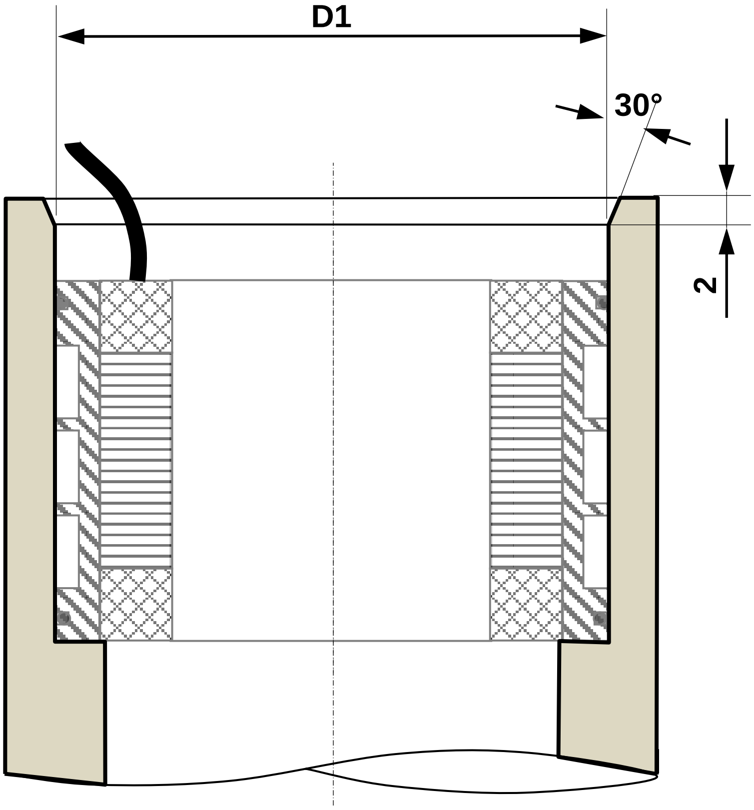
The tab below show the main housing dimensions. :

Motor	D1 for aluminum Re>160Mpa	D1 for steel Re>350Mpa	D1 for stainless steel Re>290	D2 mini	D3 mini	Ø Stator	L mini
NK3	$62^{-0.120}_{-0.150}$	$62^{-0.060}_{-0.090}$	$62^{-0.080}_{-0.110}$	70	60.5	$62^{+0.02}_{-0.05}$	17
NK4	$80^{-0.140}_{-0.170}$	$80^{-0.060}_{-0.090}$	$80^{-0.090}_{-0.120}$	90	79	$80^{+0.02}_{-0.05}$	22
NK6	$111^{-0.175}_{-0.210}$	$111^{-0.060}_{-0.095}$	$111^{-0.105}_{-0.140}$	120	107	$111^{+0.02}_{-0.05}$	25
NK8	$143^{-0.215}_{-0.255}$	$143^{-0.070}_{-0.110}$	$143^{-0.130}_{-0.170}$	155	138	$143^{+0.02}_{-0.06}$	29



Warning : D3 and L give the place for the end winding. Respect the spacing indicated in the outline drawing or add an insulation sheet between the end winding and the housing.

3.4.4.1. Water cooled stator interfaces



Motor	D1 (mm)
NK3	82H8
NK4	100H8
NK6	131H8
NK8	163H8

3.4.5. Water cooled version recommendations

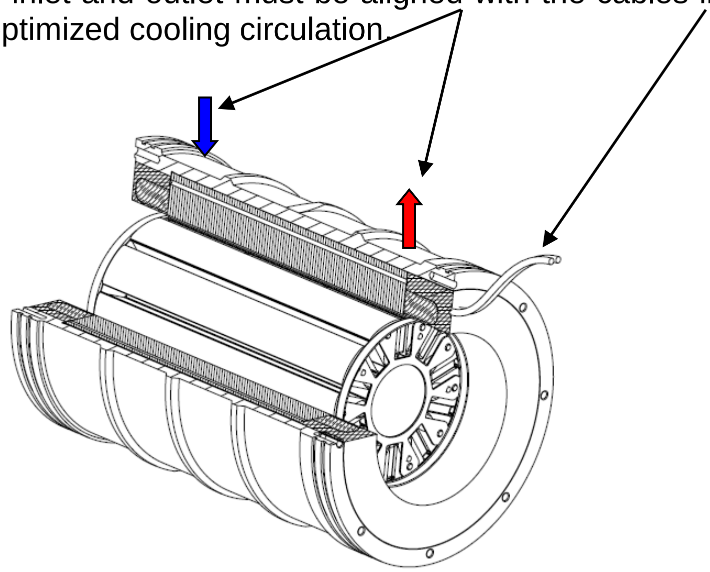
3.4.5.1. O-ring recommendations

The cooling circuit is sealed by four O-rings seal between stator and user's housing.

Caution: The 2 O-rings must be greased with an ordinary lubricant before mounting to avoid damages and leakages.

Caution: Be careful not to make damage on the O-ring during the mounting to avoid leakage. It's recommended to realize a waterproof test with 5 bars air pressure during 30 minutes and check if there is not pressure decreasing.

Caution: Water inlet and outlet must be aligned with the cables inlet to guarantee an optimized cooling circulation.



Motor	O-ring diameter (mm)	Cross section (mm)	Material	Hardness	Working temperature (°C)	PARKER part number
NK3	75.92	1.78	NBR	70 shores	-25 / +120	5340P0069
NK4	94.97	1.78	NBR	70 shores	-25 / +120	5340P0081
NK6	126.72	1.78	NBR	70 shores	-25 / +120	5340P0077
NK8	151.64	1.78	NBR	70 shores	-25 / +120	5340P0093

3.4.5.2. Condensation water drain hole

Condensation and risk of rust may occur when the temperature gradient between the air and the water becomes significant, so drain holes must be integrated on the frame design. These holes must be positioned at the lowest point in the motor housing.
Condensation water drain holes must be checked at least once a year

3.5. Cooling

In compliance with the IEC 60034-1 standards:

3.5.1. Natural and fan cooled motor

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

The NK torque and speed data are given with the following conditions :

- ✓ The stator is thermally well connected to a metallic surface (S)
- ✓ This surface must not exceed 40°C

Motor type	Surface S (cm²)
NK110	202
NK205	135
NK210	270
NK310	265
NK420	395
NK430	580
NK620	630
NK630	935
NK820	810
NK840	1620
NK860	2430

3.5.2. Water cooled motor

Danger: The cooling system has to be operational when the motor is running or energized.

Danger: The Inlet temperature and the water flow have to be monitored to avoid any exceeding values.

Caution: When motor is not running, the cooling system has to be stopped 10 minutes after motor shut down.

Caution: 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: $T_{water} > T_{air} - 2°C$.
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

Caution: the ambient air temperature shall not exceed 40°C in the vicinity of the motor flange

Danger: If the water flow stops, the motor can be damaged or destroyed causing accidents.

3.5.3. 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 corrosion of the motor cooling system, the water must have anti-corrosion additive.

The servomotors 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.

3.5.4. 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
All NK…W	0.5 bar

Note : all motors drop pressure are checked before shipping.

3.5.5. 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:

$$Pc = \left(\frac{1}{\rho} - 1\right).Pn$$

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

Refer to the respective 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 : NK860W
For a torque of 80 N.m @ 2500 rpm, the efficiency is 92%.
Water flow = 5 l/min

Pn = 80 x 2500 x π/30
Pn = 20.9 kW

$$Pc = \left(\frac{1}{0.92} - 1\right).20.9$$ = ***1.8 kW***

So, the chiller must evacuate 1.8 kW and has a water flow of 5 l/min for this point of running.

3.5.6. Flow derating according to glycol concentration

Flow rate [l/min]	Glycol concentration [%]					
	0	10	20	30	40	50
	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**.

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]
Cp thermal specific capacity of the water as coolant [J/kg°K]
(***Cp*** depends on the % glycol concentration please see below)

Thermal specific capacity *Cp* according to % glycol concentration and temperature

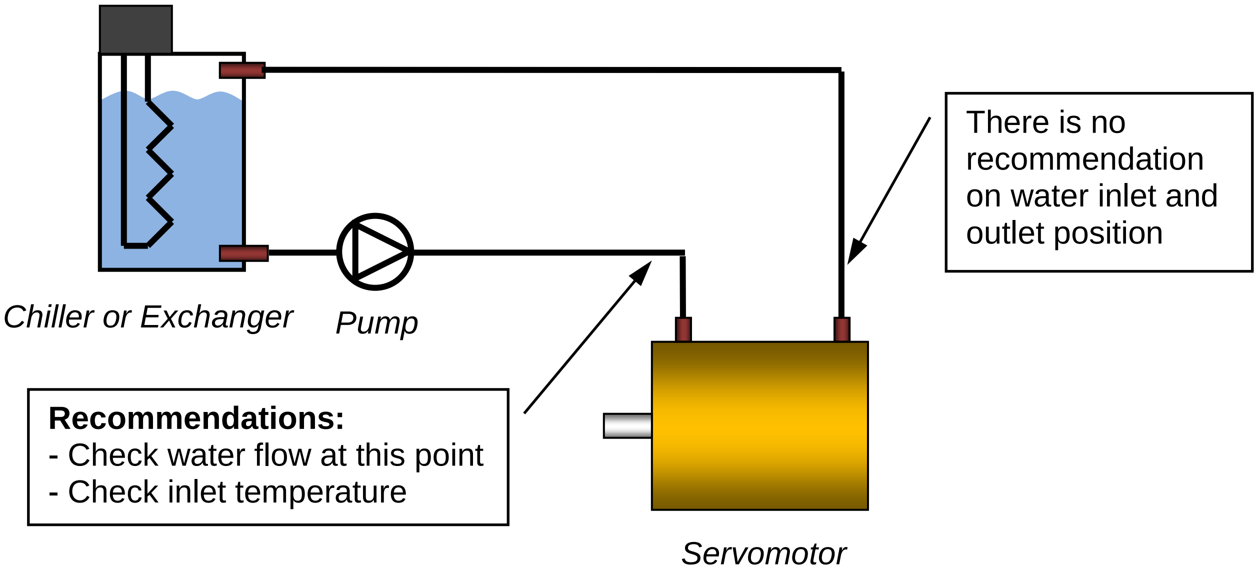
We have considered an average temperature of the coolant of 30°C.

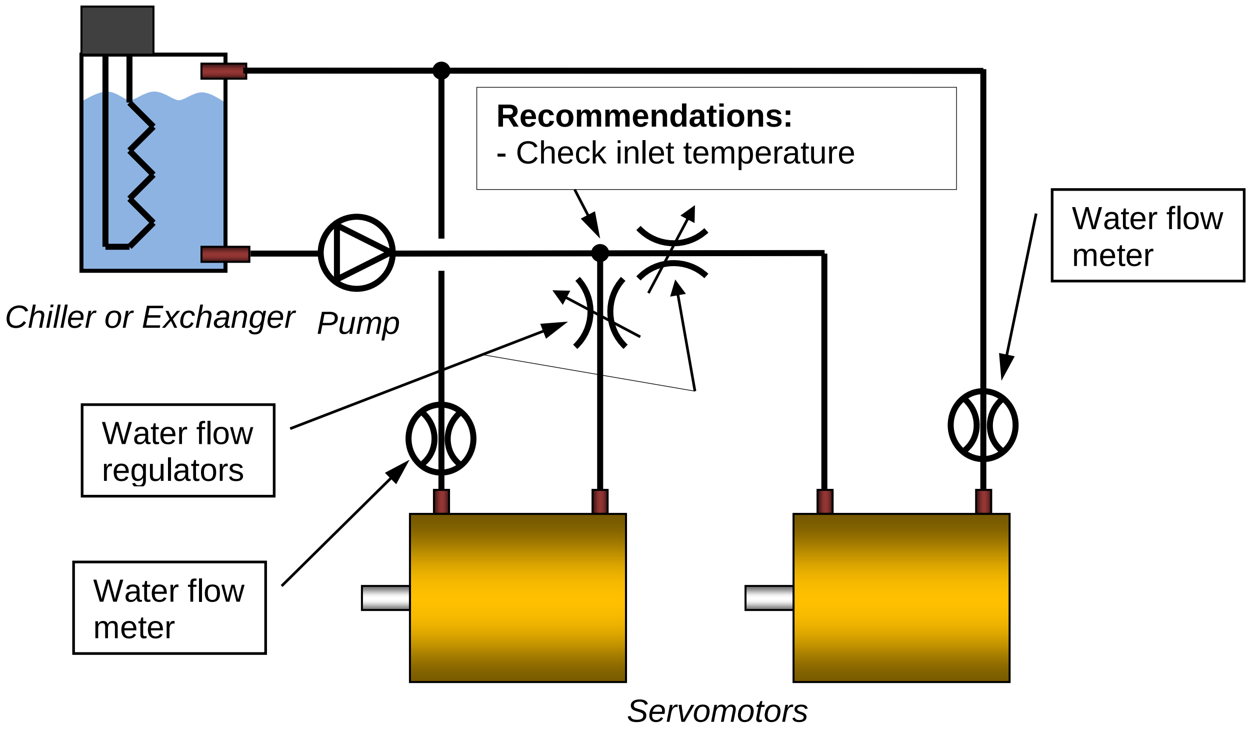
Glycol concentration [%]	Average temperature of the water as coolant [°C]	Thermal specific capacity of the water ***Cp*** [J/kg°K]
0	30	4176
30	30	3755
40	30	3551
50	30	3354

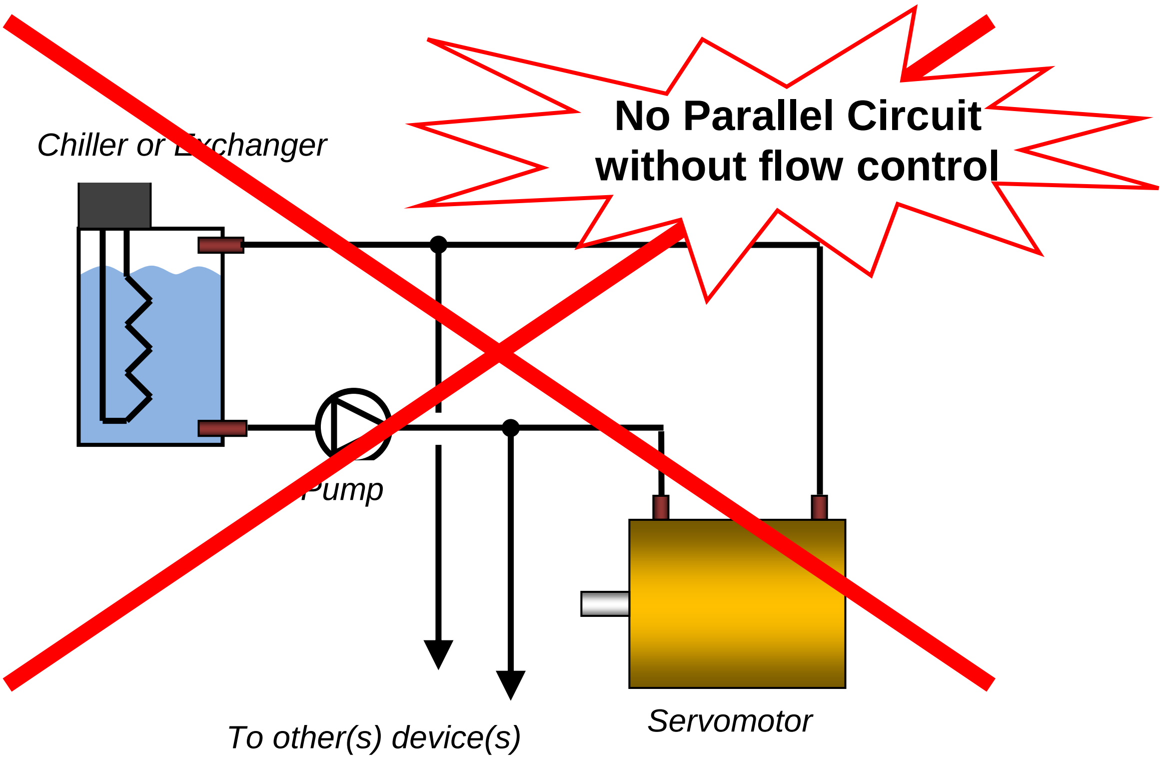
3.5.7. Water cooling diagram

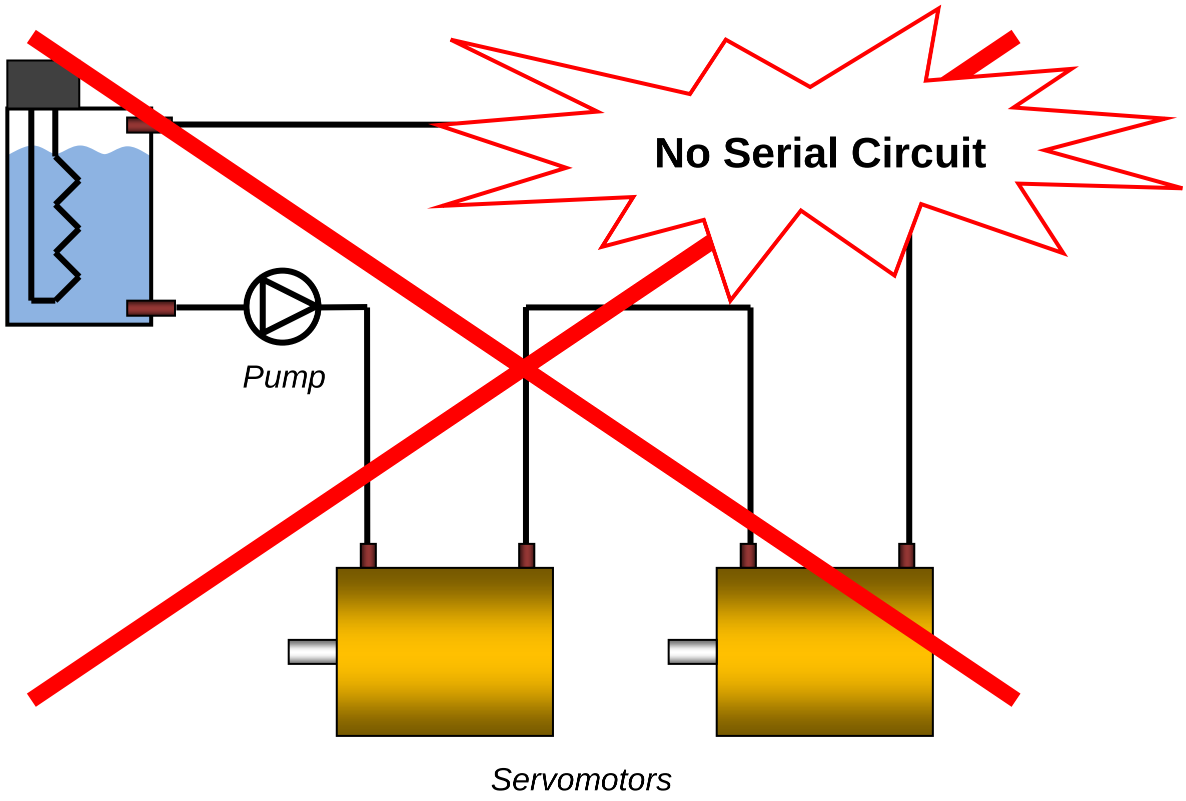
	Recommendation: The use of a filter allows to reduce the presence of impurities or chips in the water circuit in order to prevent its obstruction. We recommend 0.1mm filter.

This section shows typical water cooling diagram :






No Parallel Circuit
without flow control
Chiller or Exchanger
Pump
To other(s) device(s)
Servomotor


No Serial Circuit
Pump
Servomotors

3.6. Thermal Protection

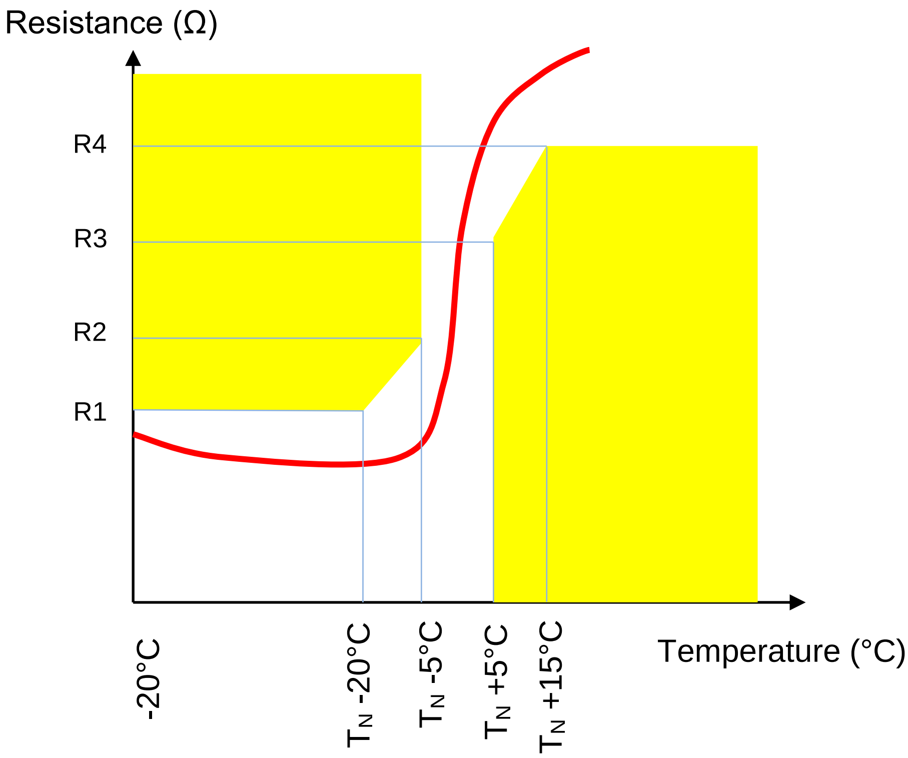
Different protections against thermal overloading of the motor are proposed as an option: Thermoswitch, PTC thermistors or KTY temperature built into the stator winding. No thermal protection are available for the NK1 motor
The thermal sensors, due to their thermal inertia, are unable to follow very fast winding temperature variations. They acheive 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

3.6.1. Alarm tripping with PTC thermistors :

One thermal probe (PTC thermistors) fitted in the NK servomotor winding trip the electronic system at **150° ± 5° C** for class F version. 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)

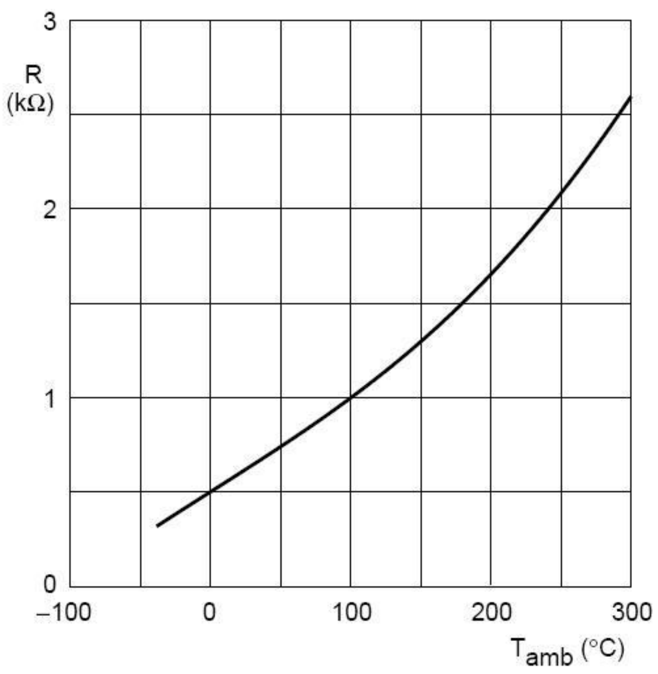


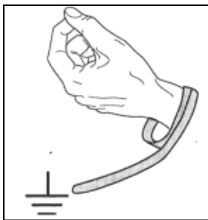
Temperature	**Resistance value for NK2, NK6 and NK8**	**Resistance value for NK3 and NK4**
-20°C up to T_N-20°C	R1≤500Ω	R1≤750Ω
TNF-5°C	R2≤1100Ω	R2≤1650Ω
TNF+5°C	R3≥2660Ω	R3≥3990Ω
TNF+15°C	R4≥8000Ω	R4≥12000Ω

3.6.2. 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.

3.7. Power Electrical Connections

3.7.1. 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_o 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
$\sqrt{2}$ x 0.8 Io ≅ **1,13 x I_o**.

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

Section [mm²]	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%*I_0 at low speed or at motor stall.

Example:
Io=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

3.7.2. Conversion Awg/kcmil/mm²:

Awg	kcmil	mm²
	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

3.7.3. 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.

3.7.4. Ground connection

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

3.7.1. Motor cable

The motor cables are flexible, so cables can take any direction.
The electrical connection on motor in kit version is realized by high performance cable. The motor cable section depends of the motor current level. Please refer to the outline drawing to know the cross section.

	Caution: The motor cables are designed for high current density, so cable surface can reach temperatures exceeding 100°C.

	Caution: The wiring must comply with the drive commissioning manual and with recommended cables. Caution: Section motor cable is lower than commissioning section cable between motor and drive due to high performance motor cable design. Do not take the same cable section than motor ones.

3.8. Feedback system

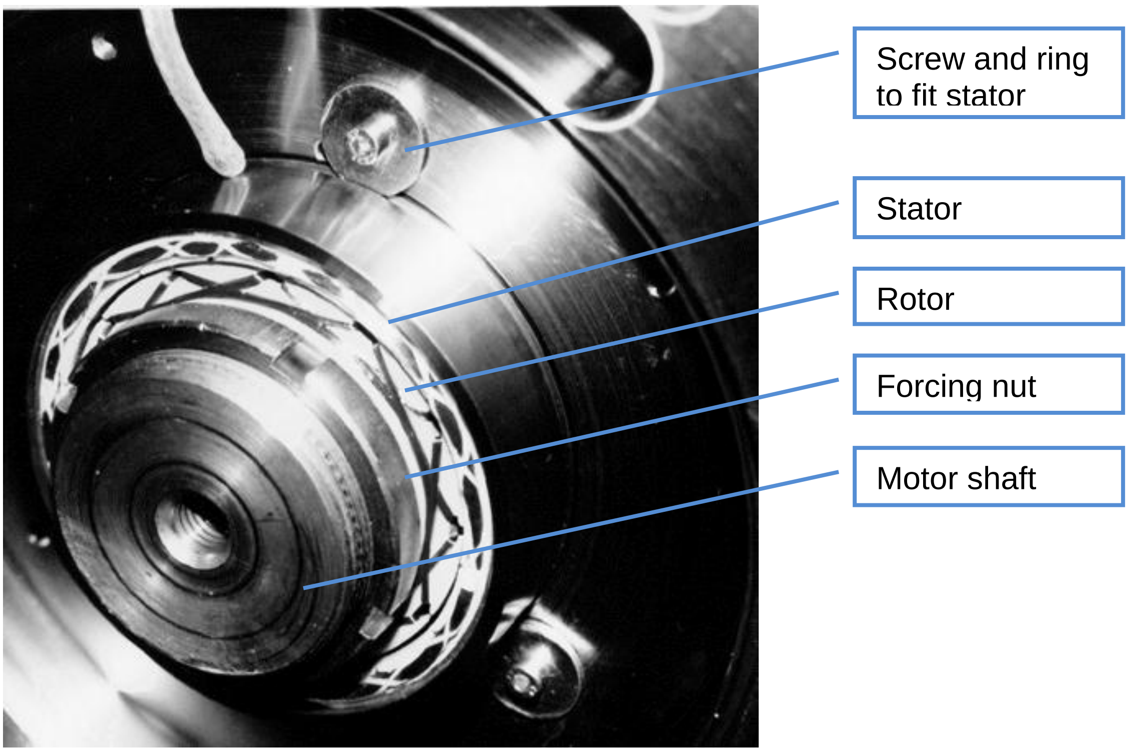
An angular position sensor is often used to run the motor and it depends on the drive functionalities. A drive with a sensorless mode needn't a feedback system.
A classic position sensor is an encoder, but a resolver could be an lower cost and more robust alternative.

3.8.1. Resolver

3.8.1.1. Overview

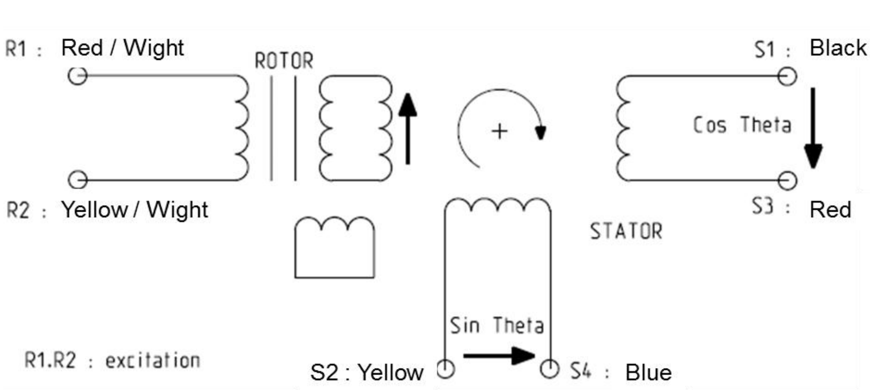
A resolver is an angular position sensor. It is used to determine rotor position. Its signals are processed by the drive in order to control the stator currents, the speed and the position.
The resolver is a high precision device and must be wired and mounted with care.

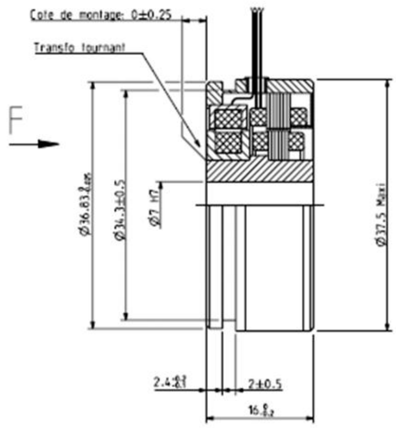
3.8.1.2. Example of resolver mounting



3.8.1.3. Resolver characteristics

Motor associated	NK1	NK2 & NK3	NK4, NK6 & NK8	NK6 & NK8
Parker part number	220005P1000	220005P1001	220005P1002	220005P1003
Electrical specification	Values @ 8 kHz			
Polarity	2 poles			
Input voltage	7 Vrms			
Input current	70mA maximum	86mA maximum		56mA maximum
Zero voltage	20mV maximum			
Encoder accuracy	± 10’ maxi			
Ratio	0,5 ± 5 %			
Output impedance (primary in short circuit whatever the position of the rotor)	Typical 120 + 200j Ω			Typical 95 + 180j Ω
Dielectric rigidity (50 – 60 Hz)	500 V – 1 min			
Insulation resistance	≥ 10MΩ	≥ 100MΩ		
Rotor inertia	~6 g.cm²	~30 g.cm²		~123 g cm²
Operating temperature range	-55 to +155 °C			





S1 = Cos - | S2 = Sin - | R1 = exitation +
S3 = Cos + | S4 = Sin + | R2 = exitation -

Rotor is clock wise rotation viewed from mounting flange end (F view)

⚠	Resolvers are single pole pair resolvers: they give absolute position on 1 motor rotation.

⚠	For easy motor integration and electrical checking a connector is recommended for the signals.

3.8.1.4. Cables and connectors associated to the resolver

To connect NK motor with a connector M23 to PARKER drive : AC890, COMPAX3 or SLVD, you can use complete cable with part number on the tabs 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	Cable reference for SLVD	Cable reference for 637/638
Resolver	CS4UA1F1R0xxx	CC3UA1F1R0xxx	CS5UA1F1R0xxx	CS1UA1F1R0xxx

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

Feedback Sensor	Cable reference	Plug reference
Resolver	6537P0047	220065R4621

3.8.1.5. Resolver setting

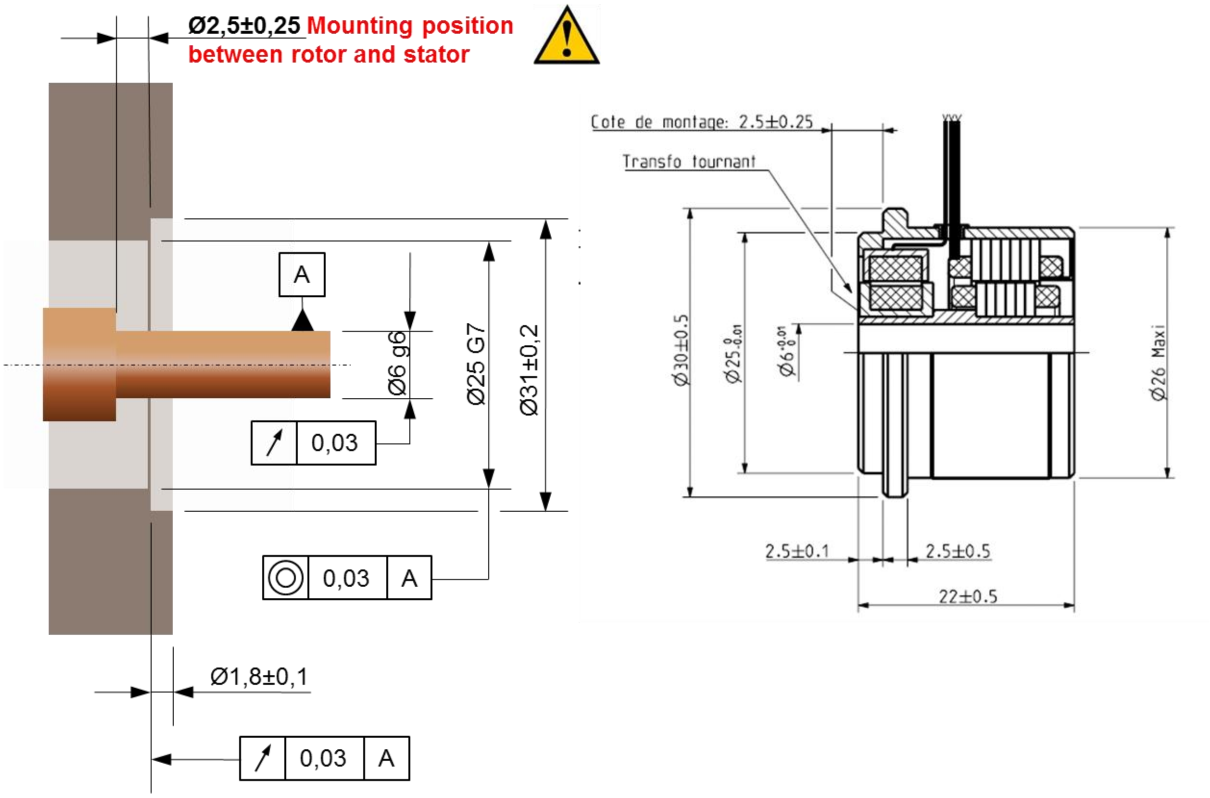
During the setting procedure, it is strictly necessary to respect the 3 following conditions:

- The rotor must be able to rotate freely. The maximum friction torque on the rotor must not exceed 1% of the motor permanent torque.
- The cooling circuit has to be in use.
- The operator must be able to reach the resolver stator and to manually turn it and lock it (access to the locking screws).

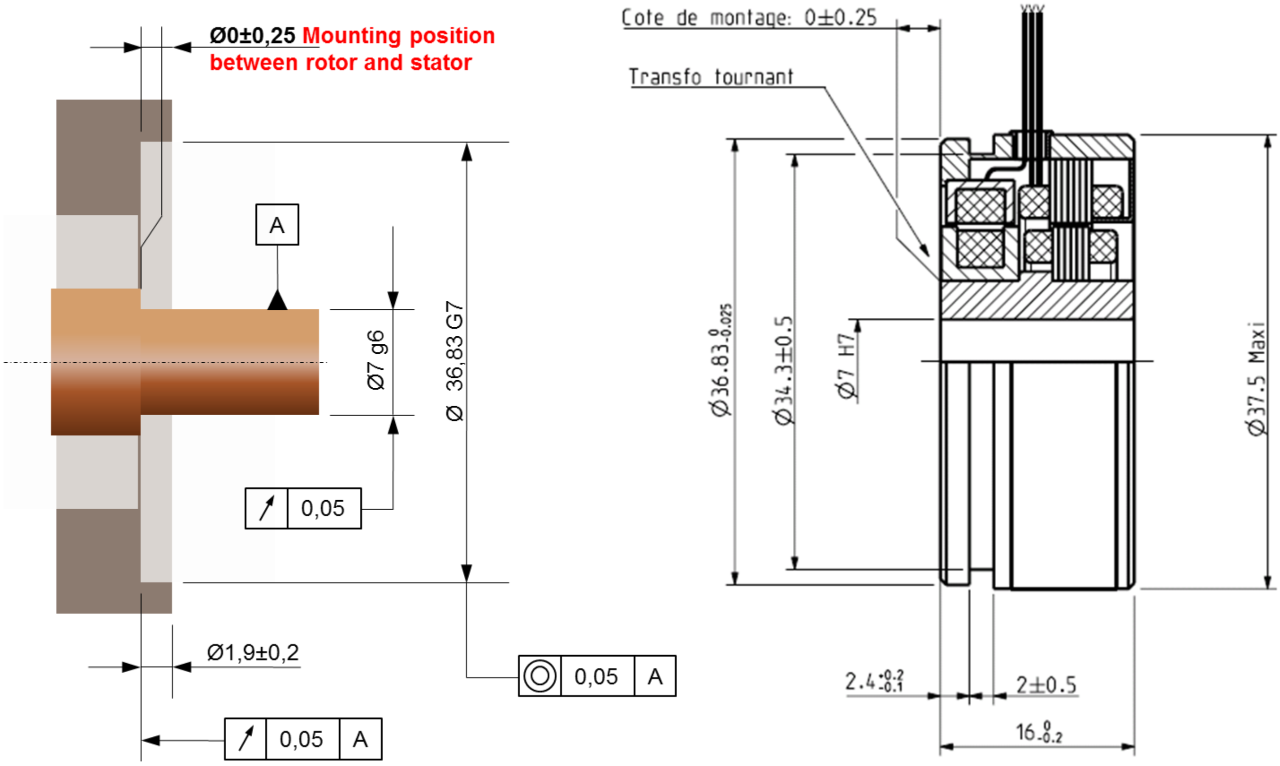
Look at the drive instruction manual for the setting procedure details.

3.8.1.6. Resolver drawings

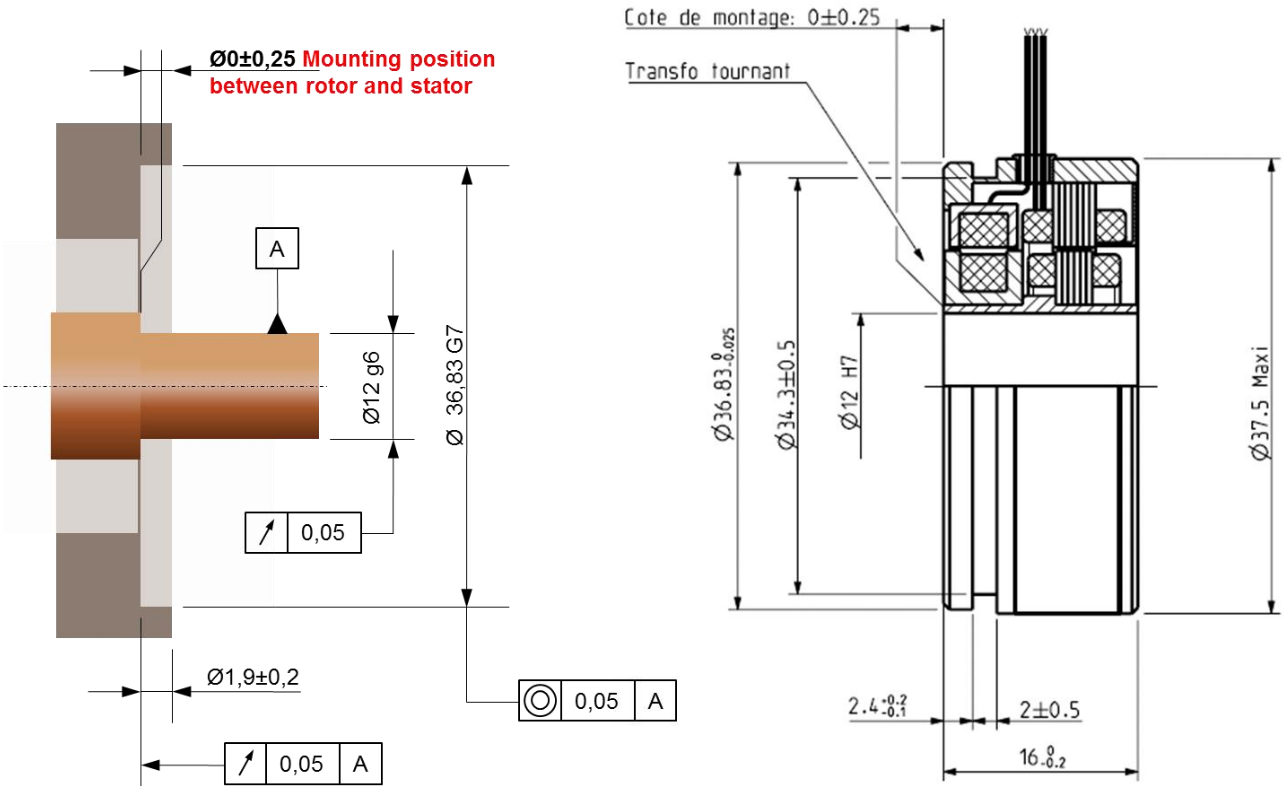
Resolver part number 220005P1000



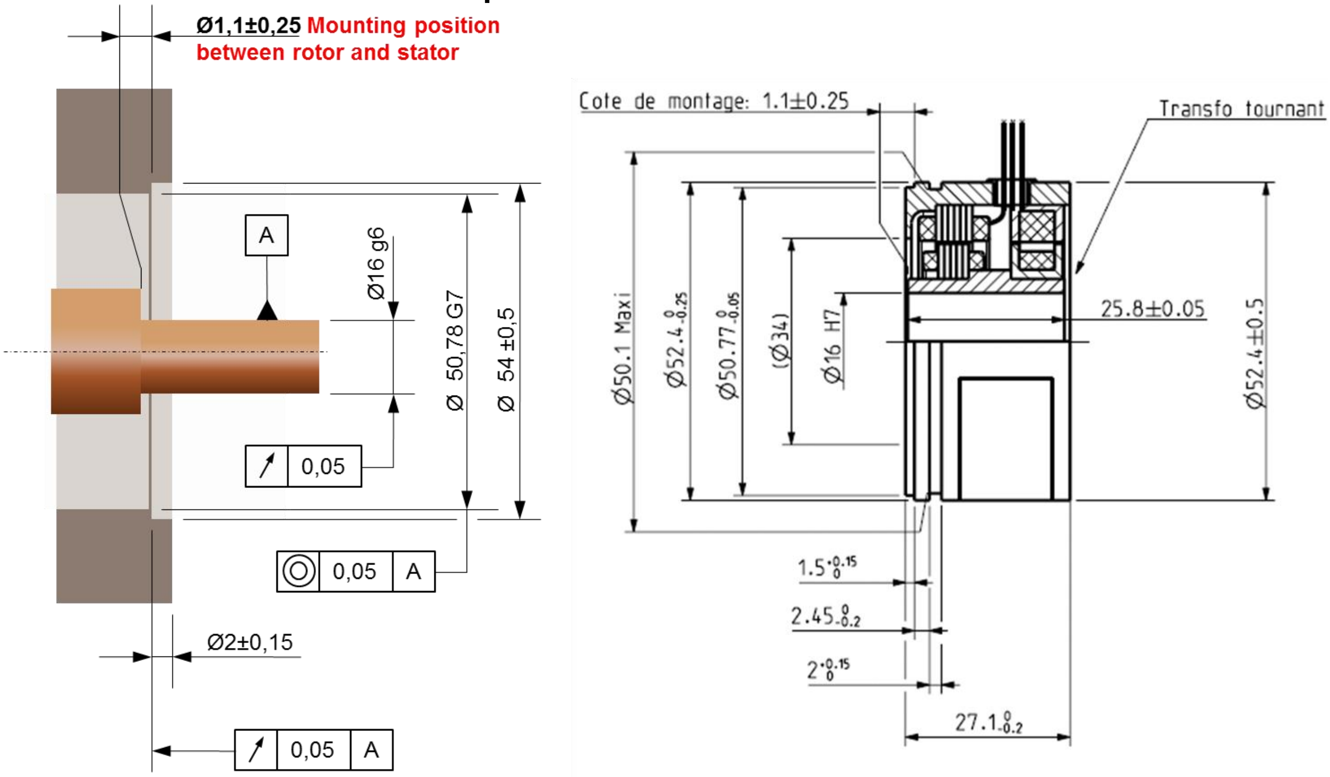
Resolver part number 220005P1001



Resolver part number 220005P1002



Resolver part number 220005P1003



3.8.2. Encoder

Instead of a resolver we can provide an encoder:

- Incremental encoder
- incremental encoder with 10 poles commutations channels
- Hiperface single turn or multiturn
- Endat, single turn or multiturn
- …

4. COMMISSIONING, USE AND MAINTENANCE

4.1. Instructions for commissioning, use and maintenance

4.1.1. Equipment delivery

All servomotors 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

Kit motors are delivered in two part, rotor and stator divided.

DANGER: Do not handle the stator with the help of electrical cables or use any other inappropriate method. Use non-magnetic material to handle rotor.

4.1.3. Storage

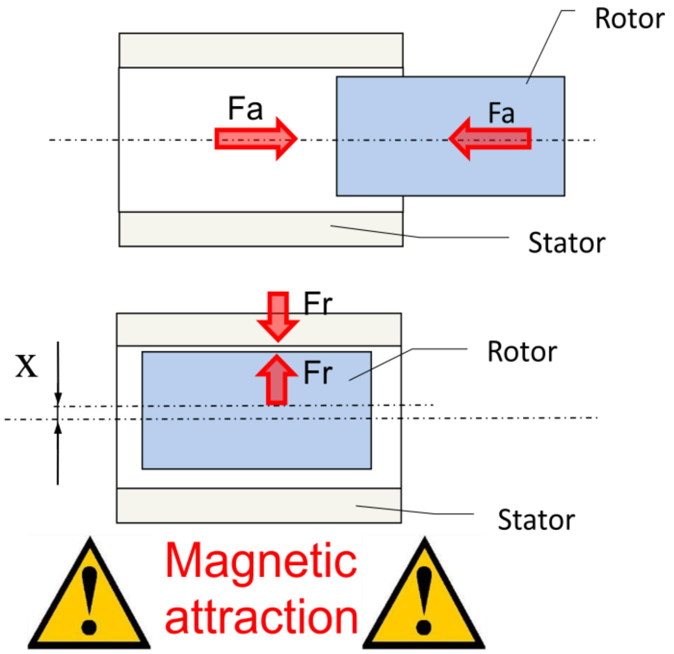
Before being mounted, the motor has to be stored in a dry place, without rapid or important temperature variations in order to avoid condensation.
During storage, the ambient temperature must be kept between -20 and +60°C.
If the torque motor has to be stored for a long time, verify that the rotor and stator are coated with corrosion proof product.

4.2. Machine Integration

4.2.1. General warnings

	Caution: The integrator bears the entire responsibility for the preparation of the machine design.
	Danger : The integrator must certify the motor by an approved organism to comply with all the regulations (CE, UL, …) and perform all the mandatory routine tests (exemples : IEC60034…)
	Attention: Rotor has strong permanent magnets. It creates strong attraction force that can crush fingers or hands. Firmly hold the rotor and move away all magnetic parts. Caution: Clean the working area of all ferromagnetic part such as tools, screws, steel particles. Use wood table to work or make machine assembly.
	Caution: Anyone wearing pacemaker, hearing aid, watches, magnetic data storage device must keep at 1 meter from kit motor.
	Caution: Before mounting the motor, the surface must be cleaned.

The axial attraction force (Fa) during the rotor insertion in the stator is:



Radial attraction (Fr) is proportional with axial offset (x)/

Fr(N) = Kr . x(mm)

Motor	**Fa** N	**Kr** N/mm	**Xmax** mm
NK110	15	300	0.4
NK210	21	1000	0.4
NK310	33	1600	0.4
NK420	60	2000	0.4
NK430	60	3000	0.4
NK620	83	3000	0.4
NK630	83	4500	0.4
NK820	121	3330	0.5
NK840	121	6660	0.5
NK860	121	10000	0.5

4.2.2. Tightening torque

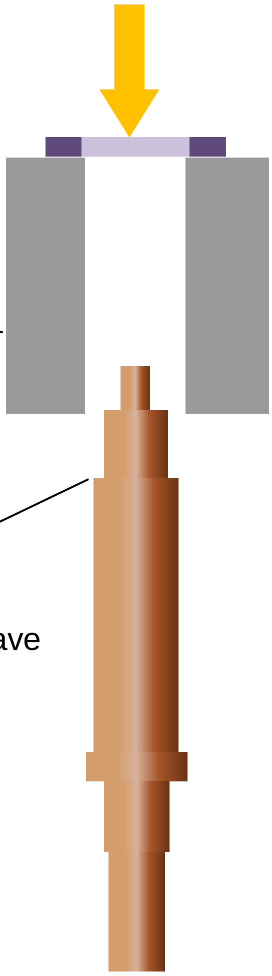
The table below gives the average tightening torques required regarding the fixing screw diameter. These values are valid for both motor's feet and flange bolting.

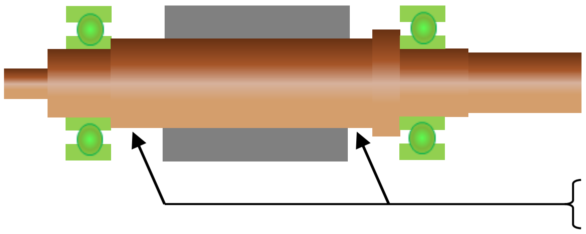
Screw diameter	Tightening torque
M2 x 0.35	0.35 N.m
M2.5 x 0.4	0.6 N.m
M3 x 0.5	1.1 N.m
M3.5 x 0.6	1.7 N.m
M4 x 0.7	2.5 N.m
M5 x 0.8	5 N.m
M6 x1	8.5 N.m
M7 x 1	14 N.m
M8 x 1.25	20 N.m

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.

4.2.3. Rotor integration step by step

Step 1	
	Push down the rotor on the shaft with a press. Maximum press force is described in §3.4.4.1. Make sure you have followed the shaft interface instruction (see §3.4.4.1).

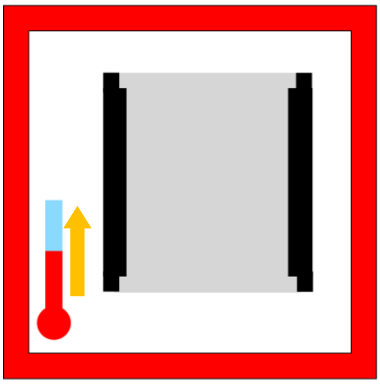
Step 2	
	Rotor balancing is an option and depend on speed application. For high speed application, rotor must be balanced with bearings and shaft. Balancing recommended level : G2.5 Area to add or remove material to balance rotor

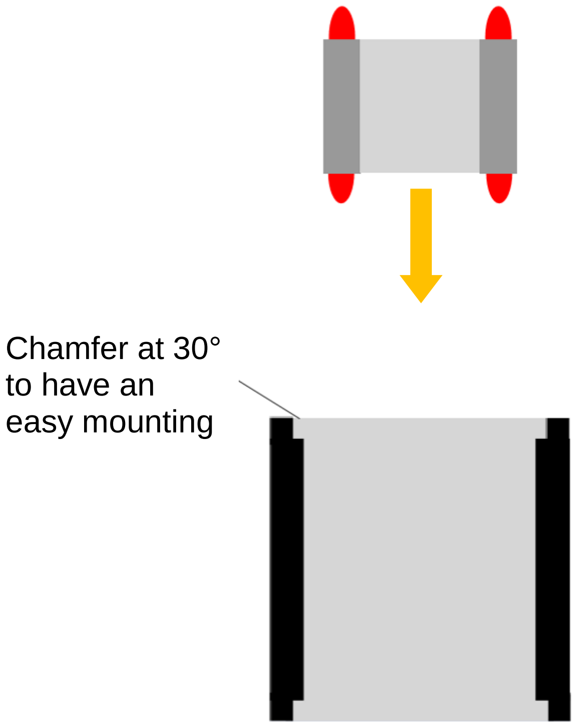
Rotors are not balanced before delivery. The electro-spindle manufacturer must balance the complete spindle rotor (shaft, bearings and rotor) using an appropriate method: for example, by removing or add material from shaft.

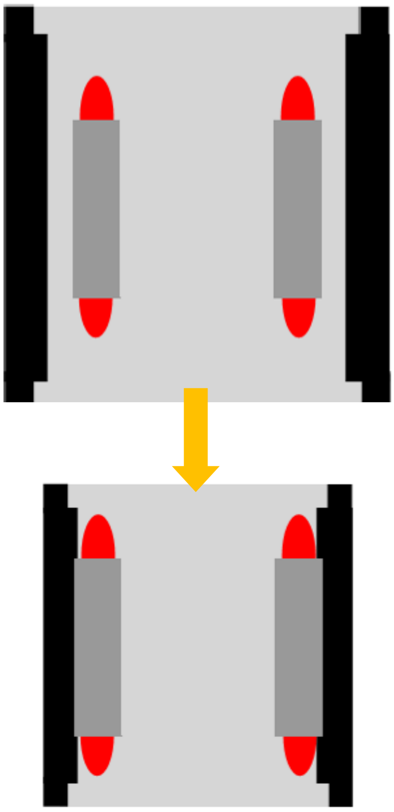
	<u>Caution:</u> In case of drilling, be careful about shaving of metal with magnetic part. We recommend to add material (screws)

	<u>Caution:</u> Balancing must never be made by removing material from the rotor sides, the rotor lamination or any other part of the rotor.

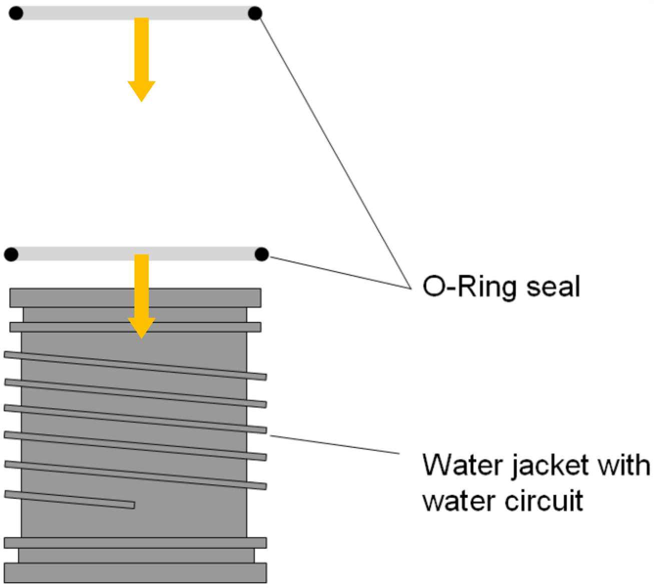
4.2.1. Natural cooled stator integration step by step

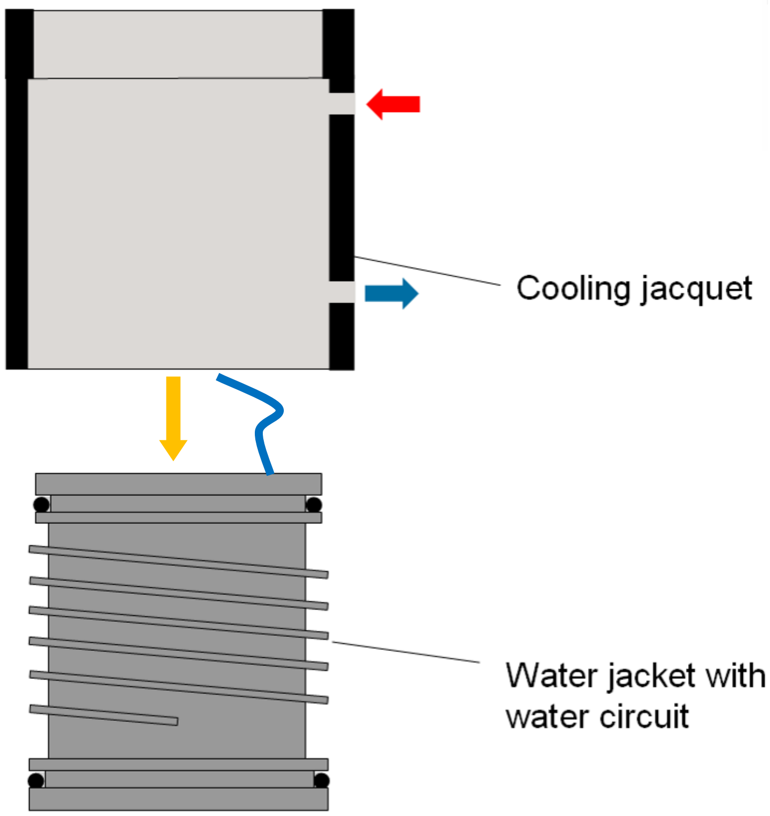
Step 1	
	Increase the housing temperature to 250°C to 300°C

Step 2	
	Push down the stator in the water jacket. Make sure you have followed the housing interface instruction (§3.4.2.2).

<table>
<tr><td colspan="2">Step 3</td></tr>
<tr><td></td><td>After fitting, let stator+housing go back to ambient temperature</td></tr>
</table>

4.2.2. Water cooled stator integration step by step

Step 1	
 	Assemble O-Ring seal on water jacket. O-Ring information's for standard water jacket in chapter "O-Ring specification" (§3.4.5.1).

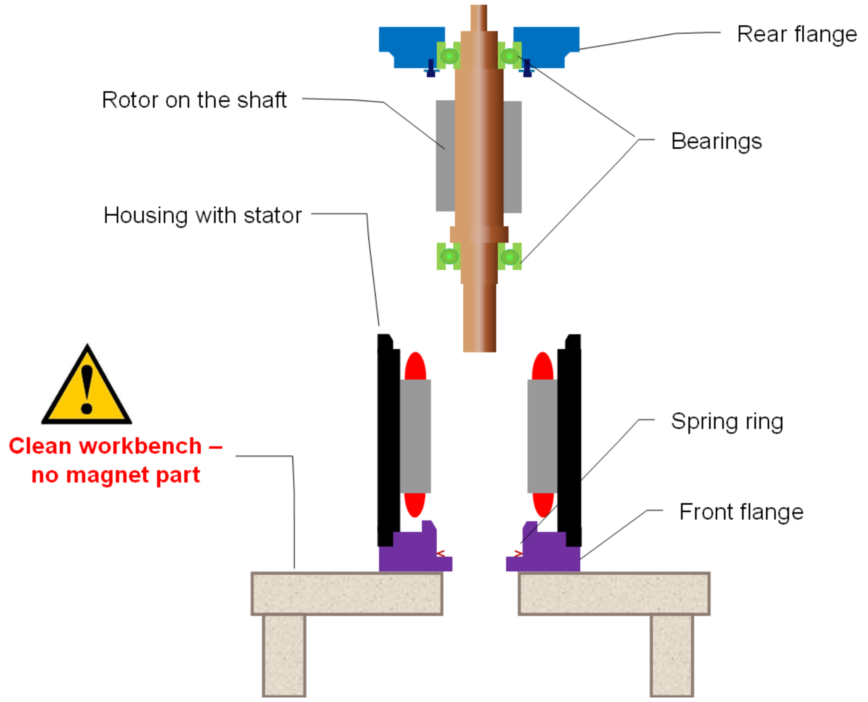
Step 2	
 	Prepare the cooling jacket for his integration : **Water inlet and outlet must be aligned with the cables inlet** Make sure you have followed the cooling jacket interface instructions. The 4 O-rings must be greased with an ordinary lubricant before mounting to avoid damages and leakages

4.2.3. Motor integration

Rotor assembly into stator

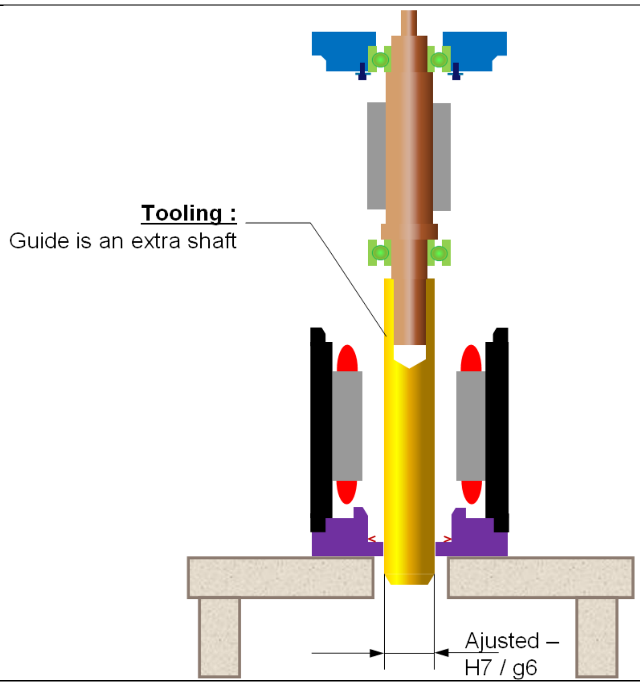
There are different solutions, depends of the weight of the rotor:

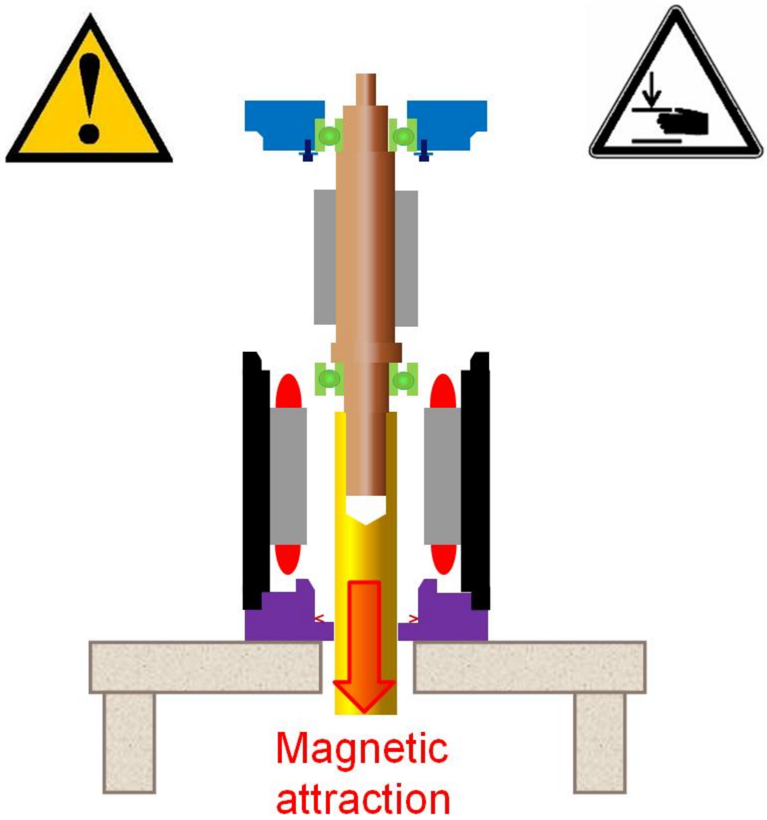
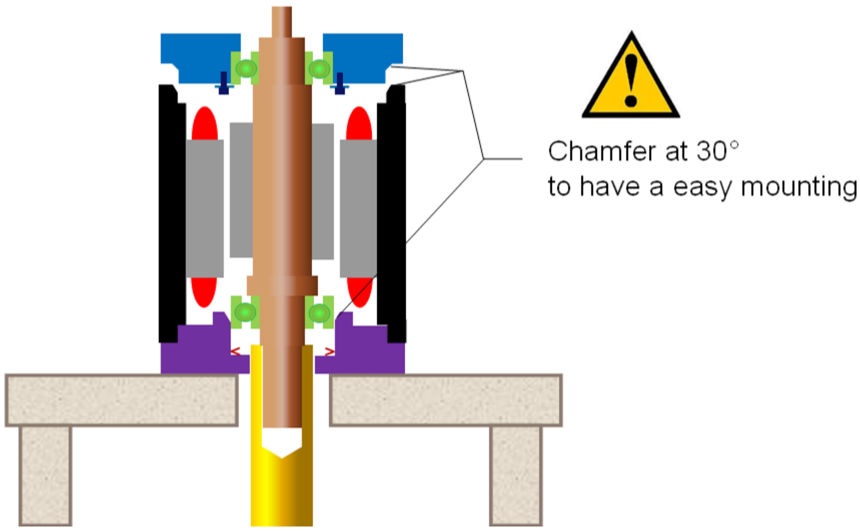
-1st solution: for light motor

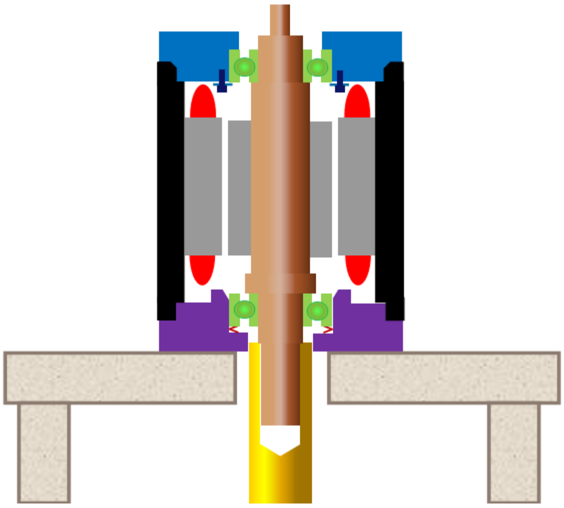
<table>
<tr><td colspan="2">Step 1</td></tr>
<tr><td>
</td><td>Screw the stator onto the front flange.

Put the stator onto workbench.

Put spring ring.

Prepare rotor : fit onto rear flange.</td></tr>
<tr><td colspan="2">Step 2</td></tr>
<tr><td>
</td><td>For an easier assembly, use an extra shaft to guide rotor on stator to avoid gluing due to magnetic parts.</td></tr>
</table>

Step 3	
	<u>Danger :</u> do not put your hand inside the motor during way-down.
	Make sure you have done chamfers at 30°.

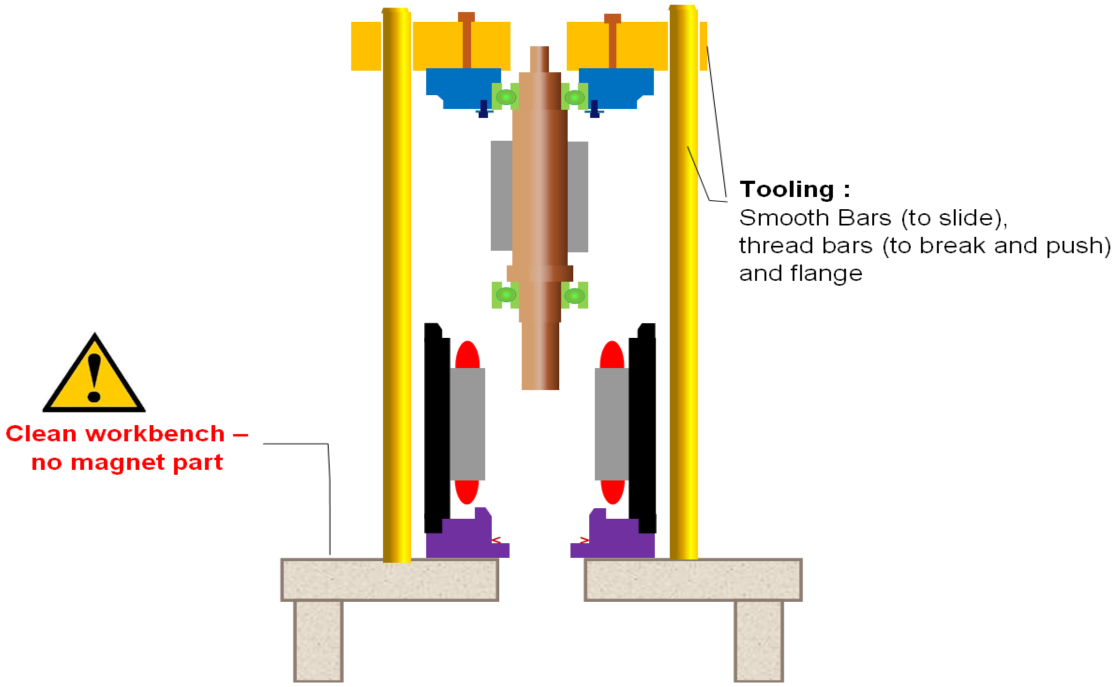
Step 4	
	Screw the rear flange on the stator to close motor.

Step 5
Last step is the encoder or resolver mounting

	<u>Caution: </u>After 15 days, check all tightening torques on screws and nuts

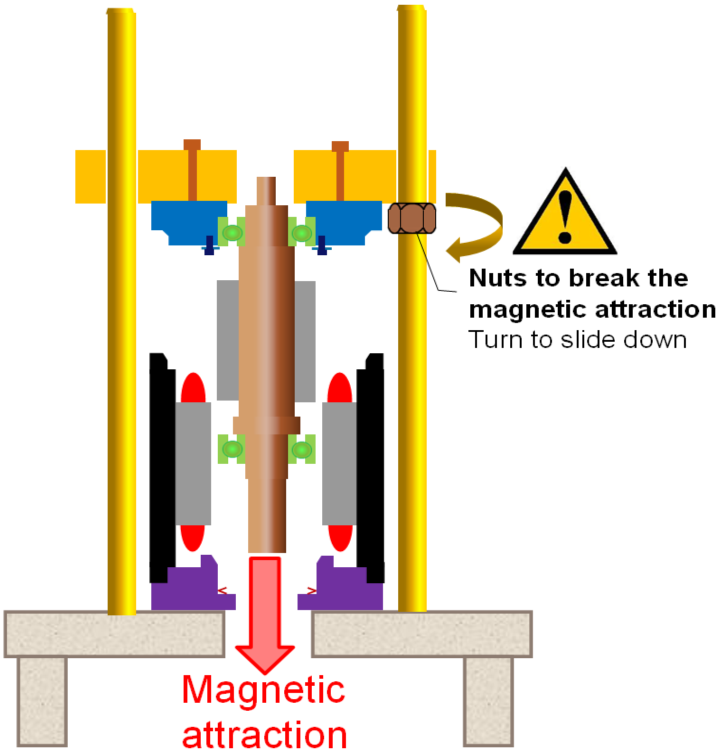
-2nd solution : for heavy motor

Step 2

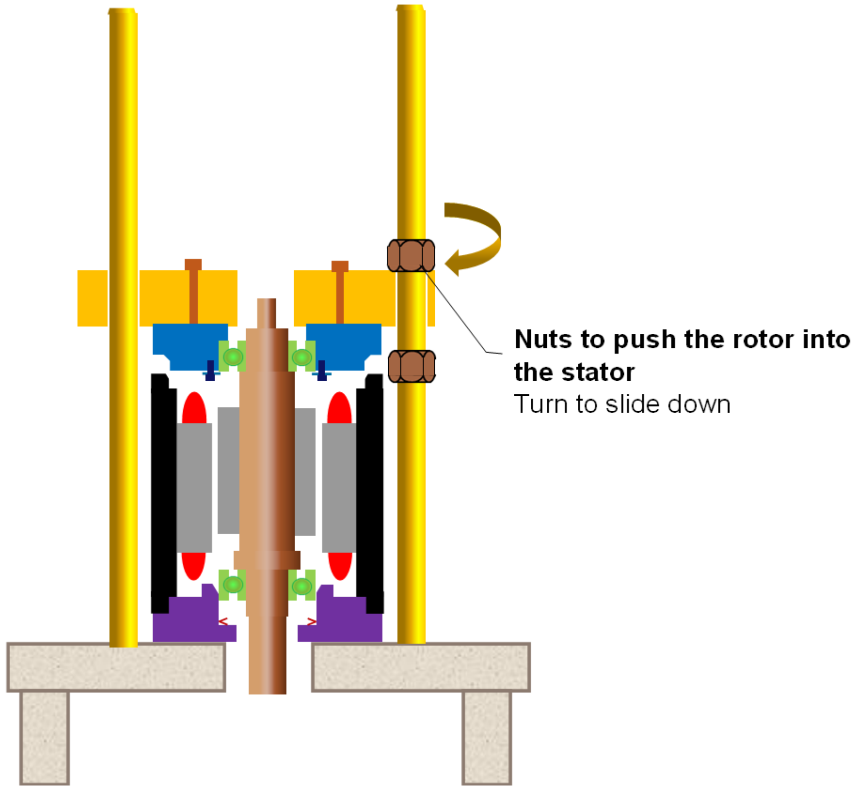
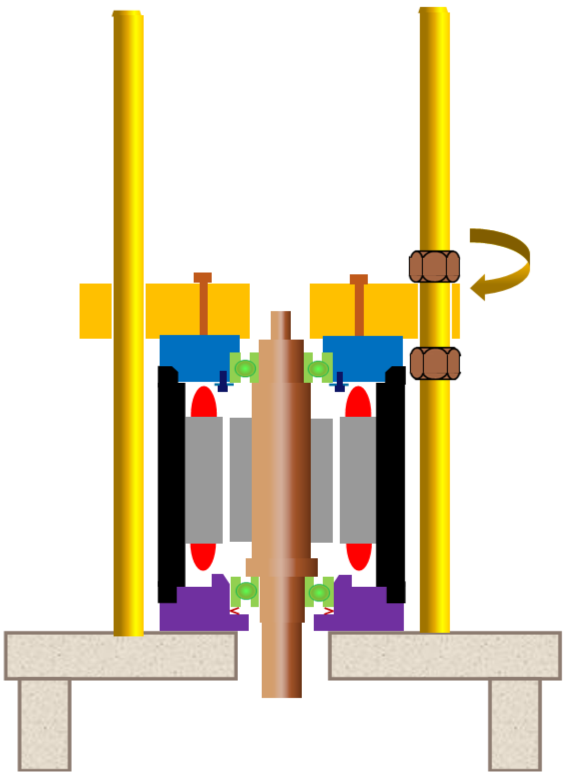


For an easier assembly, use extra smooth and thread bars outside of the stator to guide and push rotor onto the stator.

Step 4



Caution : do not put your hand inside the motor during way-down.

Step 5	
	Make sure the rotor is well setting up in place.
Step 6	
	Unscrew the mobile flange onto the rear flange. Fit rear flange.

Step 7
Last step is the encoder or resolver mounting

⚠	Caution: After 15 days, check all tightening torques on screws and nuts

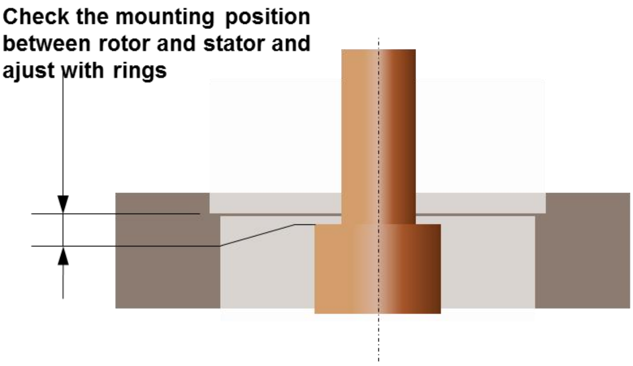
4.3. Resolver mounting

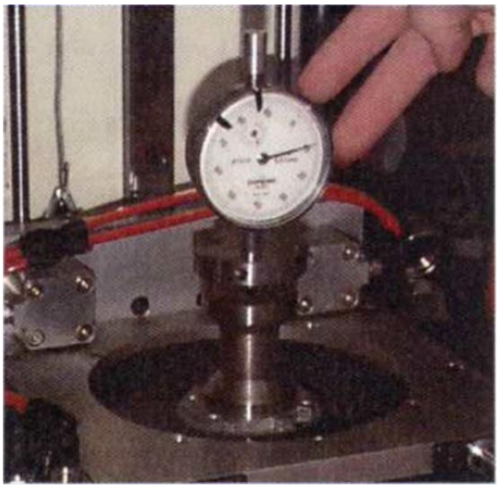
Caution: The resolver is a high precision, carefully manufactured device and the following precautions should be taken to maintain its characteristics:

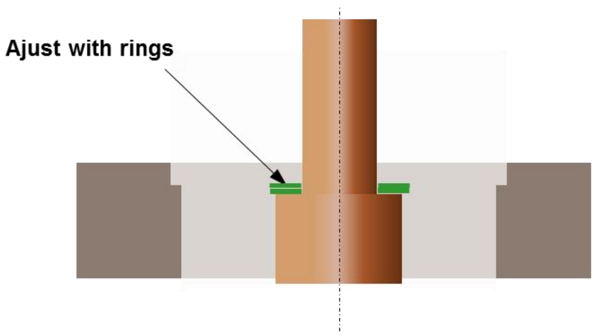
⇒ avoid shocks
⇒ avoid impact between rotor and stator.
⇒ do not hold the stator by its cables
⇒ Do not mismatch the rotor, stator and resolver.
⇒ Connect the resolver according to the drive user manual.
⇒ The resolver is not watertight. Protect it against oil spray.

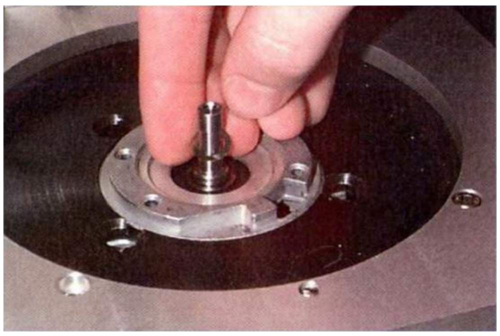
Attention: Do not mix resolver wires with motor wires to avoid EMI (electromagnetic interference). EMI risk to set default the drive.
So, careful to separate resolver and motor wires.

4.3.1. Mounting step by step

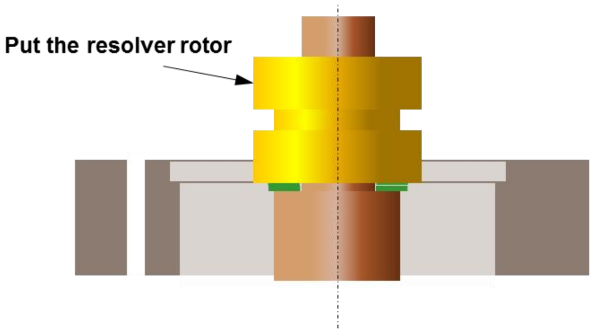


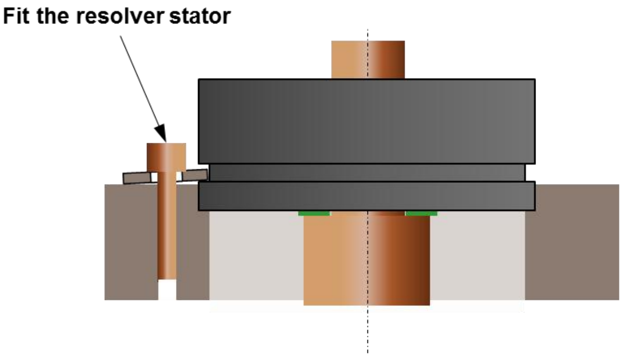


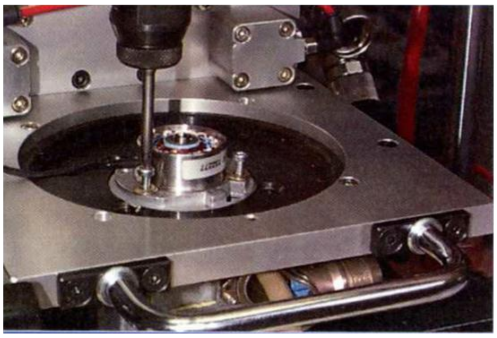




![Parker logo]







4.3.2. Setting of the resolver

At the time of the procedure of setting, it is imperative to observe the 3 following conditions:

- The motor rotor must be free in rotation. The torque of maximum friction on the rotor should not exceed 1 % of torque permanent motor.
- The coolant cooling system must be under operation.
- The operator must have access to the resolver stator and be able to turn it manually and then lock it in place (with lock screw).

To refer to the drive manuals, for the details of the setting procedure.

4.4. Electrical connections

Danger: Check that the power to the electrical cabinet is off prior to making any connections.

Caution: The wiring must comply with the drive commissioning manual and with recommended cables.
Caution: Section motor cable is lower than commissioning section cable between motor and drive due to high performance motor cable design. Do not take the same cable section than motor.

Danger: The spindle servomotor must be earthed by connecting to an unpainted section of the motor.

Caution: The motor cables are designed for high current density, so cable surface can reach temperatures exceeding 100°C.

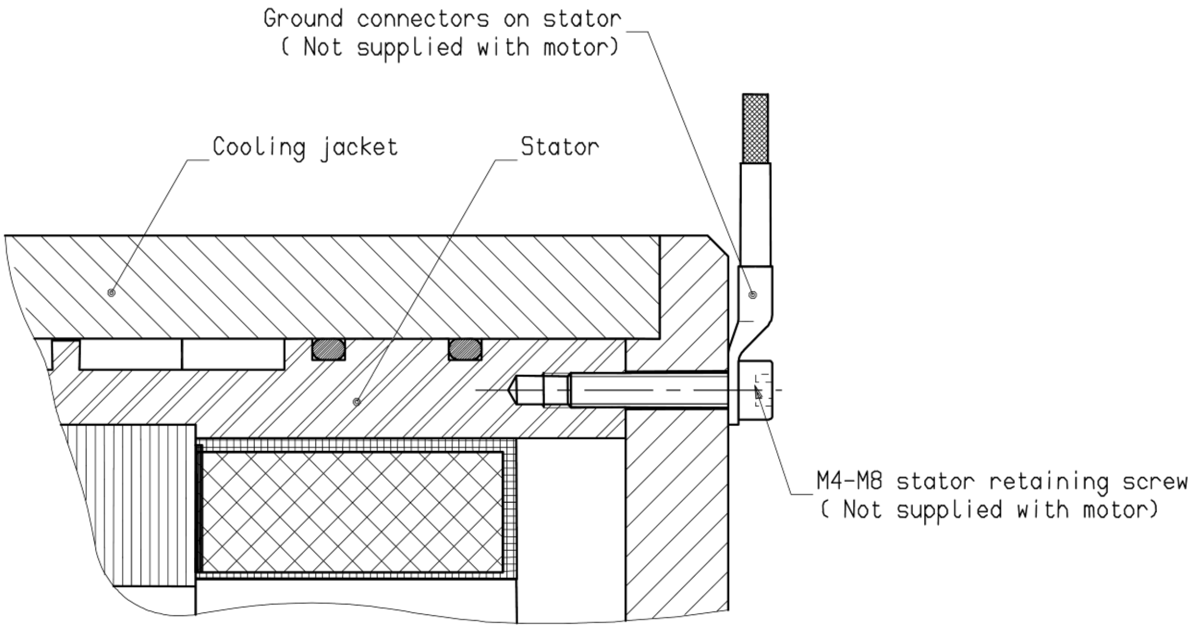
Caution: After 15 days, check all tightening torques on cable connection.

Please, read **§3.7 "Electrical connection"** to have information about cable.
A lot of information are already available in the drive documentations.

The motor must be connected to the servo amplifier according to the drive user manual. The color code given in the table C must be followed :

Signal	Color
U	Black
V	White
W	Red

	The motor is shipped without a ground cable. It is mandatory to connect a (green-yellow) ground cable between the motor frame and machine. The ground cable cross-section must be the same as the power cable cross-section



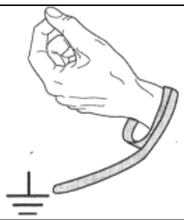
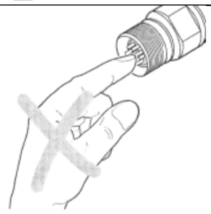
Before applying power:

- ✓ Check there is no damage on winding or cable due the mounting by a dielectric test
- ✓ 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.

4.5. Encoder cable handling

	Danger: before any intervention the drive must be stopped in accordance with the procedure.

	Caution: It is forbidden to disconnect the Encoder cable under voltage (high risk of damage and sensor destruction).

	Warning: Always wear an antistatic wrist strap during encoder handling.
	Warning: Do not touch encoder contacts (risk of damage due to electrostatic discharges ESD.

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4.6. Tests

The motor components delivered by Parvex are tested :
- dielectric test,
- surge test,
- winding resistance and inductance,
- direction of rotation,
- rotor flux.

But complete motor must be tested for safety reason and to comply with the regulations (CE,…).

Danger : The integrator must certify the motor by an approved organism to comply with all the regulations (CE, UL, …) and perform all the mandatory routine tests (exemples : IEC60034…).
The typical process is the qualification of a complete unit and routine tests (including safety tests) on each unit produced

Exemple of a summary of the recommended safety tests, to be validated bu an approved organism.
Attention : other could be needed in accordance with regulations:
- **The continuity of the grounding circuit** :
  On **each** complete unit, the resistance between any conductive point and the grounding conductor shall not exeed than100mΩ. This test shall be performed before the dielectric tests. (EN60204-1: Safety of the machine)
- **Below exemples of dielectric** tests performed on **each** complete unit (Sefelec SMG50 can be used) for a 400V supply :

Dielectric Test	**Motor U,V,W wires**	**Thermal sensor wires**	**Brake wires**	**Resolver wires**	**Frame**	**Test duration, depends on power**
Motor	1800V for 400 V	Connected on Frame	Connected on Frame	Connected on Frame	0V	1min
Thermal sensor	Connected on Frame	1800V for 400 V	Connected on Frame	Connected on Frame	0V	1min
Resolver	Connected on Frame	Connected on Frame	Connected on Frame	620V	0V	1s
Brake	Connected on Frame	Connected on Frame	500V	Connected on Frame	0V	1s
Encoder	Check with encoder supplier for tests to be done					
…	…					

4.7. 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	• If there is a thermal protector, check it and its connection and how it is set in the drive. • Check the servomotor insulation (in doubt, measure when the motor is hot and cold. The minimum insulation resistance measured under 50VDC max is 50 MΩ : - Between phase wire and housing, - Between thermal protector and housing, - Between resolver winding and housing.
You find that the motor speed is drifting	• Adjust the offset of the servo drive.
You notice that the motor is racing	• Check the speed set-point of the servo drive. • Check you are well and truly in speed regulation (and not in torque regulation). • Check the encoder setting
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 torque motor • 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 the cooling circuit
You find that the motor is too noisy	Several possible explanations : • Unsatisfactory mechanical balancing • Defective coupling • Loosening of several pieces • Poor adjustment of the servo drive or the position loop : check rotation with the loop open.
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.