HSD
MECHATRONIC
DIVISION

Instruction Manual

H5803H0005_EN

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CE

Information on the publication

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List of Updates		
Revision	**Modified sections**	**Description of modifications**
00 of 06 / 2002	---	First edition
01 of 09 / 2005	---	General Revision
02 of 11 / 2007	Cover § 3.1.4, 3.1.5 § 4.2 § 4.2.8 § 4.6 § 4.9, 4.10 § 6.4 § 8.1 § 8.2 § 8.3.11 § 8.3.12, 8.3.13 § 11	Updated images ES775 removed, out of production Views with new bore positions updated Equivalent electric networks added Technical card and electric network equivalent to 13.5 kW model added Missing pneumatic connections added Electrical connections with HSD mounting plate and MIL connectors added Clamping force of A/E 63 hooks added Shaft kit replacement: procedure and notes about spare parts Procedure for encoder reader replacement added Gauges to adjust A/E 63 added Adjustment procedure S1 and S4 with kit updated Spare part list updated
03 of 07 / 2008	§4.6.1	Updated air specifications section

This publication is the English translation of the original Italian version of the manual HSD H5803H0005.

In case of discrepancies between this translation and the original version, refer to the original version in Italian.

The updated version of this manual is available at HSD website or at the HSD Customer Service (see page 111).

Manual prepared by the HSD Documentation Department with FrameMaker 7.0

Index

1 Preliminary Information

1.1 Documents supplied with the product

The documentation supplied with the product consists of:

- Manufacturer's Declaration complying with Annex IIB of Directive 2006/42/EC
- Product inspection certificate
- This manual, containing the warnings and instructions for transport, installation, operation, maintenance and disposal of the product.

Check that all the documents listed above are present at the time of delivery of the product; if necessary, request a new copy from HSD S.p.A.

1.2 Purpose of the manual

The manual forms an integral part of the product and must therefore accompany the product; if this is not the case, the product loses one of its essential safety requirements.

The manual must be handled with care, distributed and made available to all persons concerned.

The purpose of the warnings is to protect the safety of the persons exposed to the residual risks.

The instructions provide tips on the proper behaviour for the correct use of the product as intended by the manufacturer.

In the event that contradictions are discovered between these instructions and the safety standards, please contact **HSD S.p.A.** for any corrections and/or amendments.

In order to avoid incorrect operation that could result in danger for persons and/or damage to the product, it is important to read and understand all the documentation accompanying the product.

It is important to keep this manual in a suitable place and always within reach for consultation.

The information contained in the manual is indispensable for safe operation of the product in accordance with its intended use.

1.3 Symbols used in the manual

Indicates a procedure, practice or any other similar measure that, if not observed or correctly followed, may cause personal injuries.

Indicates an operational procedure, practice or any other similar measure that, if not observed or correctly followed, can damage or completely destroy the product.

Indicates information of particular general interest that must not be ignored.

1.4 Risks associated with the use of the product

HSD S.p.A. is not acquainted, and cannot be acquainted with the conditions of installation of the product, so the installer or end user must carry out an analysis of the risks, relating specifically to the mode and typology of installation.

It is, however, the responsibility of the party conducting the installation to guarantee an adequate degree of protection against the risk of accidental contact with moving parts and elements.

The installer and user must also bear in mind other types of risk, in particular those arising from the presence of foreign bodies and from the transport of explosive, inflammable or toxic gases at high temperatures.

Furthermore, consideration must be given to the risks inherent in the maintenance operations, that must be carried out under conditions of maximum safety by isolating the product and with the tool at a standstill.

At the end of the choices and according to the product installation mode defined and employed by the installer and/or the client, the final machine may be considered a “self-contained machine” in the sense of the Machine Safety Directive. **A complete assessment of the risks** must be carried out and a declaration of conformity must be drawn up on the basis of Annex IIA of Directive 2006/42/EC.

1.4.1 Risks associated with incorrect use and/or operation

Disconnecting, removing, modifying or in any other way deactivating any safety, protection or monitoring device or individual parts of the product as a whole is absolutely forbidden.

- Do not place your hands, arms or any other parts of the body in the vicinity of moving parts.
- Use of the product in atmospheres with an explosion risk is forbidden.
- It is forbidden for an unauthorised operator to eliminate possible defects or faults in the function or the product and/or to change the type of operation and installation.
- After carrying out any special operations involving the removal of guards, barriers or other protective devices, install these again before restarting the machine and check that they are correctly positioned and functioning efficiently.
- All the protective and safety devices must be maintained in a perfect and efficient condition at all times. The warning and danger signs must be kept in clearly legible conditions at all times and must not be removed.
- When looking for the cause of any fault or malfunction of the product, take all the precautions described in the instruction manual in order to avoid personal injury or damage to equipment.
- Remember to tighten all screws, bolts or ring nuts of all mechanical elements to be adjusted or set-up.
- Before starting the product, ensure that all the safety devices are installed and in proper working order; if this is not the case, it is absolutely forbidden to start the product and the person responsible for internal safety or the head of maintenance must be informed immediately.
- The operator must be equipped with Personal Protective Equipment (PPE) in accordance with the provisions of the laws in force; wearing loose clothes and various accessories (ties, wide sleeves, etc.) is forbidden.

1.4.2 Specific risks during product maintenance

To safely operate an HSD product fitted on the machine, refer to the manual of the machine itself.

- Disconnect the product from the main power supply before carrying out any maintenance operations!
- Even when the product is disconnected from the power supply, the rotating parts (and moving parts in general) can nevertheless move, due to their inertia; before carrying out maintenance operations therefore, check that the moving parts of the product are at a standstill.

1.4.3 Residual risks

The product has been analysed on the basis of Directive 2006/42/EC in order to identify possible sources of risk. The risks that still remain (residual risks) and the respective countermeasures are described in the relevant sections of this manual.

1.5 Information on the product

1.5.1 Purpose of the product

The product is part of a machine intended to be assembled to or incorporated into other parts of machinery or machines in order to create a machine according to Directive 2006/42/EC.

It is forbidden to set the product into operation before the machine into which it is to be incorporated complies with the provisions of Directive 2006/42/EC and subsequent amendments.

1.5.2 Range of applications

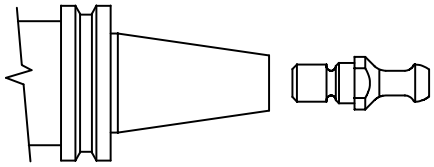
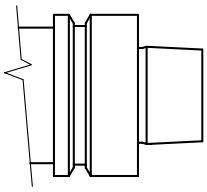
The product has been designed to carry out milling and boring operations in the field of wood and its derivatives, plastic, fibre, aluminium, and light machining operations on other metals.

1.5.3 EC marking and identification of the product

The EC marking plate and the serial number represent the only elements to identify the product acknowledged by HSD S.p.A. The user of the product is obliged to maintain the integrity of these signs.

In the 3 “Technical specifications” section you can see the EC marking plate, along with its position and that of the Serial Number of the product.

1.6 Glossary

ISO 30	 **CONE ISO30 DIN 69871** / **TIE-ROD HSD 0804H0009**	Tool holder cone hooking system, described by the standard DIN 69871. The electrospindle has a plate similar to that shown in the next image, indicating the type of mounting.
HSK	 **CONE HSK - DIN 69893**	Tool holder cone hooking system, described by standard DIN 69893. The electrospindle has a plate similar to that shown in the next image, indicating the type of mounting.
Level or class of dynamic balancing	Value of the balancing of a rotating object in accordance with standard ISO 1940/1, indicated by the letter G. Low values for G indicate a higher degree of balancing; the maximum balancing precision is G=0.4. G takes on discrete values in relation to multiples of 2.5 (G=0.4 G=1 G=2.5 …).	
Rated voltage	Maximum supply voltage.	
Rated frequency	Minimum frequency corresponding to the maximum value for the supply voltage.	
Nominal characteristics	All the various rated values reached in relation to the rated frequency.	
Service S1	Operation under constant load, with a duration sufficient to allow the motor to attain a thermal equilibrium. The corresponding abbreviation is S1. (*Standard IEC EN 60034-1*)	
Service S6	Sequence of identical operating cycles, each comprising a period of operation under constant load and a period of operation without load while maintaining the rotational speed; there is no rest period. The corresponding abbreviation is S6, followed by the percentage ratio between the period of operation under load and the length of the cycle. *Example: S6 40%* (40% period of operation with load, 60% period of operation in rotation but without load) (*Standard IEC EN 60034-1*)	
Torque and Power	$C(Nm) = \frac{(60 \times W)}{2 \times \pi \times rpm}$	**C** = Torque **W** = Power **rpm** = revolutions per minute
	Providing a precise physical definition of torque and power would be going beyond the scope and possibility of this manual. Nevertheless the torque can be roughly correlated to the force with which the tool contacts the piece being machined (and with equal torque, the force increases as the diameter of the tool decreases). Power, on the other hand, is proportional to the torque and the rotational speed and determines the maximum machining speed (taking into consideration the performance of the tool, the characteristics of the material being machined and the type of machining).	
Coolant	Fluid, liquid or gas (including air) by means of which the heat is transferred from the spindle to the atmosphere.	
Scheduled maintenance	All the activities intended to maintain the operating and functioning conditions of the product as provided for by HSD S.p.A. at the moment of its launch on the market; it is carried out through scheduled operations to adjust, repair and replace parts.	

1.7 Warranty

HSD S.p.A. guarantees that the product has been inspected at its plant with a positive result.

Works under warranty shall be performed free at the HSD S.p.A. facilities, transport at the customer's expense; HSD S.p.A. shall not be liable for termination of production during the warranty period.

The warranty does not cover faults due to normal wear of those parts which, by their nature, are subject to rapid and continuous wear (e.g. gaskets, belts, bearings, etc.). In particular, HSD S.p.A. gives no guarantee as to the service life of the bearings, as this depends on various factors including: the degree of balancing of the tools, the types of machining operation, collisions and/or mechanical stresses beyond the values indicated by the manufacturer.

HSD S.p.A. accepts no liability for faults in the conformity of the product caused by a failure to observe the instructions contained in the instruction manual, or due to incorrect operation or handling of the product. **The buyer shall therefore have a right to replacement of parts found to be defective only if the faults have not been caused by tampering with the product, namely by installing non-original HSD spare parts and/or by replacement of components not provided for and not authorised in the present manual, and in all cases without the prior written approval of HSD S.p.A.**

On no account shall HSD S.p.A. or its suppliers be responsible for damage (including but not limited to damage to the physical integrity of the product or damages due to loss or reduced earnings, stoppages in production, loss of information or other economic losses) resulting from the use of HSD products, even in cases where HSD S.p.A. has been warned of the possibility of such damage.

The buyer's warranty shall be voided if HSD S.p.A. is not notified in detail in writing of the nature of any faults discovered in the product within 15 days of the fault being discovered. The buyer's warranty shall also be voided in the event that he does not allow the seller to carry out any requested inspections or if the seller requests the defective parts to be returned to the works and the buyer fails to return them within two weeks of the request.

Measured drawings and photographs are provided purely as reference examples for a simpler understanding of the text.

In line with its policy of continuous development and advancement of the product, the company reserves the right to modify either its functional or aesthetic characteristics, to vary the design of any functional element or accessory, or to suspend production and delivery; this without undertaking to give notice to anyone and without incurring any other obligation. In addition, HSD S.p.A. reserves the right to make any structural or functional modification, as well as modifications to the supply of spare parts and accessories, without the obligation to communicate these changes to anyone and for any reason.

2 Transport, packaging, unpacking, storage

2.1 Warnings

- Lifting and handling the product may create hazardous situations for the persons involved; we therefore recommend that the instructions given by HSD S.p.A. are observed and that only suitable tools are used.
- The installation and assembly operations must always be carried out by specialised technicians only.
- We recommend that all lifting and handling operations of the product or its parts be carried out with great care, avoiding collisions that could compromise the proper functioning, or damage coated parts.

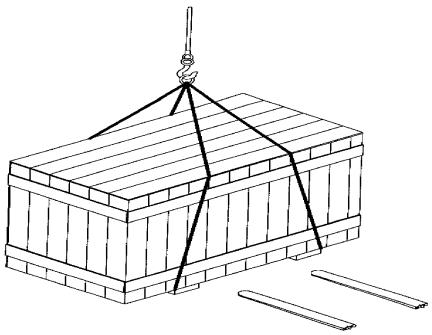
The user is responsible for selecting the lifting equipment (ropes, straps or chains, etc.) considered most suitable in terms of both functionality and lifting capacity, with regard to the weight indicated on the packaging and on the product label.

2.2 Dimensions and weights

- Product crate for shipment:
  - the gross weight is specified on the packaging;
  - the packaging linear dimensions are specified in the documents supplied with the product.
- Unpacked product:
  - the weight (according to the version) is indicated in chapter 3 “Technical specifications”;
  - dimensional drawings are available upon request at the customer service.

2.3 Transport and Packaging Conditions

The product is shipped protected by a covering of VCI plastic and expanded foam, packed in a wooden crate or case of special cardboard.
The figure below shows a few methods of lifting the packed product (using ropes and using a fork-lift truck; in the latter case, ensure that during lifting the centre of gravity of the crate is always between the two forks).



The examples shown are only indications, as it is not possible to determine in advance all the possible configurations for lifting a product manufactured by HSD S.p.A.

2.4 Unpacking Procedure

Before opening the package, check that the seals on the package are not broken

If the product is packed in a wooden crate, insert a screwdriver under the locking hook. Lever it open, paying attention not to damage the packaging and its contents.

If the product is packed in a cardboard case, remove the strip of adhesive tape, paying attention not to damage the package and its contents.

Do not lift the product by holding it from the electric fan section (if provided), in order not to damage the guard.

Do not rest the product on the spindle shaft .

The expanded foam and plastic cover can be disposed of as plastic material.

2.5 Storage

If the product is to be stored, it must be protected against the weather, moisture, dust and aggressive atmospheric and environmental agents.

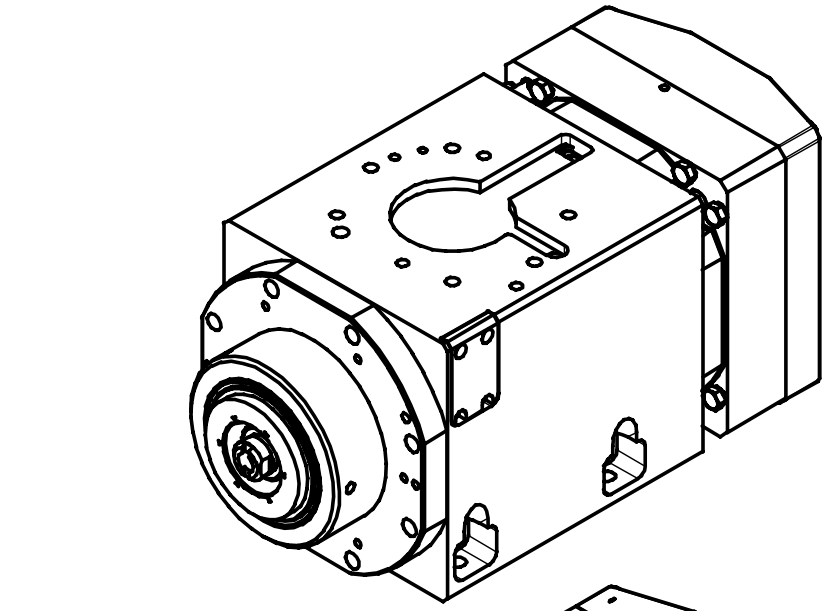
It is therefore necessary:

- to carry out periodic checks to ensure the good general condition of conservation;
- to manually rotate the shaft (roughly once a month) to maintain optimum lubrication of the bearings.

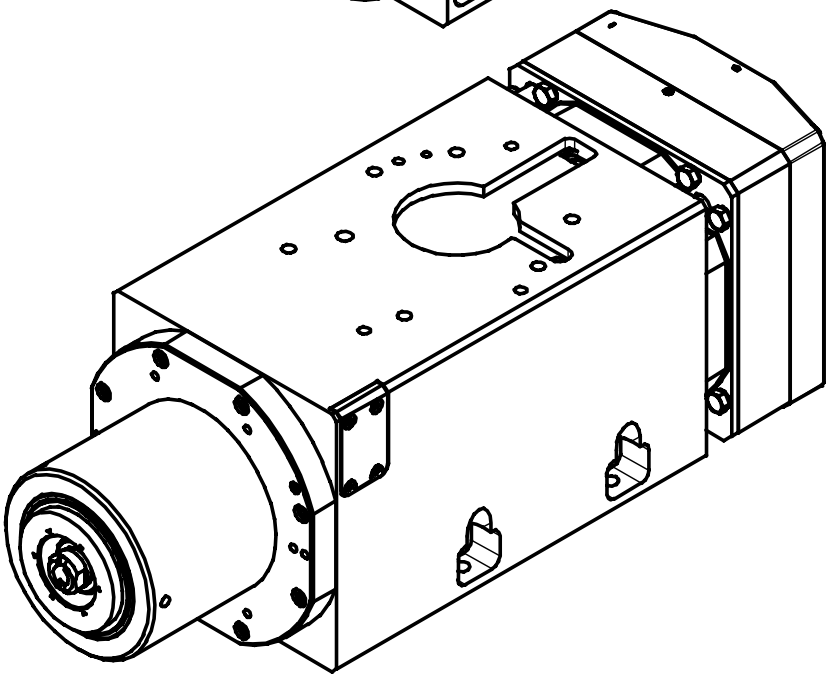
STORAGE TEMPERATURE: from -5°C (+23°F) to +55°C (+131°F)

RELATIVE HUMIDITY (NON-CONDENSING): from 5% to 55%

3 Technical specifications



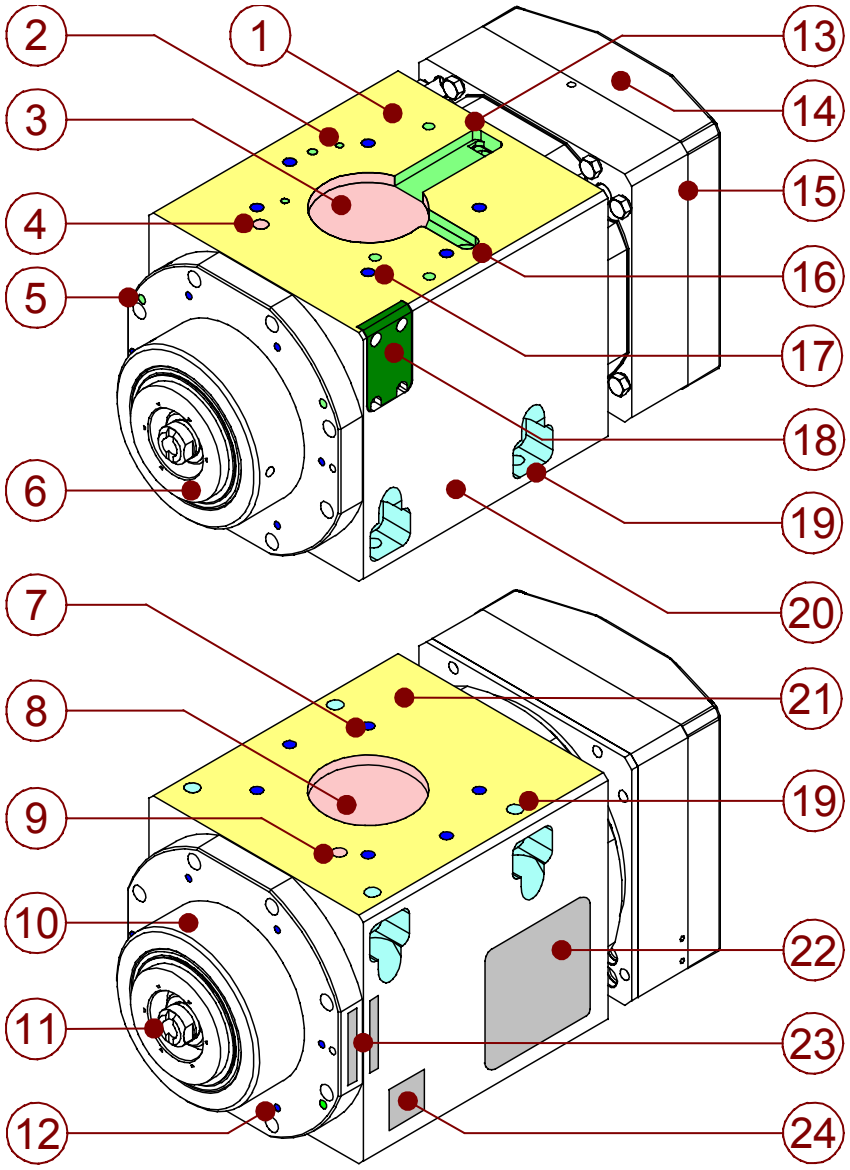
ES779



ES789

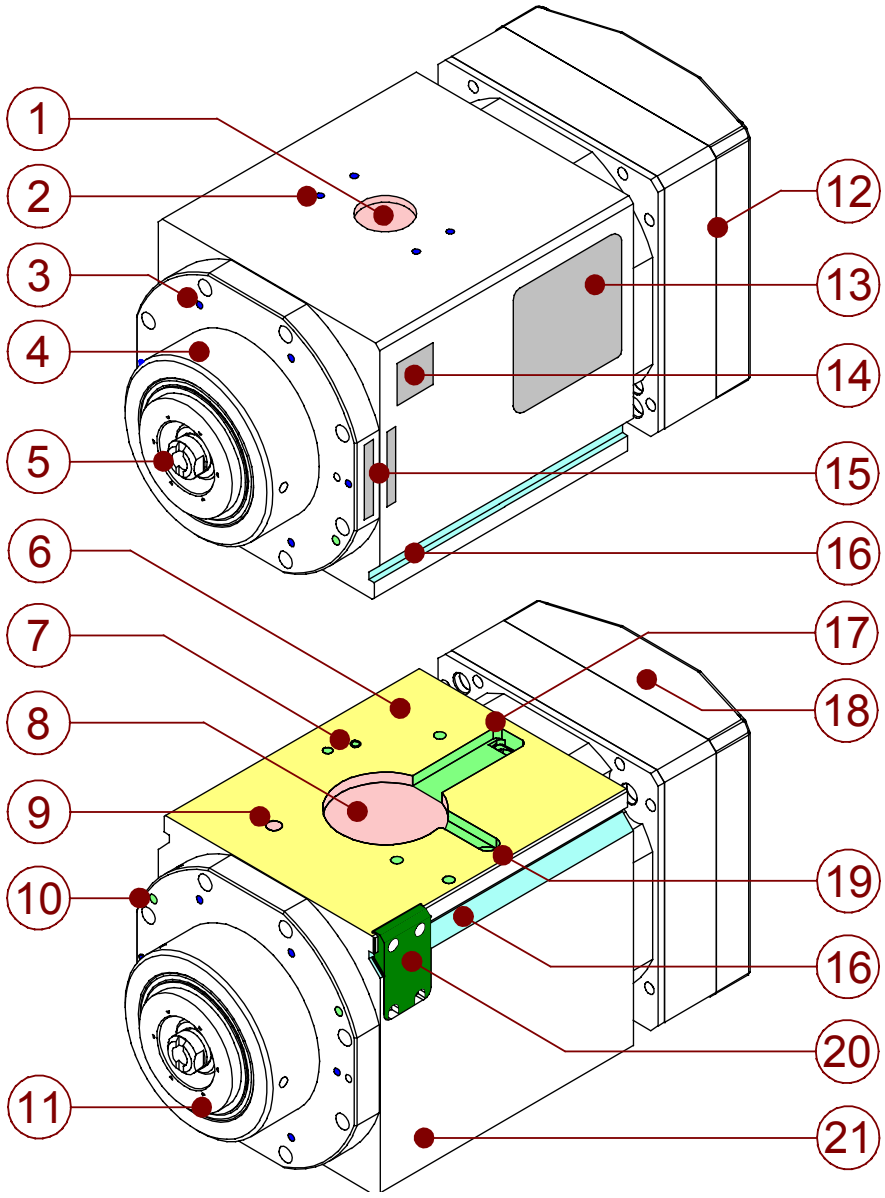
3.1 Main parts

3.1.1 ES779 non connectorised, with fixing bores



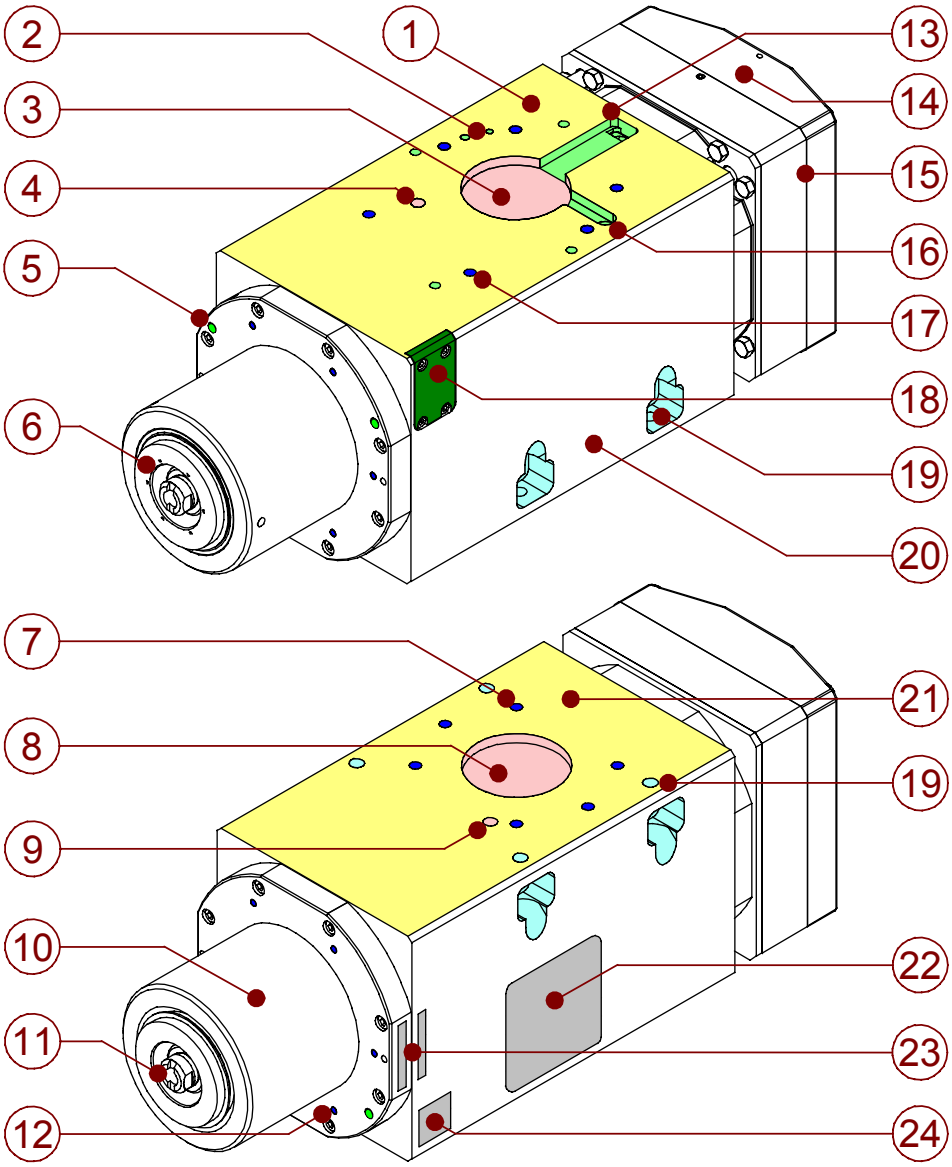
1	Resting surface	**9**	H7 bore Ø8, depth 10 for positioning	**17**	6 M8 bores, thread depth 12 for fastening
2	6 bores for compressed air and fluid inlet / outlet	**10**	Nose	**18**	Encoder compartment
3	H8 bore Ø60, depth 6 for positioning	**11**	HSK collet	**19**	4 through bores Ø8.5 for fastening
4	H7 bore Ø8, depth 10 for positioning	**12**	6 M5 bores for accessories	**20**	Framework
5	2 M6 bores for tool lubricant-coolant outlet	**13**	Engine cable passage	**21**	Resting surface
6	Shaft	**14**	Sensor area	**22**	EC marking plate
7	6 M8 bores, thread depth 12 for fastening	**15**	Cylinder	**23**	Serial number
8	H8 bore Ø60, depth 6 for positioning	**16**	Sensor cable passage	**24**	Description of tool holder

3.1.2 ES779 non connectorised, with fixing grooves



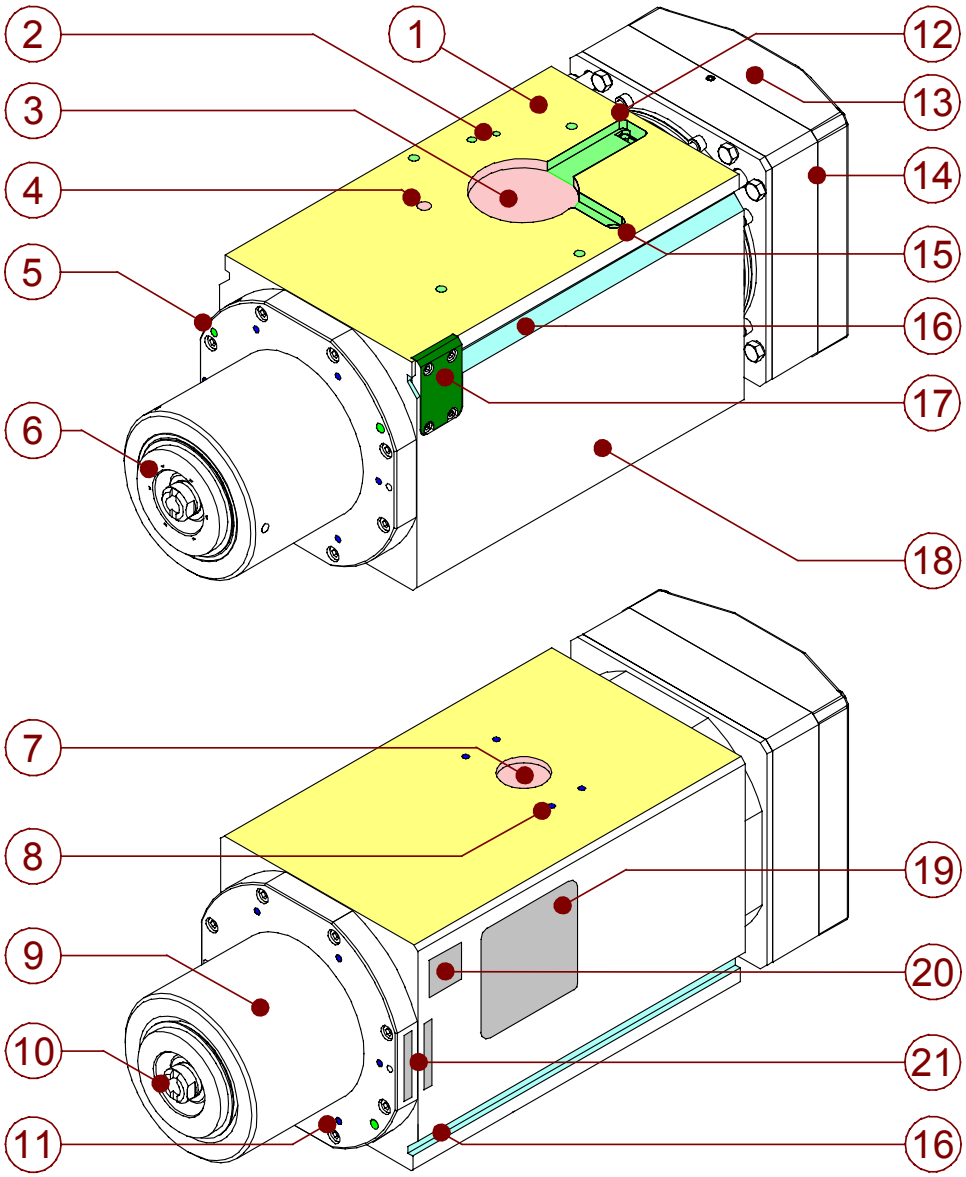
1	H8 bore Ø30, depth 4	**8**	H8 bore Ø60, depth 6 for positioning	**15**	Serial number
2	4 M5 bores, thread depth 6 for accessories	**9**	H7 bore Ø8, depth 10 for positioning	**16**	Fixing groove
3	6 M5 bores for accessories	**10**	2 M6 bores for tool lubricant-coolant outlet	**17**	Engine cable passage
4	Nose	**11**	Shaft	**18**	Sensor area
5	HSK collet	**12**	Cylinder	**19**	Sensor cable passage
6	Resting surface	**13**	EC marking plate	**20**	Encoder compartment
7	6 bores for compressed air and fluid inlet / outlet	**14**	Description of tool holder	**21**	Framework

3.1.3 ES789 non connectorised, with fixing bores



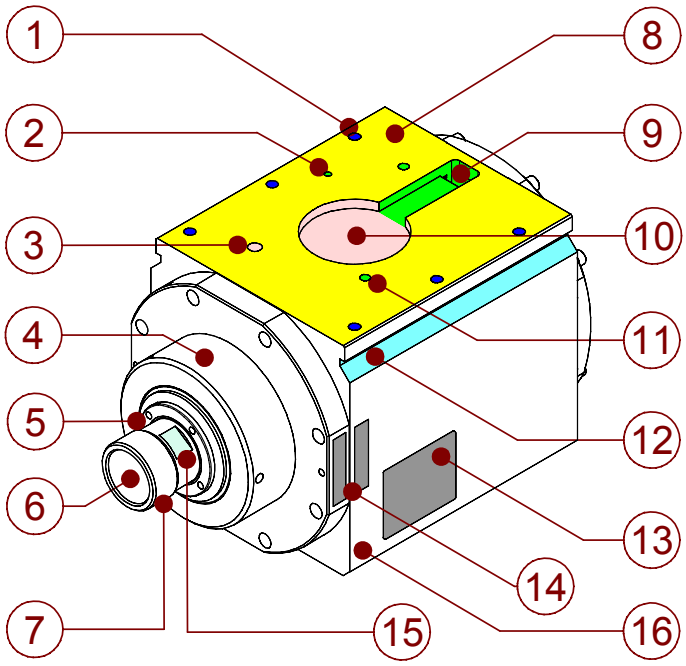
1	Resting surface	**9**	H7 bore Ø8, depth 10 for positioning	**17**	6 M8 bores, thread depth 12 for fastening
2	6 bores for compressed air and fluid inlet / outlet	**10**	Nose	**18**	Encoder compartment
3	H8 bore Ø60, depth 6 for positioning	**11**	HSK collet	**19**	4 through bores Ø8.5 for fastening
4	H7 bore Ø8, depth 10 for positioning	**12**	6 M5 bores for accessories	**20**	Framework
5	2 M6 bores for tool lubricant-coolant outlet	**13**	Engine cable passage	**21**	Resting surface
6	Shaft	**14**	Sensor area	**22**	EC marking plate
7	6 M8 bores, thread depth 12 for fastening	**15**	Cylinder	**23**	Serial Number
8	H8 bore Ø60, depth 6 for positioning	**16**	Sensor cable passage	**24**	Description of tool holder

3.1.4 ES789 non connectorised, with fixing grooves



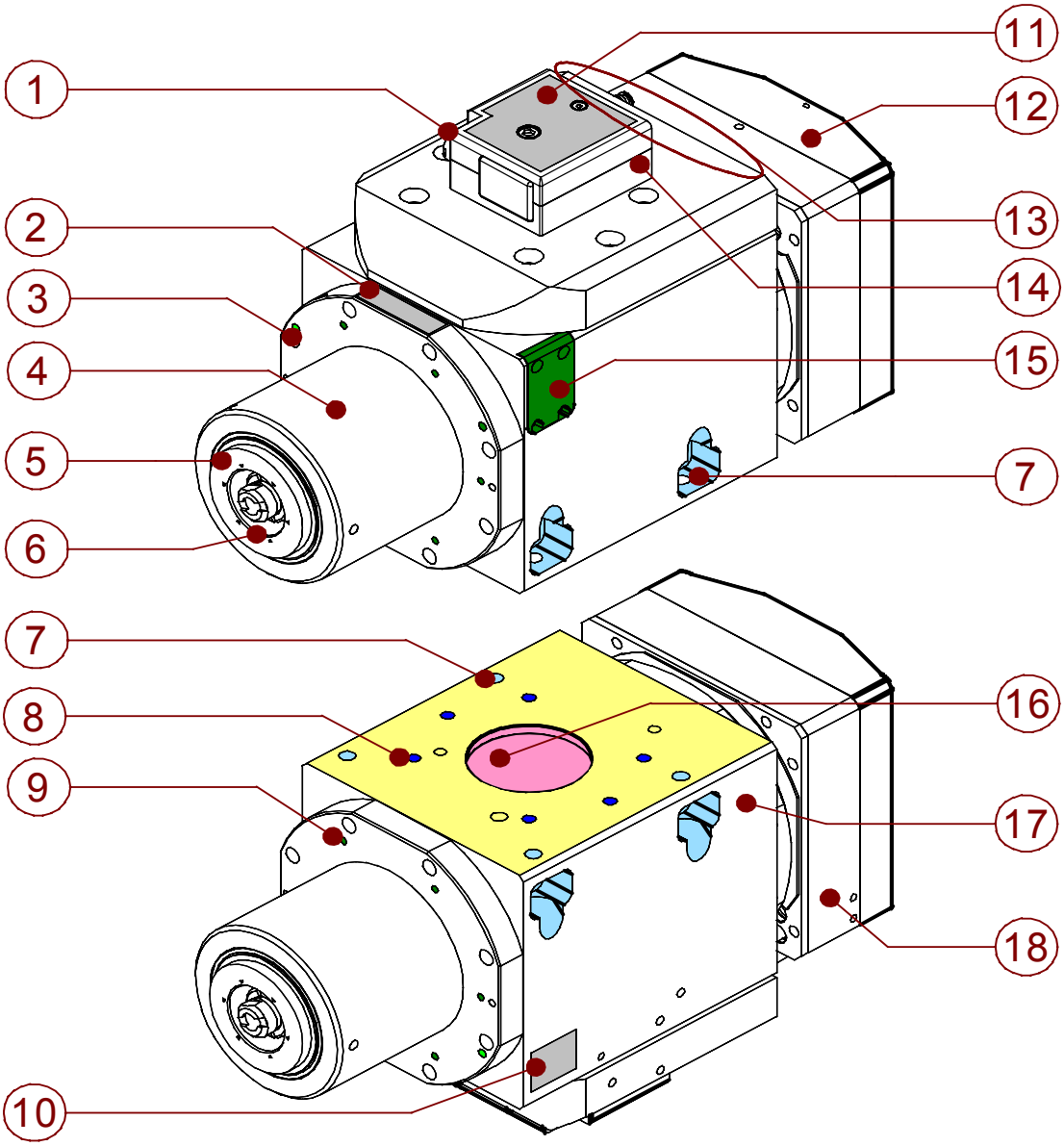
1	Resting surface	**8**	4 M5 bores, thread depth 6 for accessories	**15**	Sensor cable passage
2	6 bores for compressed air and fluid inlet / outlet	**9**	Nose	**16**	Fixing groove
3	H8 bore Ø60, depth 6 for positioning	**10**	HSK collet	**17**	Encoder compartment
4	H7 bore Ø8, depth 10 for positioning	**11**	6 M5 bores for accessories	**18**	Framework
5	2 M6 bores for tool lubricant-coolant outlet	**12**	Engine cable passage	**19**	EC marking plate
6	Shaft	**13**	Sensor area	**20**	Description of tool holder
7	H8 bore Ø30, depth 4	**14**	Cylinder	**21**	Serial number

3.1.5 ES779 Collet, non connectorised



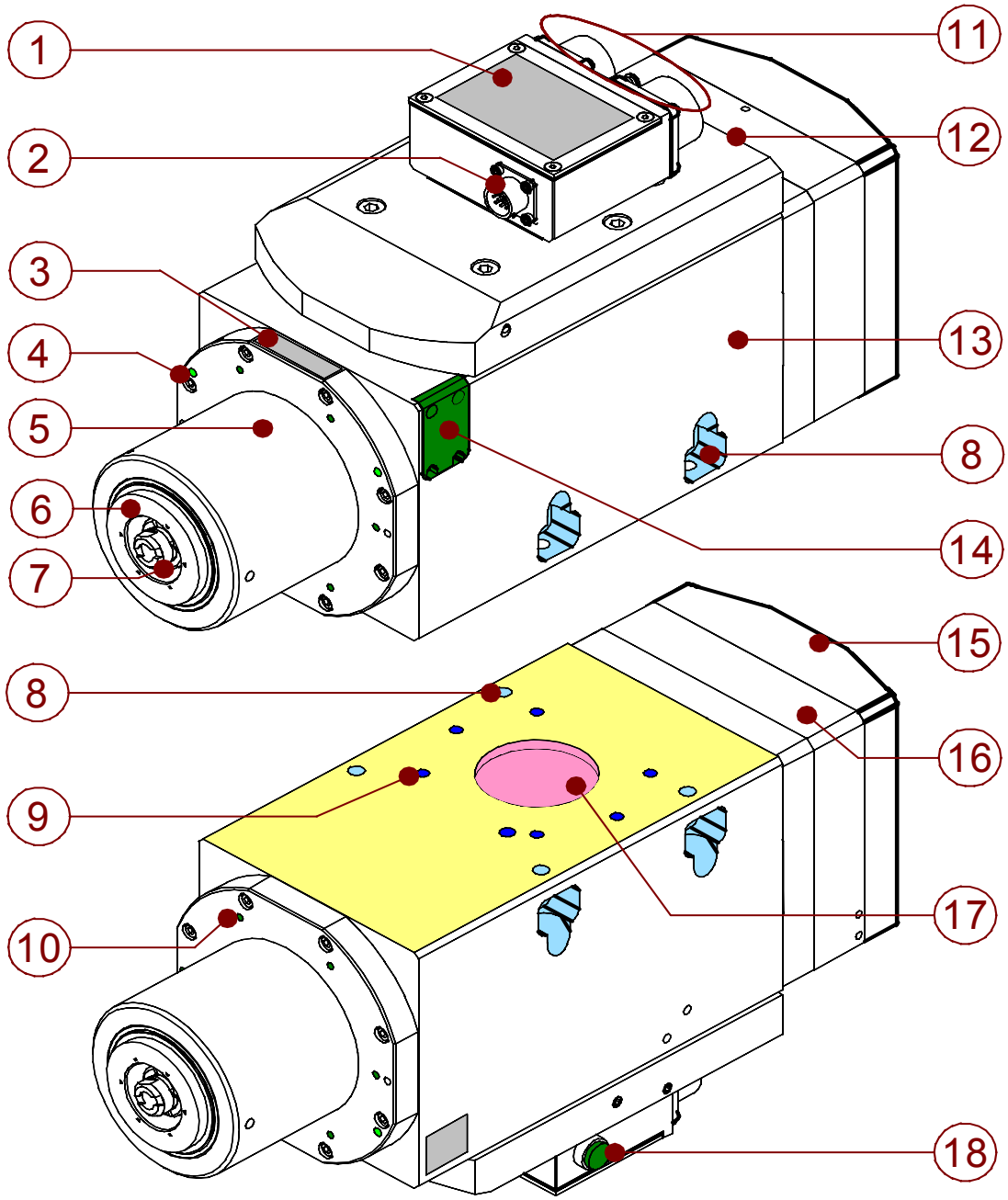
1	6 M8 bores, thread depth 16 for fastening	**7**	M40 thread, 1.5 step for ring nut	**13**	EC marking plate
2	Pressurisation air inlet	**8**	Resting surface	**14**	Serial number
3	H7 bore Ø8, depth 10 for positioning	**9**	Engine cable passage	**15**	Slot for CH34 wrench
4	Nose	**10**	H8 bore Ø60, depth 6 for positioning	**16**	Framework
5	Shaft	**11**	2 bores for coolant inlet / outlet		
6	ER32 collet seat	**12**	Fixing groove (one per side)		

3.1.6 Variations for versions with electrical connectors of HSD type



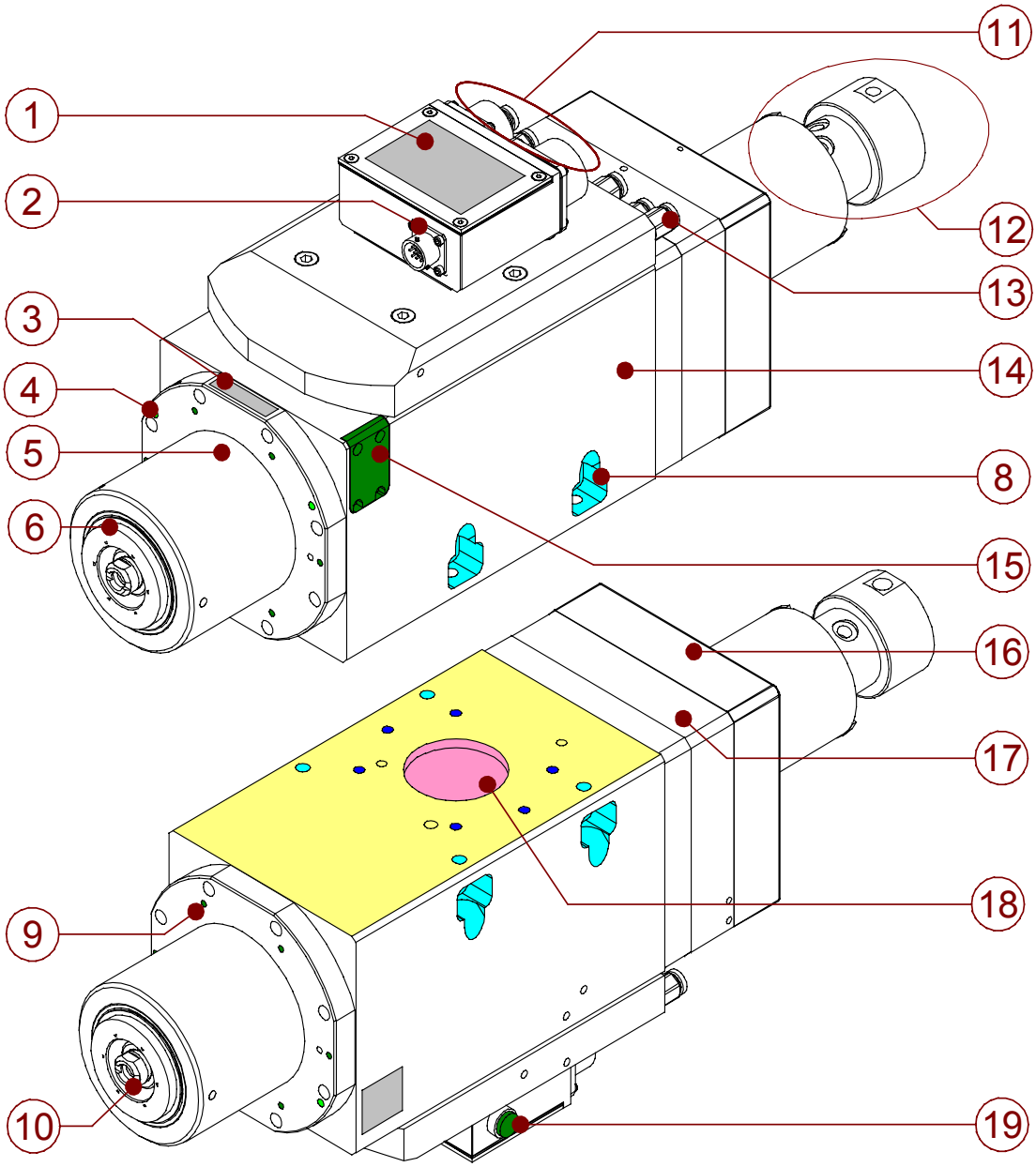
1	Button for manual tool unlocking	**10**	Description of tool holder
2	Serial number	**11**	EC marking plate
3	2 M6 bores for tool lubricant-coolant outlet	**12**	Sensor area
4	Nose	**13**	Hydraulic/pneumatic connectors
5	Shaft	**14**	HSD electrical connector
6	HSK collet	**15**	Encoder compartment
7	4 through bores Ø8.5 for fastening	**16**	H8 bore Ø60, depth 6 for positioning
8	6 M8 bores, thread depth 12 for fastening	**17**	Framework
9	6 M5 bores for accessories	**18**	Cylinder

3.1.7 Variations for versions with MIL standard electrical connectors



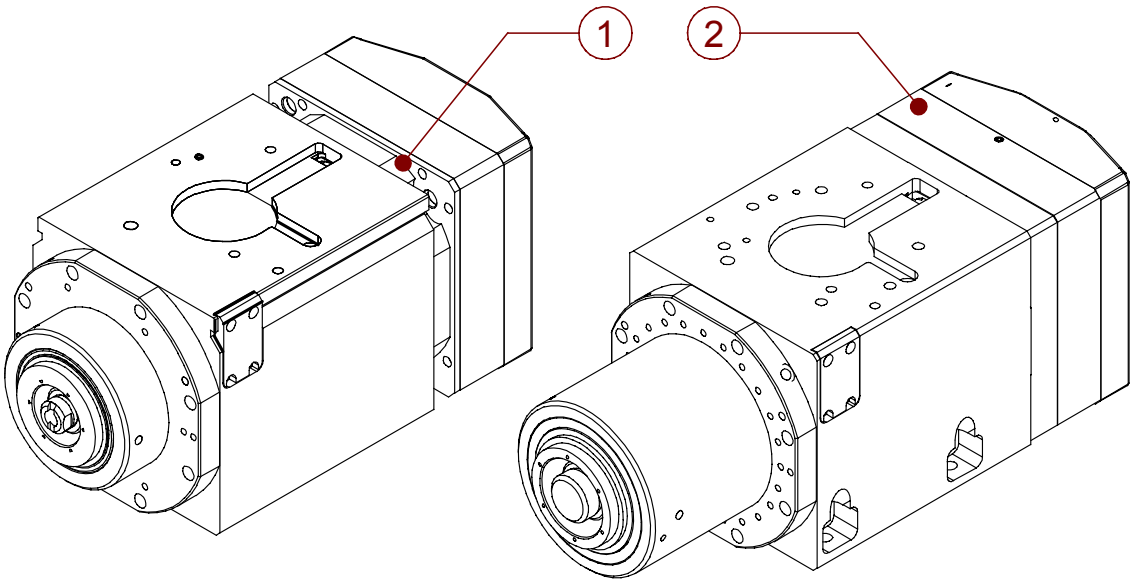
1	EC marking plate	**10**	6 M5 bores for accessories
2	Electrical connector (encoder)	**11**	Electrical connectors (standard MIL)
3	Serial number	**12**	Hydraulic/pneumatic connector zone
4	2 M6 bores for tool lubricant-coolant outlet	**13**	Framework
5	Nose	**14**	Encoder compartment
6	Shaft	**15**	Sensor area
7	HSK collet	**16**	Cylinder
8	4 through bores Ø8.5 for fastening	**17**	H8 bore Ø60, depth 6 for positioning
9	6 M8 bores, thread depth 12 for fastening	**18**	Button for manual tool unlocking

3.1.8 ES789 variations with distributor



1	EC marking plate	**11**	Electrical connectors (standard MIL)
2	Electrical connector (encoder)	**12**	Fluids distributor
3	Serial number	**13**	Hydraulic/pneumatic connector zone
4	2 M6 bores for tool lubricant-coolant outlet	**14**	Framework
5	Nose	**15**	Encoder compartment
6	Shaft	**16**	Sensor area
7	4 through bores Ø8.5 for fastening	**17**	Cylinder
8	6 M8 bores, thread depth 12 for fastening	**18**	H8 bore Ø60, depth 6 for positioning
9	6 M5 bores for accessories	**19**	Button for manual tool unlocking
10	HSK collet		

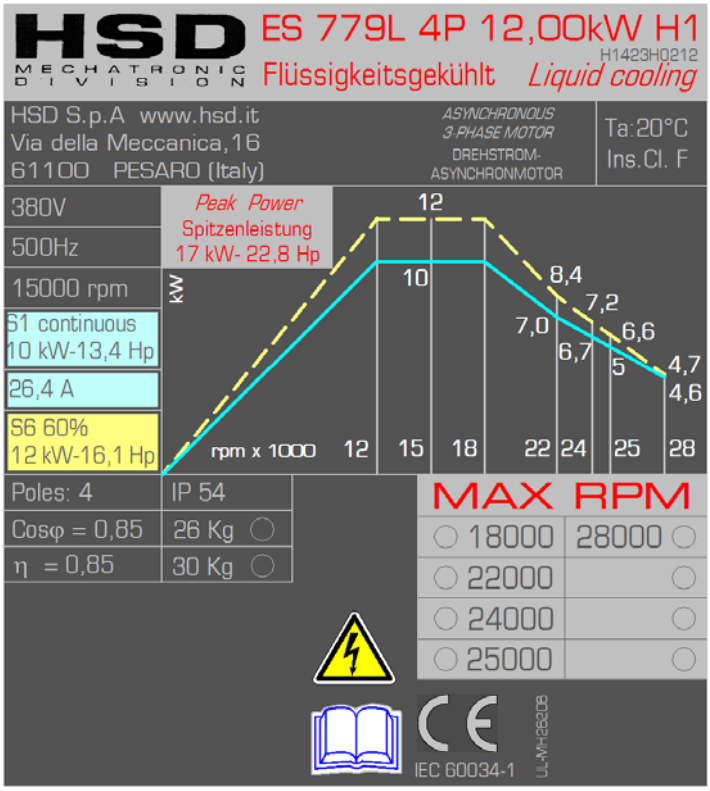
3.1.9 Variations with floating piston or fixed piston



1	Floating piston	**2**	Fixed piston

3.2 Characteristics and performance

3.2.1 ES779 12kW with 500Hz (15,000 rpm) rated frequency



H1423H0212 Rev.03 (SP.120.80.44)

Tensione nominale (*)	Nennspannung (*)	*Rated voltage (*)*	V	310		380		380		380		380		380		380	
Frequenza nominale	Nennfrequenz	*Rated frequency*	Hz	400		500		600		733		800		833		933	
Velocità nominale	Nominale Geschwindigkeit	*Rated speed*	rpm	12000		15000		18000		22000		24000		25000		28000	
Tipo di servizio	Betriebsart	*Duty type*		S1 cont	***S6 60%***	S1 cont	***S6 60%***	S1 cont	***S6 60%***	S1 cont	***S6 60%***	S1 cont	***S6 60%***	S1 cont	***S6 60%***	S1 cont	***S6 60%***
Potenza nominale	Nennleistung	*Rated power*	kW	10	***12***	10	***12***	10	***12***	7	***8,4***	6,7	***7,2***	5	***6,6***	4,6	***4,7***
Coppia nominale	Nenndrehmoment	*Rated torque*	Nm	8	***9,6***	6,4	***7,6***	5,3	***6,4***	3	***3,7***	2,7	***2,9***	1,8	***2,5***	1,6	***1,6***
Corrente nominale	Nennstrom	*Rated current*	A	31	***37,5***	26,4	***31,5***	26	***31***	20	***24***	18,6	***20***	13,7	***18***	12	***12,5***
Rendimento nominale η	Nennwirkungsgrad η	*Rated efficiency η*		0,85													
Fattore di potenza cos φ	Leistungsfaktor cos φ	*Power factor cos φ*		0,85													
Numero di poli	Polzahl	*Number of poles*		4													
Classe di isolamento	Isolierklasse	*Insulation class*		F													
Tipo di raffreddamento	Kühlungstyp	*Type of cooling*		*Raffreddamento a liquido* / Flüssigkeit / *Liquid cooling*													
Peso versione NASO CORTO	Gewicht Version KURZE NASE	*Weight of SHORT NOSE variant*	kg	26													
Peso versione NASO LUNGO	Gewicht Version LANG NASE	*Weight of LONG NOSE variant*	kg	30													

[(*) fornita da inverter] [(*) von Inverter geliefert] *[(*) from inverter]*

Versioni disponibili **- Verfügbare Versionen** ***- Available models***

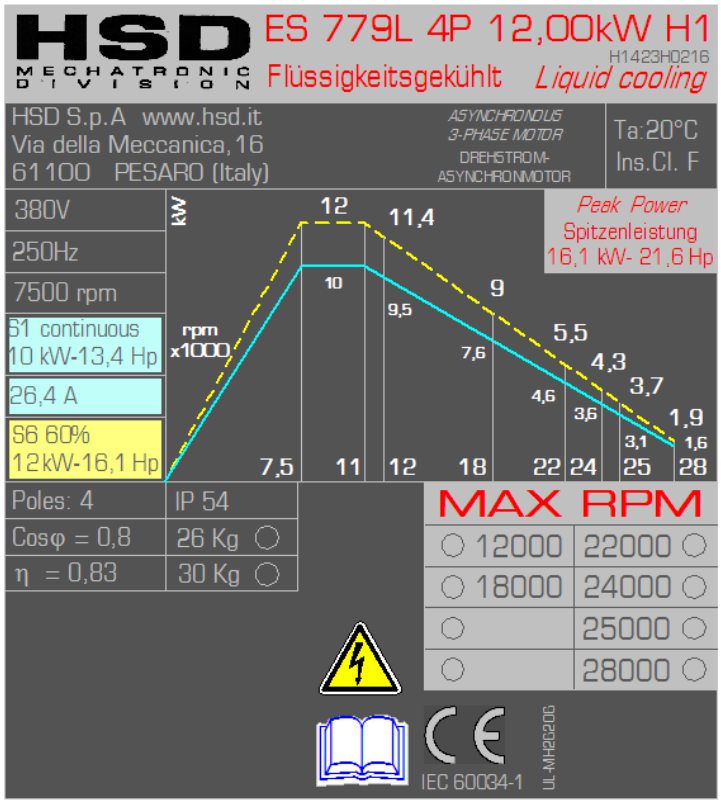
ATTACCO PORTAUTENSILE	*CUSCINETTI ANTERIORI*	*CUSCINETTI POSTERIORI*	*VELOCITÀ MASSIMA*
WERKZEUGHALTER	VORDERE LAGER	HINTERE LAGER	MAX. DREHZAHL
TOOL HOLDER	*FRONT BEARINGS*	*REAR BEARINGS*	*MAX SPEED*
HSK A63	*CERAMICI* / KERAMIK / *CERAMIC*	*CERAMICI* / KERAMIK / *CERAMIC*	*18000rpm*
HSK E63	*CERAMICI* / KERAMIK / *CERAMIC*	*CERAMICI* / KERAMIK / *CERAMIC*	*18000rpm*
HSK F63	*CERAMICI* / KERAMIK / *CERAMIC*	*ACCIAIO* / STAHL / *STEEL*	22000rpm
HSK E40 - F50	*CERAMICI* / KERAMIK / *CERAMIC*	*ACCIAIO* / STAHL / *STEEL*	24000rpm
HSK F63	*CERAMICI* / KERAMIK / *CERAMIC*	*CERAMICI* / KERAMIK / *CERAMIC*	25000rpm
HSK E40 - F50	*CERAMICI* / KERAMIK / *CERAMIC*	*CERAMICI* / KERAMIK / *CERAMIC*	28000rpm

The maximum value of rated current “S1/cont” is used to set the parameter of the “maximum direct current” of the inverter

Equivalent electrical network SP.120.80.44

Rated power (S1/Cont)	kW	10
Rated current (S1/Cont)	A	26.4
Rated voltage	V	380
Rated speed	rpm	11,810
Rated frequency	Hz	400
No-load line voltage	V	300
No-load current	A	7.5
Stator resistance (20°C)	Ohm	0.11
Rotor resistance (20°C)	Ohm	0.16
Stator leakage reactance	Ohm	0.9
Rotor leakage reactance	Ohm	1.9
Main field reactance	Ohm	23
Field weakening initial speed	rpm	15,000
Motor maximum speed	rpm	28,000
Power factor		0.85
Rotor moment of inertia	kg	1.5E-03
Connection	Y/D	Y

3.2.2 ES779 12kW DP with 250Hz (7,500 rpm) rated frequency



H1423H0216 Rev.05 (SP.120.080.45)

Tensione nominale (*)	Nennspannung (*)	*Rated voltage (*)*	V	380		380		380		380		380		380		380		380	
Frequenza nominale	Nennfrequenz	*Rated frequency*	Hz	250		367		400		600		733		800		833		933	
Velocità nominale	Nominale Geschwindigkeit	*Rated speed*	rpm	7500		11000		12000		18000		22000		24000		25000		28000	
Tipo di servizio	Betriebsart	*Duty type*		S1 cont	***S6 60%***	S1 cont	***S6 60%***	S1 cont	***S6 60%***	S1 cont	***S6 60%***	S1 cont	***S6 60%***	S1 cont	***S6 60%***	S1 cont	***S6 60%***	S1 cont	***S6 60%***
Potenza nominale	Nennleistung	*Rated power*	kW	10	***12***	10	***12***	9,5	***11,4***	7,9	***9***	4,6	***5,5***	3,6	***4,3***	3,1	***3,7***	1,6	***1,9***
Coppia nominale	Nenndrehmoment	*Rated torque*	Nm	12,7	***15,3***	8,7	***10,4***	7,6	***9,1***	4,2	***4,8***	2	***2,4***	1,4	***1,7***	1,2	***1,4***	0,55	***0,65***
Corrente nominale	Nennstrom	*Rated current*	A	24	***29***	22,6	***27,1***	21,5	***25,8***	17,8	***20,4***	13,6	***16,3***	10	***12***	8,5	***10,2***	5,2	***6,2***
Rendimento nominale η	Nennwirkungsgrad η	*Rated efficiency η*		0,83															
Fattore di potenza cos φ	Leistungsfaktor cos φ	*Power factor cos φ*		0,8															
Numero di poli	Polzahl	*Number of poles*		4															
Classe di isolamento	Isolierklasse	*Insulation class*		F															
Tipo di raffreddamento	Kühlungstyp	*Type of cooling*		*Raffreddamento a liquido* / Flüssigkeit / *Liquid cooling*															
Peso versione NASO CORTO	Gewicht Version KURZE NASE	*Weight of SHORT NOSE variant*	kg	26															
Peso versione NASO LUNGO	Gewicht Version LANG NASE	*Weight of LONG NOSE variant*	kg	30															

[(*) fornita da inverter] [(*) von Inverter geliefert] *[(*) from inverter]*

Versioni disponibili **- Verfügbare Versionen** ***- Available models***

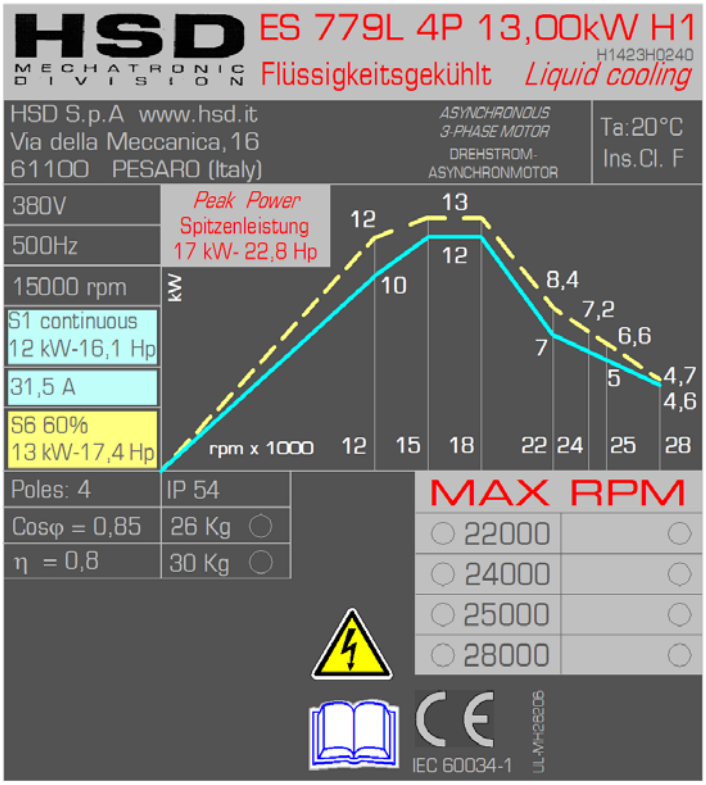
ATTACCO PORTAUTENSILE	*CUSCINETTI ANTERIORI*	*CUSCINETTI POSTERIORI*	*VELOCITÀ MASSIMA*
WERKZEUGHALTER	VORDERE LAGER	HINTERE LAGER	MAX. DREHZAHL
TOOL HOLDER	*FRONT BEARINGS*	*REAR BEARINGS*	*MAX SPEED*
HSK A63	*CERAMICI* / KERAMIK / *CERAMIC*	*CERAMICI* / KERAMIK / *CERAMIC*	18000rpm
HSK E63	*CERAMICI* / KERAMIK / *CERAMIC*	*CERAMICI* / KERAMIK / *CERAMIC*	18000rpm
HSK F63	*CERAMICI* / KERAMIK / *CERAMIC*	*ACCIAIO* / STAHL / *STEEL*	22000rpm
HSK F63	*CERAMICI* / KERAMIK / *CERAMIC*	*CERAMICI* / KERAMIK / *CERAMIC*	25000rpm
HSK E40 - F50	*ACCIAIO* / STAHL / *STEEL*	*ACCIAIO* / STAHL / *STEEL*	12000rpm
HSK E40 - F50	*CERAMICI* / KERAMIK / *CERAMIC*	*ACCIAIO* / STAHL / *STEEL*	24000rpm
HSK E40 - F50	*CERAMICI* / KERAMIK / *CERAMIC*	*CERAMICI* / KERAMIK / *CERAMIC*	28000rpm
HSK E40 - F50	*CERAMICI* / KERAMIK / *CERAMIC*	*CERAMICI* / KERAMIK / *CERAMIC*	28000rpm

The maximum value of rated current “S1/cont” is used to set the parameter of the “maximum direct current” of the inverter

Equivalent electrical network SP 120.80.45

Rated power (S1/Cont)	kW	10
Rated current (S1/Cont)	A	24
Rated voltage	V	380
Rated speed	rpm	7,250
Rated frequency	Hz	250
No-load line voltage	V	354
No-load current	A	11
Stator resistance (20°C)	Ohm	0.26
Rotor resistance (20°C)	Ohm	0.24
Stator leakage reactance	Ohm	1.1
Rotor leakage reactance	Ohm	1.78
Main field reactance	Ohm	17
Field weakening initial speed	rpm	7,500
Motor maximum speed	rpm	
Power factor		0.8
Rotor moment of inertia	kg	1.1E-03
Connection	Y/D	Y

3.2.3 ES779 13kW with 500Hz (15,000 rpm) rated frequency



H1423H0240 Rev.01 (SP.120.80.44.Par)

Tensione nominale (*)	Nennspannung (*)	*Rated voltage (*)*	V	310		380		380		380		380		380		380			
Frequenza nominale	Nennfrequenz	*Rated frequency*	Hz	400		500		600		733		800		833		933			
Velocità nominale	Nominale Geschwindigkeit	*Rated speed*	rpm	12000		15000		18000		22000		24000		25000		28000			
Tipo di servizio	Betriebsart	*Duty type*		S1 cont	***S6 60%***	S1 cont	***S6 60%***	S1 cont	***S6 60%***	S1 cont	***S6 60%***	S1 cont	***S6 60%***	S1 cont	***S6 60%***	S1 cont	***S6 60%***		
Potenza nominale	Nennleistung	*Rated power*	kW	10	***12***	12	***13***	12	***13***	7	***8,4***	6,7	***7,2***	5	***6,6***	4,6	***4,7***		
Coppia nominale	Nenndrehmoment	*Rated torque*	Nm	8	***9,6***	7,6	***8,2***	6,4	***6,9***	3	***3,7***	2,7	***2,9***	1,8	***2,5***	1,6	***1,6***		
Corrente nominale	Nennstrom	*Rated current*	A	31	***37,5***	31,5	***34,1***	31	***33,6***	20	***24***	18,6	***20***	13,7	***18***	12	***12,5***		
Rendimento nominale η	Nennwirkungsgrad η	*Rated efficiency η*		0,8															
Fattore di potenza cos φ	Leistungsfaktor cos φ	*Power factor cos φ*		0,85															
Numero di poli	Polzahl	*Number of poles*		4															
Classe di isolamento	Isolierklasse	*Insulation class*		F															
Tipo di raffreddamento	Kühlungstyp	*Type of cooling*		*Raffreddamento a liquido* / Flüssigkeit / *Liquid cooling*															
Peso versione NASO CORTO	Gewicht Version KURZE NASE	*Weight of SHORT NOSE variant*	kg	26															
Peso versione NASO LUNGO	Gewicht Version LANG NASE	*Weight of LONG NOSE variant*	kg	30															

[(*) fornita da inverter] [(*) von Inverter geliefert] *[(*) from inverter]*

Versioni disponibili **- Verfügbare Versionen** ***- Available models***

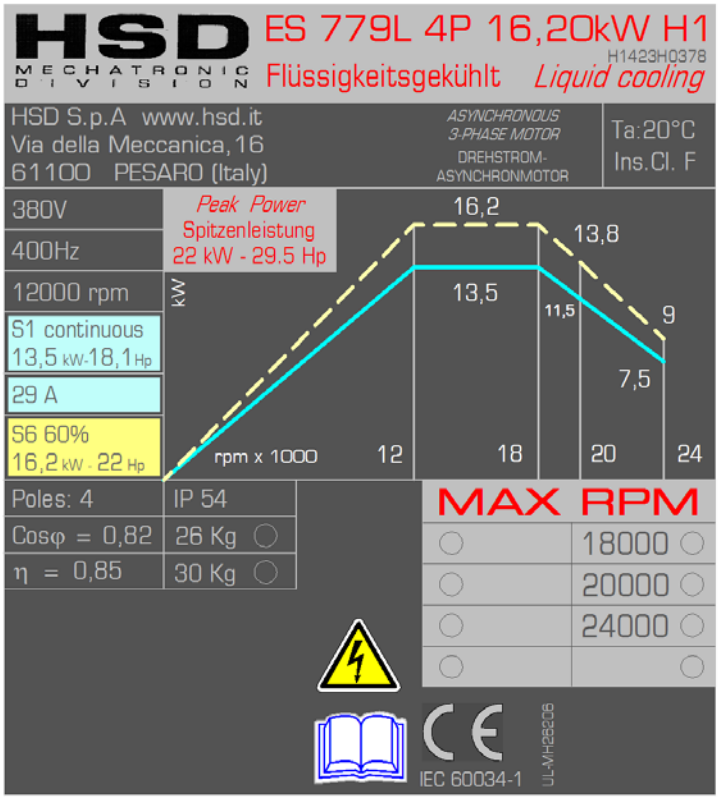
ATTACCO PORTAUTENSILE	*CUSCINETTI ANTERIORI*	*CUSCINETTI POSTERIORI*	*VELOCITÀ MASSIMA*
WERKZEUGHALTER	VORDERE LAGER	HINTERE LAGER	MAX. DREHZAHL
TOOL HOLDER	*FRONT BEARINGS*	*REAR BEARINGS*	*MAX SPEED*
HSK F63	*CERAMICI* / KERAMIK / *CERAMIC*	*ACCIAIO* / STAHL / *STEEL*	22000rpm
HSK F63	*CERAMICI* / KERAMIK / *CERAMIC*	*CERAMICI* / KERAMIK / *CERAMIC*	25000rpm
HSK E40 - F50	*CERAMICI* / KERAMIK / *CERAMIC*	*ACCIAIO* / STAHL / *STEEL*	24000rpm
HSK E40 - F50	*CERAMICI* / KERAMIK / *CERAMIC*	*CERAMICI* / KERAMIK / *CERAMIC*	28000rpm

The maximum value of rated current “S1/cont” is used to set the parameter of the “maximum direct current” of the inverter

Equivalent electrical network SP 120.80.44 par

Rated power (S1/Cont)	kW	12
Rated current (S1/Cont)	A	31.5
Rated voltage	V	380
Rated speed	rpm	11,810
Rated frequency	Hz	400
No-load line voltage	V	300
No-load current	A	7.5
Stator resistance (20°C)	Ohm	0.11
Rotor resistance (20°C)	Ohm	0.16
Stator leakage reactance	Ohm	0.9
Rotor leakage reactance	Ohm	1.9
Main field reactance	Ohm	23
Field weakening initial speed	rpm	15,000
Motor maximum speed	rpm	28,000
Power factor		0.85
Rotor moment of inertia	kg	1.5E-03
Connection	Y/D	Y

3.2.4 ES779 13.5kW with 400Hz (12,000 rpm) rated frequency



H1423H0378 Rev.00 (SP. 120.080.4S)

Tensione nominale (*)	Nennspannung (*)	*Rated voltage (*)*	V	380		380		380		380	
Frequenza nominale	Nennfrequenz	*Rated frequency*	Hz	400		600		667		800	
Velocità nominale	Nominale Geschwindigkeit	*Rated speed*	rpm	12000		18000		20000		24000	
Tipo di servizio	Betriebsart	*Duty type*		S1 cont	***S6 60%***	S1 cont	***S6 60%***	S1 cont	***S6 60%***	S1 cont	***S6 60%***
Potenza nominale	Nennleistung	*Rated power*	kW	13,5	***16,2***	13,5	***16,2***	11,5	***13,8***	7,5	***9***
Coppia nominale	Nenndrehmoment	*Rated torque*	Nm	10,7	***12,9***	7,2	***8,6***	5,5	***6,6***	3,0	***3,6***
Corrente nominale	Nennstrom	*Rated current*	A	29,0	***35,0***	29,0	***35,0***	25,0	***30,0***	16,5	***19,8***
Rendimento nominale η	Nennwirkungsgrad η	*Rated efficiency η*		0,85							
Fattore di potenza cos φ	Leistungsfaktor cos φ	*Power factor cos φ*		0,82							
Numero di poli	Polzahl	*Number of poles*		4							
Classe di isolamento	Isolierklasse	*Insulation class*		F							
Tipo di raffreddamento	Kühlungstyp	*Type of cooling*		*Raffreddamento a liquido* / Flüssigkeit / *Liquid cooling*							
Peso versione NASO CORTO	Gewicht Version KURZE NASE	*Weight of SHORT NOSE variant*	kg	26							
Peso versione NASO LUNGO	Gewicht Version LANG NASE	*Weight of LONG NOSE variant*	kg	30							

[(*) fornita da inverter] [(*) von Inverter geliefert] *[(*) from inverter]*

Versioni disponibili **- Verfügbare Versionen** ***- Available models***

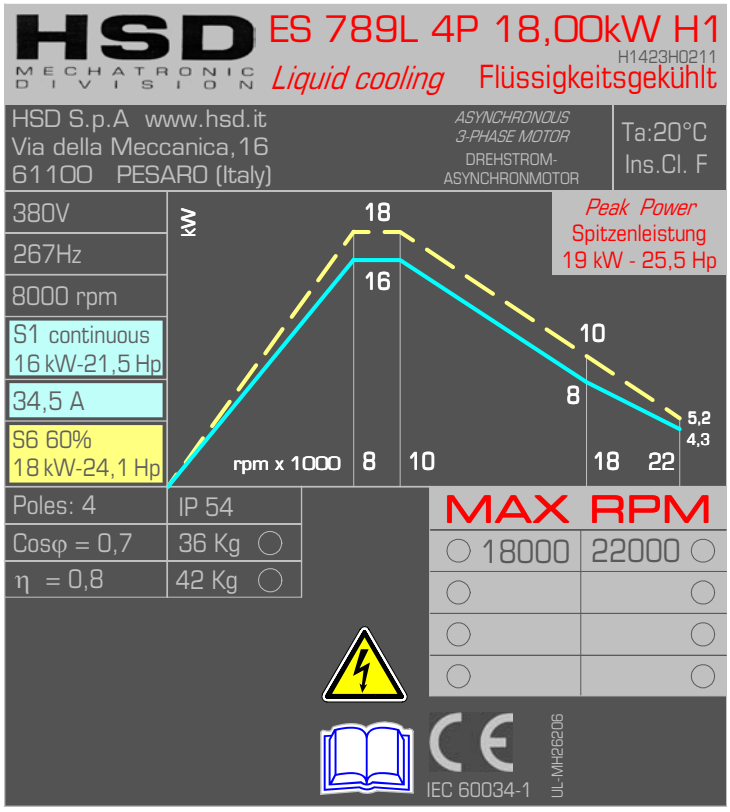
ATTACCO PORTAUTENSILE	*CUSCINETTI ANTERIORI*	*CUSCINETTI POSTERIORI*	*VELOCITÀ MASSIMA*
WERKZEUGHALTER	VORDERE LAGER	HINTERE LAGER	MAX. DREHZAHL
TOOL HOLDER	*FRONT BEARINGS*	*REAR BEARINGS*	*MAX SPEED*
HSK A63	*CERAMICI* / KERAMIK / *CERAMIC*	*ACCIAIO* / STAHL / *STEEL*	18000rpm

The maximum value of rated current “S1/cont” is used to set the parameter of the “maximum direct current” of the inverter

Equivalent electrical network SP 120.80.4S

Rated power (S1/Cont)	kW	13.5
Rated current (S1/Cont)	A	29
Rated voltage	V	380
Rated speed	rpm	11,830
Rated frequency	Hz	400
No-load line voltage	V	369.56
No-load current	A	5.6
Stator resistance (20°C)	Ohm	0.18
Rotor resistance (20°C)	Ohm	0.13
Stator leakage reactance	Ohm	2.1
Rotor leakage reactance	Ohm	1.3
Main field reactance	Ohm	37.6
Field weakening initial speed	rpm	12,000
Motor maximum speed	rpm	24,000
Power factor		0.82
Rotor moment of inertia	kg	
Connection	Y/D	

3.2.5 ES789 18kW with 267Hz (8,000 rpm) rated frequency



PEAK CURRENT	
120 A	500 ms
145 A	15 ms
170 A	5 ms

H1423H0211 Rev.02 (2120H0120)

Tensione nominale (*)	Nennspannung (*)	*Rated voltage (*)*	V	380		380		380		380											
Frequenza nominale	Nennfrequenz	*Rated frequency*	Hz	267		333		600		733											
Velocità nominale	Nominale Geschwindigkeit	*Rated speed*	rpm	8000		10000		18000		22000											
Tipo di servizio	Betriebsart	*Duty type*		S1 cont	*S6 60%*	S1 cont	*S6 60%*	S1 cont	*S6 60%*	S1 cont	*S6 60%*										
Potenza nominale	Nennleistung	*Rated power*	kW	16	*18*	16	*18*	8	*10*	4,3	*5,2*										
Coppia nominale	Nenndrehmoment	*Rated torque*	Nm	19	*21,5*	15,3	*17,2*	4.2	*5,3*	1,9	*2,3*										
Corrente nominale	Nennstrom	*Rated current*	A	34,5	*45*	34,5	*45*	18	*26*	8	*11*										
Rendimento nominale η	Nennwirkungsgrad η	*Rated efficiency η*		0,8																	
Fattore di potenza cos φ	Leistungsfaktor cos φ	*Power factor cos φ*		0,7																	
Numero di poli	Polzahl	*Number of poles*		4																	
Classe di isolamento	Isolierklasse	*Insulation class*		F																	
Tipo di raffreddamento	Kühlungstyp	*Type of cooling*		*Raffreddamento a liquido* / Flüssigkeit / *Liquid cooling*																	
Peso versione NASO LUNGO	Gewicht Version LANGE NASE	*Weight of LONG NOSE variant*	kg	36																	
Peso versione con DISTRIBUTORE	Gewicht Version DISTRIBUTOR	*Weight of DISTRIBUTOR variant*		42																	

[(*) fornita da inverter] [(*) von Inverter geliefert] *[(*) from inverter]*

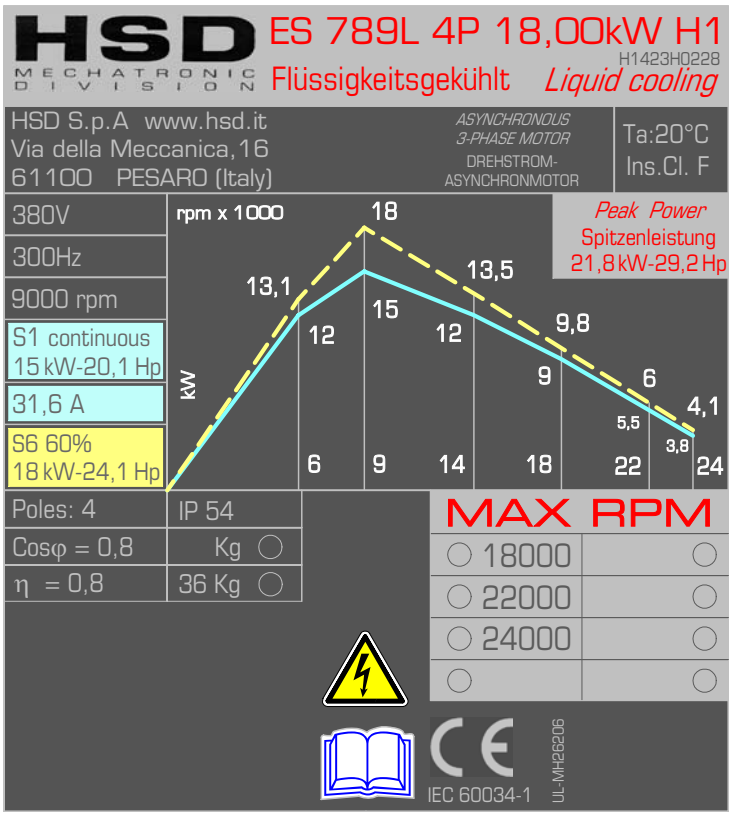
ATTACCO PORTAUTENSILE	*CUSCINETTI ANTERIORI*	*CUSCINETTI POSTERIORI*	*VELOCITÀ MASSIMA*
WERKZEUGHALTER	VORDERE LAGER	HINTERE LAGER	MAX. DREHZAHL
TOOL HOLDER	*FRONT BEARINGS*	*REAR BEARINGS*	*MAX SPEED*
HSK F63	*CERAMICI* / KERAMIK / *CERAMIC*	*ACCIAIO* / STAHL / *STEEL*	18000rpm
HSK F63	*CRONIDUR* / *CHROMEX*	*CERAMICI* / KERAMIK / *CERAMIC*	22000rpm

The maximum value of rated current “S1/cont” is used to set the parameter of the “maximum direct current” of the inverter

Equivalent electrical network SP 120.150.4A

Rated power (S1/Cont)	kW	16
Rated current (S1/Cont)	A	34.5
Rated voltage	V	380
Rated speed	rpm	7,810
Rated frequency	Hz	267
No-load line voltage	V	266
No-load current	A	11
Stator resistance (20°C)	Ohm	0.12
Rotor resistance (20°C)	Ohm	0.2
Stator leakage reactance	Ohm	1
Rotor leakage reactance	Ohm	1.7
Main field reactance	Ohm	19
Field weakening initial speed	rpm	8,000
Motor maximum speed	rpm	18,000
Power factor		0.8
Rotor moment of inertia	kg	0.0025
Connection	Y/D	Y

3.2.6 ES789 18kW DP with 300Hz (9,000 rpm) rated frequency



H1423H0228 Rev.02 (SP.120.150.4E)

Tensione nominale (*)	Nennspannung (*)	*Rated voltage (*)*	V	255		380		380		380		380		380									
Frequenza nominale	Nennfrequenz	*Rated frequency*	Hz	200		300		467		600		733		800									
Velocità nominale	Nominale Geschwindigkeit	*Rated speed*	rpm	6000		9000		14000		18000		22000		24000									
Tipo di servizio	Betriebsart	*Duty type*		S1 cont	***S6 60%***	S1 cont	***S6 60%***	S1 cont	***S6 60%***	S1 cont	***S6 60%***	S1 cont	***S6 60%***	S1 cont	***S6 60%***								
Potenza nominale	Nennleistung	*Rated power*	kW	12	***13,1***	15	***18***	12	***13,5***	9	***9,8***	5,5	***6***	3,8	***4,1***								
Coppia nominale	Nenndrehmoment	*Rated torque*	Nm	19,1	***20,9***	15,9	***19,1***	8,2	***9,2***	4,8	***5,2***	2,4	***2,6***	1,5	***1,6***								
Corrente nominale	Nennstrom	*Rated current*	A	36,8	***41,3***	31,6	***38,7***	29,1	***32,8***	24,3	***26,4***	16,2	***17,6***	11,1	***12,2***								
Rendimento nominale η	Nennwirkungsgrad η	*Rated efficiency η*		0,8																			
Fattore di potenza cos φ	Leistungsfaktor cos φ	*Power factor cos φ*		0,8																			
Numero di poli	Polzahl	*Number of poles*		4																			
Classe di isolamento	Isolierklasse	*Insulation class*		F																			
Tipo di raffreddamento	Kühlungstyp	*Type of cooling*		*Raffreddamento a liquido* / Flüssigkeit / *Liquid cooling*																			
Peso versione NASO LUNGO	Gewicht Version LANGE NASE	*Weight of LONG NOSE variant*	kg	36																			

[(*) fornita da inverter] [(*) von Inverter geliefert] *[(*) from inverter]*

Versioni disponibili **- Verfügbare Versionen** ***- Available models***

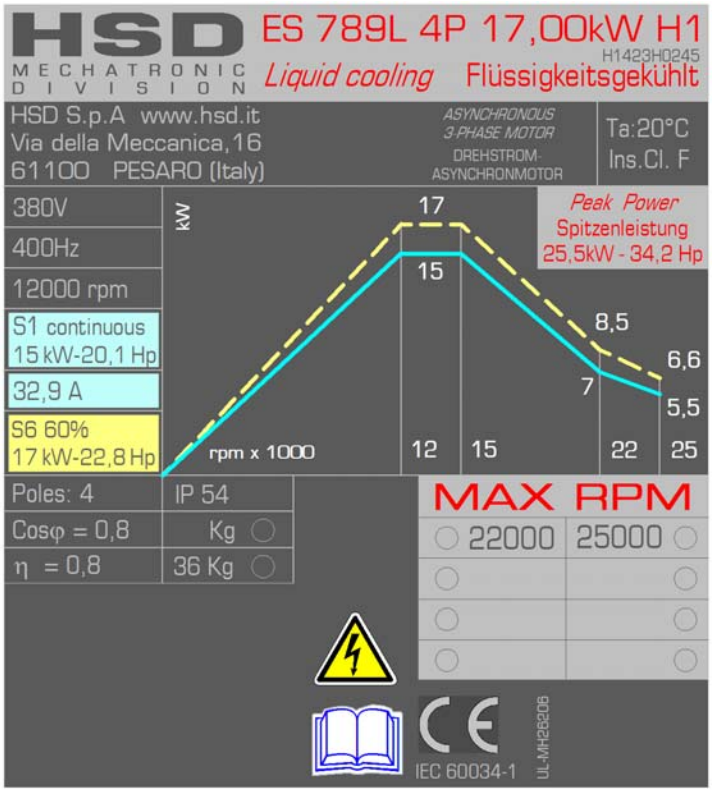
ATTACCO PORTAUTENSILE	*CUSCINETTI ANTERIORI*	*CUSCINETTI POSTERIORI*	*VELOCITÀ MASSIMA*
WERKZEUGHALTER	VORDERE LAGER	HINTERE LAGER	MAX. DREHZAHL
TOOL HOLDER	*FRONT BEARINGS*	*REAR BEARINGS*	*MAX SPEED*
HSK F63	*CERAMICI* / KERAMIK / *CERAMIC*	*ACCIAIO* / STAHL / *STEEL*	18000rpm
HSK F63	*CERAMICI* / KERAMIK / *CERAMIC*	*CERAMICI* / KERAMIK / *CERAMIC*	22000rpm
HSK F63	*CERAMICI* / KERAMIK / *CERAMIC*	*CERAMICI* / KERAMIK / *CERAMIC*	24000rpm

The maximum value of rated current “S1/cont” is used to set the parameter of the “maximum direct current” of the inverter

Equivalent electrical network SP 120.150.4E

Rated power (S1/Cont)	kW	15
Rated current (S1/Cont)	A	33
Rated voltage	V	380
Rated speed	rpm	8,880
Rated frequency	Hz	300
No-load line voltage	V	373
No-load current	A	6.4
Stator resistance (20°C)	Ohm	0.13
Rotor resistance (20°C)	Ohm	0.14
Stator leakage reactance	Ohm	1.7
Rotor leakage reactance	Ohm	1.26
Main field reactance	Ohm	34
Field weakening initial speed	rpm	9,000
Motor maximum speed	rpm	24,000
Power factor		0.8
Rotor moment of inertia	kg	3.8E-03
Connection	Y/D	Y

3.2.7 ES789 17kW with 400Hz (12,000 rpm) rated frequency



H1423H0245 Rev.01 (SP.120.150.45)

Tensione nominale (*)	Nennspannung (*)	*Rated voltage (*)*	V		380		380		380		380							
Frequenza nominale	Nennfrequenz	*Rated frequency*	Hz		400		500		733		833							
Velocità nominale	Nominale Geschwindigkeit	*Rated speed*	rpm		12000		15000		22000		25000							
Tipo di servizio	Betriebsart	*Duty type*			S1 cont	***S6 60%***	S1 cont	***S6 60%***	S1 cont	***S6 60%***	S1 cont	***S6 60%***						
Potenza nominale	Nennleistung	*Rated power*	kW		15	***17***	15	***17***	7	***8,5***	5,5	***6,6***						
Coppia nominale	Nenndrehmoment	*Rated torque*	Nm		12	***13,5***	9,6	***10,8***	3	***3,6***	2,1	***2,5***						
Corrente nominale	Nennstrom	*Rated current*	A		34	***38***	34	***38***	16,5	***20***	15,9	***18,8***						
Rendimento nominale η	Nennwirkungsgrad η	*Rated efficiency η*			0,8													
Fattore di potenza cos φ	Leistungsfaktor cos φ	*Power factor cos φ*			0,8													
Numero di poli	Polzahl	*Number of poles*			4													
Classe di isolamento	Isolierklasse	*Insulation class*			F													
Tipo di raffreddamento	Kühlungstyp	*Type of cooling*			*Raffreddamento a liquido* / Flüssigkeit / *Liquid cooling*													
Peso versione NASO LUNGO	Gewicht Version LANGE NASE	*Weight of LONG NOSE variant*	kg		36													

[(*) fornita da inverter] [(*) von Inverter geliefert] *[(*) from inverter]*

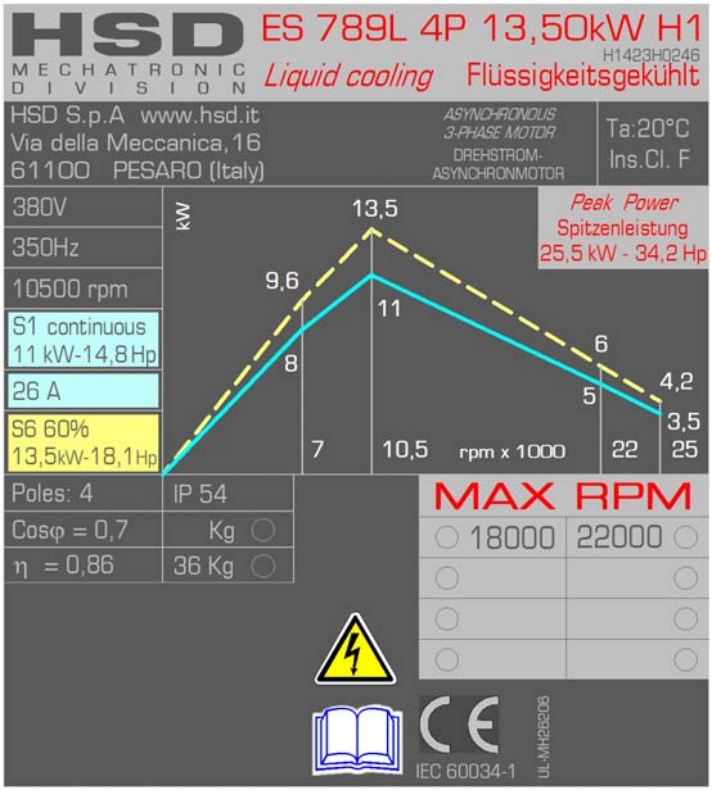
ATTACCO PORTAUTENSILE	*CUSCINETTI ANTERIORI*	*CUSCINETTI POSTERIORI*	*VELOCITÀ MASSIMA*
WERKZEUGHALTER	VORDERE LAGER	HINTERE LAGER	MAX. DREHZAHL
TOOL HOLDER	*FRONT BEARINGS*	*REAR BEARINGS*	*MAX SPEED*
HSK F63	*CERAMICI* / KERAMIK / *CERAMIC*	*ACCIAIO* / STAHL / *STEEL*	22000rpm
HSK F63	*CRONIDUR* / *CHROMEX*	*CERAMICI* / KERAMIK / *CERAMIC*	25000rpm

The maximum value of rated current “S1/cont” is used to set the parameter of the “maximum direct current” of the inverter

Equivalent electrical network SP 120.150.45

Rated power (S1/Cont)	kW	15
Rated current (S1/Cont)	A	34
Rated voltage	V	380
Rated speed	rpm	11748
Rated frequency	Hz	400
No-load line voltage	V	364
No-load current	A	9.5
Stator resistance (20°C)	Ohm	0.09
Rotor resistance (20°C)	Ohm	0.13
Stator leakage reactance	Ohm	0.61
Rotor leakage reactance	Ohm	1.8
Main field reactance	Ohm	27.9
Field weakening initial speed	rpm	12000
Motor maximum speed	rpm	
Power factor		0.8
Rotor moment of inertia	kg	2.5E-03
Connection	Y/D	Y

3.2.8 ES789 13.5kW with 350Hz (10,500 rpm) rated frequency



H1423H0246 Rev.01 (SP.120.150.49)

Tensione nominale (*)	Nennspannung (*)	*Rated voltage (*)*	V	380		380		380		380									
Frequenza nominale	Nennfrequenz	*Rated frequency*	Hz	233		350		733		833									
Velocità nominale	Nominale Geschwindigkeit	*Rated speed*	rpm	7000		10500		22000		25000									
Tipo di servizio	Betriebsart	*Duty type*		S1 cont	***S6 60%***	S1 cont	***S6 60%***	S1 cont	***S6 60%***	S1 cont	***S6 60%***								
Potenza nominale	Nennleistung	*Rated power*	kW	8	***9,6***	11	***13,5***	5	***6***	3,5	***4,2***								
Coppia nominale	Nenndrehmoment	*Rated torque*	Nm	10,9	***13,1***	10	***12,3***	2,2	***2,6***	1,3	***1,6***								
Corrente nominale	Nennstrom	*Rated current*	A	27,5	***33***	26	***32,5***	13,3	***16***	9,5	***11***								
Rendimento nominale η	Nennwirkungsgrad η	*Rated efficiency η*		0,86															
Fattore di potenza cos φ	Leistungsfaktor cos φ	*Power factor cos φ*		0,7															
Numero di poli	Polzahl	*Number of poles*		4															
Classe di isolamento	Isolierklasse	*Insulation class*		F															
Tipo di raffreddamento	Kühlungstyp	*Type of cooling*		*Raffreddamento a liquido* / Flüssigkeit / *Liquid cooling*															
Peso versione NASO LUNGO	Gewicht Version LANGE NASE	*Weight of LONG NOSE variant*	kg	36															

[(*) fornita da inverter] [(*) von Inverter geliefert] *[(*) from inverter]*

ATTACCO PORTAUTENSILE	*CUSCINETTI ANTERIORI*	*CUSCINETTI POSTERIORI*	*VELOCITÀ MASSIMA*
WERKZEUGHALTER	VORDERE LAGER	HINTERE LAGER	MAX. DREHZAHL
TOOL HOLDER	*FRONT BEARINGS*	*REAR BEARINGS*	*MAX SPEED*
HSK F63	*CERAMICI* / KERAMIK / *CERAMIC*	*ACCIAIO* / STAHL / *STEEL*	22000rpm
HSK F63	*CRONIDUR* / *CHROMEX*	*CERAMICI* / KERAMIK / *CERAMIC*	25000rpm

The maximum value of rated current “S1/cont” is used to set the parameter of the “maximum direct current” of the inverter

Equivalent electrical network SP 120.150.49

Rated power (S1/Cont)	kW	11
Rated current (S1/Cont)	A	27.5
Rated voltage	V	380
Rated speed	rpm	10,350
Rated frequency	Hz	350
No-load line voltage	V	380
No-load current	A	6.0
Stator resistance (20°C)	Ohm	0.14
Rotor resistance (20°C)	Ohm	0.22
Stator leakage reactance	Ohm	1.1
Rotor leakage reactance	Ohm	1.8
Main field reactance	Ohm	38
Field weakening initial speed	rpm	10,500
Motor maximum speed	rpm	20,000
Power factor		0.8
Rotor moment of inertia	kg	25E-03
Connection	Y/D	Y

4 Installation and commissioning

4.1 Dimensional drawings

Dimensional drawings are available upon request at HSD customer service.

4.2 Preliminary checks before installation

Before carrying out any operation, CHECK:

- that no part of the product has suffered knocks or damage during the transport and/or handling;
- that connectors are not damaged.

4.3 Preparation of the auxiliary systems of the plant

It is the responsibility of the customer to have the auxiliary systems of the plant ready (e.g. electrical system, air, etc.).
The electric power line must have the necessary transmission power. Connection to the electric mains network may only be carried out by qualified persons.

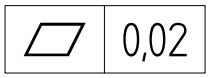
The Customer is responsible for the whole electric power supply to the product up to the connectors.
The user must ensure all the safety conditions necessary for the earthing of the product.
The earthing system must conform to the standards in force in the country of installation and must be inspected at regular intervals by qualified personnel.

4.4 Mechanical connections

The supporting structure to which the product will be secured must be sufficiently stable for the weight of the product and for the type of machining operation to be carried out.

4.4.1 Resting surface

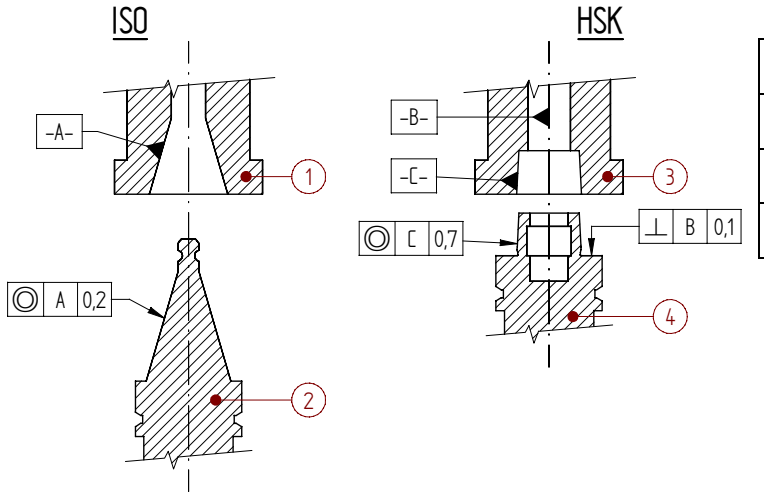
The surface on which the electrospindle is to be fitted must have a flatness less than 0.02 mm.



4.4.2 Tool change system

The tool holder magazine must position cones with the following precision:

- **ISO: spindle shaft/tool holder cone concentricity: 0.2 mm;**
- **HSK: spindle shaft/tool holder cone concentricity: 0.7 mm**
  spindle shaft/tool holder stop surface perpendicularity: 0.1 mm.



1	Spindle shaft ISO
2	Tool holder cone ISO
3	Spindle shaft HSK
4	Tool holder cone HSK

4.4.3 Fastening of models with "*fixing bores*"

To fit the machine electrospindle, choose any of the resting surfaces shown in figures of section 3 "Technical specifications", with the corresponding fixing and positioning bores.
In particular, if the surface chosen has fixing bores either of the through or the threaded type, simply use all the fixing bores of one type only.

In connectorised models, there is only one resting surface.

4.4.4 Fastening of models with "*fixing grooves*"

To fit the machine electrospindle, use 2 side grooves and positioning bores in the resting surface (see figures in section 3 "Technical specifications").

4.4.5 "*Collet*" model fastening

To fasten the machine electrospindle, alternatively use 2 side grooves or threaded bores in the resting surface; for the correct positioning, use 2 bores with specific tolerance on the resting surface (see the figure in section 3.1).

4.4.6 Threaded service bores

There are six M5 threaded bores on the electrospindle nose to mount some accessories.
In models with "fixing grooves", moreover, there are 4 M5 threaded bores on the surface opposite to the resting surface.
(See figures in section 3 "Technical specifications").

In "Collet" models, there are no service threaded bores.

4.5 Fluids distributor

Only for non connectorised versions: the interface surface that creates the connection between the compressed air circuits/cooling liquids circuits and the electrospindle must be made so as to prevent leaks and contamination between the various ducts.

4.6 Pneumatic connections

4.6.1 Specifications for compressed air to be supplied to HSD products

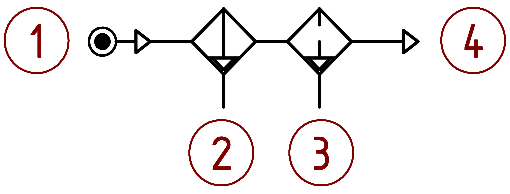
Inject compressed air with a purity rating complying with ISO 8573-1, types 2, 4, 3, i.e:

- Type 2 for solid particles: size of solid particles < 1 μm.
- Type 4 for humidity: dew point < 3°C (37.4°F).
- Type 3 for total oil: oil concentration < 1 mg/m^3.

Failure to comply with these specifications may result in electrospindle malfunction.
The warranty is not valid if pollutants are found during repair operations.

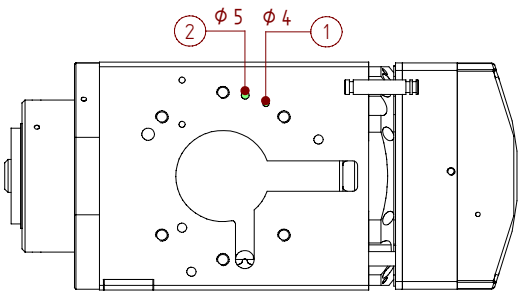
As an example, the above mentioned specifications can be implemented by following the indications below:

- If a lubricated air circuit is present in the machine, it should be isolated from the dry air circuit (to be used by the electrospindle) by means of non-return valves.
- The filters indicated in the diagrams of the following figures should be installed as near the electrospindle as possible.
- taking into account the fact that the efficiency of the filters is <100%, it is essential that the machine be fed with properly treated air;
  As a general guide, and for the circuits illustrated below, inject compressed air with a purity rating complying with ISO 8573-1, types 7, 6, 4, i.e.:
  - Type 7 for solid particles:
    solid particle size < 40 μm;
    solid particle concentration < 10mg/m3;
  - Type 6 for humidity:
    dew point < 10°C;
  - Type 4 for total oil:
    oil concentration < 5 mg/m3.
- At the end of the working day, empty the pneumatic system to enable the automatic purging of filters.
- Carry out regular maintenance operations of the filters according to the manufacturer's indications, and replace them when they are saturated and lose effectiveness (approximately every 6/12 months).

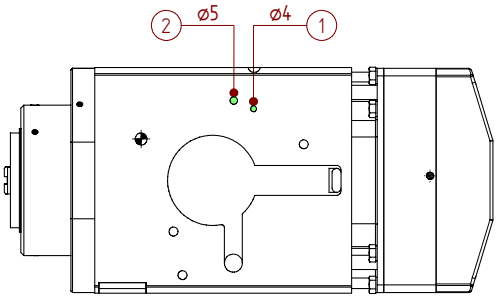


1. Mains power supply.
2. Pre-filter 5 μm.
3. De-oiling filter 0.1 μm.
4. To the HSD product.

Figure 1 : pneumatic connection points



versions with “*fixing bores*”



versions with “*fixing grooves*”

versions with connectors

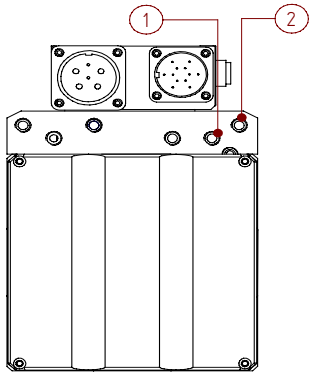
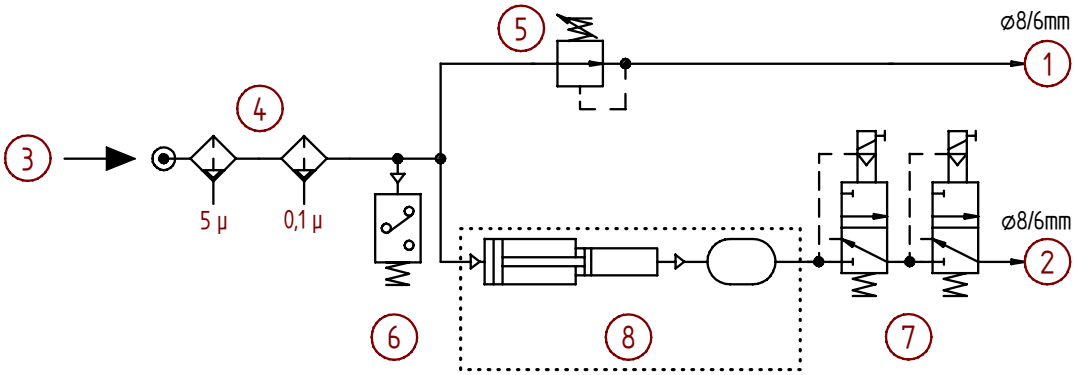


Figure 2 : indicative pneumatic layout



1	Air inlet for pressurisation and cone cleaning	4 bar (58 PSI)
2	Air inlet and outlet for tool holder unlocking	10 bar (145 PSI)
3	Line lead-in	10 bar (145 PSI)
4	Air filtration and purification stage for 99.97% at 0.1 µm (*as an example: pair of condensate separation filters with automatic draining; first stage at 5 µm and second at 0.1µm, with a purification capacity of 99.97% at 0.1 µm*)	
5	Pressure regulator set to 4 bar (58 PSI)	
6	Pressure gauge	
7	Pair of 3-way monostable solenoid valves (use solenoid valves suitable for the pressures employed)	
8	Possible pressure multiplication system	

The use of two electric valves in series instead of just one reduces the possibility of malfunctioning.
Although such malfunctioning is very rare, the seriousness sometimes means the application of the redundancy principle.

THE CIRCUIT SHOWN IS PURELY INDICATIVE

IMPORTANT:

- In order to guarantee the reliable function of the electrospindle, and in particular of the precision bearings, it is absolutely essential to avoid the possibility of contamination of the dry air circuit with oil from the lubricated air circuit (if installed) or from the compressor.
- Keep the dry air circuit and lubricated air circuit completely separate and independent; where this is not possible, take every measure necessary to prevent an abnormal flow-back of lubricated air, for example using non-return valve upline of the oiler and tapping the dry air for the electrospindle upline of these valves.
- Purely as an example and not as a limitation we should point out that such back-flows may cause fluctuations in pressure, for example during the starting and stopping phases of the machine or compressor, or fluctuations in the mains voltage, faults in the compressor, etc.

4.6.2 Automatic cleaning of the tool holder cone

The tool holder cone and its tapered mounting on the spindle shaft is automatically cleaned by a jet of compressed air during the tool changing phase.
This procedure protects the coupling surfaces against deposits of contaminants.
The state of the coupling surfaces must be checked at regular intervals, along with their level of cleanliness, as described in section 7 “Scheduled maintenance”.

The jet of cleaning air is active for the whole time that the collet is open.

4.6.3 Internal pressurisation

The internal pressurisation prevents harmful particles from entering the electrospindle.
Pressurisation circuit must be fed with air compressed at the pressure indicated in Figure 2.

The pressurisation air must be present even when the electrospindle is at a standstill and the machine is switched on, so that no dust from other machining areas can come into the spindle.

With the spindle at standstill, check there is a uniform outlet of air around the spindle shaft (pressurisation); if this is not the case, check the efficiency of the pneumatic circuit and the tightness of the connections.

4.7 Hydraulic connections and specifications of the cooler

The gaskets that isolate the fluid circuits inside the electrospindle are made of NBR (nitrile rubber): use only additives that do not degrade this material.

For the cooling circuit use water with 10% ethylene glycol and anticorrosion additives.

Upon request, HSD supplies “ARTIC-FLU-5” (order No.: H2161H0022).
ARTIC-FLU-5 is a premixed coolant ready for use, tested by HSD S.p.A.
It contains ethylene glycol and corrosion inhibitors with an ecological formula without amines, nitrates or phosphates, and guarantees protection against corrosion for roughly 1 year.
ARTIC-FLU-5 prevents the formation of rust, scale and foam deposits, as well as the hardening, cracking or swelling of the seals and sleeves.
It complies with various international standards, including CUNA NC 956-16.

4.7.1 Specifications of the cooler

Electrospindle power	From 0 to 12 kW	From 13 to 20
Cooling capacity	1,600 W	3,400 W
Minimum flow rate	5 litres/minute	5 litres/minute
Type of coolant	Water + 10% Ethylene Glycol + corrosion inhibitors	Water + 10% Ethylene Glycol + corrosion inhibitors
Temperature of the cooler set	+25+/-3°C (+77+/-5°F)	+25+/-3°C (+77+/-5°F)

4.7.2 Hydraulic connection points

The following figures illustrate the hydraulic connection points according to correspondence shown in this table:

1	Engine coolant inlet
2	Engine coolant outlet
3	First lubricant-coolant inlet for tool
4	First lubricant-coolant outlet for tool
5	Second lubricant-coolant inlet for tool **(*)**
6	Second lubricant-coolant outlet for tool **(*)**
	(*) *present only in some versions.*

Figure 3 : hydraulic connections for ES779 with fixing bores

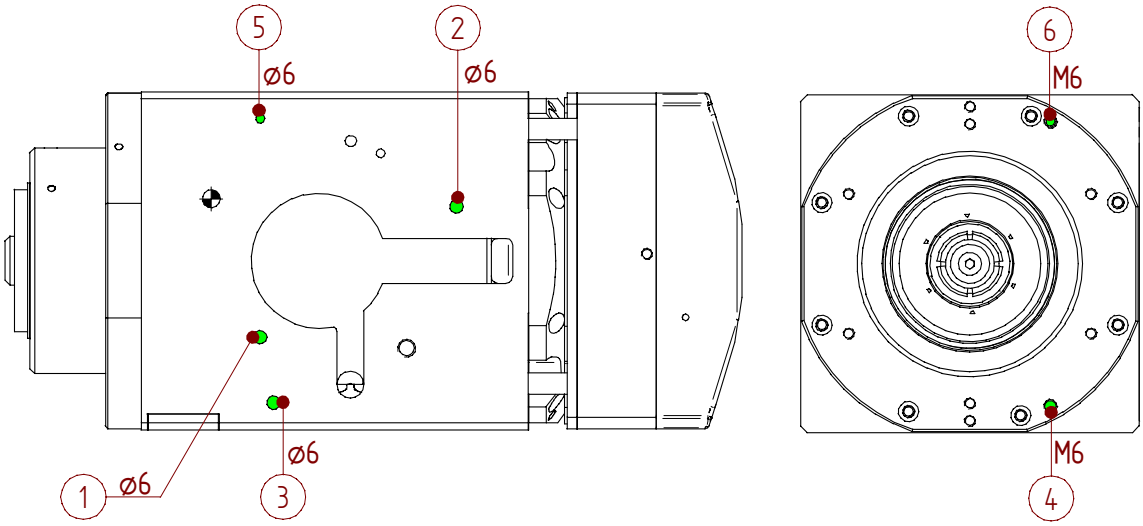


Figure 4 : hydraulic connections for ES779 with fixing grooves

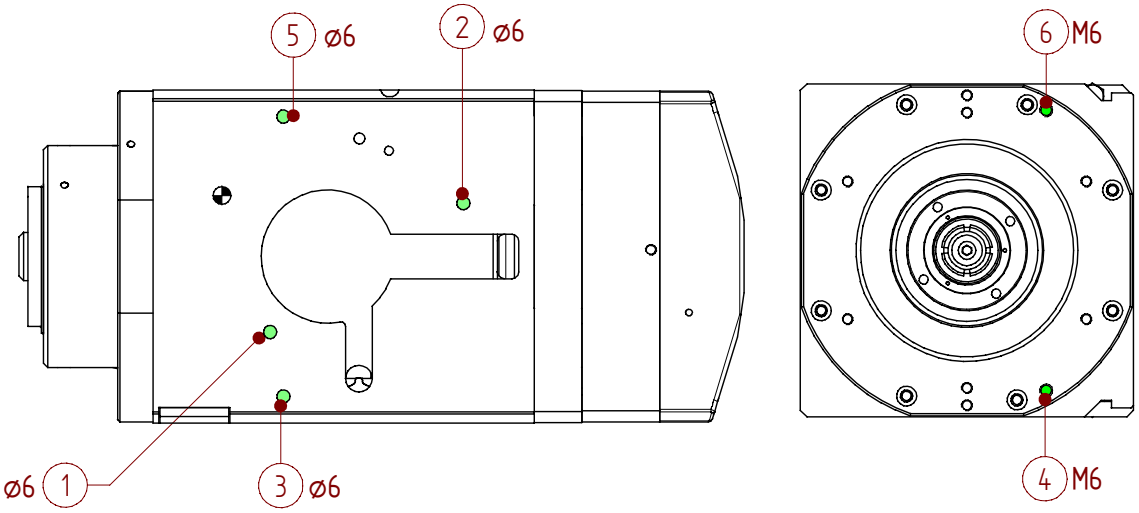


Figure 5 : hydraulic connections for ES789 with fixing bores

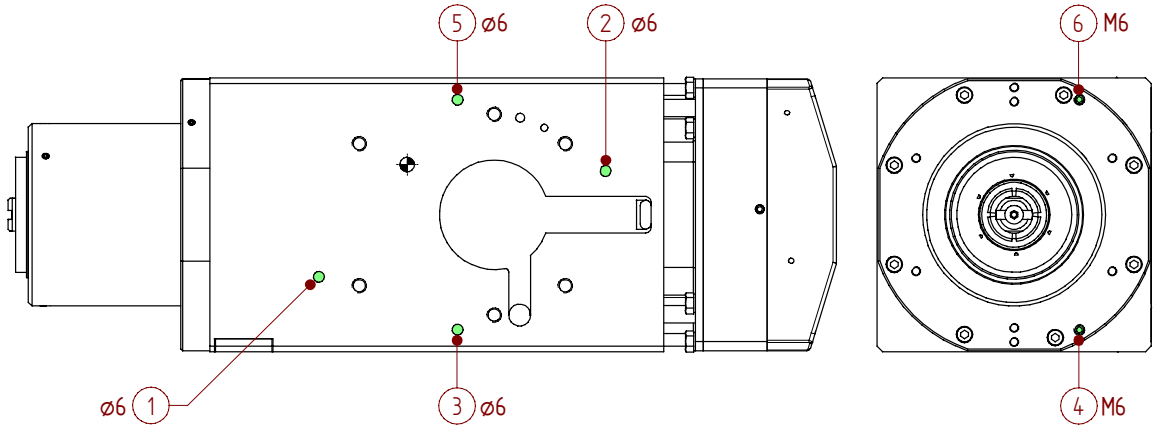


Figure 6 : hydraulic connections for ES789 with fixing grooves

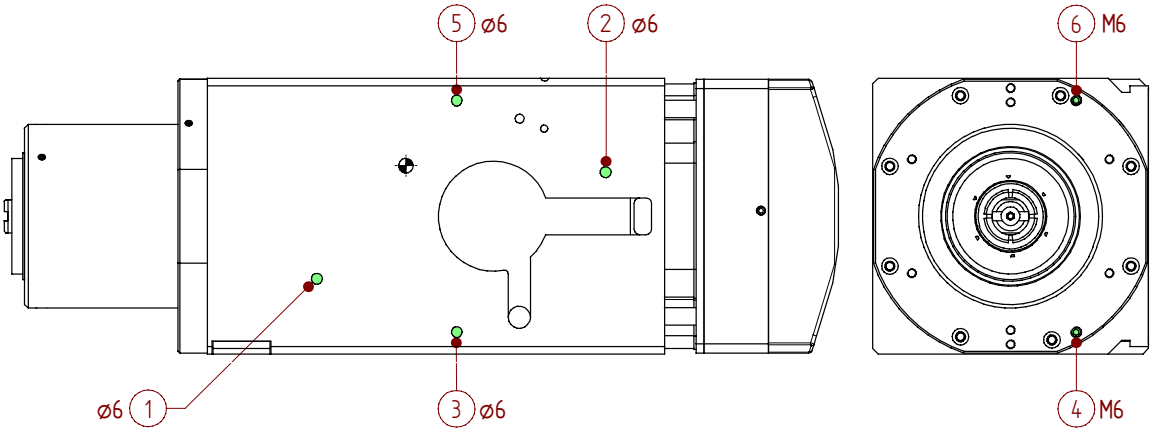
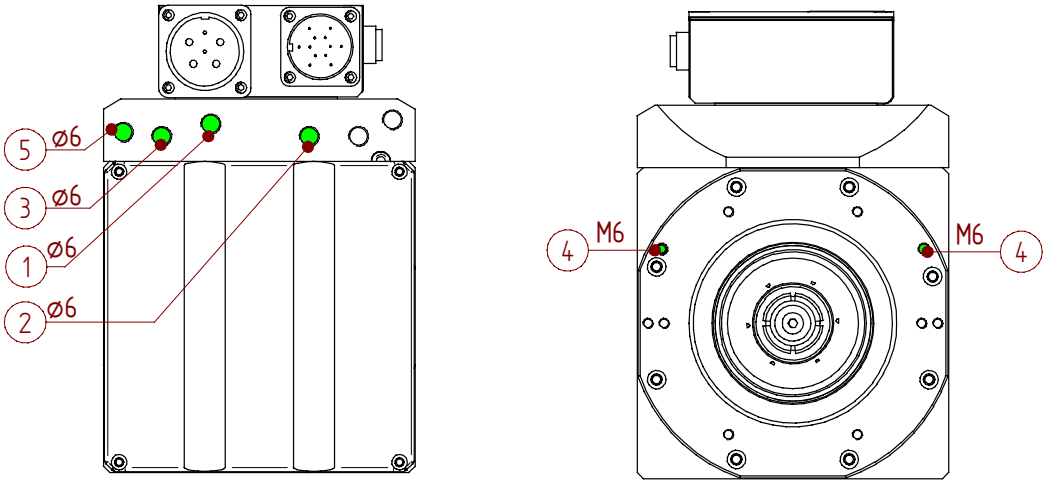
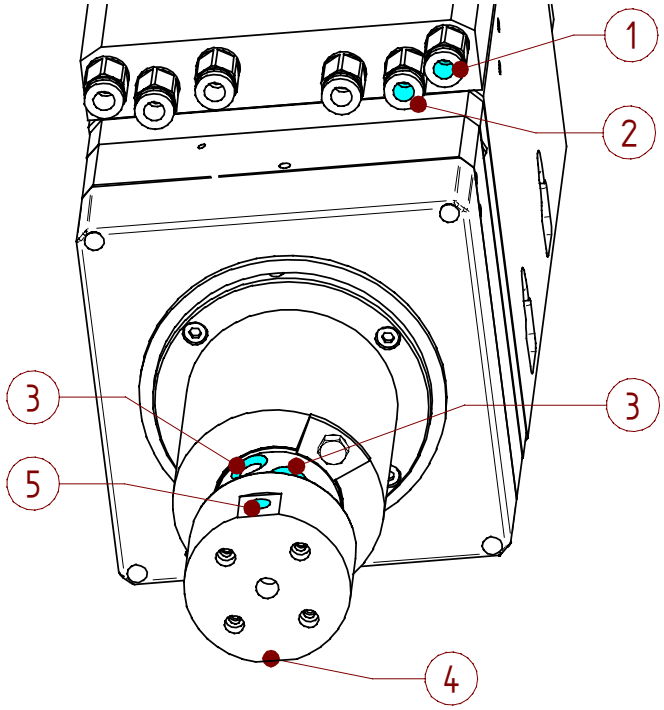


Figure 7 : hydraulic connections for all the other models with electrical connections



4.8 Pneumatic/hydraulic connections of models with distributor



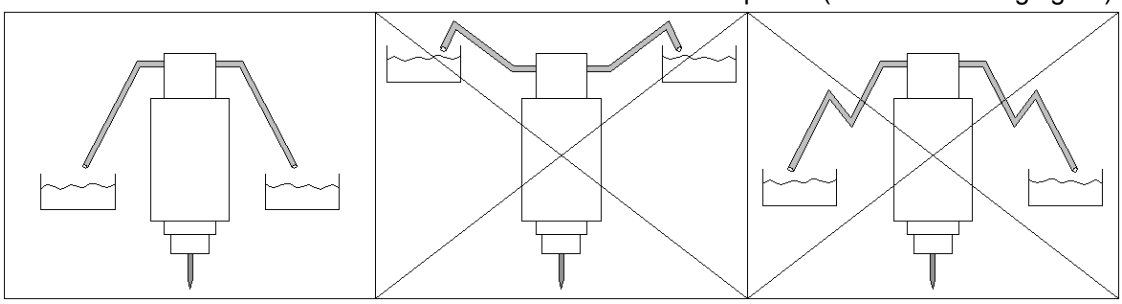
1	Air inlet for tool changing (8x6 pipe 10 bar)
2	Air inlet for pressurisation (4x2 pipe 6 bar)
3	4 bores for safety drainage
4	Air inlet for tool cooling and cone cleaning (G1/8)
5	Tool coolant inlet; oil-water mix (G1/4)

Specifications of the distributor

Inlet air maximum pressure	20 bar
Inlet pressure drop	350 (NL/min)/1 bar
Filtration degree	< 50 microns
Coolant inlet maximum pressure	80 bar
Dry running	Possible

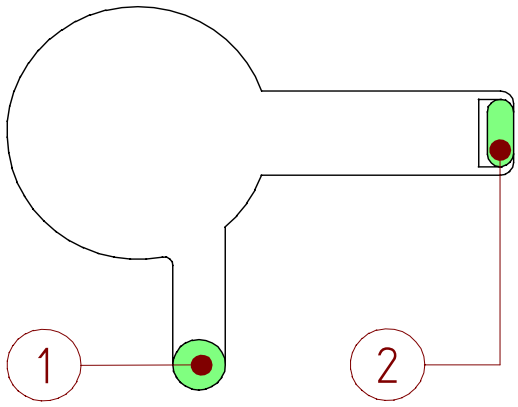
The cooling water reaches the tool through a fluid rotating distributor

Pipes connecting to distributor safety drainage must be oriented downwards. Pipes must remain oriented downwards even when the machine moves the electrospindle (see the following figure).



4.9 Electrical connections of models with free cables

1	Enconder and Sensor cable outlet **(*)**
2	Power and Thermal Alarm cable outlet
	(*)*The encoder is optional*



The electrical power supply to the electrospindle MUST be provided via inverter.

4.9.1 ES779 and ES789 Power Cables

Colour	Description
Red	U Motor Phase
Black	V Motor phase
White	W Motor Phase
Yellow/green	⏚ Motor Earth
Grey	Thermal alarm
Grey	Thermal alarm

4.9.2 Sensor Cables (all motors)

Colour	Description
White	+24 V DC Sensor S1
Green	0 V Sensor S1
Brown	OUTPUT Sensor S1
Yellow	+24 V DC Sensor S2
Pink	0 V Sensor S2
Grey	OUTPUT Sensor S2
Blue	+24 V DC Sensor S3
Black	0 V Sensor S3
Red	OUTPUT Sensor S3
Violet (1)	+24 V DC Sensor S4 (2)
Beige (2)	0 V Sensor S4 (2)
Orange (2)	Sensor S4 OUTPUT (2)

(1) *Only HSK versions:*
weld "OUTPUT Sensor S1"
to the Brown conductor

(2) *Only HSK versions*

***Only HSK versions*:**
the welding specified in note "(1)" of the previous table connects S1 and S4 in series. This eliminates the false signals of S4 in the phases when it is not important.

4.9.3 Encoder cables (*Optional*)

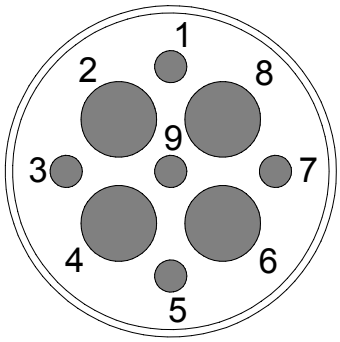
Colour	Description
Brown	B +
Blue	B -
Yellow	A +
Green	A -
Black	0V
Grey	Z +
Red	Vcc **(*)**
White	Z -
(*) +5 V DC or +12 V DC according to model	

Check power supply voltage of the Encoder model before connecting and feeding it so as not to damage electronic circuits.

The cables of the Sensors and Encoder ARE NOT "high-flexibility" ones.
If the application requires it, use "high-flexibility" cables for the connections.

4.10 Electrical connections of models with HSD connectors

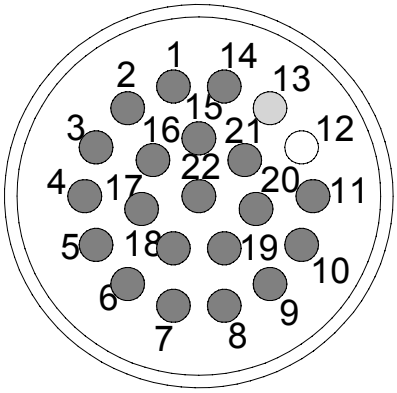
4.10.1 Power connector diagram



PIN	DESCRIPTION
1	THERMAL PROTECTIVE DEVICE: bimetallic normally-closed (NC) switch to be connected in series to the machine alarm or the inverter alarm. 48V DC MAX; 1.6A MAX
2	PE ⏚ in common with PIN 7
3	not used
4	Motor U phase
5	THERMAL PROTECTIVE DEVICE (see PIN 1)
6	Motor V phase
7	PE ⏚ in common with PIN 2
8	Motor W phase
9	Not used

Use cables of not less than 6 mm² (or at least AWG10) for the even PINS, and 1 mm² minimum (or at least AWG18) for the odd ones

4.10.2 Signal connector diagram

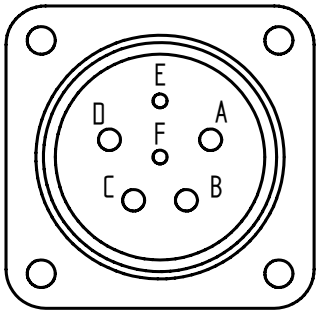


Use cables of not less than 0.35 mm² (or at least AWG22)

PIN	DESCRIPTION
1	sensor S2 (collet open) OUTPUT
2	S1+ S4 sensor series (tool locked) OUTPUT
3	S3 sensor (stopped shaft) OUTPUT *(S3 optional)*
4	+24V DC power to S1, S2, S3
5	+24V DC power to push-button LIGHT BULB
6	0V power supply to S1, S2, S3
7	+24V DC power supply to BUTTON
8	PUSH-BUTTON OUTPUT
9	Not used
10	Not used
11	0V power supply to BUTTON and LIGHT BULB
12	Not used
13	Not used
14	S1 sensor (tool present) OUTPUT
15	A + *(ENCODER optional)*
16	A - (*ENCODER optional)*
17	B - (*ENCODER optional)*
18	0V (optional *ENCODER power supply)*
19	Z + *(ENCODER optional)*
20	VCC (optional *ENCODER power supply)*
21	B + *(ENCODER optional)*
22	Z - (*ENCODER optional)*
(*) +5 V DC or +12 V DC according to model	

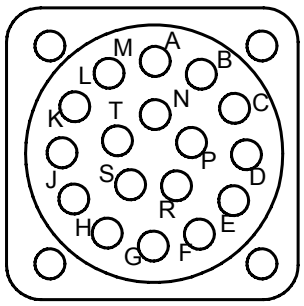
4.11 Electrical connections of models with military connectors

4.11.1 Power connector diagram (standard MIL)



PIN	DESCRIPTION
A	U Motor phase
B	V Motor phase
C	W Motor phase
D	U Motor phase
E	THERMAL PROTECTIVE DEVICE: bimetallic normally-closed (NC) switch to be connected in series to the machine alarm or the inverter alarm. 48V DC MAX; 1.6A MAX
F	THERMAL PROTECTIVE DEVICE (see PIN E)

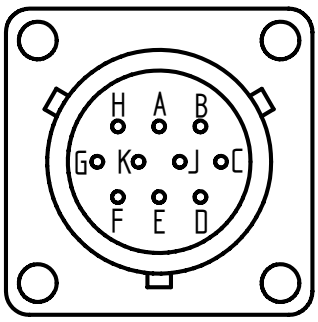
4.11.2 Signal connector diagram (standard MIL)



PIN	DESCRIPTION
A	sensor S2 (collet open) OUTPUT
B	S1+ S4 sensor series (tool locked) OUTPUT
C	S3 sensor (stopped shaft) OUTPUT *(S3 optional)*
D	+24V DC power to S1, S2, S3
E	+24V DC power to push-button LIGHT BULB
F	0V power supply S1, S2, S3, S4
G	+24V DC power supply to BUTTON
H	PUSH-BUTTON OUTPUT
J	0V power to BUTTON and LIGHT BULB
M	S1 sensor (tool insert) OUTPUT
N	THERMAL PROTECTIVE DEVICE
P	THERMAL PROTECTIVE DEVICE
K-L O,P-T	Not used

Contacts of the thermal probe can be found in the power connector or in the signals connector according to the electrospindle model.
For the correct pin-out of connectors, see the dimensional drawing of the spindle concerned

4.11.3 Encoder connector diagram



PIN	DESCRIPTION
A	A +
B	A -
C	B -
D	0V power to ENCODER
E	Z +
F	VCC ENCODER power supply **(*)**
J	B +
K	Z -
(*) +5 V DC or +12 V DC according to model	

4.12 Tool release button

The position of the button is shown in section 3.1

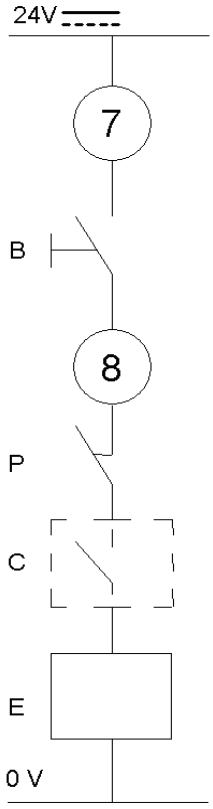
The button on the electrospindle can be used to manually command the release of the tool holder: so that by keeping the button pressed the tool is expelled and the collet remains open until the button is released again.

Characteristics of the button	
Rated voltage (DC)	24V
Maximum current	100 mA

Bulb characteristics	
Rated voltage (DC)	24V
Rated power	0.7W
Rated current	29 mA

4.12.1 Electric diagram for manual tool holder release

- When the spindle is rotating, a control system must disable the command arriving from the button.
- The activation of the button must only be possible with the spindle idle.
- The tool locking/release operation via this button must only be carried out with the machine in MANUAL working mode (not AUTOMATIC).
- The tool could be ejected at high speed if the safety conditions described above are not respected.



7 - 8	PINS 7 and 8 of the SIGNALS connector
B	Tool release button
P	Pressure switch that, in the event of low pressure, does not allow the release of the tool holder
C	Safety check (zero speed device)
E	CNC

5 General checks after installation

5.1 Checks before the start-up

5.1.1 Pneumatic circuit

- Pneumatic circuit pipes must have the diameter specified in section 4.6 “Pneumatic connections”. Input compressed, dry and filtered air, according to the specifications indicated in the same section;
- for the connections, check any labels on the product and refer to section 4.6 “Pneumatic connections”;
- compressed air must always be present, even when the electrospindle is stopped: check (with the electrospindle stopped and tool holder installed) that a uniform and continuous flow of air comes out from the labyrinth on the spindle nose;
- the cone cleaning air must be present during tool changing;
- The expulsion progress of the tool-holder cone must be that indicated in section 6.4 “Tool holder locking and ejection device”.

5.1.2 Hydraulic circuit

- The liquids used must respect the specifications and warnings in section 4.7 “Hydraulic connections and specifications of the cooler”.

5.1.3 Electrical circuit

- The earthed cable of the product (indicated in section 4.8 and 4.10) must be connected to the earthed cable of the machine;

- the thermal safety switch must activate a procedure for protecting against the overheating of the coils of the electrospindle (see section 6.6.4).

5.1.4 Programming the inverter

- The maximum voltage set on the inverter must correspond to the rated value indicated on the motor rating plate.
- The set frequency value at which the maximum voltage (rated frequency) is to be attained must correspond to the value indicated on the motor rating plate.
- The maximum speed set on the inverter must correspond to the value indicated on the motor rating plate.
- The maximum direct current supplied to the inverter must correspond to the rated current indicated on the motor rating plate.
- If it is considered necessary to check the other parameters of the inverter, please contact HSD S.p.A.

5.2 Checks during initial starting

Start the electrospindle only if the sensors confirm the following conditions simultaneously:

Sensor 1	**ON**	**Tool-holder cone attached**
Sensor 1 + Sensor 4 (*)	**ON (*)**	**HSK cone blocked in the correct position (*)**
Sensor 2	**OFF**	**Collet closed**
		(*) *HSK versions only*

The “ON” condition of the sensor corresponds to the output equal to the supply voltage.
The “OFF” condition of the sensor corresponds to an output of 0V.

It is forbidden to start the electrospindle without the tool holder installed.

- the control sensors must intervene according to the logic described in section 6.6;
- the tool changing cycle may only start when the shaft is at a standstill;
- with the tool holder inserted, and without machining, carry out the preheating cycle described in section 6.3.

6 Use and Adjustment

6.1 Environmental Conditions

HSD S.p.A. has inspected and tested its products in accordance with standard environmental conditions(CEI EN 60034-1:2006-05). Contact HSD S.p.A. for information on the possibility of applications in special environments.

6.2 Running-in

Before being packed, the product was subjected to an automatic running-in cycle to guarantee the correct distribution of the lubricant (long-life grease) on the races of the bearings, and to run in the spheres and races of the bearings themselves. If present, also the reducers and servomotors are run in, and dynamic tests are carried out on the inner pneumatic and hydraulic circuits.
The running-in cycle also includes a strict inspection of all the command and signalling elements, simulating various types of operating cycle on the test bench.

6.3 Preheating

HSD S.p.A. uses high-precision angular contact bearing pairs, pre-loaded and lubricated for life with special grease for high speeds.
When the machine is switched on for the first time every day, allow the electrospindle to perform a brief preheating cycle in order to allow the bearings to gradually attain a uniform operating temperature, and hence to obtain a uniform expansion of the bearing races and the correct preload and rigidity.

The following cycle is recommended, with tool holder inserted, but without machining operations:

- 50% of the maximum rated speed for 2 minutes.
- 75% of the maximum rated speed for 2 minutes.
- 100% of the maximum rated speed for 1 minute.

The preheating cycle should also be performed every time that the machine is inoperative long enough for the electrospindle to cool down to room temperature.

Only in cases of the first start-up after storage or machine shutdown for more than four months, allow the machine to run for 2 minutes at 5,000 rpm before proceeding with the preheating cycle.

While the machine is operating, the spindle can reach high temperatures. Be very careful not to touch it without due precautions.

6.4 Tool holder locking and ejection device

The blocking and expulsion of the tool-holder are achieved by the double-acting movement of a pneumatic piston, activated with compressed air of the pressure indicated in section 4.6 “Pneumatic connections”.

The tool-holder cone expulsion must be around 0.5 mm - 0.9 mm for versions ISO and around 0.5 mm - 0.6 mm for versions HSK.

The tool-holder is blocked mechanically by elastic springs that develop an axial force equal to:

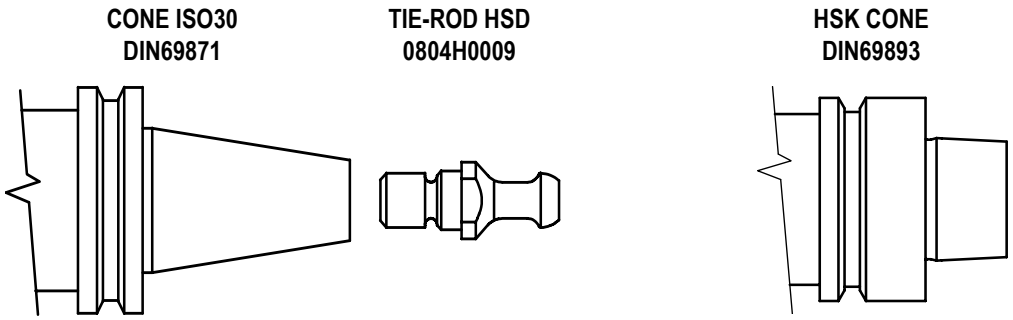
ELECTROSPINDLE MODEL	AXIAL FORCE OF THE SPRINGS	AXIAL FORCE ON TOOL HOLDER
ES779 HSK E40-F50	2,300 ± 10%	6,800 ± 10%
ES779 HSK A/E 63	6,300 ± 10%	18,000 ± 10%
ES779 HSK F63	3,430 ± 10%	11,000 ± 10%
ES789 HSK F63	3,430 ± 10%	11,000 ± 10%

The axial force exerted on the tool-holder by the blocking system is guaranteed constant for a minimum duration of 2,000,000 cycles of tool change

1 tool changing cycle = tool blocked / tool released / tool blocked

All HSD electrospindles have a mechanical reaction system that neutralises the axial force of the piston on the shaft during the tool changing phase, thus guaranteeing the integrity of the precision bearings.

6.4.1 Tool holder cone



- The geometry of the conicity must respect standard DIN69871 for ISO30 cones, and standard DIN69893 for HSK cones.
- The tool holder cone ISO30 must have an AT3 precision rating;
- Avoid the presence of plugs, slots, or other forms affecting the dynamic balancing of the tool holder;
- At the maximum rated speed of the electrospindle, the level of dynamic balancing must be G = 2.5 or better (ISO1940 standard);
- The balancing must be carried out with the tool holder assembled (cone, mill collet, ring nut, tool);
- The tie-rod (also known as the shank) of the cone ISO30 must only be the one supplied by HSD (code 0804H0009).

6.4.2 Installation of the tie-rod HSD 0804H0009 in the cone ISO30 DIN69871

- Carefully clean the tie-rod and the tie-rod housing in the cone ISO30.
- Cover the thread of the tie-rod with high resistance, thread-blocking liquid (LOCTITE 270 or another equivalent product).
- Tighten the tie-rod to the cone with a torque of 62 Nm.
- Leave the cone to rest, to allow the thread-blocking liquid to adhere (12 hours with LOCTITE 270, or depending on the manufacturer's indications if using an alternative, equivalent thread-blocker).

The use of non-original HSD tie-rods, or incorrect installation, may cause the tool holder cone to be thrown out.

It is forbidden to use ISO or HSK tool holders not conforming to the conditions described above; failure to observe these instructions represents a source of risk, damage or incorrect hooking of the tool holder cone, with serious risks for the user.

6.4.3 General recommendations relating to tool holder cones

IMPORTANT:

- The choice of tool holder is a determining factor for safety purposes.
- The conical surfaces of the tool holder and of its housing on the shaft/spindle must be kept thoroughly clean in order to permit secure mounting (see section 7 “Scheduled maintenance”).
- During machining operations, be sure to avoid any contact between the non-cutting rotating parts and the piece being machined.
- The seat of the tool holder cone must always be protected against any impurity that may come in: use a closing device or a tool holder cone.
- At the end of the working day, always remove the tool holder cone from the electrospindle, to avoid any problem of it sticking. Close the seat of the tool holder by means of a tool holder cone that is clean and at room temperature.
- Do not set the electrospindle in rotation without the tool holder installed. In particular, for the HSK models, the rotation of the electrospindle without its tool holder jeopardises the balancing and the working of the collet.

6.5 Tool

The tools must have a degree of dynamic balancing of G = 2.5 or better (standard ISO1940).

OBSERVE THE MAXIMUM ROTATIONAL SPEED (rpm) SPECIFIED BY THE TOOL MANUFACTURER.

Depending on the type and quality of the machining operation to be performed and the material used, it is the responsibility of the user to decide whether to operate with a lower speed (NEVER HIGHER) than that specified by the tool manufacturer.

When selecting the tool, it is essential to pay attention to the following recommendations:

- Always use properly sharpened tools, locking them correctly in the respective tool holder.
- Never use deformed or damaged tools, tools with missing parts or tools that are not perfectly balanced.
- Before inserting the tool in the respective collet, always check that all the surfaces are free from damage and thoroughly cleaned.
- The essential conditions for using a tool at high speed are:
  - compact, short and light tool
  - accurate and with some blocked inserts with a high safety degree
  - balanced and symmetrically coupled with the tool holder
  - with cutting edges near the rotation axis

6.5.1 Speed limits regarding the tool

As an example, the charts on the following pages show the maximum rotation speed of the electrospindle when empty, on the basis of the weight of the TOOL+TOOL HOLDER assembly (including ring nut and mill collet if present), and, furthermore, depending on the distance between the nose of the electrospindle and the centre of gravity “G” of the tool+tool holder assembly.

Next to each chart there is the tool+tool holder assembly that was envisaged as assembled in the spindle shaft to calculate the curves.

The mass of the tool+tool holder assembly was applied to the centre of gravity “G”, highlighted in the drawing.

Some possible positions of the centre of gravity “G” were considered, and for each position a curve has been drawn on the chart.

The degree of balancing is that recommended in the previous paragraphs.

The charts on the following pages are approximate, i.e. they do not take into account (because HSD S.p.A. cannot know this piece of information) the machining operation parameters, the specific characteristics of the tool used by the customer, or the particular type of material being machined: it is the user's responsibility to evaluate each time the maximum speed that allows him to work safely.

Procedure for reading the charts

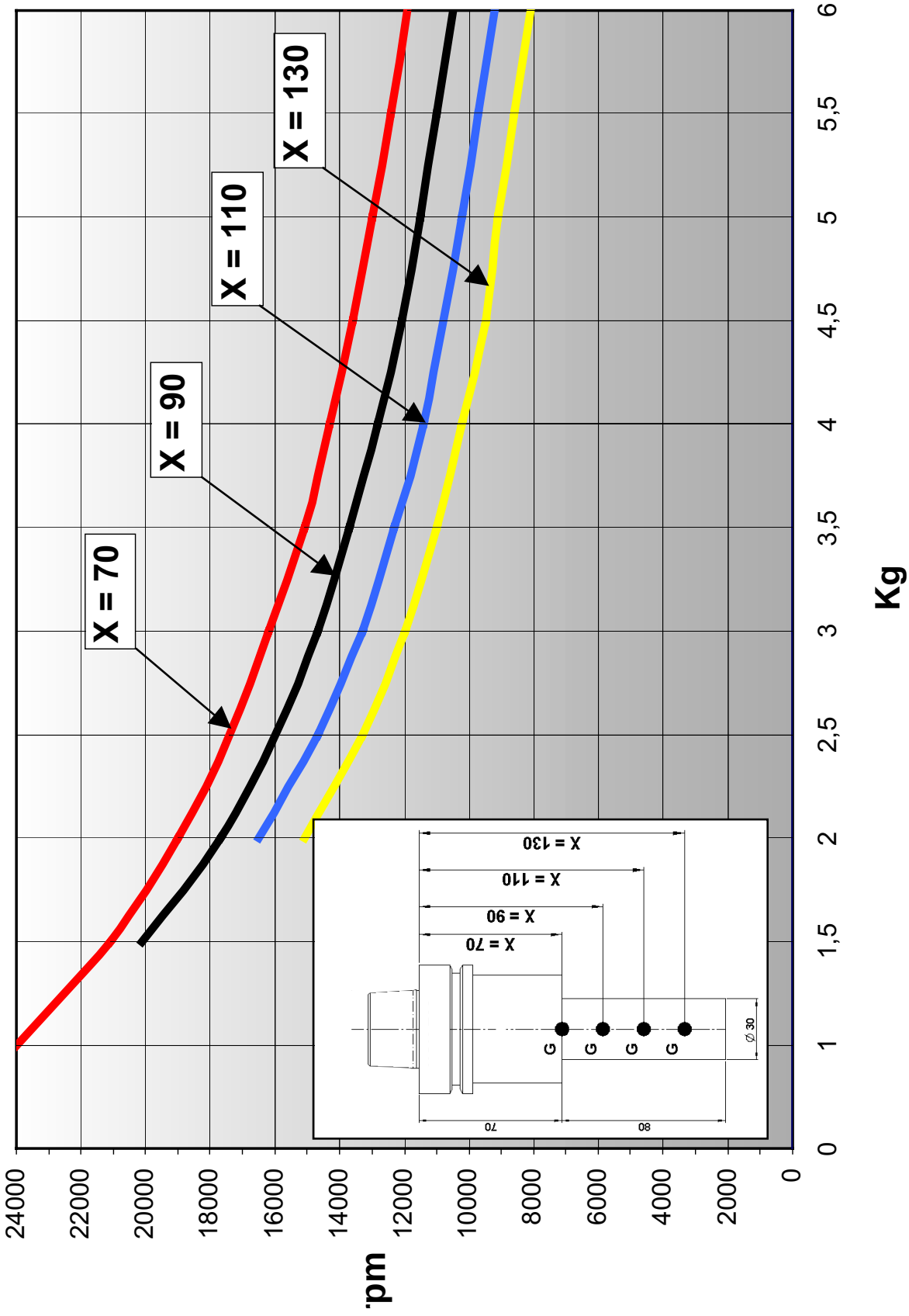
5. Identify the chart relating to your electrospindle;
6. On the basis of the distance “**X**” between the spindle nose and the centre of gravity “**G**” of the tool+tool holder assembly, choose one of the curves. If the **“X”** measured on your electrospindle does not appear on the chart, choose the curve associated with the **“X”** that is the next measurement bigger (see example);
7. Corresponding to the weight of the tool+tool holder assembly, read the value of the maximum speed.

EXAMPLE

On an **ES789 HSK** a tool+tool holder assembly with an overall weight of **4.5 kg** (including the ring nut and mill collet) is to be used; the distance between the spindle nose and the centre of gravity **“G”** of the tool+tool holder assembly is **“X”=120 mm**:

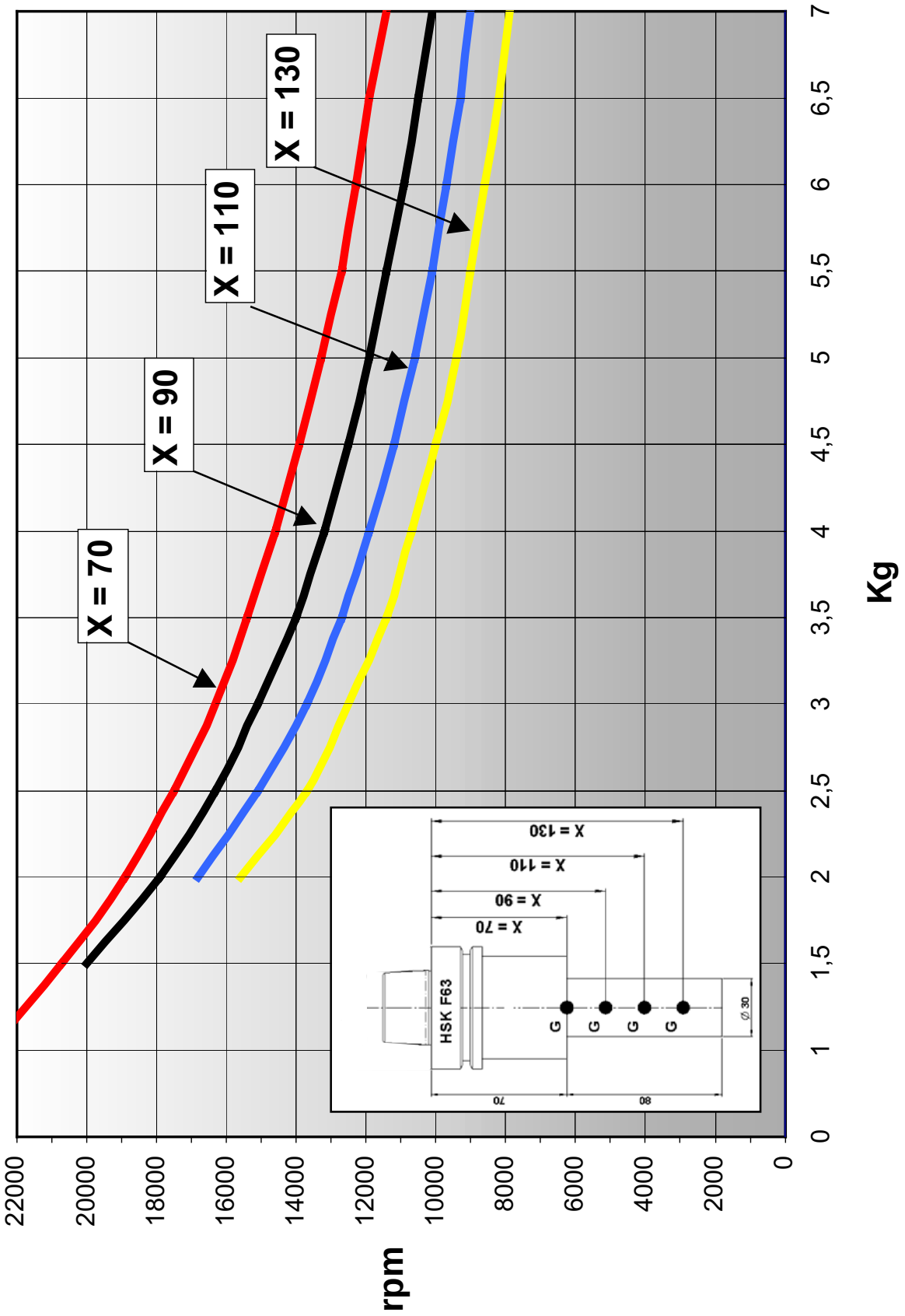
1. The chart relating to this particular electrospindle is “ES789 HSK” on page 66;
2. With no specific curve for **“X”=120 mm**, it is necessary to refer to the **yellow** curve associated with **“X”=130 mm**;
3. Corresponding to the weight of **4.5 kg**, you can read the maximum speed, when empty, of **10,000 rpm**.

ES779 HSK Short Nose



DO NOT EXCEED THE MAXIMUM ROTATIONAL SPEED (rpm) SPECIFIED BY THE TOOL MANUFACTURER!

ES789 HSK



DO NOT EXCEED THE MAXIMUM ROTATIONAL SPEED (rpm) SPECIFIED BY THE TOOL MANUFACTURER!

6.6 Sensors

The electrospindle is equipped with inductive sensors for monitoring its status, and a “thermal alarm” to protect the electric coils.

NAME	INFORMATION OF THE SIGNAL
S1	Tool holder cone attached
S2	Collet open - Tool released
S3 (*)	Shaft idle **(*)**
S1+S4 (**)	HSK cone blocked in the correct position **(**)**
Thermal alarm	Motor overheated: stop the electrospindle!
(*) *Not present in some versions* **(**)** *Only in HSK versions*	

6.6.1 Technical characteristics of the inductive sensors

Proximity sensors PNP normally open (NO)	
Supply voltage	10 - 30V (DC)
Maximum load	200 mA
Power consumption when OFF	<10 mA
Nominal detection distance	0.8 mm

6.6.2 States of the electrospindle and corresponding outputs of the inductive sensors

The “ON” condition of the sensor corresponds to the output equal to the supply voltage; the “OFF” condition corresponds to an output of 0V.

STATE	S1	S2	S3 (*)	S1+S4 (**)
Collet open (Tool-holder cone ejected)	**OFF**	**ON**	**IDLE**	**OFF**
Tool holder cone correctly locked	**ON**	**OFF**	**IDLE or STARTED UP (***)**	**ON**
Collet closed but tool holder cone missing	**OFF**	**OFF**	**IDLE**	**OFF**
(*) *Not present in some versions* **(**)** *HSK versions only* **(***)** *Depending on the operating status of the machine*				

For HSK versions there is one further status of the electrospindle, in which the tool-holder cone is attached, but not correctly positioned on the stop as regards the surface of the HSK hooking system. This situation is indicated by the output:

S1	S1+S4
ON	**OFF**

This condition is dangerous:
if it arises, stop the rotation or the tool change procedure, check the machine and remove whatever is preventing the correct hooking-up of the HSK tool-holder.

The shaft of the electrospindle can only be rotated in the *“Tool holder cone correctly locked”* status; if the outputs of S1 or S1+S4 move to “OFF”, stop the rotation of the shaft of the electrospindle.

6.6.3 Description of the inductive sensors

Sensor S1: “Tool holder attached” signal

The signal of sensor S1 indicates the presence of the tool holder cone in the closed collet.

Ignore output S1 during the period from the tool release command to the tool hooking command.

Sensors S1+S4: “HSK cone blocked in correct position” signal

The S1+S4 signal is present only in HSK versions.

Sensors S1 and S4 are connected in sequence (section 8.3.3).
Sensor S1 checks that the HSK tool holder cone is present in the closed collet, then activates the reading of sensor S4.
If activated by S1, S4 checks that the stop surfaces of the tool holder cone and the HSK hooking system are correctly in contact.
The output is “ON” only if both conditions have been checked.

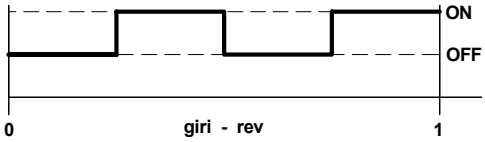
Ignore the output of S1+S4 during the period from the tool release command to the tool hooking command.

Sensor S2: “Collet open” signal

Signal S2 is relevant during the tool changing cycle: it signals the opening of the collet and the possibility to continue to the next phase of the tool change cycle.

Sensor S3: “Shaft idle” signal

Sensor S3 supplies two “ON” pulses and two “OFF” pulses at each rotation of the shaft, as shown in the figure below.



Above a certain rotation speed, the output of S3 may appear to be permanently “ON”, only returning to a regular status when the speed drops below this threshold. This phenomenon is not a malfunction and depends on the performance of the CNC.

Ignore the signal S3 during the tool changing phase, as it may appear to be in either of the two statuses (“ON” or “OFF”)

The S3 signal is not present in certain versions.

6.6.4 Use and technical characteristics of the thermal alarm

The electrospindle is equipped with a normally closed bimetallic switch installed in the electric windings of the stator. If a temperature is reached that is harmful for the electric windings, the switch open and the alarm to which it is connected must stop the machining operation; the contact closes automatically when the temperature drops and returns to safe values.
The bimetallic switch must be connected to the machine alarm or the inverter alarm, as shown in section 4.9.

Technical characteristics of the bimetallic switch:

Power supply	48V DC MAX
Current	1.6A MAX
Switching cycles	10,000 cycles
Contact breaking time	< 1 ms
Contact resistance (according to MIL R 5757)	< 50mΩ
Insulation voltage	2 kV

6.7 Encoder (optional)

6.7.1 General description

The encoder codes in an incremental system the registered position data with A and B, A negated and B negated signals, in phase quadrature; it also provides Zero and Zero negated signals (see following figures
).Signals are taken outside as shown in section 4.9.3 “Encoder cables (Optional)”.

There are three models of encoder available:

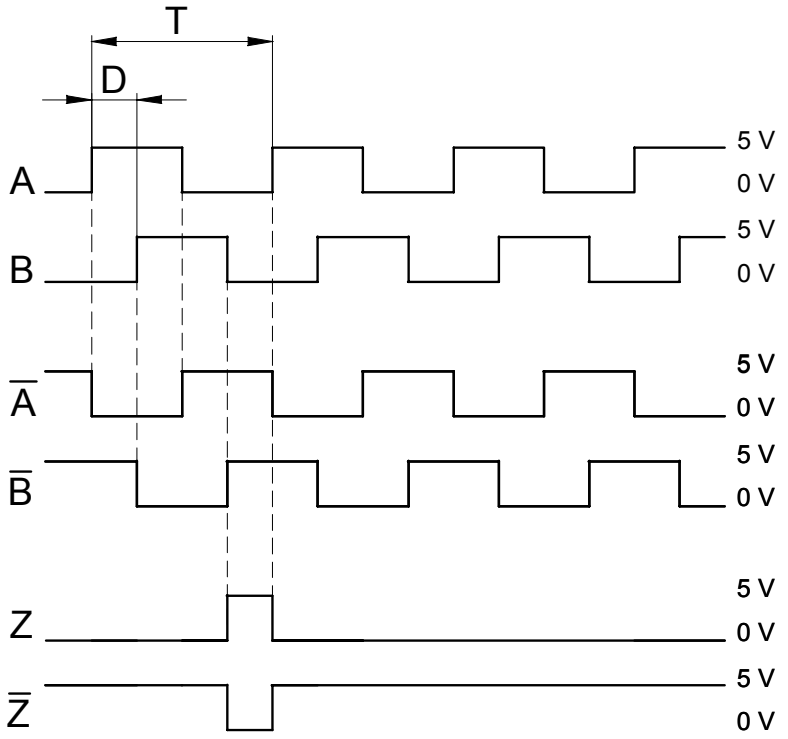
- HSD “Square Wave” type;
- Lenord+Bauer “Square Wave” type;
- Lenord+Bauer “Sinusoidal” type.

6.7.2 Technical specifications of the HSD Square Wave encoder

SPECIFICATION	VALUE
Rated supply voltage	12 V DC ÷ 24 V DC +/- 10%
Consumption	99 mA at 12 V DC 51 mA at 24 V DC
Operating temperature	0° C ÷ 70° C (+32° F ÷ 158° F)
Max. operating height	2,000 m (6,500 ft)
Signal input:	400 pulses per rev + zero reference
Signal output:	TTL-level compatible (0V, +5V line driver)

A voltage over the specified (24V ±10%) may damage the encoder reader

Signals of the HSD Square Wave encoder

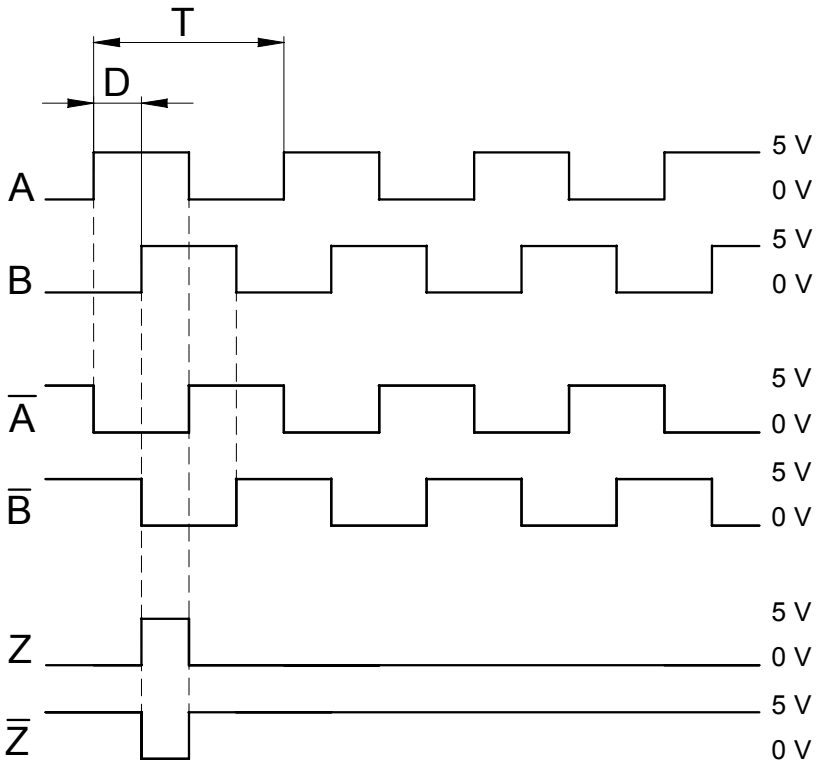


T	Period
D	Phase Difference (D=T/4)

6.7.3 Technical specifications of the Lenord+Bauer Square Wave encoder

SPECIFICATION	VALUE
Rated supply voltage	5 V DC +/- 5%
Operating temperature	-30° C ÷ +85° C (-22° F ÷ +185° F)
Max. operating height	2,000 m (6,500 ft)
Signal input:	1024 pulses per rev + zero reference (256 pulses multiplied x4 internally)
Signal output:	TTL-level compatible (0V, +5V line driver)

Signals of the Lenord+Bauer Square Wave encoder



T	Period
D	Phase Difference (D=T/4)

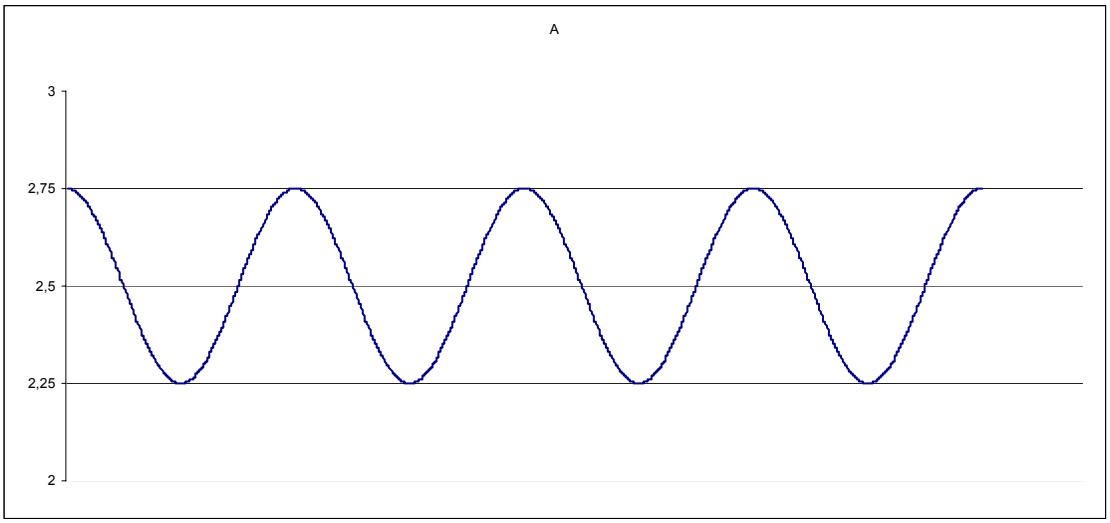
A voltage over the specified value (5V ±5%) may damage the encoder reader

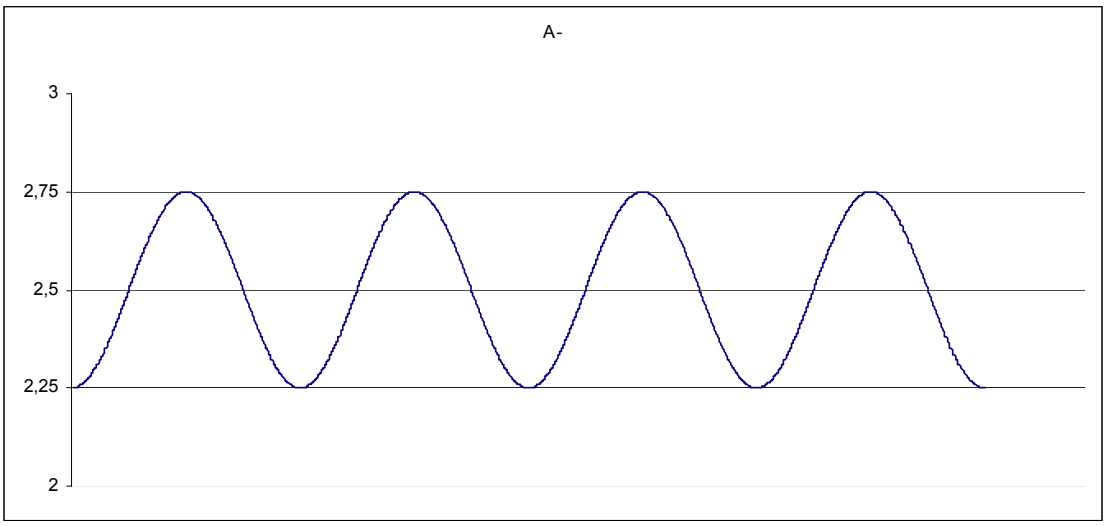
6.7.4 Technical specifications of the Lenord+Bauer Sinus Wave encoder

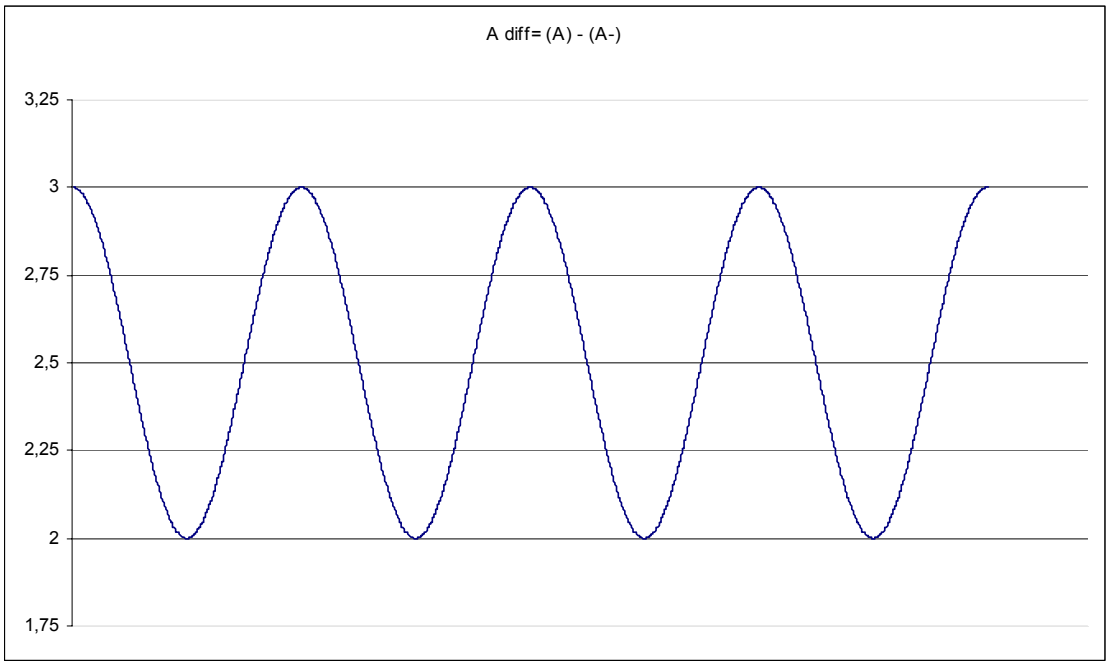
SPECIFICATION	VALUE
“U” rated supply voltage	5 V DC +/- 5%
Operating temperature	-30° C ÷ 85° C (-22° F ÷ 185° F)
Max. operating height	2,000 m (6,500 ft)
Signal input:	256 pulses per rev + zero reference
A B Signal output:	500 mV peak-to-peak with average value “U ref.”=U/2
	1 V peak-to-peak as signal difference with average value “U ref.” (see following figures)
A B signal phase difference	90° (a quarter of period)
Z signal output:	500 mV of peak according to rest value U ref. ±80mV
	1 V of peak as signal difference with rest value U ref.-160mV= 2.34V (see following figures)

A voltage over the specified value (5V ±5%) may damage the encoder reader

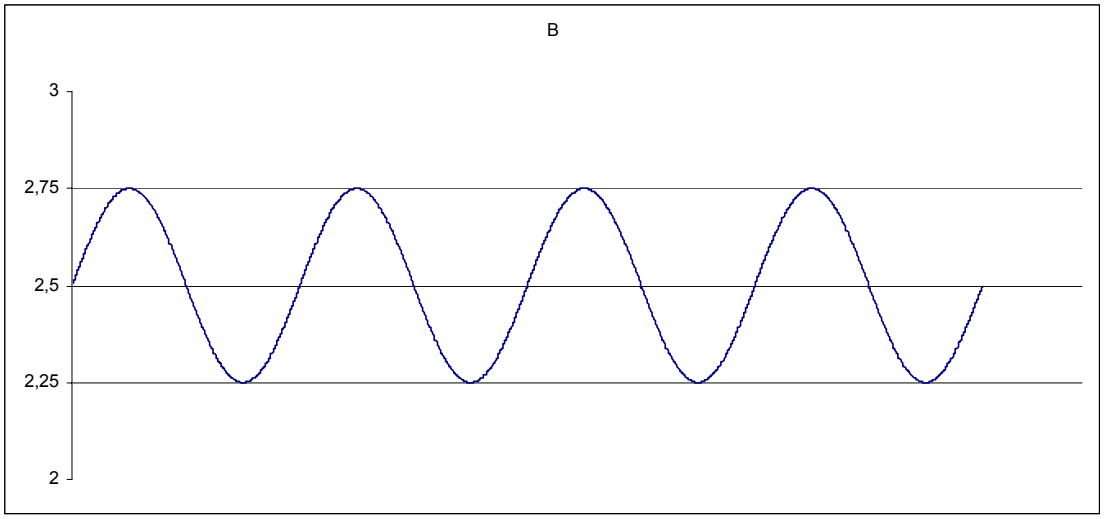
A signal temporal performance:

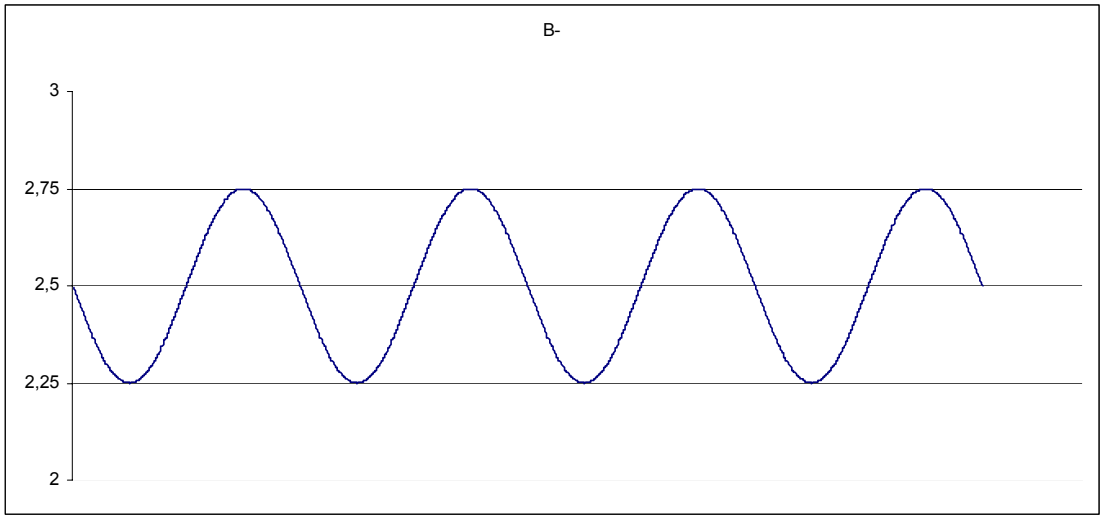


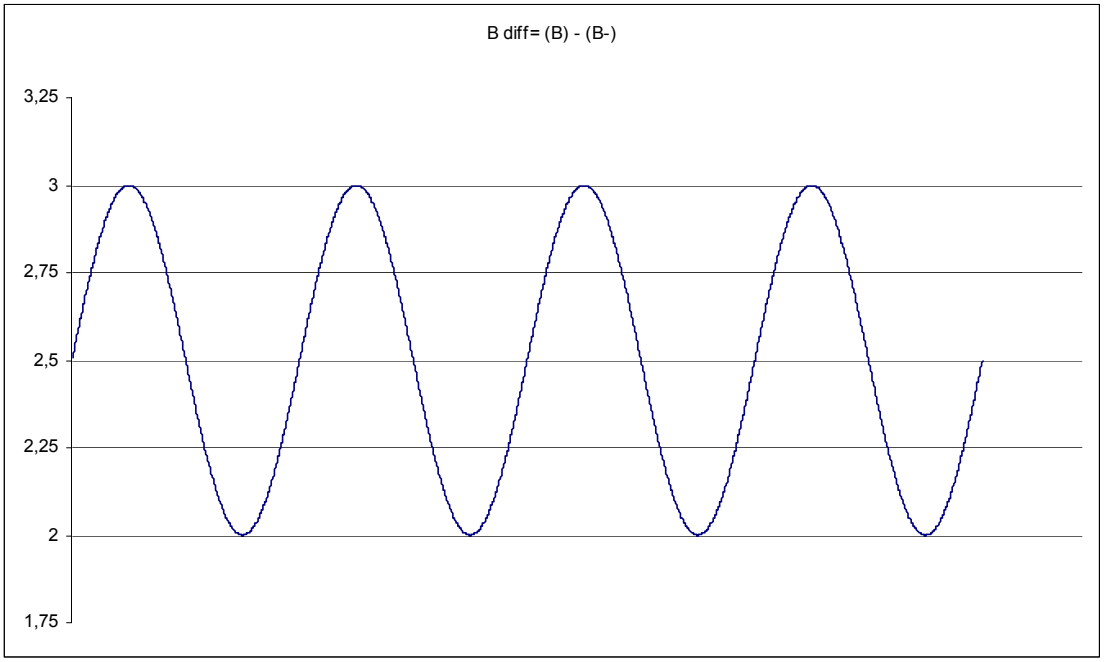




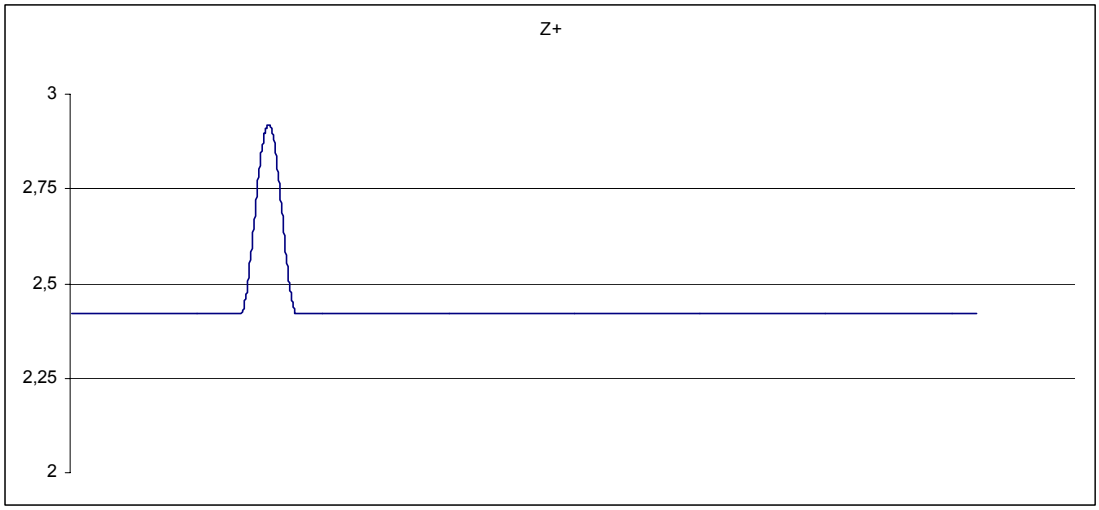
B signal temporal performance:

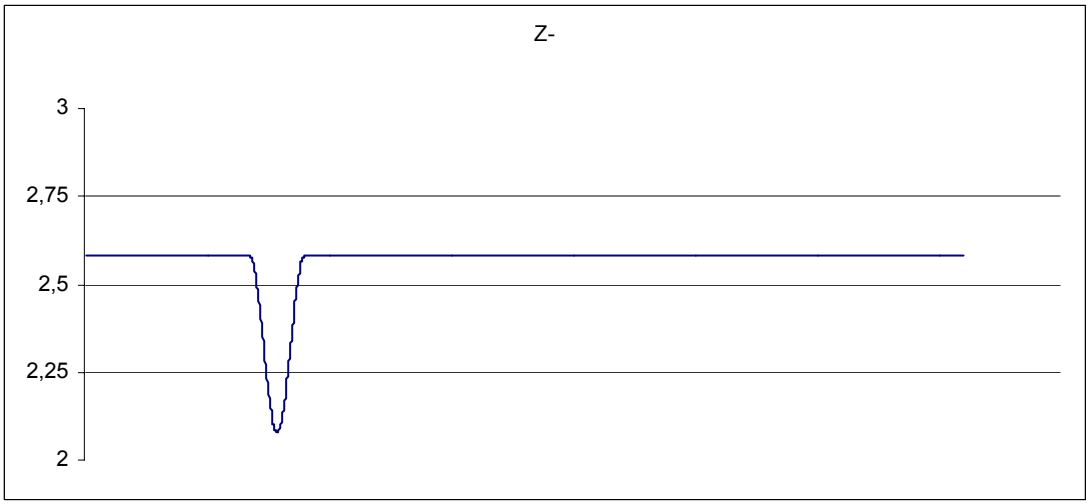


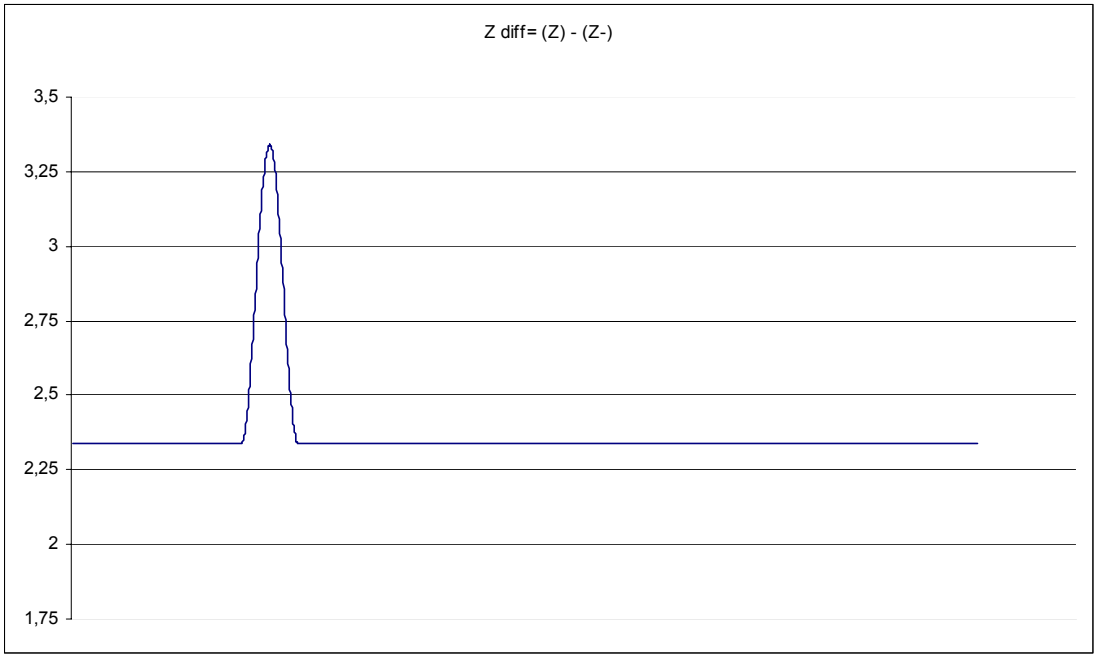




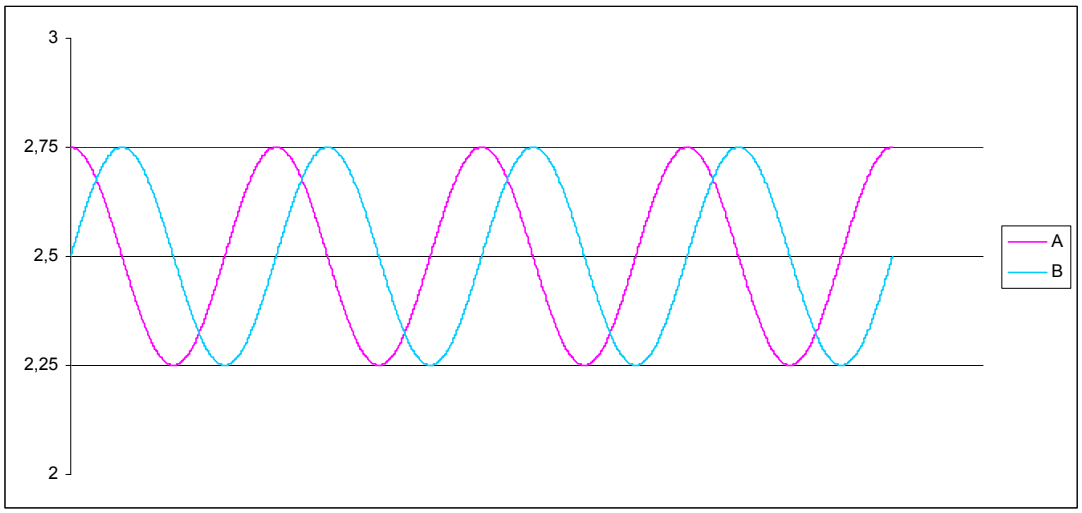
Z signal temporal performance:



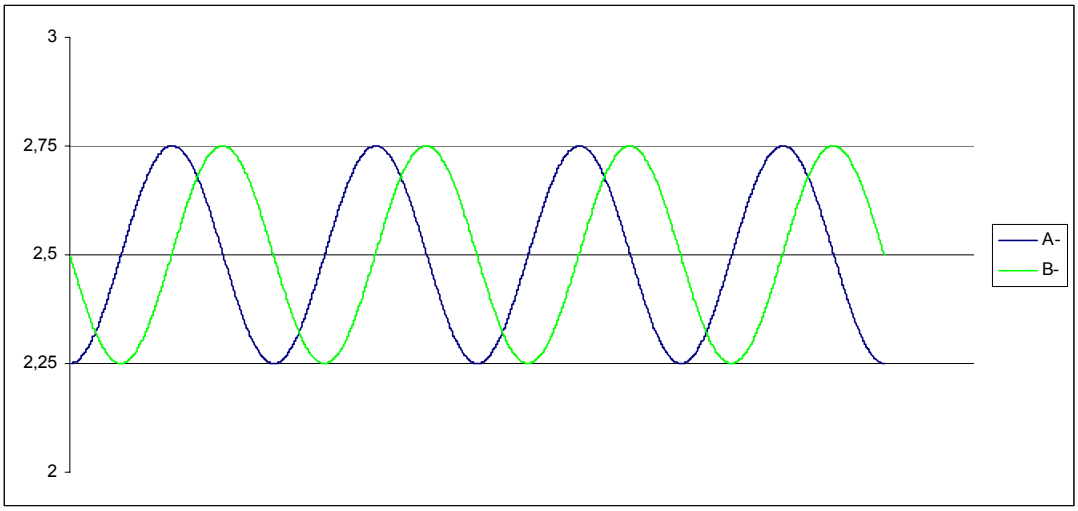




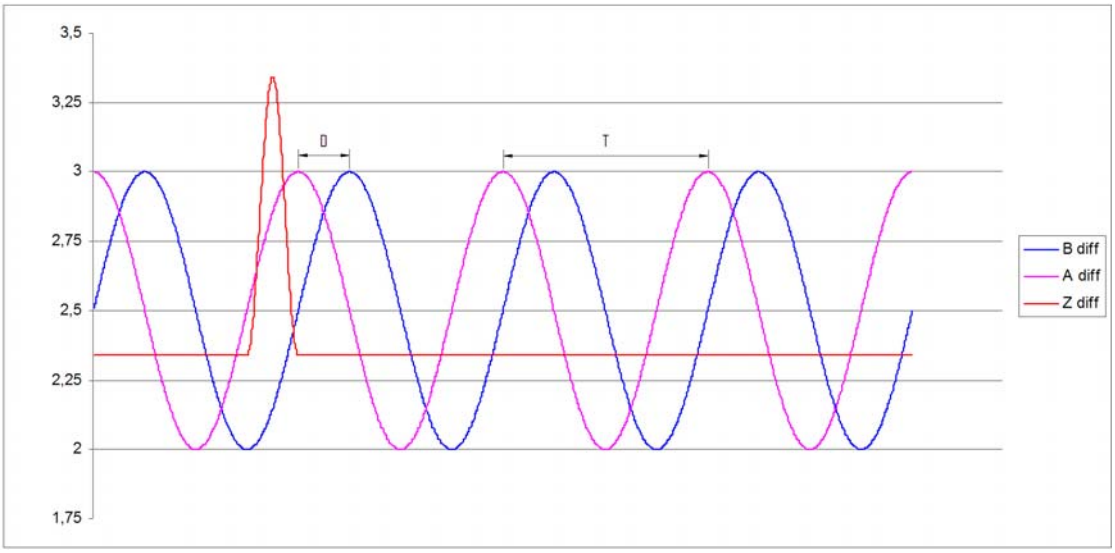
A and B signal phase difference



A and B negated signal phase difference

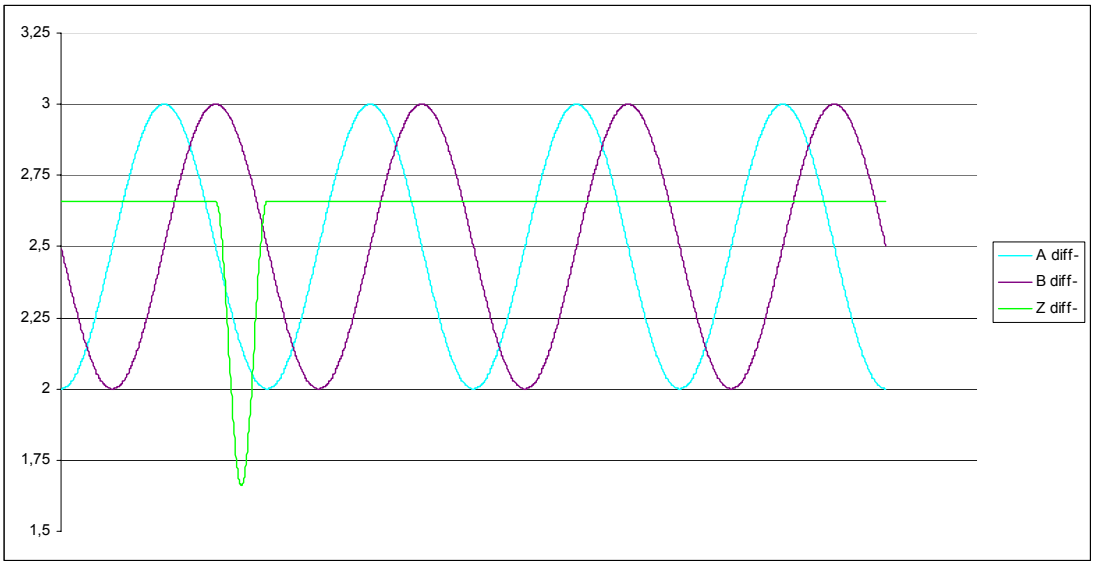


Differential signal temporal performance:



T	Period
D	Phase Difference (D=T/4)
A diff.	(A) - (A-)
B diff.	(B) - (B-)
Z diff.	(Z) - (Z-)

Differential negated signal temporal performance:



7 Scheduled maintenance

To safely operate an electrospindle installed on the machine, refer to the specific manual of the machine.

The punctual respect of the scheduled maintenance is essential in order to maintain the conditions of use and working planned by HSD S.p.A. when the product was put onto the market.

The frequency has been calculated on the basis of a working week of 5 days, each of 8 working hours, under normal environmental working conditions.

Read this section carefully before carrying out any maintenance operation on the electrospindle. The safety regulations during the maintenance of the electrospindle must take into account that:

- maintenance and/or lubrication operations must only be carried out by trained and qualified personnel, duly authorised by the technical management of the plant, in accordance with the safety directives and standards in force, using tools, instruments and products suitable for this work;
- during maintenance works, it is obligatory to wear suitable clothing, such as close-fitting overalls, safety shoes, strictly avoiding wide garments or items with protruding parts;
- during maintenance works, we recommend that the machine be cordoned off and the signs indicating “MACHINE MAINTENANCE” posted.

During any maintenance operations, the electrospindle must be:

- **disconnected and isolated from the electric power supply;**
- **the tool must be strictly at a standstill (not rotating).**

The maintenance manager must appoint a team of persons in order to guarantee proper co-ordination among the team members and the maximum safety of the persons exposed to danger. All persons involved in the maintenance operations must be in full visual contact for signalling possible dangers.

7.1 Daily maintenance

7.1.1 Checking and cleaning the tool holder seat and the tool holder cone

The contact surfaces between the tool holder and the tool holder seat must be kept clean in order to guarantee safe hooking.

At the start of the work day, check that the surfaces shown in figures 8 and 11 are thoroughly clean, with no traces of dust, grease, cooling liquid, oil, metal particles or machining residues, nor signs of oxidisation or scale; if necessary, **wipe with a soft, clean cloth**.

Figure 8 :
ISO tool holder

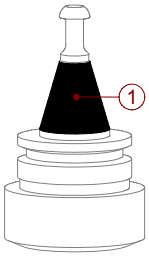
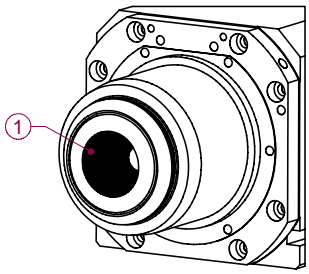


Figure 9 :
ISO tool holder seat



(1) Conical surfaces (in black)

(2) Stop surfaces (in grey, only HSK)

Figure 10 :
HSK tool holder

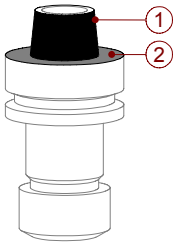
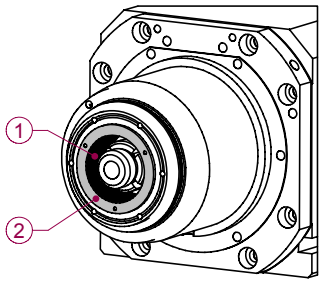


Figure 11 :
HSK tool holder seat

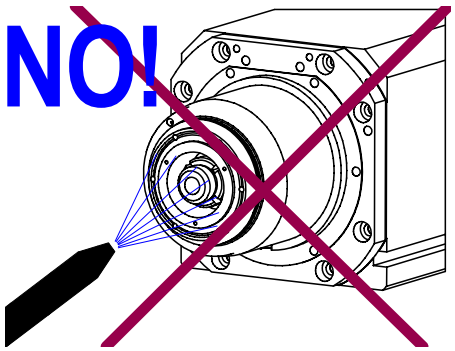


For cleaning the surfaces indicated, use soft, clean cloths;
NEVER USE abrasive instruments such as wire wool, metal scrapers, emery cloth, acids or other aggressive elements.

At the end of the working day, clean the surfaces shown in figures 8 to 11 with a soft, clean cloth; inadequate cleaning may result in serious consequences for the operator's safety, for the wear of the electrospindle and tool holder, for the precision and efficiency of the machining operation.

Do not direct jets of compressed air inside the tool holder seat if the tool holder cone is missing, or if the tool holder cone fitted has through bores (Figure 12).

Figure 12 :



7.1.2 Protection of the tool holder seat

The tool holder seat must always be protected against the impurities that may come in and could damage, oxidise or in any other way harm the contact surfaces: never leave the electrospindle without a tool holder cone inserted.

The cone used for protection must not have through bores.

To avoid sticking, remove the tool-holder installed on the electrospindle and replace it with a protective closing device, both after heavy machining operations and at the end of the working day.

The protective closing device must be another clean tool-holder, at room temperature, or one of the protective closings appropriately created by HSD and illustrated in figures 13 to 15.

The tool holder to be removed may be hot! Use gloves!

Figure 13
Rubber cover ϕ100 mm
code H1401H0010

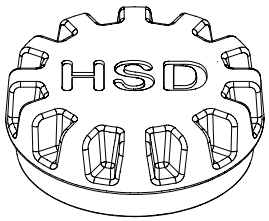


Figure 14
ISO30 protective cone
code H1707H0030

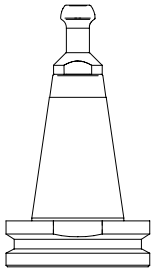
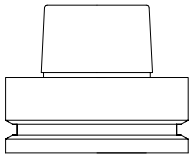


Figure 15 HSK F63 protective cone,
coded H1707H0031



7.2 Biweekly Maintenance

7.2.1 Clean the tool holder cone with ethyl alcohol

- For all the versions:
  - carefully clean the contact surfaces of the tool holders (shown in figure 8 and10) with a soft, clean cloth dipped in ethyl alcohol;
- Only for HSK versions:
  - after cleaning with ethyl alcohol, spray the tapered surfaces with KLÜBER LUSIN PROTECT G 31, and distribute the product uniformly using a clean, dry cloth;
  - allow the product to dry before using the tool holder again.

7.3 Monthly maintenance

7.3.1 Lubrication of the HSK collet

In order to maintain the proper efficiency of the HSK collet over a long period of time, it must be lubricated every month with grease:
METAFLUX-Fett-Paste No. 70-8508
or alternatively
METAFLUX-Moly-Spray No. 70.82

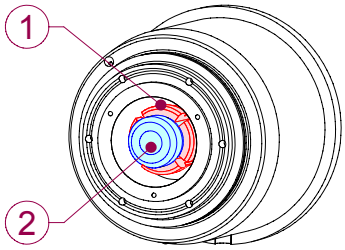


Figure 16

(1) Segments
(2) Ejector

USE ONLY THE GREASES INDICATED ABOVE.
Other products are not compatible with those used by HSD S.p.A. for the initial lubrication.
Greases that are incompatible, mixed or used successively on the same collet form substances harmful to the functioning of the collet, with serious consequences for safety.

Proceed as follows:

- spread the grease in the gap between the segments of the collet and the ejector (Figure 16), using a clean, thin, plastic tool;
- carry out roughly ten tool changes to distribute the grease uniformly;
- remove the tool holder from the spindle shaft and remove any visible remains of grease with a clean cloth.
  Excessive grease is harmful as it can collect chips or other machining residues, soiling the collet, the tapered surfaces and the stop surfaces. These areas must be kept as clean as possible in order to guarantee the safety of the operator, the precision of the machining operation, and to reduce wear on the spindle and tool holder cone.

7.3.2 Check of functionality collet HSK

Frequency :6 months or 200000 tool changes

- Control the expulsion limit (see limit " B1" in table 1, pag 100)
- Through a blocked tool tighten the dowel in the expeller
- Check the tightening strength (using Power Check).
  If the tightening force is inferior of 70 % of the nominal value, it is necessary to effect the following operations:
  - grease again , and check again the tightening force
  - change the collet and check again
  - change completey the thightening device

7.4 Bearings

Do not carry out any work on the bearings as these are lubricated for life with a special grease for high speed and REQUIRE NO FURTHER LUBRICATION.

8 Replacement of components

To safely operate an electrospindle installed on the machine, refer to the specific manual of the machine.

Inside the electrospindle, there is a pre-loaded spring with a force of hundreds of kilograms. This spring is attached to a tie-rod that may be thrown out violently if the electrospindle is dismantled by personnel who have not been sufficiently trained.

Carry out only the operations described in this manual, paying close attention to the instructions given; for further information, contact HSD S.p.A. Customer Service.

Observe the safety precautions for maintenance given on page 79.

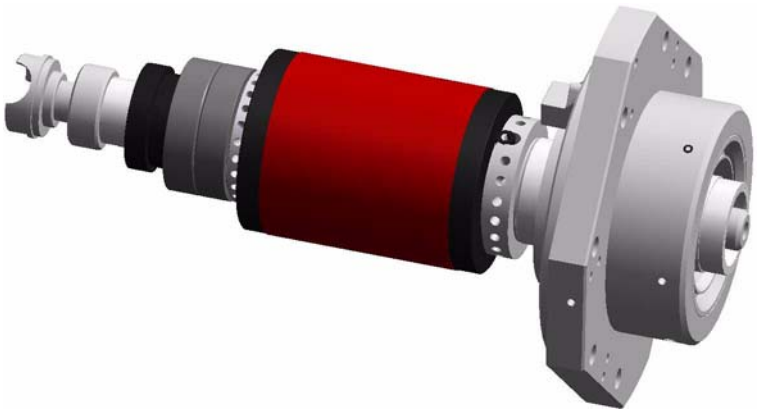
Only the adjustment and replacement operations with original HSD S.p.A. spare parts described in this section of the manual are permitted.
Any other type of operation is not permitted and will invalidate the product warranty.

8.1 Replacement of the Shaft Kit

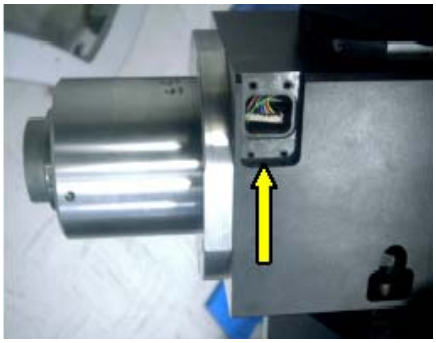
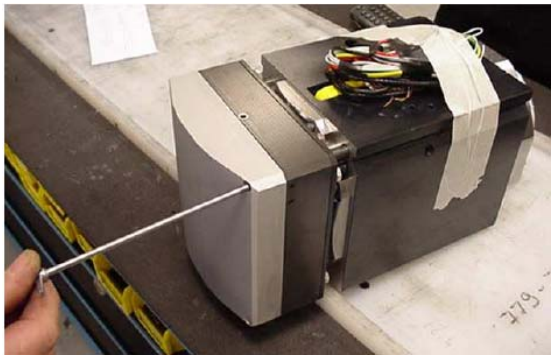
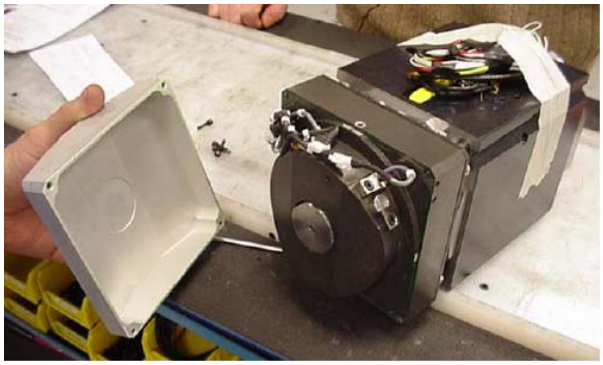
SPARE SHAFT KIT

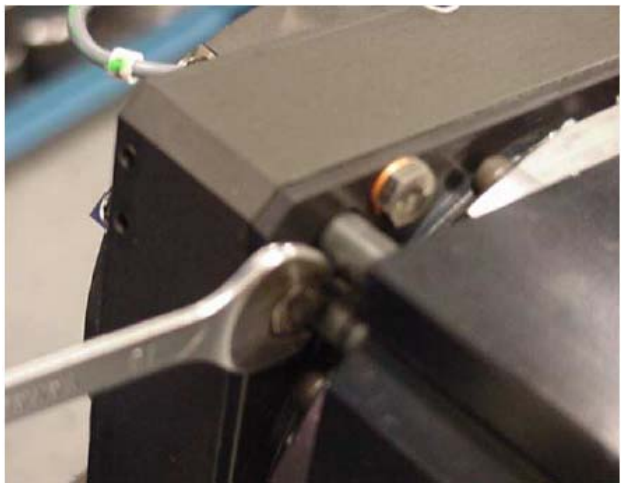
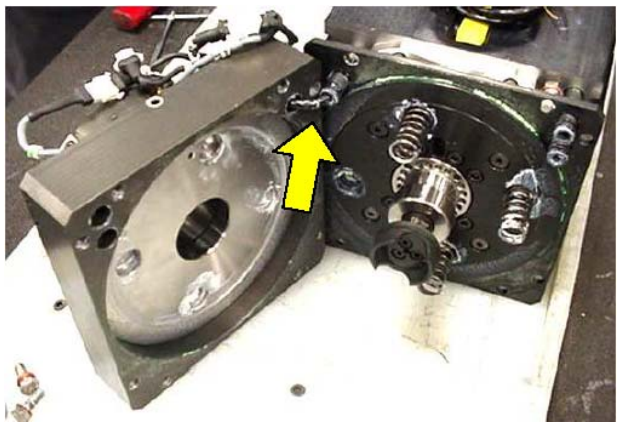
Spare shaft kits are available, to install in case of bearing wear. The shaft kit has a shaft, bearings already run in, rotor, tie-rod and coupling system.
To obtain a shaft kit suitable for your own model, inform the HSD commercial office about the spindle serial number
The serial number is usually stamped on the front flange or the framework front part (see section 3.1 “Main parts”)

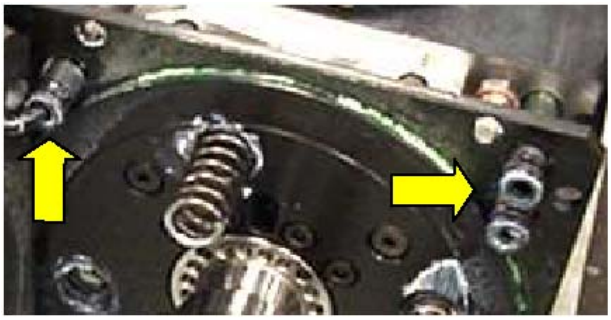
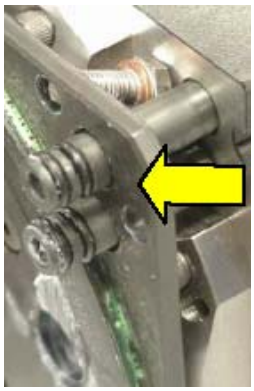
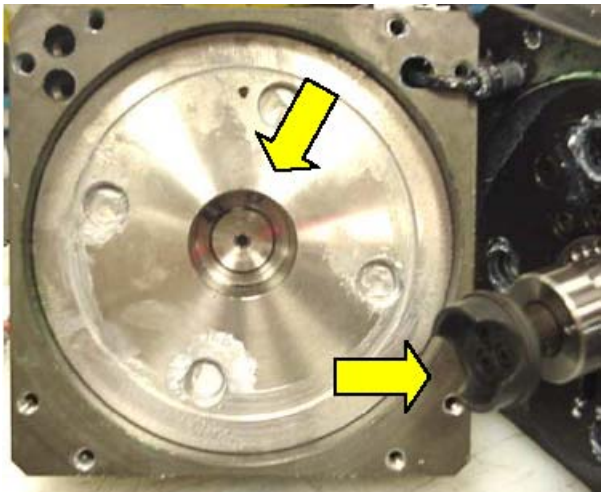
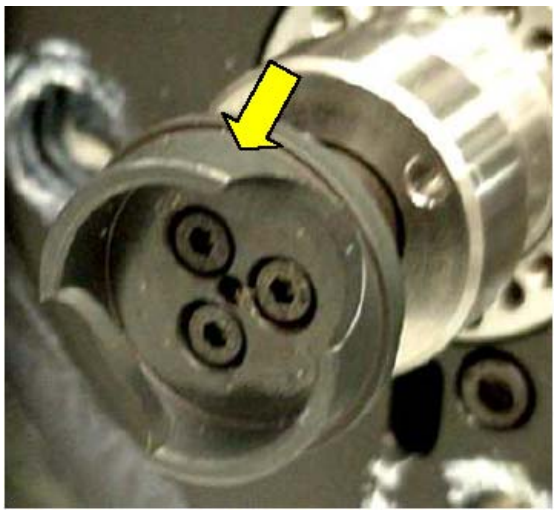
In model ES789 with distributor for tool internal cooling, the shaft kit cannot be replaced.Contact HSD Customer Service

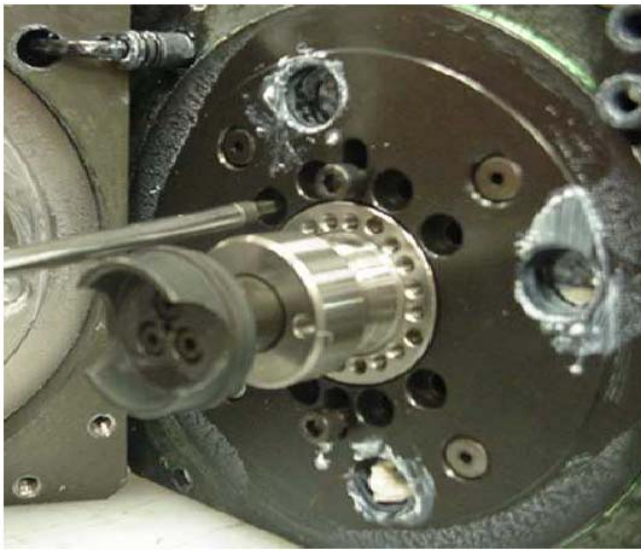
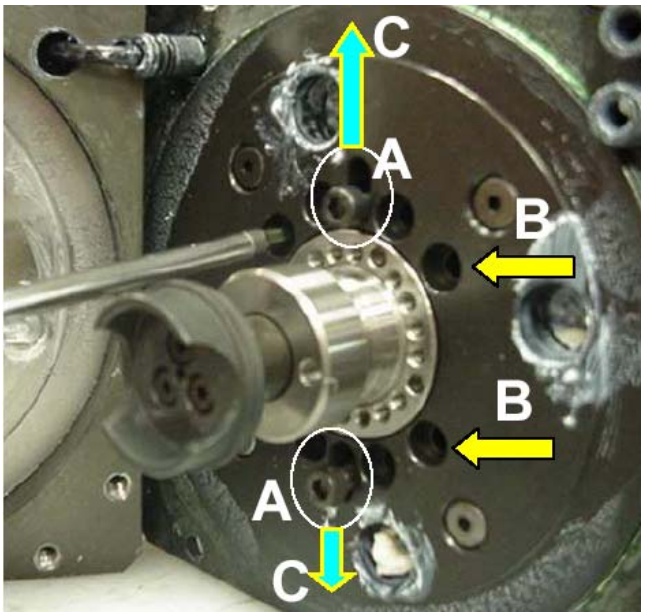


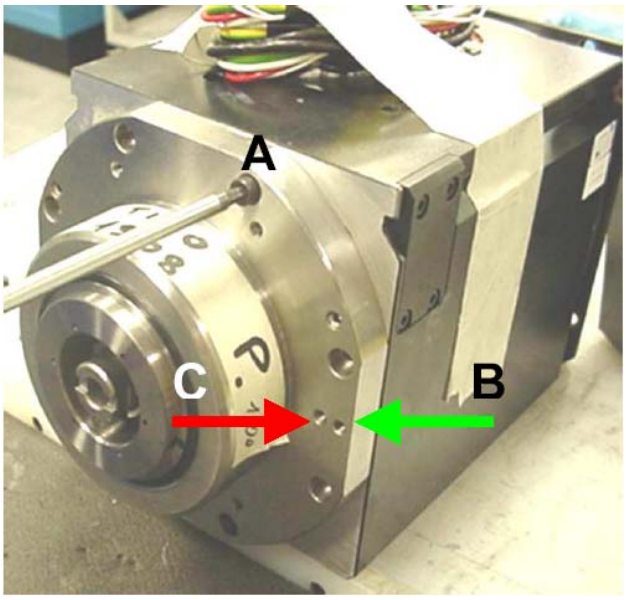
Follow the instructions indicated below to replace the shaft kit.

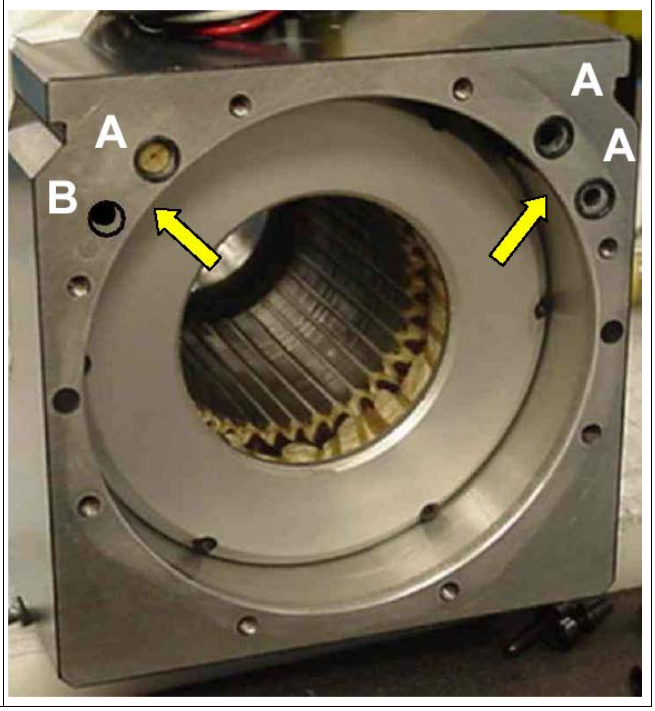
Op.	Description	Image
1	If the electrospindle is provided with encoder, remove the small cover indicated in figure. Check that the OR2081 is not worn or missing.	
2	Remove the 4 fixing screws of the electrospindle casing.	
3	The casing is fixed to the electrospindle framework through a light silicone layer: simply apply a light force to remove the casing.	

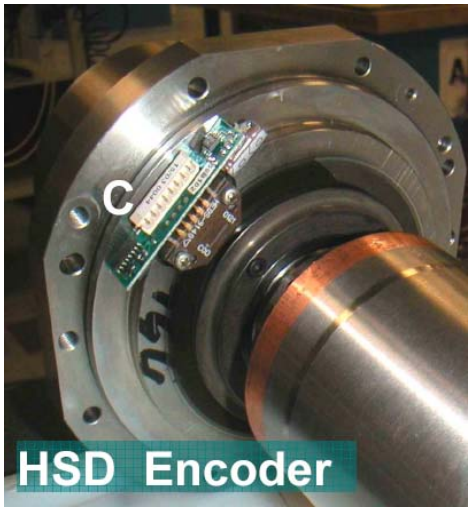
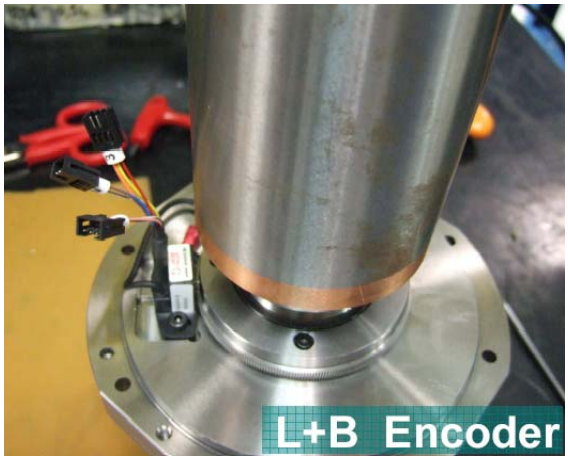
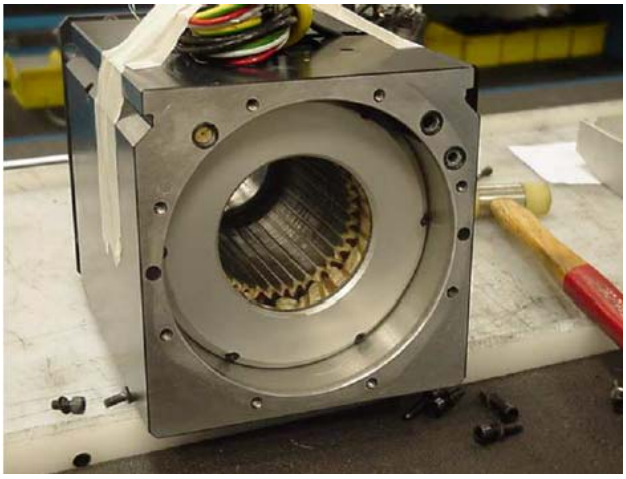
Op.	Description	Image
4	Remove the 8 hexagonal head screws (2 for each angle) of the cylinder unit.	 
5	Open the release cylinder unit, paying attention to the cable indicated in figure. Remove the 4 springs.	

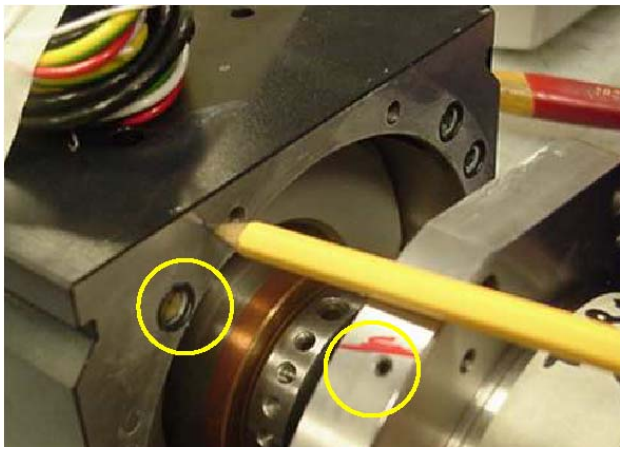
Op.	Description	Image
6	Check that the six OR2025 indicated in figure are not damaged or missing.	 
7	Check that the cone release cylinder (upper figure) and the piston tie-rod (lower figure) are not worn or damaged: in this case, only the shaft kit must be replaced, but the electrospindle should be sent to HSD customer service.	 

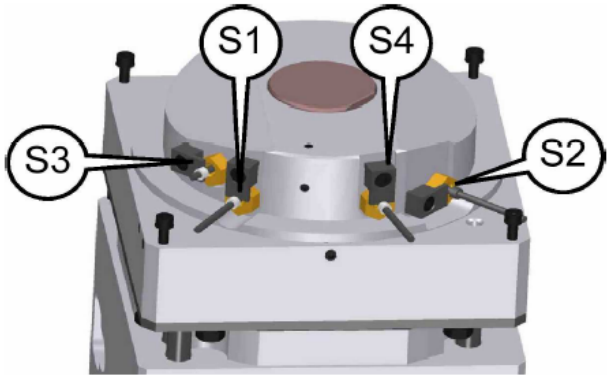
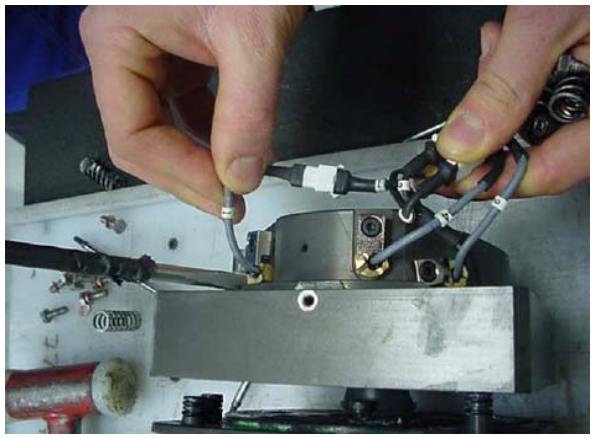
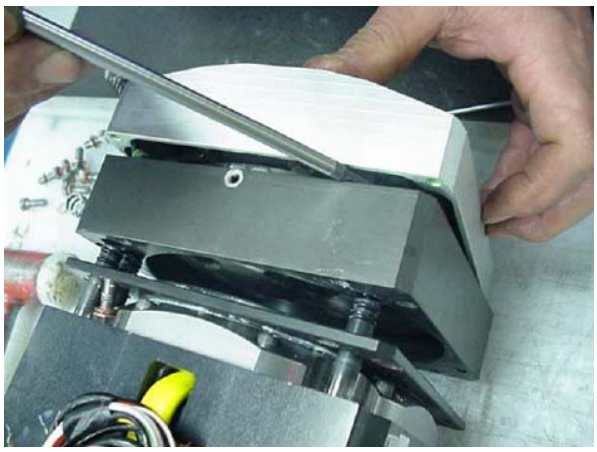
Op.	Description	Image
8	Screw two 5x16 screws in two oval bores (“A”) near the piston tie-rod, but do not fully tighten them. Remove the eight 5x10 screws (“B”) around the tie-rod. Radially move both screws in the oval bores (direction “C”) outwards and tighten them so as to block them in that position.	 

Op.	Description	Image
9	From the front part of the electrospindle (“nose”), remove the eight 5x20 screws that fix the shaft [figure alongside, (C)]. To extract the shaft kit, use two headless, flat end screws (UNI 5923), M5x20 or longer. Insert the screws in the bores indicated with (B) (the outer bores, one on each side). DO NOT use the bores marked with (C) (those inside).	
10	Carefully take out the shaft kit by some centimetres. FOR VERSIONS WITH ENCODER: Check, from the window, that the Encoder wiring does not get entangled.	

Op.	Description	Image
11	Check that the 3 ORM 0080-15 indicated in figure “A” and the ORM 0050-15 indicated in “B” are not damaged or missing. NOTE: in some models, bore “B” is not present.	 

Op.	Description	Image
12	VERSIONS WITH HSD ENCODER: Disconnect the connector “C”. VERSIONS WITH L+B ENCODER: Disconnect the three connectors indicated in figure.	 
13	Remove the shaft kit.	
14	Clean resting surfaces and grease bearing seats.	

Op.	Description	Image
15	Insert the new shaft kit partially. Be careful when aligning the bore for pressurisation air passage of the shaft with that on the flange.	
16	VERSIONS WITH HSD ENCODER: Connect the connector “C”. VERSIONS WITH L+B ENCODER: Check the three connectors.	
17	FOR ALL VERSIONS WITH ENCODER: Insert the shaft kit completely into the electrospindle by slightly pulling the encoder wiring through the window; position the wiring and the encoder connector so as not to cause interference with rotating parts.	
18	Insert the shaft completely into the electrospindle being careful with the OR shown in point “11”.	
19	Refit removed parts in points 9, 8, 4, 3 and 1.	

Op.	Description	Image
20	Carry out sensor calibration as described in section 8.3 “Replacement and adjustment of the sensor group”.	
21	Refit the upper cover casing of the electrospindle being careful not to damage sensors. Use Loctite 510 or an equivalent product on the casing edge.	 

To ensure maximum accuracy in machining operations, it is recommended to set to zero the axis affected by the modification in the machine (axis parallel to spindle shaft)

Summary of OR used in the shaft kit:

- OR 2081
- OR 2025
- ORM 0080-15
- ORM 0050-15

8.2 Replacement of the encoder reader

In case the encoder reader must be replaced, follow the shaft kit removal procedure until point “12” and proceed as follows:

Models of HSD Square Wave encoder:

- loosen the two fixing screws of the optical reader,
- delicately lift the reader from its seat,
- carefully slide the reader from the encoder disk being careful not to scratch it,
- more delicately, position the new reader and slot it into its seat,
- lock the two fixing screws,
- check that, by rotating the shaft, the encoder disk is at the same distance from both ends of the optical reader fork,
- follow backwards the shaft kit assembly procedure.

Models with Lenord-Bauer sinusoidal encoder

- unlock the two fixing screws,
- unlock the screw fixing the reader earth cable to the flange,
- remove the faulty reader,
- place the new reader in its seat keeping it at distance from the toothed wheel,
- lock the two screws without tightening them fully,
- interpose the thickness spacer between the toothed wheel and the new reader,

Place the thickness spacer between the toothed wheel and the encoder reader BEFORE carrying out other operations.
Otherwise, the magnetic component of the reader can be attracted and collide with the toothed wheel, with possible damages to the reader.

- push the reader towards the toothed wheel, moving everything “together”,
- tighten definitively the two fixing screws of the reader,
- slide off the thickness spacer previously placed,
- visually check that, when turning the shaft, the toothed wheel does not touch the reader,
- lock again the screw fixing the reader earth cable to the flange,
- follow backwards the shaft kit assembly procedure.

8.3 Replacement and adjustment of the sensor group

8.3.1 Access to the sensors

- Refer to figures 17 to 18 to access to sensor zone.
- Unlock the four screws (1).
- Remove the casing (2) according to the direction of the arrow in figure.
  The casing is fixed to the electrospindle framework through a light silicone layer: simply apply a light force to remove the casing.
- When refitting the casing (2), pay attention not to damage sensor cables inside. Moreover, apply Loctite 510 or an equivalent product on the casing edge.

Figure 17: ES779

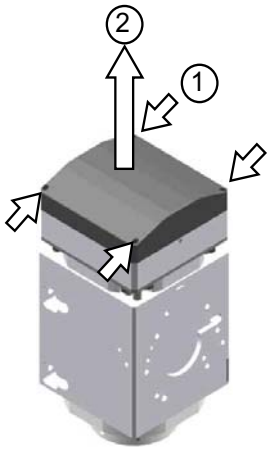


Figure 18: ES789

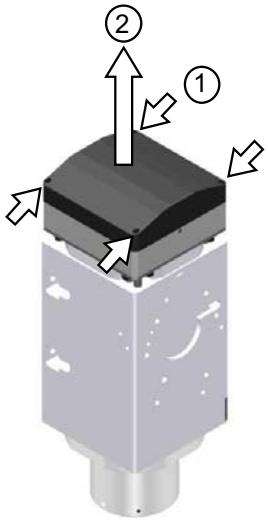
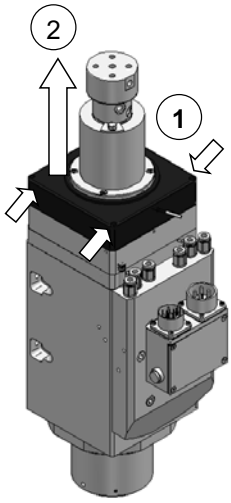
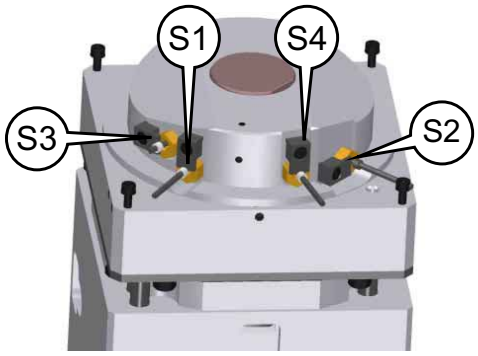


Figure 19: ES789 with distributor

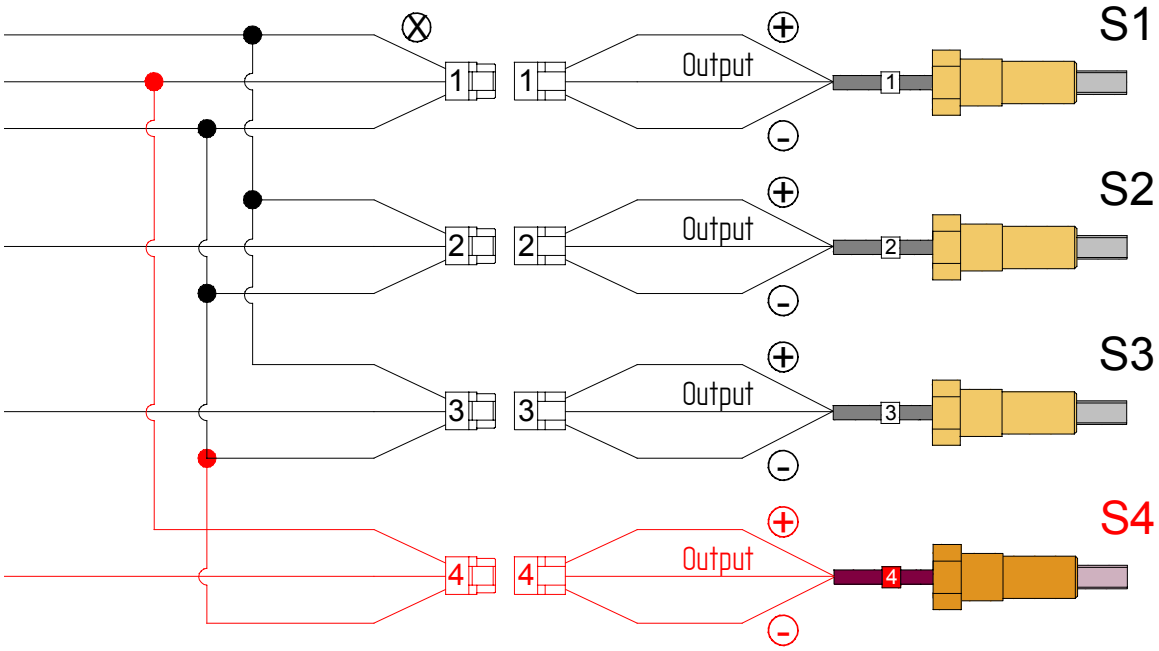


8.3.2 Identification of the sensors

Figure 20: ES779 and ES789



8.3.3 Sensor wiring



(X)	**For the colours of the user-side, see the table in section 4.10.**

(+)	**Brown**	**+ 24V DC**
Output	**Black**	**ON / OFF**
(-)	**Blue**	**0V**

The S1 sensor is present only in HSK versions.

8.3.4 Description of the sensor unit

The sensors are pre-assembled in calibrated bushes to allow simple insertion to the right depth in the electrospindle. It is therefore important to correctly identify the sensor to be replaced: for this reason, both the sensors installed on the electrospindle and those supplied as spare parts bear a numbered label (see figure below

Confusion of the sensors will result in damage to the moving parts.

Figure 21: sensor unit

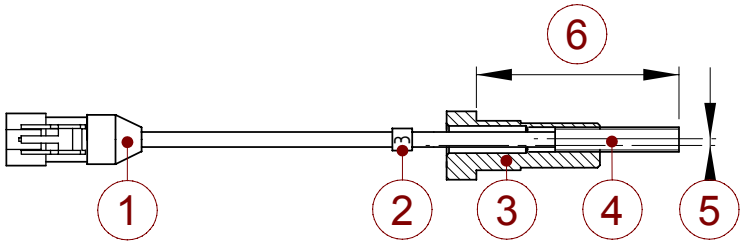
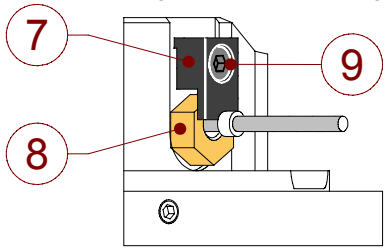


Figure 22: sensor fixing



1	Electrical connector	**6**	Calibrated position
2	Numbered label	**7**	Bracket
3	Bush	**8**	Sensor unit
4	Sensor	**9**	Screw
5	Eccentricity between bush and regulation sensor		

8.3.5 Replacement and adjustment of the sensor unit

For the replacement and adjustment of the sensors shown in this paragraph (and those to follow), always refer to figures 21 and 22 of the previous paragraph.

8. remove screw “9” that blocks the bracket “7” of the sensor unit “8” to be replaced;
9. Unthread the faulty sensor unit from its seat, and disconnect its electrical connector“1”.
10. connect the electrical connector of the new sensor unit to the correspondingly numbered connector of the spindle;
11. check the functioning of the new sensor by bringing it into contact with a metallic mass;
12. Insert the new sensor unit in the empty seat;
13. reposition the bracket “7” and lock the screw “9” again without tighten it completely, so that the sensor unit can rotate;
14. rotate the sensor unit a few degrees at a time, until you obtain the outputs requested in the paragraphs immediately below;
15. tighten the screw “9” by blocking the sensor unit with an open-end spanner so as to maintain the calibration carried out.

8.3.6 Sensor S1 adjustment (for all models)

For HSK models, a kit of gauges and thickness spacers is available for adjustment of S1 and S4 sensors; the kit is described in paragraphs 8.3.11 to 8.3.13.
The use of the kit allows a quicker and more precise adjustment: HSD S.p.A. strongly recommends the use of the kit, given the importance (for safety purposes) of a correct sensor adjustment.

After replacing the sensor unit as described in section 8.3.5, adjust it as follows:

1. do not tighten the sensor completely until an accurate adjustment has been performed;
2. attach the tool holder cone and ensure that the output of S1 is **"ON"**; if the output is **"OFF",** rotate the sensor unit until it becomes **"ON";**
3. the sensor "4" is eccentric in relation to the bush "3" that contains it: rotate the bush slowly in the direction that takes the sensor away from the tool holder;
   stop immediately when the output of the sensor becomes **"OFF"**;
4. carefully rotate the bush back by about 15° - 20°, so that the output of the sensor returns to **"ON"**;
5. rotate the shaft manually, and check that the signal remains **"ON"** for the whole rotation;
6. tighten fixing screw "9";
7. release the tool holder by powering the piston at the pressure indicated in the section 4.6 "Pneumatic connections", and check that in this condition (collet open) the output of S1 is **"OFF"**;
8. release the pressure at the piston and allow the collet to close without tool holder: in this condition, the output of S1 must be **"OFF"** for the whole rotation of the shaft;
9. if points (7) and (8) **are not satisfied** repeat the procedure from the start, making an even slighter rotation movement at point (4);
10. if points (7) and (8) **are satisfied**, make a cycle of 10 tool changes;
11. at the end of the cycle, check that the conditions in the following table are satisfied:

CONDITION	S1 OUTPUT
tool holder locked	**ON ***
missing tool holder with closed collet	**OFF ***
collet open (tool holder ejected)	**OFF**

* for the whole rotation of the shaft

12. if the conditions of the table **are not satisfied**, repeat the procedure from the beginning;
13. if the conditions of the table **are satisfied,** perform a cycle of 100 tool changes with the machine, using the maximum possible number of different tool holders.
14. At the end of the cycle, check that the conditions in the table under point (11) are satisfied: **if this is the case,** the regulation procedure for S1 is complete; **if this is not the case,** repeat the procedure from the beginning.

8.3.7 S2 sensor adjustment for ISO models

After replacing the sensor as described in section 8.3.5, calibrate it as follows:

1. correctly attach a tool holder before beginning the adjustment of the sensor;
2. check that, in this state, the output of S2 is **“OFF”**; if the output is **“ON”,** rotate the sensor unit until it becomes **“OFF”;**
3. feed the cylinder by means of a one-way pressure regulator initially set at 0 bar (0 PSI);
4. increase the feed pressure by steps of 0.1 bar (1.5 PSI) so as to move the piston slowly forward and, at the same time, check that the output of S2 is **“OFF”**;
5. as long as the tool holder is firmly blocked, the output of S2 must be **“OFF”**;
   if the output changes during the movement of the piston, slightly rotate the sensor unit until the output returns to **“OFF”**;
6. when the tool holder begins to slacken (but is not yet free to fall), the output of S2 must still be **“OFF”** (if necessary, rotate the sensor unit);
7. when you reach the feed pressure at which the tool holder is finally free to fall, increase the pressure by another 0.2 bar (3 PSI) and block the pressure regulator;
8. rotate the sensor unit so that, in this state, the output of S2 becomes **“ON”;**
9. perform a cycle of 10 tool changes;
10. at the end of the cycle, check that the steps from (1) to (8) are satisfied **without the need to ever rotate the sensor**;
11. if the outputs requested **are not satisfied,** repeat the entire procedure from the start;
12. if the outputs requested **are** satisfied, perform a cycle of 100 tool changes with the machine, using the maximum possible number of different tool holders;
13. at the end of the cycle, check that the steps from (1) to (8) are satisfied **without the need to ever rotate the sensor**;
14. if the outputs requested **are not satisfied,** repeat the entire procedure from the start;
15. if the outputs requested **are satisfied,** the regulation procedure for S2 is complete.

8.3.8 Sensor S2 adjustment for HSK models

Figure 23: position of the ejector

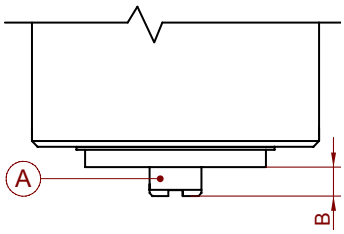


Figure 24: (A) ejector
(B) reference position

	B1	B2
HSK E25	6.5	6.35
HSK E40/F50	8.5	8.35
HSK A/E/F63	10.5	10.3

(+/- 0.1 mm)

Table 1 : values of (B)

After replacing the sensor as described in section 8.3.5, calibrate it as follows:

1. bring the spindle to the “collet open (tool holder ejected)” status by feeding the cylinder with the pressure indicated in section 4.6 “Pneumatic connections”;
   in these conditions, the position (B) (figure 24) takes on the maximum value;
2. as shown in figures 23 and 24, use a depth gauge to check that the position (B) of the ejector in relation to the spindle nose takes on the value “**B1**” indicated in table 1;
   if this is not the case, stop and contact HSD Customer Service;
3. fully discharge the pressure from the cylinder;
   in these conditions, the position (B) takes on the minimum value;
4. feed the cylinder by means of a one-way pressure regulator initially set at 0 bar (0 PSI);
5. increase the pressure in steps of 0.1 bar (1.5 PSI), so as to slowly move the ejector forwards;
6. stop when position (B) reaches the value “**B2**”;
7. if necessary, loosen the screw “9” (Figure 22 “: sensor fixing”) of sensor S2;
8. rotate sensor S2 until you find the position supplying the signal **“ON”** with (B) > **B2** and **“OFF”** with (B) < **B2**;
9. finally tighten screw “9” completely;
10. perform a cycle of 10 tool changes;
11. at the end of the cycle, check that point (8) has been met **without the need to rotate the sensor**;
12. if it **is necessary** to rotate the sensor, repeat the whole procedure from the beginning;
13. if it is **not necessary** to rotate the sensor, perform a cycle of 100 tool changes with the machine, using the maximum possible number of different tool holders;
14. at the end of the cycle, check that point (8) has been met **without the need to rotate the sensor**;
15. if it **is necessary** to rotate the sensor, repeat the whole procedure from the beginning;
16. if it is **not necessary** to rotate the sensor, the S2 adjustment procedure is complete.

8.3.9 Sensor S3 adjustment (for all models)

After replacing the sensor as described in section 8.3.5, calibrate it as follows:

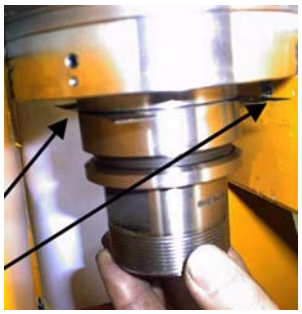
1. check that the signal from the sensor corresponds to that described in section 6.6.3;
2. if this is not the case, rotate the sensor until you find the position in which you obtain the output described in section 6.6.3;
3. definitively tighten the screw"9".

8.3.10 Adjustment of S4 sensor (present only in models HSK)

For HSK models, a kit of gauges and thickness spacers is available for adjustment of S1 and S4 sensors; the kit is described in paragraphs 8.3.11 to 8.3.13.
The use of the kit allows a quicker and more precise adjustment: HSD S.p.A. strongly recommends the use of the kit, given the importance (for safety purposes) of a correct sensor adjustment.

After replacing the sensor as described in section 8.3.5, calibrate it as follows:

1. take thickness spacers of 0.12 mm and 0.16 mm, which will be interposed between the stop surfaces of the tool holder cone and the spindle shaft, as shown in the figure below;
2. insert and lock the tool holder cone in the spindle, and check that the signal supplied by sensor S4 corresponds to that described in the following table:



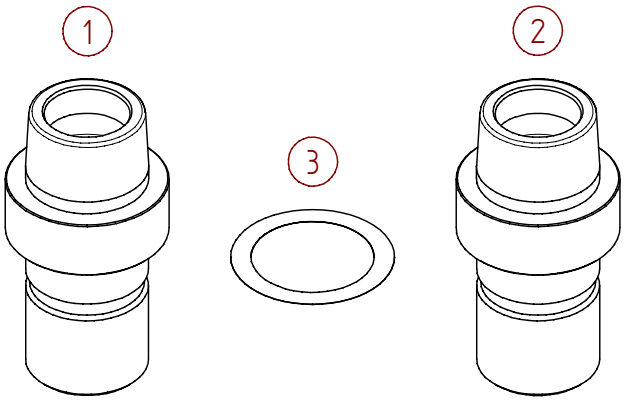
CONDITION	THICKNESS SPACER INTERPOSED	S4 OUTPUT
tool holder locked	0.12 mm	ON
tool holder locked	0.16 mm	OFF
collet open (tool holder ejected)		OFF

3.rotate the shaft manually and check that the conditions of the table are satisfied for all 360° of the rotation;

4. if this is not the case, rotate the sensor until you find the position at which you obtain the output described in the table;
5. finally tighten screw "9" completely;
6. perform a cycle of 10 tool changes;
7. at the end of the cycle, check that the condition in point (2) of the table is satisfied for all 360° of the rotation of the shaft; if this is not the case, repeat the procedure from the start;
8. if the conditions of the table are satisfied, perform a cycle of 100 tool changes with the machine, using the maximum possible number of different tool holders;
9. at the end of the cycle, check that the condition in point (2) of the table is satisfied for all 360° of the rotation of the shaft; if this is not the case, repeat the procedure from the start;
10. if the condition in point (2) of the table is satisfied, the adjustment of S4 is complete.

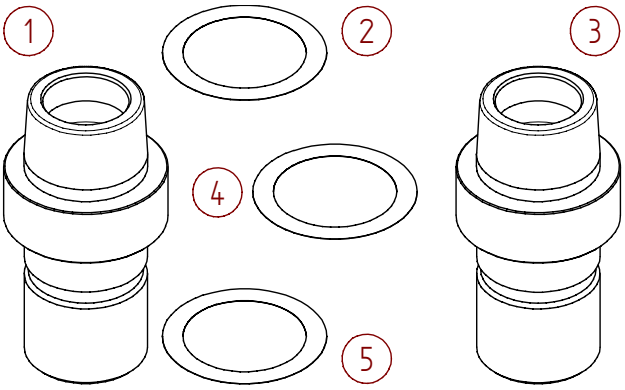
8.3.11 Kit of adjustment gauges for HSK sensors S1 and S4

Figure 25: kit H3811H0402 for the adjustment of sensors S1 and S4 HSK E40 - F50



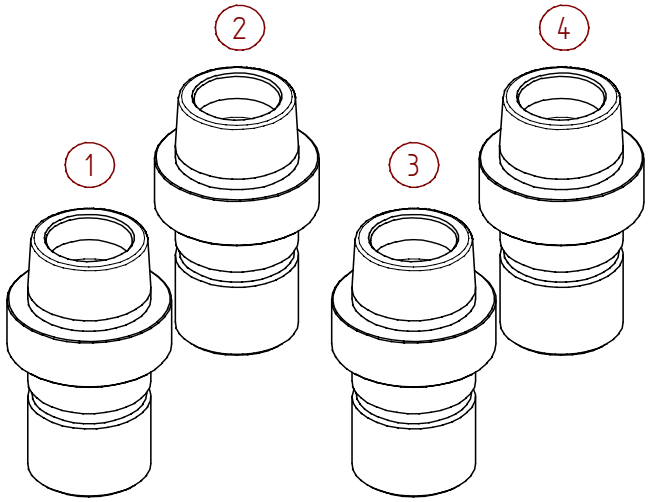
1	Gauge for adjusting sensor S1 (11.56 mm)
2	Gauge for adjusting sensor S4 (11.32 mm)
3	Thickness spacer (0.04 mm)

Figure 26: kit H3811H0110 for the adjustment of sensors S1 and S4 HSK F63



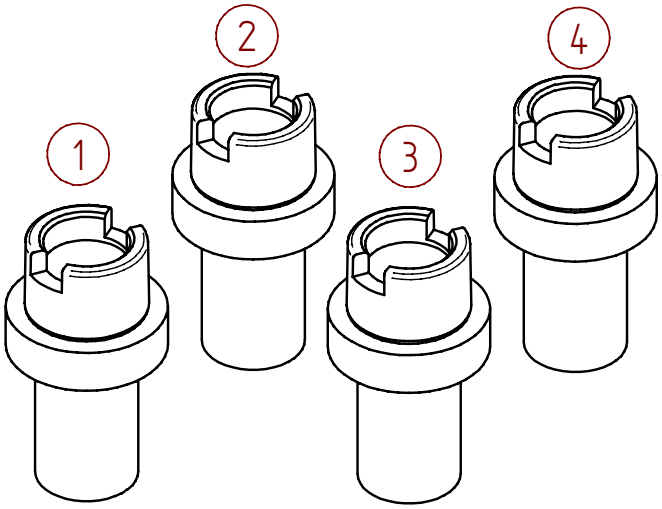
1	Gauge for adjusting sensor S1 (14.29 mm)
2	Thickness spacer for adjusting sensor S1 (0.04 mm)
3	Gauge for adjusting sensor S4 (14.13 mm)
4	Thickness spacer for adjusting sensor S4 (0.12 mm)
5	Thickness spacer for adjusting sensor S4 (0.16 mm)

Figure 27: Kit 3811H0763 for adjusting sensors S1 and S4 HSK E63



1	S1 gauge reads H3811H0735
2	S1 gauge DOES NOT read H3811H0736
3	S4 gauge reads H3811H0737
4	S4 gauge DOES NOT read H3811H0738

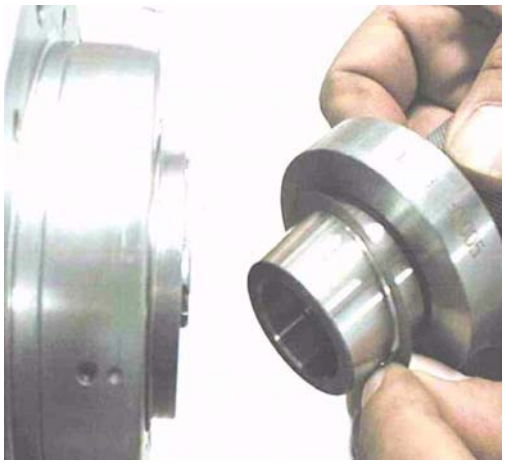
Figure 28: Kit 3811H0775 for adjusting sensors S1 and S4 HSK A63



1	S1 gauge reads H3811H0698
2	S1 gauge DOES NOT read H3811H0699
3	S4 gauge reads H3811H0700
4	S4 gauge DOES NOT read H3811H0701

Figure 29: use of the gauge as a normal tool holder, with or without a thickness spacer interposed

Figure 30: interposition of the thickness spacer between the stop surfaces of the gauge and the spindle shaft



The use of the gauges allows the immediate positioning of the HSK collet in the position at which the sensors are regulated, thus allowing an adjustment that is not only quicker but also more precise, given that the gauges have been produced with stricter tolerances compared with regular tool holders.

Although it is possible to adjust the sensors without using the kit (as described in the previous paragraphs), HSD strongly recommends the use of the kit, in view of the importance (for safety purposes) of the accurate adjustment of the sensors.

The gauges and thickness spacers shown in figure 25 and 26 are identified by the indication of the thickness engraved on their surface, or shown on the label of their packaging.

8.3.12 Adjustment of S1 using the kit

After replacing the sensor as described in section 8.3.5, calibrate it as follows:

1. for E40 - F50 models, use a 11.56 mm gauge and a 0.04 mm thickness spacer;
   for F63 models, use a 14.29 mm gauge and a 0.04 mm thickness spacer;
   for A/E63 models, use gauges S1 READS/DOES NOT READ
2. use the gauges and thickness spacers as shown in figures 8.7 and 8.8, and check that the signal supplied by the S1 sensor corresponds to that described in the following table:

CONDITION	S1 OUTPUT
Gauge blocked E40 - F50 - F63: thickness spacer interposed A/E63: S1 gauge READS	**ON**
Gauge blocked E40 - F50 - F63: no thickness spacer interposed A/E63: S1 Gauge DOES NOT READ	**OFF**
Gauge missing (tool holder missing)	**OFF**
Collet open (tool holder ejected)	**OFF**

3. rotate the shaft manually and check that the conditions of the table are satisfied for all 360° of the rotation;
4. if this is not the case, rotate the sensor until you find the position at which you obtain the output described in the table;
5. finally tighten screw “3” completely;
6. perform a cycle of 10 tool changes;
7. at the end of the cycle, check that the condition in point (2) of the table is satisfied for all 360° of the rotation of the shaft; if this is not the case, repeat the procedure from the start;
8. if the conditions of the table are satisfied, perform a cycle of 100 tool changes with the machine, using the maximum possible number of different tool holders;
9. at the end of the cycle, check that the condition in point (2) of the table is satisfied for all 360° of the rotation of the shaft; if this is not the case, repeat the procedure from the start;
10. if the condition in point (2) of the table is satisfied, the adjustment of S1 is complete.

8.3.13 Adjustment of S4 using the kit

After replacing the sensor as described in section 8.3.5, calibrate it as follows:

1. for E40 - F50 models, use a 11.32 mm gauge and a 0.04 mm thickness spacer;
   for F63 models, use a 14.13 mm gauge and 0.12 or 0.16 mm thickness spacers;
   for A/E63 models, use gauges S4 READS/DOES NOT READ
2. use the gauges and thickness spacers as shown in figures 8.7 and 8.8, and check that the signal supplied by sensor S4 corresponds to that described in the following table:

CONDITION	S4 OUTPUT
Gauge blocked E40 - F50: 0.04 mm F63: 0.12 mm A/E63: S4 Gauge READS	**ON**
Gauge blocked E40 - F50: NONE F63: 0.16 mm A/E63: S4 Gauge DOES NOT READ	**OFF**
Collet open (tool holder ejected)	**OFF**

3. rotate the shaft manually and check that the conditions of the table are satisfied for all 360° of the rotation;
4. if this is not the case, rotate the sensor until you find the position at which you obtain the output described in the table;
5. finally tighten screw “3” completely;
6. perform a cycle of 10 tool changes;
7. at the end of the cycle, check that the condition in point (2) of the table is satisfied for all 360° of the rotation of the shaft; if this is not the case, repeat the procedure from the start;
8. if the conditions of the table are satisfied, perform a cycle of 100 tool changes with the machine, using the maximum possible number of different tool holders;
9. at the end of the cycle, check that the condition in point (2) of the table is satisfied for all 360° of the rotation of the shaft; if this is not the case, repeat the procedure from the start;
10. if the condition in point (2) of the table is satisfied, the adjustment of S4 is complete.

9 Disposal of the product

Inside the electrospindle, there is a pre-loaded spring with a force of hundreds of kilograms. This spring is attached to a tie-rod that may be thrown out violently if the electrospindle is dismantled by personnel who have not been sufficiently trained.

Carry out only the operations described in this manual, paying close attention to the instructions given; for further information, contact HSD S.p.A. Customer Service.

At the end of the electrospindle working life, the user company is responsible for its scrapping. First of all, proceed with the general cleaning of the various elements, then separate the various parts into components and electrical material. The different materials must be divided: for example, the electrical motors (copper coils), metal parts, plastic materials, etc., and then disposed of separately, in conformity with current regulations in the country of installation.

10 Troubleshooting

BEFORE STARTING WORK ON THE ELECTROSPINDLE, READ AND IMPLEMENT ALL THE WARNINGS AND RECOMMENDATIONS RELATED TO SAFETY AND MAINTENANCE.

Problems	Causes	Remedies
The electrospindle does not rotate:	No power supply:	Check for mains voltage; Check the connectors; Check the integrity and continuity of the electric connections.
	The tool holder is not inserted:	Insert a tool holder.
	The tool holder is not inserted correctly:	See heading “The tool holder is not locked” in this same chapter.
	The thermal protective device has tripped:	Wait for the electrospindle to cool down: the thermal protective device is reset automatically. If the thermal protective device trips frequently, see heading “The electrospindle overheats” further forward in this same chapter.
	The inverter protective device has tripped:	Consult the manual or the manufacturer of the inverter.
	Sensor S1 or sensor S4 (only HSK) is disconnected or faulty:	Check the connectors; check the integrity and continuity of the electrical connectors; carry out the adjustment of the sensor as described in section 8.3 “Replacement and adjustment of the sensor group”; if necessary, replace the faulty sensor as described in section 8.3 “Replacement and adjustment of the sensor group”.
	Rotation refused:	consult the manual or the manufacturer of the machine, of the numerical control and of the inverter to which the electrospindle is connected.

Problems	Causes	Remedies
The tool holder is not locked:	Foreign body between tool holder and spindle shaft:	Remove the macroscopic impurities and clean as described in section 7 “Scheduled maintenance”.
	The tool holder cone is not of the required type:	Select a tool holder meeting the specifications given in section 6.4.1 “Tool holder cone”.
	The collet does not open due to lack of pressure:	■ Check the required pressure values indicated in section 4.6 “Pneumatic connections”; ■ Check the integrity and efficiency of the pneumatic circuit.
	Sensor S2 is disconnected or faulty:	■ Check the connectors; ■ Check the integrity and continuity of the electrical connectors; ■ Carry out the adjustment of the sensor as described in section 8.3 “Replacement and adjustment of the sensor group”; ■ If necessary, replace the faulty sensor as described in section 8.3 “Replacement and adjustment of the sensor group”.
The tool holder is not ejected:	Insufficient pressure:	■ Check the required pressure values indicated in section 4.6 “Pneumatic connections”; ■ Check the integrity and efficiency of the pneumatic circuit.
	Tool cannot be ejected:	Consult the manual or the manufacturer of the machine, of the numerical control or of the inverter to which the electrospindle is connected.
Lack of pressure:	Insufficient pressure or inefficient pneumatic circuit:	■ Check the required pressure values indicated in section 4.6 “Pneumatic connections”; ■ Check the integrity and efficiency of the pneumatic circuit; ■ Contact HSD Customer Service.
One of the sensors does not provide the required output:	Sensor disconnected or faulty:	■ Check the connectors; ■ Check the integrity and continuity of the electrical connectors; ■ Carry out the adjustment of the sensor as described in section 8.3 “Replacement and adjustment of the sensor group”; ■ If necessary, replace the faulty sensor as described in section 8.3 “Replacement and adjustment of the sensor group”.

Problems	Causes	Remedies
The electrospindle overheats:	Insufficient cooling:	■ Check the system specifications in section 4.7 “Hydraulic connections and specifications of the cooler”; ■ Check the integrity and efficiency of the cooling circuit.
	The machining operation is too heavy:	■ Reduce the severity of the machining operation.
	Incorrect parametrisation of the inverter:	■ Check the parameters on the rating plate of the electrospindle in section 3 “Technical specifications”, in the section relating to the model concerned.
Performance below specifications:	Incorrect parametrisation of the inverter:	■ Check the parameters on the rating plate of the electrospindle in section 3 “Technical specifications”, in the section relating to the model concerned.
Vibrations of the electrospindle:	The tool holder is not balanced:	■ Select a tool holder meeting the specifications given in section 6.4.1 “Tool holder cone”.
	The tool is not balanced:	■ Select and use a tool meeting the specifications given in section 6.5 “Tool”.
	Dirt between tool holder cone and spindle shaft:	■ Remove the macroscopic impurities and clean as described in section 7 “Scheduled maintenance”.
	Incorrect parametrisation of the inverter:	■ Check the parameters on the rating plate of the electrospindle in section 3 “Technical specifications”, in the section relating to the model concerned.
	The machining operation is too heavy:	■ Reduce the severity of the machining operation.
	Anchor screws loose:	■ Tighten the anchor screws.
	Bearings damaged:	■ Contact HSD Customer Service.
Noisiness of bearings:	Bearings damaged:	■ Contact HSD Customer Service.

11 List of spare parts

HSD code	Description
H41805006	Sensor S1
H4180500601	Sensor S2
H4180500602	Sensor S3
H5664H0016	Sensor S4
H6200H0052	HSD movable terminal board
2138A0607	Military power quick connector
2138A0604	Military signal quick connector
2138A0229	Encoder quick connector
2147A0404	Straight fitting for encoder connector
2147A0137	Elbow fitting for encoder connector
H1401H0010	Rubber cover to protect the inside of the spindle
H1707H0030	ISO30 cone to protect the inside of the spindle
H1707H0031	HSK F63 cone to protect the inside of the spindle
H3811H0402	Kit of gauges HSK E40 - F50 for the adjustment of sensors S1 and S4
H3811H0110	HSK F63 kit of gauges to adjust sensors S1 and S4
H3811H0775	HSK A63 kit of gauges to adjust sensors S1 and S4
H3811H0739	HSK E63 kit of gauges to adjust sensors S1 and S4
H2161H0022	Cooling liquid Artic-Flu-5

SPARE SHAFT KIT

Spare shaft kits are available, to install in case of bearing wear. The shaft kit has a shaft, bearings already run in, rotor, tie-rod and coupling system.
To obtain a shaft kit suitable for your own model, inform the HSD commercial office about the spindle serial number
The serial number is usually stamped on the front flange or the framework front part (see section 3.1 “Main parts”)

For the OR used during the shaft kit replacement procedure, see section 8.1 “Replacement of the Shaft Kit”

12 Customer Service

HSD S.p.A.

TECHNOLOGICAL EQUIPMENT FOR AUTOMATION

registered office:
Via della Meccanica, 16
61122 PESARO (ITALIA)
Loc. Chiusa di Ginestreto
factory headquarters:
P.le Alfio De Simoni, sn
61122 PESARO (ITALIA)
Tel. (+39)0721.205.211
Fax (+39)0721.205.247
E-mail **supporthsd@hsd.it**
www.hsd.it

HSD Deutschland GmbH

Brückenstrasse, 32
D-73037 Göppingen
Tel. +49(0)7161 956660
Fax +49(0)7161 9566610
E-mail **supporthsddeut@hsddeutschland.de**
www.hsddeutschland.de

HSD USA Inc.

3764 SW, 30th Avenue
33312 Hollywood, Florida USA
Phone no. (+1) 954 587 1991
Fax (+1) 954 587 8338
E-mail **supporthsdusa@hsd.it**
www.hsdusa.com

HSD Mechatronic Shangai Co. Ltd.

D2, First floor, 207 Taigu Road
Waigaoqiao Free Trade Zone
200131, Shangai – China
Phone no. (+86) 215866 1236
E-mail sales@hsd-china.cn
www.hsd-china.cn

HSD
MECHATRONIC
DIVISION

HSD S.p.A.
Sede legale:
Via della Meccanica, 16
61122 Pesaro (PU) Italy
Tel. +39 0721 439100
Fax +39 0721 439150

Sede centrale:
P.le A.De Simoni, sn
61122 PESARO (ITALIA)
Tel. +39 0721 205 211
Fax +39 0721 205 247
E-mail supporthsd@hsd.it
web www.hsd.it