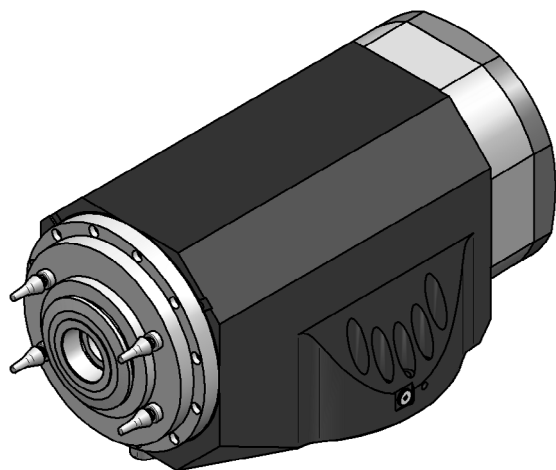


ES 798



ES 799



Information on the publication

Document code	Revision	Approval	Date of issue
H5801H0062	04	UTE 015/07	12 / 2009

List of Updates		
Revision	Modified sections	Description of modifications
00 (06.2007)	First edition	First edition
01 (07.2008)	§ 1.1 § 3.5.1 § 4.3 §4.4 § 4.4.9 §4.5 § 4.7.2 § 6.6 § 6.7.1 § 6.7.2 § 6.8 § 11 § 12	EC directive updated ES798 parameters added Fixing specifications added Pneumatic connections updated Oil piston specifications added Hydraulic connections added ES798 sensor connections added Rotating distributor specifications added Section on capacitive sensor status updated Thermal alarm section updated Encoder section extended Updated the list of spare parts Addresses section updated
02 (10.2008)	§ 6.8	Added L+B square wave encoder type
03 (12.2009)	§ 3.5 § 6.7.1	Updated characteristics and performance Updated table
04 (12.2010)	General revision	General revision (addresses, brands)

This publication is the English translation of the original Italian version of the manual HSD H5801H0062 Rev.04.

In the event of discrepancies between this translation and the original version, you should refer to the original Italian version, available on the website www.hsd.it, or from the Customer Service office (indicated on page [12](#)).

The manual is supplied together with the electrospindle. The manual is the most updated document about the product up to the revision date. For updates, visit the HSD internet sites or refer to the HSD Customer Support Service (see chapter [12](#)).

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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 product delivery; 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 that the marked part may be red-hot and must not be touched without due care.



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, stone, marble, 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 section 3 “[Technical specifications](#)” you can see the EC mark, along with its position and that of the Serial Number of the product.

1.6 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 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 packing and on the product label.

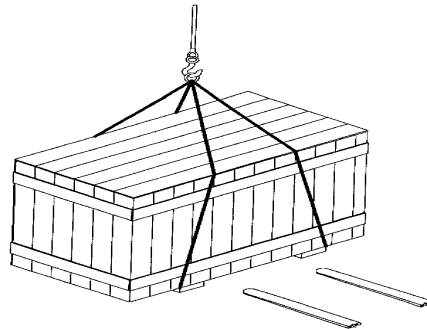
2.2 Dimensions and weights

- Weight of the packed product: indicated on the packing.
- Linear dimensions of the packed product: indicated on the documents accompanying the product.

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 packaging and its contents.



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



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 (+41°F) to +55°C (+131°F)

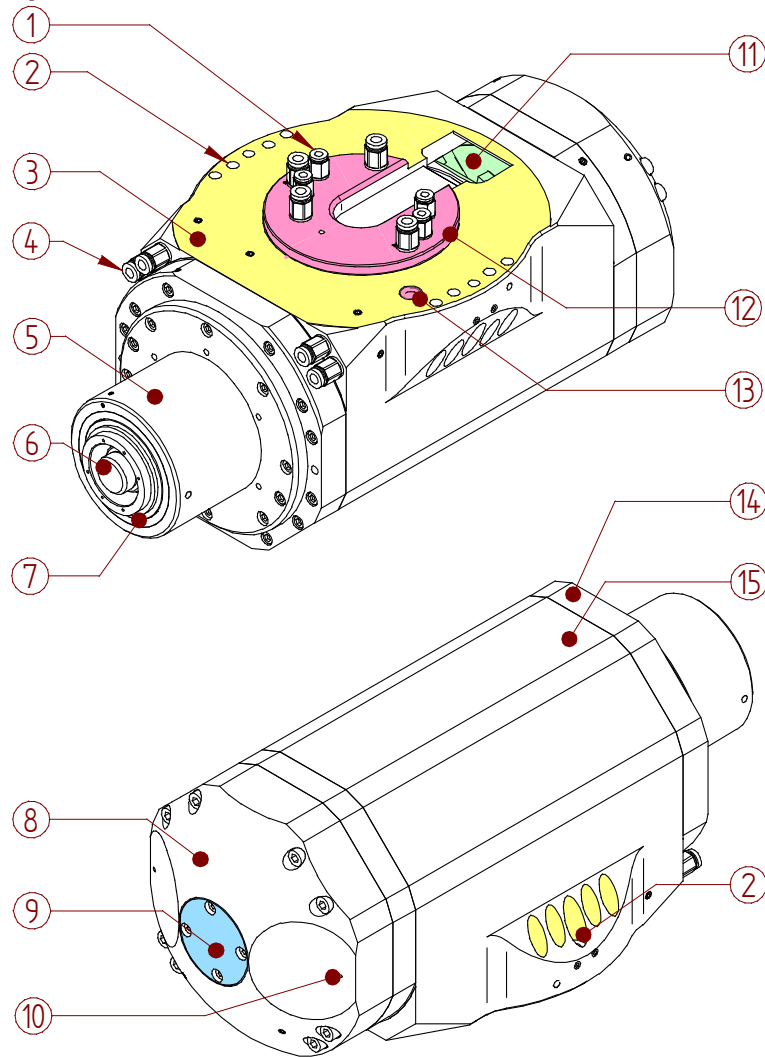
RELATIVE HUMIDITY (NON-CONDENSING): from 5% to 55%



The maximum storage time for an HSD product is 12 months. Beyond this limit, the product must be inspected by HSD-authorized personnel. For further information, contact HSD Customer Service.

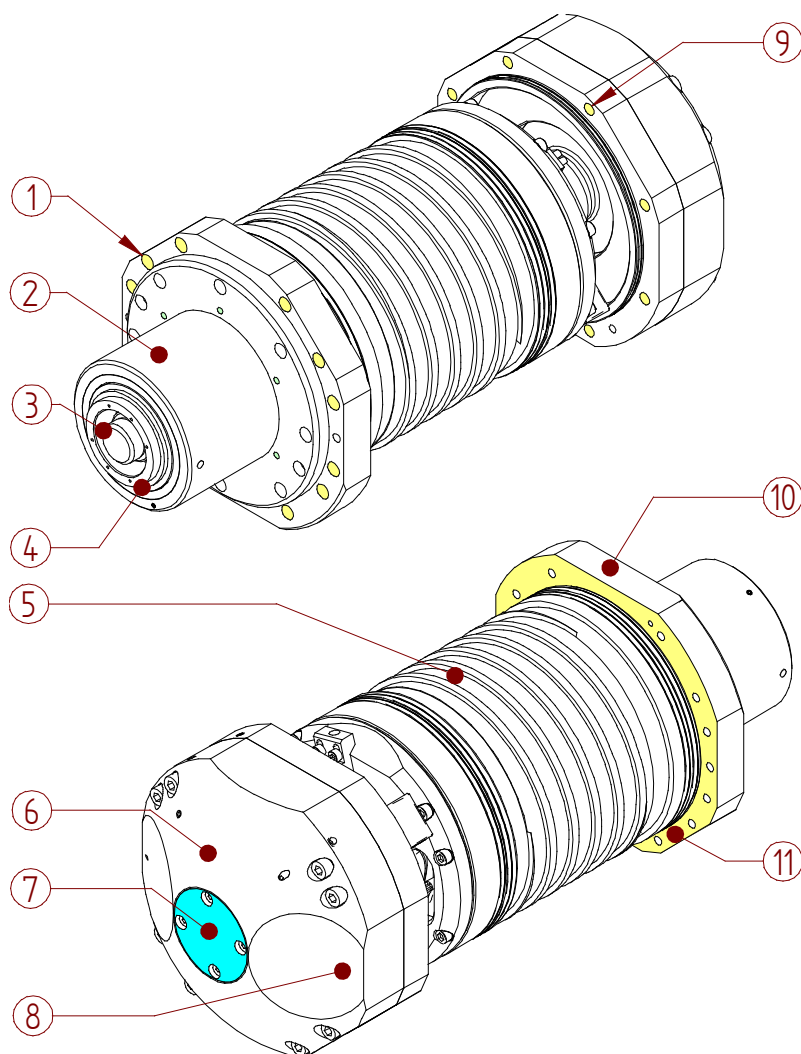
3 Technical specifications

3.1 Main parts of ES798



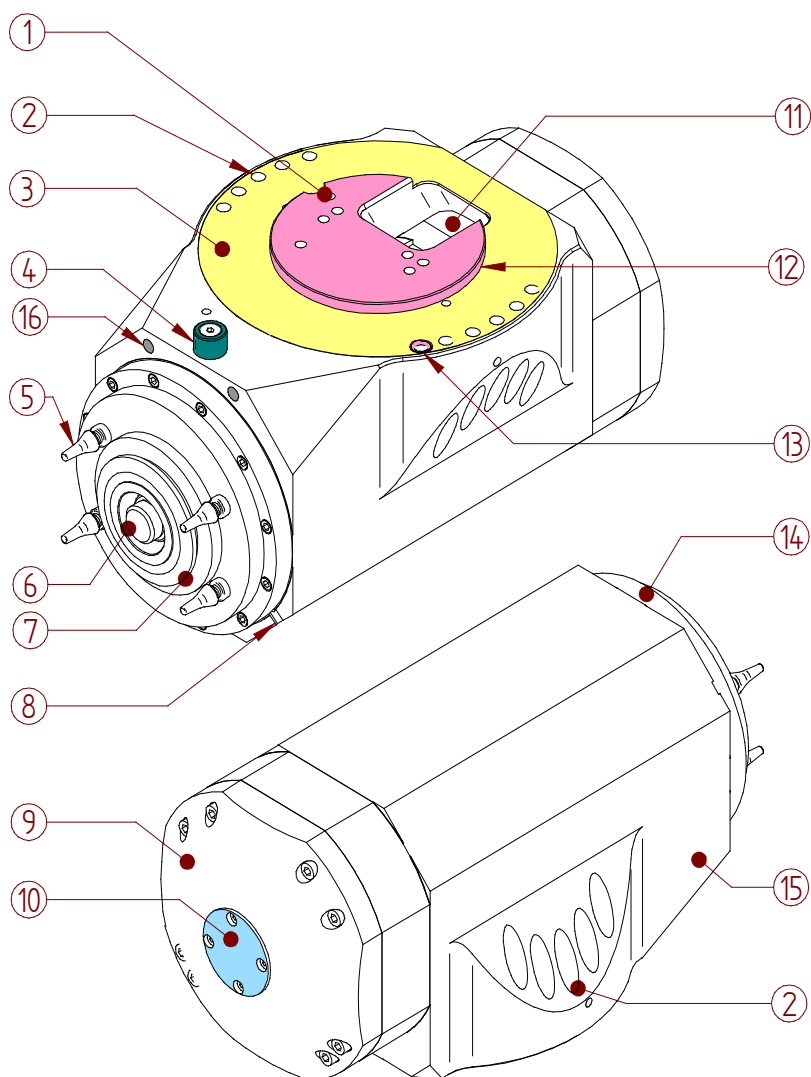
1	Bores for compressed air and fluid inlet / outlet	6	HSK collet	11	Cable outlet bore
2	10 fixing bores of Ø9	7	Shaft	12	Keying Ø140 h5
3	Resting surface	8	Cylinder unit	13	Seat for bushing DIN179-a 10x12
4	4 outlets for external tool cooling liquid	9	Plug / Fluid distributor	14	Rear flange
5	Nose	10	2 drainage bores for fluid distributor safety	15	Framework

3.2 Main parts of ES798 without external framework



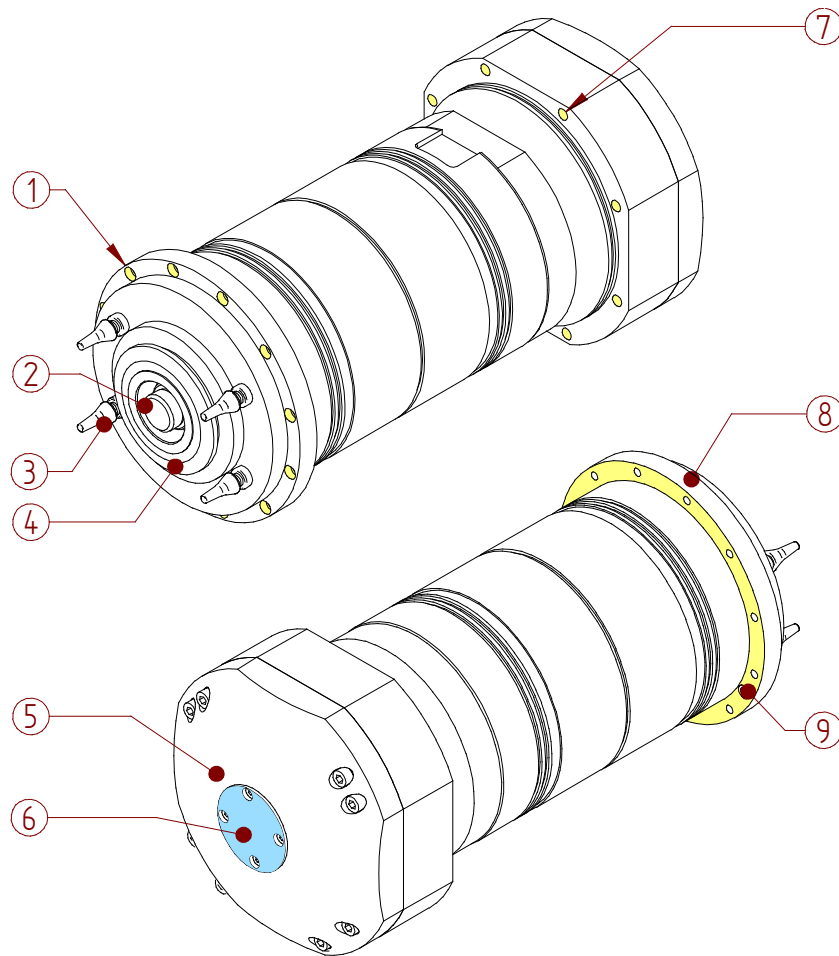
1	12 fixing bores of Ø6.5	5	Internal framework with helicoidal structure	9	8 cylinder fixing bores of Ø9
2	Nose	6	Cylinder unit	10	Rear flange
3	HSK collet	7	Plug / fluid distributor	11	Fixing surface
4	Shaft	8	2 drainage bores for fluid distributor safety		

3.3 Main parts of ES799



1	Bores for compressed air and fluid inlet / outlet	6	HSK collet	11	Cable outlet bore
2	10 fixing bores of Ø9	7	Shaft	12	Keying Ø160 h5
3	Resting surface	8	2 drainage bores for fluid distributor safety	13	Seat for bushing DIN179-a 10x12
4	Machine A-axis mechanical block	9	Cylinder unit	14	Rear flange
5	4 outlets for external tool cooling liquid	10	Plug / fluid distributor	15	Framework

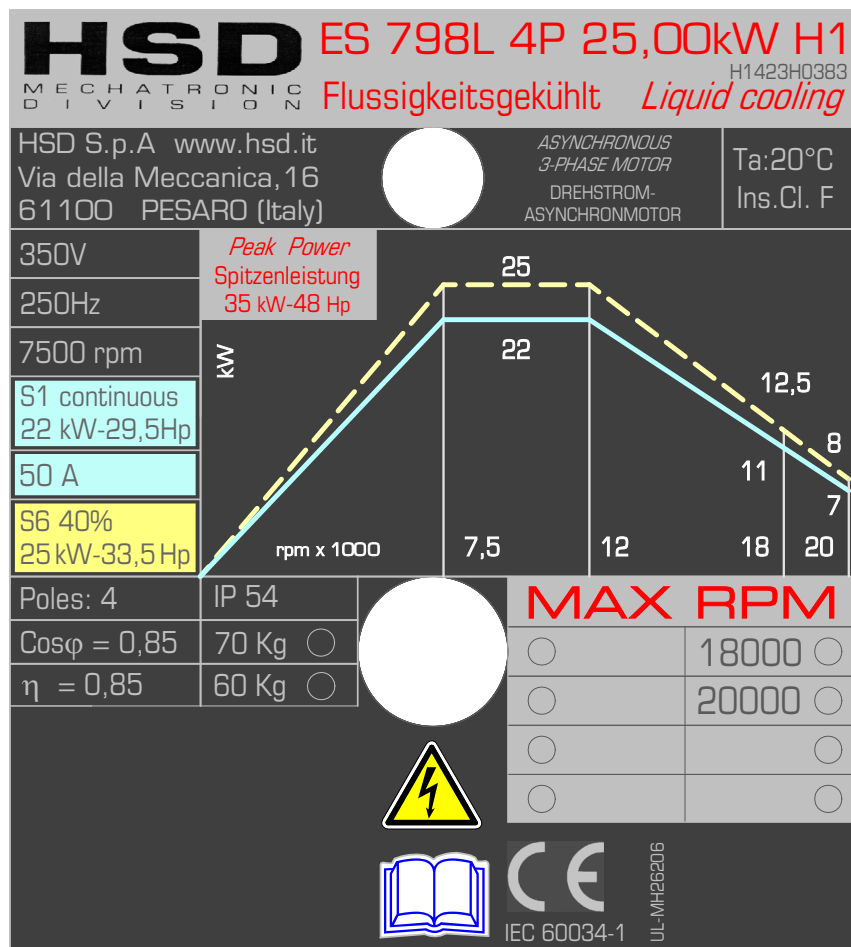
3.4 Main parts of ES799 without external framework



1	12 fixing bores of Ø6.5	4	Shaft	7	8 cylinder fixing bores of Ø9
2	HSK collet	5	Cylinder unit	8	Rear flange
3	4 outlets for external tool cooling liquid	6	Plug / fluid distributor	9	Fixing surface

3.5 Characteristics and performance

3.5.1 ES798



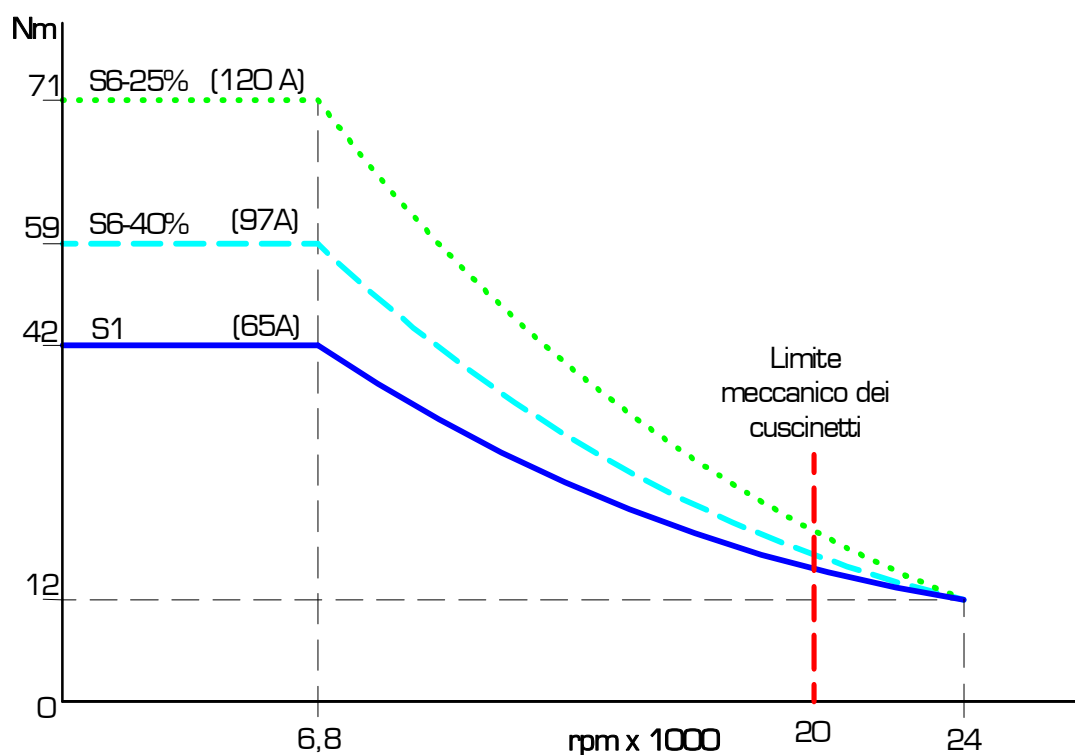
H1423H0383 (SP 150.140.41)

Rated voltage	V	350	350	350	350
Rated frequency	Hz	250	400	600	633
Rated speed	rpm	7,500	12,000	18,000	20,000
Duty type		S1 cont	S6 60%	S1 cont	S6 60%
Rated power	kW	22	25	11	12.5
Rated torque	Nm	28	32	5.8	6.6
Rated current	A	50	57	24	27
Rated output		0.85			
Power factor cos		0.85			
Number of poles		4			
Type of insulation		F			
Cooling		Liquid			
Weight with housing	kg	70			
Weight without housing	kg	60			

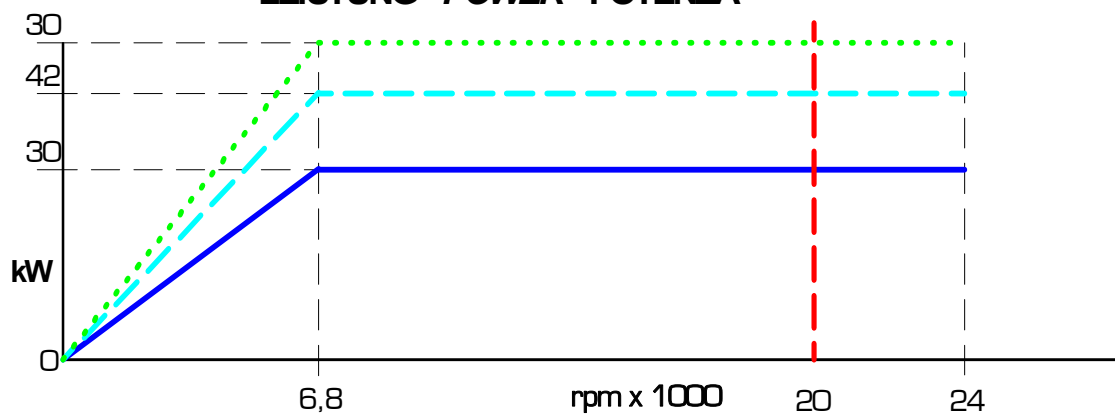
Equivalent electrical network SP 150.140.41

Rated power (S1/Cont)	kW	22
Rated current (S1/Cont)	A	50
Rated voltage	V	350
Rated speed	rpm	7,385
Rated frequency	Hz	250
No-load line voltage	V	346
No-load current	A	16.9
Stator resistance (20°C)	Ohm	0.04
Rotor resistance (20°C)	Ohm	0.06
Stator leakage reactance	Ohm	0.8
Rotor leakage reactance	Ohm	1.0
Main field reactance	Ohm	11.2
Field weakening initial speed	rpm	7,500
Motor maximum speed	rpm	20,000
Power factor		0.85
Rotor moment of inertia	kg	6.2E-03
Connection	Y/D	Y

3.5.2 ES799

NENNDREHMOMENT - *RATED TORQUE* - COPPIA NOMINALE

From HSD Drawing code 5530H0274

LEISTUNG - *POWER* - POTENZA

Siemens code: 1FE1073-4WN11

For further information, refer to the “design manual” of the “1FE1 integrated synchronous motors” available on the SIEMENS website.

3.6 Checks carried out on the product

- Tool change
- Expulsion stroke
- Tool locking force
- Collet functioning
- Encoder functioning
- Sensor functioning
- Cone-cleaning air passage - pressurisation
- Cooling liquid seal
- Hydraulic seal of piston unit
- Earth conductor efficiency
- Electrical rigidity
- Electrical insulation
- Radial oscillation
- Front radial vibration <0.5mm/s
- Rear radial vibration <0.5mm/s
- Final running-in

4 Installation and commissioning

4.1 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 the connectors are not damaged.

4.2 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.

4.3 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.

4.3.1 Resting surface for electrospindles with framework





The resting surface on which the product is to be installed must have a flatness better than

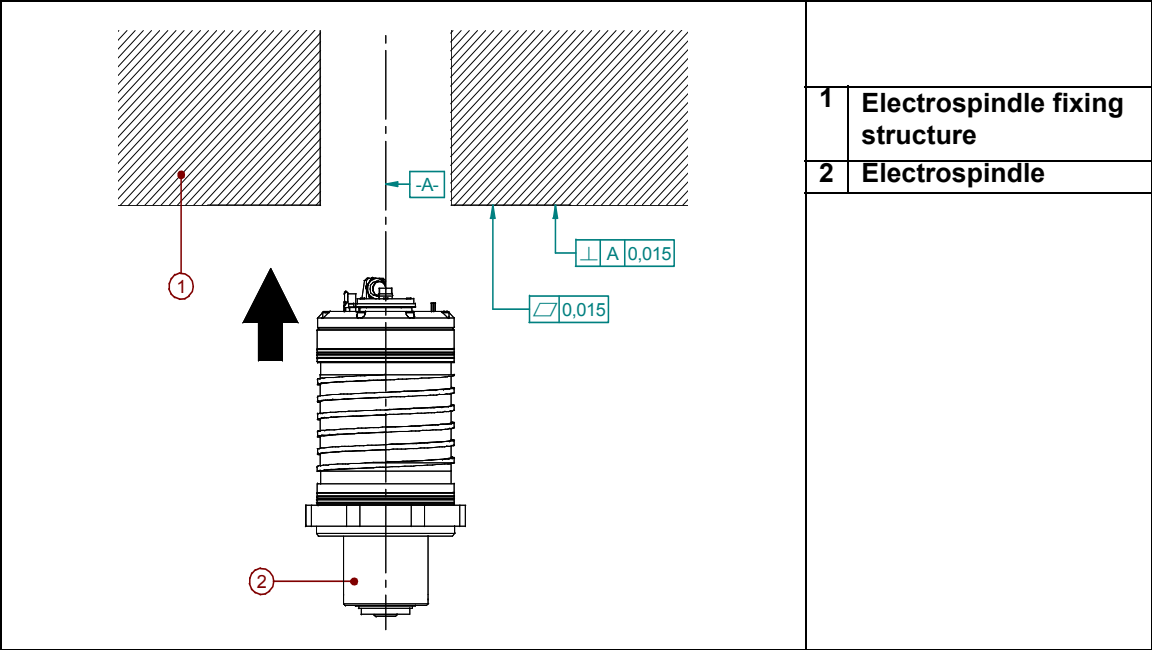
	0,02
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4.3.2 Fixing structure for spindles without framework



The fixing structure on which the electrospindle is to be fitted must have a planarity of less than 0.015mm, and a perpendicularity with respect to the spindle axis less than 0.015mm

	0,015	
	A	0,015



4.3.3 Fixing the ES798 without framework

Use the twelve Ø6.5 through bores on the front flange.
Fix the cylinder unit as shown in section 4.3.7.



Respect the position of $270 \pm 0.05\text{mm}$ between the front flange and the cylinder unit.

4.3.4 Fixing the ES799 without framework

Use the ten Ø9 through bores on the front flange.
Fix the cylinder unit using eight M8 screws.



Respect the position of $310 \pm 0.05\text{mm}$ between the front flange and the cylinder unit.

4.3.5 Fixing the ES798 with framework

Use the twelve Ø6.5 through bores on the front flange.
The structure on which the electrospindle is to be fixed must have the seat of the Ø10 dowel in line with the DIN179-a 10x12 bushing on the electrospindle framework.

4.3.6 Fixing the ES799 with framework

Use the ten Ø10.5 through bores on the front flange.
The structure on which the electrospindle is to be fixed must have the seat of the Ø10 dowel in line with the DIN179-a 10x12 bushing on the electrospindle framework.

4.3.7 Fixing the ES798 cylinder unit

The cylinder of the ES798 electrospindle consists of two parts - the cylinder and the cover.

To assemble/disassemble the cylinder, proceed as follows:

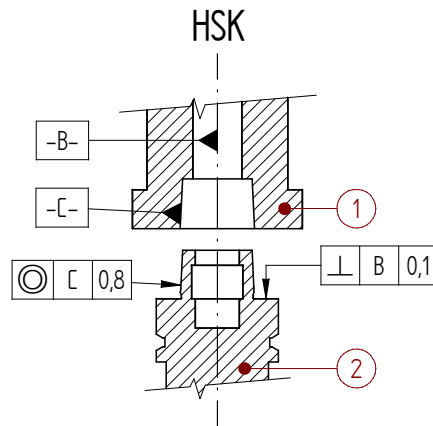
- remove the eight M8 screws from the cover;
- use the eight M8 screws to fix the cylinder;
- reassemble the cover.

4.3.8 Tool change system



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

- spindle shaft / tool-holder cone concentricity: 0.8mm;
- spindle axis / tool-holder stop surface perpendicularity: 0.1mm.



1	HSK spindle shaft
2	HSK tool-holder cone



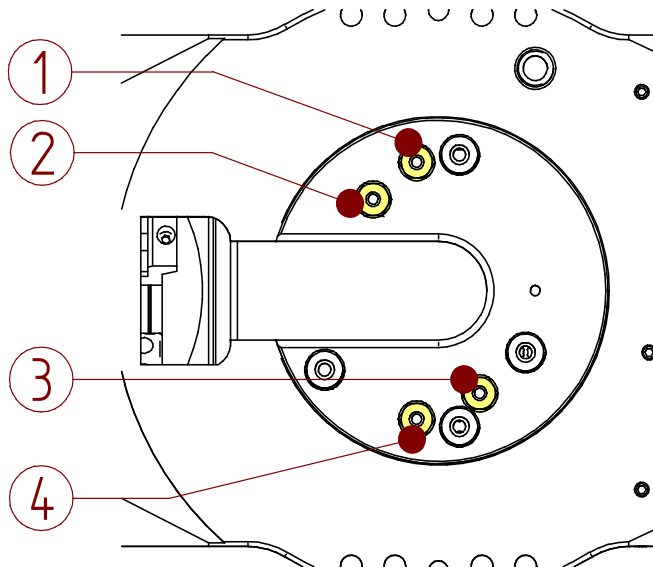
Pay attention to the phasing of the dragging devices, which must be correctly coupled with the seats on the tool-holder.

4.4 Pneumatic connections

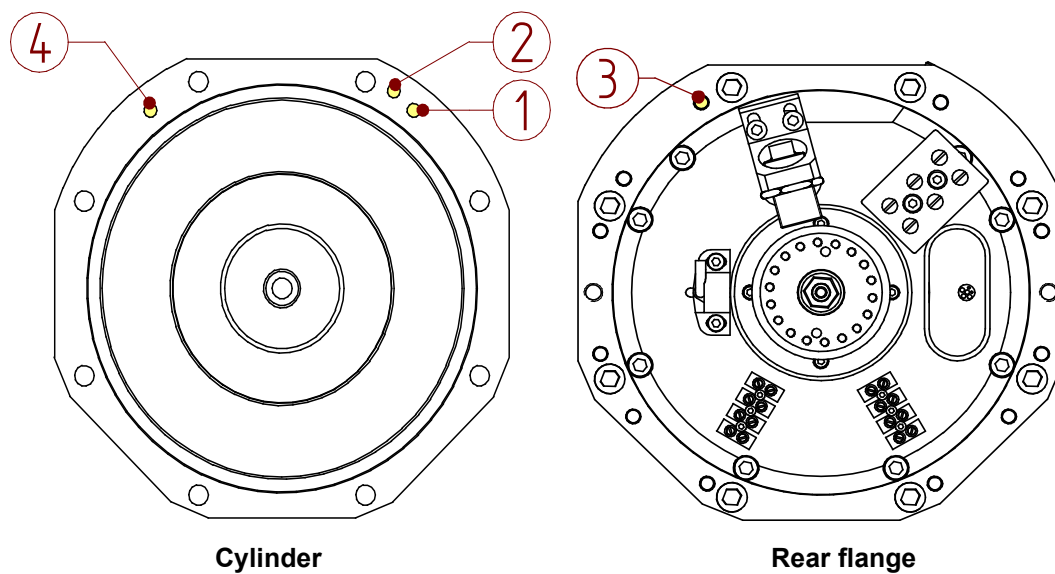


The pneumatic connection points are shown in section 3

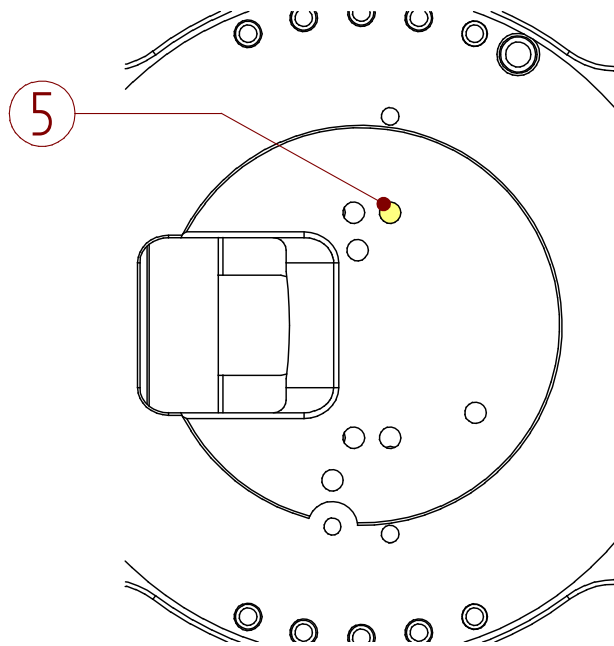
4.4.1 Pneumatic connection points for the ES798



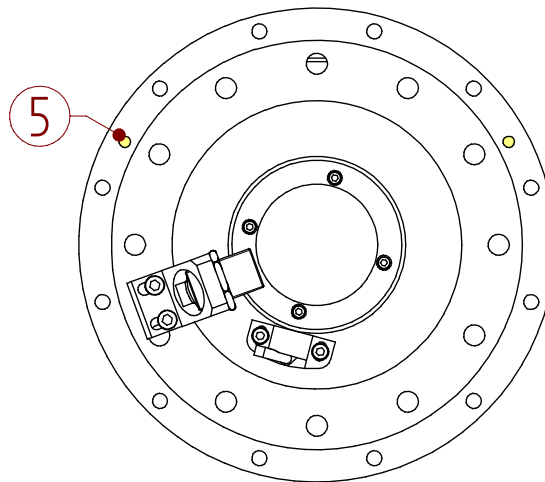
4.4.2 Pneumatic connection points for the ES798 without framework



4.4.3 Pneumatic connection points for the ES799



4.4.4 Pneumatic connection points for the ES799 without framework



Rear flange

	Description	Power supply	Coupling
1	Tool unlocking air inlet	6 bar	G 1/8
2	Tool locking air inlet	6 bar	G 1/8
3	Pressurisation air inlet (only ES798)	4 bar	G 1/8
4	Cone cleaning / internal tool cooling air inlet (only ES798)		G 1/8
5	Pressurisation / cone cleaning air inlet (only ES799)	0.5/6 bar	G 1/8

4.4.5 Compressed air specifications for HSD products



Caution

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

class 2 for the solid particles: size of the solid particles $< 1 \mu\text{m}$

Class 4 for humidity: dew point $< 3^\circ\text{C}$ (37.4°F)

Class 3 for total oil: oil concentration $< 1 \text{ mg/m}^3$

The product could break if these specifications are disregarded.

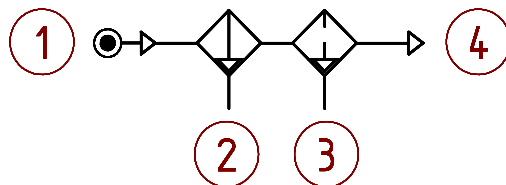
The warranty is not valid if pollutants are found during repair operations.



Information

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

- If the machine is equipped with a lubricated air circuit it should be isolated from the dry air circuit for the product by means of non-return valves.
- Install the filters indicated in the figure below as close to the HSD product as possible.



1. Mains power supply.
2. Pre-filter $5 \mu\text{m}$.
3. De-oiling filter $0.1 \mu\text{m}$.
4. To the HSD product.

- 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, through point (1) indicated in the previous figure blow in compressed air with a purity rating complying with ISO 8573-1, classes 7 6 4, i.e. :
 - Type 7 for solid particles:
 - solid particle size $< 40 \mu\text{m}$;
 - solid particle concentration $< 10 \text{ mg/m}^3$;
 - class 6 for the humidity:
 - dew point $< 10^\circ\text{C}$;
 - class 4 for the total oil:
 - oil concentration $< 5 \text{ mg/m}^3$.
- 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).

4.4.6 Cleaning the tool-holder cone

The tool-holder cone and its tapered mounting on the spindle shaft are 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 must be active for the whole time that the collet is open.


4.4.7 Internal pressurisation


The pneumatic circuit of internal pressurisation prevents harmful particles from entering the electrospindle. The air introduced finds an outlet through the gaps of the front labyrinth, in the area of the electrospindle nose.



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.

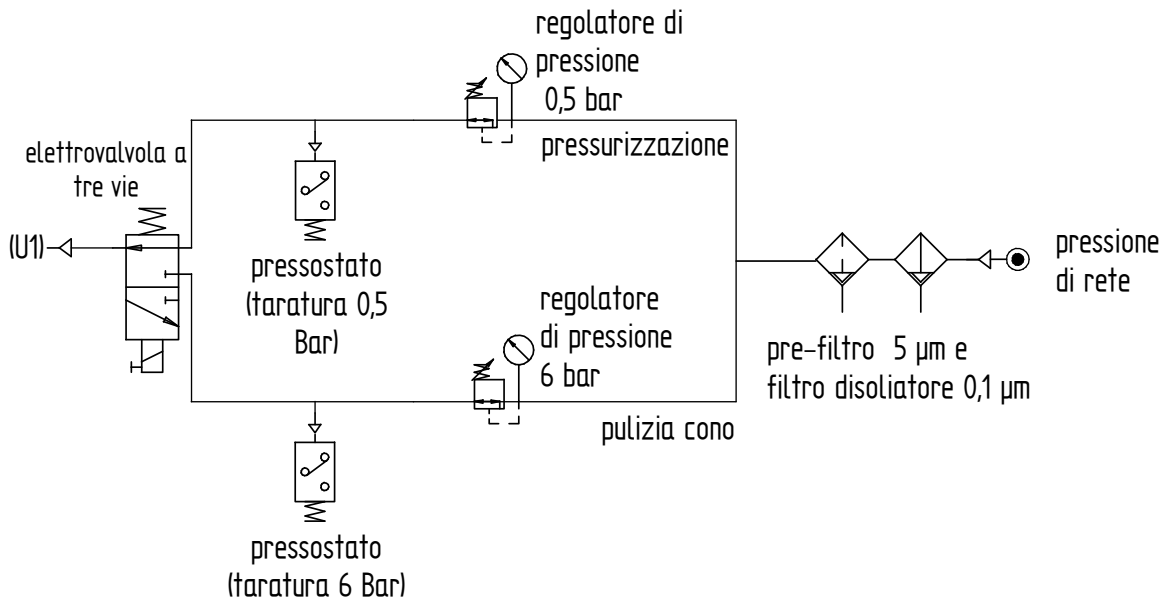
With the spindle at standstill, check there is a uniform outlet of air around the spindle shaft (pressurisation); if this is not the case, check the efficiency of the pneumatic circuit and the tightness of the connections.

	Pressurisation air consumption - ES798:	2880 litres / hour ^(*)
		48 litres / minute ^(*)
		1.69 cfm ^(*)
(*) volume with: P = 4 bar (58 PSI) and T = 20° C (68°F)		

	Pressurisation air consumption - ES799:	3000 litres / hour ^(*)
		50 litres / minute ^(*)
		1.76 cfm ^(*)
(*) volume with: P = 0.5 bar (7.2 PSI) and T = 20°C (68°F)		

In the ES799 electrospindle, the pressurisation and cone cleaning air inlets are unified. The customer must create a circuit (as shown below) to pass from a fixed pressure of 0.5 bar for the 5 bar pressurisation during the tool change phase, to clean the tool-holder

Figura 1 : indicative pneumatic layout



THE CIRCUIT SHOWN IS PURELY INDICATIVE

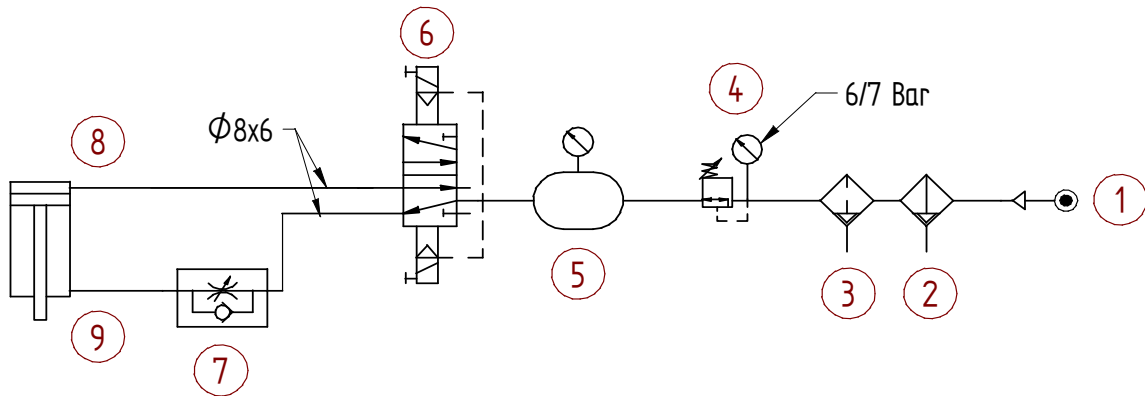
4.4.8 Functioning of ES798 tool change piston



Information

The circuit given here is only an example.

Below is a diagram giving an example of how the system can be set up.



Reference	Description
1	Mains power supply.
2	Pre-filter 5 µm.
3	De-oiling filter 0.1 µm.
4	Pressure regulator.
5	Pneumatic tank.
6	Bistable solenoid valve 5-2.
7	Unidirectional flow regulator (to regulate the locking pulse).
8	Air inlet for unlocking the tool.
9	Air inlet for locking tool.

4.4.9 Functioning of ES799 tool change piston

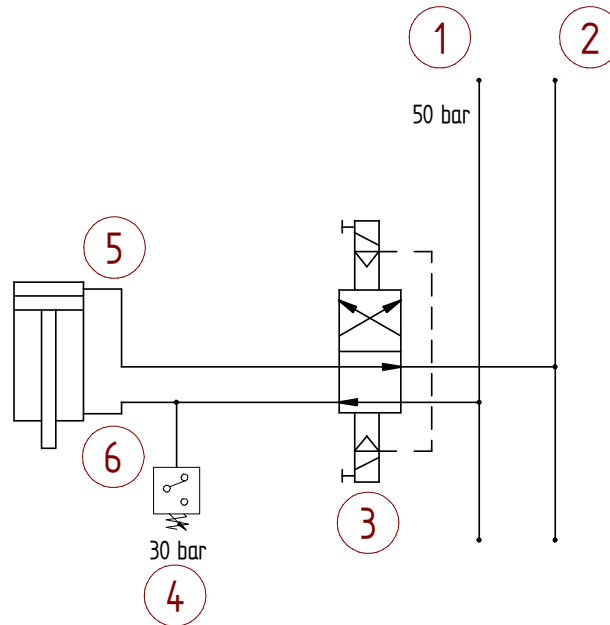


Information

The circuit given here is only an example.

The ES799 electrospindle has an oil cylinder for tool change.

Below is a diagram giving an example of how the system can be set up.



Reference	Description
1	High pressure circuit (50 bar)
2	Low pressure circuit
3	Bistable solenoid valve
4	Safety switch on the piston return circuit (set at 30 bar)
5	Oil inlet for unlocking the tool.
6	Oil inlet for locking the tool.



Information

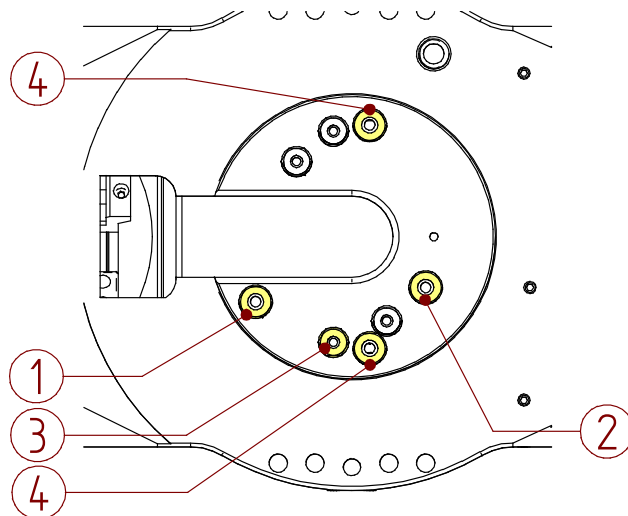
It is unnecessary to supply a constant 50 bar for tool locking.

When the piston is confirmed as having moved back from the safety switch to the upper limit switch, pressure can be reduced to 10 bar.

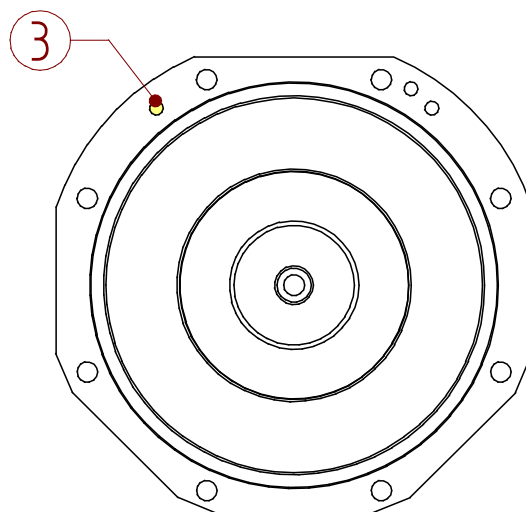
4.5 Hydraulic connections

4.5.1 Hydraulic connection points

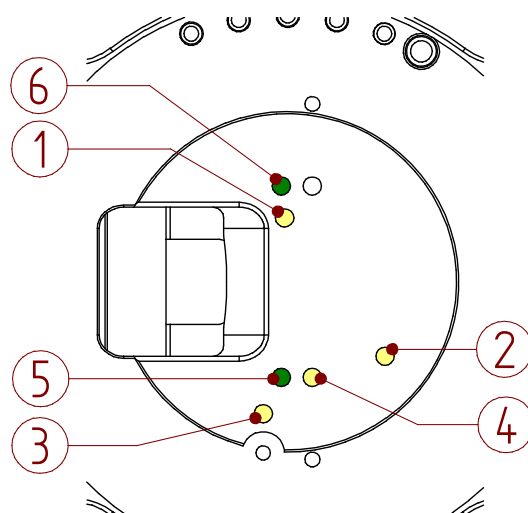
ES798



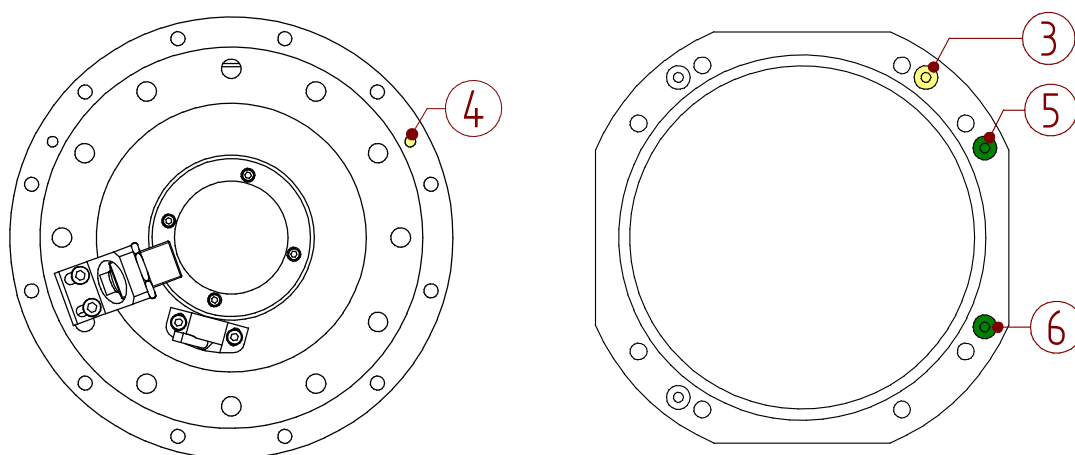
ES798



ES799



ES799 without framework



	Description	Coupling
1	Stator cooling liquid inlet	G 1/8
2	Stator cooling liquid outlet	G 1/8
3	Internal tool cooling liquid inlet	G 1/8
4	External tool cooling liquid inlet	G 1/8
5	Tool unlocking oil inlet (only ES799)	G 1/8
6	Tool locking oil inlet (only ES799)	G 1/8

4.6 Technical data of the refrigerator

Use water charged with 10% ethylene glycol and with anti-corrosion additives.

Upon request, HSD supplies "ARTIC-FLU-5" (order No.: H2161H0022).

ARTIC-FLU-5 is a premixed cooling liquid, ready for use and tested by HSD S.p.A.

It contains monoethylene glycol and corrosion inhibitors, has an ecological formula without amines, nitrates or phosphates, and guarantees protection against corrosion for approximately 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 conforms to various international standards, including standard CUNA NC 956-16.

Technical data of the refrigerator

Cooling capacity	3200 W
Minimum flow rate	4 litres/minute
Type of coolant	Water + 15% ethylene glycol + corrosion inhibitor
Temperature of the refrigerator set	+25 +/-3°C (+77 +/-5°F)

4.7 Electrical connections



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

4.7.1 Power wiring

The phases and earth are marked by identification plates on the cables themselves

4.7.2 Wiring the ES798 sensor

Colour	Description	
Brown	+V _s	Power supply
Black	Out	Output voltage
Blue	0V	

Wiring the ES798 encoder

Colour	Description
Red	5V Sense Power supply (+5V)
Black	GND
Yellow	A +
Green	A -
Brown	B +
Blue	B -
White	Z -
Grey	Z +

4.7.3 Wiring the ES799 sensor

Colour	Description	
Brown	+U _B	Power supply
Black	A ₁	Output voltage
White	A ₂	Output current
Blue	0V	

4.7.4 Wiring the ES799 encoder

Colour	Description
Green	5V Sense
Red	Power supply (+5V)
Blue	GND
White	A +
Brown	A -
Pink	B +
Black	B -
Grey	Z -
Yellow	Z +

5 General checks after installation

5.1 Checks before the start-up

5.1.1 Pneumatic circuit

- 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 3 “Technical specifications”.

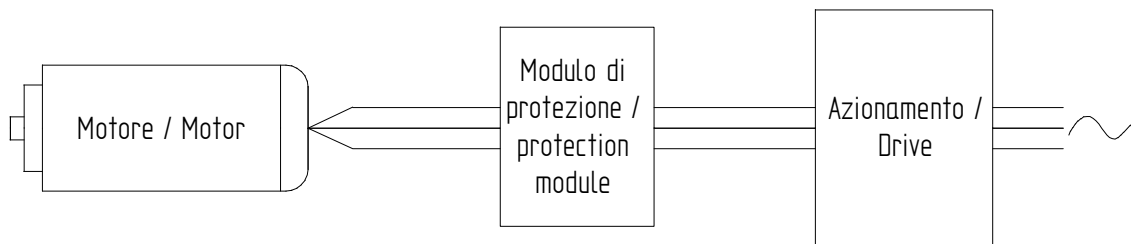
5.1.3 Electrical circuit



- the earthed cable of the product (indicated in section 4.7 “Electrical connections”) 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 4.7 “Electrical connections”).

5.1.4 Programming the inverter

The ES799 electrospindle is fitted with a synchronous motor with permanent magnets; it may therefore behave as a current generator. The output voltage is determined by the rotation speed (see section 3 “Technical specifications”). Consequently, it is necessary to use protection modules for the overvoltage caused by the regenerative effects of the synchronous motor. Below there is an example of a circuit including a protection module:



5.1.5 Parameterisation of the inverter

ES798

To parameterise the inverter, refer to the identification plate parameters

ES799

To facilitate the parameterisation of the motor, Siemens supplies a file of data to be entered in the drive. To use these files it is necessary to purchase the tool “SimocomU” (produced by Siemens) which allows you to check motor rotation directly from a PC.

5.2 Checks during initial start-up



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



The cylinder of this electrospindle is double-acting: it is necessary to keep the cylinder under pressure to maintain the piston at the upper end stop, far from the fast-rotating parts.

- the tool change 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 checked 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 ambient conditions.

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 pre-load and rigidity.



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

- 25% of the maximum rated speed for 5 minutes.
- 50% of the maximum rated speed for 3 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.



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

6.4 Tool-holder locking and ejection device

The tool-holder is locked and ejected by means of the double-acting movement of a piston.
Model ES798 has a compressed air-driven piston;
model ES799 has an oil-driven piston.

The expulsion of the tool-holder cone must be approx. 0.5mm - 0.6mm.

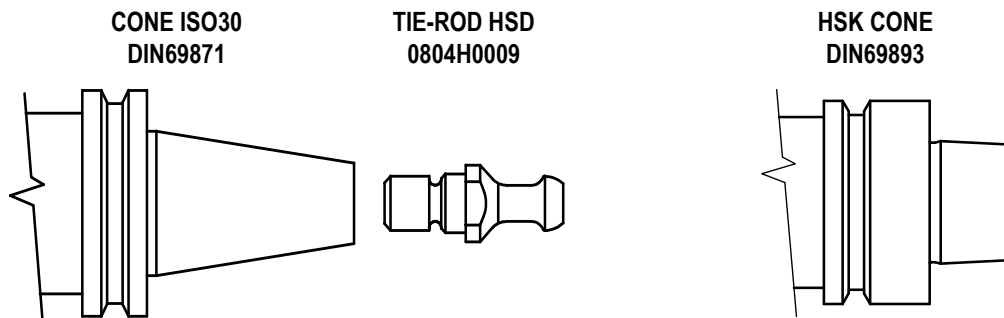


All HSD electrospindles have a mechanical reaction system that neutralises the axial force of the piston on the shaft during the tool change phase, thus guaranteeing the integrity of the precision bearings.

6.4.1 Torque transmittable to the tool-holder

TYPE OF HOOK-UP	TORQUE TRANSMITTABLE
HSK A63	97 Nm

6.4.2 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).

6.4.3 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 hooking (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 impurities that may enter: 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 (ISO1940 standard) at the maximum rated speed of the electrospindle.



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 lightweight tool
 - precise, and with any inserts locked for a higher degree of safety
 - balanced and symmetrically matching the tool-holder
 - with cutting edges close to the rotation axis

6.6 Fluids distributor

The ES798 and ES799 electrospindles are optionally fitted with a rotating distributor for internal tool cooling. The cooling action works with cooling liquids.

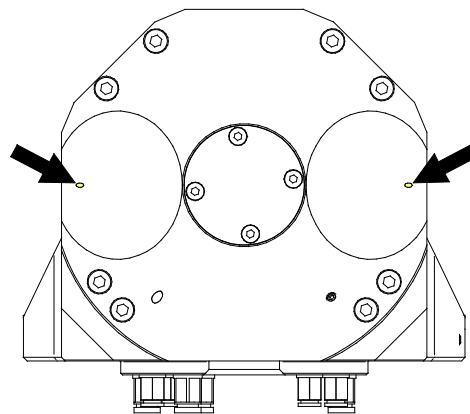
The hydraulic connection points concerned are shown in section 4.5.1

The standard distributor has the following characteristics:

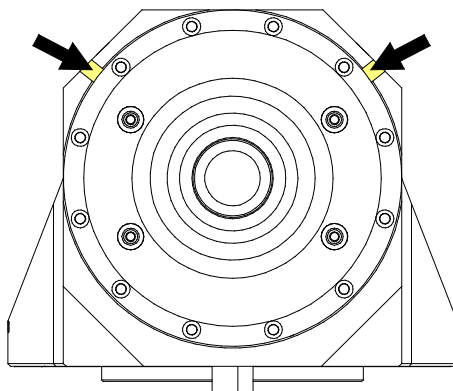
Characteristics	
Minimum pressure	0.5 bar
Maximum pressure	7 bar
Maximum speed	24,000 rpm
Maximum temperature of cooling liquid	70°C
Degree of filtering of cooling liquid	60 µm
Dry running	Possible
Maximum capacity	20l/min

There are distributor drainage bores on the electrospindles; these may be useful in the event of anomalies, excess pressure or excess liquid capacity.

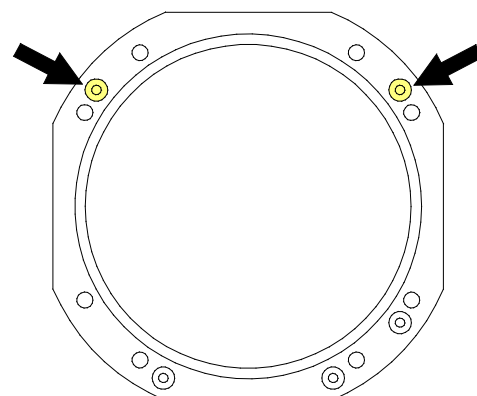
The position of the bores is shown in the figures below:



ES798



ES799



ES799 without framework (cylinder)



If you wish to use a rotating distributor other than the standard HSD distributor, contact the HSD Service Centre

6.7 Sensors

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

6.7.1 Statuses of the electrospindle and corresponding outputs of the capacitive sensors

ES798

Reading range		2-5	mm
Power supply		14-30	V DC
Output voltage		0-10	V
Output voltage	Collet closed without tool	5.3 - 7	V (23°)
	Collet closed with tool attached	3.8 - 5.3	V (23°)
	Tool attached badly	1.4 - 3.8	V (23°)
	Tool expelled	1 - 1.4	V (23°)



The electrospindle shaft can only rotate when the output values correspond to the *tool attached* status; if the values change, stop the electrospindle shaft rotation immediately.

ES799

Reading range		0-10	mm
Power supply		15-30	V DC
Output voltage		0-10	V
Output current		4-20	mA
Output voltage in A1	Collet closed without tool	3.2 - 5	V (23°)
	Collet closed with tool attached	2.5 - 3.2	V (23°)
	Tool attached badly	1.3 - 2.5	V (23°)
	Tool expelled	1.1 - 1.3	V (23°)
Output voltage load		= or < 10	mA
Output current in A2	reading distance = 0mm	4 / ± 0.8	mA (23°)
	reading distance = 10mm	20 / ± 0.8	mA (23°)



The electrospindle shaft can only rotate when the values in A₁ or A₂ correspond to the *tool attached* status; if the values change, stop the electrospindle shaft rotation immediately.

6.7.2 Use and technical characteristics of the thermal alarm

The thermal alarm must be connected to the Numerical Control, which must stop the machining operations as quickly as possible and stop the electrospindle shaft rotation if an excess temperature is detected.



If the shaft blocks while the tool is still being pushed against the piece being worked, the bearings of the spindle could break; if you wait too long before removing the tool from the piece and stopping the rotation, the stator could be burnt.

ES798

The electrospindle is fitted with a bimetallic switch (normally closed), inserted in the electric coils of the stator, and which opens when a temperature that is harmful for the coils is reached; the contact closes automatically when the temperature drops and returns to safe values.

ES799

The thermal alarm contains two KTY84 type probes.

For further information, refer to the “design manual” of the “1FE1 integrated synchronous motors” available on the SIEMENS website.

6.8 Encoder

6.8.1 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.

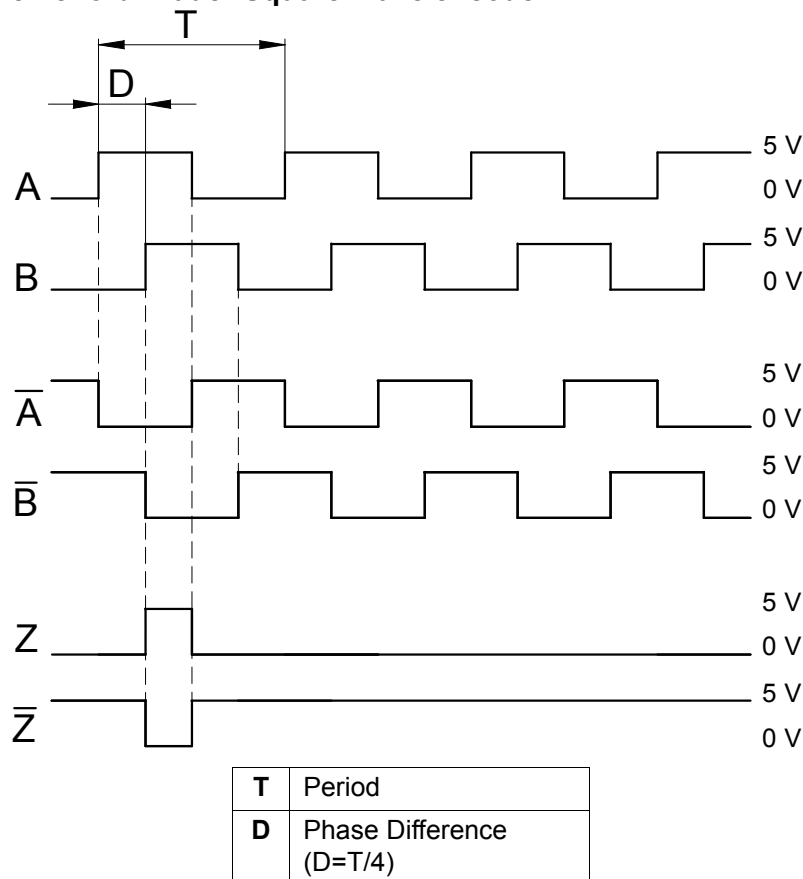
There are three models of encoder available:

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

6.8.2 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



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

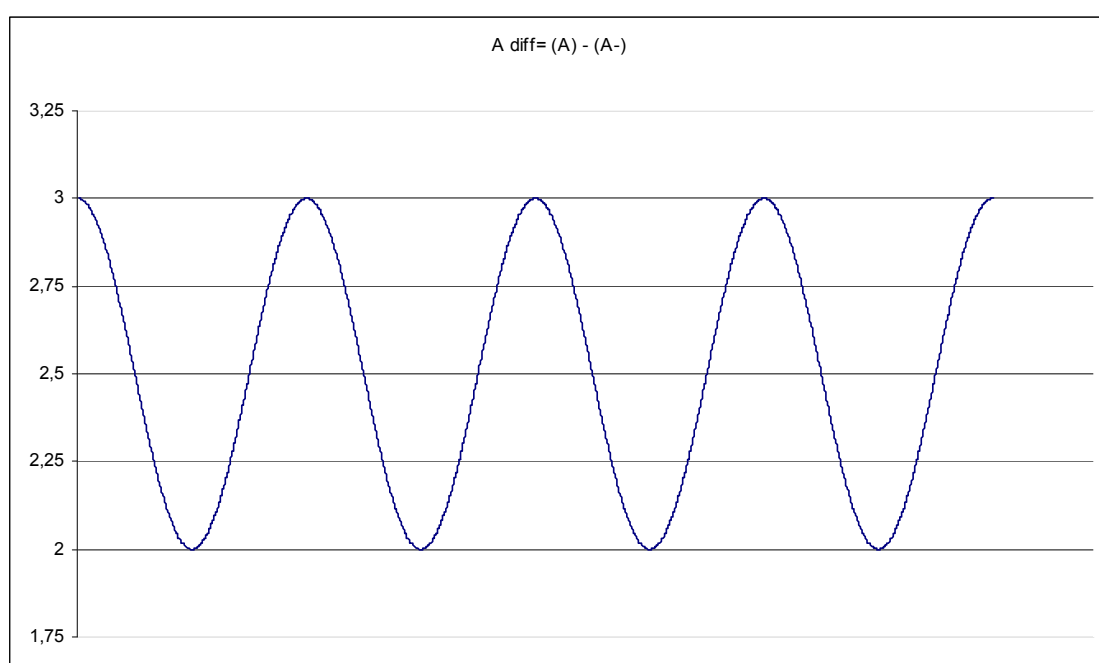
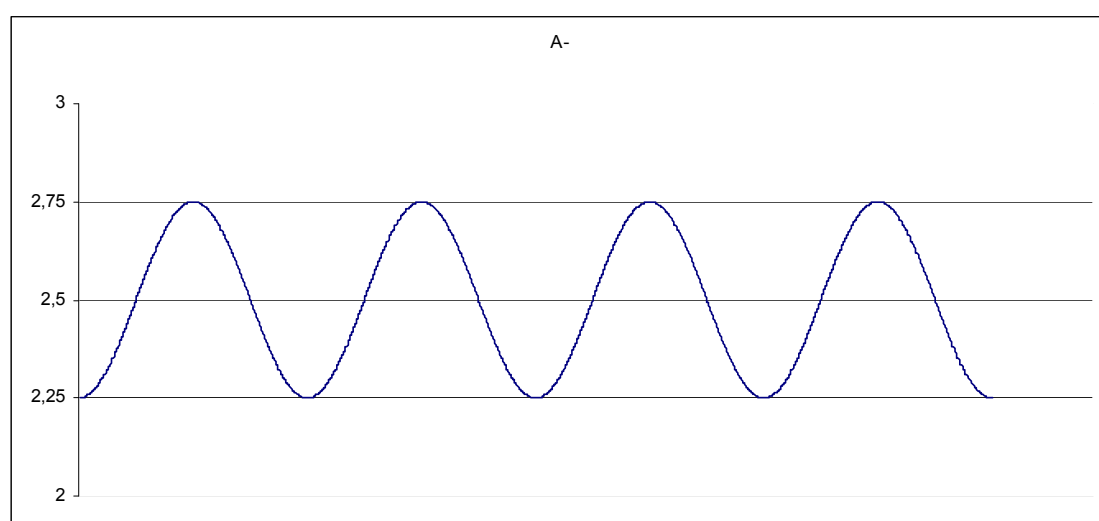
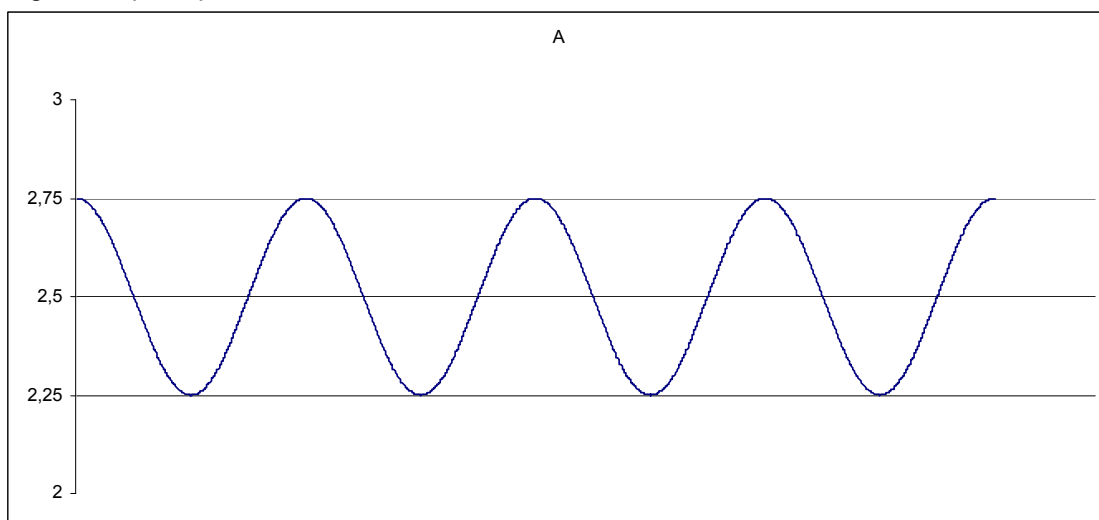
6.8.3 Technical characteristics of the Lenord+Bauer sinusoidal encoder

SPECIFICATION	VALUE
"U" rated supply voltage	5V DC +/- 5%
Operating temperature	-30°C - 85°C (-22°F - 185°F)
Max. operating height	2,000m (6,500 ft)
Signal input:	<ul style="list-style-type: none"> • 256 pulses per revolution + zero notch (ES798) • 250 pulses per revolution + zero notch (ES799)
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)

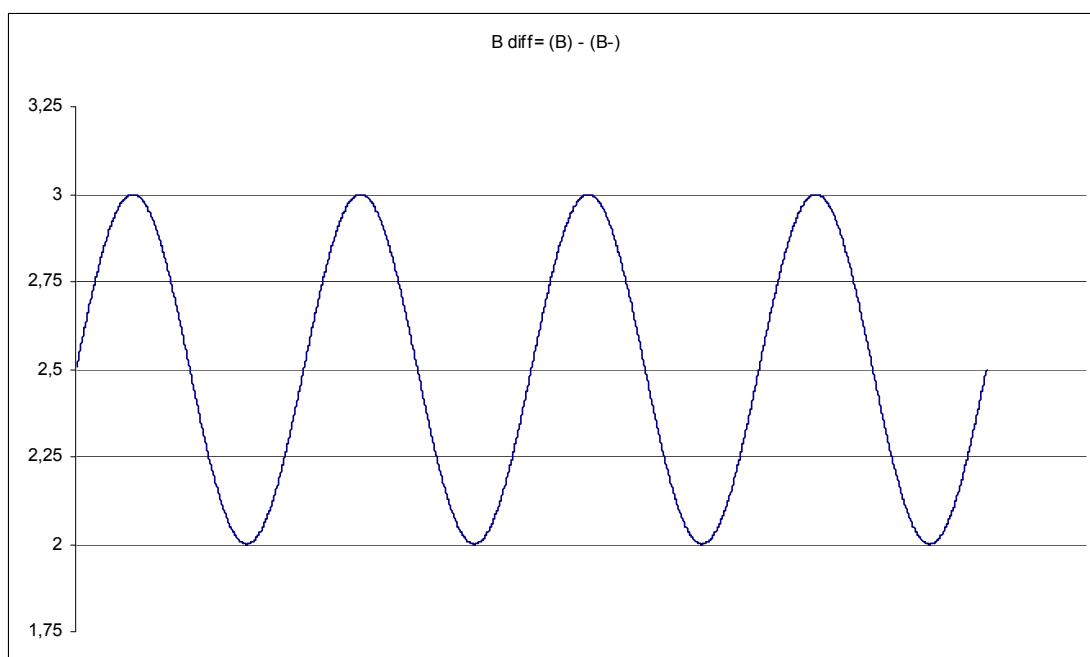
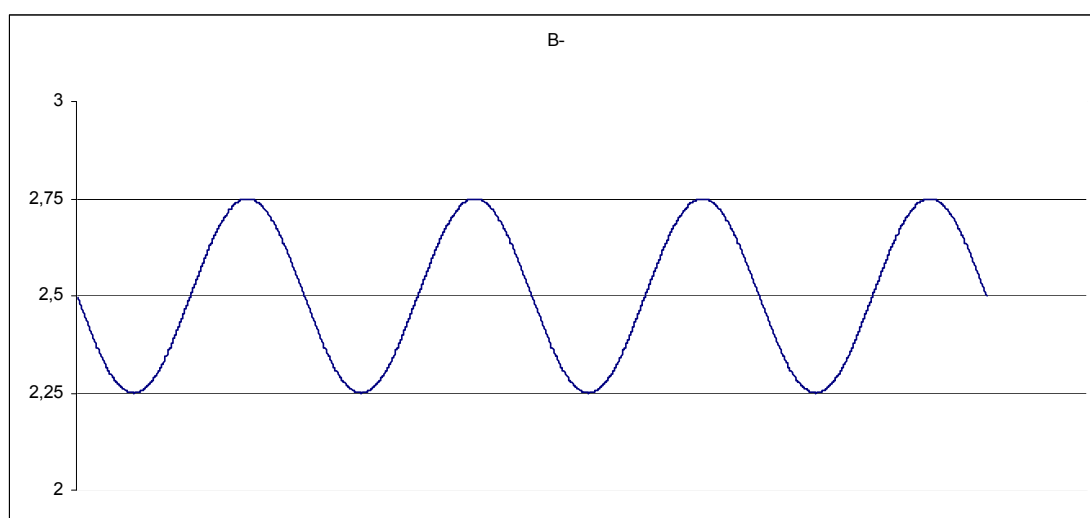
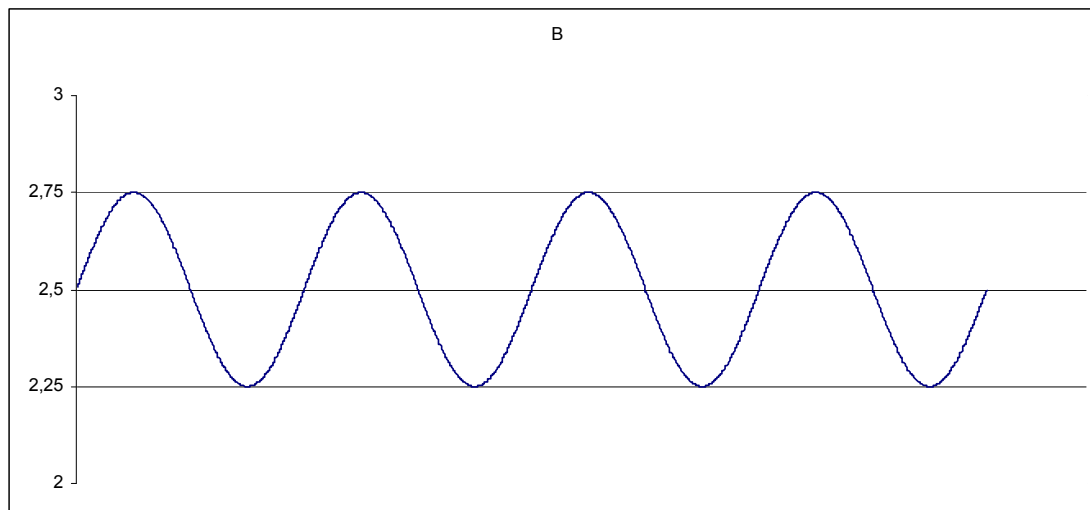


A voltage over the specified value (5V ±5%) may damage the encoder reader

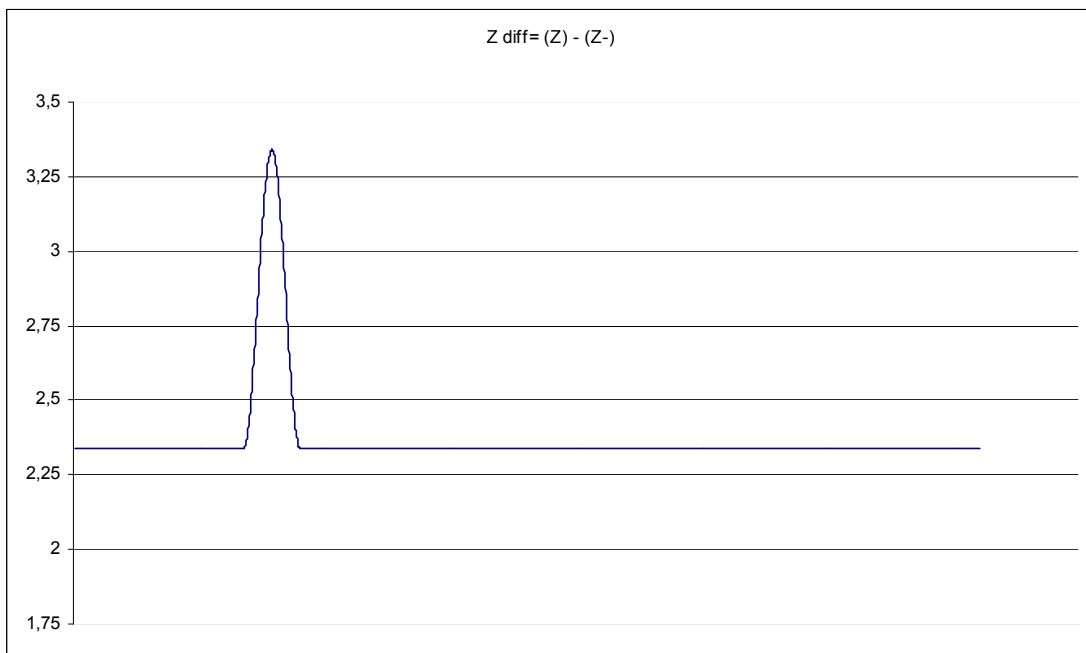
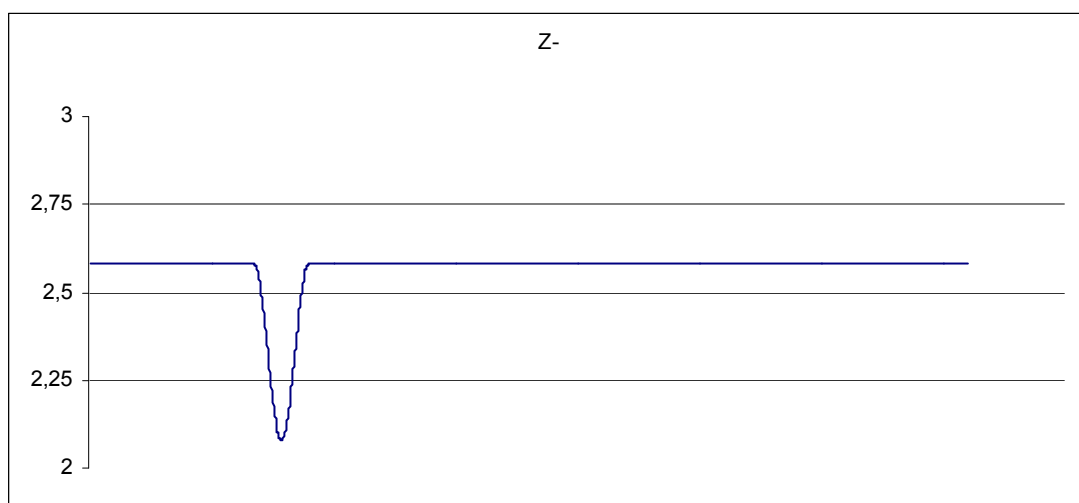
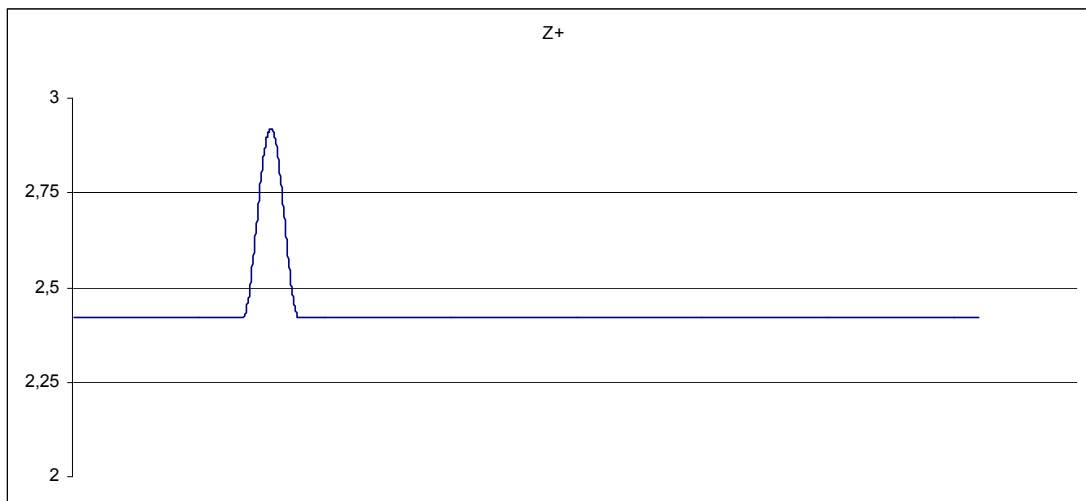
A signal temporal performance:



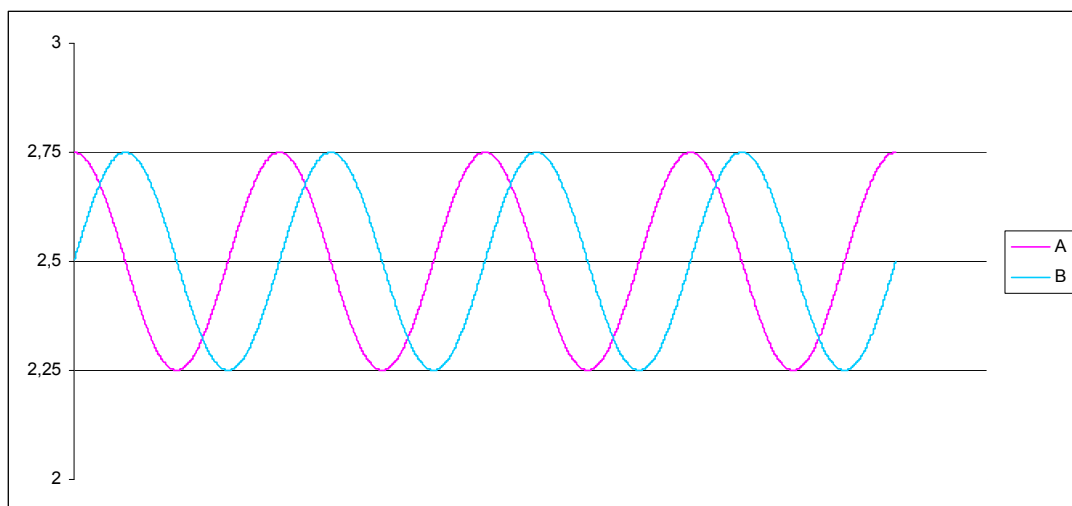
B signal temporal performance:



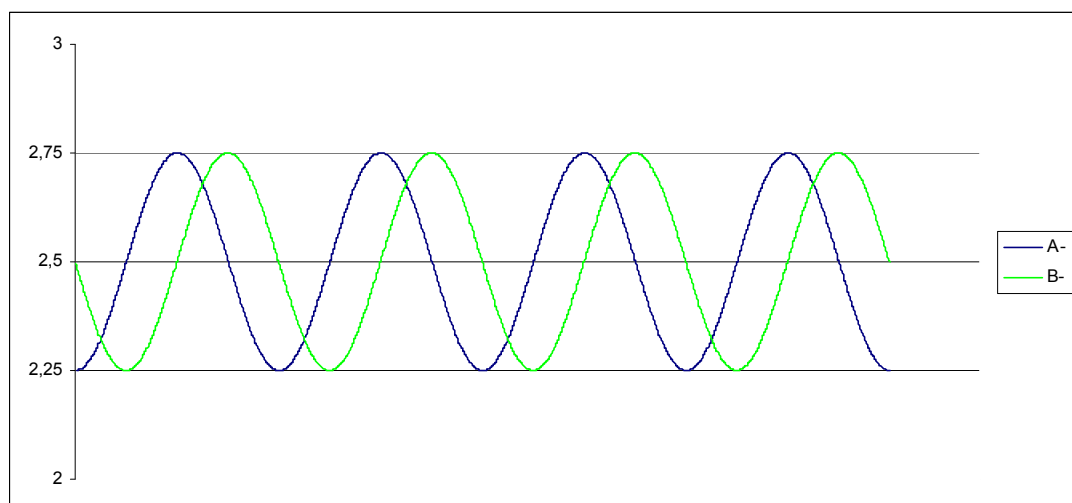
Z signal temporal performance:



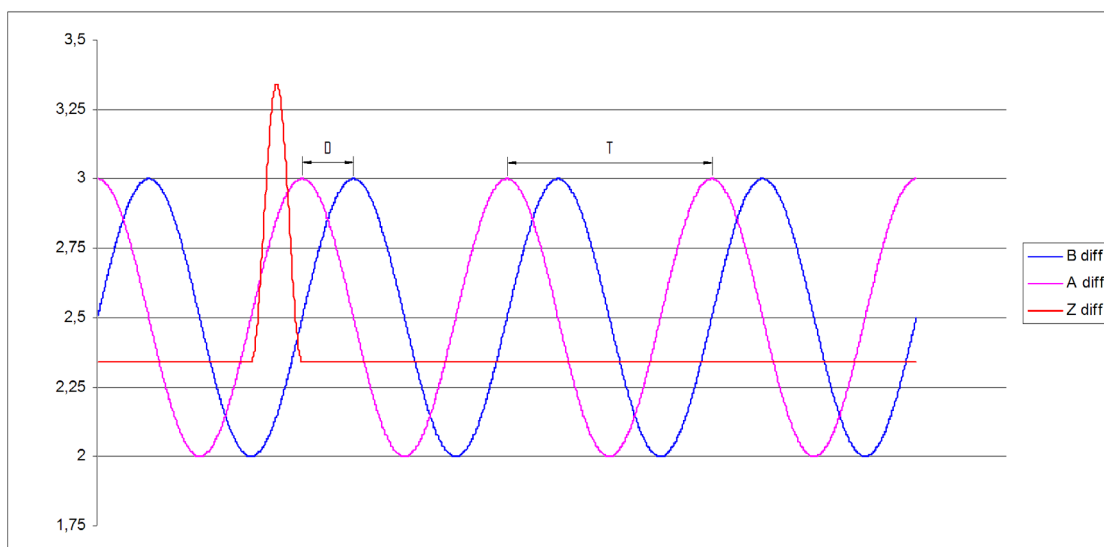
A and B signal phase difference



A and B negated signal phase difference

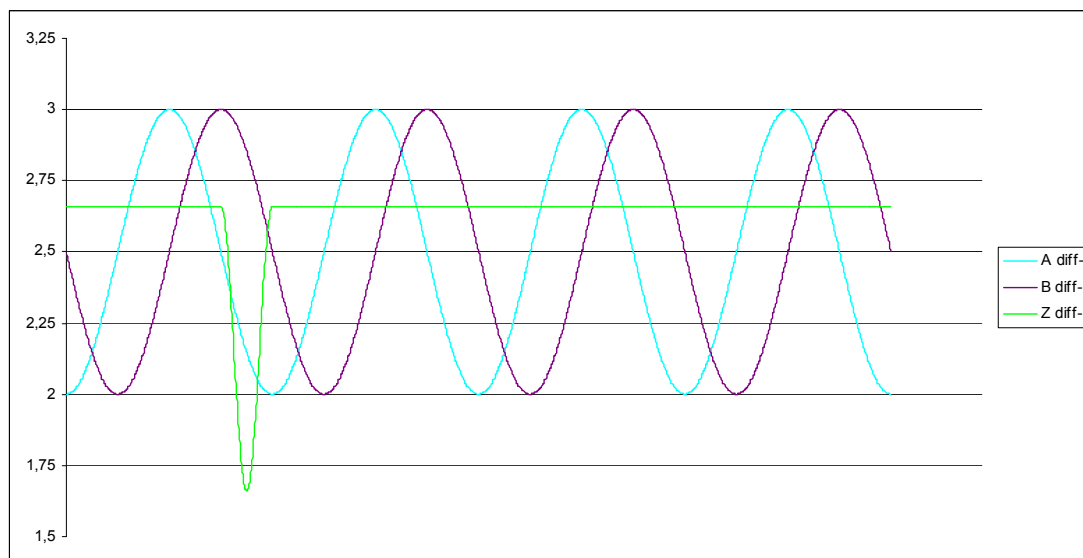


Differential signal temporal performance:



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:

- the operations described must only be carried out by trained and qualified personnel, purposely 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 2 and 3 are thoroughly clean, with no traces of dust, grease, cooling liquid, oil, metal particles or machining residues, nor signs of oxidation or scale; if necessary, **wipe with a soft, clean cloth**.

Figura 2 :
HSK tool-holder

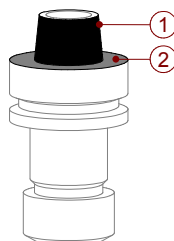
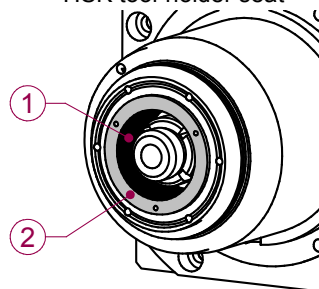


Figura 3 :
HSK tool-holder seat



- (1) Conical surfaces (in black)
- (2) Stop surfaces (in grey, only HSK)



At the end of the working day, clean the surfaces shown in figures 2 and 3 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.



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.

<p>Never point jets into the pressurised seal labyrinth area as the infiltrations damage the inside of the electrospindle.</p> <p>Do not point jets inside the electrospindle when the tool-holder is not attached as the coupling surface with the tool-holder may get dirty, or machining operation waste may enter the electrospindle. (Figura 4).</p>		<p>Figura 4 :</p>
1	Coupling surface	
2	Labyrinth seal	

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.

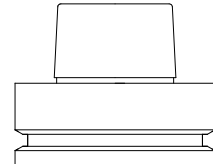


To avoid sticking, remove the tool-holder installed on the electrospindle and replace it with a protective closing device, both after heavy machining operations and at the end of the working day.

The protection closure must be another tool-holder that is clean and at room temperature.

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

Figura 5 HSK protective cone



7.2 Weekly maintenance

7.2.1 Checking the connections

Check the good condition of the electric cables, and that the connectors are well fixed.
Check the seal of the tubes and connectors of the pneumatic and hydraulic circuits.

7.3 Fortnightly maintenance

7.3.1 Clean the tool-holder cone with ethyl alcohol

- Carefully clean the contact surfaces of the tool-holders (shown in figure 2) with a soft, clean cloth dipped in ethyl alcohol;
- 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.

7.4 Monthly maintenance

7.4.1 Checking the cooling liquid

Check that the colour and transparency of the cooling liquid have not altered, and that there are no traces of rust or particles of scale or metal.

If necessary, substitute the cooling liquid, and if you notice any rust or metal particles, check the circuit to find and eliminate the source.

7.4.2 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**

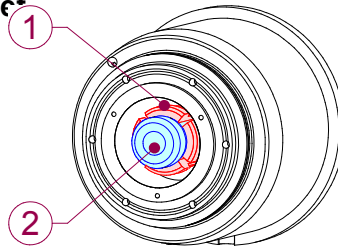


Figura 6

- (1) Segment
- (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 (Figura 6), 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.

7.5 Check of functionality collet HSK

Frequency :6 months or 200000 tool changes

- Control the expulsion limit ($10,5 \pm 0,1\text{mm}$)
- 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 completely the tightening device

7.6 Annual maintenance

7.6.1 Substitution of cooling liquid

Substitute the cooling liquid once a year (or on the basis of the indications supplied by the manufacturer of the refrigerating unit and the cooling liquid).

7.7 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 Replacing components



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.



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

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 SAFETY AND MAINTENANCE.

Problems	Causes	Solutions
The electrospindle does not rotate:	No power supply:	Check for mains voltage; Check the connectors; Check the integrity and continuity of the electrical connectors.
	The tool-holder is not inserted:	Insert a tool-holder.
	The tool-holder is not inserted correctly:	See heading "The tool-holder is not attached" in this same section.
	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 section.
	The inverter protective device has tripped:	Consult the manual or the manufacturer of the inverter.
	The sensor is disconnected or faulty:	Check the connectors; check the integrity and continuity of the electrical connectors; if necessary, replace the faulty sensor .
	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.
The tool-holder is not attached:	Foreign matter between tool-holder and shaft/spindle:	Remove the macroscopic impurities and clean as described in section 7 " Scheduled maintenance ".
	The cone of the tool-holder is not of the requested type:	Select a tool-holder meeting the specifications given in section 6.4 " Tool-holder locking and ejection device ".

Problems	Causes	Solutions
The tool-holder is not ejected:	The collet does not open due to lack of pressure:	<ul style="list-style-type: none"> ■ Check the required pressure values indicated in section 4.4 "Pneumatic connections" and 3 "Technical specifications"; ■ Check the integrity and efficiency of the pneumatic circuit.
	Insufficient pressure:	<ul style="list-style-type: none"> ■ Check the required pressure values indicated in section 4.4 "Pneumatic connections" and 3 "Technical specifications"; ■ 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:	<ul style="list-style-type: none"> ■ Check the required pressure values indicated in section 4.4 "Pneumatic connections"; ■ Check the integrity and efficiency of the pneumatic circuit; ■ Contact HSD Customer Service.
The sensor does not supply the requested output:	Sensor disconnected or faulty:	<ul style="list-style-type: none"> ■ Check the connectors; ■ Check the integrity and continuity of the electrical connectors; ■ If necessary, replace the faulty sensor .
The electrospindle overheats:	Cooling problems:	<ul style="list-style-type: none"> ■ Check the cooling circuit specifications in paragraph 4.5 "Hydraulic connections"; ■ Check the hydraulic cooling circuit is undamaged and working efficiently; ■ Contact HSD Customer Service.
	The machining operation is too heavy:	<ul style="list-style-type: none"> ■ Reduce the heaviness of the machining operation.
	Incorrect parameterisation of the inverter:	<ul style="list-style-type: none"> ■ Check the electrospindle parameters in chapter 3 "Technical specifications".
Performance below specifications:	Incorrect parameterisation of the inverter:	<ul style="list-style-type: none"> ■ Check the parameters on the rating plate of the electrospindle in section 3 "Technical specifications", in the section relating to the model concerned.

Problems	Causes	Solutions
Vibrations of the electrospindle:	The tool-holder is not balanced:	■ Select a tool-holder meeting the specifications given in section 6.4 “ Tool-holder locking and ejection device ”.
	The tool is not balanced:	■ Select and use a tool meeting the specifications given in section 6.5.
	Dirt between tool-holder cone and shaft/spindle:	■ Remove the macroscopic impurities and clean as described in section 7 “ Scheduled maintenance ”.
	Incorrect parameterisation 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 heaviness of the machining operation.
	Locking screws loose:	■ Tighten the locking screws.
	Bearings damaged:	■ Contact HSD Customer Service.
Noisiness of bearings:	Bearings damaged:	■ Contact HSD Customer Service.

11 List of spare parts

HSD code	Description
2164A0776	Capacitive sensor
H5631H0105	Encoder reader L+B for ES798
H2211H0046	Encoder reader L+B for ES799
Contact HSD	Encoder reader L+B square-wave TTL
H6355H0025	Distributor unit ES799/ES798
H2161H0022	Cooling fluid ARTIC-FLU-5 (5-litre canister)

12 Assistance**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 Shanghai Co. Ltd.

D2, First floor, 207 Taigu Road

Waigaoqiao Free Trade Zone

200131, Shanghai – China

Phone no. (+86) 215866 1236

E-mail **sales@hsd-china.cn**
www.hsd-china.cn



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