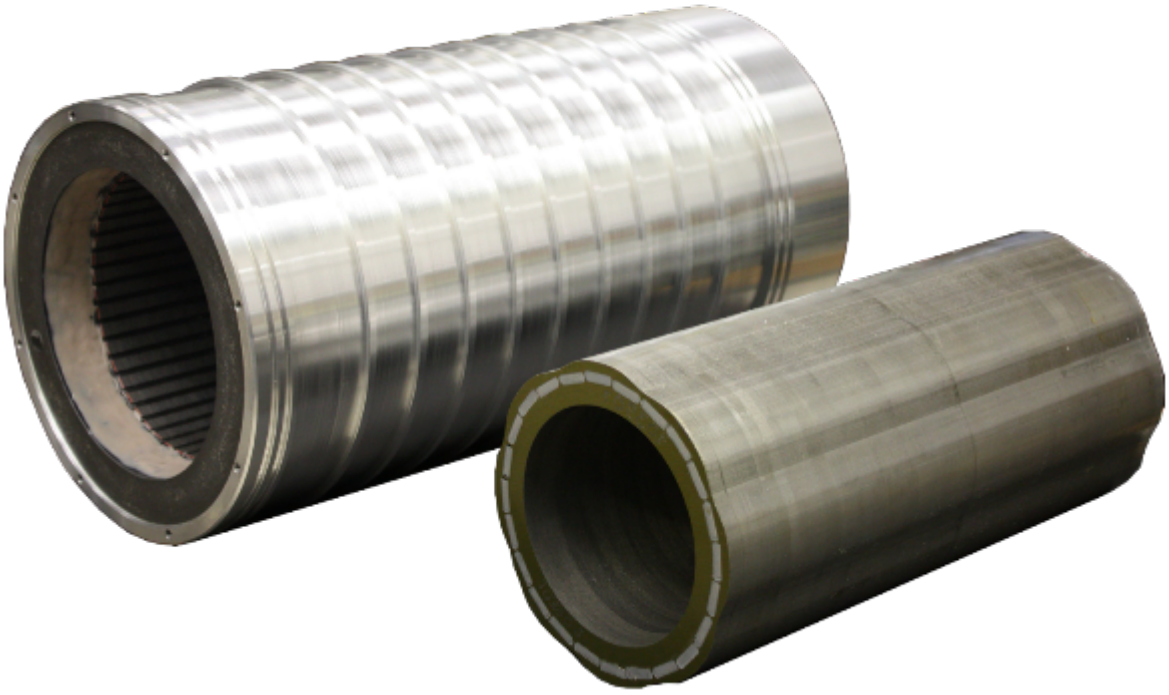
Spindle Servomotors

HKW Series

Technical Manual

PVD3656-GB-HKW



EU DECLARATION OF CONFORMITY

We ,

Parker Hannifin Manufacturing France SAS
Electromechanical & Drives Division Europe
Etablissement de Longvic
4 Boulevard Eiffel - CS40090
21604 LONGVIC Cedex - France

manufacturer, with brand name **Parker**, declare under our sole responsibility that the products

SERVOMOTORS TYPE HKW

satisfy the arrangements of the directives :

Directive 2014/35/EU : "Low Voltage Directive", LVD
Directive 2011/65/EU : "Restriction of Hazardous Substances", RoHS
Directive 2014/30/EU : "Electromagnetic Compatibility", EMC

and meet standards or normative document according to :

EN 60034-1:2010/AC:2010 : Rotating electrical machines - Part 1 : Rating and performance.
EN 60034-5:2001/A1:2007 : Rotating electrical machines - Part 5 : Degrees of protection provided by the integral design of rotating electrical machines (IP code) - Classification.
EN 60204-1:2006/AC:2010 : Safety of machinery – Electrical equipment of machines – Part 1 : General requirements.

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

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

Further information :

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

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

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

HKW C.E. Marking : April 12th 2010

Longvic, November 18th 2016

In the name of Parker
A. ANDRIOT
Quality Manager



Ref : DCE-HKW-001rev0

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1. INTRODUCTION

1.1. Purpose and intended audience

This manual contains information that must be observed to select, install, operate and maintain PARKER HKW high speed motors in kit.

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

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

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

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

1.2. Safety

1.2.1. Principle

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

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

1.2.2. General Safety Rules

	**Generality** DANGER: The installation, commission and operation must be performed by qualified personnel, in conjunction with this documentation. The qualified personnel must know the safety (C18510 authorization, standard VDE 0105 or IEC 0364) and local regulations. They must be authorized to install, commission and operate in accordance with established practices and standards.
	**Electrical hazard** Servo drives may contain non-insulated live AC or DC components. Respect the drives commissioning manual. Users are advised to guard against access to live parts before installing the equipment. Some parts of the motor or installation elements can be subjected to dangerous voltages, when the motor is driven by the inverter , when the motor rotor is manually rotated, when the motor is driven by its load, when the motor is at standstill or stopped. For measurements use only a meter to IEC 61010 (CAT III or higher). Always begin using the highest range. CAT I and CAT II meters must not be used on this product. Allow at least 5 minutes for the drive's capacitors to discharge to safe voltage levels (<50V). Use the specified meter capable of measuring up to 1000V dc & ac rms to confirm that less than 50V is present between all power terminals and between power terminals and earth. The motor must be permanently connected to an appropriate safety earth. The continuity of the grounding circuit has to be checked on the complete circuit : the resistance between any conductive point and the grounding conductor shall not exceed more than100mΩ. 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 :

www.parker.com/eme/hkw

2.2. Overview

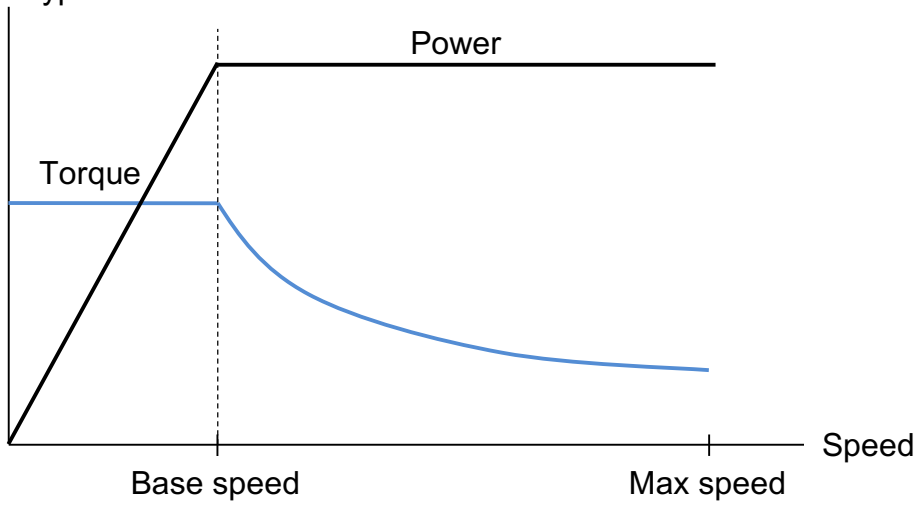
The HKW frameless servomotor are the active parts of a servo motor: a rotor and a stator. The HKW series can not be used alone and must integrated into a complete system to provide a complete servomotor. The design, the construction, the certification and the tests are the responsibility of the integrator.

HKW series is high-speed motor in kit version from PARKER. HKW are innovating solutions through direct drive, specifically conceived for industrial applications where high speed and compactness are needed.

The HKW motors are synchronous AC brushless motors with permanent magnets, based on an original patented technique taking advantage of flux weakening. This motor principle allows, at the same time, a high torque at low speed and a constant power after a given speed (called base speed).

The consequence is a two areas performance:
- A constant torque area from the null speed to the base speed, where the motor is performing as an axis motor.
- A constant power area that allows to perform at higher speed.

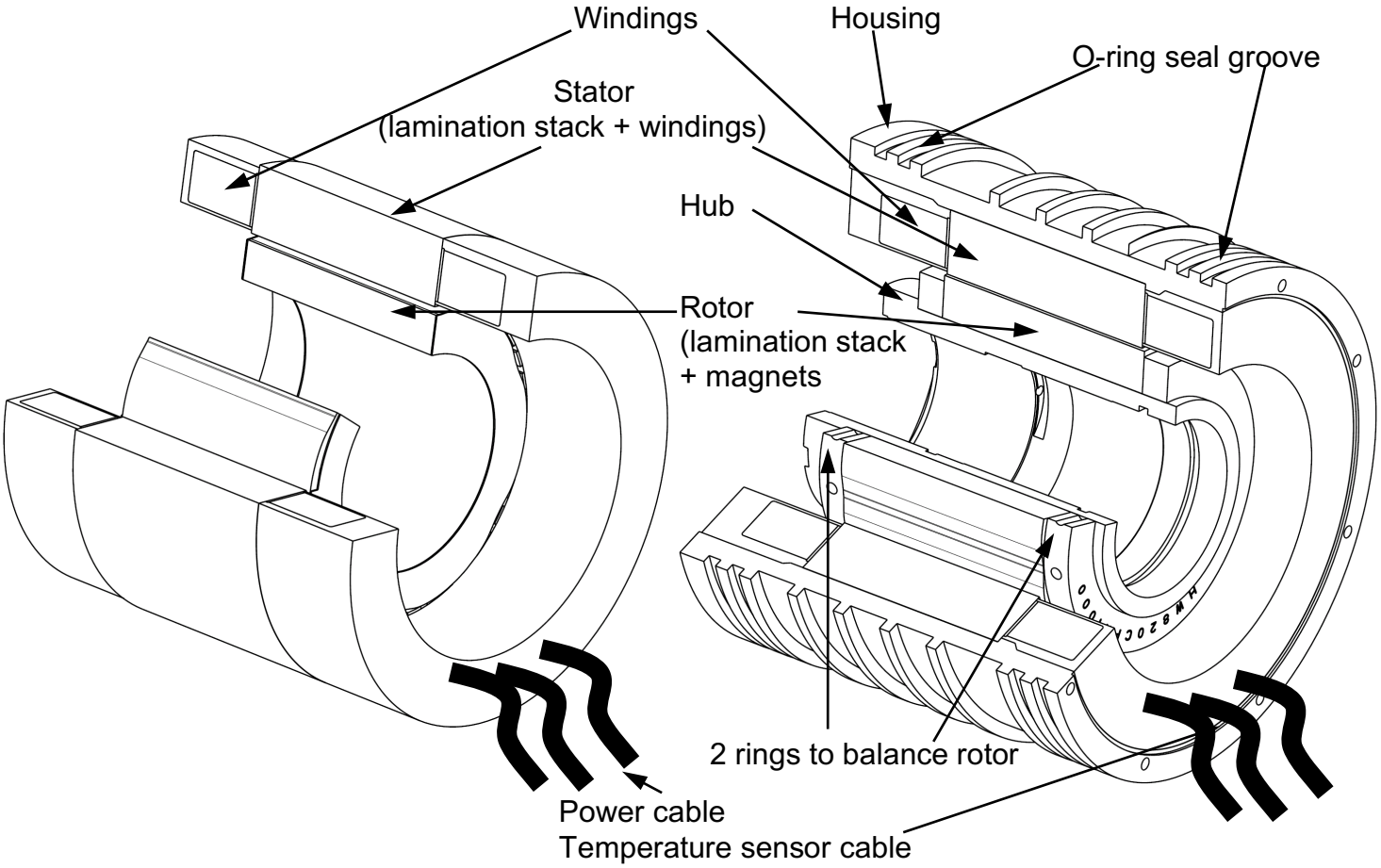
HKW motor typical curve



With this advanced technology, there are no currents in the rotor and no iron losses in the laminations of the rotor. The result is a rotor temperature rise that is very low. Other advantages are: very compact construction and high acceleration capability.

2.3. Motor description and Applications

The HKW motors are delivered as individual components: a rotor with or without hub and a stator with or without housing. PARKER can provide position sensor (2 poles resolver giving an absolute position on one turn) as an option.

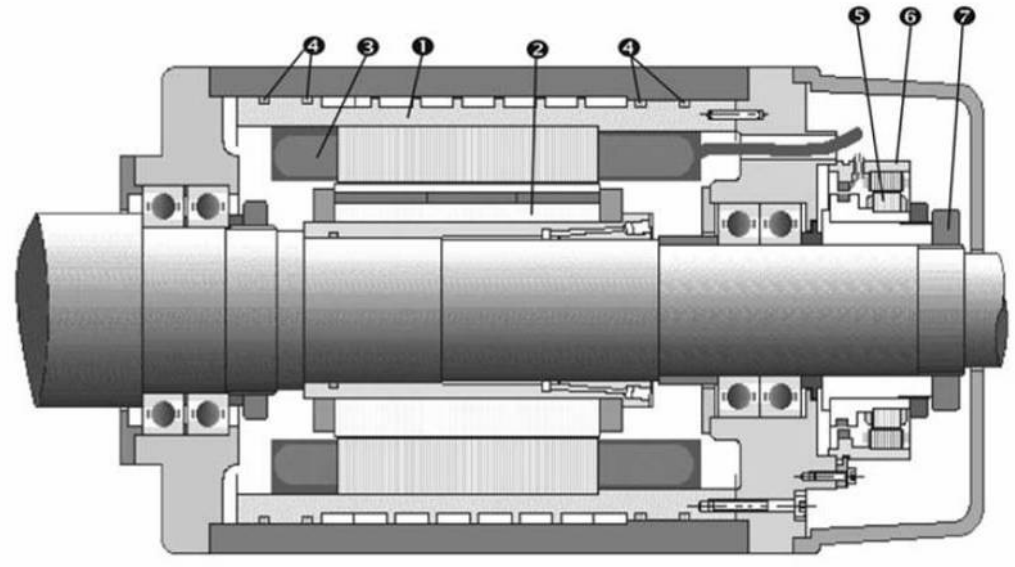


Without hub and housing version ***With hub and housing version***

Many windings are available to get the wished torque and speed characteristics for power up to 80KW with the DIGIVEX drives.

Higher power is available with the universal PARKER AC890 drives.

These components are typically assembled according to Figure 1 to make a complete motor spindle unit. The stator is water cooled to allow a higher torque density and a lower stator temperature rise. The motor is designed to have a large shaft diameter to increase the mechanical rigidity.



1 Stator housing 3 Winding 5 Resolver's rotor 7 Nut
2 Rotor 4 O-Ring 6 Resolver's stator

Figure 1 : Typical HKW motor assembly

The HKW motors have been successfully used in all high speed machine and specially in machine tool applications in place of the traditional induction motors. For the end user the main improvements provided by the HKW motors are :
better accuracy due to the low shaft thermal expansion (low heat generation in the rotor),
reduced tool changing time due to higher acceleration capability,
better surface finishing due to the low motor vibrations,
lower maintenance (bearing lifetime increase due to the lower temperature rise).

2.4. General Technical Data

Motor type	Permanent-magnet synchronous motor
Magnet material	Nd-Fe-B
Number of poles	

Size:	HKW085	HKW108	HKW155	HKW195	HKW242	HKW310
Nbr of poles:	4	6	6	6	8	16

Outer diameter without water housing	85 mm 108 mm 155 mm 195 mm 242 mm 310 mm
Degree of protection	IP00
Cooling	Water cooled
Cooling water temperature	5°C to 25°C (IEC 60034-1) – to avoid condensation see §3.5
Altitude	Up to 1000m (IEC 60034-1) (for higher altitude see “Altitude derating”)
Rated voltage	400VAC and 480VAC
Connections	Power cable, PTC probes and KTY84-130 sensor
Insulation of the stator winding	Class F according to EN 60034-1 with potting
Thermal protection	1 PTC probes and 1 KTY84-130 sensor
Ambiant temperature	0…+40°C (IEC 60034-1) - to avoid condensation see §3.5
Storage temperature	-20… +60°C
Encoder systems	Resolver as an option Other on request

2.5. Product Code

Code	H	K	W	1	5	5	_	1	6	0	C	A	P	R	1	0	0	0

Product Series

Cooling Method

W = Water cooling

Stator external diameter without water jacket

085 = 85 mm
108 = 108 mm
155 = 155 mm
195 = 195 mm
242 = 242 mm
310 = 310 mm

Type

_ : Motor
S : Stator
R : Rotor

Active Part Length

Torque / Speed characteristics

See motor datas

Unused character

Mechanical Option

0 : without water jacket, without hub
1 : with water jacket, without hub
2 : without water jacket, with hub
3 : with water jacket, with hub

000 : Standard motor

3. TECHNICAL DATAS

3.1. Motor selection

3.1.1. Altitude derating

From 0 to1000 m : no derating
From 1000 to 4000 m : torque derating of 5% for each step of 1000 m

3.1.2. Temperature derating

3.1.2.1. 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 **90°C** corresponding to a winding temperature of **115°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 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 water Inlet temperature > 25°C.

$$Torque\_derating[\%] = 100 * \sqrt{\frac{(115°C - Inlet\_temperature°C)}{90°C}}$$

	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.

N.B. No general rules can apply concerning the torque derating of HKW motors **at high speed**. Please refer to PARKER on a case by case basis.
In fact, the torque derating at high speed also depends on :
the flux weakening ratio which leads to a short circuit current inherent of the motor type (no action can reduce its value),
the maximal speed of the motor which determines the iron losses and mechanical losses due to the rotation.

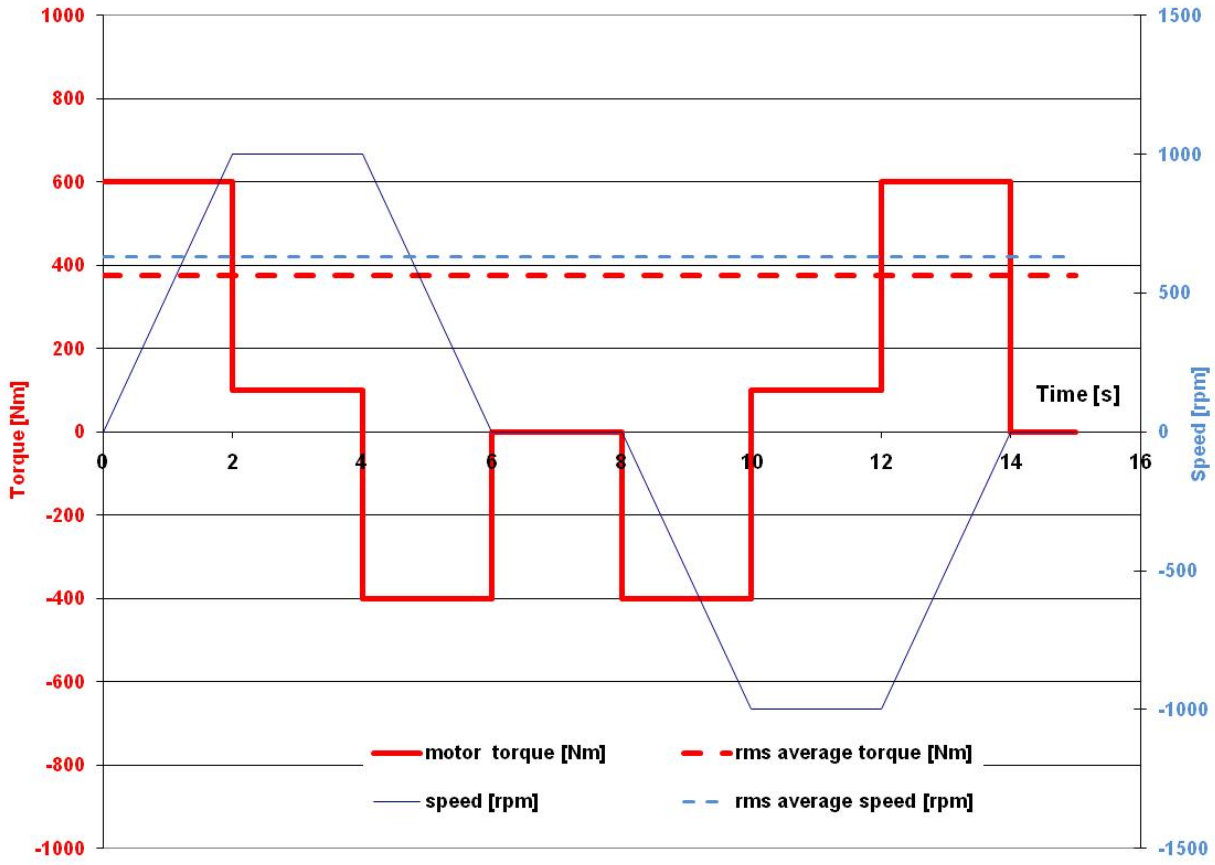
3.1.3. Thermal equivalent torque (rms torque)

The selection of the right motor can be made through the calculation of the rms torque M_{rms} (i.e. root mean squared torque) (sometimes called equivalent torque).
This calculation does not take into account the thermal time constant. It can be used only if the overload time is much shorter than the copper thermal time constant.
The rms torque M_{rms} reflects the heating of the motor during its duty cycle.
Let us consider:
- the period of the cycle T *[s],*
- the successively samples of movements i characterized each ones by the maximal torque M_i *[Nm]* reached during the duration Δt_i *[s]*.

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

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

Illustration :



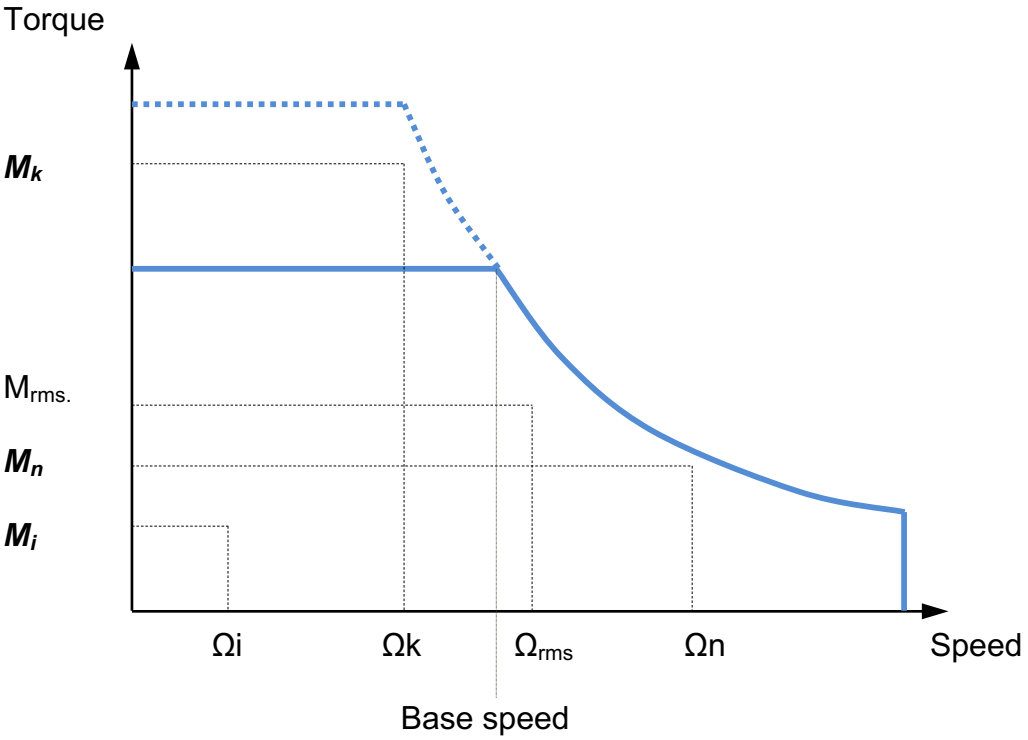
The maximal torque M_i delivered by the motor at each segment i of movement is obtained by the algebric sum of the acceleration-deceleration torque and the resistant torque.
Therefore, M_{max} corresponds to the maximal value of M_i.

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

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

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

Furthermore, each 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. Acceleration – Deceleration time with HKW motors

A HKW motor shows two phases during its acceleration (resp. deceleration) time:
- from 0 to the *Base speed* during its acceleration (or inversely from the *Base speed* to 0 during its deceleration), the phase is called “at constant Torque”.
- from the *Base speed* to the *Maximal speed* during its acceleration (or inversely from the *Maximal speed* to the *Base speed* during its deceleration), the phase is called “at constant Power” or “Spindle mode”.

We assume that the resistant torque is maintained constant and that the motor is able to provide it during the whole acceleration (resp. deceleration) phase. So the calculation of the total acceleration (resp. deceleration) time can be separated in two parts as explained below. When the resistant torque is not constant, the calculation becomes more complex and can be made through iterative means.

Notations:

N_{base}	*Base speed* of the motor [rpm]
Ω_{base}	Base angular speed of the motor [rad/s]
$\sum J$	Total inertia {motor rotor inertia + load inertia reflected to the motor} [kgm²]
M_{motor}	equal to M_{S6} (peak torque) for a short acceleration (deceleration) time, otherwise M_{S1} (constant torque) [Nm]
$M_{resistant}$	Resistant torque, considered as constant during the whole acceleration (resp. deceleration) phase [Nm]
M	Torque available for the acceleration (respectively deceleration) [Nm]
N_{max}	*Maximal speed* of the application [rpm]
Ω_{max}	Maximal angular speed of the application [rad/s]
P_{motor}	equal to P_{S6} (peak power) for a short acceleration (deceleration) time, otherwise P_{S1} (constant power) [W]
P	Power available for the acceleration (respectively deceleration) [W]
t_1	Acceleration (respectively deceleration) time “at constant Torque” [s]
t_2	Acceleration (respectively deceleration) time “at constant Power” [s]
Δt	Global acceleration (respectively deceleration) time [s]

Angular speeds:

$$\Omega_{base} = \frac{2 * \pi * N_{base}}{60} \qquad \Omega_{\max} = \frac{2 * \pi * N_{\max}}{60}$$

3.1.4.1. Constant Torque Phase – t1 calculation

Acceleration time t_1 “at constant Torque” from 0 to the *Base speed* :

$$M = M_{motor} - M_{resistant}$$
$$t_1 = \frac{\Omega_{base} * \sum J}{M}$$

Deceleration time t_1 “at constant Torque” from *Base speed* to 0:

$$M = M_{motor} + M_{resistant}$$
$$t_1 = \frac{\Omega_{base} * \sum J}{M}$$

3.1.4.2. Constant Torque Phase – t_2 calculation

Method #1:
This method is simple and provides an estimation of ***t_2*** sufficient in most situations:
- when the resistant torque ***$M_{resistant}$*** is small compared to ***M_{motor}***
- when the resistant torque ***$M_{resistant}$*** is equal to 0.

Procedure to follow:
We calculate firstly an estimation of the resistant power ***$P_{resistant}$*** as follows:

$$P_{resistant} \approx M_{resistant} * \frac{(\Omega_{max} + \Omega_{base})}{2}$$

Acceleration time t_2 "at constant Power" from *Base speed* to *Maximal speed*:
The power available for the acceleration is equal to:

$$P = P_{mot} - P_{resistant}$$

So the estimated duration ***t_2*** is given by the formula:

$$t_2 = \frac{\frac{1}{2}\Sigma J * (\Omega_{max}{}^2 - \Omega_{base}{}^2)}{P}$$

Deceleration time t_2 "at constant Power" from *Maximal speed* to *Base speed*:
The power available for the deceleration is equal to:

$$P = P_{mot} + P_{resistant}$$

So the estimated duration ***t_2*** is given by the formula:

$$t_2 = \frac{\frac{1}{2}\Sigma J * (\Omega_{max}{}^2 - \Omega_{base}{}^2)}{P}$$

Total acceleration (resp. deceleration) time ***Δt*** will be given by the sum of t_1 and t_2:

$$\Lambda t = t_1 + t_2$$

Method #2:
This method is more complex but provides the exact solution for t_2. It is sometimes used where justified by the required accuracy or by a resistant torque $M_{resistant}$ non-negligible compared to M_{motor}. This method is only valid if $M_{resistant} \neq 0$.

t_2 is solution of a nonlinear first order differential equation.
$M_{resistant} \neq 0$

Procedure to follow:
Acceleration time t_2 "at constant Power" from *Base speed* to *Maximal speed*:

$$a = \Sigma J$$

$$b = P_{motor}$$

$$c = M_{resistant}$$

$$d = M_{motor} - M_{resistant}$$

$$y_0 = \Omega_{base}$$

$$y_1 = \Omega_{\max}$$

$$\lambda = y_0 - \frac{b}{c}$$

$$\mu = \frac{a * \lambda}{c}$$

$$t_x = -\frac{1}{c} * Ln\left|\frac{1}{\lambda} * (y_1 - \frac{b}{c})\right|$$

$$t_1 = \frac{y_0 * a}{d} \qquad acceleration\_time \qquad in\_axis\,\mathrm{mode}$$

$$t_2 = \mu + \frac{a}{c}(b * t_x - \lambda * e^{-c * t_x}) \qquad acceleration\_time \qquad in\_spindle\,\mathrm{mode}$$

Total acceleration time Δt from 0 to *Maximal speed* is given by the sum of t_1 and t_2:

$$\Lambda t = t_1 + t_2$$

Deceleration time t_2 “at constant Power” from *Maximal speed* to *Base speed*:

$$a = \Sigma J$$

$$b = -P_{motor} \qquad \text{negative value} \Leftrightarrow braking$$

$$c = M_{resistant}$$

$$d = -M_{motor} - M_{resistant}$$

$$y_0 = \Omega_{\max}$$

$$y_1 = \Omega_{base}$$

$$\lambda = y_0 - \frac{b}{c}$$

$$\mu = \frac{a * \lambda}{c}$$

$$t_x = -\frac{1}{c} * Ln\left|\frac{1}{\lambda} * (y_1 - \frac{b}{c})\right|$$

$$t_1 = -\frac{y_1 * a}{d} \qquad deceleration\_time \qquad in\_axis \bmod e$$

$$t_2 = \mu + \frac{a}{c}(b * t_x - \lambda * e^{-c * t_x}) \qquad deceleration\_time \qquad in\_spindle \bmod e$$

Total deceleration time Δt from *Max speed* to 0 will be given by the sum of t_1 and t_2:

$$\Lambda t = t_1 + t_2$$

3.1.4.3. Numerical example:

The HKW motor taken to illustrate the calculations is the type ***HKW155_160CAD***
Corresponding data are as follows:

P_{S1} = P_{S6} = 63 kW
N_{base} = 10300 rpm
N_{max} = 24000 rpm
M_{S1} = 58.4 Nm
M_{S6} = 93.5 Nm
J_{motor}= 0.01455 kgm²

We will consider:
$M_{resistant}$ = 6 Nm
J_{load} = ***J_{motor}*** 0.01455 kgm²

Method #1

$$\Omega_{base} = \frac{2*\pi*N_{base}}{60} \quad \frac{2*\pi*10300}{60} = 1079 \quad \text{rad/s}$$

$$\Omega_{\max} = \frac{2*\pi*N_{\max}}{60} \quad \frac{2*\pi*24000}{60} = 2513 \quad \text{rad/s}$$

$$\Sigma J = J_{motor} + J_{load} \quad 0.01455 + 0.001455 = 0.02910 \quad \text{kgm}^2$$

$$P_{resistant} \approx M_{resistant} * \frac{(\Omega_{\max} + \Omega_{base})}{2} \quad = 6 * \frac{(2513 + 1079)}{2} = 10776 \quad \text{W}$$

Acceleration duration t_1 "at constant Torque" from 0 to the *Base speed* :

$$M = M_{motor} - M_{resistant} \quad = 58.4 - 6 = 52.4 \quad \text{Nm}$$

$$t_1 = \frac{\Omega_{base} * \Sigma J}{M} \quad = \frac{1079 * 0.02910}{52.4} = 0.599 \quad \text{s}$$

Deceleration time t_1 "at constant Torque" from the *Base speed* to 0:

$$M = M_{motor} + M_{resistant} \quad = 58.4 + 6 = 64.4 \quad \text{Nm}$$

$$t_1 = \frac{\Omega_{base} * \Sigma J}{M} \quad = \frac{1079 * 0.02910}{64.4} = 0.487 \quad \text{s}$$

Acceleration time t_2 "at constant Power" from *Base speed* to *Maximal speed*:
The power available for the acceleration is equal to:

$$P = P_{mot} - P_{resistant} \quad = 63000 - 10776 = 52224 \quad \text{W}$$

So the estimated duration ***t_2*** is given by the formula:

$$t_2 = \frac{\frac{1}{2}\Sigma J(\Omega_{\max}{}^2 - \Omega_{base}{}^2)}{P} \quad = \frac{0.5 * 0.02910 * (2513^2 - 1079^2)}{52224} = 1.436 \quad \text{s}$$

Total acceleration time ***Δt*** from 0 to *Maximal speed* is given by the sum of t_1 and t_2:

$$\Delta t = t_1 + t_2 \quad 0.599 + 1.436 = 2.035 \quad s$$

Deceleration time t_2 "at constant Power" from *Maximal speed* to *Base speed*:
The power available for the deceleration is equal to:

$$P = P_{mot} + P_{resistant} \quad = 63000 + 10776 = 73776 \quad W$$

So the estimated duration t_2 is given by the formula:

$$t_2 = \frac{\frac{1}{2}\Sigma J(\Omega_{\max}{}^2 - \Omega_{base}{}^2)}{P} \quad = \frac{0.5 * 0.02910 * (2513^2 - 1079^2)}{73776} = 1.016 \quad \text{s}$$

Total deceleration time Δt from *Max speed* to 0 will be given by the sum of t_1 and t_2:

$$\Lambda t = t_1 + t_2 \quad = 0.487 + 1.016 = 1.503 \quad \text{s}$$

Method #2
t_2 is solution of a nonlinear first order differential equation.
$M_{resistant} \neq 0$

Acceleration time t_2 "at constant Power" from *Base speed* to *Maximal speed*:

$$a = \Sigma J = J_{motor} + J_{load} \quad = 0.02910 \quad \text{kgm}^2$$

$$b = P_{mot} \quad = 63000 \quad W$$

$$c = M_{resistant} \quad = 6 \quad Nm$$

$$d = M_{mot} - M_{resistant} = M \quad = 58.4 - 6 = 52.4 \quad Nm$$

$$y_0 = \Omega_{base} \quad = 1079 \quad rad/s$$

$$y_1 = \Omega_{\max} \quad = 2513 \quad rad/s$$

$$\lambda = y_0 - \frac{b}{c} \quad = 1079 - \frac{63000}{6} = -9421$$

$$\mu = \frac{a * \lambda}{c} \quad = \frac{0.02910 * (-9421)}{6} = -45.69$$

$$t_x = -\frac{1}{c} * Ln\left|\frac{1}{\lambda} * (y_1 - \frac{b}{c})\right| \quad = -\frac{1}{6} * Ln\left|\frac{1}{-9421} * (2513 - \frac{63000}{6})\right| = 0.0275$$

$$t_1 = \frac{y_0 * a}{d} \quad = \frac{1079 * 0.02910}{52.4} = 0.599\,\text{s} \qquad acceleration\_axis\,\text{mod}\,e$$

$$t_2 = \mu + \frac{a}{c}(b * t_x - \lambda * e^{-c * t_x}) \qquad acceleration\_spindle\,\text{mod}\,e$$

$$t_2 = -45.69 + \frac{0.02910}{6}(63000 * 0.0275 - (-9421) * e^{-6*0.0275}) = 1.455\,\text{s}$$

Total acceleration time Δt from 0 to *Maximal speed* is given by the sum of t_1 and t_2:

$$\Lambda t = t_1 + t_2 \quad = 0.599 + 1.455 = 2.054 s$$

Deceleration time t_2 “at constant Power” from *Maximal speed* to *Base speed*:

$a = \Sigma J = J_{motor} + J_{load} \quad = 0.02910 \quad \text{kgm}^2$

$b = -P_{mot} = -63000 \quad W \quad \text{negative value} \Leftrightarrow \textit{braking}$

$c = M_{resistant} \quad = 6 \quad Nm$

$d = -M_{mot} - M_{resistant} = M = -58.4 - 6 = -64.4 \quad \text{Nm} \quad \text{negative value} \Leftrightarrow \textit{braking}$

$y_0 = \Omega_{\max} \quad = 2513 \quad rad/s$

$y_1 = \Omega_{base} \quad = 1079 \quad rad/s$

$$\lambda = y_0 - \frac{b}{c} \quad = 2513 - \frac{-63000}{6} = 13013$$

$$\mu = \frac{a * \lambda}{c} \quad = \frac{0.02910 * 13013}{6} = 63.114$$

$$t_x = -\frac{1}{c} * Ln\left|\frac{1}{\lambda} * (y_1 - \frac{b}{c})\right| = \quad -\frac{1}{6} * Ln\left|\frac{1}{13013} * (1079 - \frac{-63000}{6})\right| = 0.01947$$

$$t_1 = -\frac{y_1 * a}{d} \quad = -\frac{1079 * 0.02910}{-64.4} = 0.487\,s \qquad deceleration\_time \qquad in\_axis\,\text{mode}$$

$$t_2 = \mu + \frac{a}{c}(b * t_x - \lambda * e^{-c * t_x}) \qquad deceleration\_time \qquad in\_spindle\,\text{mode}$$

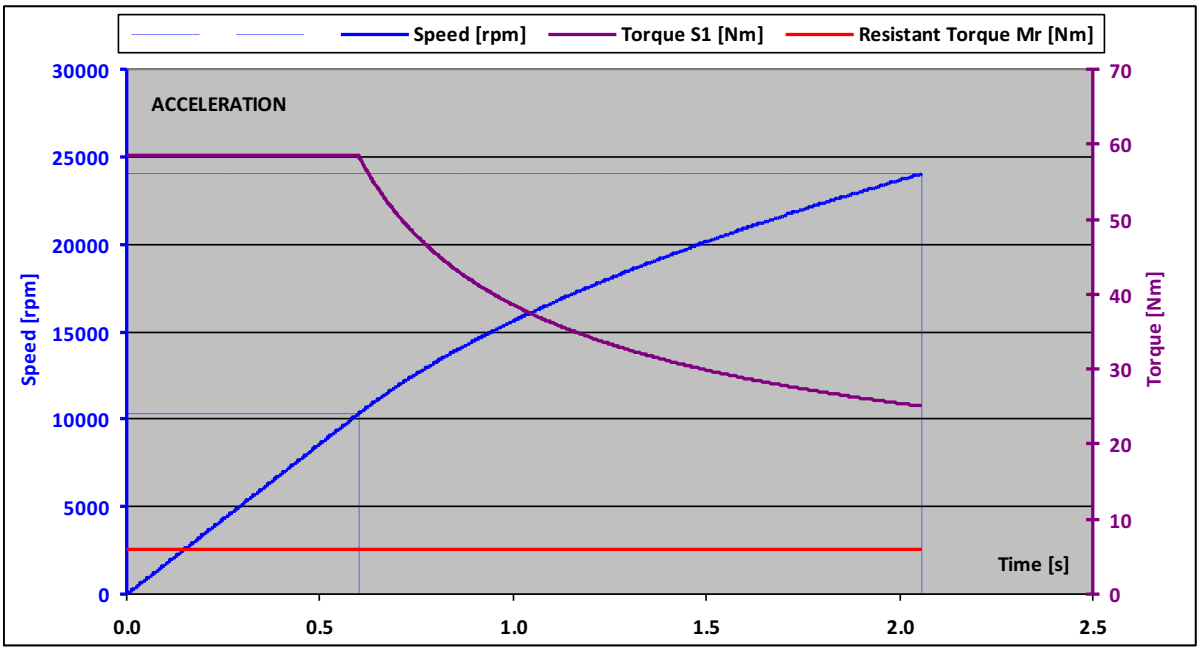
$$t_2 = 63.114 + \frac{0.02910}{6}(-63000 * 0.01947 - 13013 * e^{-6*0.01947}) = 1.0095 \quad s$$

Total deceleration time Δt from *Max speed* to 0 will be given by the sum of t_1 and t_2:

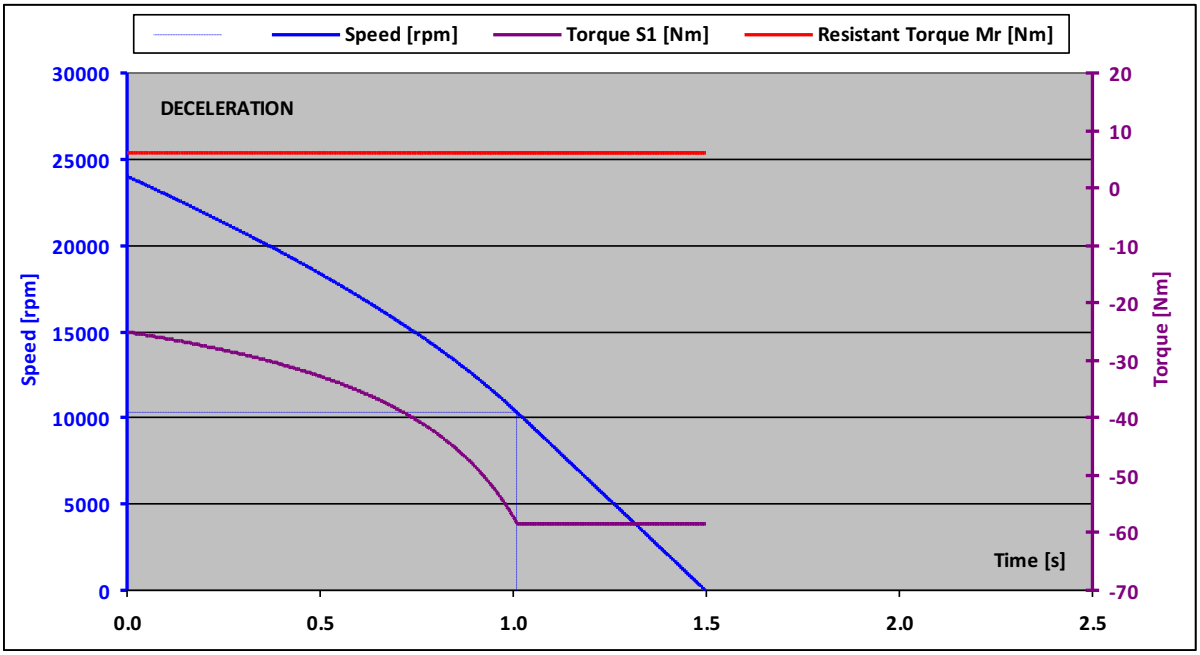
$\Lambda t = t_1 + t_2 \quad = 0.487 + 1.0095 = 1.497 \quad \text{s}$

Illustrations:

Acceleration phase



Deceleration phase



3.1.5. Drive selection

The drive selection depends on its rated power, nominal current and maximal electrical frequency able to be managed by the drive and by the flux weakening ratio.

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

	Short circuit current of the motor must be lower than the permanent current of the drive $I_{cc\_motor} < I_{S1\_drive}$ Please refer to the drive technical documentation

	Short circuit current of the motor must be lower than 0.8 times the peak current of the drive $I_{cc\_motor} < 0.8 \times I_{peak\_drive}$ Please refer to the drive technical documentation

	Max back emf of the motor must be lower than the max voltage (from the motor) supported by the drive Please refer to the drive technical documentation

	The drive must be able to manage the flux weakening and must avoid voltage higher than the nominal motor voltage at the motor terminals. Please, check field weakening ratio supported by the drive. Field weakening ratio = Max speed divided by the basis speed

	Due to the maximum electrical frequency able to be managed by the drive, the motor has a speed limitation given as follows: $\text{Speed limitation}(\text{rpm}) = \frac{2 * \text{Max\_drive\_frequency}(\text{Hz}) * 60}{\text{Number\_of\_poles}}$

	Other limitations can come from mechanical integration like the bearing type (steel straight, hybrid or Xlife) or seal…

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

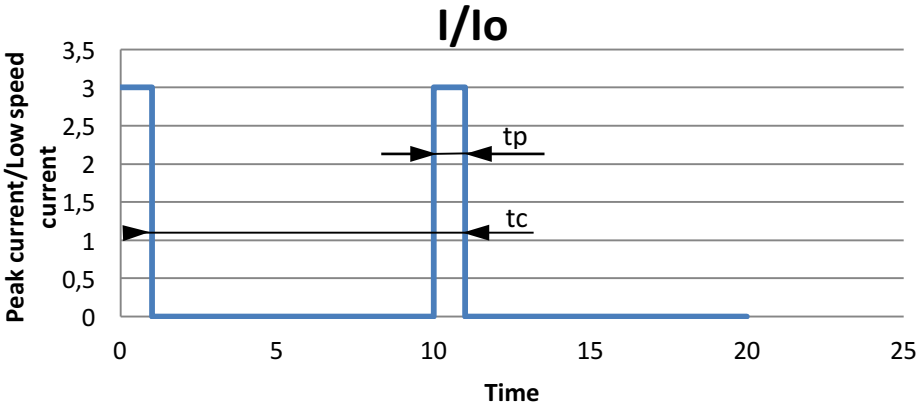
Recommended reduced current at speed < 3 rpm:

$$I_{reduced} = \frac{1}{\sqrt{2}} * I_0 \cong 0.8 * I_0$$

	Warning: The current must be limited to the prescribed values. If the nominal torque has to be maintained at stop or low speed (< 3 rpm), imperatively limit the current to 80% of Io (permanent current at low speed), in order to avoid an excessive overheating of the motor.

	Please refer to the drive technical documentation for any further information and to choose functions to program the drive.

3.1.7. Peak current limitations



It is possible to use the HKW motors 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):

	Tp (second)							
Ipeak/In	1,2	1,4	1,6	1,8	2	2,2	2,4	**>2.4**
HKW085	2,8	1,3	0,8	0,6	0,4	0,3	0,3	not allowed
HKW108	2,5	1,1	0,7	0,5	0,4	0,3	0,2	
HKW155	2,5	1,1	0,7	0,5	0,4	0,3	0,2	
HKW195	5,1	2,4	1,4	1,0	0,8	0,6	0,5	
HKW242	5,1	2,4	1,4	1,0	0,8	0,6	0,5	
HKW310	4,9	2,3	1,4	1,0	0,7	0,6	0,5	

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

3.1.8. Maximum speed according to polarity

Due to the maximum electrical frequency able to be managed by the drive, the motor shows a speed limitation given as follows:

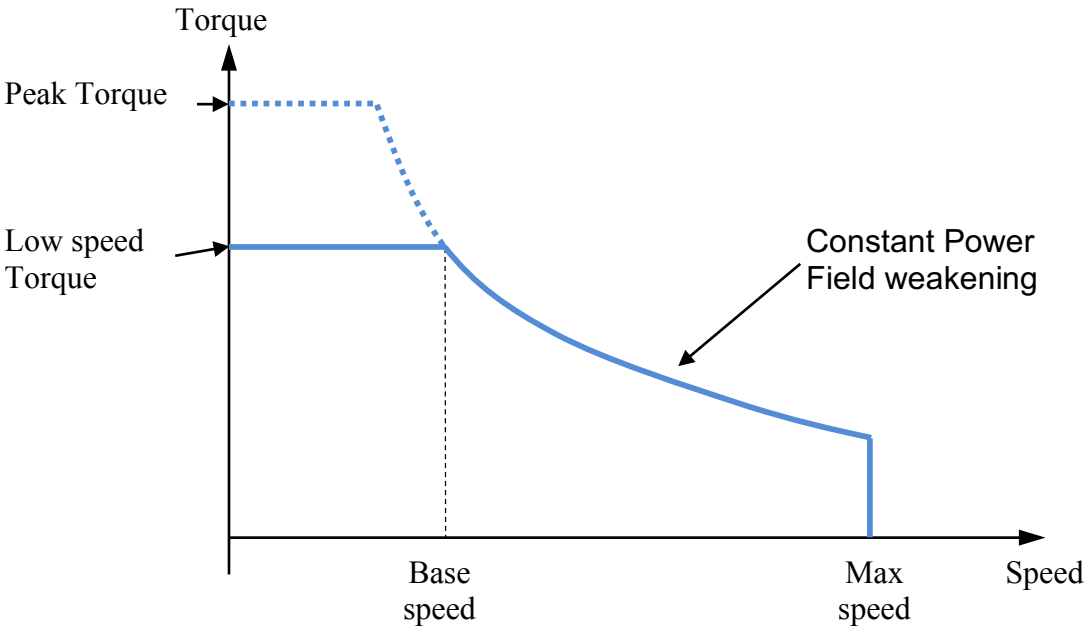
$$\text{Speed limitation}(\text{rpm}) = \frac{2 * \text{Max\_drive\_frequency}(\text{Hz}) * 60}{\text{Number\_of\_poles}}$$

Motor family:	HKW085	HKW108	HKW155	HKW195	HKW242	HKW310
Number of poles:	4	6	6	6	8	16
Number of pole pairs:	2	3	3	3	4	8
AC890 Drive with **F_{max}=800 Hz** Speed limitation [rpm]	24000	16000	16000	16000	12000	6000
DIGIVEX Drive with **F_{max}=1500 Hz** Speed limitation [rpm]	45000	30000	24000*	20000*	12000*	8000*

* Speed limit due to mechanical limit, not due to frequency limit.

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

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



3.2.1. Intrinsic characteristics

Motor	S1 Power PS1 [kW]	Max. Speed Nmax [rpm]	Frequency at max speed [Hz]	Low speed Torque Mo [Nm]	Low speed Current Io [Arms]	Peak Torque Mpeak [Nm]	Peak Current I peak [Arms]	Base speed Nb [rpm]	Moment of Inertia J [kgm²]
400 VAC power supply - three-phased - water cooled									
HKW085_066BAU	2,3	50000	1667	4,9	6,8	7,3	13,5	4480	0,00049
HKW085_066BAP	4,9	50000	1667	4,5	12,2	7,3	27	10400	0,00049
HKW085_066BAK	10,2	50000	1667	4,2	22,4	7,3	54	23200	0,00049
HKW085_099BAQ	4,7	50000	1667	7,4	12,6	11	25,1	6070	0,00068
HKW085_099BAL	10	50000	1667	7,3	24,7	11	50,2	13100	0,00068
HKW085_099BAI	15,6	50000	1667	6,8	35	11	78,1	21900	0,00068
HKW108_080CAN	4,9	30000	1500	10	9,6	15	14,5	4680	0,00082
HKW108_080CAI	10,4	30000	1500	10	19,2	15	28,9	9930	0,00082
HKW108_080CAF	16	30000	1500	10	28,9	15	43,4	15300	0,00082
HKW108_140CAI	10,2	30000	1500	20	21,9	30	33	4870	0,00143
HKW108_140CAF	15,6	30000	1500	20	32,9	30	49,6	7450	0,00143
HKW108_140CAD	25	30000	1500	20	49,4	30	74,3	11900	0,00143
HKW108_200CAJ	9	30000	1500	30	20,7	45	31,2	2870	0,00204
HKW108_200CAF	15,5	30000	1500	30	34,5	45	52	4940	0,00204
HKW108_200CAD	25	30000	1500	30	51,8	45	78	7960	0,00204
HKW155_080CRR	8,8	24000	1200	22	18,2	33	27,6	3820	0,0052
HKW155_080CRP	14	24000	1200	22	28,5	33	43,1	6080	0,0052
HKW155_080CAR	10,3	18000	900	28	19	42	29,4	3510	0,0052
HKW155_080CAP	16	18000	900	28	29,6	42	46	5500	0,0052
HKW155_120CAR	10	24000	1200	48	21,8	75	36,3	1990	0,0078
HKW155_120CAK	23	24000	1200	48	49,5	75	82,5	4600	0,0078
HKW155_120CAH	32	24000	1200	46	65,1	75	113	6640	0,0078
HKW155_120CAF	43	24000	1200	44	82,9	75	151	9330	0,0078
HKW155_160CAR	10	24000	1200	68	23,2	100	36,3	1410	0,0104
HKW155_160CAP	16	24000	1200	68	36,3	100	56,7	2250	0,0104
HKW155_160CAH	32	24000	1200	68	72,6	100	113	4500	0,0104
HKW155_160CAF	44	24000	1200	66	93,8	100	151	6370	0,0104
HKW155_160CAD	63	24000	1200	58	123	100	227	10300	0,0104

Motor	S1 Power PS1 [kW]	Max. Speed Nmax [rpm]	Frequency at max speed [Hz]	Low speed Torque Mo [Nm]	Low speed Current Io [Arms]	Peak Torque Mpeak [Nm]	Peak Current I peak [Arms]	Base speed Nb [rpm]	Moment of Inertia J [kgm²]
400 VAC power supply - three-phased - water cooled									
HKW195_120CAV	7,2	18000	900	80	19,4	120	35,1	860	0,016
HKW195_120CAP	16	20000	1000	80	42,1	120	76	1910	0,016
HKW195_120CAI	34	20000	1000	80	84,1	120	152	4050	0,016
HKW195_120CAF	52	20000	1000	75	117	120	228	6620	0,016
HKW195_120CAE	62	20000	1000	75	140	120	274	7900	0,016
HKW195_180CAT	10	16000	800	120	26,1	180	47,2	795	0,024
HKW195_180CAP	16	20000	1000	120	42,1	180	76	1280	0,024
HKW195_180CAM	23	20000	1000	120	58,2	180	105	1830	0,024
HKW195_180CAJ	31	20000	1000	120	75,7	180	137	2470	0,024
HKW195_180CAF	52	20000	1000	120	126	180	228	4140	0,024
HKW195_180CAC	101	20000	1000	110	227	180	456	8770	0,024
HKW195_300CAM	23	20000	1000	200	58,2	300	105	1100	0,04
HKW195_300CAJ	30	20000	1000	200	75,7	300	137	1440	0,04
HKW195_300CAF	52	20000	1000	200	126	300	228	2490	0,04
HKW195_300CAE	63	20000	1000	200	151	300	274	3010	0,04
HKW195_300CAC	105	20000	1000	200	252	300	456	5010	0,04
HKW195_300CAX	175	20000	1000	200	454	300	821	8350	0,04
HKW195_300CBU	127	20000	1000	270	289	350	419	1500	0,04
HKW195_360CBU	135	20000	1000	340	308	420	419	3790	0,048
HKW195_420CBU	126	20000	1000	400	311	490	419	3000	0,056
HKW195_420CBX	230	18000	900	390	542	490	754	5630	0,056
HKW242_225DAN	15	11000	733	280	37,2	360	49,9	510	0,105
HKW242_225DAF	33	13000	867	280	74,4	360	99,7	1130	0,105
HKW242_225DAD	50	13000	867	280	112	360	150	1710	0,105
HKW242_225DAC	67	13000	867	275	146	360	199	2330	0,105
HKW242_225DAB	101	13000	867	260	206	360	299	3710	0,105
HKW242_375DAF	30	13000	867	480	76,8	600	99,7	600	0,175
HKW242_375DAD	49	13000	867	480	115	600	150	975	0,175
HKW242_375DAC	67	13000	867	480	154	600	199	1330	0,175
HKW242_375DAB	101	13000	867	480	230	600	299	2010	0,175
HKW242_375DAA	200	13000	867	460	439	600	598	4150	0,175
HKW242_375DBB	195	13000	867	620	465	800	653	3000	0,175
HKW242_375DBY	276	13000	867	585	578	800	870	4500	0,175
HKW242_375DBW	158	10000	667	630	316	800	435	2400	0,175
HKW310_200HAJ	37	8000	1067	600	87,1	900	141	590	0,23
HKW310_200HAH	46	8000	1067	580	105	900	177	760	0,23
HKW310_200HAE	77	8000	1067	575	166	900	282	1280	0,23
HKW310_200HAD	95	8000	1067	565	204	900	353	1610	0,23
HKW310_200HAC	115	8000	1067	550	265	900	471	2000	0,23
HKW310_300HAJ	35,4	8000	1067	940	91,2	1350	141	360	0,34
HKW310_300HAH	45	8000	1067	940	114	1350	177	460	0,34
HKW310_300HAE	76	8000	1067	930	180	1350	282	780	0,34
HKW310_300HAD	95	8000	1067	920	223	1350	353	990	0,34
HKW310_300HAC	120	8000	1067	900	290	1350	471	1270	0,34
HKW310_400HAJ	34	6000	800	1250	91	1800	141	260	0,45
HKW310_400HAH	44,5	8000	1067	1250	114	1800	177	340	0,45
HKW310_400HAF	62	8000	1067	1250	152	1800	235	475	0,45
HKW310_400HAE	75	8000	1067	1250	182	1800	282	575	0,45
HKW310_400HAD	94	8000	1067	1250	227	1800	353	720	0,45
HKW310_400HAC	120	8000	1067	1250	303	1800	471	910	0,45
HKW310_400HAY	230	8000	1067	1080	520	1800	942	2030	0,45
HKW310_500HBX	160	5000	667	1890	380	2700	569	810	0,56
HKW310_500HBB	200	6000	800	1880	472	2700	711	1030	0,56
HKW310_500HBY	270	7000	933	1840	616	2700	949	1400	0,56

3.2.2. Further Data

	Back emf constant at 1000 rpm	Torque constant	Winding resistance phase to phase (25°C)	Quadrature Inductance phase to phase (Back EMF voltage axis)	Winding direct inductance phase to phase	Short-circuit current	Optimal phasing at permanent current
	Ke	Kt (sine)	Rb	Lq	Ld	Icc	Av
	[Vrms]	[Nm/Arms]	[Ohms]	[mH]	[mH]	[Arms]	[°]
HKW085_066BAU	45.2	0.721	5.370	52.20	45.50	5.5	20
HKW085_066BAP	22.6	0.369	1.350	13.00	11.40	11.0	20
HKW085_066BAK	11.3	0.188	0.337	3.26	2.84	21.9	20
HKW085_099BAQ	36.5	0.587	2.160	22.70	19.80	10.2	20
HKW085_099BAL	18.3	0.296	0.541	5.68	4.96	20.3	20
HKW085_099BAI	11.7	0.194	0.205	2.35	2.05	31.6	20
HKW108_080CAN	62.8	1.040	2.780	22.40	19.70	11.7	15
HKW108_080CAI	31.4	0.521	0.694	5.61	4.92	23.5	15
HKW108_080CAF	20.9	0.346	0.309	2.49	2.19	35.2	15
HKW108_140CAI	55.1	0.913	0.960	9.79	8.60	23.5	15
HKW108_140CAF	36.7	0.608	0.427	4.35	3.82	35.3	15
HKW108_140CAD	24.5	0.405	0.189	1.93	1.70	53.0	15
HKW108_200CAJ	87.5	1.450	1.500	17.30	15.20	21.2	15
HKW108_200CAF	52.5	0.870	0.545	6.21	5.46	35.4	15
HKW108_200CAD	35	0.579	0.241	2.76	2.43	53.0	15
HKW155_080CRR	72.2	1.210	1.450	18.80	15.60	17.0	20
HKW155_080CRP	46.2	0.772	0.575	7.68	6.40	26.5	20
HKW155_080CAR	88.4	1.470	1.450	18.80	15.60	20.8	20
HKW155_080CAP	56.6	0.946	0.575	7.68	6.40	32.5	20
HKW155_120CAR	133	2.200	1.760	28.10	23.40	20.8	20
HKW155_120CAK	58.3	0.970	0.320	5.45	4.54	47.2	20
HKW155_120CAH	42.4	0.707	0.177	2.88	2.40	65.0	20
HKW155_120CAF	31.8	0.531	0.099	1.62	1.35	87.0	20
HKW155_160CAR	177	2.930	2.070	37.50	31.30	20.8	20
HKW155_160CAP	113	1.870	0.823	15.40	12.80	32.5	20
HKW155_160CAH	56.6	0.937	0.209	3.84	3.20	65.0	20
HKW155_160CAF	42.4	0.704	0.117	2.16	1.80	87.0	20
HKW155_160CAD	28.3	0.472	0.052	0.96	0.80	130.0	20
HKW195_120CAV	261	4.120	2.380	67.50	60.80	15.8	20
HKW195_120CAP	120	1.900	0.492	14.40	13.00	34.1	20
HKW195_120CAI	60.1	0.951	0.122	3.60	3.24	68.2	20
HKW195_120CAF	40.1	0.641	0.056	1.60	1.44	103.0	20
HKW195_120CAE	33.4	0.536	0.038	1.11	1.00	123.0	20
HKW195_180CAT	291	4.600	1.660	54.60	50.50	21.1	20
HKW195_180CAP	180	2.850	0.617	21.00	19.40	34.1	20
HKW195_180CAM	130	2.060	0.332	11.00	10.10	47.2	20
HKW195_180CAJ	100	1.590	0.191	6.49	6.00	61.4	20
HKW195_180CAF	60.1	0.952	0.071	2.34	2.16	103.0	20
HKW195_180CAC	30.1	0.485	0.017	0.58	0.54	204.0	20
HKW195_300CAM	217	3.440	0.466	17.90	16.90	47.2	20
HKW195_300CAJ	167	2.640	0.269	10.60	10.00	61.4	20
HKW195_300CAF	100	1.590	0.099	3.82	3.60	103.0	20
HKW195_300CAE	83.5	1.320	0.067	2.65	2.50	123.0	20
HKW195_300CAC	50.1	0.794	0.024	0.95	0.90	204.0	20
HKW195_300CAX	27.8	0.441	0.007	0.29	0.28	368.0	20
HKW195_300CBU	60.4	0.934	0.024	0.81	0.85	261.0	20
HKW195_360CBU	72.5	1.100	0.027	0.97	1.02	261.0	20
HKW195_420CBU	84.6	1.290	0.031	1.13	1.19	261.0	20
HKW195_420CBX	47	0.720	0.010	0.35	0.37	470.0	20

	Back emf constant at 1000 rpm	Torque constant	Winding resistance phase to phase (25°C)	Quadrature Inductance phase to phase (Back EMF voltage axis)	Winding direct inductance phase to phase	Short-circuit current	Optimal phasing at permanent current
	Ke	Kt (sine)	Rb	Lq	Ld	Icc	Av
	[Vrms]	[Nm/Arms]	[Ohms]	[mH]	[mH]	[Arms]	[°]
HKW242_225DAN	489	7.530	1.520	41.90	41.50	32.5	20
HKW242_225DAF	244	3.760	0.381	10.50	10.40	65.0	20
HKW242_225DAD	163	2.500	0.169	4.66	4.61	97.6	20
HKW242_225DAC	122	1.880	0.095	2.62	2.59	130.0	20
HKW242_225DAB	81.5	1.260	0.042	1.16	1.15	195.0	20
HKW242_375DAF	407	6.250	0.566	17.40	17.30	65.0	20
HKW242_375DAD	272	4.170	0.251	7.74	7.68	97.6	20
HKW242_375DAC	204	3.120	0.141	4.36	4.32	130.0	20
HKW242_375DAB	136	2.090	0.063	1.94	1.92	195.0	20
HKW242_375DAA	67.9	1.050	0.016	0.48	0.48	390.0	20
HKW242_375DBB	88.2	1.330	0.017	0.55	0.55	441.0	20
HKW242_375DBY	66.1	1.010	0.009	0.31	0.31	589.0	20
HKW242_375DBW	132	1.990	0.037	1.23	1.24	294.0	20
HKW310_200HAJ	431	6.890	0.392	9.25	7.80	76.4	10
HKW310_200HAH	345	5.520	0.235	5.92	4.99	95.5	10
HKW310_200HAE	215	3.460	0.093	2.31	1.95	152.0	10
HKW310_200HAD	172	2.770	0.059	1.48	1.25	190.0	10
HKW310_200HAC	129	2.080	0.033	0.83	0.70	254.0	10
HKW310_300HAJ	646	10.300	0.525	13.90	11.70	76.4	10
HKW310_300HAH	517	8.250	0.315	8.88	7.49	95.5	10
HKW310_300HAE	323	5.170	0.124	3.47	2.93	152.0	10
HKW310_300HAD	258	4.130	0.079	2.22	1.87	190.0	10
HKW310_300HAC	194	3.100	0.044	1.25	1.05	254.0	10
HKW310_400HAJ	861	13.700	0.658	18.50	15.60	76.4	10
HKW310_400HAH	689	11.000	0.395	11.80	9.98	95.5	10
HKW310_400HAF	517	8.220	0.222	6.66	5.62	127.0	10
HKW310_400HAE	431	6.870	0.156	4.62	3.90	152.0	10
HKW310_400HAD	345	5.510	0.099	2.96	2.50	190.0	10
HKW310_400HAC	258	4.130	0.056	1.66	1.40	254.0	10
HKW310_400HAY	129	2.080	0.014	0.42	0.35	508.0	10
HKW310_500HBX	324	4.970	0.047	1.34	1.16	384.0	10
HKW310_500HBB	259	3.980	0.030	0.86	0.74	480.0	10
HKW310_500HBY	194	2.990	0.017	0.48	0.42	640.0	10

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 HKW155_160CAP
L_{ph_ph} = 15.4 mH or 15.4E-3 H
R_{ph_ph} at 25°C = 0.823 Ohm
→ τ_{elec} = 15.4E-3/0.823 = **18.7 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 phase 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 HKW155_160CAP
R_{ph_ph} at 25°C = 0.823 Ohm
J = 0.0137 kgm²
Ke_{ph_ph} [$V_{rms}/_{1000rpm}$] = 113 [$V_{rms}/_{1000rpm}$]
→ Ke_{ph_ph} [$V_{rms/rad/s}$] = 113/(2*π*1000/60) = 1.079 [$V_{rms/rad/s}$]
→ τ_{mech}=0.5*0.823*0.0137/(1.079²) = **4.8 ms**

Remarks:

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

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

3.2.3.3. 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]
HKW085_066B	9,7	7,1	25
HKW085_099B	11,5	5,6	23
HKW108_080C	8,1	3,2	43
HKW108_140C	10,2	2,5	34
HKW108_200C	11,5	2,1	30
HKW155_080C	13,4	7,9	61
HKW155_120C	17,0	4,2	49
HKW155_160C	18,7	3,6	42
HKW155_240C	15,0	3,6	37
HKW195_120C	29,5	3,1	57
HKW195_180C	34,4	2,5	50
HKW195_300C	39,9	2,1	45
HKW195_360C	43,3	1.4	54
HKW195_420C	36,7	1.3	50
HKW242_225D	27,6	1.3	62
HKW242_375D	30,9	3,4	55
HKW310_200H	25,2	2,5	79
HKW310_300H	28,2	2,3	71
HKW310_400H	30,0	2,0	66
HKW310_500H	28.6	1,4	64

3.2.4. Voltage withstand characteristics of HKW 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 over voltage 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 HKW motors 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 480V AC.
Higher supply voltages are available on request.

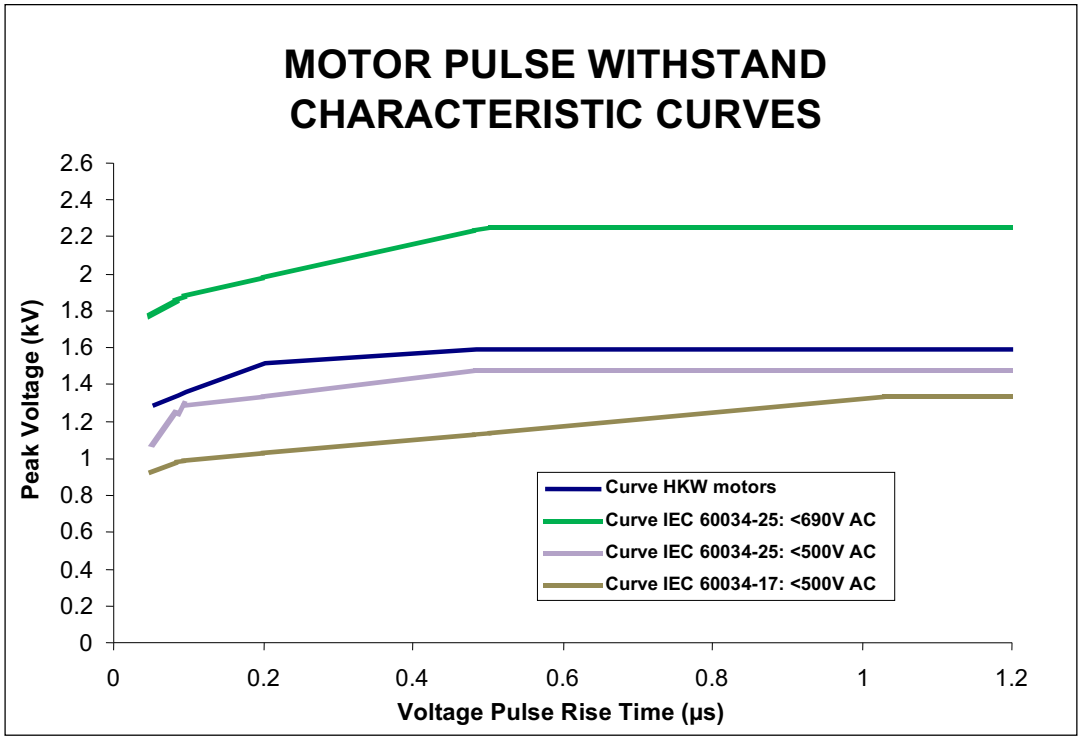


Figure 1: Minimum Voltage withstands characteristics for motors insulations according to IEC standards. At the top are the typical capabilities for the HKW motors with additional insulation.

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

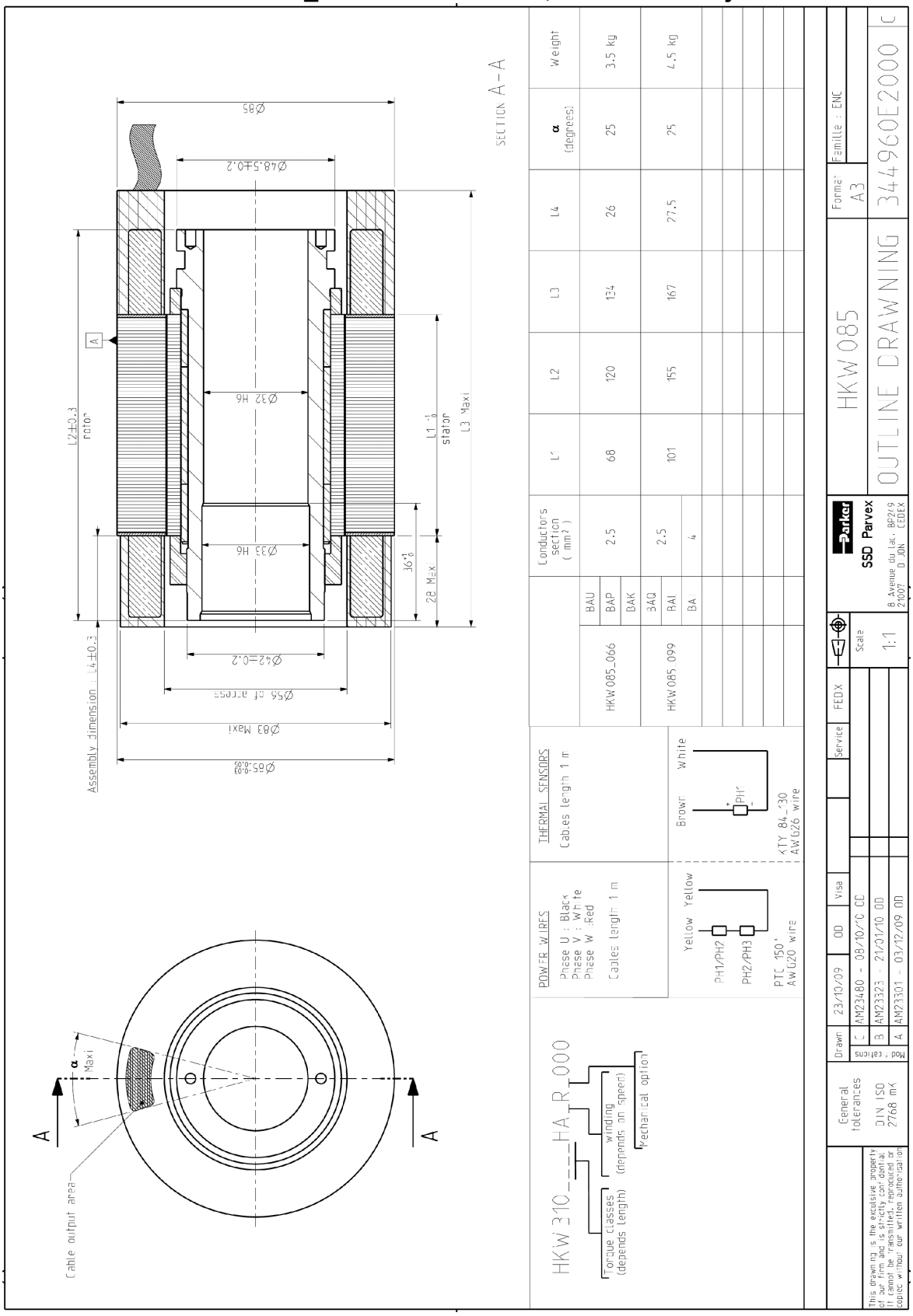
The HKW motors can be used with a supply voltage up to 480 V under the following conditions:

- The pulse rise times must be longer than 50 ns.
- The repetitive pulse voltages must not exceed the values given in figure 1, Curve IEC 60034-25 : <500V AC.

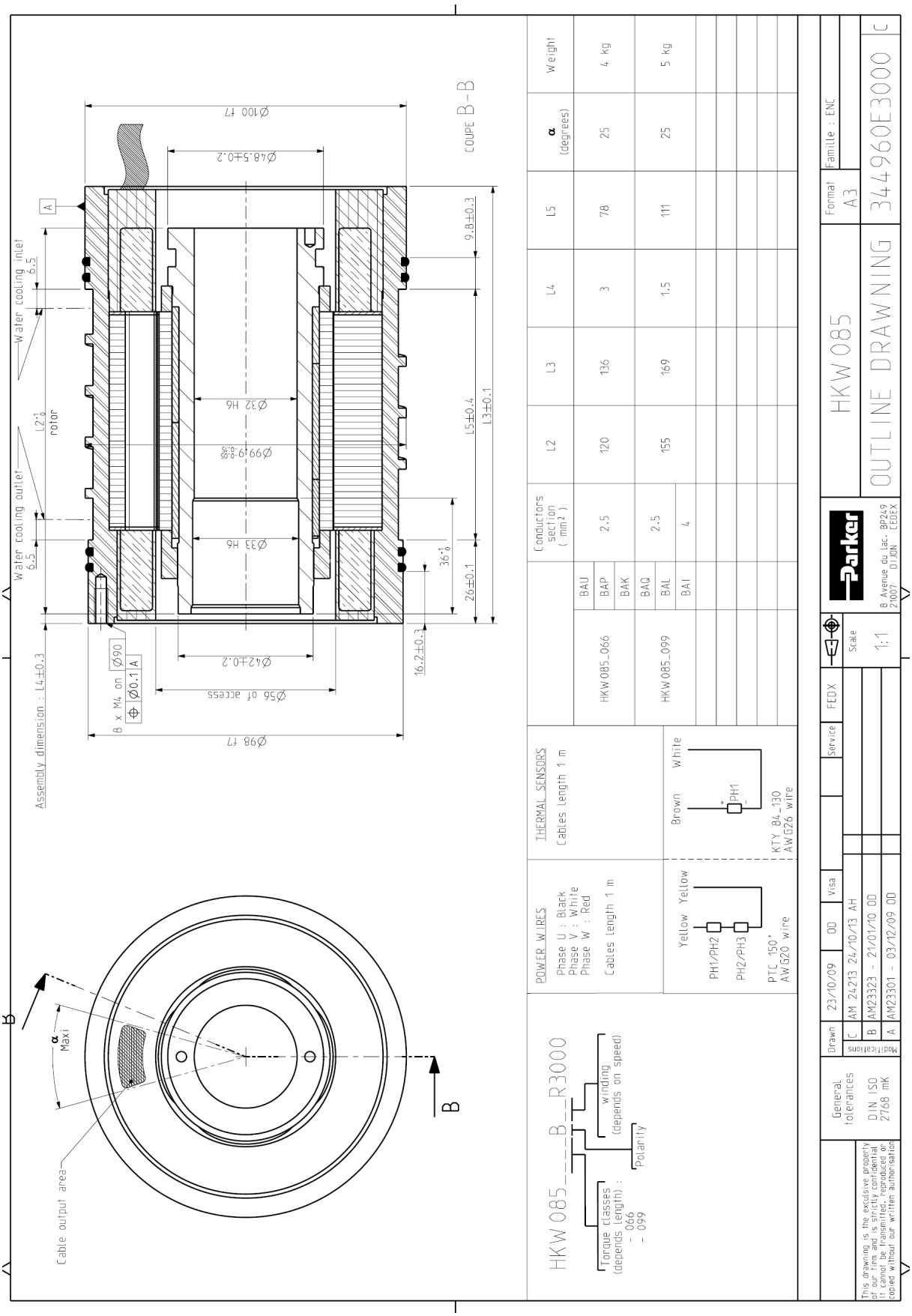
3.3. Dimension drawings

3.3.1. HKW085 standard configurations

3.3.1.1. HKW085_***R2000 : with hub, without water jacket

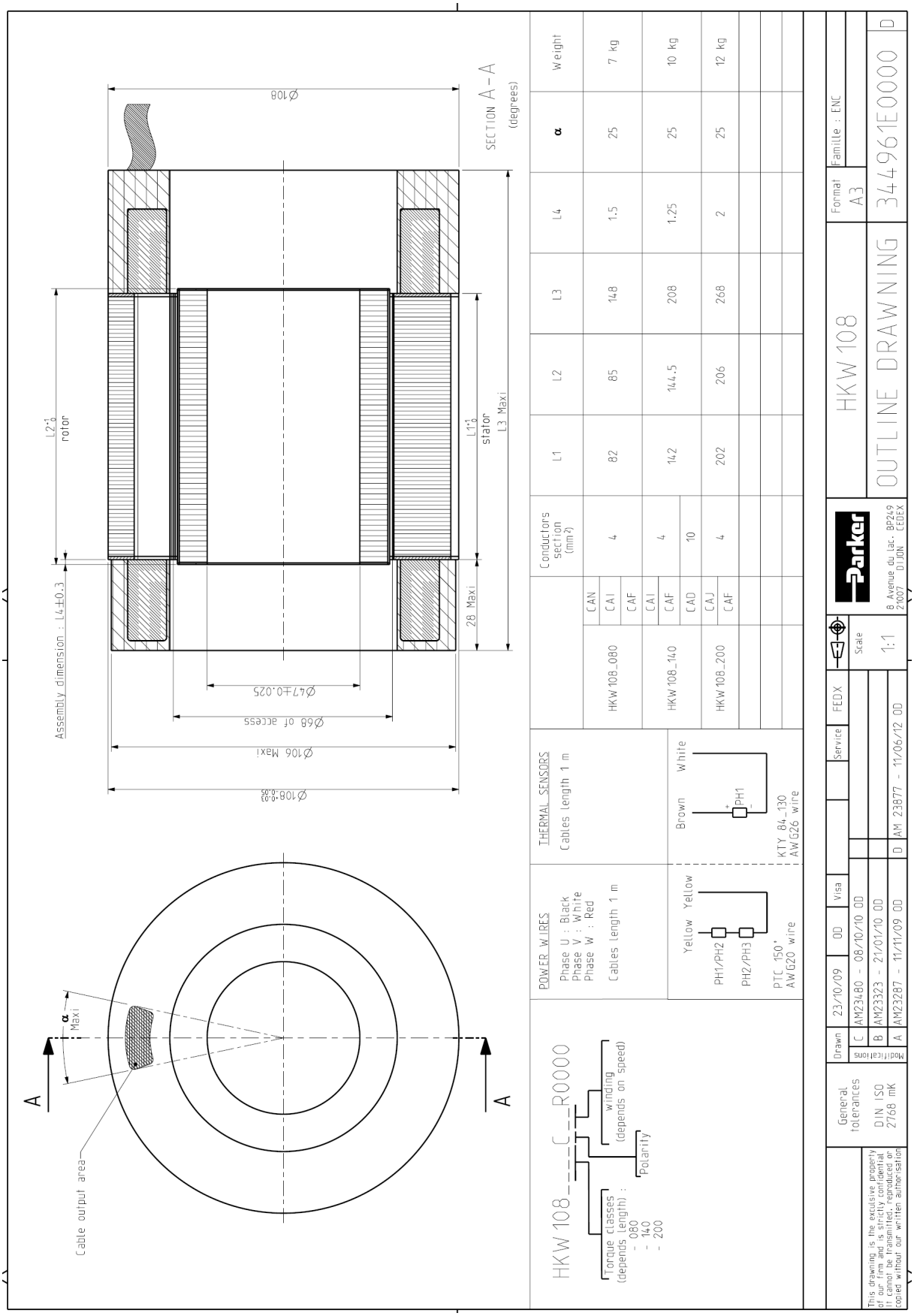


3.3.1.2. HKW085_***R3000 : with hub, with water jacket

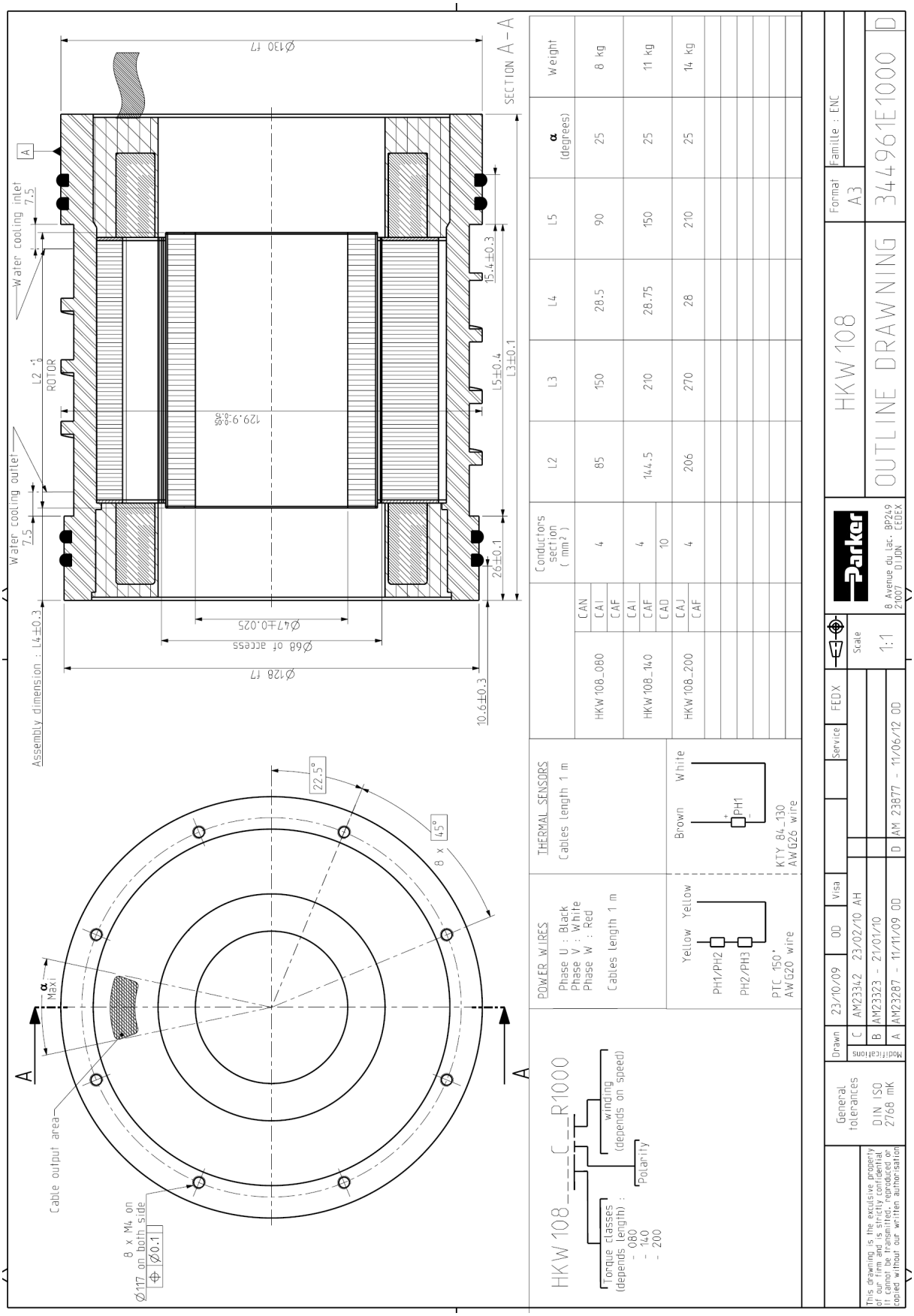


3.3.2. HKW108 standard configurations

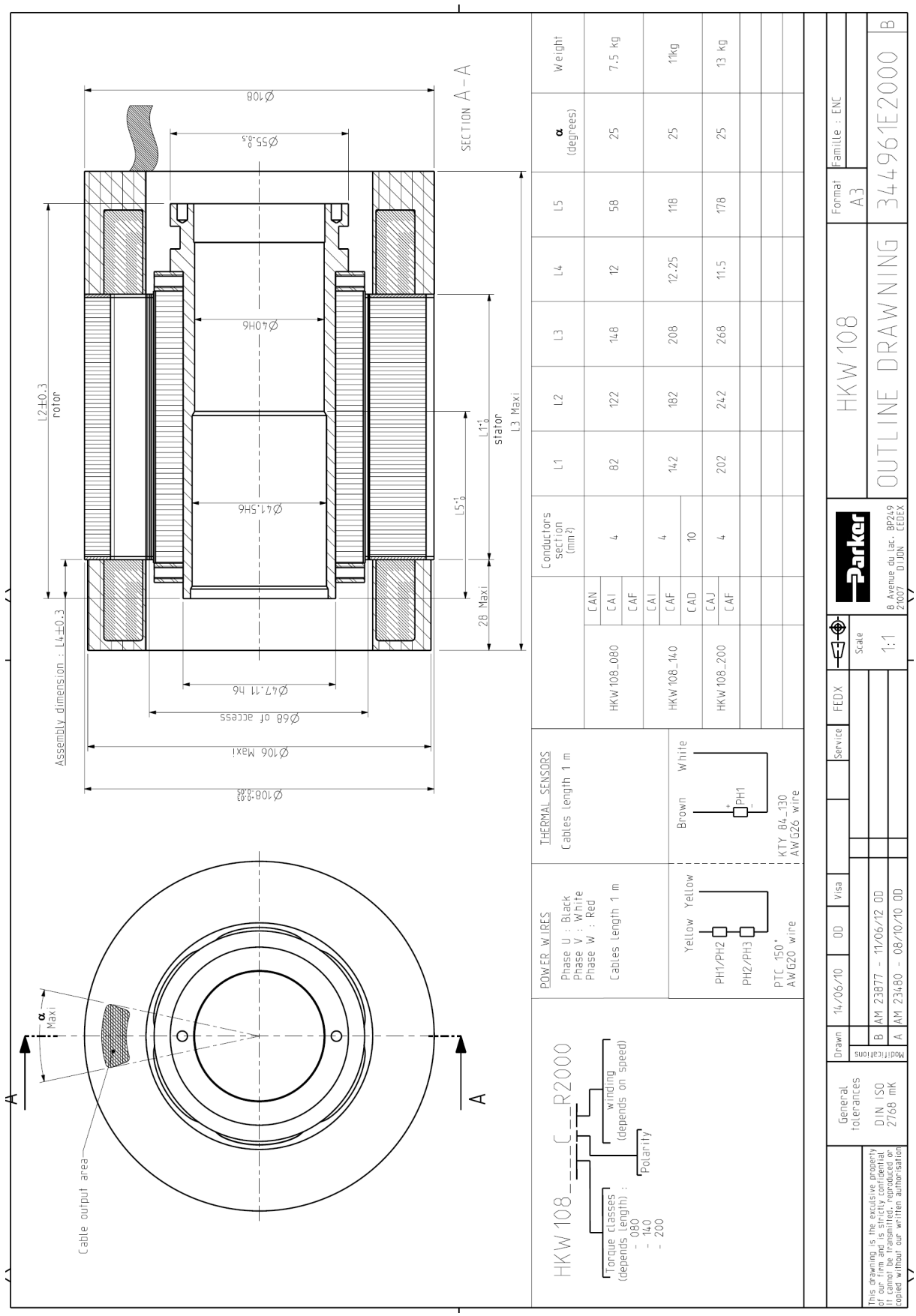
3.3.2.1. HKW108_***R0000 : without hub, without water jacket



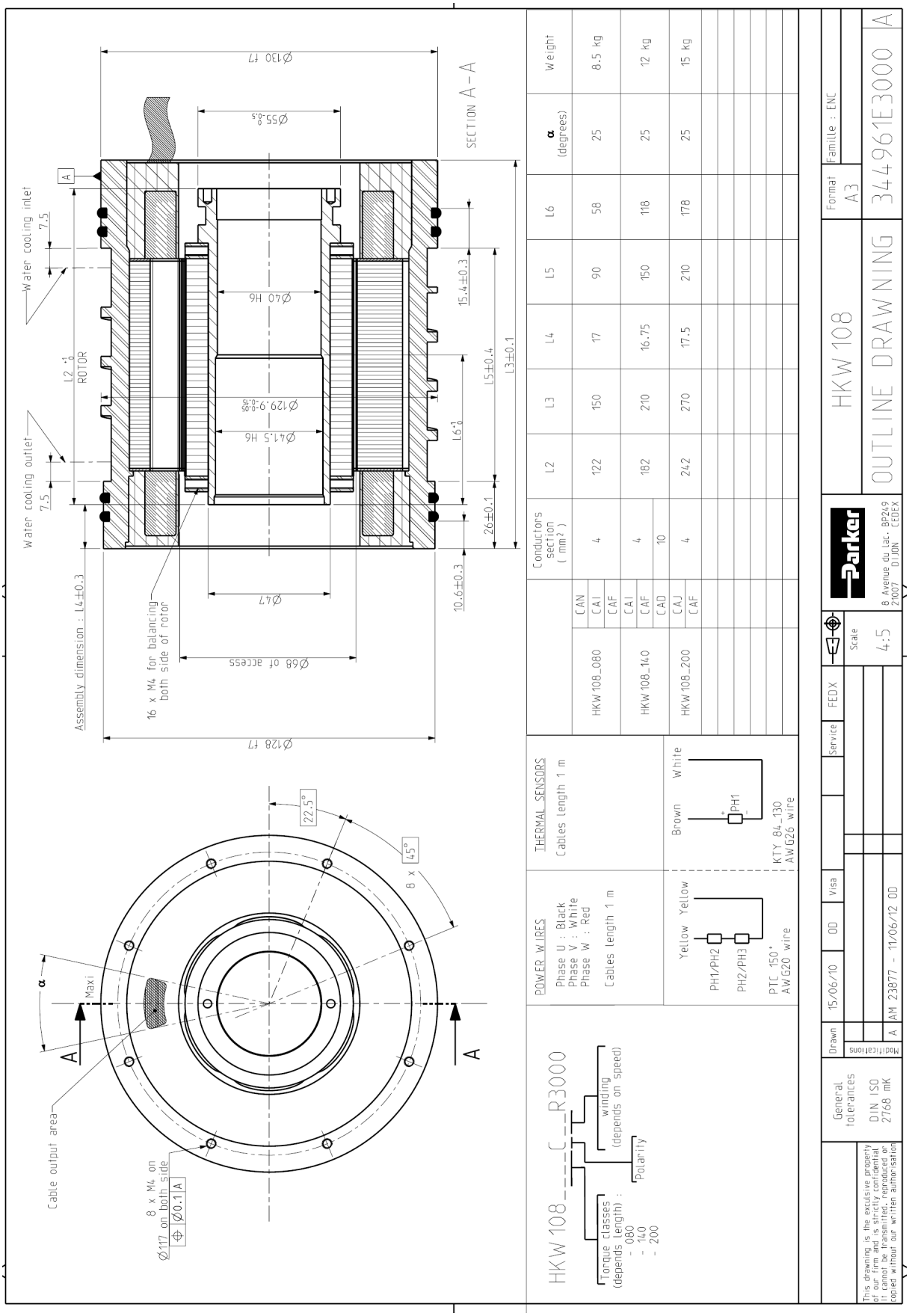
3.3.2.2. HKW108_***R1000 : without hub, with water jacket



3.3.2.3. HKW108_***R2000 : with hub, without water jacket

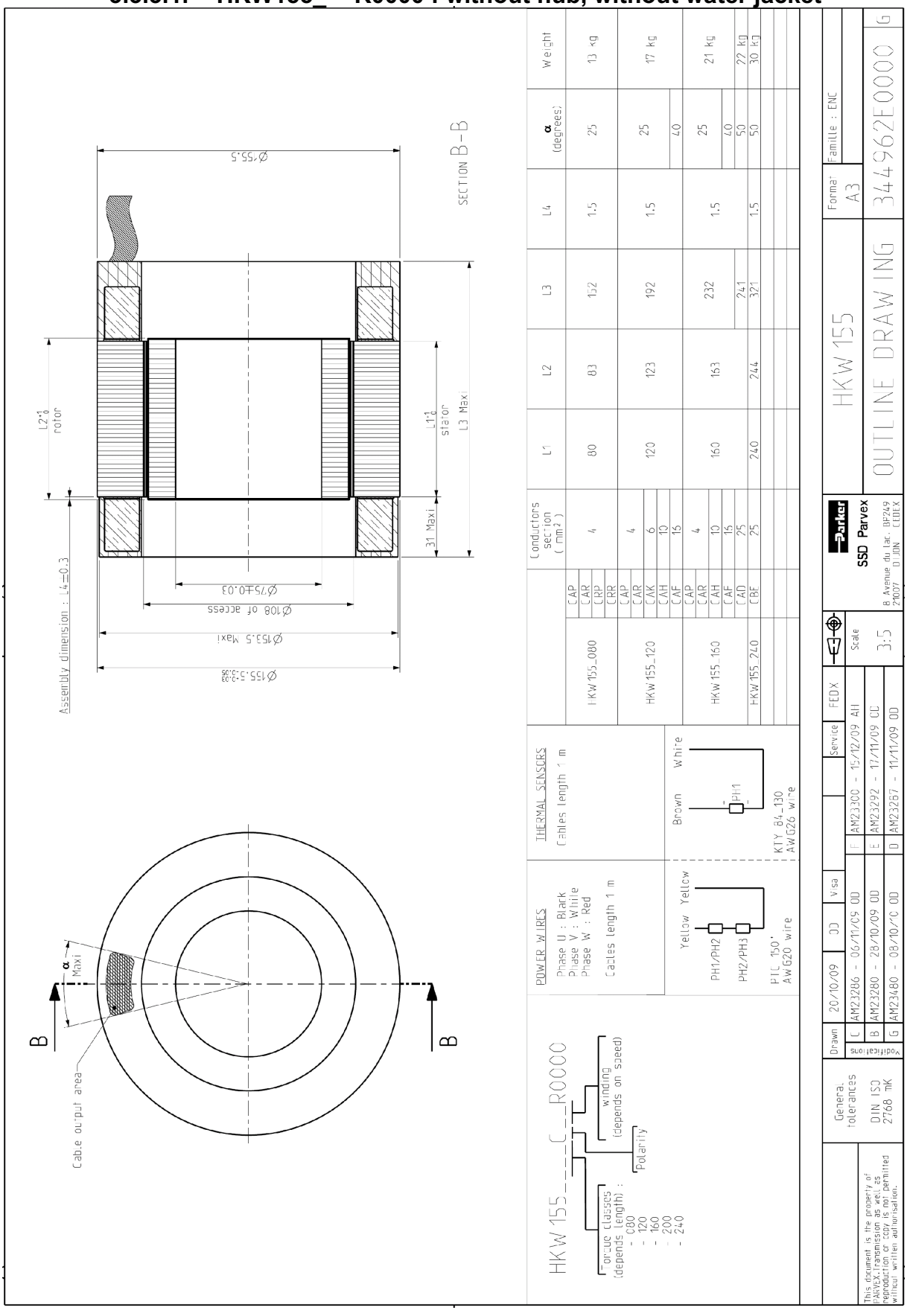


3.3.2.4. HKW108_***R3000 : with hub, with water jacket

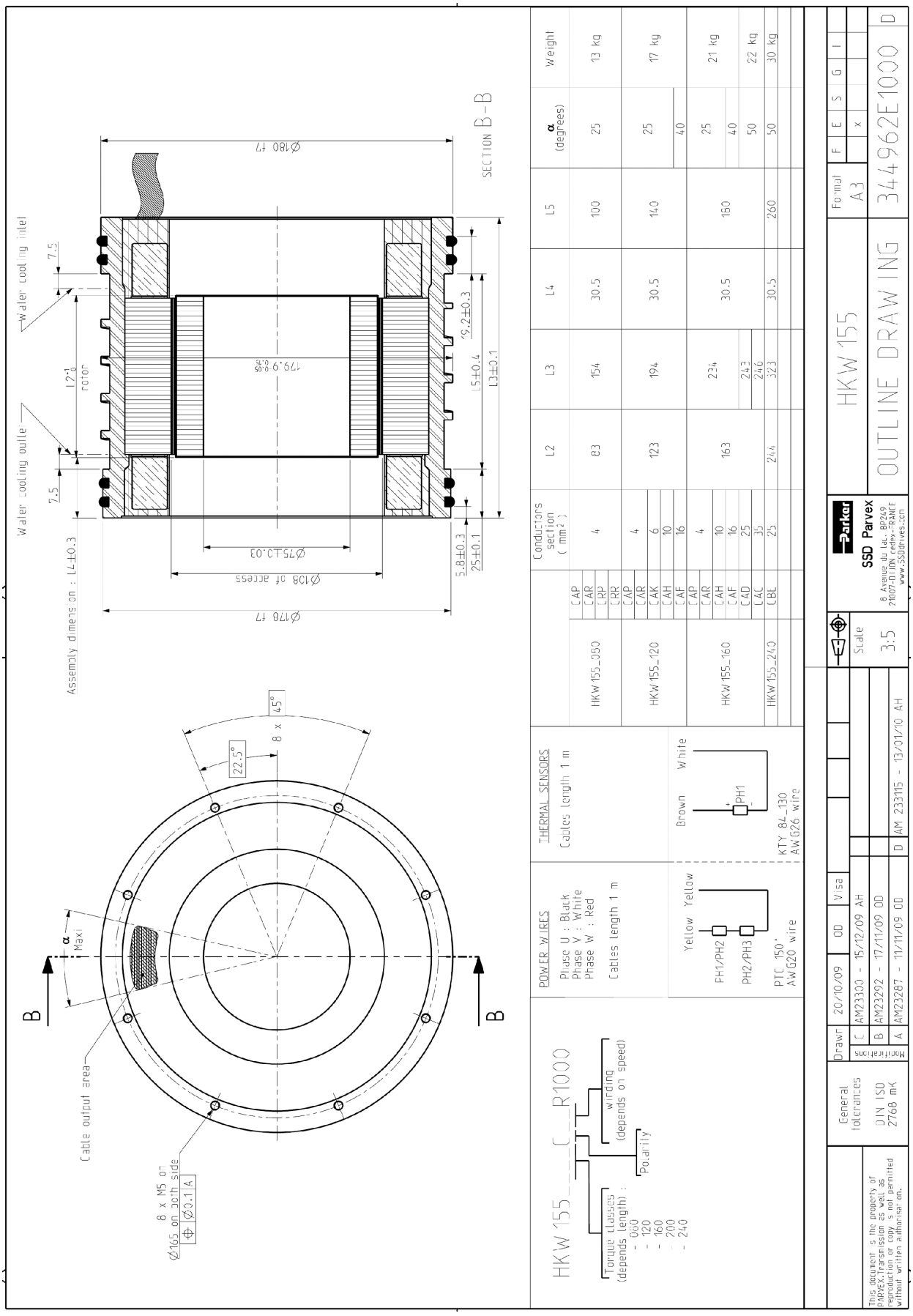


3.3.3. HKW155 standard configurations

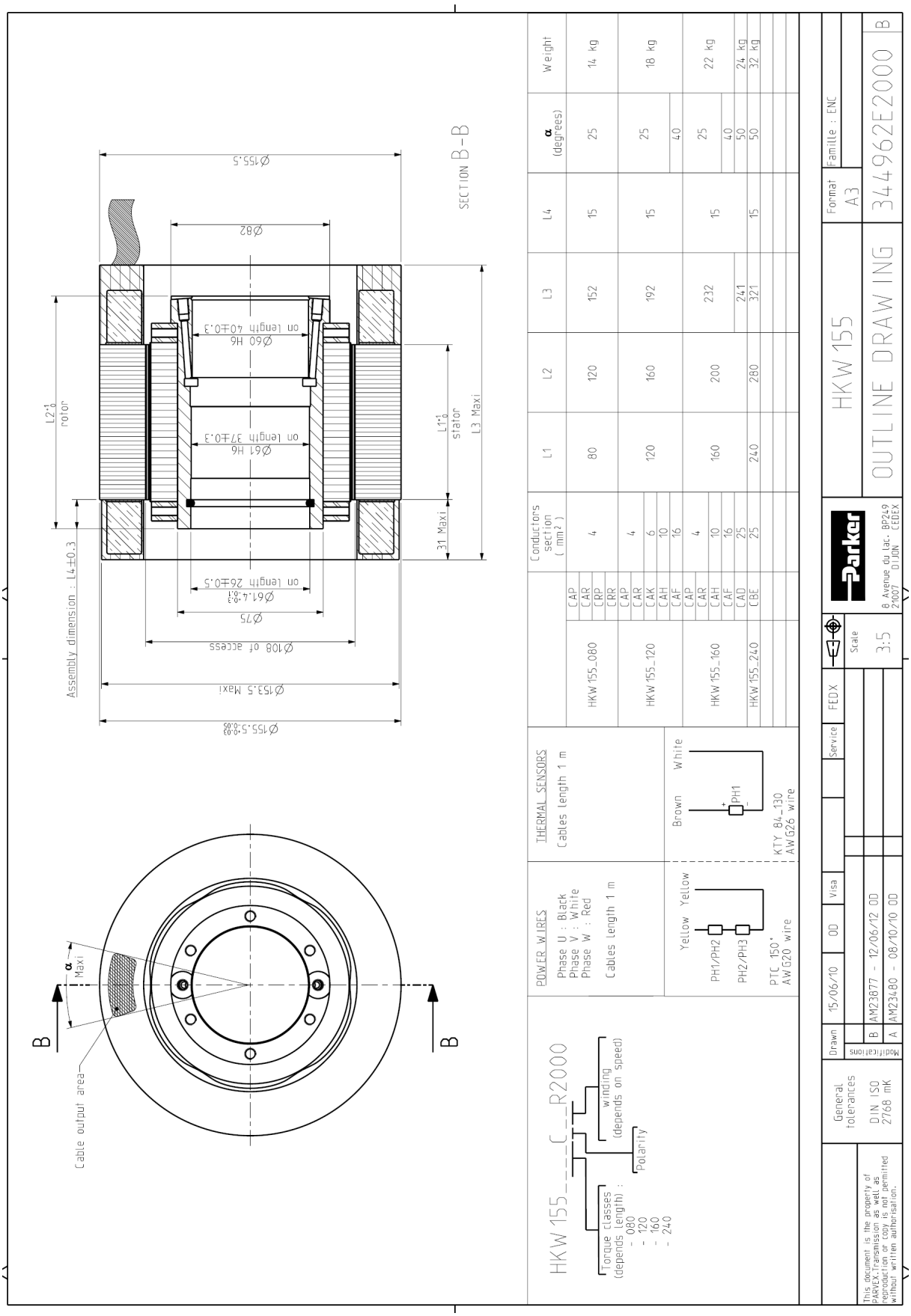
3.3.3.1. HKW155_***R0000 : without hub, without water jacket



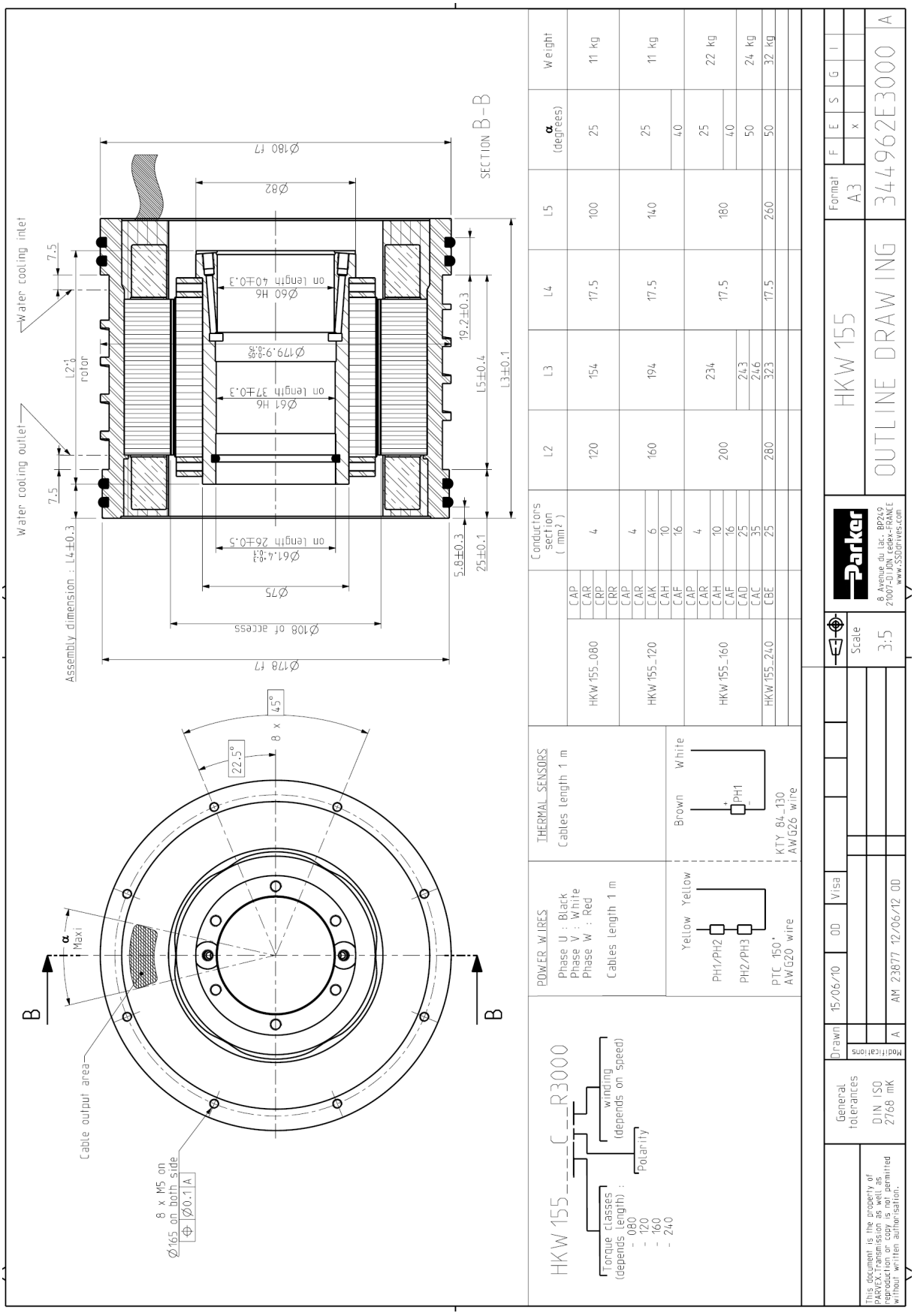
3.3.3.2. HKW155_***R1000 : without hub, with water jacket



3.3.3.3. HKW155_***R2000 : with hub, without water jacket

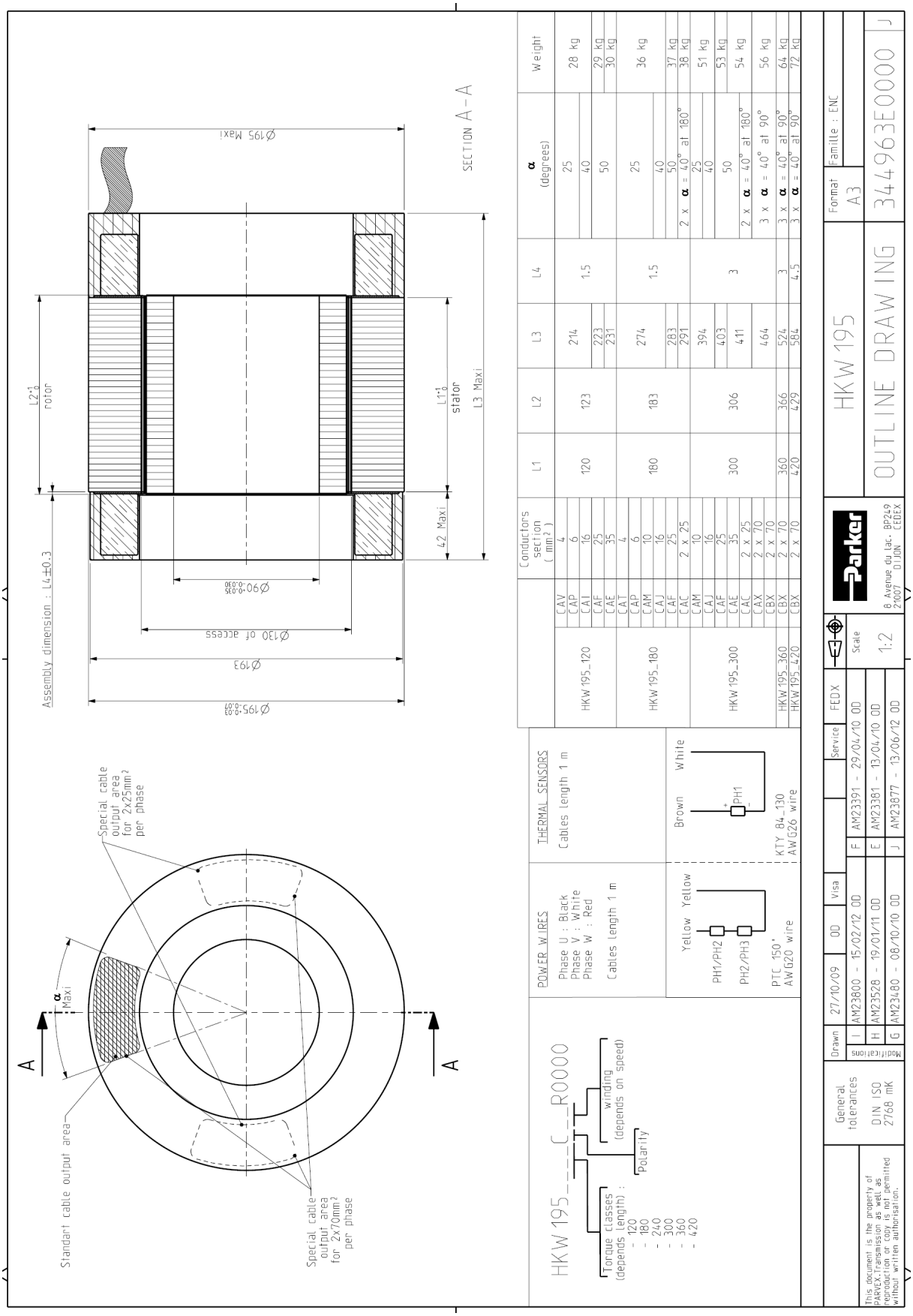


3.3.3.4. HKW155_***R3000 : with hub, with water jacket

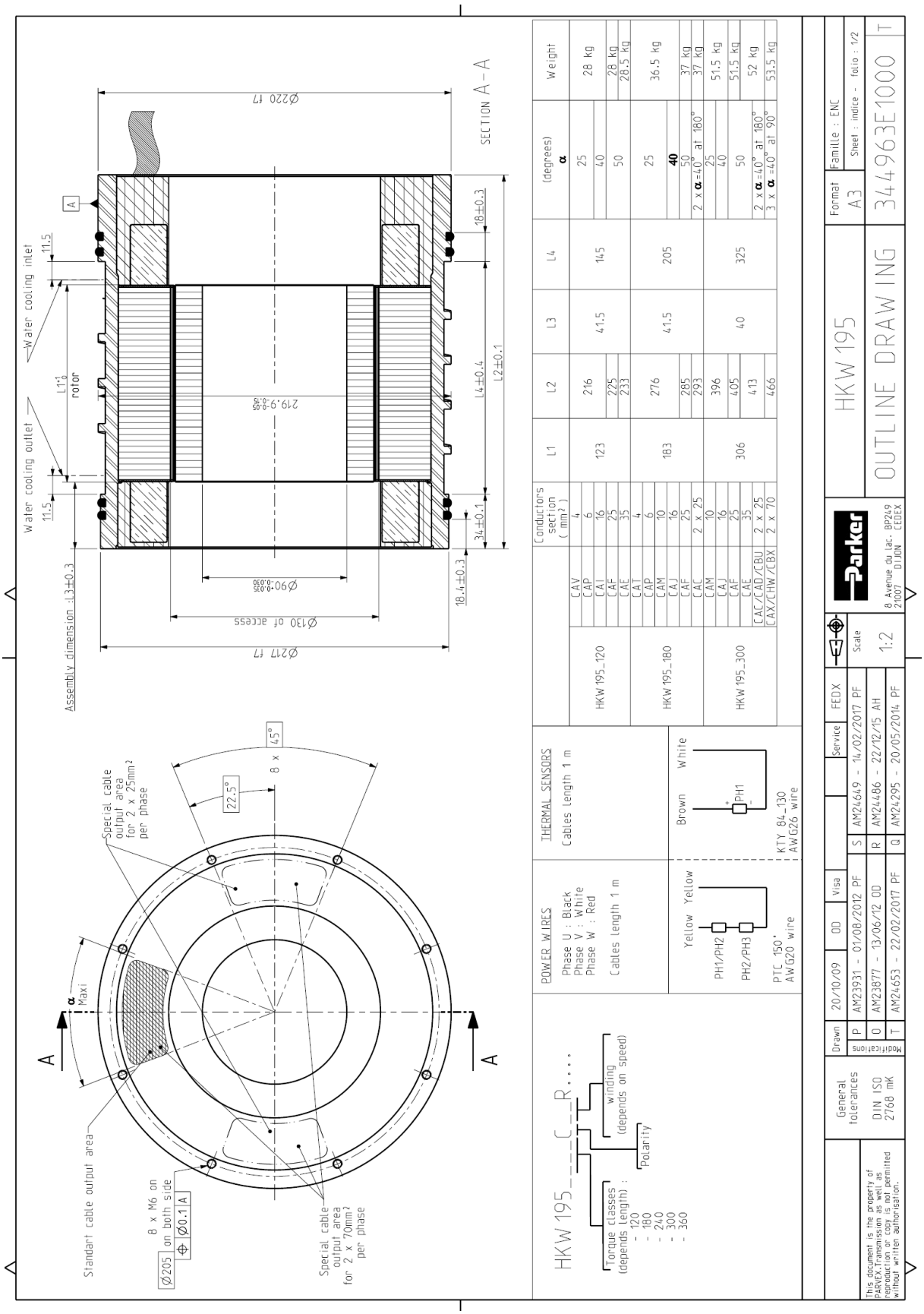


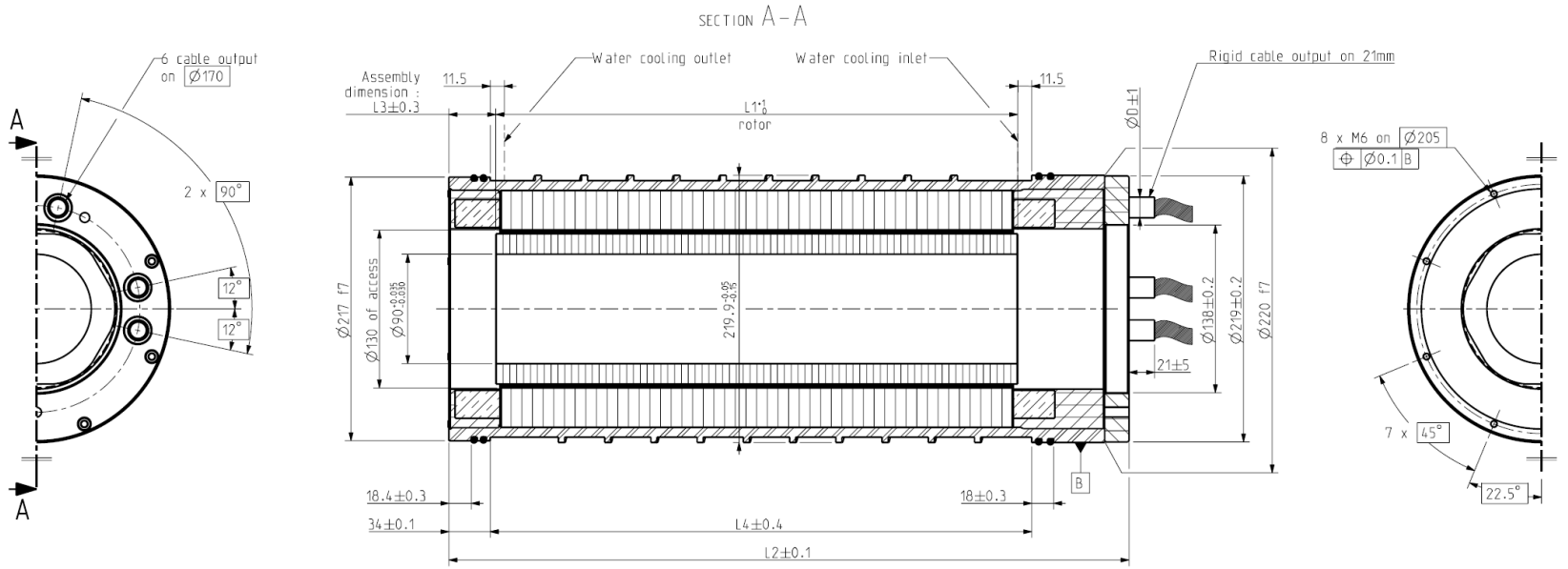
3.3.4. HKW195 standard configurations

3.3.4.1. HKW195_***R0000 : without hub, without water jacket



3.3.4.2. HKW195_***R1000 : without hub, with water jacket





HKW 195_____R....

Torque classes (depends length)

winding (depends on speed)

Polarity

POWER WIRES

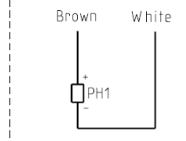
Phase U : Black
Phase V : White
Phase W : Red

Cables length 1 m
Static bending radius >=60 mm

THERMAL SENSORS

Cables length 1 m





		Conductors section (mm²)	L1	L2	L3	L4	ØD	Weight
HKW 195_360	CBD	2 x 25	366	499	40	385	15	70 kg
	CBU / CBW	2 x 35					17	
	CBX	2 x 70					21	
HKW 195_400D	DAR	2 x 35	403	559	41.5	445	17	85 kg
	DHR							
	DAX							
HKW 195_420	CBU	2 x 35	429	559	38.5	445	17	87 kg
	CBX	2 x 70					21	

Drawing valid for:

Weight:

General tolerances DIN ISO 2768 mk

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Drawn	25/03/10	OD	Visa		Service	FEDX
Modifications P	AM23931 - 01/08/2012 PF		S	AM24649 - 14/02/2017 PF		
Modifications O	AM23877 - 13/06/12 OD		R	AM24486 - 22/12/15 AH		
Modifications T	AM24653 - 22/02/2017 PF		Q	AM24295 - 20/05/2014 PF		

Scale 1:1

Parker
8 Avenue du lac. BP 249
21007-DIJON cedex-FRANCE
www.parker.com

HKW 195

OUTLINE DRAWING

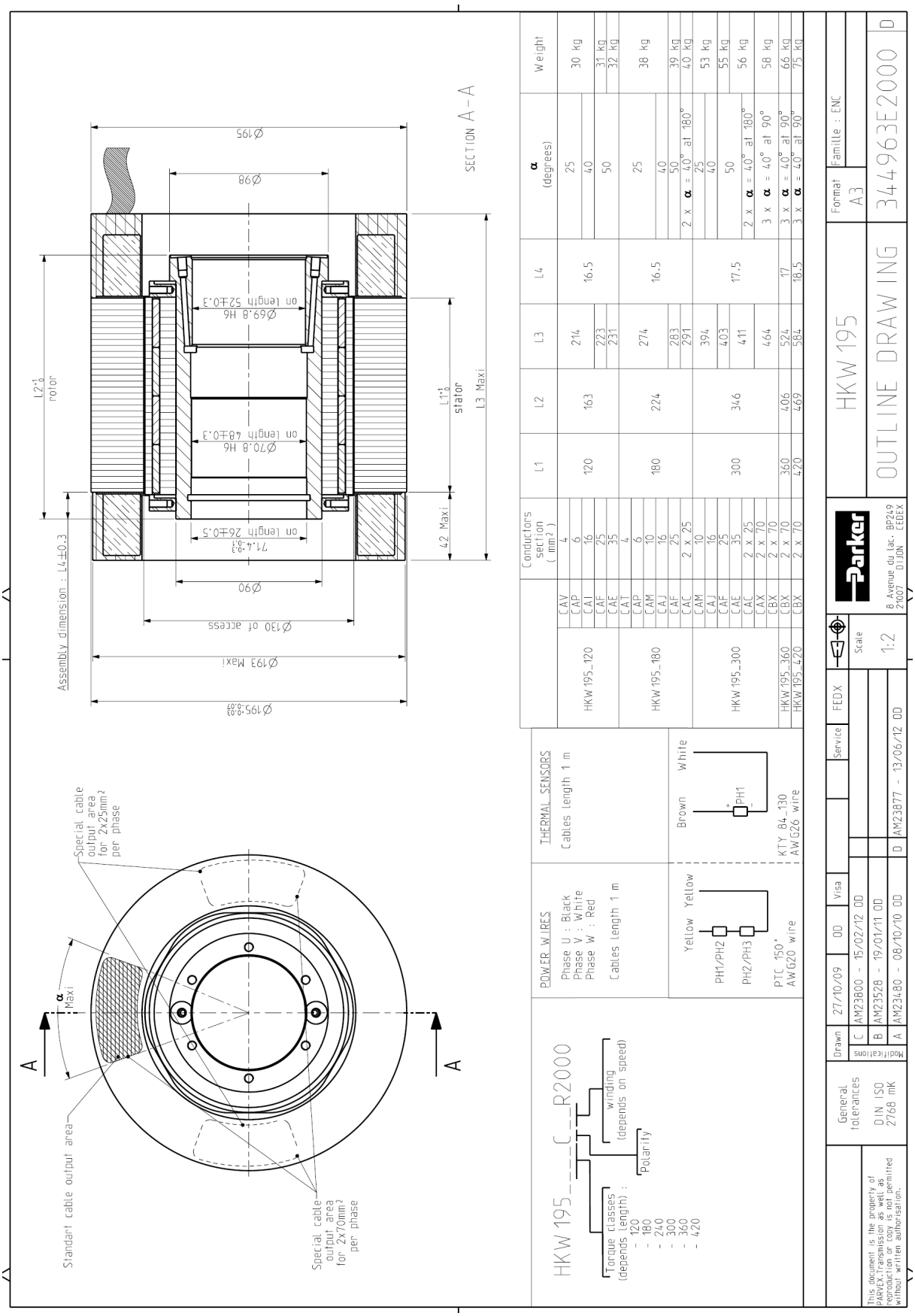
Format A3

Famille : ENC

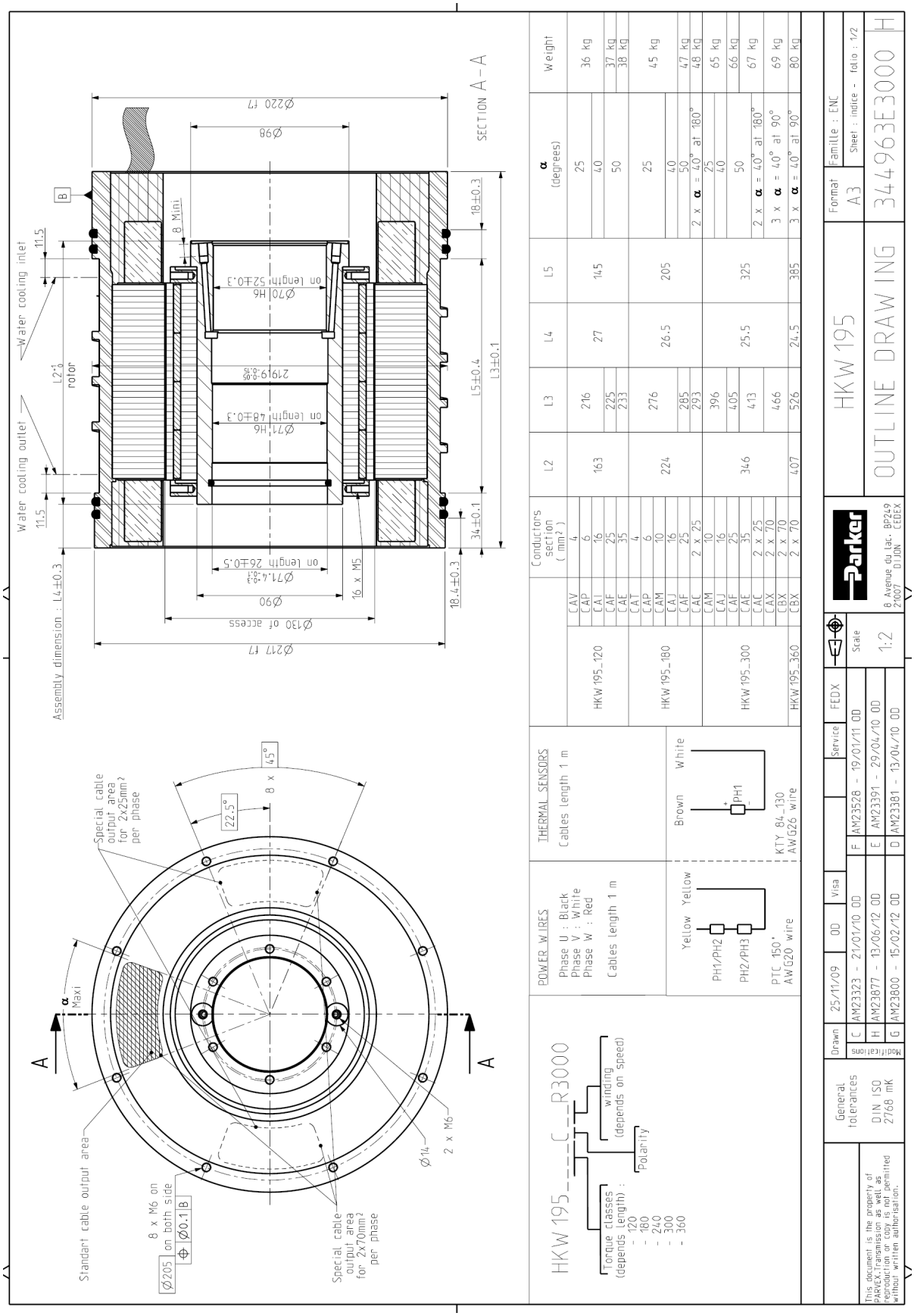
Sheet : indice - folio : 2/2

34496 3E1000 T

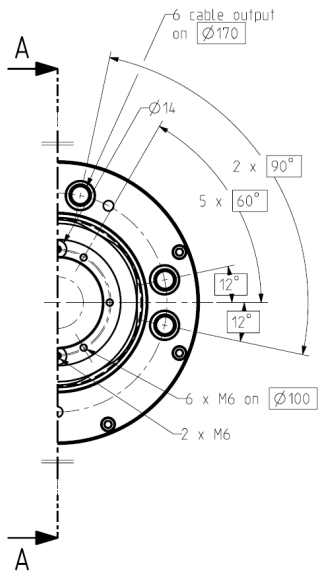
3.3.4.3. HKW195_***R2000 : with hub, without water jacket



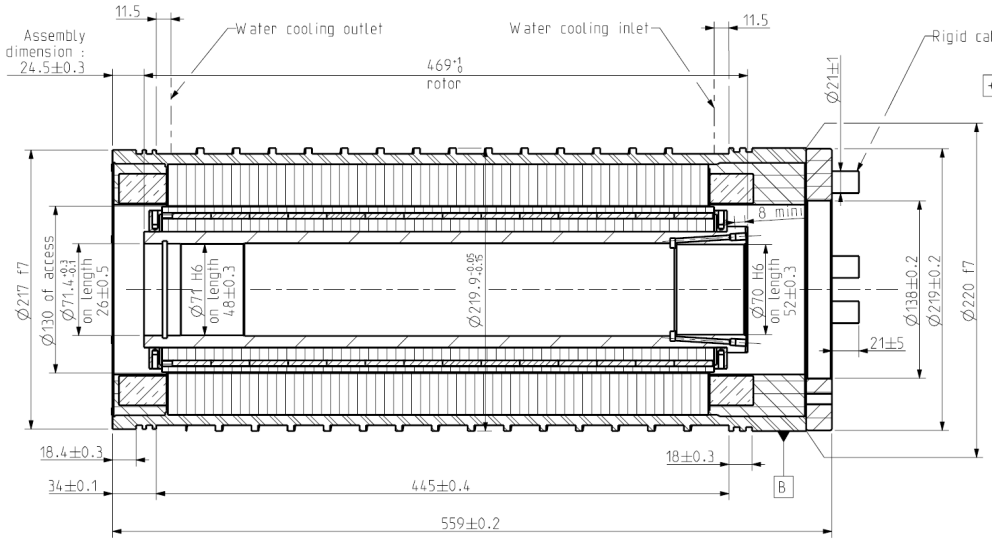
3.3.4.4. HKW195_***R3000 : with hub, with water jacket

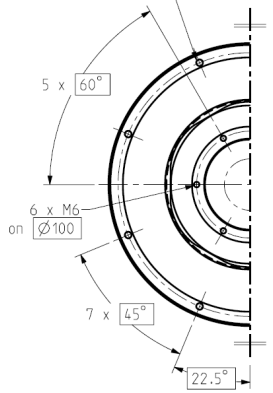


+	Weight : 90kg



SECTION A-A





HKW 195_420CBXR3000

Torque classes (depends length)
winding (depends on speed)
Polarity

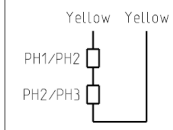
POWER WIRES

Phase U : Black
Phase V : White
Phase W : Red

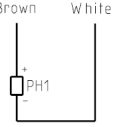
Cables length 1 m
Cross section : 70 mm²
Static bending radius >=60 mm
Ø of cable : 14.6±0.25 mm

THERMAL SENSORS

Cables length 1 m



PTC 150°
AWG20 wire



KTY 84_130
AWG26 wire

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Modifications					
Drawn	16/04/10	OD	Vise		
G	AM23800 - 15/02/12 OD				
F	AM23528 - 19/01/11 OD				
E	AM23391 - 29/04/10 OD	H	AM23877 - 13/06/12 OD		

Parker
8 Avenue du Lac. BP249
21007 DIJON CEDEX

General Tolerances
DIN ISO 2768 mK

Scale 3:10

Format A3

Version : 0+

Sheet : indice - folio : 2/2

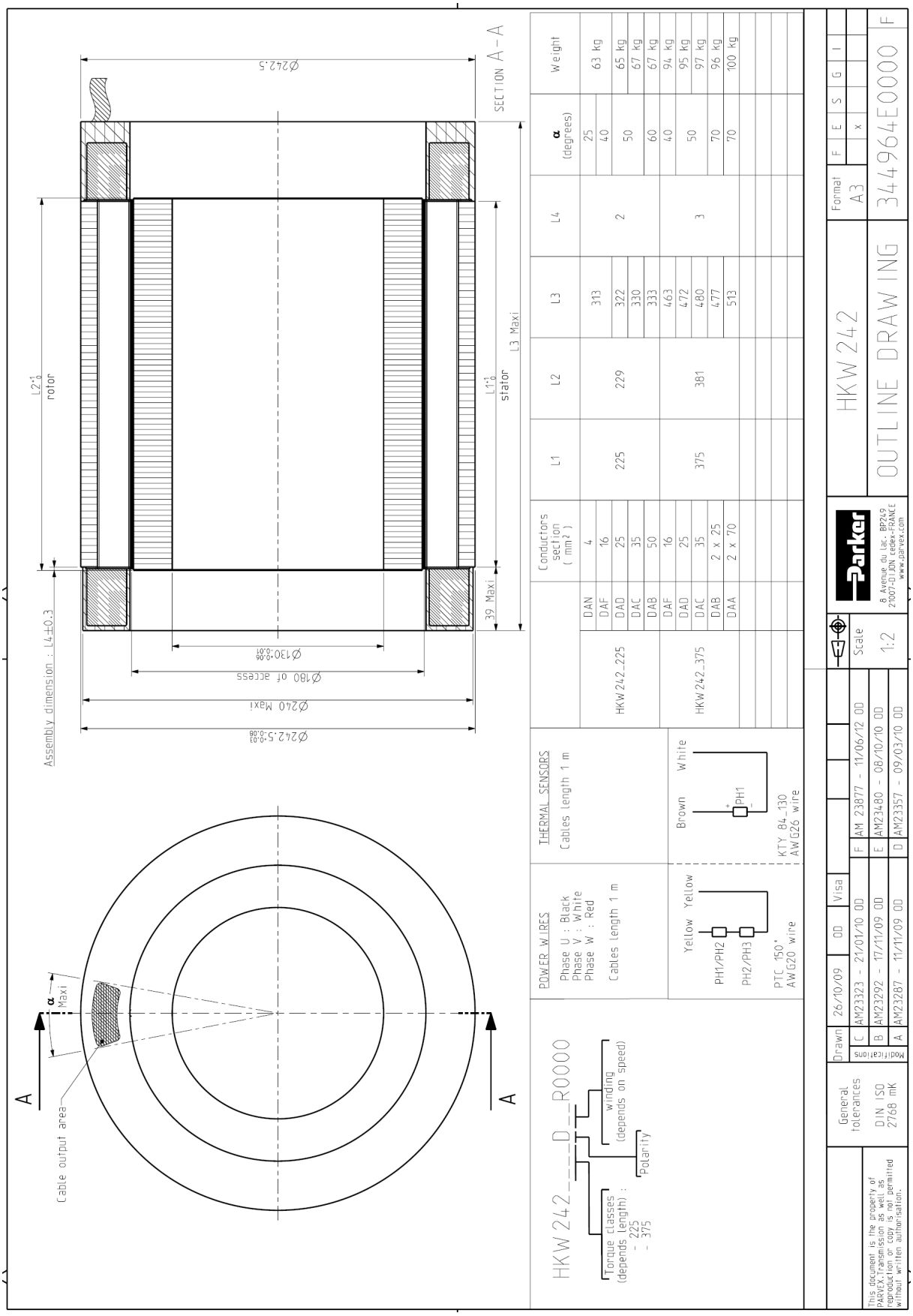
HKW 195

OUTLINE DRAWING

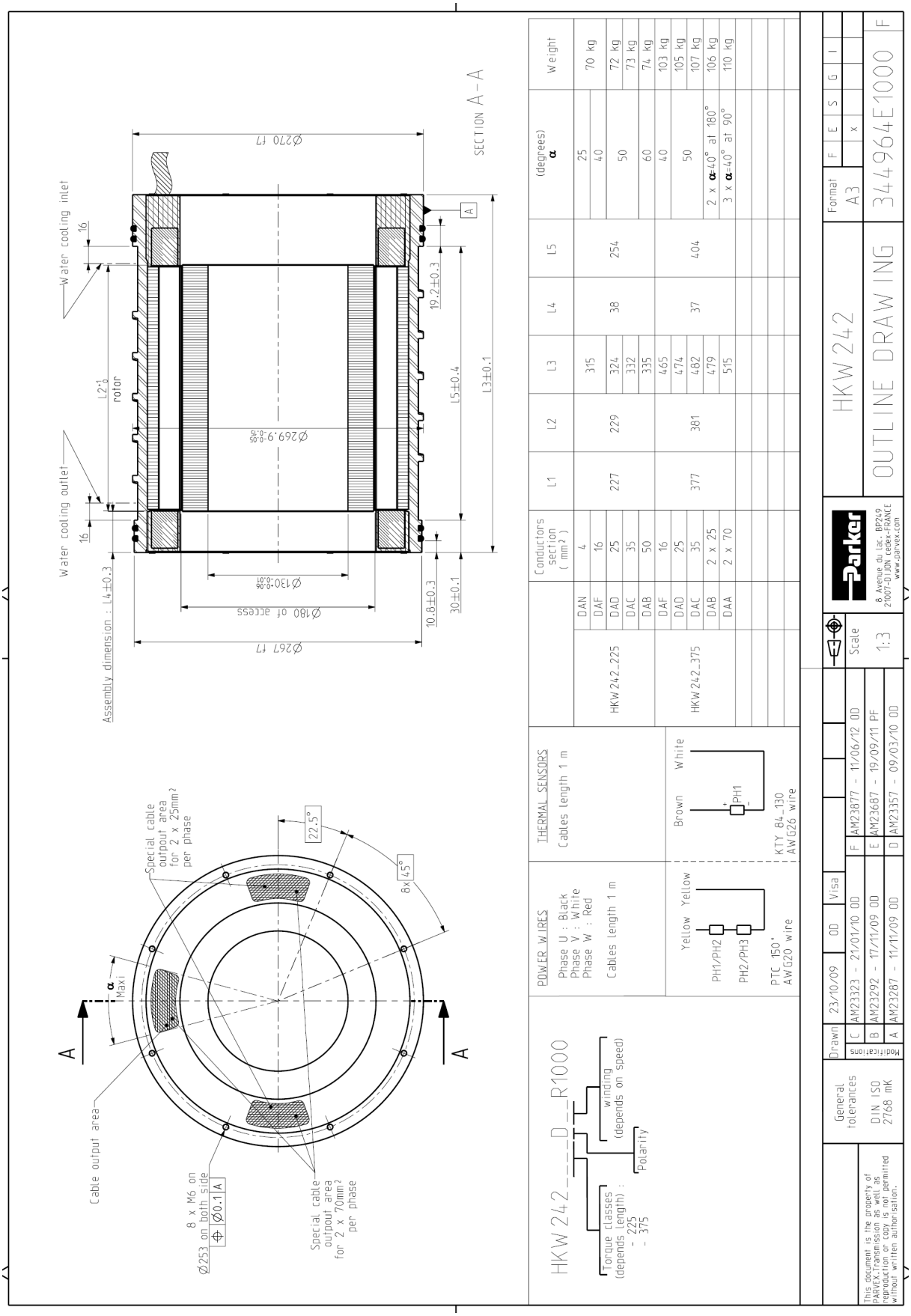
344963E3000 H

3.3.5. HKW242 standard configurations

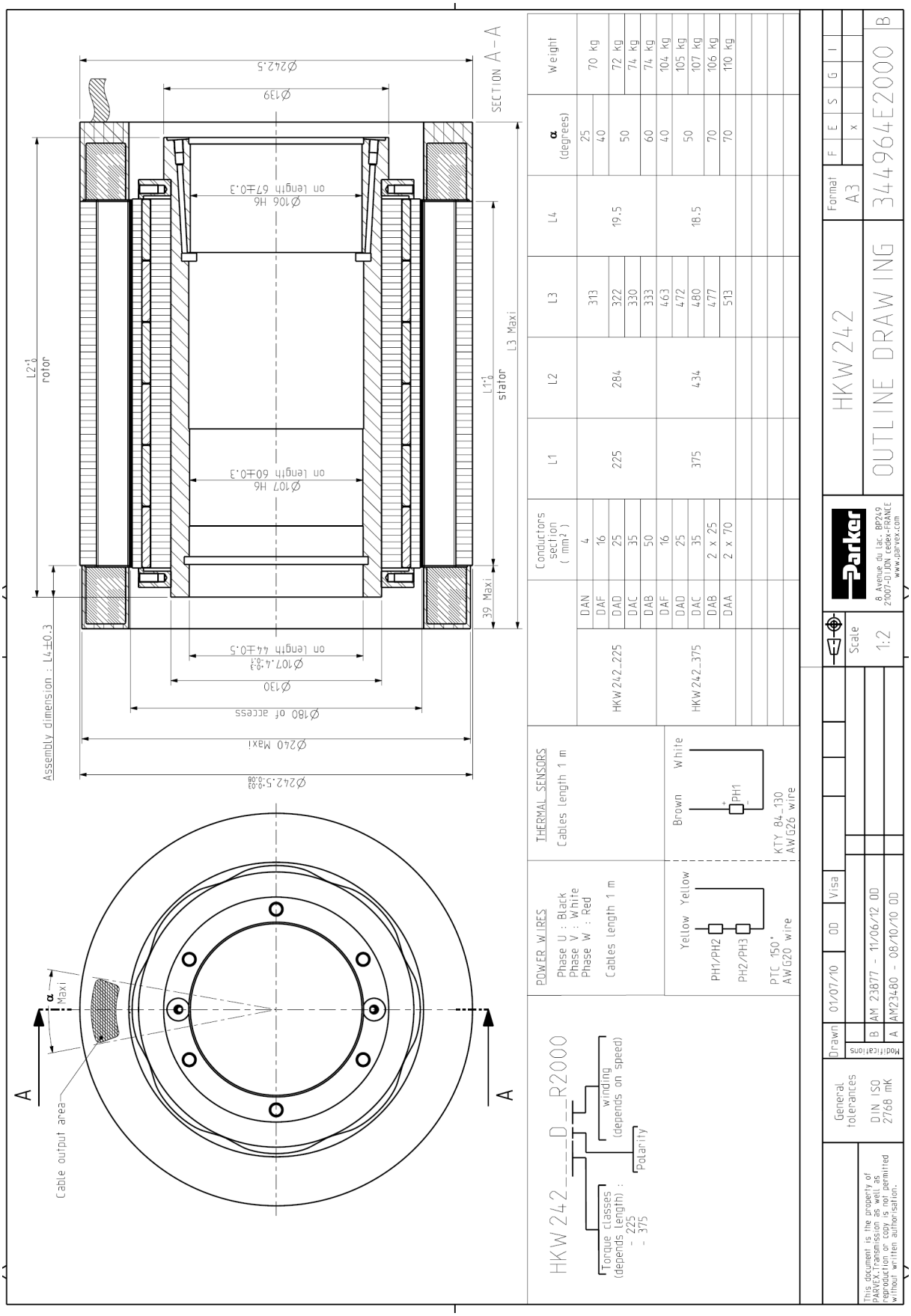
3.3.5.1. HKW242_***R0000 : without hub, without water jacket



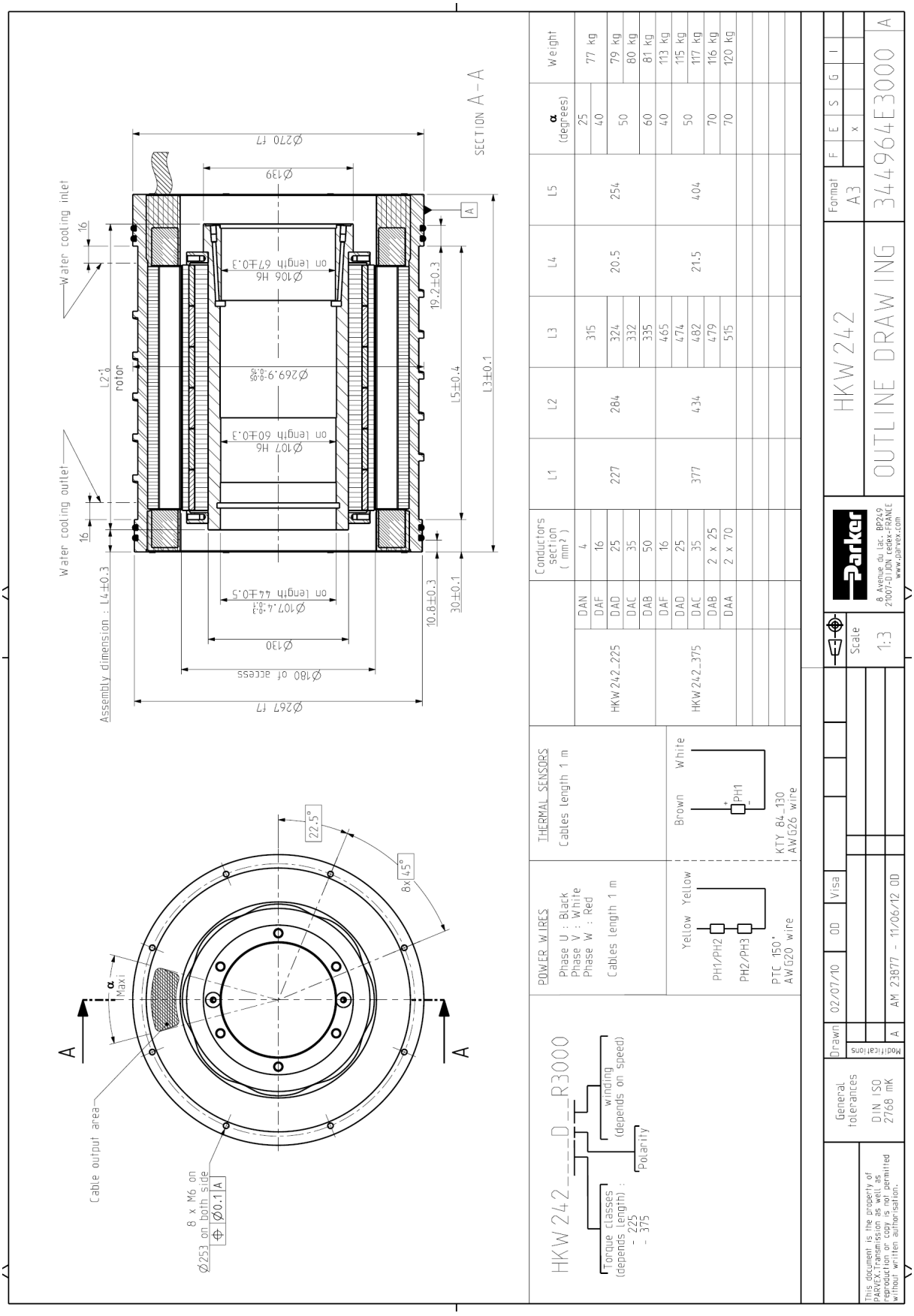
3.3.5.2. HKW242_***R1000 : without hub, with water jacket



3.3.5.3. HKW242_***R2000 : with hub, without water jacket

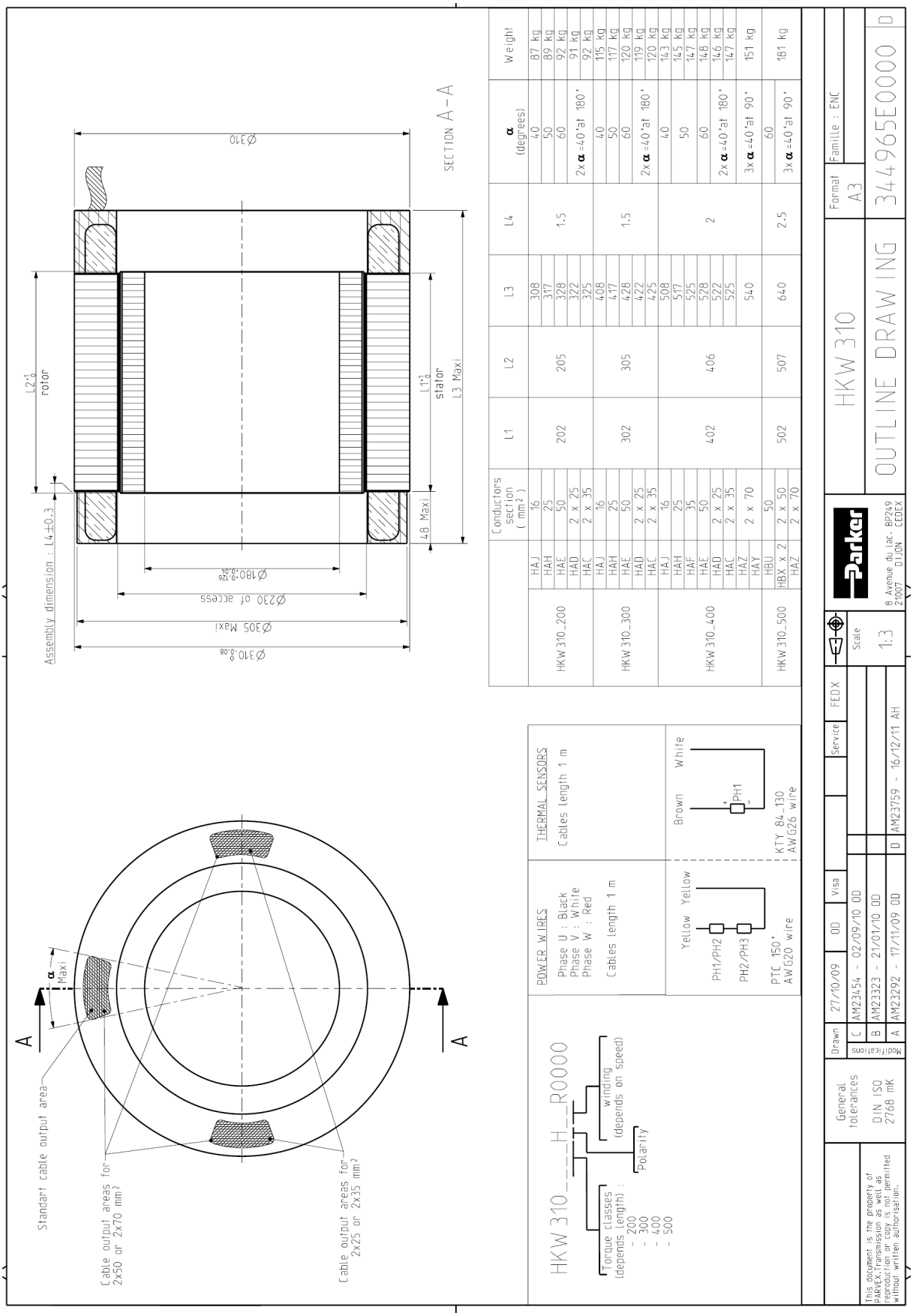


3.3.5.4. HKW242_***R3000 : with hub, with water jacket



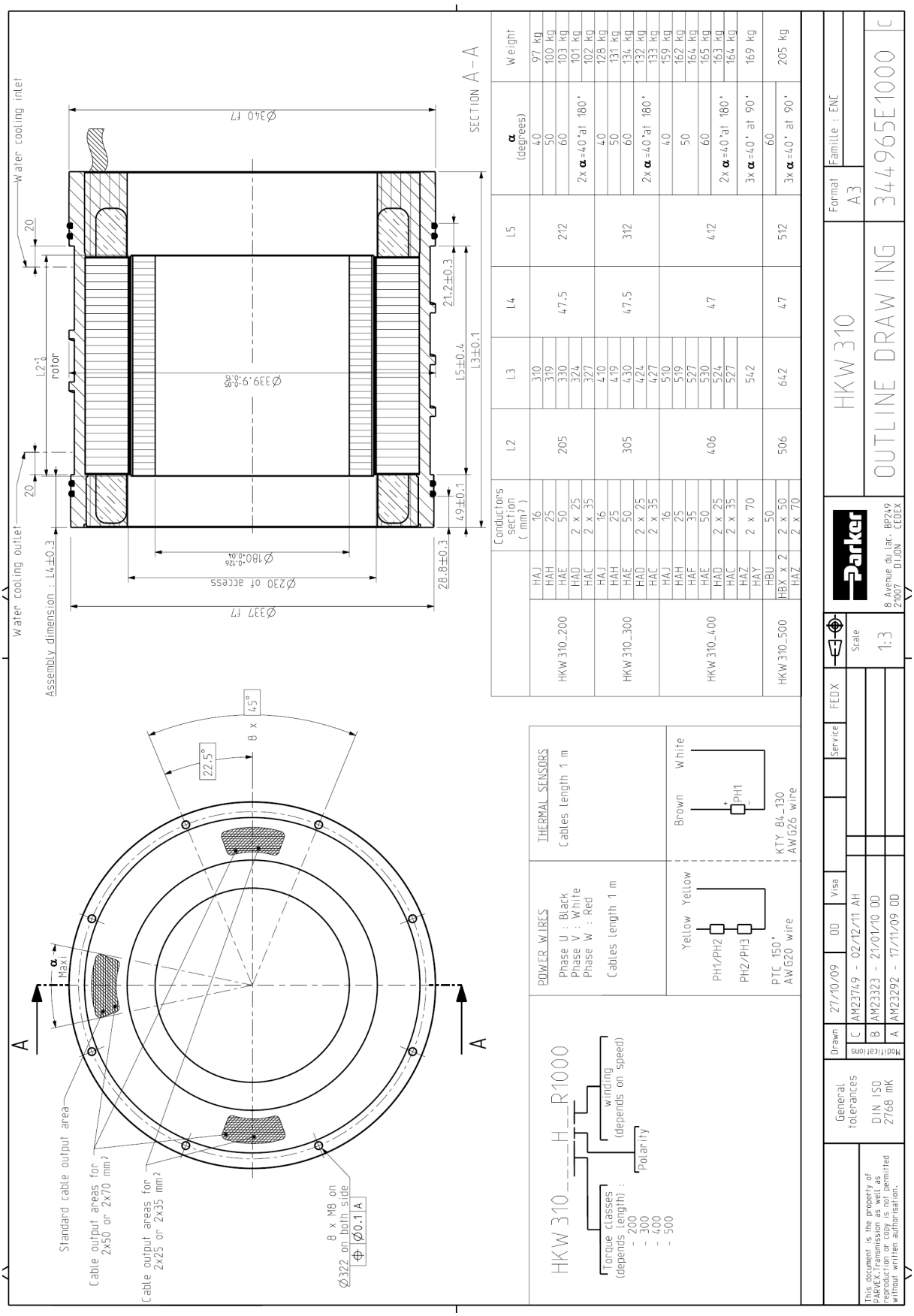
3.3.6. HKW310 standard configurations

3.3.6.1. HKW310_***R0000 : without hub, without water jacket



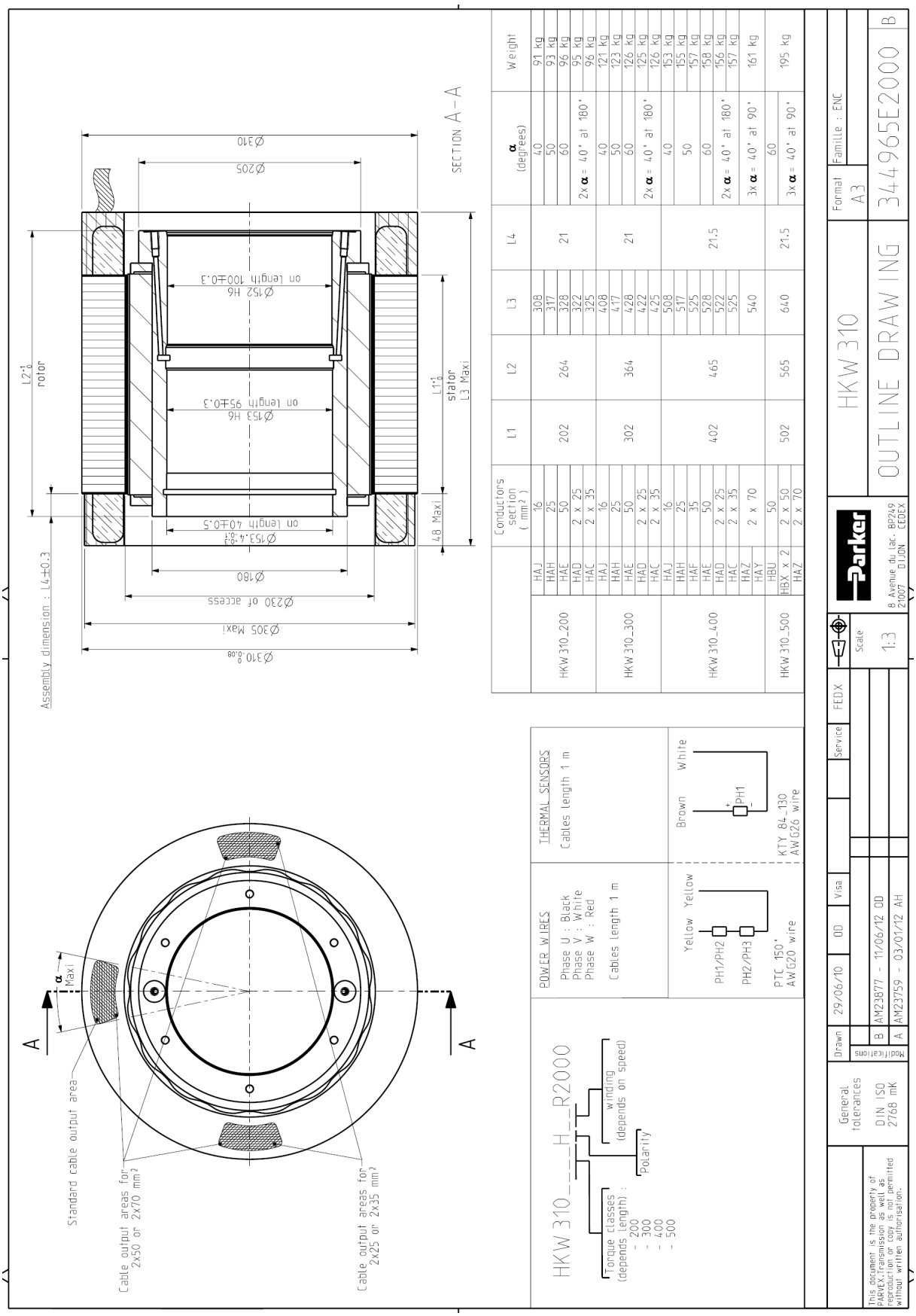
	Conductors section (mm²)	L1	L2	L3	L4	α (degrees)	Weight
HKW 310_200	HAJ 16	202	205	308	1.5	40	87 kg
	HAH 25			317		50	89 kg
	HAE 50			328		60	92 kg
	HAD 2 x 25			322		2x α =40°at 180°	91 kg
	HAC 2 x 35			325			92 kg
HKW 310_300	HAJ 16	302	305	408	1.5	40	115 kg
	HAH 25			417		50	117 kg
	HAE 50			428		60	120 kg
	HAD 2 x 25			422		2x α =40°at 180°	119 kg
	HAC 2 x 35			425			120 kg
HKW 310_400	HAJ 16	402	406	508	2	40	143 kg
	HAH 25			517		50	145 kg
	HAF 35			525			147 kg
	HAE 50			528		60	148 kg
	HAD 2 x 25			522		2x α =40°at 180°	146 kg
	HAC 2 x 35			525			147 kg
	HAZ 2 x 70			540		3x α =40°at 90°	151 kg
	HAY					60	
	HBU 50	502	507	640	2.5	3x α =40°at 90°	181 kg
HKW 310_500	HBX x 2 2 x 50						
	HAZ 2 x 70						

3.3.6.2. HKW310_***R1000 : without hub, with water jacket

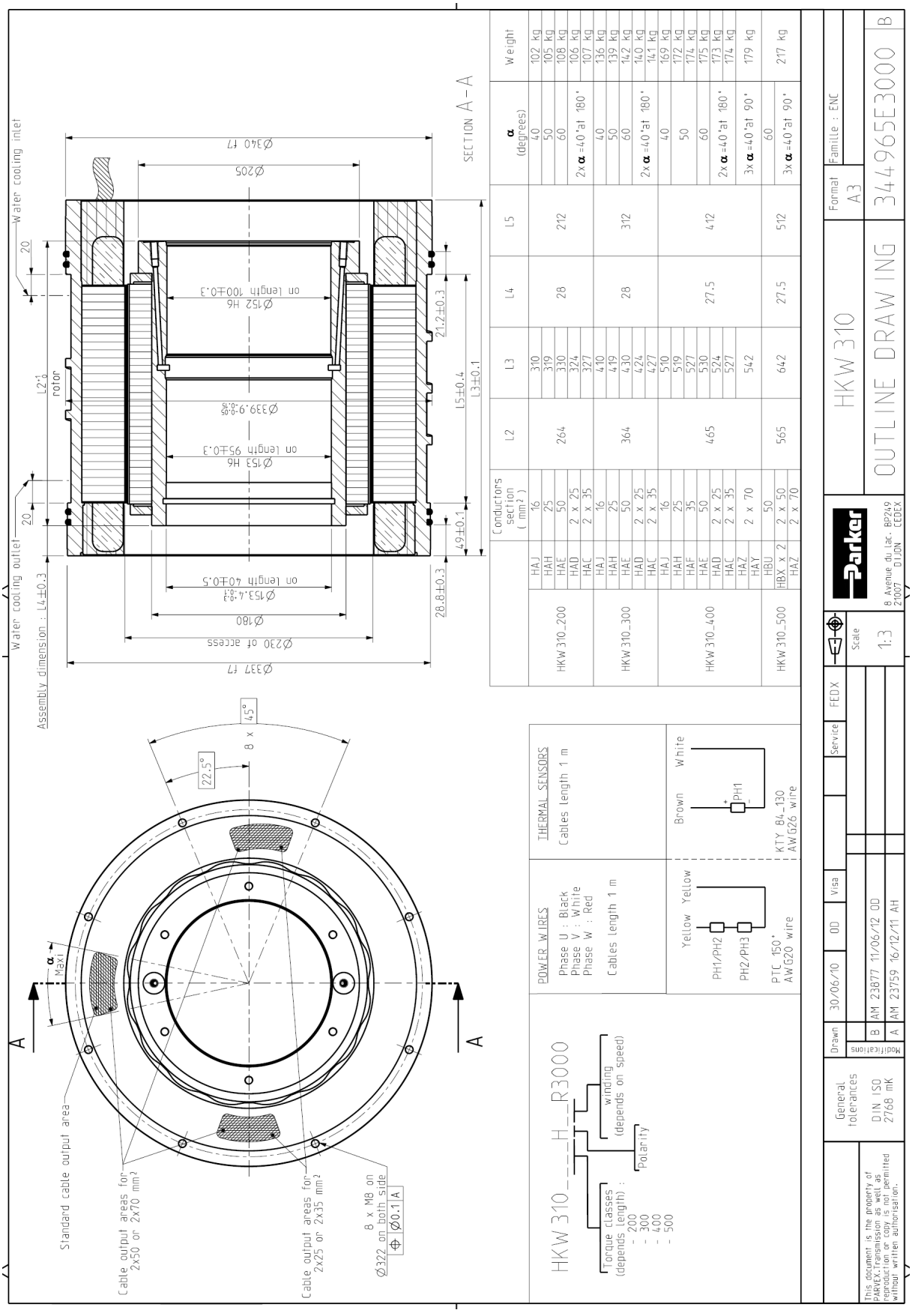


	Conductors section (mm²)	L2	L3	L4	L5	α (degrees)	Weight
HKW 310_200	HAJ 16	205	310	47.5	212	40	97 kg
	HAH 25		319			50	100 kg
	HAE 50		330			60	103 kg
	HAD 2 x 25		324			2x α=40°at 180°	101 kg
	HAC 2 x 35		327				102 kg
HKW 310_300	HAJ 16	305	410	47.5	312	40	128 kg
	HAH 25		419			50	131 kg
	HAE 50		430			60	134 kg
	HAD 2 x 25		424			2x α=40°at 180°	132 kg
	HAC 2 x 35		427				133 kg
HKW 310_400	HAJ 16	406	510	47	412	40	159 kg
	HAH 25		519			50	162 kg
	HAF 35		527				164 kg
	HAE 50		530			60	165 kg
	HAD 2 x 25		524			2x α=40°at 180°	163 kg
	HAC 2 x 35		527				164 kg
	HAZ 2 x 70		542			3x α=40° at 90°	169 kg
	HAY					60	
	HBU 50					3x α=40° at 90°	205 kg
HKW 310_500	HBX x 2 2 x 50	506	642	47	512		
	HAZ 2 x 70						

3.3.6.3. HKW310_***R2000 : with hub, without water jacket



3.3.6.4. HKW310_***R3000 : with hub, with water jacket



	Conductors section (mm²)	L2	L3	L4	L5	α (degrees)	Weight
HKW310_200	HAJ 16	264	310	28	212	40	102 kg
	HAH 25		319			50	105 kg
	HAE 50		330			60	108 kg
	HAD 2 x 25		324			2x α =40'at 180°	106 kg
	HAC 2 x 35		327				107 kg
HKW310_300	HAJ 16	364	410	28	312	40	136 kg
	HAH 25		419			50	139 kg
	HAE 50		430			60	142 kg
	HAD 2 x 25		424			2x α =40'at 180°	140 kg
	HAC 2 x 35		427				141 kg
HKW310_400	HAJ 16	465	510	27.5	412	40	169 kg
	HAH 25		519				172 kg
	HAF 35		527			50	174 kg
	HAE 50		530			60	175 kg
	HAD 2 x 25		524			2x α =40'at 180°	173 kg
	HAC 2 x 35		527				174 kg
	HAZ 2 x 70		542			3x α =40'at 90°	179 kg
	HAY						
HKW310_500	HBU 50	565	642	27.5	512	60	217 kg
	HBX x 2 2 x 50					3x α =40'at 90°	
	HAZ 2 x 70						

Modifications	Drawn	30/06/10	OD	Visa		Service	FEDX		Scale	Format A3	Famille : ENC
	B	AM 23877 11/06/12 OD							1:3		
	A	AM 23759 16/12/11 AH									

General tolerances
DIN ISO 2768 mK

HKW 310

OUTLINE DRAWING

3449653000 B

Parker

8 Avenue du lac. BP249 21007 DIJON CEDEX

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3.4. Motor mounting recommendations

	Warning : The recommendations in this chapter are general. It is the integrator responsibility to check if it complies with his application and to chose and define the correct way to integrate the kit according to his application, all the regulations and standards applicable.

3.4.1. Frame recommendation

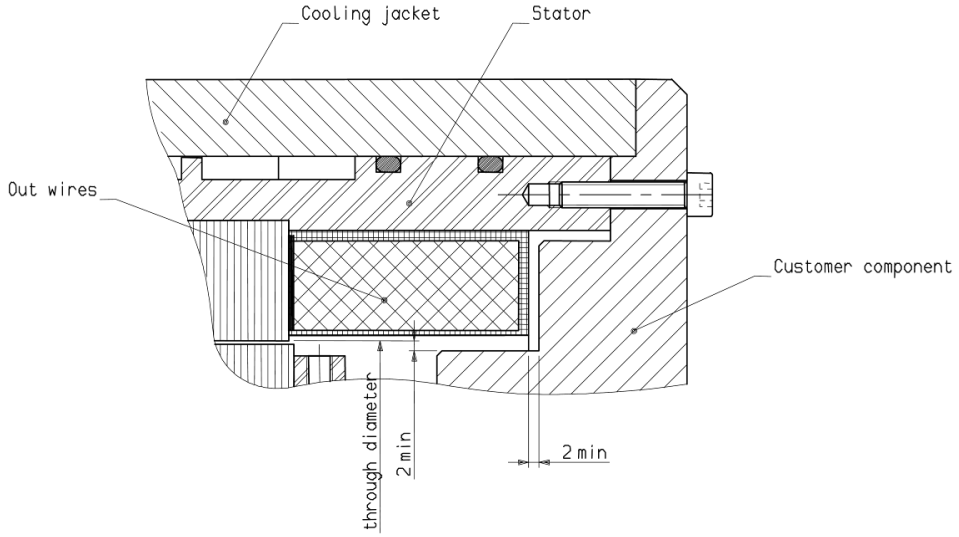
	Warning : The user has the entire responsibility to design and prepare the housing, the shaft, connection box, the support, the coupling device, shaft line alignment, and shaft line balancing.

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

	Warning : A motor well-balanced in itself and of a grade A conforming with IEC 60034-14, 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).
	Warning : A bad setting of the electronic control of the close loop (gain too high, incorrect filtring …) can occur an instability of the shaft line, vibration or/and breakdown - . Please consult us

3.4.2. Motor flanges

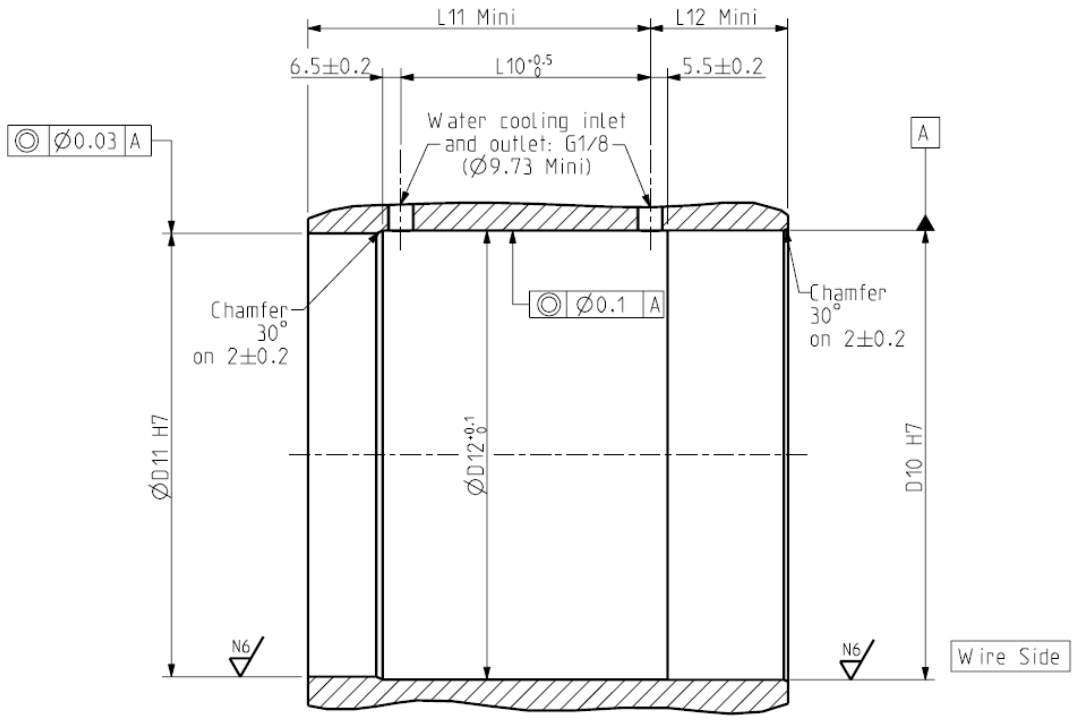
Let 2mm mini between windings and metallic part like flanges.



3.4.3. Cooling jacket interface HKW****R1000 & R3000

3.4.3.1. HKW085****R1000 & R3000

COOLING JACKET REQUIRED INTERFACE FOR STANDARD STATOR HKW085

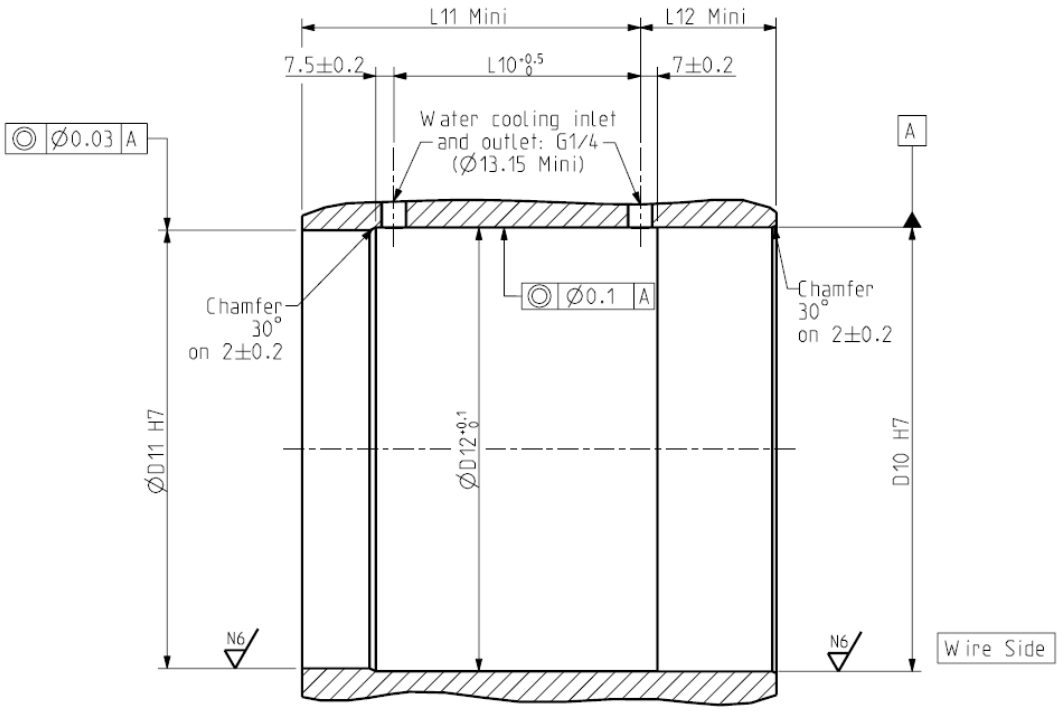


Motors	D10	D11	D12	L10	L11	L12
HKW085_066..U	100	98	99.9	64	97.5	40.5
HKW085_066..P						
HKW085_066..K						
HKW085_099..Q				97	130.5	40.5
HKW085_099..L						
HKW085_099..I						

Drawn	24/03/10	OD	Visa						General tolerances DIN ISO 2768 mK	
Modifications								Scale 1:3		
	A	AM23368 - 24/03/10 OD							Version : 1+	
Parker SSD Parvex 8 Avenue du lac. BP249 21007 DIJON CEDEX		HKW085						Format A4	Feuille : indice - folio : 1/6	
		WATER JACKET INTERFACE						344020F0011		A

3.4.3.2. HKW108****R1000 & R3000

COOLING JACKET REQUIRED INTERFACE FOR STANDARD STATOR HKW108

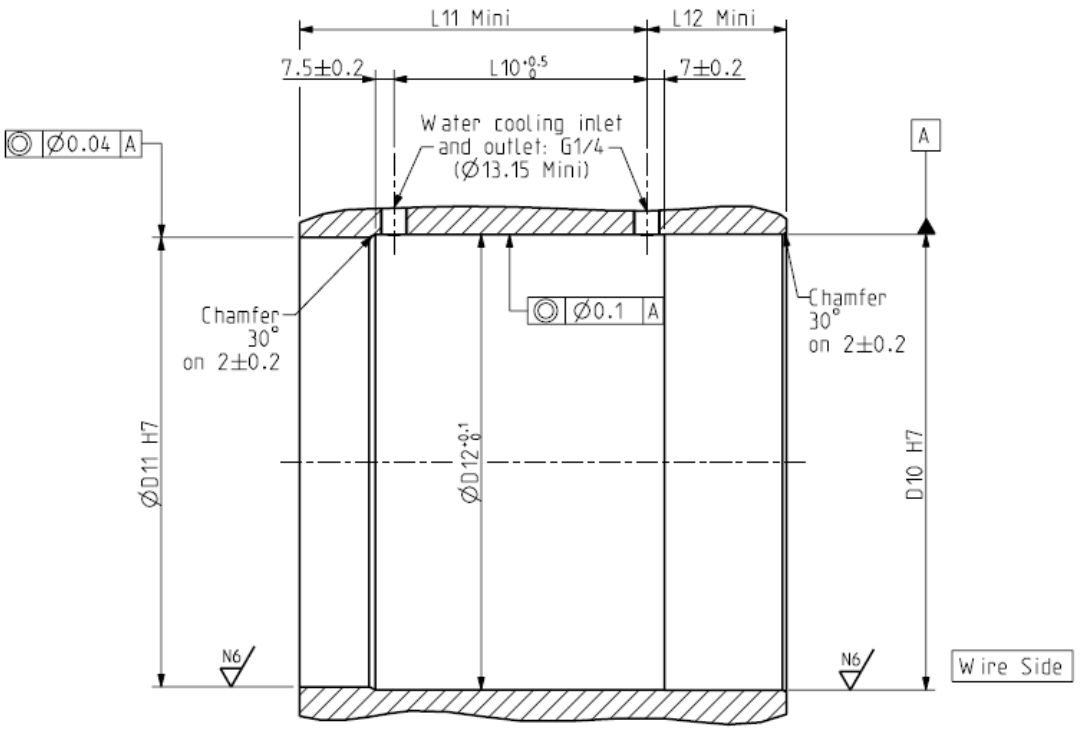


Motors	D10	D11	D12	L10	L11	L12
HKW108_080..N	130	128	129.9	74	108	44
HKW108_080..I						
HKW108_080..F						
HKW108_140..I				134	168	44
HKW108_140..F						
HKW108_140..D						
HKW108_200..J				194	228	44
HKW108_200..F						

Drawn	24/03/10	OD	Visa						General tolerances DIN ISO 2768 mK	
Modifications							Scale 1:3			
	A	AM23368 - 24/03/10 OD							Version : 1+	
SSD Parvex 8 Avenue du lac. BP249 21007 DIJON CEDEX		HKW 108					Format A4		Feuille : indice - folio : 2/6	
		WATER JACKET INTERFACE					344020F0011	A		

3.4.3.3. HKW155****R1000 & R3000

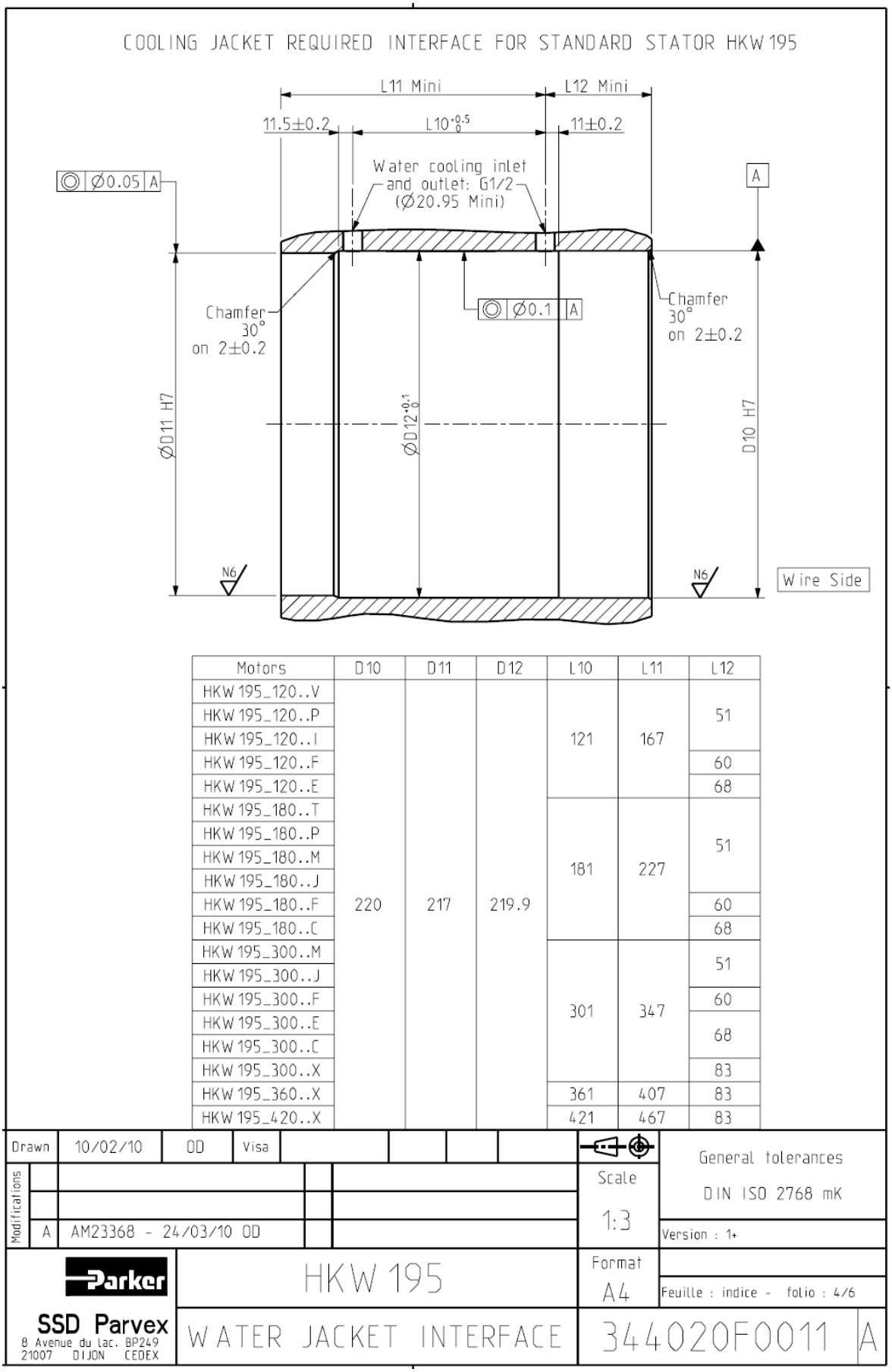
COOLING JACKET REQUIRED INTERFACE FOR STANDARD STATOR HKW155



Motors	D10	D11	D12	L10	L11	L12
HKW155_080.AP	180	178	179.9	84	117	39
HKW155_080.AR						
HKW155_080.RP						
HKW155_080.RR						
HKW155_120..P				124	157	39
HKW155_120..R						
HKW155_120..K						
HKW155_120..H						
HKW155_120..F						
HKW155_160..P				164	197	39
HKW155_160..R						
HKW155_160..H						
HKW155_160..F						
HKW155_160..D						48
HKW155_160..C						51
HKW155_240..E				244	277	48

Drawn	24/03/10	OD	Visa					General tolerances DIN ISO 2768 mK	
Modifications						Scale 1:3			
	A	AM23368 - 24/03/10 OD						Version : 1+	
Parker SSD Parvex 8 Avenue du lac. BP249 21007 DIJON CEDEX		HKW 155				Format A4		Feuille : indice - folio : 3/6	
		WATER JACKET INTERFACE				344020F0011	A		

3.4.3.4. HKW195****R1000 & R3000

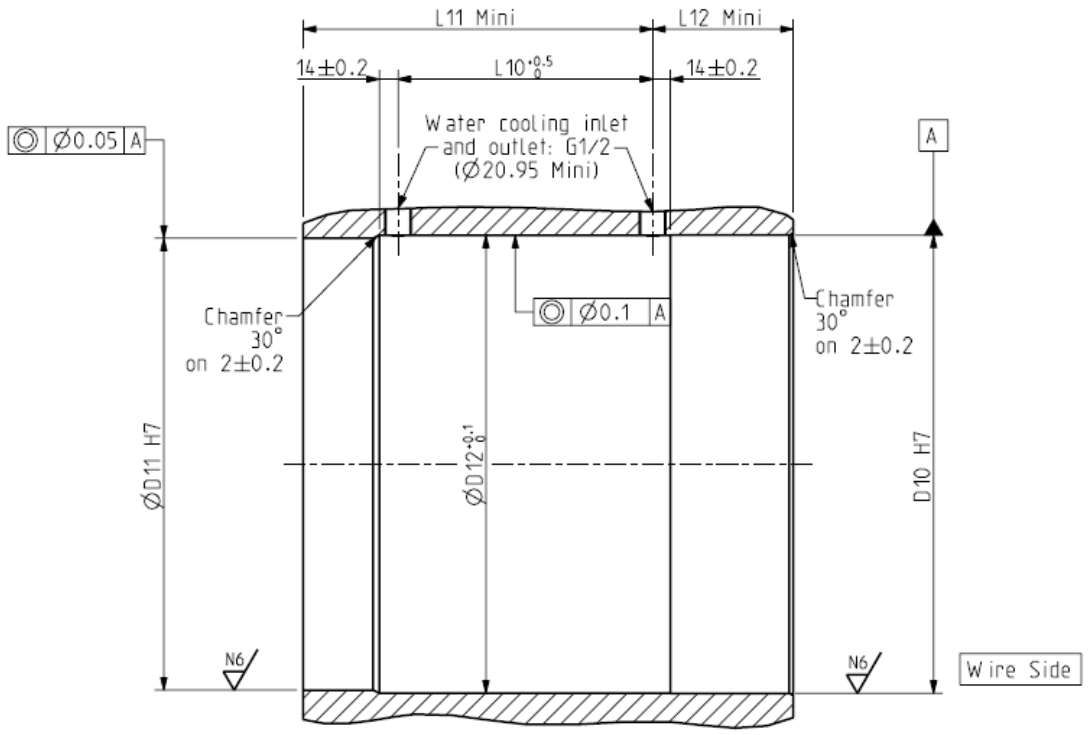


Motors	D10	D11	D12	L10	L11	L12
HKW195_120..V	220	217	219.9	121	167	51
HKW195_120..P						
HKW195_120..I						
HKW195_120..F						60
HKW195_120..E						68
HKW195_180..T				181	227	51
HKW195_180..P						
HKW195_180..M						
HKW195_180..J						
HKW195_180..F						60
HKW195_180..C						68
HKW195_300..M				301	347	51
HKW195_300..J						
HKW195_300..F						60
HKW195_300..E						68
HKW195_300..C						
HKW195_300..X						83
HKW195_360..X				361	407	83
HKW195_420..X				421	467	83

Drawn	10/02/10	OD	Visa					General tolerances DIN ISO 2768 mK	
Modifications							Scale 1:3		
	A	AM23368 - 24/03/10 OD						Version : 1+	
Parker SSD Parvex 8 Avenue du lac. BP249 21007 DIJON CEDEX		HKW 195					Format A4	Feuille : indice - folio : 4/6	
		WATER JACKET INTERFACE					344020F0011		A

3.4.3.5. HKW242****R1000 & R3000

COOLING JACKET REQUIRED INTERFACE FOR STANDARD STATOR HKW242

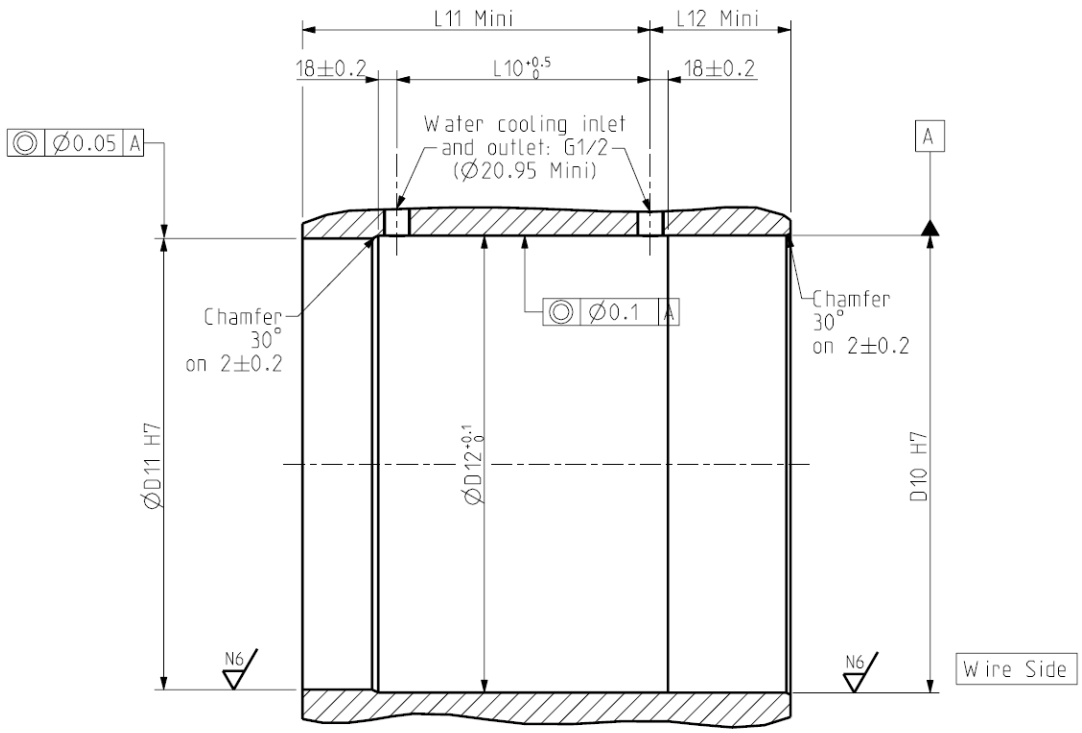


Motors	D10	D11	D12	L10	L11	L12
HKW242_225..N	270	267	269.9	222	268	49
HKW242_225..F						
HKW242_225..D						58
HKW242_225..C						66
HKW242_225..B						69
HKW242_375..F				372	418	49
HKW242_375..D						58
HKW242_375..C						66
HKW242_375..B						63
HKW242_375..A						99

Drawn	24/03/10	OD	Visa					General tolerances DIN ISO 2768 mK
Modifications							Scale 1:3	
	A	AM23368 - 24/03/10 OD						Version : 1-
Parker SSD Parvex 8 Avenue du lac. BP249 21007 DIJON CEDEX		HKW 242					Format A4	Feuille : indice - folio : 5/6
		WATER JACKET INTERFACE					344020F0011	A

3.4.3.6. HKW310****R1000 & R3000

COOLING JACKET REQUIRED INTERFACE FOR STANDARD STATOR HKW310



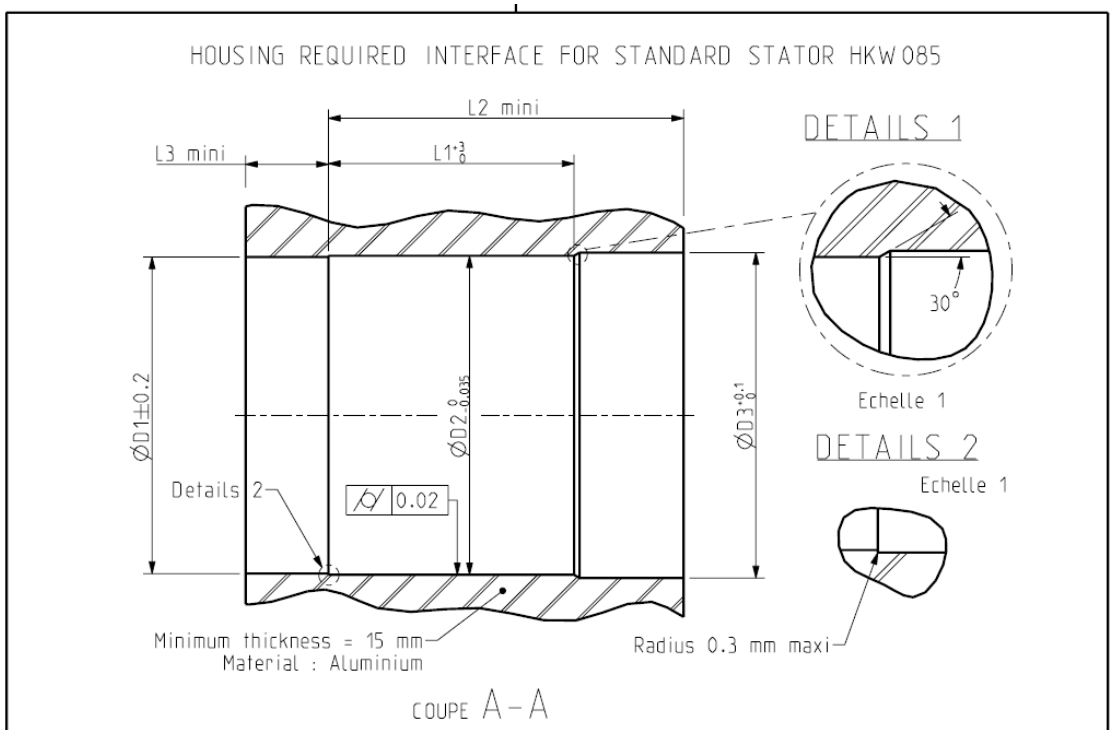
Motors	D10	D11	D12	L10	L11	L12
HKW310_200..J	340	337	339.9	172	241	71
HKW310_200..H						80
HKW310_200..E						91
HKW310_200..D						85
HKW310_200..C						88
HKW310_300..J				272	341	71
HKW310_300..H						80
HKW310_300..E						91
HKW310_300..D						85
HKW310_300..C						88
HKW310_400..J				372	441	71
HKW310_400..H						80
HKW310_400..F						88
HKW310_400..E						91
HKW310_400..D						85
HKW310_400..C						88
HKW310_400..Z						103
HKW310_400..Y						
HKW310_500..Z				472	541	103

Drawn	24/03/10	OD	Visa						General tolerances	
Modifications								Scale	DIN ISO 2768 mK	
	A	AM23368 - 24/03/10 OD						1:3	Version : 1+	
Parker SSD Parvex 8 Avenue du lac. BP249 21007 DIJON CEDEX		HKW 310						Format A4	Feuille : indice - folio : 6/6	
		WATER JACKET INTERFACE						344020F0011	A	

3.4.4. Housing interface HKW****R0000 & R2000

3.4.4.1. HKW085****R0000 & R2000

For a better thermal exchange, the housing must be in aluminium

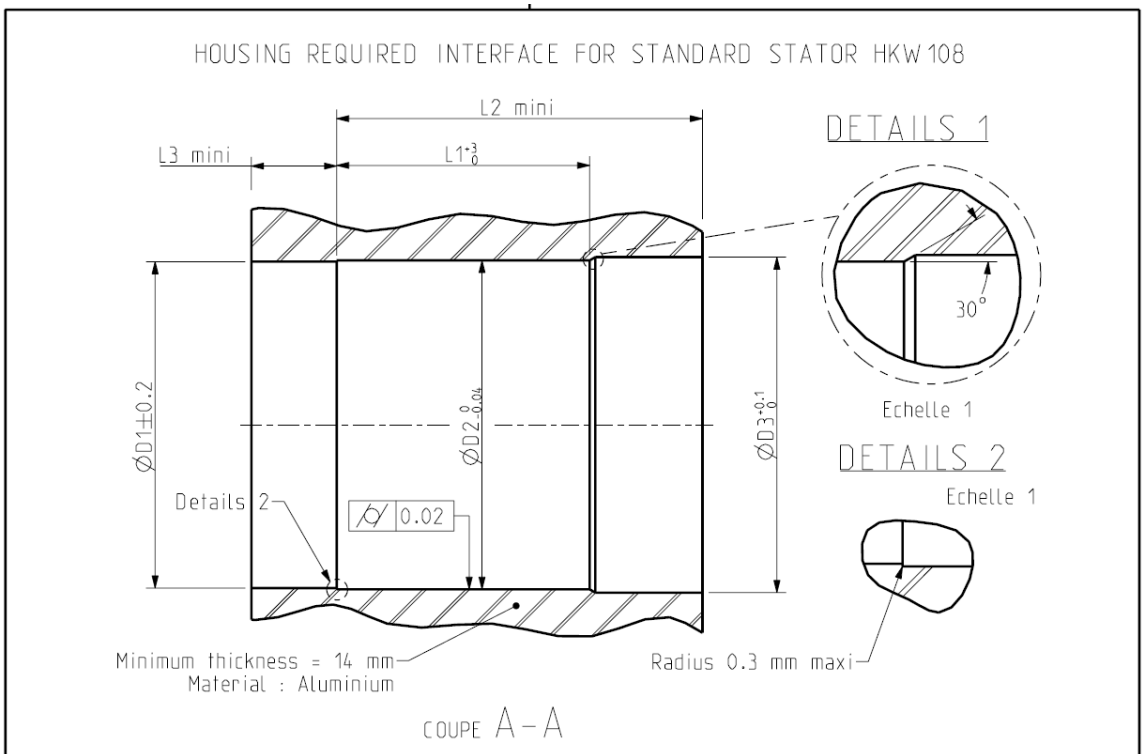


Motors	D1	D2	D3	L1	L2	L3
HKW085_066BAU	84	84.875	87	69	106	28
HKW085_066BAP						
HKW085_066BAK						
HKW085_099BAQ				102	139	
HKW085_099BAL						
HKW085_099BAI						

Drawn	03/06/10	OD	Visa						General tolerances DIN ISO 2768 mK	
Modifications								Scale 1:2	Version : 0+	
Parker SSD Parvex 8 Avenue du lac. BP249 21007 DIJON CEDEX		HKW085						Format A4	Feuille : indice - folio : 1/6	
		HOUSING INTERFACE						344020F0013	-	

3.4.4.2. HKW108****R0000 & R2000

For a better thermal exchange, the housing must be in aluminium

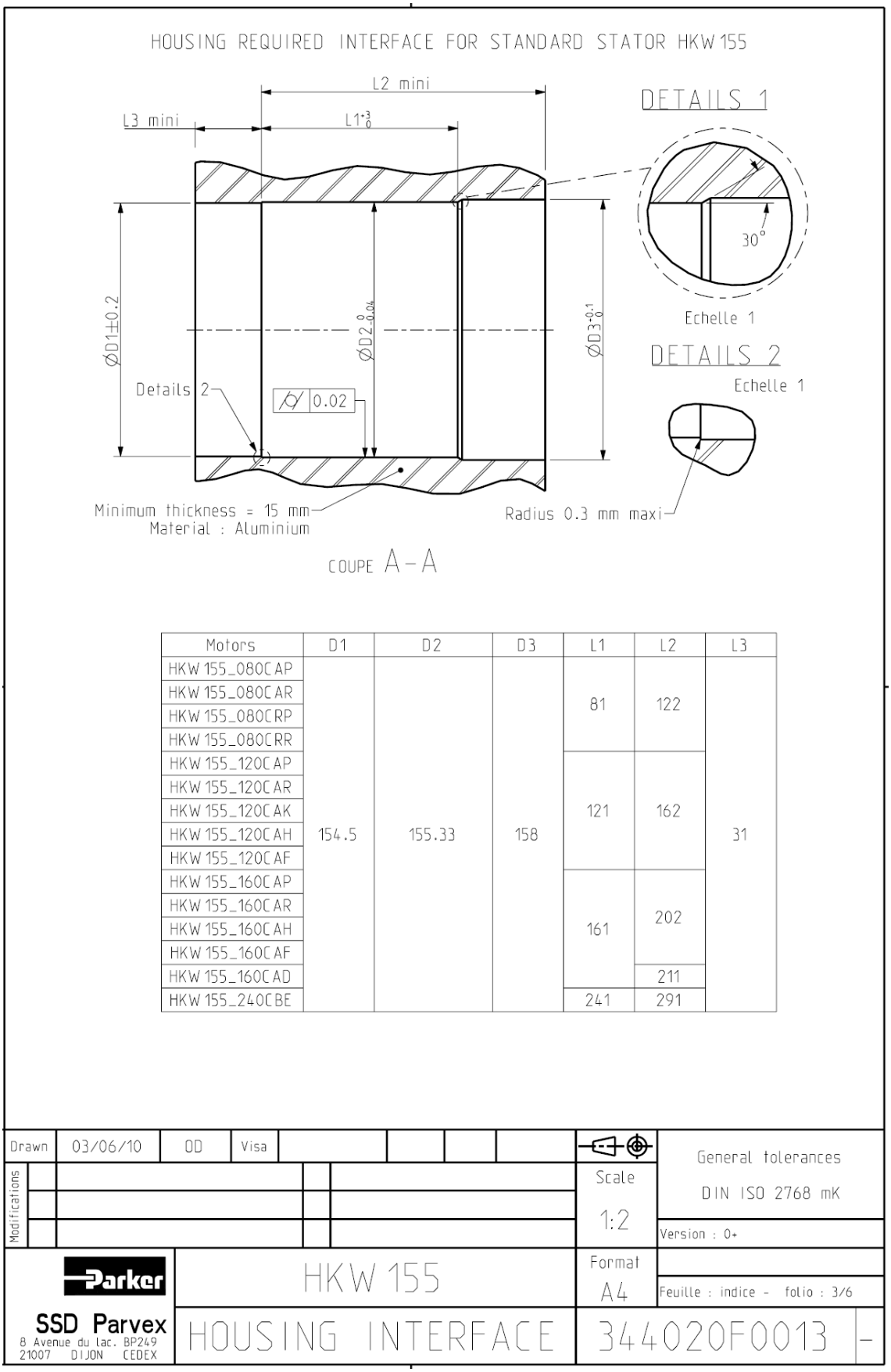


Motors	D1	D2	D3	L1	L2	L3
HKW 108_080CAN	107	107.86	110	83	121	29
HKW 108_080CAI						
HKW 108_080CAF						
HKW 108_140CAI				143	181	
HKW 108_140CAF						
HKW 108_140CAD						
HKW 108_200CAJ				203	241	
HKW 108_200CAF						

Drawn	03/06/10	OD	Visa						General tolerances	
Modifications								Scale 1:2	DIN ISO 2768 mK	
									Version : 0+	
SSD Parvex 8 Avenue du lac. BP249 21007 DIJON CEDEX		HKW 108						Format A4	Feuille : indice - folio : 2/6	
		HOUSING INTERFACE						344020F0013	-	

3.4.4.3. HKW155****R0000 & R2000

For a better thermal exchange, the housing must be in aluminium

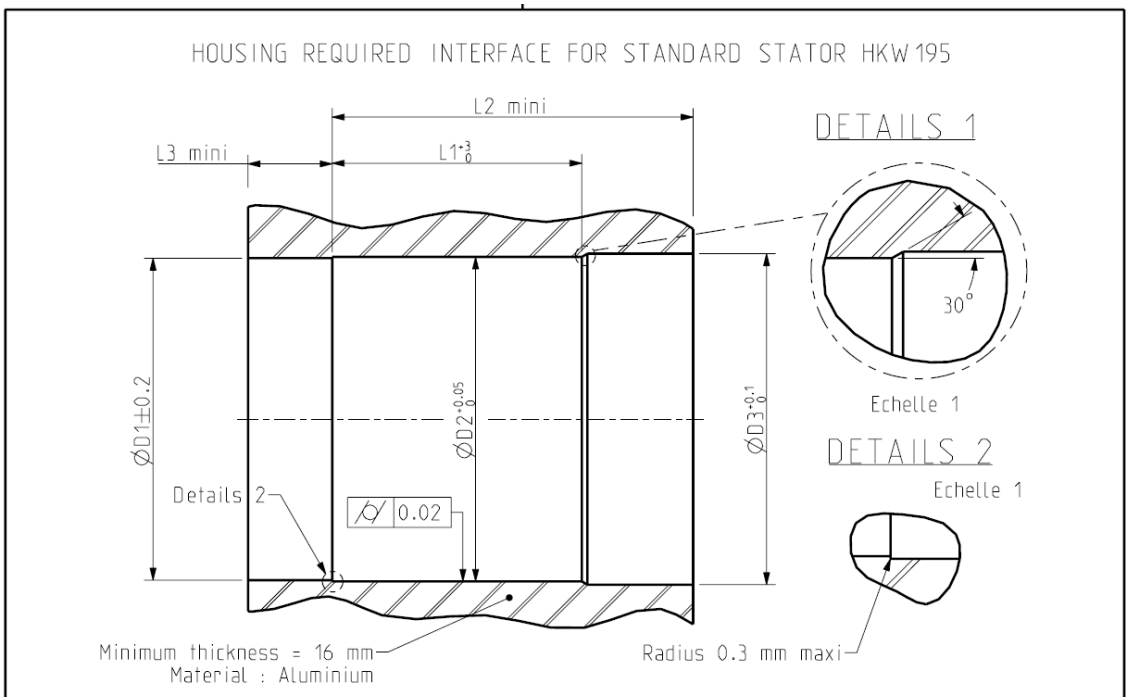


Motors	D1	D2	D3	L1	L2	L3
HKW155_080CAP	154.5	155.33	158	81	122	31
HKW155_080CAR						
HKW155_080CRP						
HKW155_080CRR						
HKW155_120CAP				121	162	
HKW155_120CAR						
HKW155_120CAK						
HKW155_120CAH						
HKW155_120CAF						
HKW155_160CAP				161	202	
HKW155_160CAR						
HKW155_160CAH						
HKW155_160CAF						
HKW155_160CAD					211	
HKW155_240CBE				241	291	

Drawn	03/06/10	OD	Visa						General tolerances DIN ISO 2768 mK	
Modifications								Scale 1:2	Version : 0+	
Parker SSD Parvex 8 Avenue du lac. BP249 21007 DIJON CEDEX		HKW 155						Format A4	Feuille : indice - folio : 3/6	
		HOUSING INTERFACE						344020F0013	-	

3.4.4.4. HKW195****R0000 & R2000

For a better thermal exchange, the housing must be in aluminium

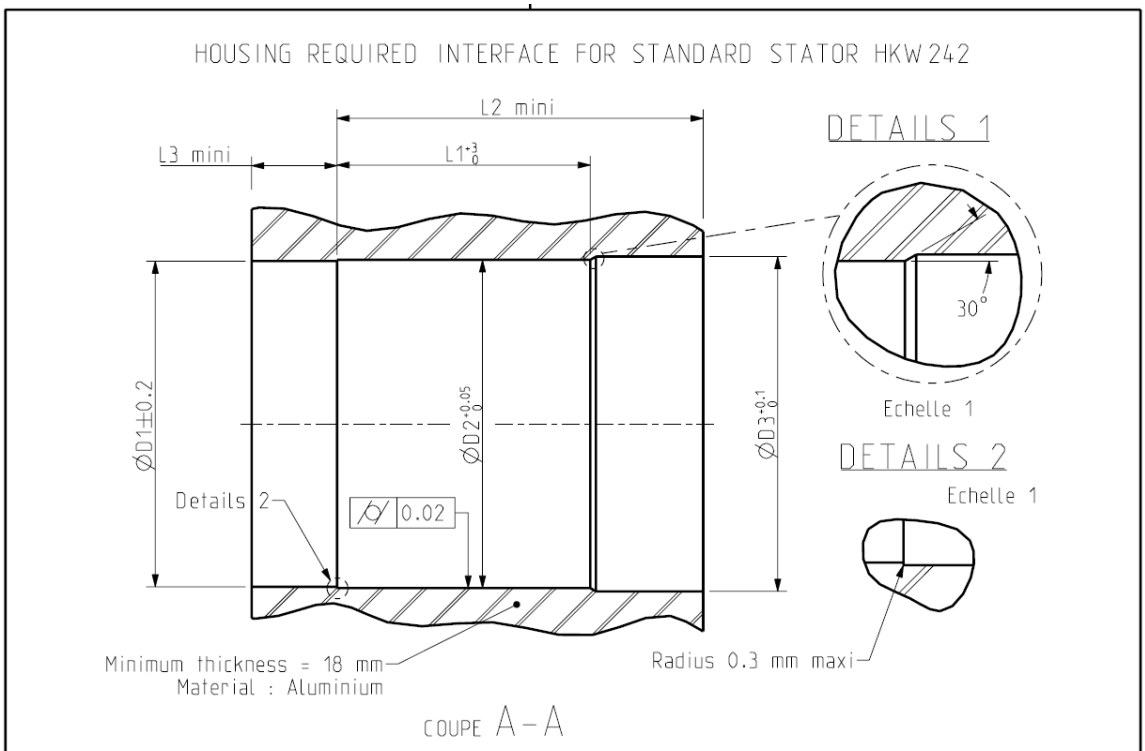


Motors	D1	D2	D3	L1	L2	L3
HKW195_120CAV	194	194.75	197	121	173	42
HKW195_120CAP						
HKW195_120CAI						
HKW195_120CAF					182	
HKW195_120CAE					190	
HKW195_180CAT				181	233	
HKW195_180CAP						
HKW195_180CAM						
HKW195_180CAJ						
HKW195_180CAF					242	
HKW195_180CAC					250	
HKW195_300CAM				301	353	
HKW195_300CAJ						
HKW195_300CAF					362	
HKW195_300CAE					370	
HKW195_300CAC						
HKW195_300CAX					423	
HKW195_300CBX						
HKW195_360CBX				361	483	
HKW195_420CBX				421	543	

Drawn	03/06/10	OD	Visa						General tolerances DIN ISO 2768 mK	
Modifications							Scale 1:2		Version : 0+	
Parker SSD Parvex 8 Avenue du lac. BP249 21007 DIJON CEDEX		HKW 195					Format A4		Feuille : indice - folio : 4/6	
		HOUSING INTERFACE					344020F0013		-	

3.4.4.5. HKW242****R0000 & R2000

For a better thermal exchange, the housing must be in aluminium

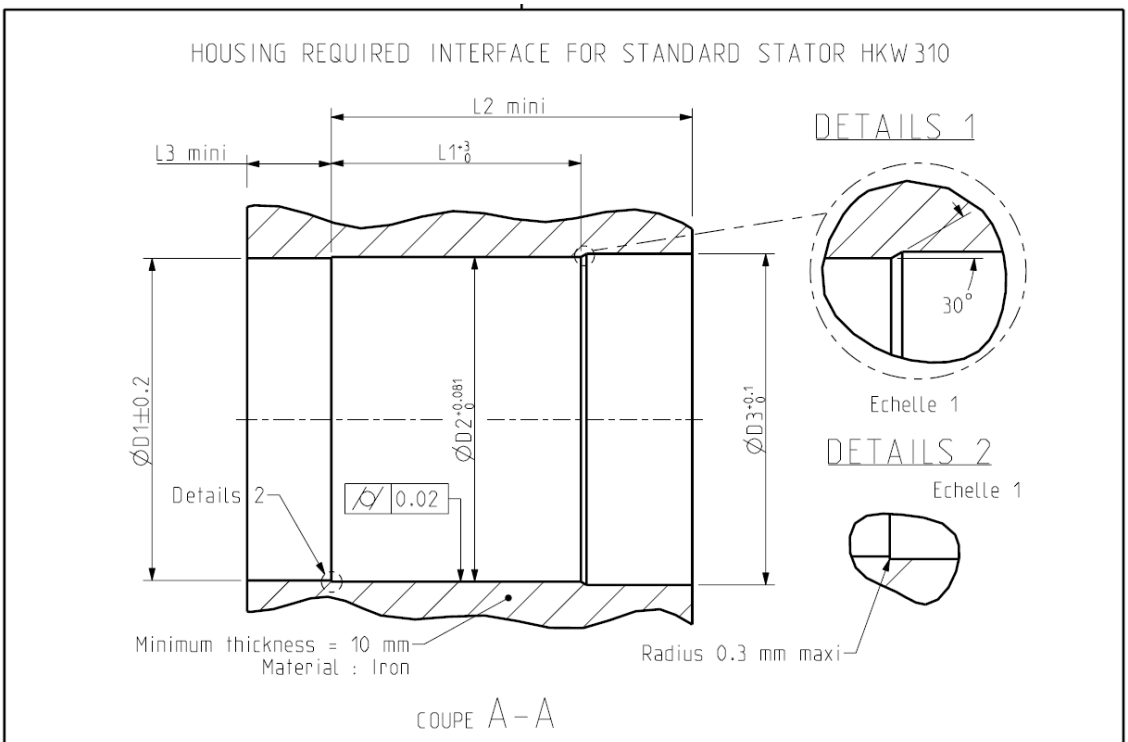


Motors	D1	D2	D3	L1	L2	L3
HKW 242_225DAN	241	242.21	245	226	275	39
HKW 242_225DAF						
HKW 242_225DAD					284	
HKW 242_225DAC					292	
HKW 242_225DAB					295	
HKW 242_375DAF				376	425	
HKW 242_375DAD					434	
HKW 242_375DAC					442	
HKW 242_375DAB					439	
HKW 242_375DAA					475	

Drawn	03/06/10	OD	Visa						General tolerances DIN ISO 2768 mK	
Modifications								Scale 1:2		
									Version : 0+	
Parker SSD Parvex 8 Avenue du lac. BP249 21007 DIJON CEDEX		HKW 242						Format A4	Feuille : indice - folio : 5/6	
		HOUSING INTERFACE						344020F0013	-	

3.4.4.6. HKW310****R0000 & R2000

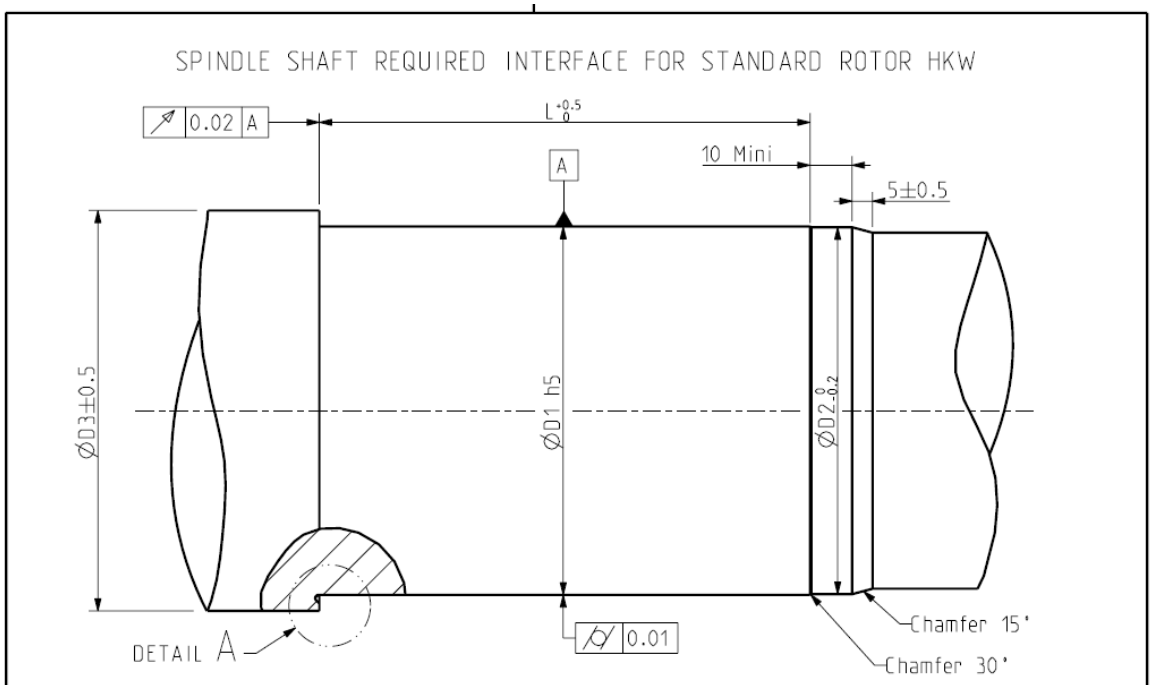
For a better thermal exchange, the housing must be in aluminium



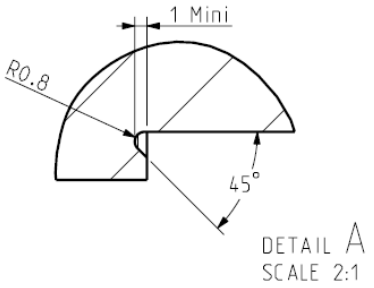
Motors	D1	D2	D3	L1	L2	L3
HKW310_200HAJ	306	309.8	311	203	261	48
HKW310_200HAH					270	
HKW310_200HAE					281	
HKW310_200HAD					275	
HKW310_200HAC					278	
HKW310_300HAJ				303	361	
HKW310_300HAH					370	
HKW310_300HAE					381	
HKW310_300HAD					375	
HKW310_300HAC					378	
HKW310_400HAJ				403	461	
HKW310_400HAH					470	
HKW310_400HAF					478	
HKW310_400HAE					481	
HKW310_400HAD					475	
HKW310_400HAC					478	
HKW310_400HAZ					493	
HKW310_400HAY						
HKW310_500HAZ				504	593	

Drawn	03/06/10	OD	Visa						General tolerances DIN ISO 2768 mK	
Modifications								Scale 1:2	Version : 0+	
Parker SSD Parvex 8 Avenue du lac. BP249 21007 DIJON CEDEX		HKW 310						Format A4	Feuille : indice - folio : 6/6	
		HOUSING INTERFACE						344020F0013	-	

3.4.5. Shaft interface for HKW****R0000 & R1000



Motors	D1	D2	D3	L
HKW 108_080	47.07	46.8	51	87
HKW 108_140				147
HKW 108_200				208
HKW 155_080	75.13	74.8	82	85
HKW 155_120				125
HKW 155_160				165
HKW 155_240				246
HKW 195_120	90.15	89.8	98	125
HKW 195_180				185
HKW 195_300				308
HKW 195_360				368
HKW 195_420				431
HKW 242_225	130.18	129.8	142	231
HKW 242_375				383
HKW 310_200	180.24	179.8	196	207
HKW 310_300				307
HKW 310_400				408
HKW 310_500				509

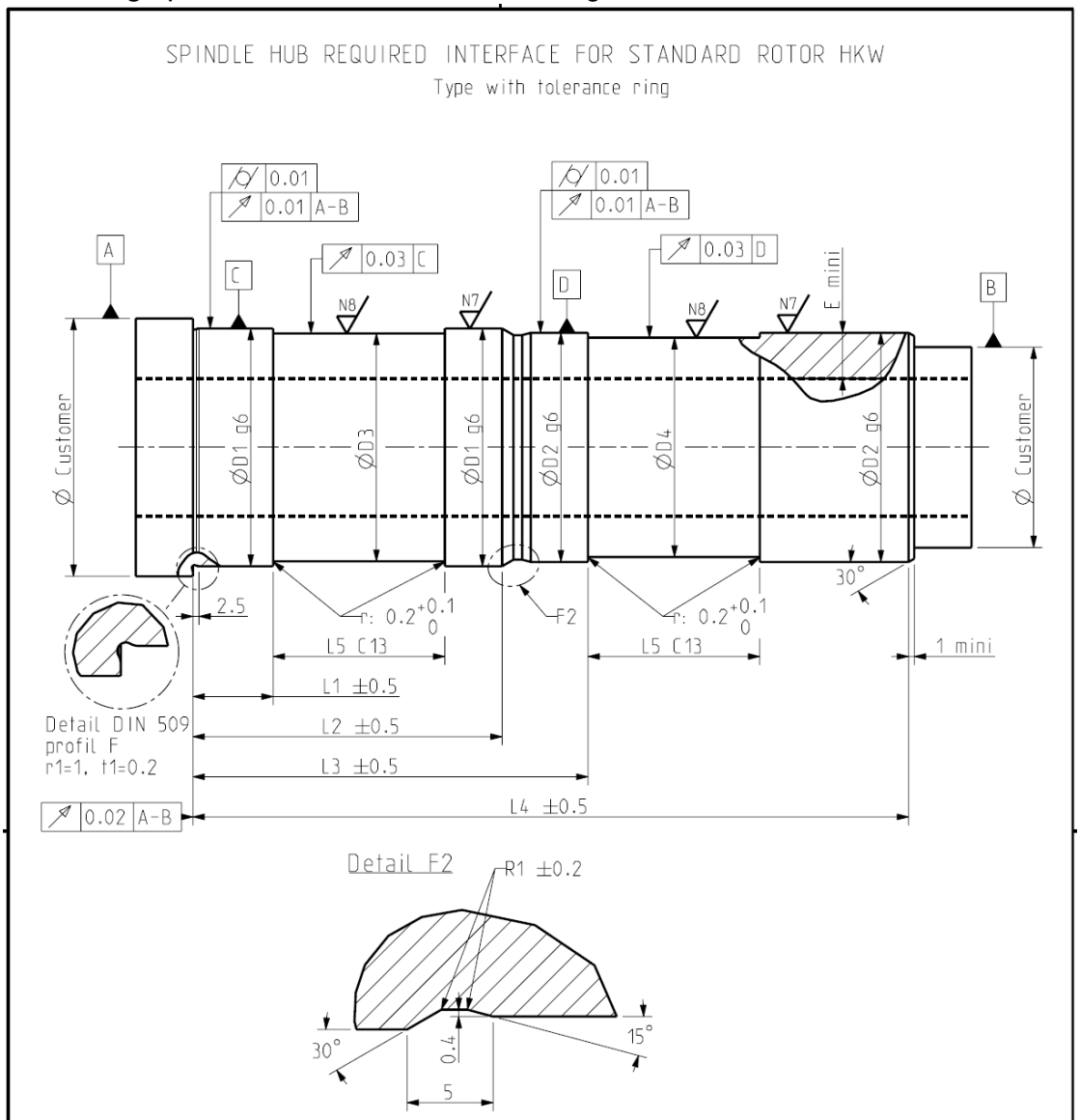


Drawn	10/02/10	OD	Visa					General tolerances DIN ISO 2768 mK
Modifications	B	AM24244 - 07/01/2014 PF					Scale 2:3	
	A	AM23368 - 24/03/10 OD						Version :
Parker 8 Avenue du lac. BP249 21007 DIJON CEDEX		HKW					Format A4	Feuille : indice - folio : 1/1
		SHAFT INTERFACE					344020F0012	B

3.4.6. Hub interface

3.4.6.1. HKW085 and HKW108****R2000 & R3000

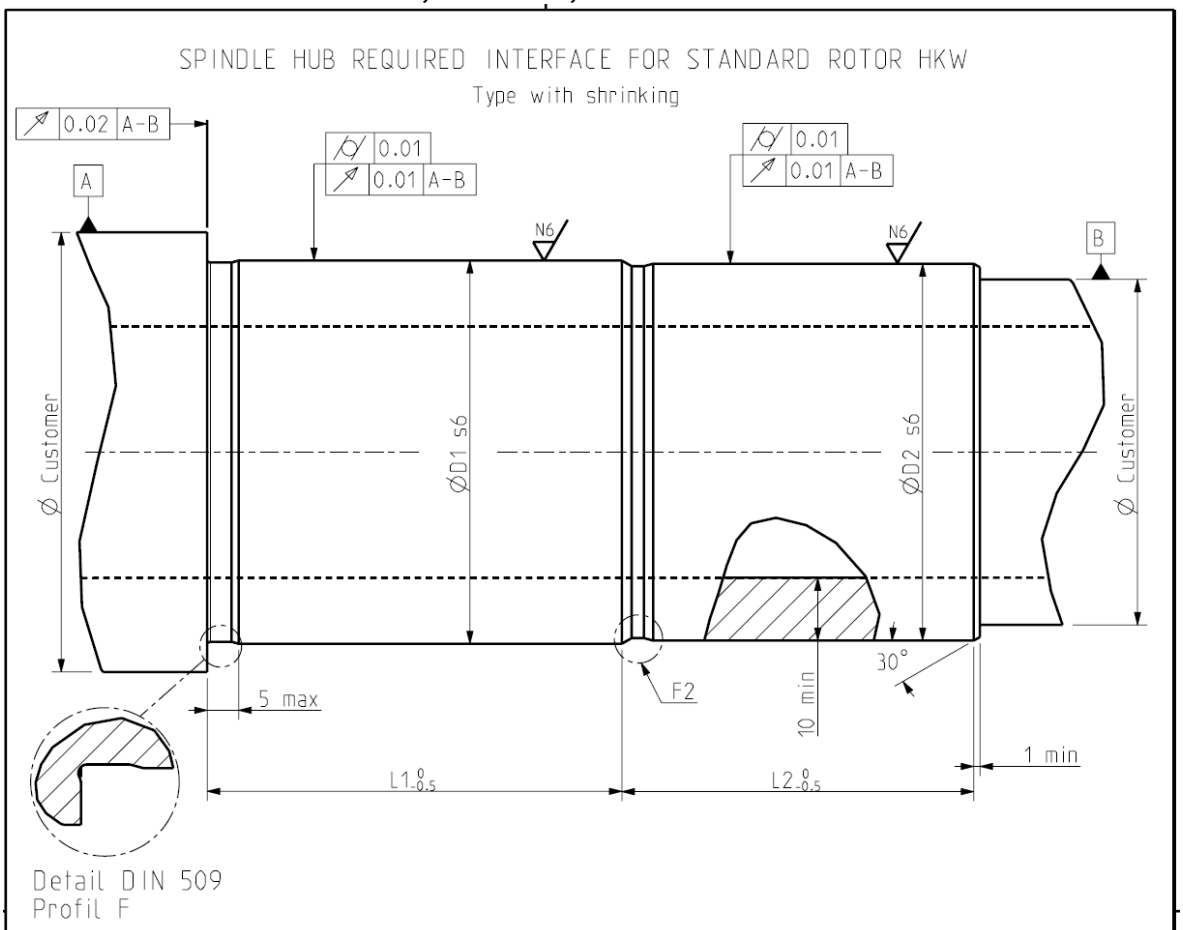
Tolerance rings part numbers are available on §4.2.3.2



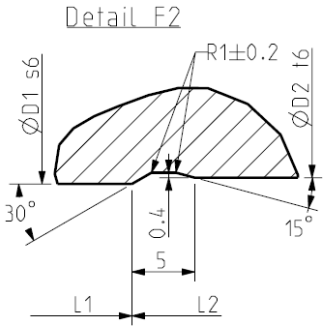
Motors	D1	D2	D3	D4	L1	L2	L3	L4	L5	E	R1
HKW 085_066	33	32	31.2 +0.13 -0.05	30.2 +0.13 -0.05	9	32	94	123	16	6	0.6
HKW 085_099							129	158			
HKW 108_080	41.5	40	39.8 +0.1 0	38.3 +0.1 0	14	54	69	125	30	8	
HKW 108_140							121	185			
HKW 108_200							181	245			

Drawn	08/06/10	OD	Visa						General tolerances DIN ISO 2768 mK
Modifications								Scale 1:1	Version : 0+
SSD Parvex 8 Avenue du lac. BP249 21007 DIJON CEDEX		HKW SERIES						Format A4	Feuille : indice - folio : 1/2
		HUB INTERFACE						344020F0014	-

3.4.6.2. HKW155, HKW195, HKW242 and HKW310****R2000 & R3000



Motors	D1	D2	L1	L2	R1
HKW 155_080	61	60	66	56	0.6
HKW 155_120				96	
HKW 155_160				136	
HKW 155_240				216	
HKW 195_120	71	70	77	88	
HKW 195_180				149	
HKW 195_300				271	
HKW 195_360				331	
HKW 195_420				391	
HKW 242_225	107	106	107	179	
HKW 242_375				329	
HKW 310_200	153	152	138	127	
HKW 310_300				227	
HKW 310_400				328	
HKW 310_500				428	



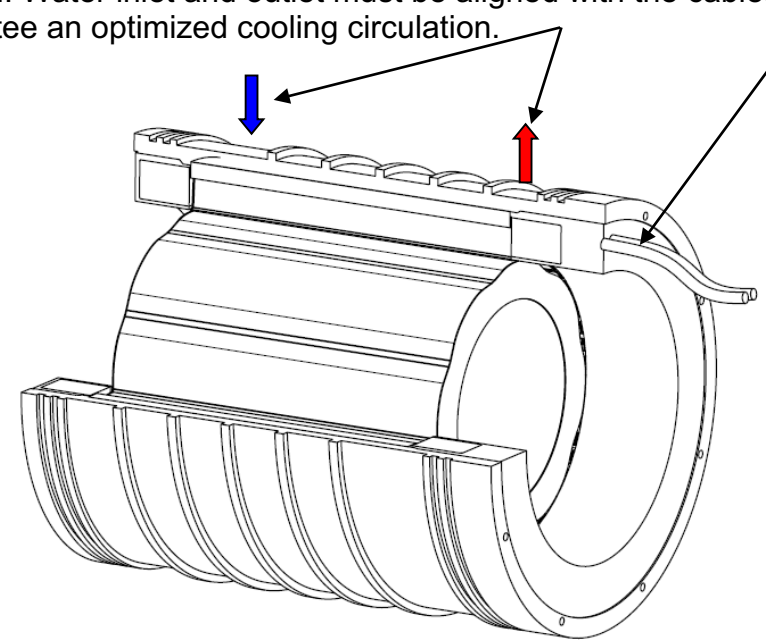
Drawn	08/06/10	OD	Visa						Scale 1:1	General tolerances DIN ISO 2768 mK
Modifications										Version :
Parker SSD Parvex 8 Avenue du lac. BP249 21007 DIJON CEDEX				HKW SERIES					Format A4	Feuille : indice - folio : 2/2
				HUB INTERFACE					344020F0014	-

3.4.7. O-ring Specification

For HKW with water jacket (R1000 and R3000), the cooling circuit is sealed by four O-rings seal between stator and user's housing.

⚠	Caution: The 4 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
HKW085	94,97	1,78	NBR	70 shores	-25 / +120	5340P0066
HKW108	122,32	2,62	FPM	70 shores	-20 / +200	5340P0061
HKW155	171,05	3,53	FPM	70 shores	-20 / +200	5340P0057
HKW195	209,14	3,53	FPM	70 shores	-20 / +200	5340P0068
HKW242	253,59	3,53	NBR	70 shores	-25 / +120	5340P0006
HKW310	329,79	3,53	FPM	70 shores	-20 / +200	5340P0075

3.4.8. 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

3.4.9. Design Compliance

The integrator is responsible for compliance with directives, regulations and standards. Nonexhaustively, the integrator has to certify the complete motor design in order to be comformed to the guide lines (nonexhaustively).

- Low Voltage Directive 2014/35/EU
- RoHs Directive 2011-65 CE
- EMC Directive 2004-108 CE

The complete motor must comply with the IEC60034 standard
The heating of the complete motor must meet the requirements of the class F insulation (cf. IEC 60034-1)

3.4.10. Dielectric test

Each complete motor must undergo once completely, a dielectric test (Routine test) in accordance with the standard IEC 60034-1 (i.e. 1500 V during 1 min for 230 Vac).

3.4.11. Earthing

A protective earth cable with the appropriate cable diameter must connect the complete motor stator to the grounding (cf. standards: NF C15-100, CEI 60364-1, IEC 60204-1).

Section of phases conductors, S [mm²]	Corresponding minimal cross-section of earthing conductor, S_p [mm²]
S<=16	S
16<S<=35	16
S>35	0.5S

3.4.12. Minimum clearances for insulation and creepage distances

Depending on the pollution degree and the voltage in use, the minimum clearances for insulation and creepage distances must meet the standard EN 60664-1.
It is the integrator's responsibility to take the needed actions to comply with these distances or by adding proper additional insulation.

3.4.1. Ground continuity compliance

The complete motors must meet the standards IEC 60204-1.
Continuity of the grounding circuit : On each complete unit, the resistance between any conductive point and the grounding conductor shall not exeed than100 mΩ. This test shall be performed before the dielectric tests. (EN 60204-1: Safety of the machine)

3.4.2. Protection rating

cf. IEC 60529 and IEC 60034-5
The frameless motors show an IP00 protection rating. It is the integrator's responsibility to ensure the appropriate protection rating depending on the use of the complete motor (protection against electric shocks of persons, protection against dust, liquids, solid particles, …

3.4.3. Overspeed test

A qualification test at 20% above the rated speed during at least 1 min, must be carried out according to the standard IEC 60034-1.

3.4.4. EMC Directive

cf. guide lines 2004-108 CE and standard IEC 61800-3
It is the integrator's responsibility to ensure that the complete motor and drive in use comply with the EMC directive.

3.4.5. Other requirements

The previous list is not exhaustive and all the other requirements in the regulation standard and directives must be checked by the integrator.

3.5. Cooling

In compliance with the IEC 60034-1 standards:

3.5.1. Water cooled motor – HKW series

	Caution : For option R0000 (without water jacket) and R2000 (without water jacket), It's **impossible** to cool the stator directly on the stack of laminations. Customers must to put a water jacket on the stator with a thermal resitance lowest as possible.
	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 temperature 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.

3.5.2. 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 corrosion of the motor cooling system (aluminum or steel), the water must have anti-corrosion additive.

The spindle 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 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.

3.5.3. Motor cooling circuit data

HKW servomotors are cooled by water. An anti-corrosion product must be mixed to the water. The main characteristics of cooling are given in the table bellow:

	Average flow necessary for cooling (water : 70% minimum)	Maxi drop pressure @ nominal water flow	Motor power losses at max speed and continuous operation	Maximum inlet cooling temperature	Maximum outlet cooling temperature
	[L/min]	[Bars]	[kW]	[°C]	[°C]
HKW085_066BAU	2.25	0.10	0.5	25	28.5
HKW085_066BAP	2.25	0.10	0.8	25	30.9
HKW085_066BAK	3.37	0.22	1.3	25	31.0
HKW085_099BAQ	3.37	0.31	0.9	25	29.1
HKW085_099BAL	3.37	0.31	1.3	25	31.2
HKW085_099BAI	3.93	0.41	1.6	25	31.6
HKW108_080CAN	3.37	0.07	1.2	25	30.5
HKW108_080CAI	3.37	0.07	1.5	25	31.9
HKW108_080CAF	3.37	0.07	1.5	25	31.9
HKW108_140CAI	5.62	0.27	2.1	25	31.0
HKW108_140CAF	5.62	0.27	2.4	25	31.9
HKW108_140CAD	5.62	0.27	2.4	25	31.9
HKW108_200CAJ	5.62	0.37	1.8	25	30.2
HKW108_200CAF	7.86	0.70	3.0	25	31.1
HKW108_200CAD	8.99	0.90	3.5	25	31.3
HKW155_080CRR	5.62	0.18	1.5	25	29.3
HKW155_080CRP	5.62	0.18	1.5	25	29.3
HKW155_080CAR	5.62	0.18	1.8	25	30.2
HKW155_080CAP	5.62	0.18	1.8	25	30.2
HKW155_120CAR	5.62	0.25	1.8	25	30.2
HKW155_120CAK	8.99	0.60	3.2	25	30.7
HKW155_120CAH	8.99	0.60	3.2	25	30.7
HKW155_120CAF	8.99	0.60	3.1	25	30.6
HKW155_160CAR	11.23	1.17	2.0	25	27.9
HKW155_160CAP	11.23	1.17	2.3	25	28.3
HKW155_160CAH	11.23	1.17	4.2	25	31.0
HKW155_160CAF	11.23	1.17	4.2	25	31.0
HKW155_160CAD	11.23	1.17	3.8	25	30.4
HKW195_120CAV	7.86	0.16	1.2	25	27.5
HKW195_120CAP	7.86	0.16	1.7	25	28.5
HKW195_120CAI	7.86	0.16	2.9	25	30.9
HKW195_120CAF	7.86	0.16	3.0	25	31.1
HKW195_120CAE	7.86	0.16	3.2	25	31.6
HKW195_180CAT	11.23	0.44	1.7	25	27.4
HKW195_180CAP	11.23	0.44	2.0	25	27.9
HKW195_180CAM	11.23	0.44	2.5	25	28.6
HKW195_180CAJ	11.23	0.44	3.4	25	29.9
HKW195_180CAF	13.48	0.62	5.3	25	31.3
HKW195_180CAC	13.48	0.62	5.8	25	31.9
HKW195_300CAM	17.97	1.70	2.4	25	27.2
HKW195_300CAJ	17.97	1.70	2.7	25	27.4
HKW195_300CAF	17.97	1.70	4.1	25	28.7
HKW195_300CAE	17.97	1.70	5.0	25	29.5
HKW195_300CAC	17.97	1.70	6.3	25	30.6
HKW195_300CAX	17.97	1.70	7.0	25	31.3
HKW195_300CBU	17.97	1.70	6.4	25	30.7
HKW195_360CBU	28.08	1.61	11.0	25	31.3
HKW195_420CBU	30.33	2.16	12.0	25	31.4
HKW195_420CBX	25.84	1.60	10.0	25	31.2

	Average flow necessary for cooling (water : 70% minimum)	Maxi drop pressure @ nominal water flow	Motor power losses at max speed and continuous operation	Maximum inlet cooling temperature	Maximum outlet cooling temperature
	[L/min]	[Bars]	[kW]	[°C]	[°C]
HKW242_225DAN	20.22	0.64	5.1	25	29.1
HKW242_225DAF	20.22	0.64	5.2	25	29.1
HKW242_225DAD	20.22	0.64	5.3	25	29.2
HKW242_225DAC	20.22	0.64	5.4	25	29.3
HKW242_225DAB	20.22	0.64	6.2	25	29.9
HKW242_375DAF	28.08	1.90	8.5	25	29.9
HKW242_375DAD	28.08	1.90	8.6	25	29.9
HKW242_375DAC	28.08	1.90	8.7	25	30.0
HKW242_375DAB	28.08	1.90	8.9	25	30.1
HKW242_375DAA	28.08	1.90	10.0	25	30.7
HKW242_375DBB	28.08	1.90	10.3	25	30.9
HKW242_375DBY	28.08	1.90	11.8	25	31.8
HKW242_375DBW	28.08	1.90	10.6	25	31.1
HKW310_200HAJ	16.85	0.27	6.2	25	30.9
HKW310_200HAH	16.85	0.27	6.3	25	31.0
HKW310_200HAE	16.85	0.27	6.4	25	31.1
HKW310_200HAD	16.85	0.27	6.7	25	31.4
HKW310_200HAC	16.85	0.27	6.7	25	31.4
HKW310_300HAJ	23.59	0.75	9.3	25	31.3
HKW310_300HAH	23.59	0.75	9.3	25	31.3
HKW310_300HAE	23.59	0.75	9.4	25	31.4
HKW310_300HAD	23.59	0.75	9.5	25	31.5
HKW310_300HAC	23.59	0.75	9.6	25	31.6
HKW310_400HAJ	31.45	1.70	12.3	25	31.3
HKW310_400HAH	31.45	1.70	12.3	25	31.3
HKW310_400HAF	31.45	1.70	12.4	25	31.3
HKW310_400HAE	31.45	1.70	12.4	25	31.3
HKW310_400HAD	31.45	1.70	12.5	25	31.4
HKW310_400HAC	31.45	1.70	12.6	25	31.5
HKW310_400HAY	33.70	1.93	13.7	25	31.5
HKW310_500HBX	39.32	3.23	15.7	25	31.4
HKW310_500HBB	39.32	3.23	16.3	25	31.7
HKW310_500HBY	39.32	3.23	17.5	25	32.2

3.5.4. Chiller selection

Chiller must be able to evacuate motor power loss (see table above).
Chiller pump must provide water flow through motor and pipe pressure drop.
Inlet temperature must be inferior to 25°C.

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

3.5.5. 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

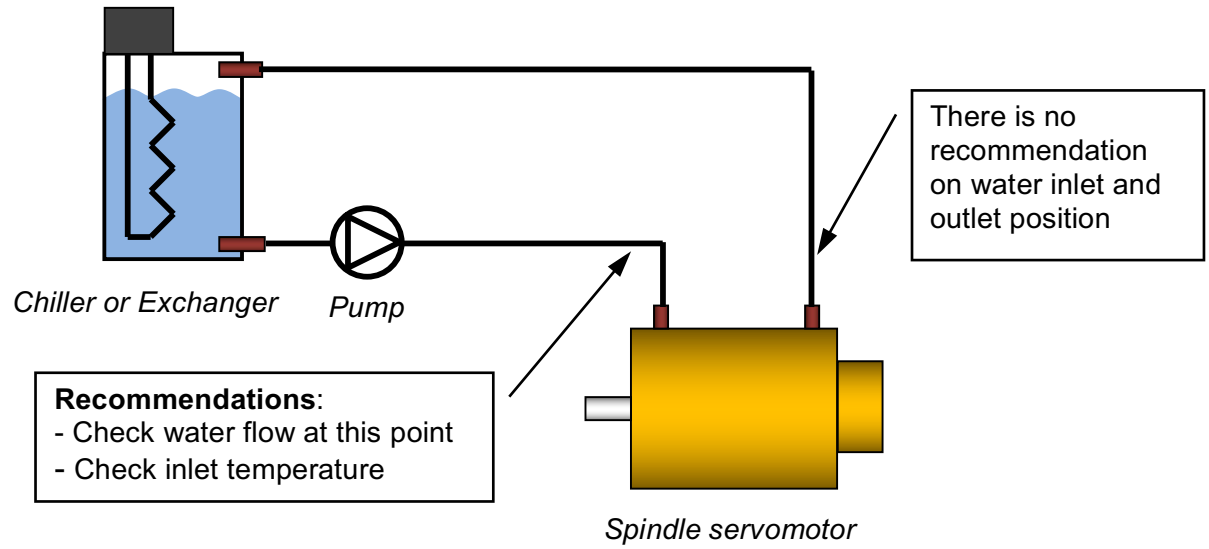
We have considered an average temperature of the coolant of 30°C.

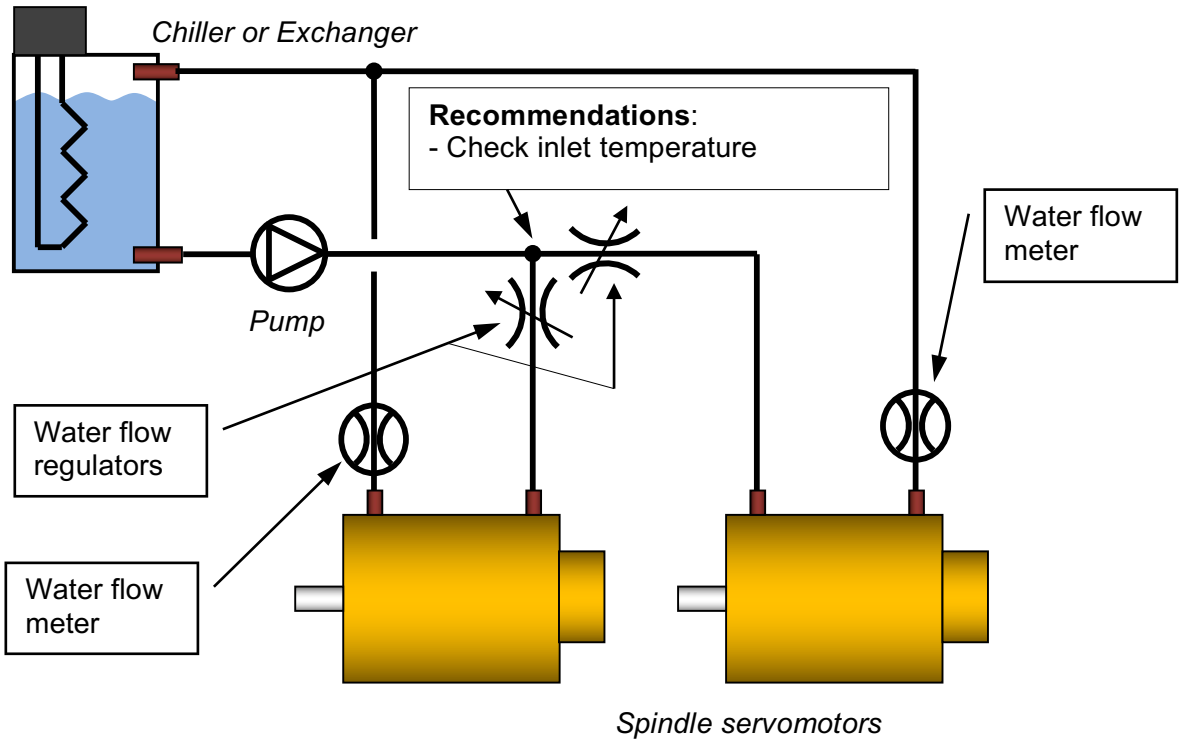
Glycol concentration [%]	Average temperature of the water as coolant [°C]	Thermal specific capacity of the water ***Cp*** [J/kg°K]
0	30	4176
30	30	3755
40	30	3551
50	30	3354

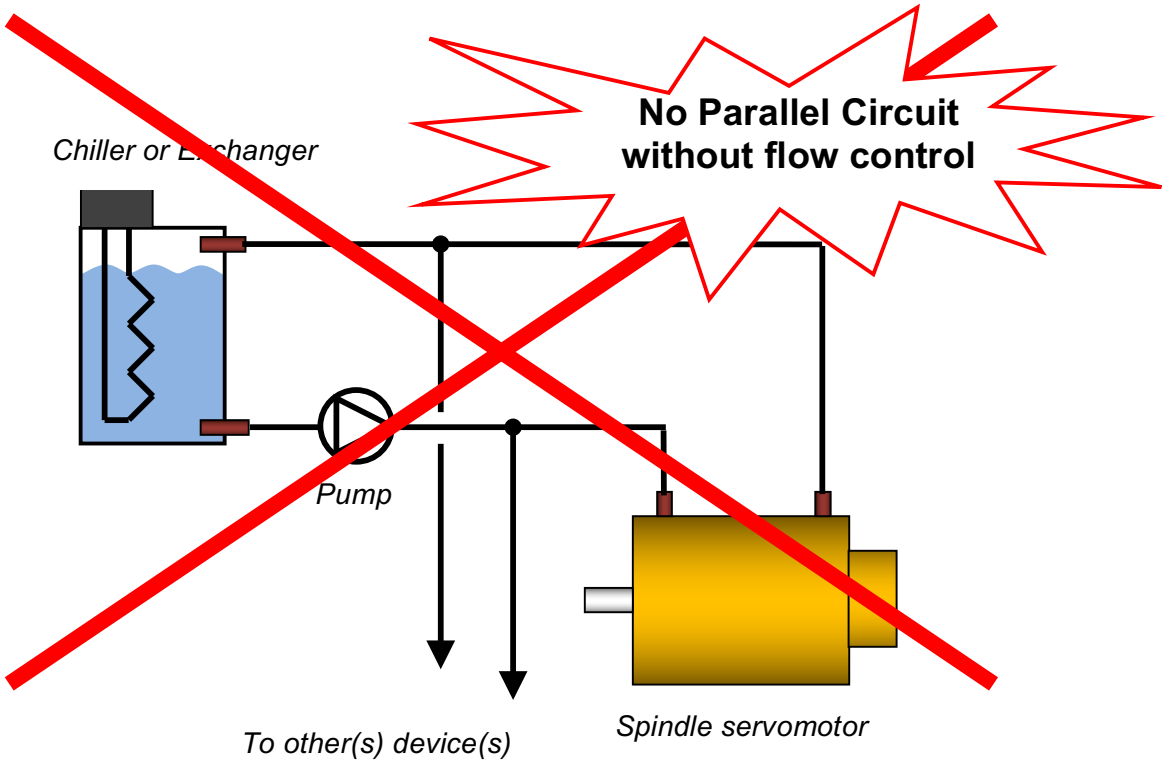
3.5.6. Water cooling diagram

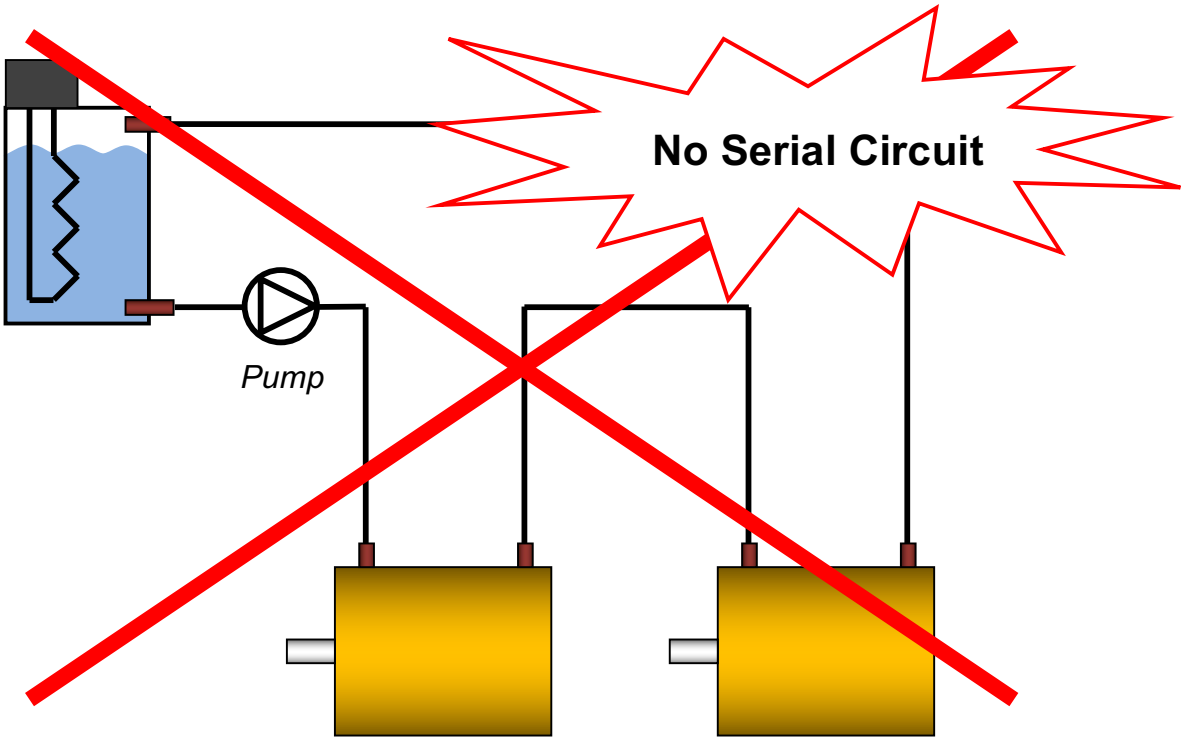
	Recommendation: The use of a filter allows to reduce the presence of impurities or chips in the water circuit in order to prevent its obstruction. We recommend 0.1mm filter.

This section shows typical water cooling diagram :





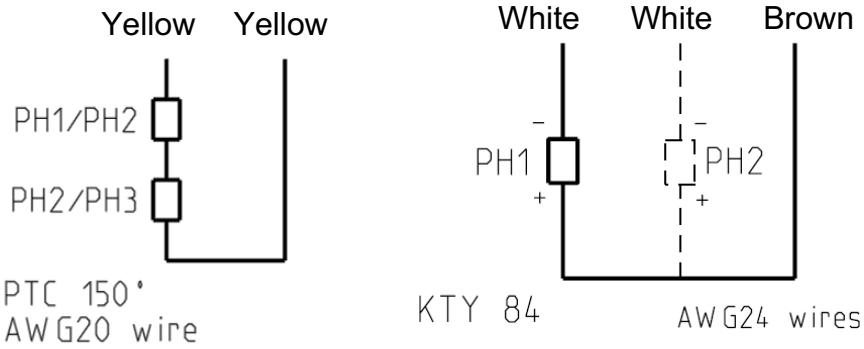

No Parallel Circuit
without flow control
Chiller or Exchanger
Pump
To other(s) device(s)
Spindle servomotor


No Serial Circuit
Pump
Spindle servomotors

3.6. Thermal Protection

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

	Warning: To protect correctly the motor against very fast overload, please refer to 3.1.7. Peak current limitations

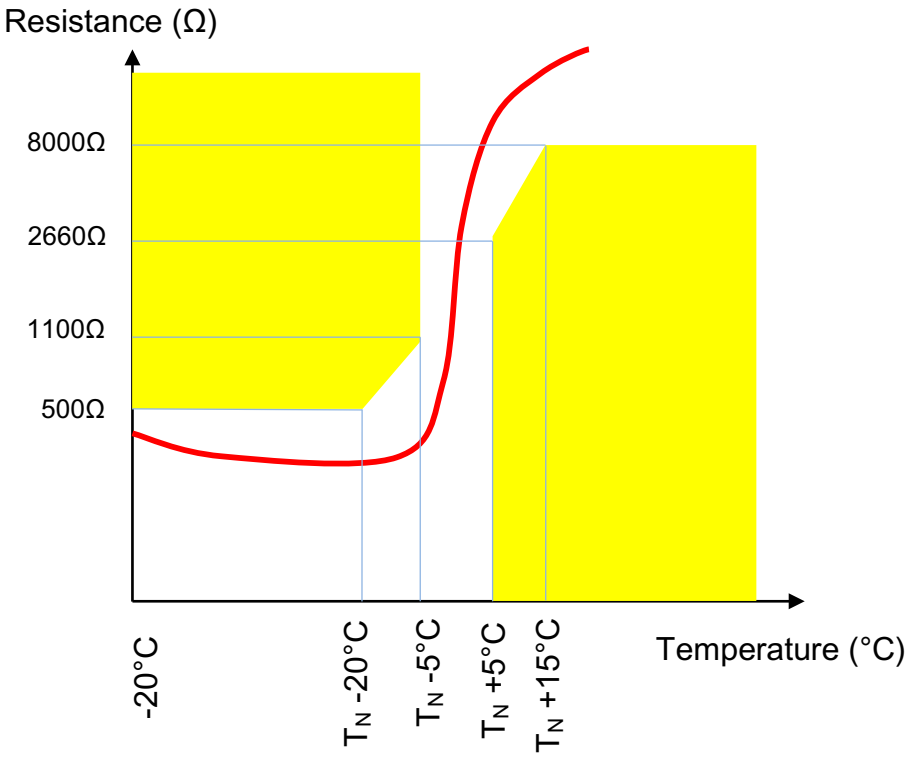


3.6.1. Alarm tripping with PTC thermistors :

The thermal probes (PTC thermistors) fitted in the servomotor winding trip the electronic system at 150° ± 5° C. When the rated tripping temperature is reached, the PTC thermistor resistance changes very quickly. This resistance can be monitored by the drive to protect the motor.

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

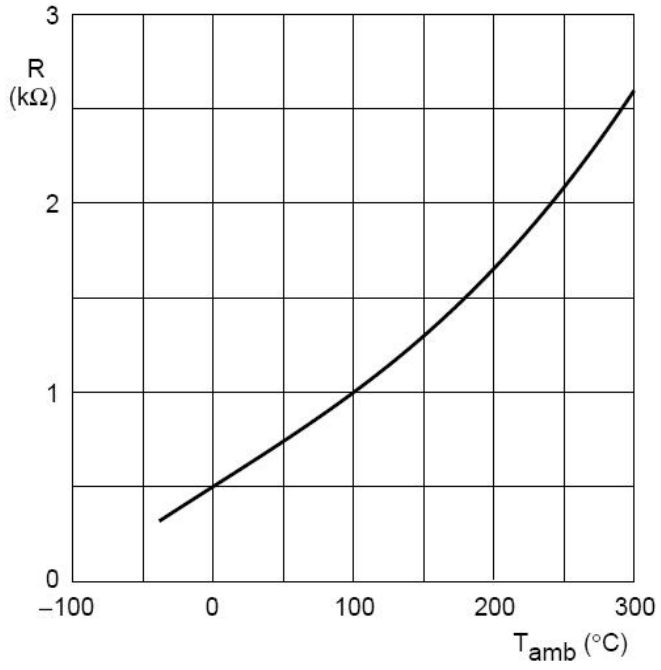
Temperature	Resistance value
-20°C up to T_N-20°C	R≤500Ω
TNF-5°C	R≤1100Ω
TNF+5°C	R≥2660Ω
TNF+15°C	R≥8000Ω

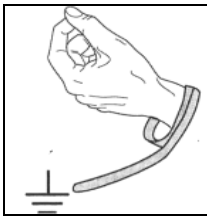


3.6.2. Temperature measurement with KTY sensors:

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 a 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.

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 $\sqrt{2} \times 0.8\ Io \cong$ **1,13 x I_o**.

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

Section	I_{max}
[mm²]	[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.

3.7.5. Motor cable

The motor cables are flexible, so cables can take any direction.



The electrical connection on HKW servomotor 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 (depending of torque/speed characteristics letter code).

	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.

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

3.8. Feedback system

3.8.1. Resolver

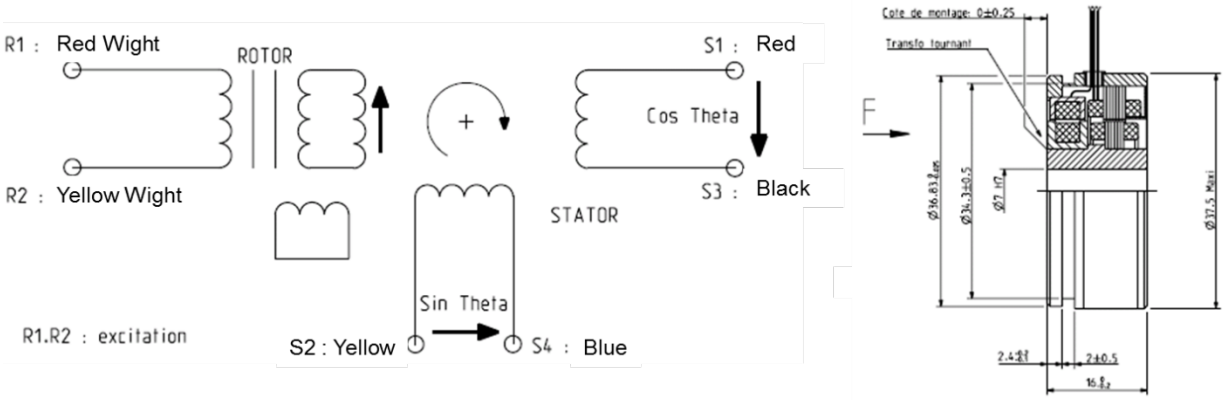
3.8.1.1. Overview

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.
Four resolver types are available (CB52, CB102, CB152 and CB158) with or without connectors.

Resolver CB



Electric scheme

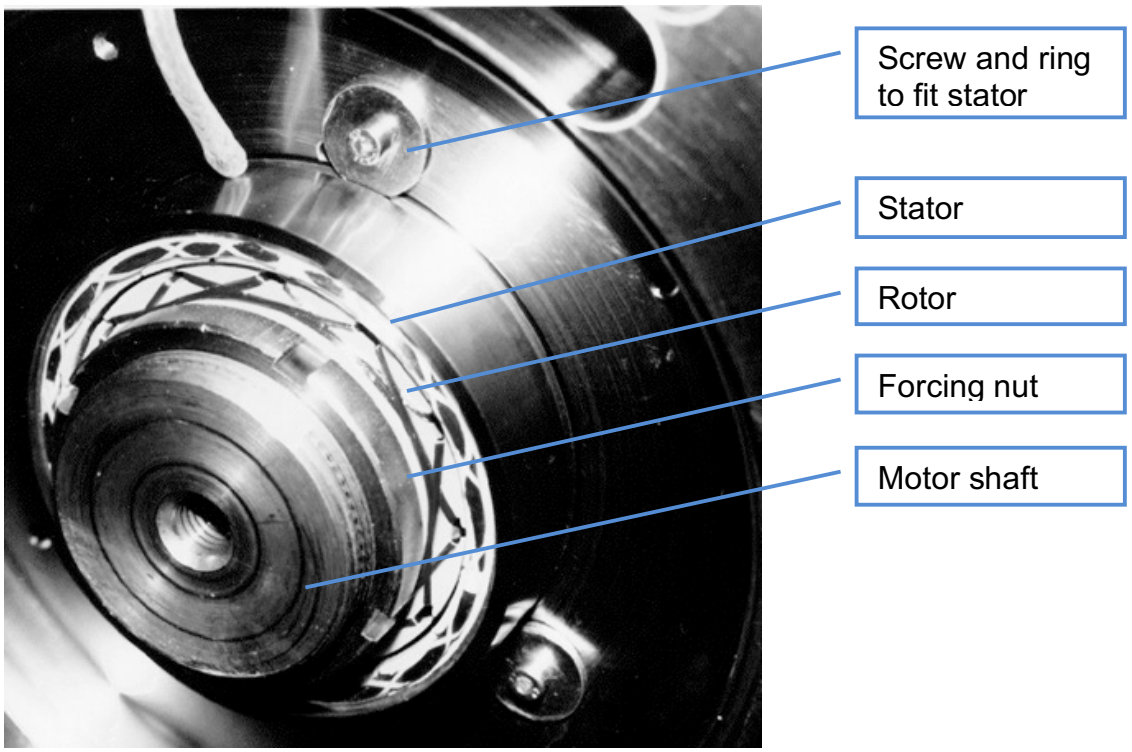


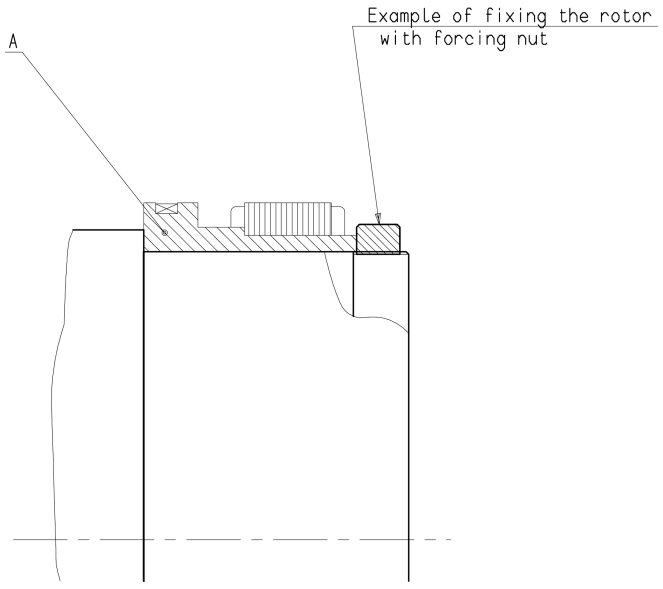
S1 = Cos - | S2 = Sin - | R1 = exitation +
S3 = Cos + | S4 = Sin + | R2 = exitation -

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

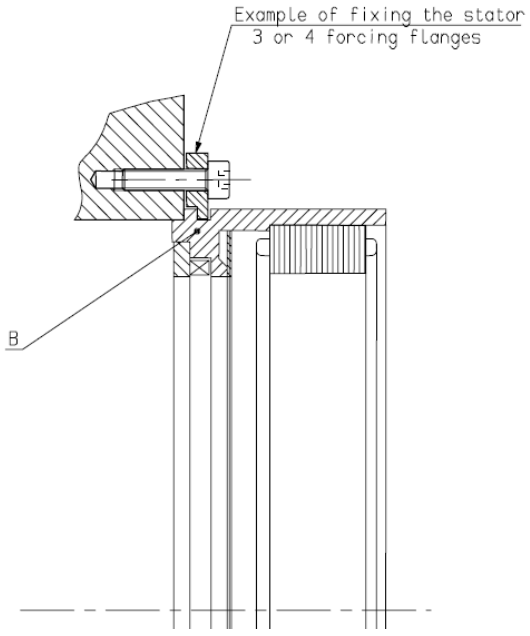
	Attention: Do not mix resolver wires with motor wires to avoid EMI (electromagnetic interference). EMI risk to set default the drive. So, careful to separate resolver and motor wires.

3.8.1.2. Example of resolver mounting





Example of fixing the rotor of the resolver



Example of fixing the stator of the resolver

3.8.1.3. Resolver characteristics

Part number without connector	**CB52SAR1000**	**CB102SAR1000**
Part number with connector	**CB52SAR2000**	**CB102SAR2000**
Motor associated	***HKW085 / HKW108 / HKW155 / HKW195***	***HKW108 / HKW155 / HKW195 / HKW242***
Maximum speed	50 000 rpm	20 000 rpm
Number of pole	2 poles	2 poles
Feeding voltage at 8 KHz	7 Vrms	7 Vrms
Feeding current at 8 KHz	70mA maximum	70mA maximum
Precision under 7Vrms at 8KHz	+/-6’	+/-10’
Transformation ratio at 8 KHz	0.425 mini, 0.55 maxi	0.425 mini, 0.55 maxi
Input DC resistance, supply transformer (R1-R2)	Mini 24 Ω Maxi 26 Ω	Mini : 15.1 Ω Maxi : 16.2 Ω
DC stator resistance output sin (S2-S4) output cos (S1-S3)	Mini 34.5 Ω Maxi 37.5 Ω	Mini 57.4 Ω Maxi 63Ω
Insulation resistance	≥ 50MΩ	≥ 50MΩ
Assembly	Direct on shaft end	Direct on shaft end
Operating temperature	-55 / +155 °C	-55 / +155 °C

Part number without connector	**CB152SAR1000**	**CB158SAR1000**
Part number with connector	**CB152SAR2000**	**CB158SAR2000**
Motor associated	***HKW195 / HKW242 / HKW310***	***HKW242 / HKW310***
Maximum speed	20 000 rpm	20 000 rpm
Number of pole	2 poles	8 poles
Feeding voltage at 8 KHz	7 Vrms	7 Vrms
Feeding current at 8 KHz	70mA maximum	70mA maximum
Precision under 7Vrms at 8KHz	+/-10’	+/-1.5’
Transformation ratio at 8 KHz	0.425 mini, 0.55 maxi	0.425 mini, 0.55 maxi
Input DC resistance, supply transformer (R1-R2)	Mini 19.2 Ω Maxi 20.8 Ω	Mini : 18.9 Ω Maxi : 20.4 Ω
DC stator resistance output sin (S2-S4) output cos (S1-S3)	Mini 50.8 Ω Maxi 56.2 Ω	Mini 45.5 Ω Maxi 50.0 Ω
Insulation resistance	≥ 50MΩ	≥ 50MΩ
Assembly	Direct on shaft end	Direct on shaft end
Operating temperature	-55 / +155 °C	-55 / +155 °C

	CB 52, CB102, CB 152 resolvers are single pole pair resolvers: they give absolute position on 1 motor rotation.

	The CB 158 resolver is a 4 pole pair resolver: it provides information every 1/4 turn. It cannot be used for absolute positioning over one revolution. It can be used to control the HKW242 and HKW310 motors only.

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

3.8.2. Cables and connectors associated to the resolver

Cable reference for DIGIVEX drive: CD1UA1F1R0xxx depending on length
Cable reference for AC 890 drive: CS4UA1F1R0xxx depending on length.
The "xxx" in the part number must be replaced by the length in meter.
Ex : for 20m cable, "xxx" = 020.

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

3.8.3. 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.

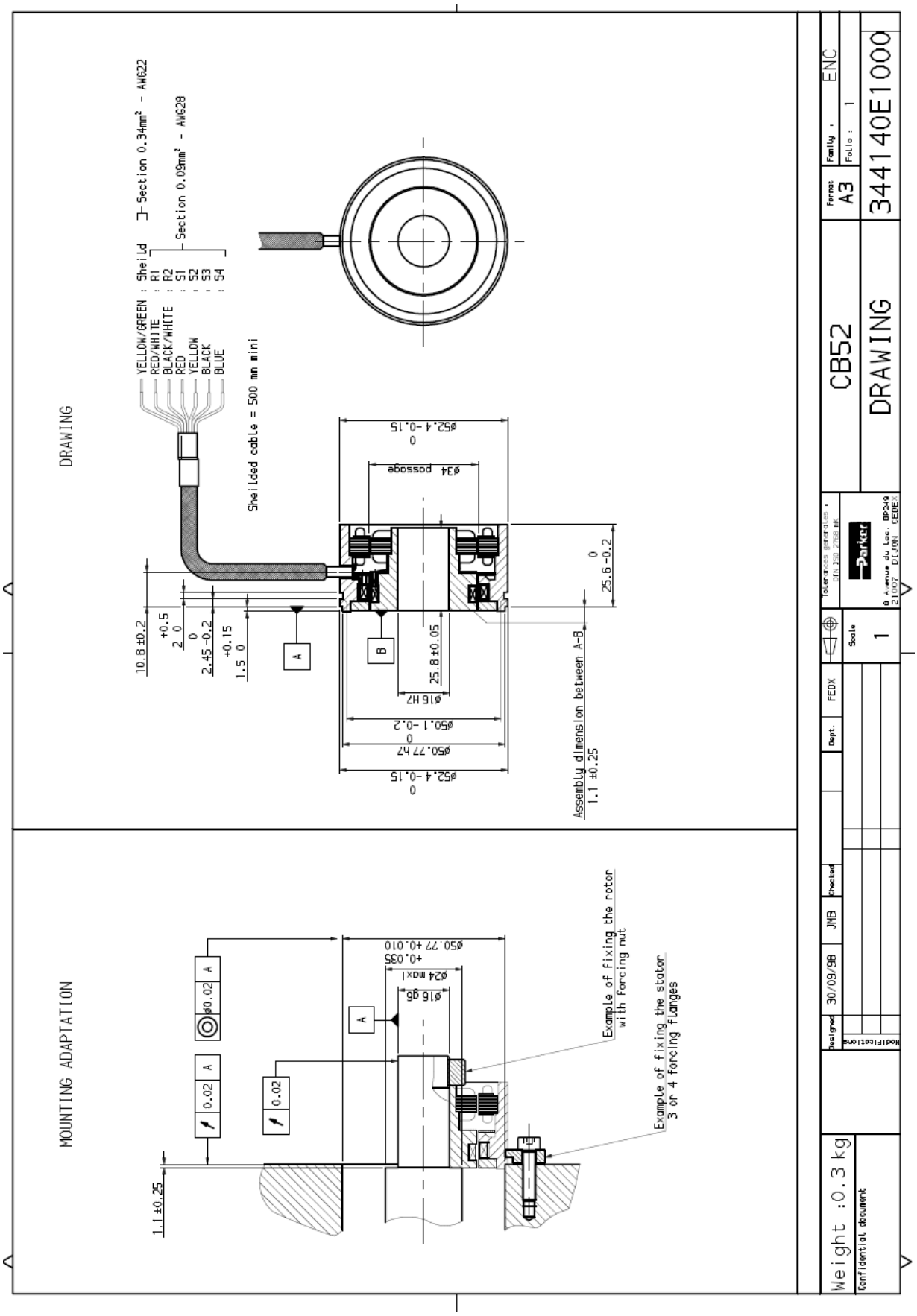
	Caution: Resolver setting is obtained by turning the resolver stator when the cooling system is in operation. An easy access to the resolver and the resolver fixing screws should be provided by the spindle design. The minimum required angle is given in the following table.

Motor	Mininum rotation angle
HKW085	190°
HKW108	130°
HKW155	130°
HKW195	130°
HKW242	100°
HKW310	55°

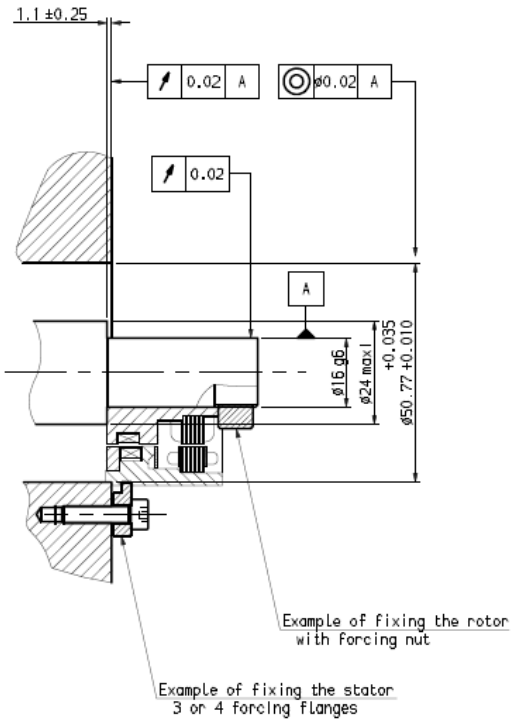
	**Attention**: To get the right electrical characteristics of the resolver, the relative position between rotor and stator must be respected (CB52: 1.1+/-0.25, CB102: 2+/-0.2 and CB152/158: 1.5+/-0.2). So, pay attention about rotor expansion of the motor: for long motors and due to the temperature rising (80 to 100°C), the shaft's expansion can be superior to tolerance interval (0.4mm). In this case, we recommend placing the resolver near the fix bearing.

	**Attention**: The resolver cable is shielded. The shielding is continued by the green & yellow lead (see resolver drawings). It must be connected to the resolver cable shielding from the drive. If the PARKER resolver cable is utilized, connect the resolver cable shielding (green & yellow) to connector pin #9.

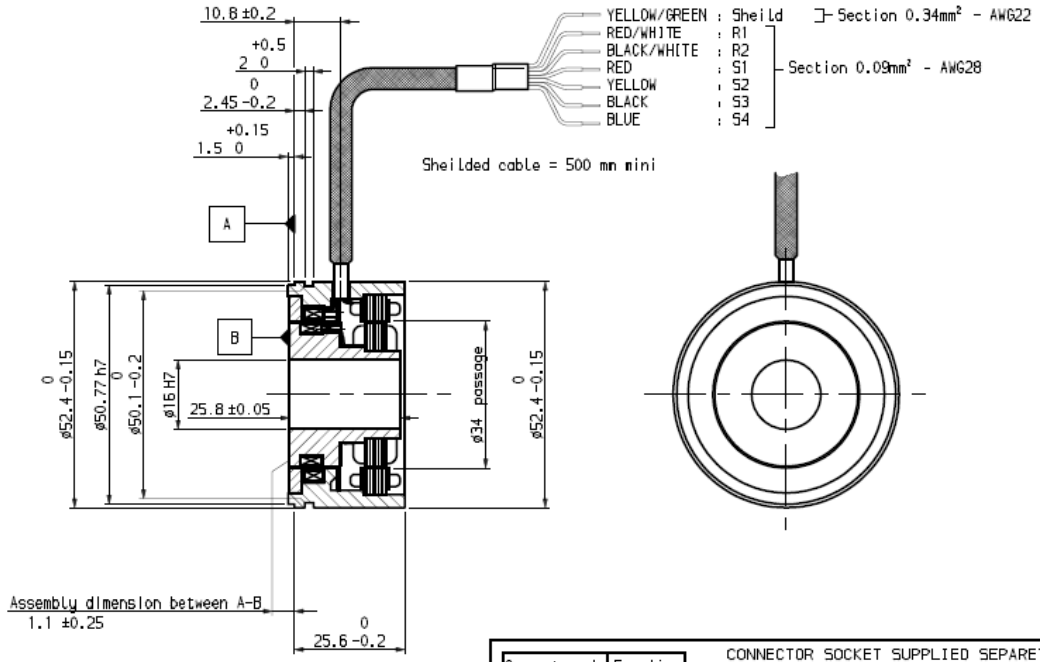
3.8.3.1. Resolver drawings



MOUNTING ADAPTATION

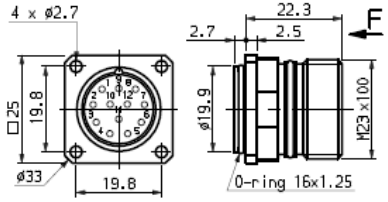


DRAWING



Connector pin	Function
1	S3
2	S1
3	/
4	/
5	/
6	/
7	S2
8	S4
9	/
10	R1
11	Sheild
12	R2

CONNECTOR SOCKET SUPPLIED SEPARETELY



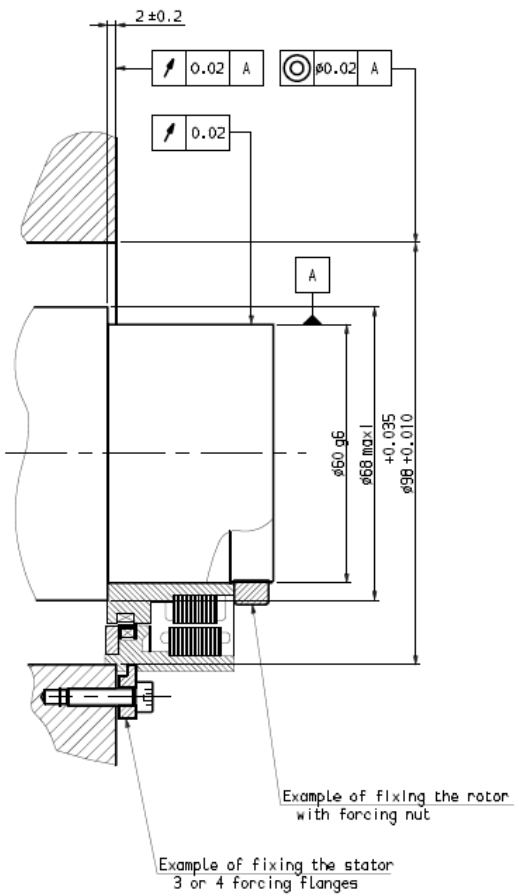
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Confidential document		Modifications	a	AM 21616 02/04/04 RP					
		Scale	1						

Tolerances generales : DIN ISO 2768 mK

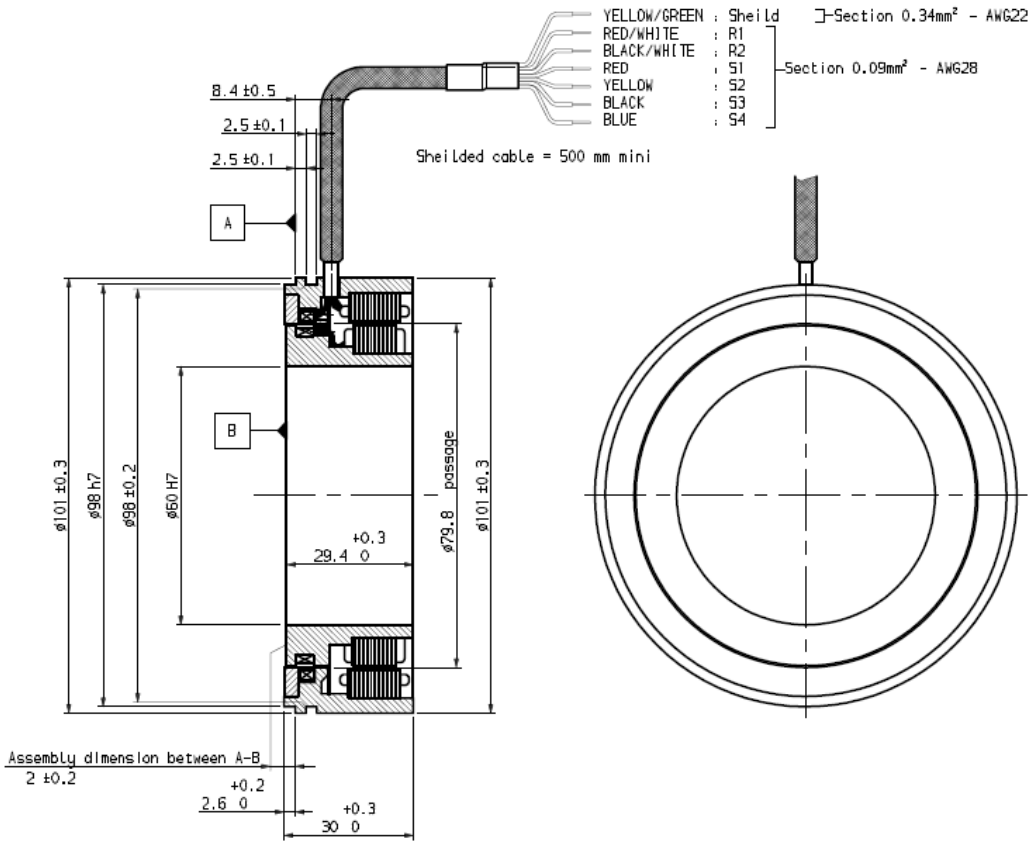
Parker
8 Avenue du Lac. BP249
21007 DIJON CEDEX

CB52	Format A3	Family :	ENC
DRAWING	344140E2000	Folio :	1
			a

MOUNTING ADAPTATION

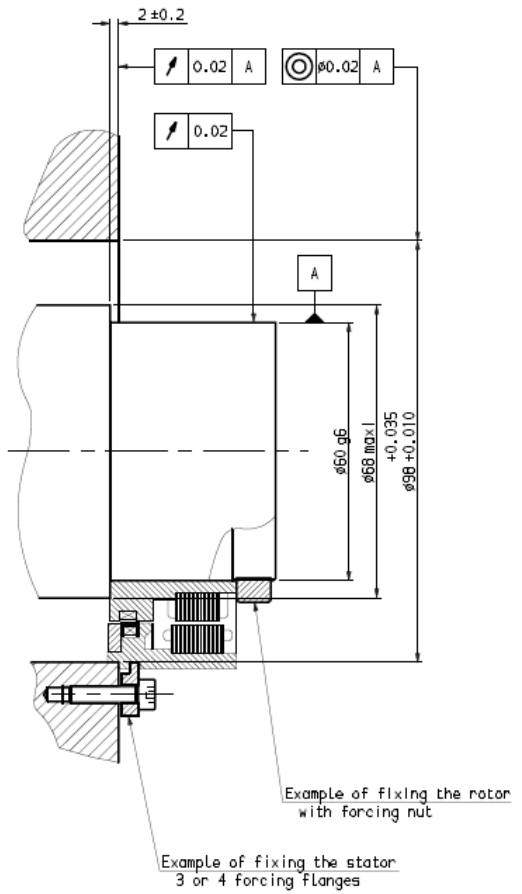


DRAWING

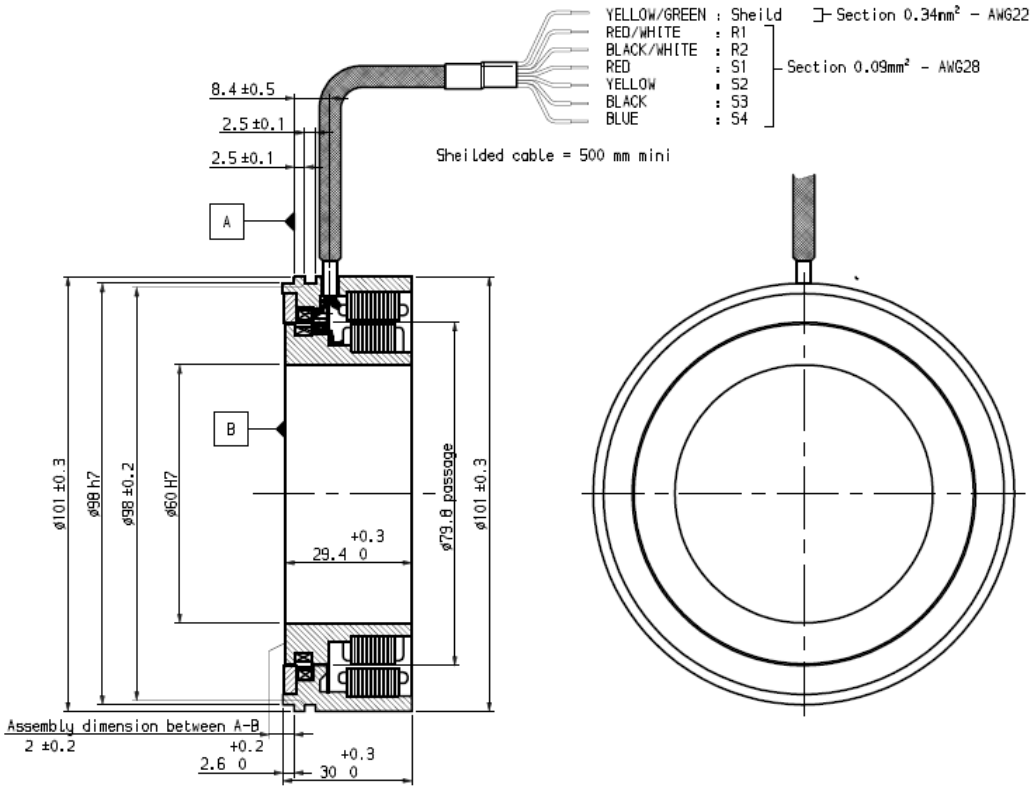


Weight :0.9 kg Confidential document		Designed	15/06/95	JMB	Checked		Dept.	FEDX	Scale 1	Tolerances generales : DIN 250 2768 MK Parker 8 Avenue du Lac. BP349 21007 DIJON CEDEX	CB102 DRAWING	A3	Family : ENC Folio : 1 343932E1000 c
		Modifications	c	AM 21132 12/09/02 RP									
			b	AM 19567 26/01/98 JMB									
			a	AM 19553 19/01/98 JMB									

MOUNTING ADAPTATION



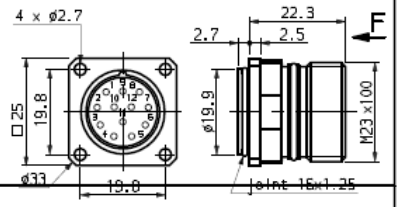
DRAWING



Raccordement	Fonction
Borne 1	S3
Borne 2	S1
Borne 3	/
Borne 4	/
Borne 5	/
Borne 6	/
Borne 7	S2
Borne 8	S4
Borne 9	/
Borne 10	R1
Borne 11	BLIndage
Borne 12	R2

Vue embase suivant F

EMBASE CONNECTEUR LIVREE SEPAREMENT



Weight :0.9 kg

Confidential document

Designed	15/06/95	JMB	Checked			Dept.	FEDX	
Modifications	c	AM 21132 11/*09/02RP						
	b	AM 19567 26/01/98 JMB						
	a	AM 19553 19/01/98 JMB	d	AM 21616 02/04/04 RP				

Scale 1

Tolerances generales : DIN ISO 2768 mK

Parker
8 Avenue du Lac. BP249
21007 DIJON CEDEX

CB102

DRAWING

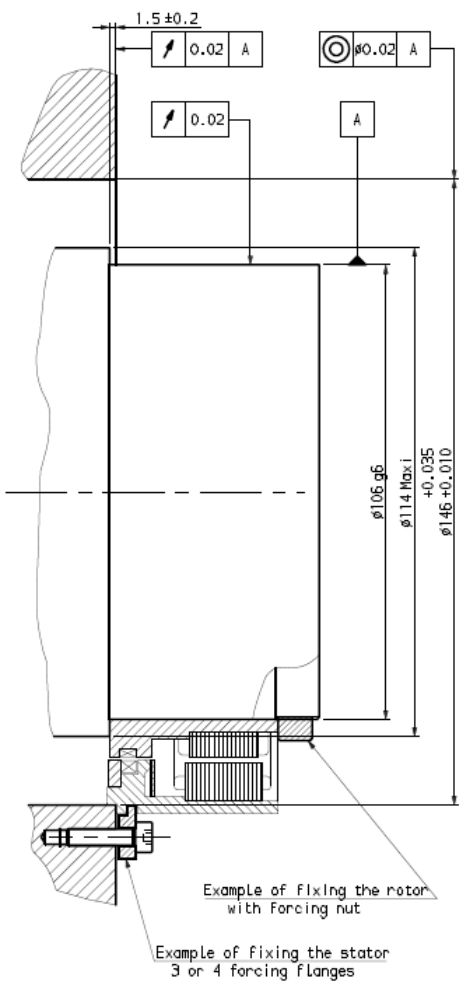
Format A3

Family : ENC

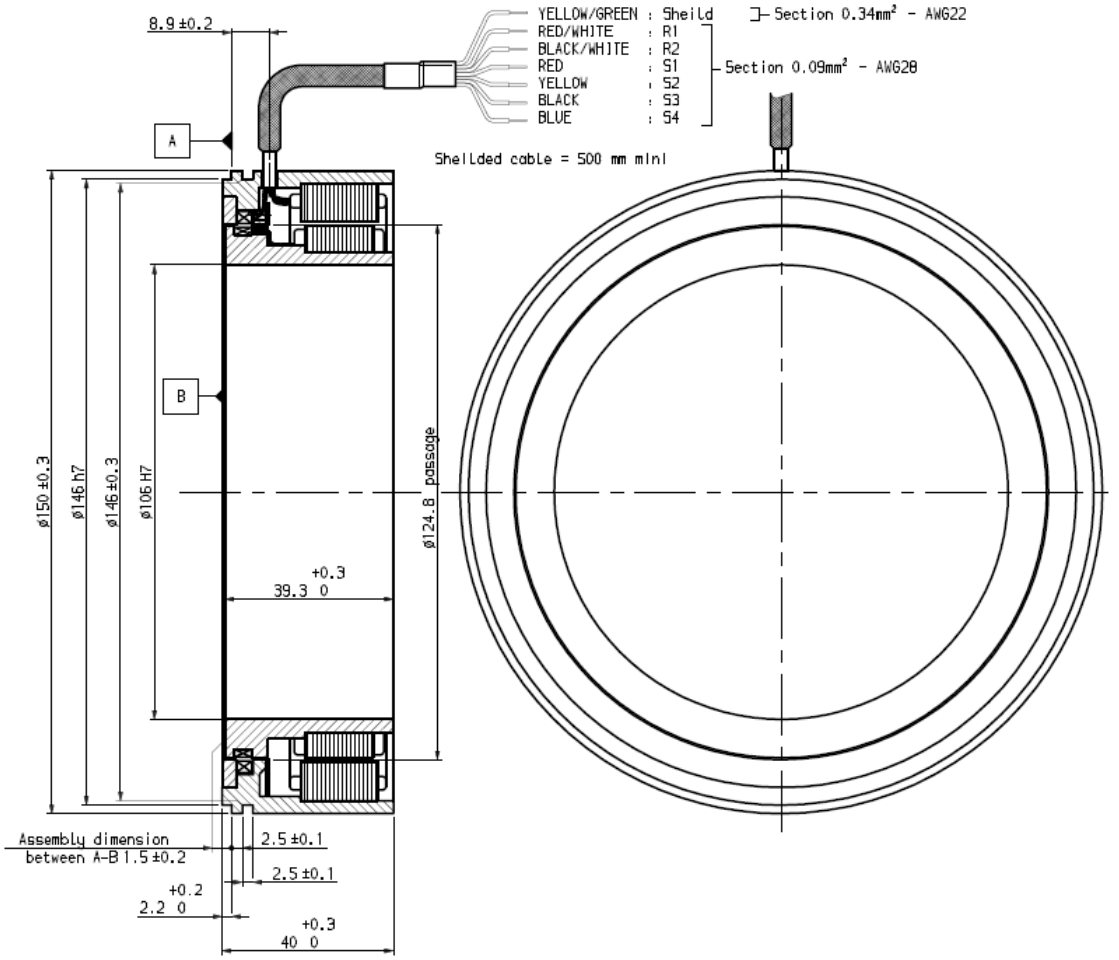
Folio : 1

343932E2000 d

MOUNTING ADAPTATION

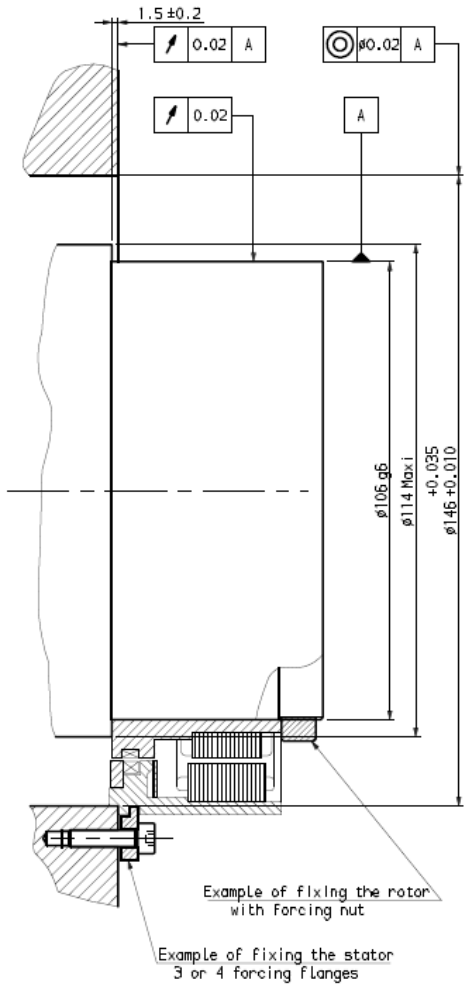


DRAWING

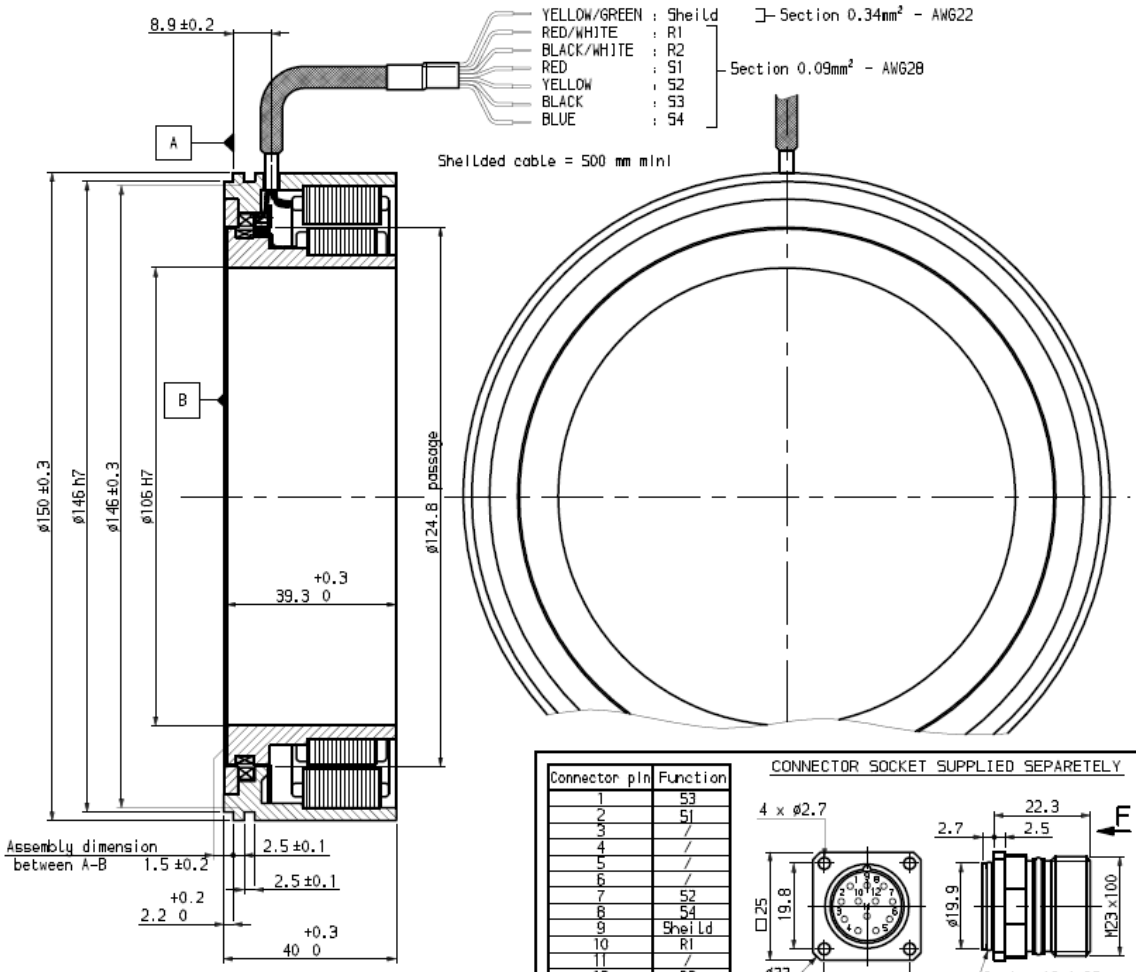


Weight : 2 kg Confidential document		Designed	26/06/95	JMB	Checked		Dept.	FEDX	Scale 1	Tolerances generales : DIN 250 2768 mK Parker 8 Avenue du Lac. BP249 21007 DIJON CEDEX	CB152 DRAWING	Format A3	Family : ENC Folio : 1
	Modifications	b	AM 19567 26/01/98 JMB								343961E1000	b	
		a	AM 19553 19/01/98 JMB										

MOUNTING ADAPTATION



DRAWING



Connector pin	Function
1	S3
2	S1
3	/
4	/
5	/
6	/
7	S2
8	S4
9	Sheild
10	R1
11	/
12	R2

CONNECTOR SOCKET SUPPLIED SEPARETELY

Weight : 2 kg

Confidential document

Designed	26/06/95	JMB	Checked		Dept.	FEDX
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Modifications b	AM 19567 26/01/98 JMB					
Modifications a	AM 19553 19/01/98 JMB					

Scale 1

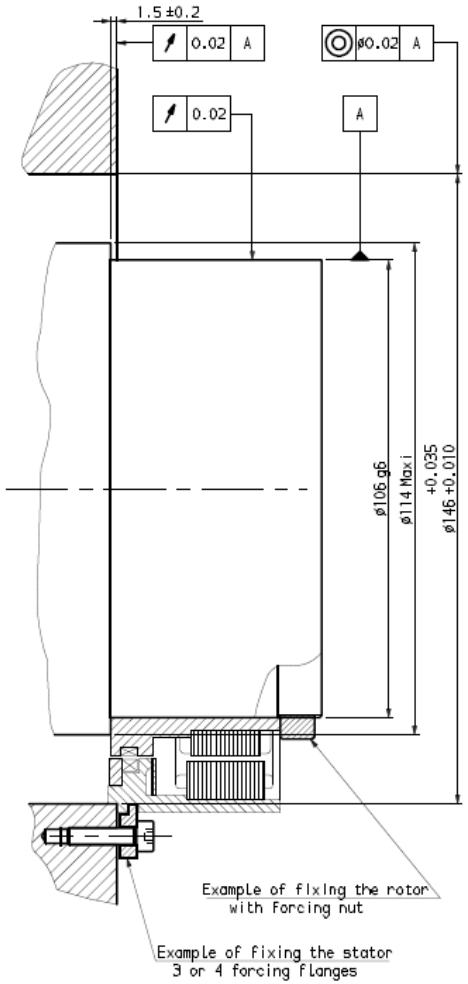
Tolerances generales : DIN ISO 2768 MK

Parker

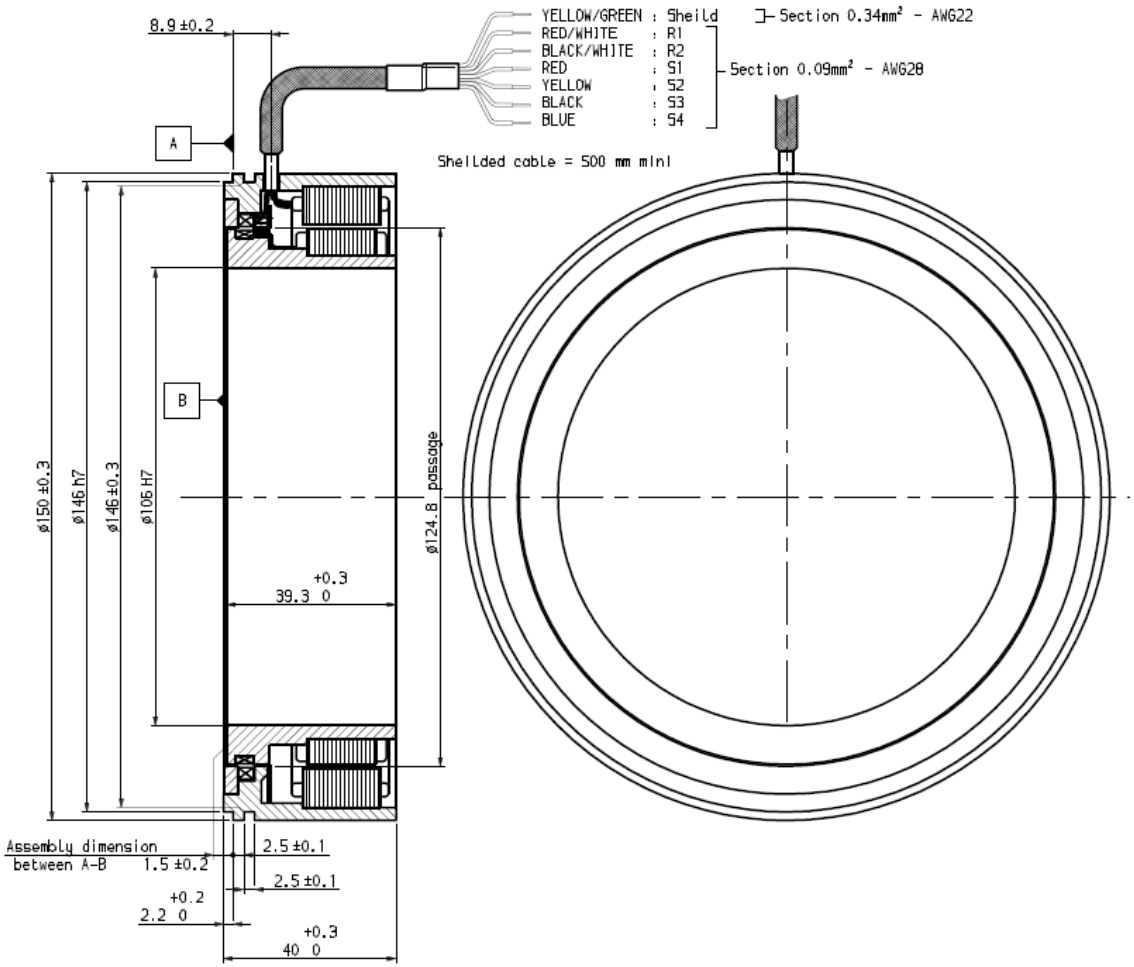
8 Avenue du Lac BP349
21007 DIJON CEDEX

CB152	Format A3	Family : ENC	
DRAWING	343961E2000	Folio : 1	c

MOUNTING ADAPTATION

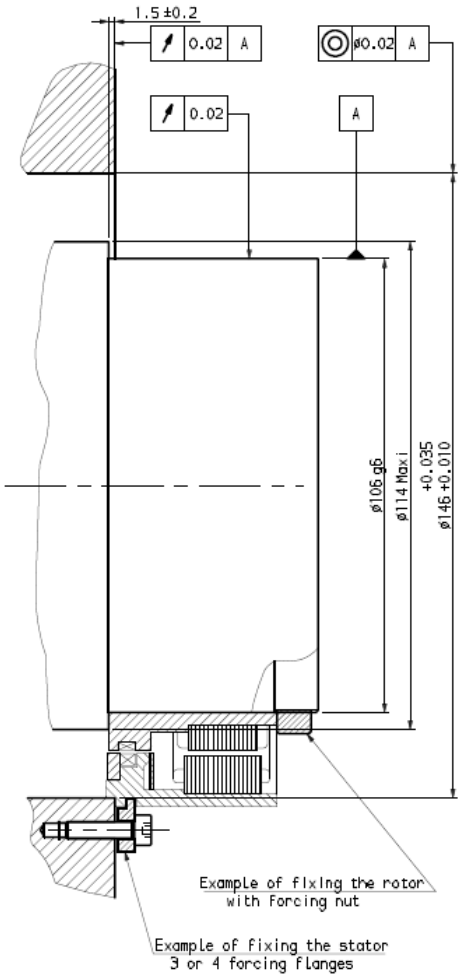


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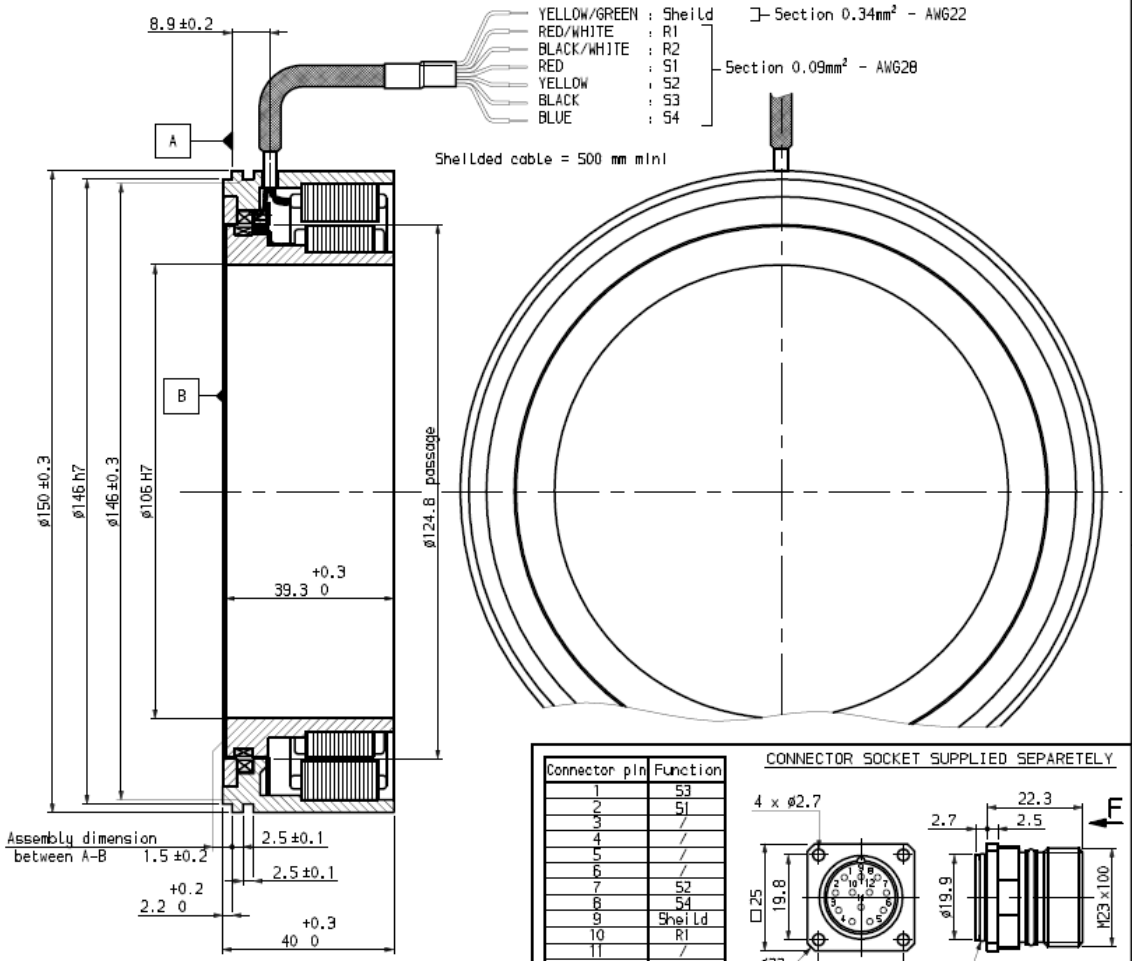


Weight : 2 kg Confidential document		Designed	04/11/98	JMB	Checked		Dept.	FEDX	Scale 1	Tolerances generales : DIN ISO 2768 mK Parker 8 Avenue du Lac BP249 21007 DIJON CEDEX	CB158 DRAWING	Format A3	Family : ENC Folio : 1 344144E1000
		Modifications											

MOUNTING ADAPTATION



DRAWING



Connector pin	Function
1	S3
2	S1
3	/
4	/
5	/
6	/
7	S2
8	S4
9	Sheild
10	R1
11	/
12	R2

CONNECTOR SOCKET SUPPLIED SEPARETELY

Weight : 2 kg		Designed	22/10/98	JMB	Checked		Dept.	FEDX	
Confidential document		Modifications	a	AM 21616 02/04/04 RP					
							Scale	1	

Tolerances generales : DIN ISO 2768 mK

Parker
8 Avenue du Lac. BP249
21007 DIJON CEDEX

CB158	Format A3	Family :	ENC
DRAWING	344144E2000	Folio :	1
			a

4. COMMISSIONING AND USE

4.1. Instructions for commissioning and use

4.1.1. Equipment delivery

All spindle servomotors undergo a thorough quality control procedure before shipping. Check the condition of the servomotor when carefully removing it from its packaging. Check that the information on the identification plate corresponds to your order. The package includes required document and accessories.

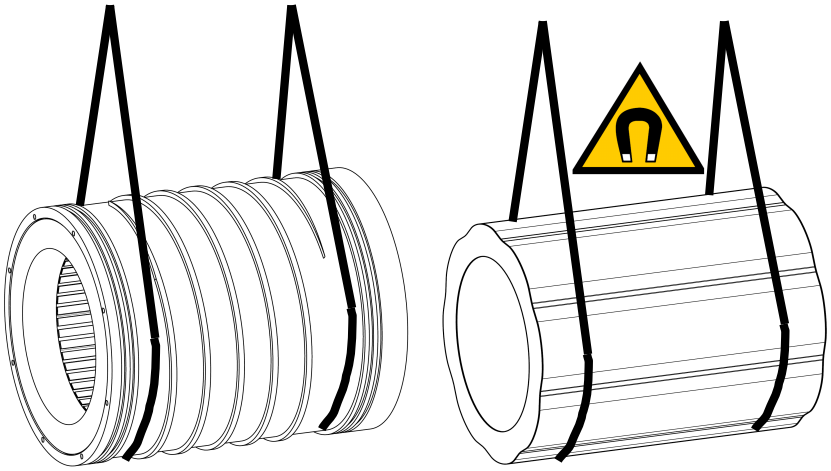
	Warning: If the equipment has been damaged during transit, the recipient should **immediately** complain to the carrier by registered letter within 24 hours.

4.1.2. Handling

Spindle Motors are delivered in two part, rotor and stator divided.

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

The drawings below show the correct handling procedure.



	DANGER: Choose the correct slings for the motor weight. The two slings must the same length.

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 high-speed motor has to be stored for a long time, verify that the surfaces 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, …) 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.

4.2.2. Tightening torque

The table below gives the average tightening torques required regarding the fixing screw diameter.

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

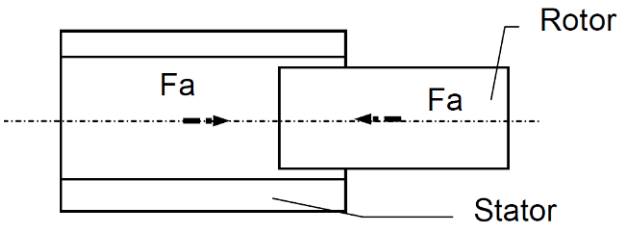
Screw diameter	Tightening torque
M9 x 1.25	31 N.m
M10 x 1.5	40 N.m
M11 x 1.5	56 N.m
M12 x 1.75	70 N.m
M14 x 2	111 N.m
M16 x 2	167 N.m
M18 x 2.5	228 N.m
M20 x 2.5	329 N.m
M22 x 2.5	437 N.m
M24 x 3	564 N.m



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

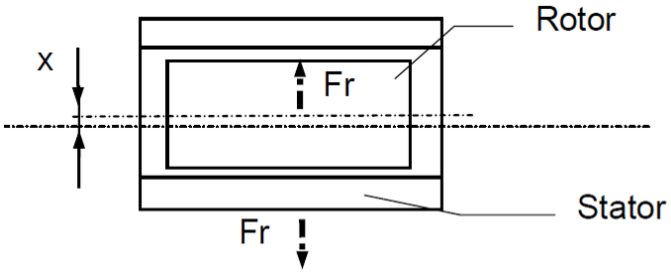
4.2.3. Rotor integration step by step

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



Motor	Axial attraction force (N)
HKW085	40
HKW108	60
HKW155	150
HKW195	200
HKW242	280
HKW310	520

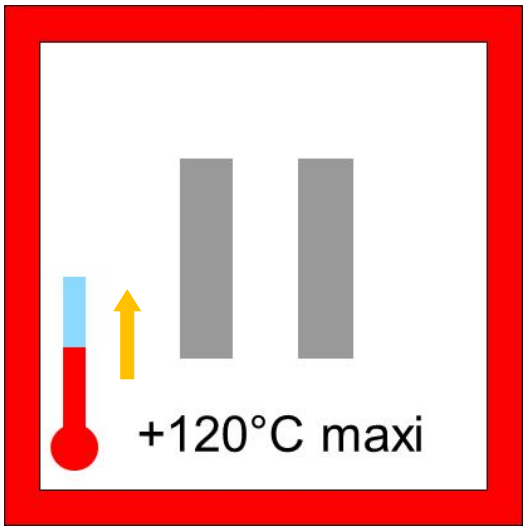
The radial attraction force is proportional to the rotor eccentricity x :



Motor	Radial attraction force Fr at the maximum rotor eccentricity (N)
HKW085_066	240
HKW085_099	360
HKW108_080	580
HKW108_140	1000
HKW108_200	1420
HKW155_080	850
HKW155_120	1275
HKW155_160	1700
HKW155_240	2125
HKW195_120	1600
HKW195_180	2400
HKW195_300	4100
HKW195_360	4800
HKW195_420	5740
HKW242_225	3500
HKW242_375	5800
HKW310_200	5800
HKW310_300	8700
HKW310_400	11600
HKW310_500	14300

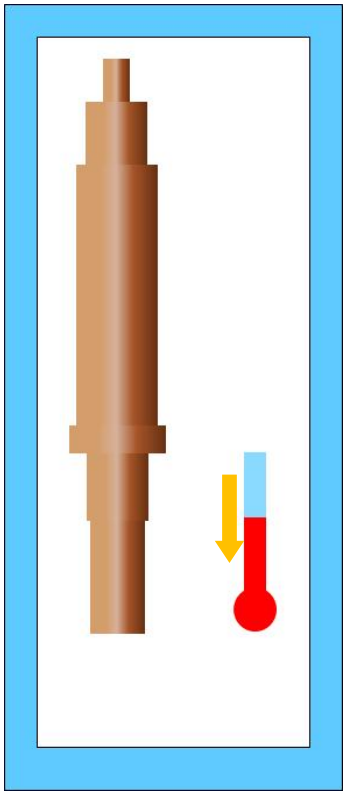
4.2.3.1. HKW without hub, option R0000 and R1000

Step 1



Increase rotor temperature to 120°C

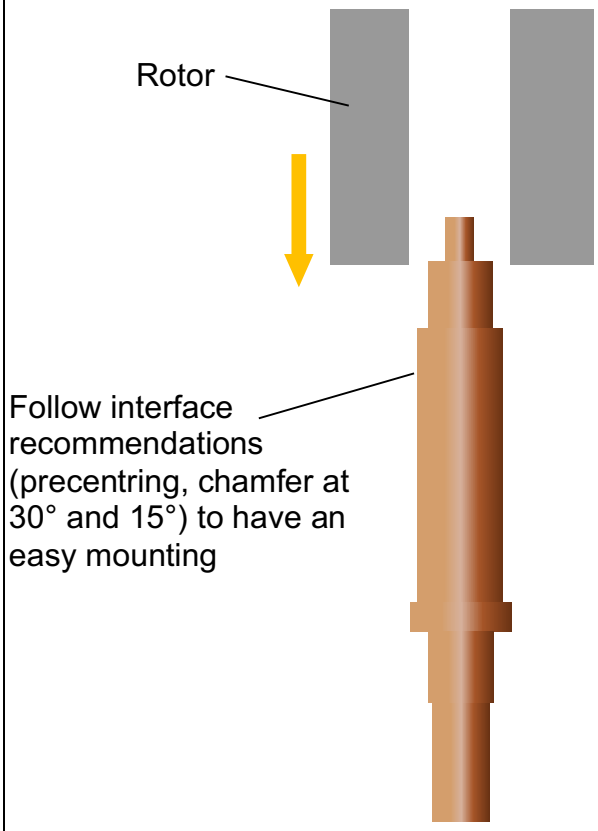
Step 2



Decrease shaft temperature with liquid nitrogen

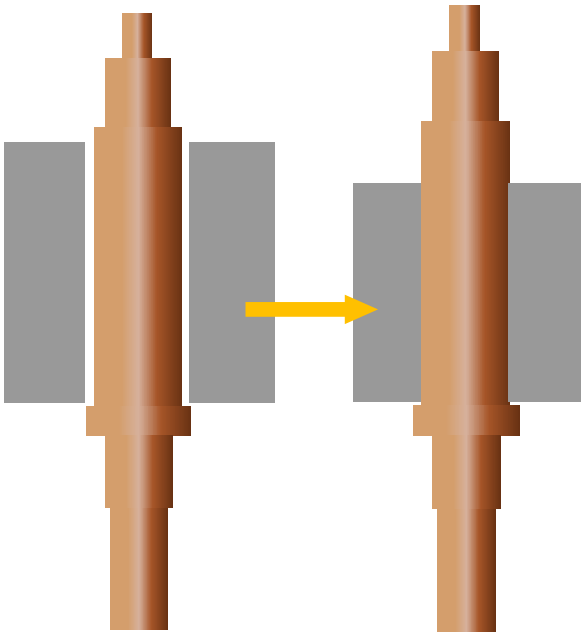
Motor	Temperature
HKW108	-180°C
HKW155	-180°C
HKW195	-180°C
HKW242	-120°C
HKW310	-80°C

Step 3

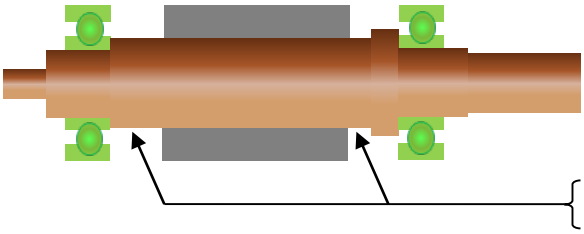


Push down the rotor on the shaft
Make sure you have followed the shaft interface instruction.

Step 4



After fitting, let rotor+shaft go back to ambient temperature

Step 5	
	Rotor balancing For high speed application, rotor must be balanced with bearings and shaft. Balancing recommended level : G1 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.

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

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

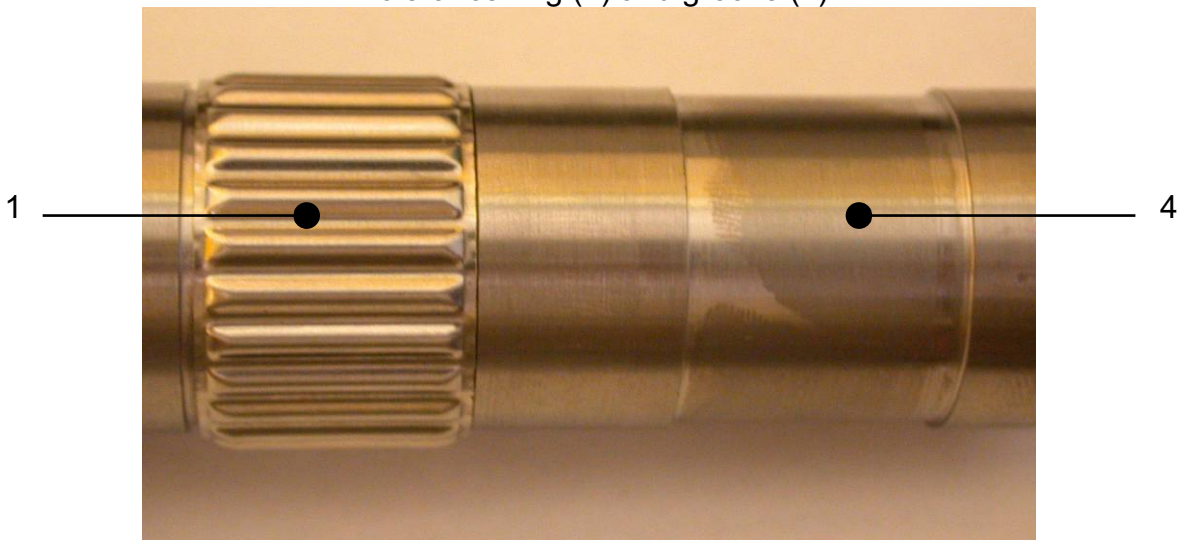
4.2.3.2. HKW085 and HKW108 with hub, option R2000 and R3000

The HKW085 and HKW108 rotors with hub are mounted with 2 tolerance rings. The torque is transmitted by these tolerance rings (1) which are located in thin grooves (4) machined on the spindle shaft (view shaft interface).

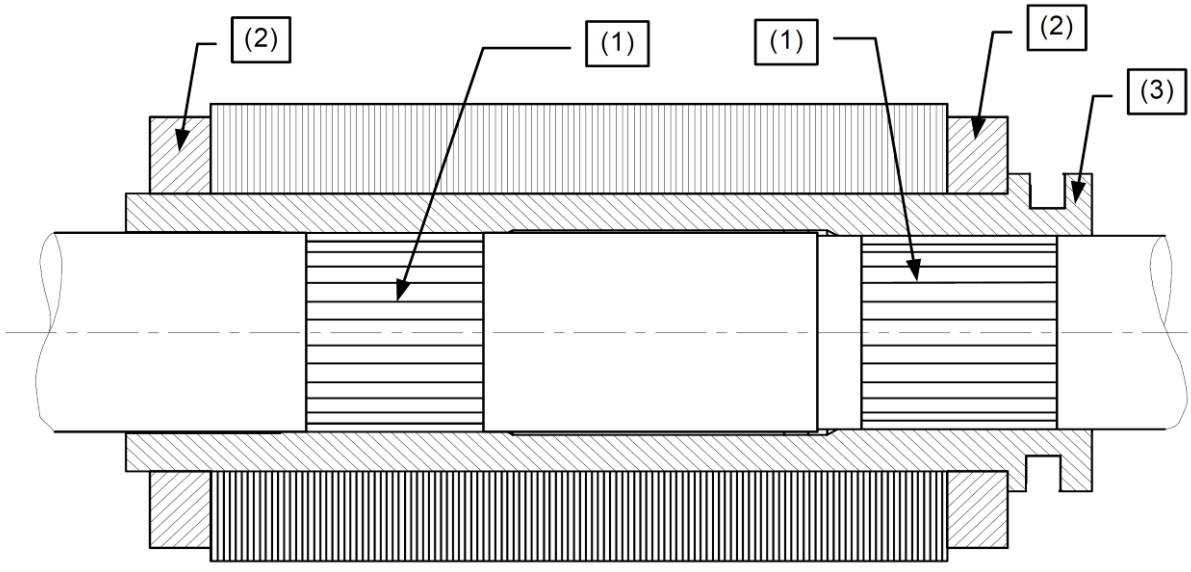
Tolerance rings part number:

	HKW085	HKW108
Part number	282280P0022	282280P0021

Tolerance ring (1) and groove (4)

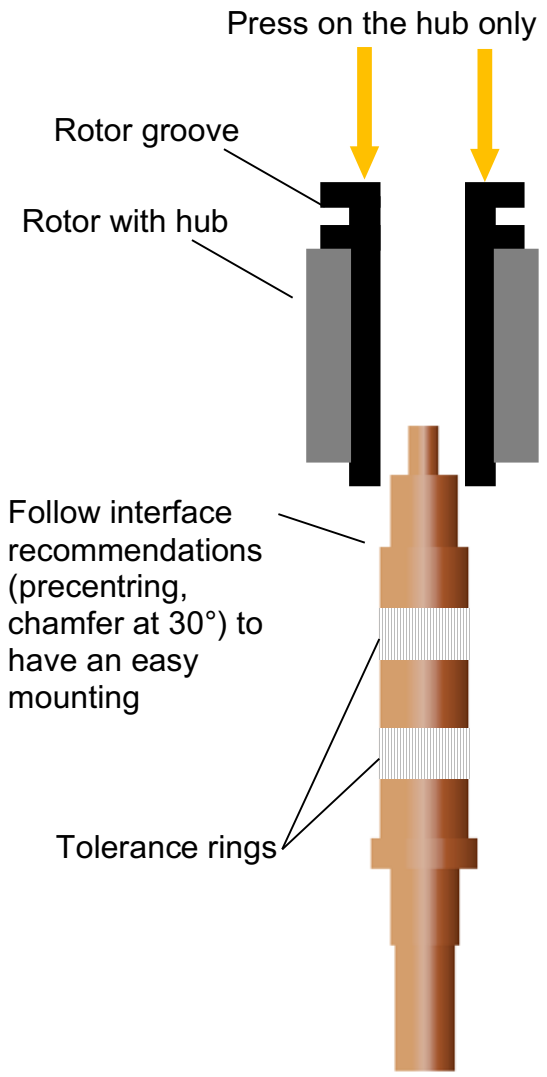


Rotor mounting by means of tolerance rings



1: tolerance rings
2: balancing flanges
3 : Hub

Step 1



Fit the tolerance rings in the motor shaft grooves with their openings facing in opposite directions.

Fit the shaft into the rotor by means of a pressing machine.

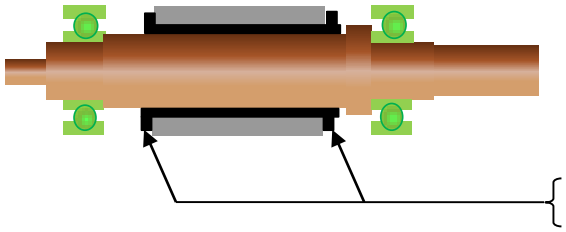
The maximum force required to insert the shaft is:

	HKW085	HKW108
Press fitting force	100 kN	150 kN

Caution: The rotor can be removed but cannot be used anymore. The shaft remains safe for other uses.

Caution: For mounting and removal operation, always use the rotor groove. Never push on laminations of the rotor

Step 2



Rotor balancing

For high speed application, rotor must be balanced with bearings and shaft.

Balancing recommended level : G1

Area to add headless screw to refine the balancing (only on HKW108)

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.



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

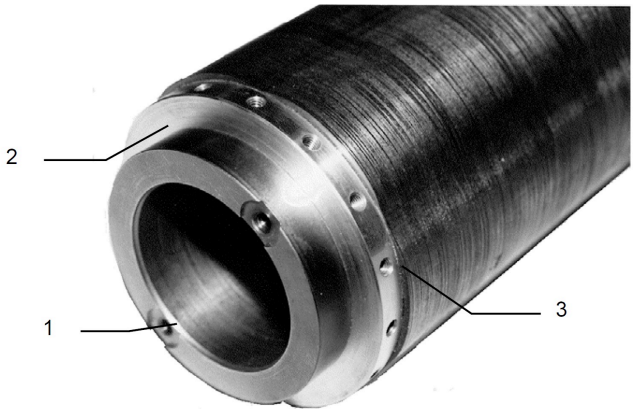
Balance can be fine on both sides of the rotor (except HKW085 and HKW310) by inserting headless screws on balancing flanges. These screws must not exceed the external diameter of the sides.



Caution: Balancing flanges of the rotor is insufficient to make the complete balancing of the spindle shaft.



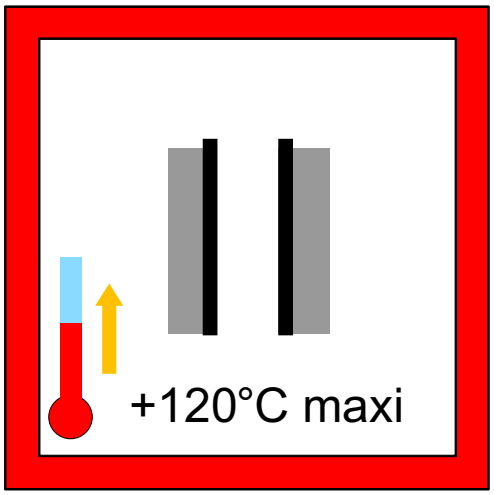
Caution: Balancing must never be made by removing material from the rotor sides, the rotor lamination or any other part of the rotor.

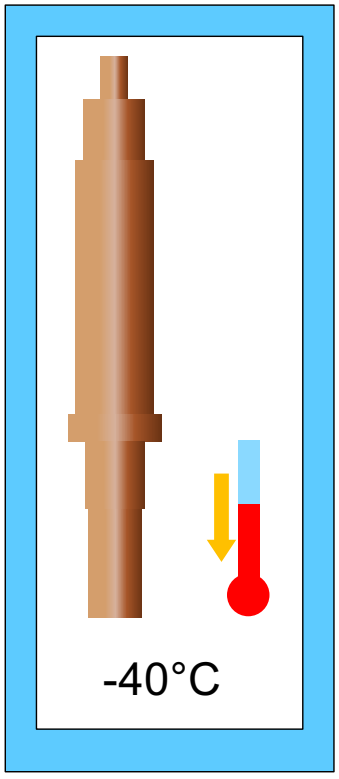


Motor	Size of the balancing screws
HKW085	No screws
HKW108	M4

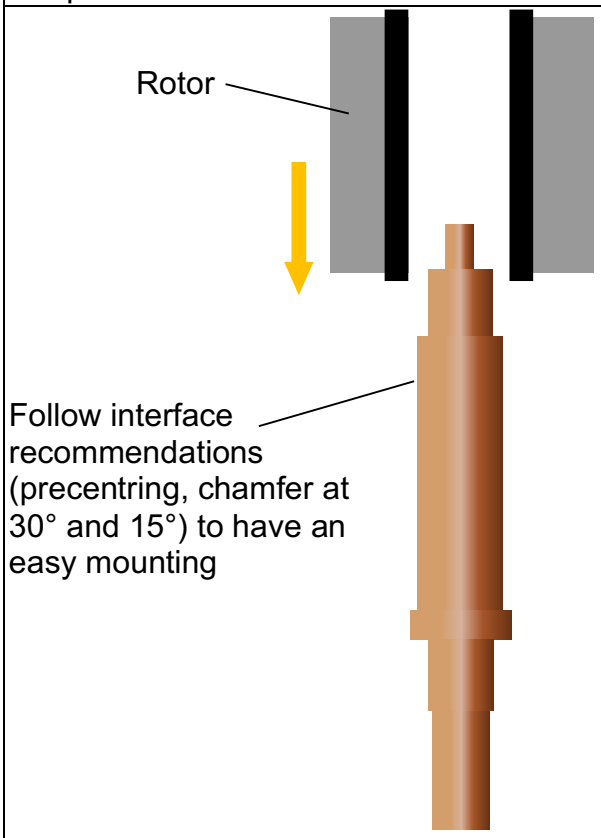
(1) - Oil Inlet (2) - Balancing flange (3) - Threaded holes

4.2.3.3. HKW155, HKW195, HKW242 and HKW310 with hub, option R2000 and R3000

Step 1	
	Increase rotor temperature to 120°C

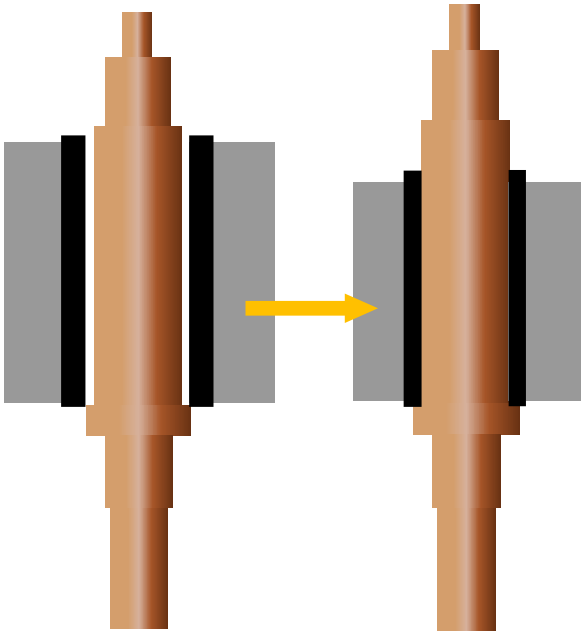
Step 2	
	Decrease shaft temperature to -40°C

Step 3



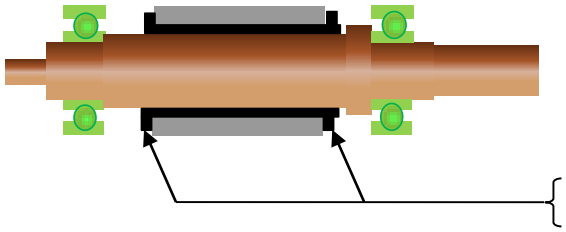
Push down the rotor on the shaft
Make sure you have followed the shaft interface instruction.

Step 4



After fitting, let rotor+shaft go back to ambient temperature

Step 5



Rotor balancing

For high speed application, rotor must be balanced with bearings and shaft.

Balancing recommended level : G1

Area to add headless screw to refine the balancing (except HKW310)

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.



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

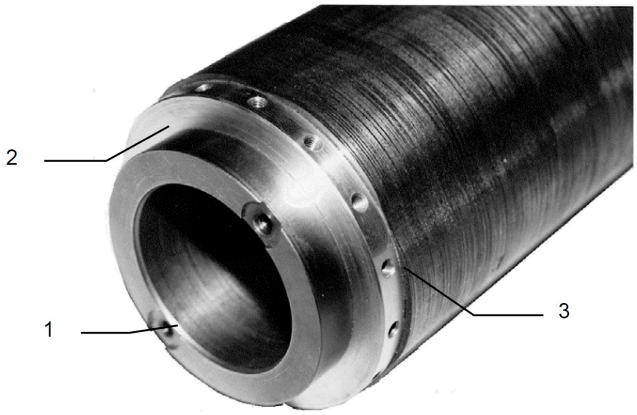
Balance can be fine on both sides of the rotor (except HKW085 and HKW310) by inserting headless screws on balancing flanges. These screws must not exceed the external diameter of the sides.



Caution: Balancing flanges of the rotor is insufficient to make the complete balancing of the spindle shaft.



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

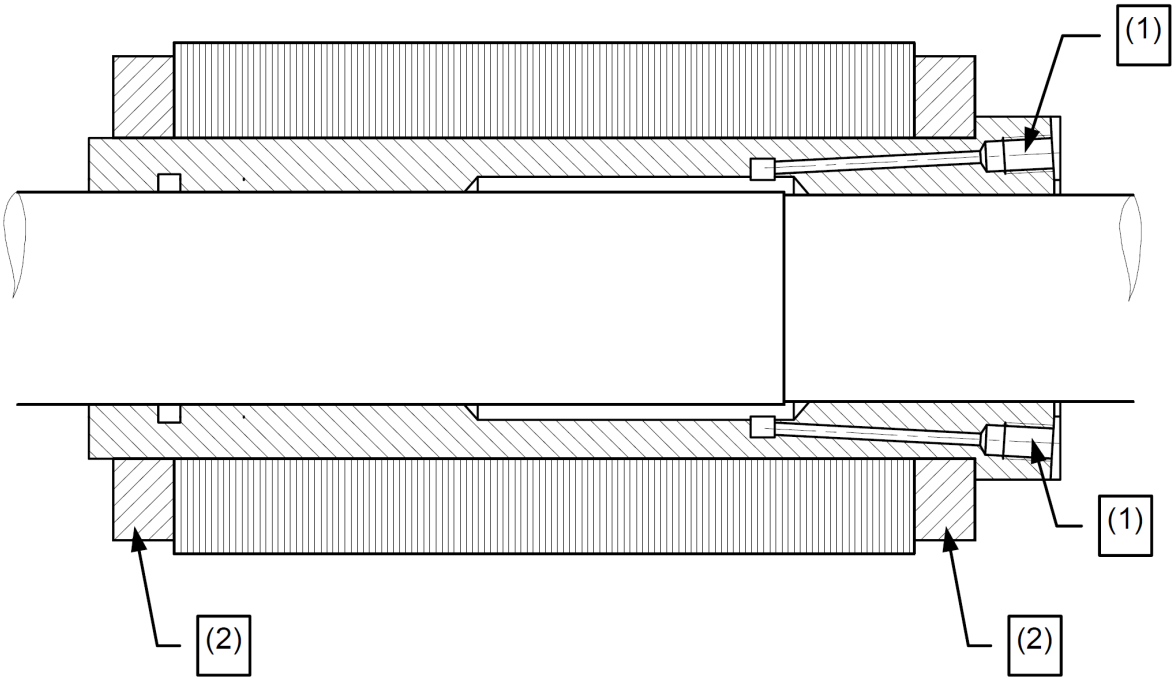


Motor	Size of the balancing screws
HKW155	M5
HKW195	M5
HKW242	M6
HKW310	No screws

(1) - Oil Inlet (2) - Balancing flange (3) - Threaded holes

The rotor can be removed by supplying oil pressure into the rotor (inlet (1)). The maximum required pressure is 1000 bars. After dismounting, the rotor and the shaft can be used again.

Mounting by means of a hydraulic hub

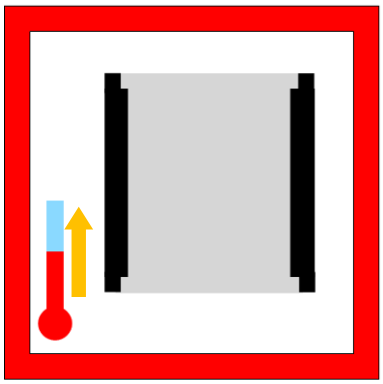


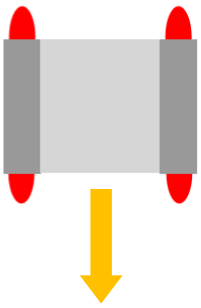
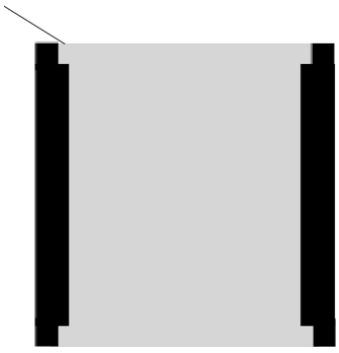
1: oil pressure inlet
2: balancing flanges

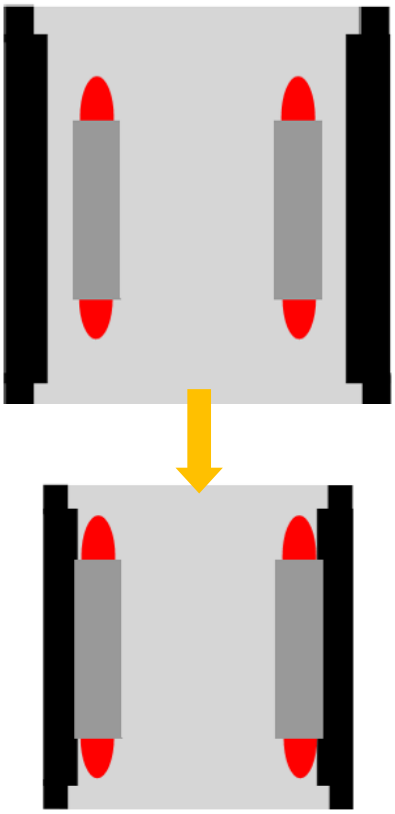
	Caution: If additional mounting or removal tools are used, these tools should not apply forces on laminations or rotor flanges.

4.3. Stator mounting on water jacket

4.3.1. HKW without water jacket, option R0000 and R2000

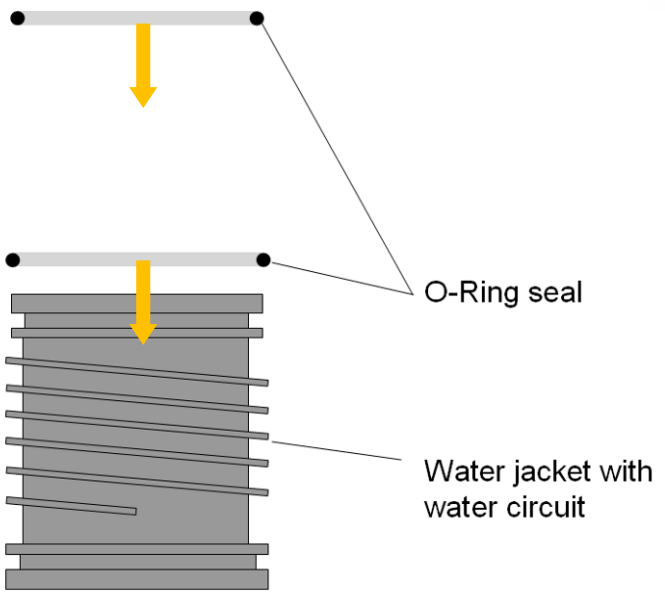
Step 1	
	Increase water jacket temperature - to 250°C for aluminum housing

Step 2	
 Chamfer at 30° to have an easy mounting 	Push down the stator in the water jacket. Make sure you have followed the water jacket interface instruction.

Step 3	
	After fitting, let stator+water jacket go back to ambient temperature

4.4. Water cooling motor assembly

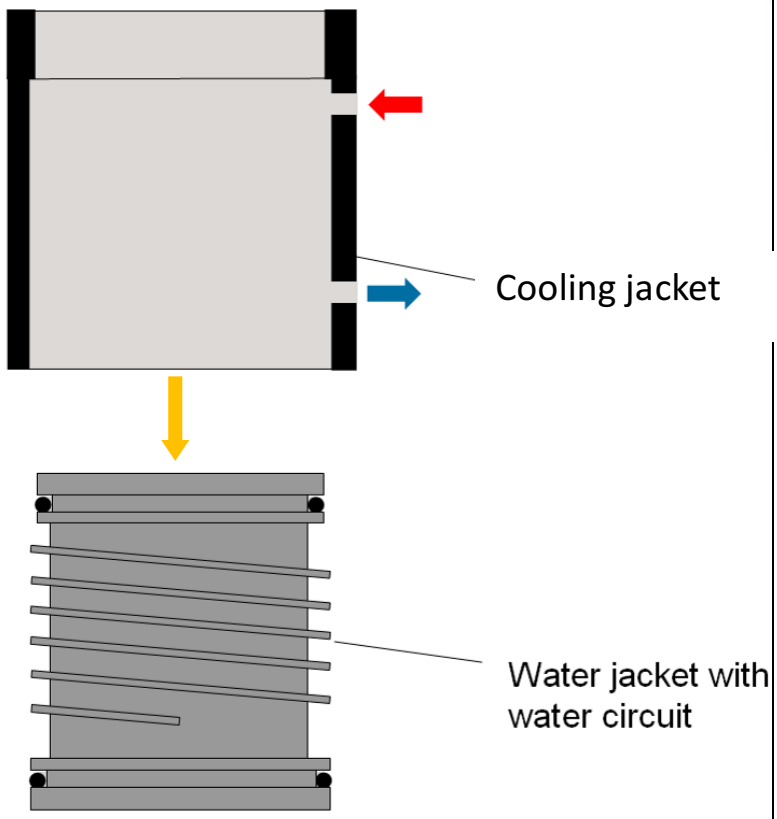
Step 1



Assemble O-Ring seal on water jacket.

O-Ring information's for standard water jacket in chapter "O-Ring specification".

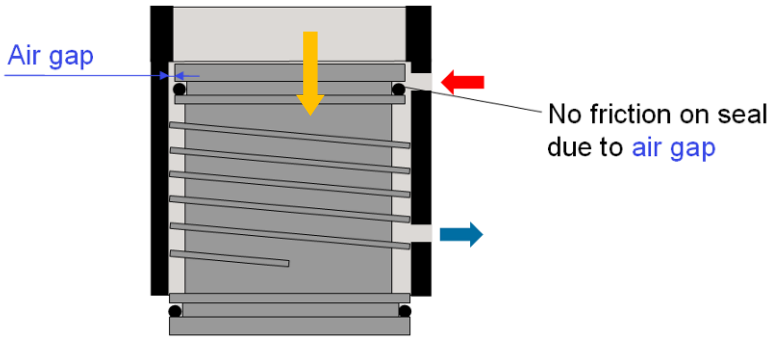
Step 2

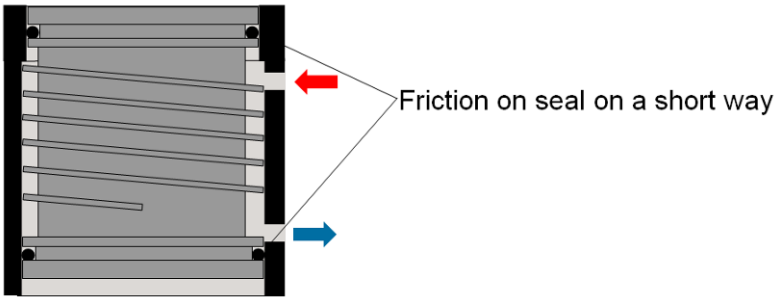


Prepare the cooling jacket for his integration :
Water inlet and outlet must be aligned with the cables inlet

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

Step 3	
	Push down the cooling jacket on the water jacket.

Step 4	
	Cooling jacket instructions have been designed to minimize the O-Ring seal friction.

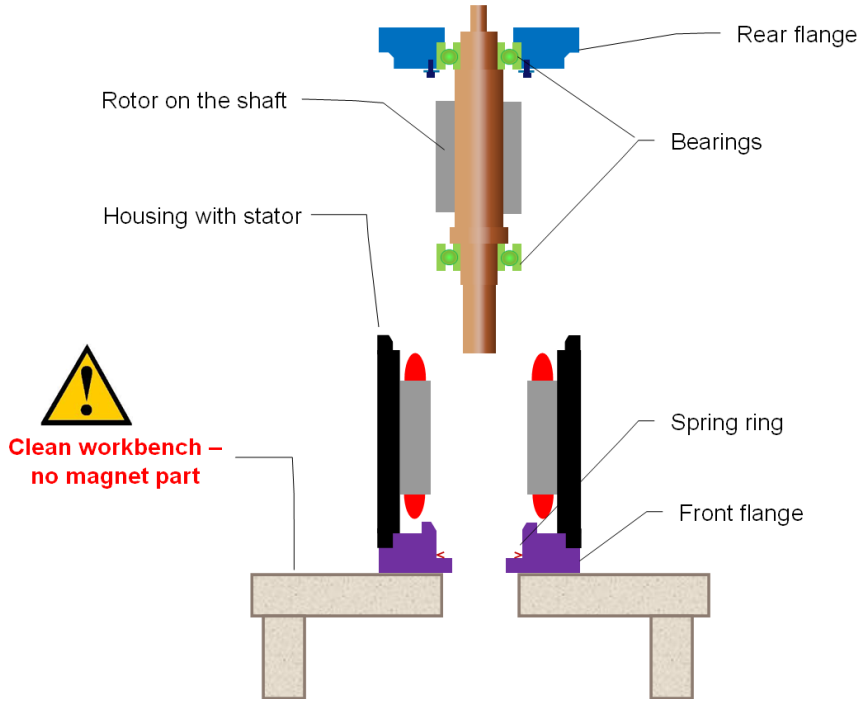
	Caution: Be careful not to make damage on the O-ring during the mounting to avoid leakage. After last mounting step, it's recommended to realize a waterproof test with 10 bars air pressure during 30 minutes and check if there is not pressure decreasing.

4.5. Motor integration

Rotor assembly into stator

There are different solutions, depends of the weight of the rotor:
-1st solution: for light motor

Step 1



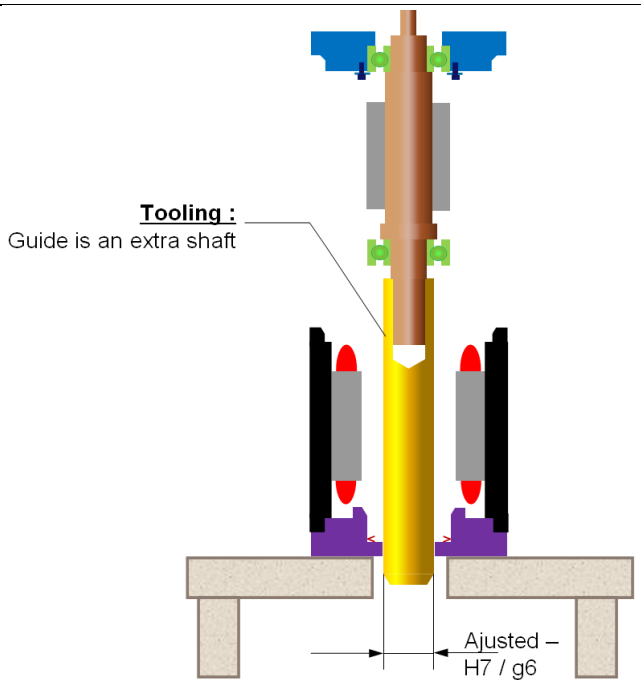
Screw the stator onto the front flange.

Put the stator onto workbench.

Put spring ring.

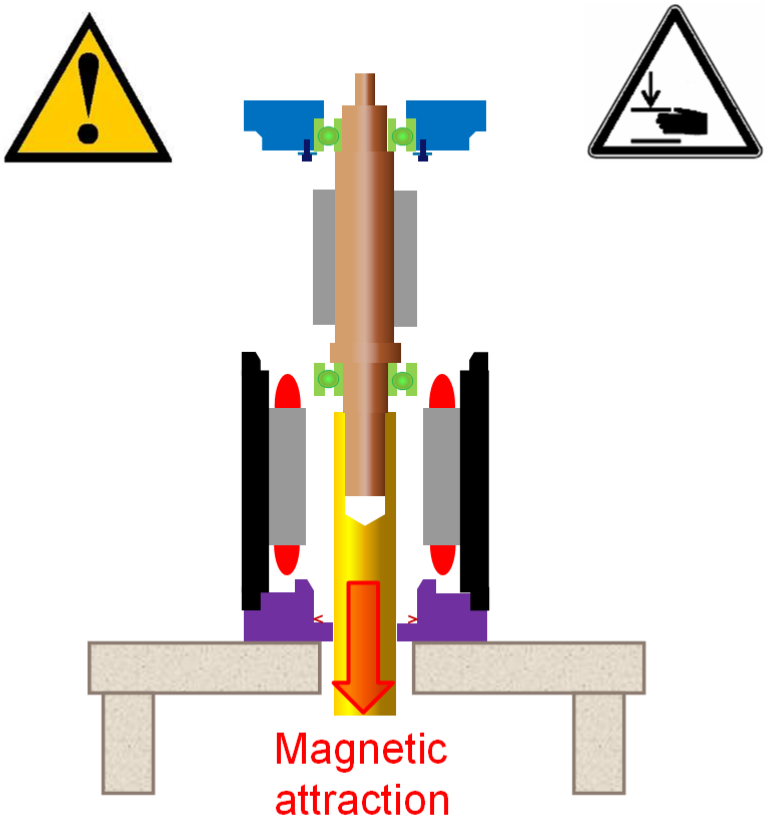
Prepare rotor : fit onto rear flange.

Step 2

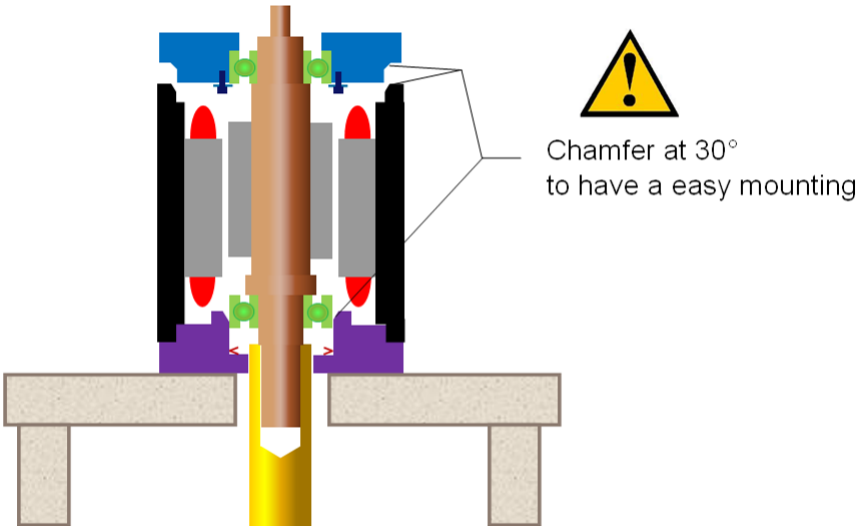


For an easier assembly, use an extra shaft to guide rotor on stator to avoid gluing due to magnetic parts.

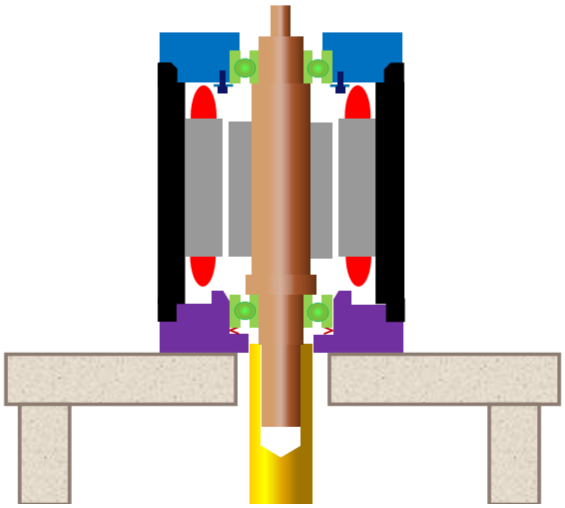
Step 3



<u>Danger :</u> do not put your hand inside the motor during way-down.



Make sure you have done chamfers at 30°.

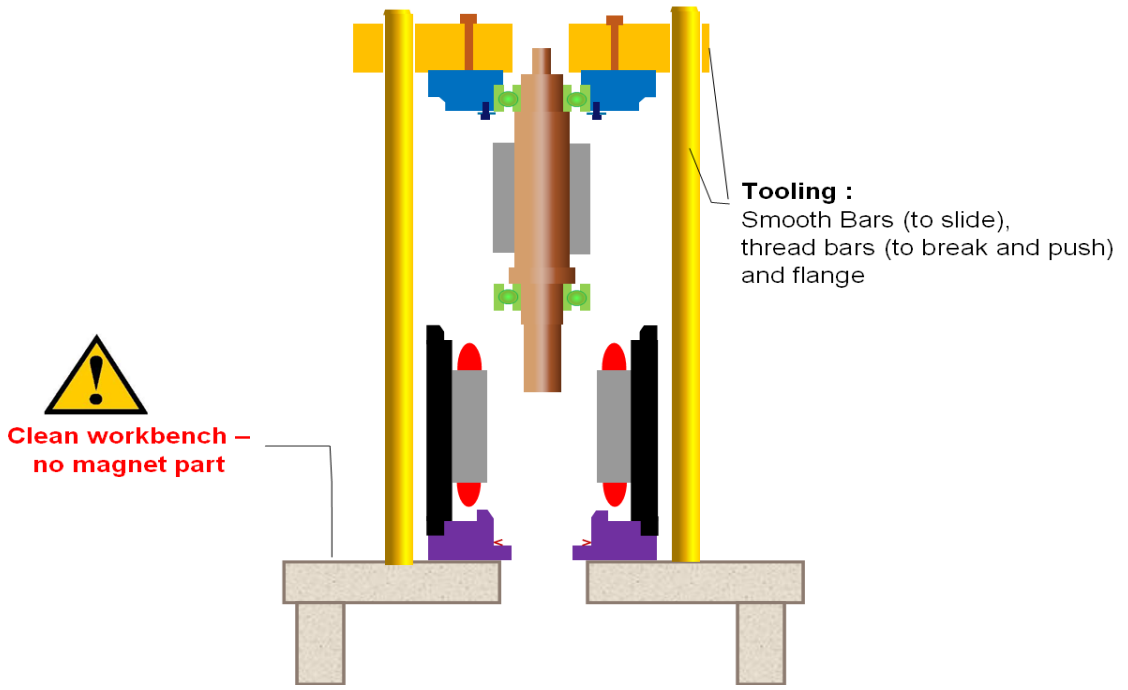
Step 4	
	Screw the rear flange on the stator to close motor.

Step 5
Last step is the encoder or resolver mounting

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

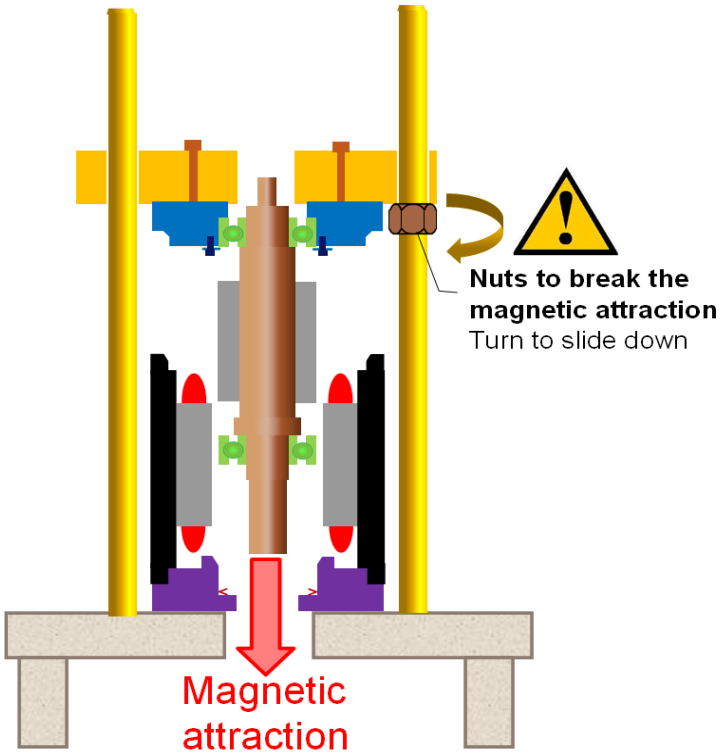
-2nd solution : for heavy motor

Step 2



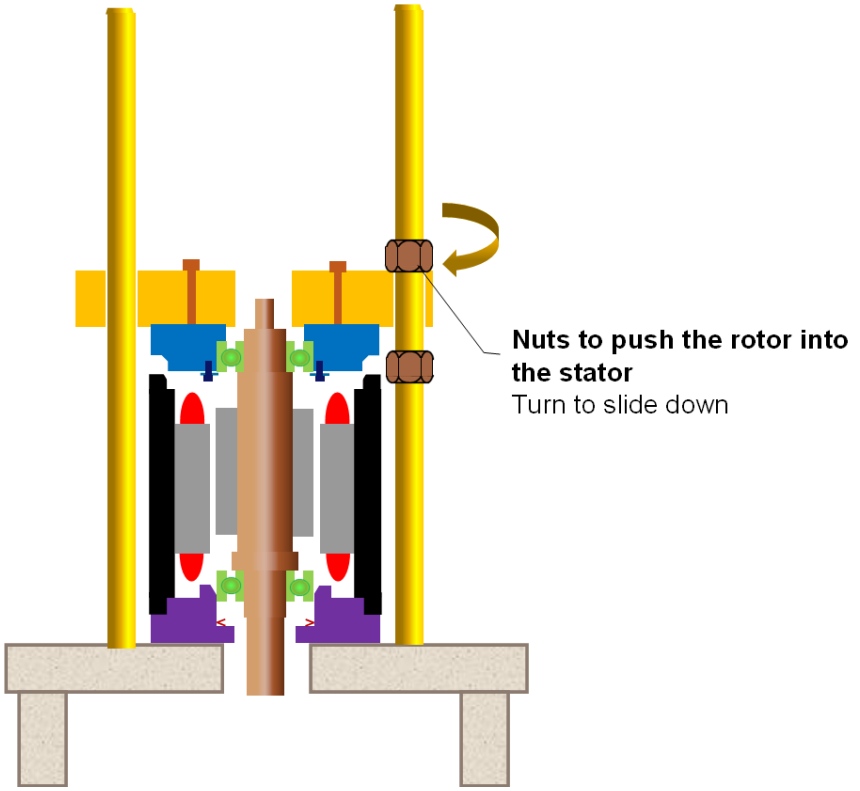
For an easier assembly, use extra smooth and thread bars outside of the stator to guide and push rotor onto the stator.

Step 4



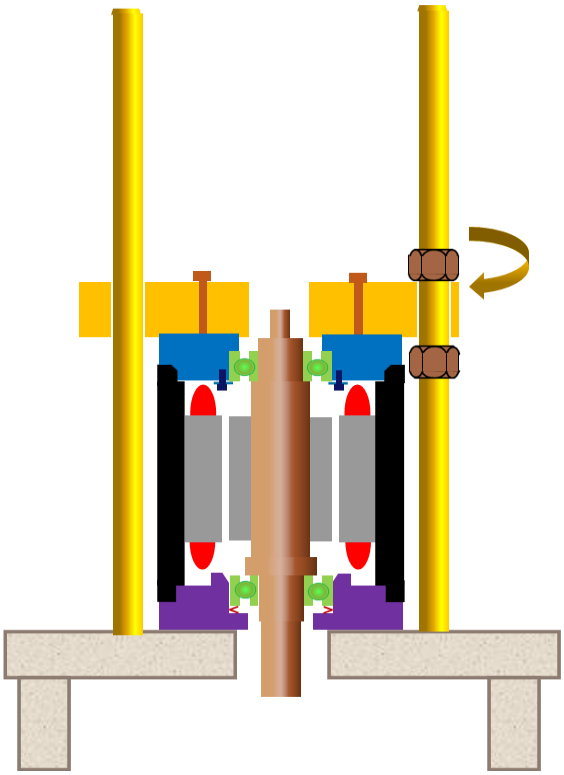
Caution : do not put your hand inside the motor during way-down.

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

4.6. 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.

	**Attention**: The resolver cable is shielded. The shielding is continued by the green & yellow lead (see resolver drawings). It must be connected to the resolver cable shielding from the drive. If the PARKER resolver cable is utilized, connect the resolver cable shielding (green & yellow) to connector pin #9.

4.6.1. 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.

4.7. Electrical connections

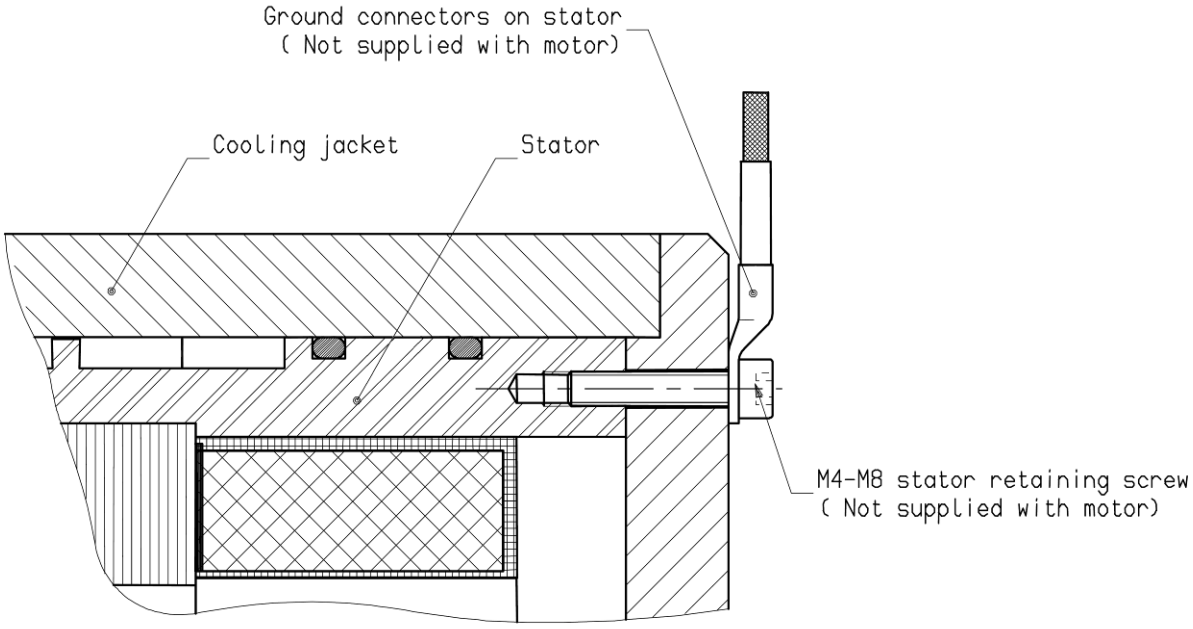
	Danger: Do not connect the kit to any electric supply . Only the motor can be connected to an electric supply.
	Danger: Check that the power to the electrical cabinet is off prior to making any connections.
	Caution: The wiring must comply with the drive commissioning manual and with recommended cables. 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.
Many usefull informations 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 spindle motor frame and machine. The ground cable cross-section must be the same as the power cable cross-section



Before applying power:

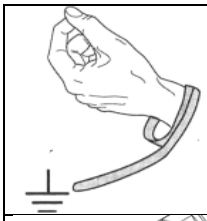
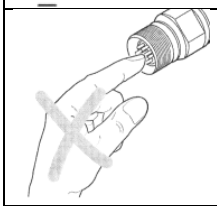
- ✓ Check there is no damage on winding or cable due the mounting by a dielectric test
- ✓ Check all external wiring circuits of the system – power, control, motor and earth connections.
- ✓ Ensure that nobody is working on another part of the system who will be affected by powering up
- ✓ Ensure that other equipment will not be adversely affected by powering up.

4.8. 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).

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

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

4.9. Tests

The motor components delivered by Parker 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, …) 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
…	…					

4.10. Troubleshooting

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

You note that the motor does not turn by hand when the motor is not connected to the drive.	• Check there is no mechanical blockage or if the motor terminals are not short-circuited.
You have difficulty starting the motor or making it run	• Check on the fuses, the voltage at the terminals (there could be an overload or the bearings could be jammed), also checks on the load current. • Check on any thermal protection, its connection and how it is set in the drive. • Check on the servomotor insulation (if in doubt, carry out hot and cold measurements). The minimum insulation resistance value measured under a max. 50V DC is 50 MΩ: • Between the phase and the casing • Between the thermal protection and the casing • Between the resolver coils and the casing.
You find that the motor speed is drifting	• Reset the offset of the servoamplifier after having given a zero instruction to the speed setpoint input.
You notice that the motor is racing	• Check the speed set-point of the servo drive. • Check you are well and truly in speed regulation (and not in torque regulation). • Check the encoder setting • Check on the servomotor phase order: U, V, W
You notice vibrations	• Check the encoder and tachometer connections, the earth connections (carefully) and the earthing of the earth wire, the setting of the servo drive speed loop, tachometer screening and filtering. • Check the stability of the secondary voltages. • Check the rigidity of the frame and motor support.
You think the motor is becoming unusually hot	• It may be overloaded or the rotation speed is too low : check the current and the operating cycle of the torque motor • Check if the mounting surface is enough or if this surface is not a heat source – see §3.5 cooling. • Friction in the machine may be too high : - Test the motor current with and without a load. - Check the motor does not have thermal insulation.

You find that the motor is too noisy	Several possible explanations : • Unsatisfactory mechanical balancing. • Defective coupling • Loosening of several pieces • Poor adjustment of servo drive or position loop : check rotation in open loop
The motor is warmer on its top	Air bubbles can be stocked in the water cooling circuit. You need to purge the circuit or to double the water flow rate during 10 minutes to remove the air bubbles.