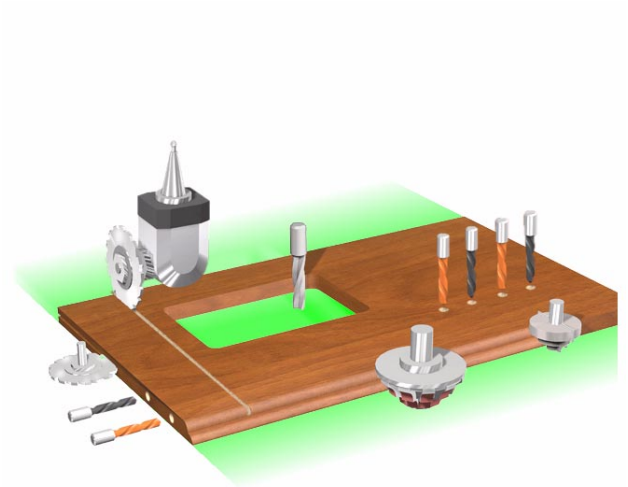
MACHINE USER'S MANUAL

NC processing centre

Arrow



Serial number

5801A0123 ENGLISH
Issue.Revision: 2.5

BIESSE GROUP woodworking machinery

RINA QUACER ISO 9001 CISQ

481/96

Information on this publication

Code:	Issue:	Revision:	Approval number:
5801A0123	2	5 (09, 1999)	

List of changes			
Revision:	Additions §:	Deletions §:	Changes §:
1	PROTEC document		
2	PROTEC document		
3	PROTEC document		
4	PROTEC document		
5	BIESSE document		

The manual must only be used by personnel who have been adequately trained to operate the machine. BIESSE cannot be considered responsible or liable for damage resulting from incorrect or improper use of the documentation provided. In order to avoid incorrect manoeuvres that might result in danger to the operator or to third parties, it is essential to read and fully understand all the documentation supplied with the machine.

Table of contents

Chapter 1. USING THE MANUAL

1.1 DOCUMENTATION

This manual has been produced in line with the requirements of Standard EN 292/2. It contains information officially supplied by BIESSE to the buyer of the machine to which it refers. A conforming copy of this manual has been deposited in the machine's "Technical Pamphlet" kept at BIESSE in line with that provided for by standard 89/392/CEE.

BIESSE does not recognise any documentation not produced, issued or distributed by BIESSE unless said documentation is accompanied by a specific declaration of recognition issued by BIESSE or one of its authorised representatives.

1.1.1 Scope of the manual

This manual has been produced for use by persons carrying out one or more of the following activities in relation to the machine: installation, use, maintenance or demolition. The manual remains applicable for the forecast technical life of the machine following its production and sale.

The information contained in this manual is not intended as and cannot be regarded as a substitute for the knowledge and experience possessed by the customer using the machine who bears the exclusive responsibility for the realisation of the operations for which the machine has been purchased.

1.1.2 Documentation available

Programming manual. Contains information on the typical operations to carry out and the procedures to follow when writing programs for use with the machine's software.

Spare parts catalogue. Used for ordering replacement parts following the procedures indicated in the introduction.

Circuit diagrams. These describe the main components of the machine (electrical, pneumatic, etc.). The diagrams are provided for use by a competent and suitably qualified technician for troubleshooting purposes.

Appendices. These contain information on any special parts fitted to the machine. In order to ensure that the maximum amount of information is available, each appendix must be consulted together with the document to which it refers.

Conditioner manual.

BECKER manual.

INFORMATION

All documents must be kept together with the machine for eventual consultation. If the machine is sold or handed-over to others, ensure that all the documents are included.

1.1.3 How to use the documents

Consult:	for:
Instruction manual	general and safety information, unloading and installing the machine, technical data and operations possible on the machine, commands and operating procedures, preventive and other maintenance procedures, replacing parts, information on BIESSE Customer Service, basic troubleshooting, shutting down the machine.
Numerical control manual	information on the numerical control operating environment, learning how to program, tooling-up, problem solving.
Circuit diagrams	analysing the correct operation of the various plants (electrical, pneumatic, etc.).
Spare parts catalogue	identifying and ordering spare parts (the indicated procedure must be strictly adhered to).
BECKER vacuum pump manual	Vacuum pump maintenance.
Conditioner assembly instructions	supplement to the summary information on maintenance provided in the “Instruction manual”.

1.1.4 Conventions

A person is said to be in front of the machine when he can see the actual front of the machine itself with the material loading and unloading zone in the forefront. The directions left and right also refer to this position.

The direction of rotation of the spindles is that observed by a person viewing from above the spindle downwards towards the nose of the spindle.

INFORMATION

ROTATION RIGHT = CLOCKWISE ROTATION
ROTATION LEFT = ANTICLOCKWISE ROTATION

Abbreviations

NC = numerical control;
R = right;
Max = maximum;
Min = minimum;
PLC = programmable logic controller;
L = left.

CAUTION

refers to practices or procedures which, if not executed correctly, may damage the product.

INFORMATION

General information, useful advice.

DANGER

Information on procedures or practices which, if not executed correctly, could cause injury, death or long term risks to health or the environment.

Chapter 2. GENERAL INFORMATION

2.1 IDENTIFICATION DATA

Constructor identification

BIESSE S.p.A. Woodworking Machinery
Via della Meccanica, 16
61100 Pesaro ITALIA
Telephone +39-07214391
E-mail: sales@biesse.it
WEB Site: http://www.biesse.it

Machine identification

The machine identification data is reported on the identification plate affixed to the rear of the right-hand column of the machine.

2.2 SAFETY

A detailed risk analysis carried out by the manufacturer has resulted in the elimination of most of the risks linked to the actual and foreseeable conditions of use of the machine. For those risks that cannot be eliminated, special protective measures have been adopted. Any residual risks resulting from a certain degree of ineffectiveness of the measures adopted are pointed out in the manual.

BIESSE recommend that the instructions, procedures and recommendations printed in this manual are scrupulously followed. This also applies to any safety standards currently in force, the use of the machine's own protection devices and personal protection means.

INFORMATION

BIESSE will not be held responsible for any injuries or damage resulting from non-compliance with safety standards and or the recommendations printed in this manual.

2.2.1 Safety devices

Passive safety devices are those measures or devices that eliminate or reduce the risks to the operator without any action required from the operator himself. The machine is protected by the following principal safety devices and systems:

- A perimeter protection that prevents objects and persons coming into contact with the structure of the machine.
- A protection around carriage Z that allows potentially hazardous chips or similar to be contained.
- An automatic monitoring system, called the emergency chain, of all devices which could create a hazardous situation for persons or for the machine if they should malfunction.
- A combined system preventing direct contact with the components of the main electrical cabinet.

Active safety devices are those which eliminate or reduce the risks to the operator and which are activated by deliberate actions performed by the operator himself.

The machine is protected by a manually operated red mushroom head emergency stop button, called an EMERGENCY-STOP, positioned on the CONSOLE and on the control panels of the work tables. Activating one of these buttons triggers the total controlled shutdown of the machine.

2.2.2 Use of qualified personnel

The machine operates under safe conditions when used by qualified personnel in line with the recommendations and instructions supplied in this manual. All installation, use and maintenance operations must be carried out exclusively by qualified personnel.

INFORMATION

BIESSE will not be held responsible for any injuries or damage resulting from the use of unqualified operators.

2.2.3 Operator

Any qualified person responsible for carrying out operations involving transport, installation, inspection, setup, tooling, use, cleaning, maintenance, repairs and demolition of the machine.

2.2.4 Workstation

The areas in which the operator must stay when the machine is working and when carrying out all the operations required to run the machine during normal production.

The workstations are located:

in front of the CONSOLE for programming, activating and operating the machine’s control devices.

in front of the machine itself for controlling the normal operation of the machine, for preparing the tool magazine and for loading the pieces.

2.2.5 Residual risks

Residual risks are those that cannot be completely eliminated.

DANGER

Only qualified and authorised personnel are allowed access to the inside of the electric cabinet.

DANGER

When machining is complete, the work tools may be very hot. Consequently, use protective gloves when carrying out a tool change and wait a few minutes for the tool to cool down.

DANGER

The machining process carried out by the machine will produce dust. Avoid inhaling the dust by using a suitable protection means.

DANGER

In the case of a power cut, the rotation of the electro-spindles cannot be stopped either manually or automatically and will continue to rotate for a few minutes due to inertia. During this time, the protection doors can be opened allowing access and thus creating a potential hazard . Consequently, proceed with the utmost caution, ensuring that all the parts of the machine are at a complete standstill before entering inside the perimeter protection(*) .

DANGER

When switching off the machine (for example at the end of the working day), it is strongly recommended that carriage Z is fully raised and the milling heads are fully lowered. In this configuration, the machine is protected against possible damage caused by a fault in the factory compressed air supply system(**) . Leaving the machine with the heads raised would create a hazardous situation in that any loss of pressure would cause the head to lower slowly and collide with the closed ports(***) . To improve safety even further, it is advisable to leave the milling head without any tools mounted.

(*). Each time the machine powers up, the control executes the bootstrap procedure and prevents any tool change or tooling-up operations from being carried out for a few minutes. This allows the still moving electro-spindles to finish their inertial rotation.

(**). If there is a fault in the compressed air system, there is no risk to carriage Z in that it is fitted with a mechanical brake.

2.2.6 Precautions taken by the operators

The machine is supplied by BIESSE protected with safety devices suitable for the envisaged operating conditions. However, in order to further improve the levels of safety during operation, it is recommended that the operators adopt a conscientious and attentive manner as regards safety, i.e.:

- wear type approved protective clothing;
- avoid wearing any items of clothing that may become entangled in the machine (ties, bracelets, necklaces);
- refrain from using the machine when under the influence of drugs or drink that may reduce his reaction time;
- always keep the working area clean and tidy;
- do not lean or climb on the machine;
- handle tools with care and wear gloves.

2.3 GUARANTEE CONDITIONS

BIESSE S.p.A. guarantee that the machine has been factory tested with positive results. The guarantee has a duration of 6 months from the date of delivery, unless there are any other agreements between BIESSE S.p.A. and the buyer with regard to the start-up of the machine at the buyer's premises. When the agreement includes start-up at the buyer's premises, the guarantee will have a duration of 6 months from the date of machine start-up at the buyer's premises and, in all cases, no longer than 9 months from the date of delivery of the machine. If the working times of the machine exceed 48 hours per week, the guarantee period will be reduced in proportion.

The BIESSE S.p.A. guarantee also covers defects in electrical and electronic components. The guarantee does not cover defects due to normal wear and tear of those parts which, by nature, are subject to rapid and continuous wear (e.g. gaskets, belts, brushes, fuses, etc.). The guarantee covering replaced or repaired parts will expire on the same date as the machine guarantee.

Furthermore, BIESSE S.p.A. will not be held responsible for conformity defects on the machine caused by non-compliance with the requirements specified in the instruction manual or resulting from improper use of treatment of the machine itself. The buyer therefore has the right to obtain replacements for defective parts, providing that the defects have not been caused by tampering or modifications made without the prior written approval of BIESSE S.p.A.

The guarantee will no longer be valid if the buyer does not provide BIESSE S.p.A with a detailed written report of any conformity defects found on the machine within 15 days of their discovery.

(***). This is only partly true, in that the ports have an opening of approximately 120 mm, which allows a tool (with diameter less than 120 mm) mounted on the heads to pass through without damaging the port.

Neither will the buyer be covered by the guarantee if he refuses to allow the seller to carry out any of the required inspections or, in the case where the seller has requested the return of the defective part at his own expense, if the buyer does not return said part within a reasonably short time period following the request.

The documentation has been drawn-up in line with the contents of the relative Directives and Safety Standards currently in force. It is therefore indispensable that the entire documentation is read thoroughly in order to obtain the best possible performance from the machine and ensure maximum life expectancy of all its components.

The configuration of some of the parts or devices described or mentioned in the documents may differ from that of a machine set-up in a particular manner to satisfy particular needs or safety requirements. In this case, although some of the descriptions, references or recommended procedures may be generalised, they still retain their validity. The supply of special tools or equipment for the machine is strictly controlled by the specific characteristics of the machine itself and the safety standards in force in each country. Dimensioned drawings and photographs are provided for information only in order to provide a better understanding of the text.

In the pursuance of its policy to constantly develop and update its products, the company reserves the right to modify the operational characteristics and appearance of the machine, modify the design of any functional component or accessories or suspend their production and supply. This it may do without prior notification and without incurring any obligations whatsoever. Furthermore, BIESSE S.p.A. reserve the right to make structural or functional modifications and/or modify the supply of spare parts and accessories without any obligation to communicate same in any way or form.

Chapter 3. INSTALLATION

3.1 WARNING

DANGER

Installation must only be carried out by personnel in possession of the necessary technical qualifications.

CAUTION

Follow the instructions carefully, avoiding operations that may damage the machine.

INFORMATION

Preserve all equipment used for transporting the machine. These items must be re-used when transporting the machine in the future.

INFORMATION

Check that all the parts of the machine listed in the consignment note (CMR) and in the packing list have been delivered, and that the parts have not been damaged by impact, torn or scratched.

CAUTION

If any damage is discovered, stop the installation procedure and inform the person responsible for the machine of the nature of the damage.

3.2 STORAGE

The requirements specified in this section must be satisfied during the following temporary storage periods of the machine:

- installation of the machine in a temporary location;
- removal of the machine and its storage which awaiting relocation.

If these requirements are not complied with, BIESSE will not be liable for damage to the machine or deterioration in its performance as provided in the technical specifications supplied.

Environmental characteristics of the storage area

temperature	from -20°C to +50°C
max. humidity	90% condensate-free

Physical characteristics of the storage area

When the machine is placed in storage, the storage area itself must comply with the following requirements.

Dimensions

The space required for storage is the overall dimensions of the machine plus an additional space for circulation and manoeuvring, which must be sufficient to allow personnel to carry out the slinging and lifting operations without difficulty and under safe conditions.

Floor

The floor must be sufficiently flat with no more than **20** mm variation (use spacers where necessary) and with a maximum slope of **0.3**% in any direction. The floor must also be able to withstand an overall load of 7 tons over the entire storage area with a minimum unit load of **1.1** Mpa.

DANGER

To avoid needless stresses on the structure of the machine, it is advisable to adjust the height of the support plates to ensure that each support plate carries the same load.

For further information, refer to "Floor type and load conditions" on page 3 - 5.

3.3 UNLOADING AND HANDLING

DANGER

Do not stand inside the operating range of the crane during machine unloading operations. Only use the unloading system described in this paragraph. Before carrying out any handling operations, remove any packaging.

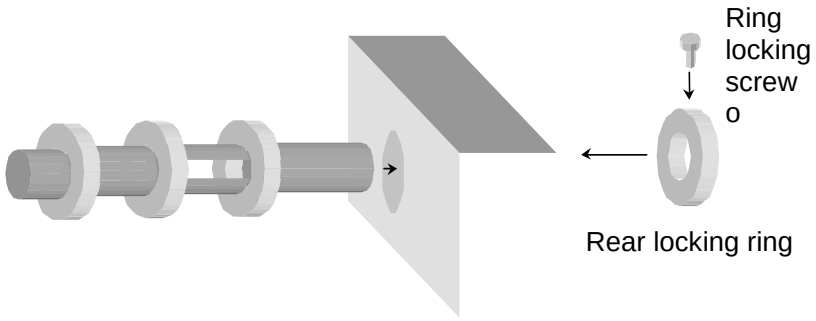
Unloading and handling the machine

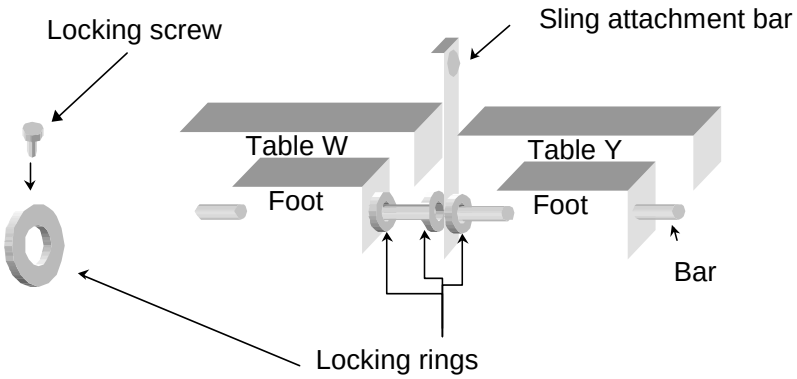
1. Insert the three-ringed lifting bars supplied in the holes specially drilled in the beam on the operator's side of the machine (see Figure 1-1).

2. Push the bar in until one of the rings makes contact with the surface of the beam.

3. Lock the lifting bar in position by inserting a ring on it and tightening it as much as possible against the back of the beam using the screw supplied. This will prevent the machine from becoming unbalanced when lifted.

4. Insert the base lifting bar (without rings and longer than the previous). The bar is inserted into one foot of the machine and then passed through two rings, through the bar with two holes at each end and then through two more rings and finally into the other foot. The outermost rings must be tightened against the feet of the machine to prevent it from swinging (see Figure 1-1). The inner rings lock the bar to which the slings are attached. Refer to the following figures.



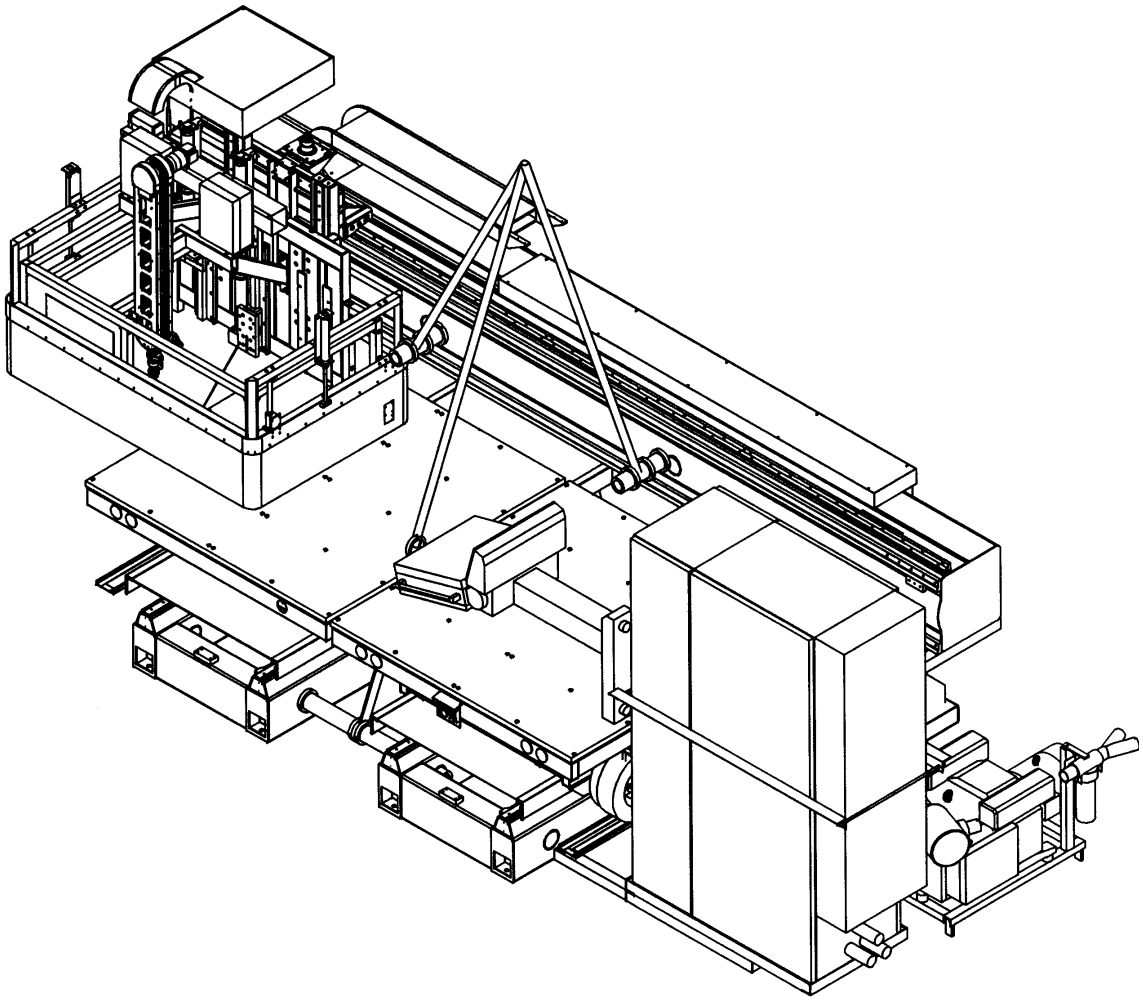


5. Attach the slings to the lifting bar inserted in the beam and in the lifting eye of the plate on the bottom lifting bar (see Figure 1-2).

6. Slowly lift the machine.

7. Before resting the machine on the ground, place the skids under the base. These will be used for moving the machine during the next stage of the handling procedure.

8. Operating from the right hand side of the machine, use a fork lift truck to lift it to the horizontal position, then manoeuvre it to its permanent installation point.



3.4 POSITIONING THE MACHINE

DANGER

Do not install the machine in an area where there are potential sources of distraction for the operator.

The machine should preferably be located in a position in which it has free space available on all sides. If this is not possible, at least 700 mm must be left between the machine itself and any walls, machinery or other obstructions.

Floor type and load conditions

The floor of the location of the machine in its complete configuration must be able to support the following stresses.

- Static load: **67500** N
- Maximum vertical dynamic load on each foot: **13320** N
- Unit load: **1.1** MPa
- Foot surface area: **2198** mm^2
- Maximum horizontal dynamic load per foot in the direction of the X-axis: **815** N
- Maximum horizontal dynamic load per foot in the direction of the Y-axis: **623** N

and have the following characteristics:

- Maximum planarity error in the floor: **20** mm (including when using spacers)
- Maximum slope of the floor in any direction: **0.3** %

The floor must also be able to support an overall load of **7** tons over the entire storage area and a unit load of **1.1** Mpa.

DANGER

To avoid needless stresses on the structure of the machine, it is advisable to adjust the height of the support plates to ensure that each support plate carries the same load.

The following requirements should also be satisfied.

Temperature

- With the machine in operation: from **0°**C to +**35°**C (with conditioning, from **0°**C to +**50°**C).
- When the machine is not in operation: from –**20°**C to +**50°**C.
- During storage and prior to installation: from –**20°**C to +**50°**C.

Relative humidity

Max **90**% without condensation.

3.5 CONNECTIONS

DANGER

All operations relating to connecting the machine to the relative power supplies must be carried out by specialised BIESSE technicians.

Electricity supply	max power installed on the machine (kVA)	(see next table)
	Service current (A)	(see next table)
	Power supply voltage (V)	380(*)
	Tolerance on the supply voltage (%)	±10
	Power supply frequency (Hz)	50 – 60 (see note 1)
Compressed air supply	Feed pressure (bar)	min 6 – max 7
	Working pressure (bar)	6
	Supply network connection (inches)	½
Air extraction	min flow (m^3/sec)	30
	n° of extraction points	2
	Diameter of extraction points (mm)	250
	min flow per extraction point (m^3/h)	5300

(*). This value may vary in line with the different standards in force in the country of installation of the machine. For more precise information, refer to the data on the machine's identification plate.

PROTECTION AGAINST INDIRECT CONTACT

The machine is fitted with electronic devices protected by a number of special R/L/C filters, with the sum of the leakage current varying in relation to the number of filters installed(*) . Furthermore, due to the presence of electronic ac/dc converters (drives) and ac/ac converters (inverters), there may be more or less continuous fault currents.

Consequently, the differential protection against indirect contact requires a type B selective protection device (complying with standard IEC 755).

(*). The filters are installed in order to comply with the requirements of Machinery Directive 89/392 and Directive 89/336 on Electromagnetic Compatibility (EMC):

If the designer of the factory's electrical system does not take these factors into account, the result may be the incorrect co-ordination of these indirect contact protection systems.

SPINDLES	MAXIMUM ELECTRICAL CHARACTERISTICS				
N°	P (Kw)	I (A)	Cos ϕ	Q (kVAR)	A (kVA)
1	26	51	0.65	22	34
2	38	74	0.65	31	49

Chapter 4. DESCRIPTION OF THE MACHINE

The machine has been designed and manufactured in accordance with that provided for by the following principal technical standards:

- Machinery Directives 89/392 - 91/368 - 93/44 - 93/68.
- EN 60204-1. “Safety of Machinery. Electrical equipment.”(*)
- EN 60439-1 “Assembled low-voltage control equipment – LV panels - part 1; requirements for ANS equipment”.
- EN 292-1, EN 292-2. “Safety of Machinery. Basic concepts, general design principles. Specifications and technical principles.”
- EN 294. “Safety of Machinery. Safety distances for preventing upper limbs reaching danger zones.”
- EN 418. “Safety of Machinery. Emergency stop systems. Functional aspects. Design principles.”
- prEN 848-3. “Boring machines / NC milling machines”
- UNI 4598. “Machine tools. Graphic signs.”
- EN 349. “Minimum spaces required to prevent parts of the body from being crushed”

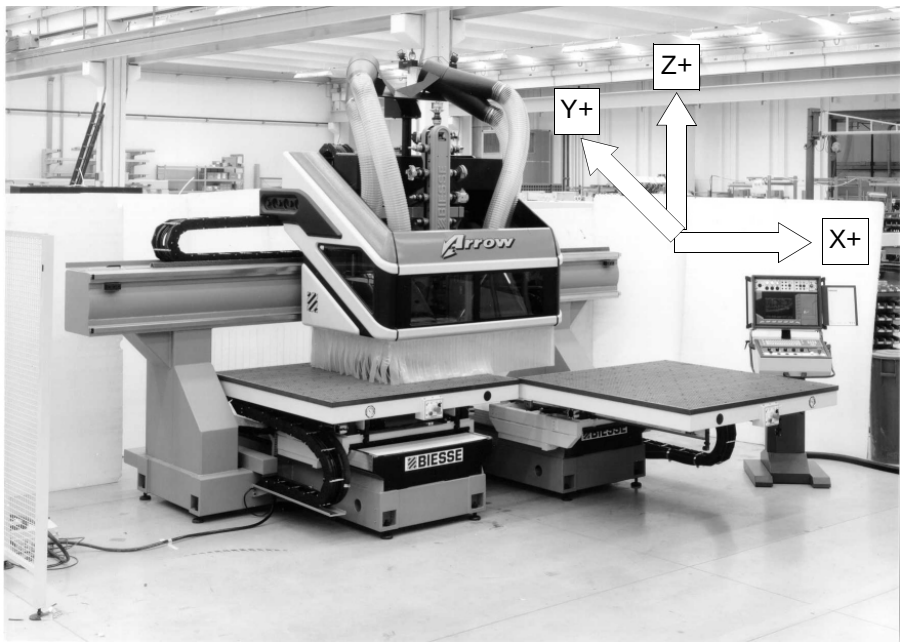
The associated technical plant systems must be designed and installed in line with accepted current practices. The principal reference standards are specified in the relative descriptive paragraphs.

The drawings and photographs illustrate the complete milling machine assembly and identify the main physical and functional elements making it up. Refer to paragraph 6.2 “CONTROLS” on page 6 - 1 for the functional description of the controls installed on the machine.

(*). In addition to the normal inspections and working tests (20.7), each machine is subjected to the tests provided for by articles 20.2, 20.3, 20.4. These tests are used to check that:
The equipotential protection connections are efficient to the extent that when a fault occurs, all the parts of the machine have the same earth potential.
The insulation between the power conductors and earth is efficient and that, on delivery, the electrical system does not have any potential sources of danger that could cause current dispersion, short-circuits, etc.
The insulation to earth is capable of supporting a high ac voltage discharge.

4.1 GENERAL VIEW OF THE MACHINE

The following photograph shows the machine in its maximum configuration, i.e. with two milling heads and one boring head.



DANGER

The directions of the X, Y and Z axes shown in Figure 1-1 refer to the directions determined in line with that described in paragraph 4.3.5 “Notes on the definition of the movement of the axes” ***on page*** 4 - 9***.***

4.2 CLASSIFICATION OF AXES

An axis refers to the movement of a part of the machine managed by the numerical control through a servomechanism(*) or the trajectory followed by that movement. In other circumstances, the axis is also the group of mechanical, electrical and electronic devices that allow said movement to be achieved.

The machine manages the following axes:

- **Co-ordinated**. These are physical axes that the control can move at the same time and in a co-ordinated manner.
- **Auxiliary**. These are physical axes that do not require any co-ordination of their movement.
- **Linear**. These are axes whose movement takes place along a straight trajectory.
- **Rotary**. These are axes whose movement takes place along a circular trajectory. These may be co-ordinated or auxiliary.
- **Dual**. These are axes whose movement is the result of the movement of an associated "master" axis.
- **Split (Gantry)**. An axis moved by two servomotors possessing the same characteristics(**) .

The following paragraphs describe some of the characteristics of the axes and those characteristics associated with them. The following table shows the type of axes that the machine may have in its various configurations and the names used to identify them.

MOVEMENT	TYPE OF AXIS	NAME
Transverse - carriage x	Linear co-ordinated	X
Longitudinal – right table	Linear – dual co-ordinated(*)	Y
Longitudinal – left table	Linear – dual co-ordinated	W
Vertical – carriage Z	Linear co-ordinated	Z
Orienting – operating unit on head 1	Rotary co-ordinated	A
Rotary – toolholder magazine	Rotary auxiliary	a

(*). In the case of the two-table machine, the left table (W-axis) can be characterised as a dual axis with respect to the right table (Y-axis) which acts as the master, and vice versa.

(*). Retroaction system involving a drive, a motor and an encoder as well as the numerical control.

(**). In the milling machine described in this manual, the two tables can be managed in gantry mode, i.e. as if they had a single axis. This option represents the alternative to dual axis programming.

4.3 AXIS MOVEMENT

Axis movement takes place along prismatic guides with recirculating ball thread travellers (see Figure 1-2).

The movement tales place:

- Along the X-axis through the tried and tested rack / pinion system with automatic play take-up device.
- Along the W and Y-axis through a precision recirculating ball thread coupling and mobile screw.
- Along the Z-axis by means of a fine pitch mobile screw and fixed lead nut. The system also has a pneumatically operated balancing device.

A gaiter on the Z-axis and a rigid protection on the Y and W axes protect the guides and screws.

All moving parts, i.e. all the travellers (except for those of the pallets and heads) and all the lead screws/nuts, are **lubricated automatically** by a centralised system managed by the NC. A loss of pressure in the system or low grease level in the reservoir is signalled automatically.

Brushless motors drive the carriages through precision reduction gears. The Z-axis is also provided with an automatic brake and an automatic balancing device that supports the moving mass.

Axis travel:

The machine referred to in this manual has the following axis travel distances:

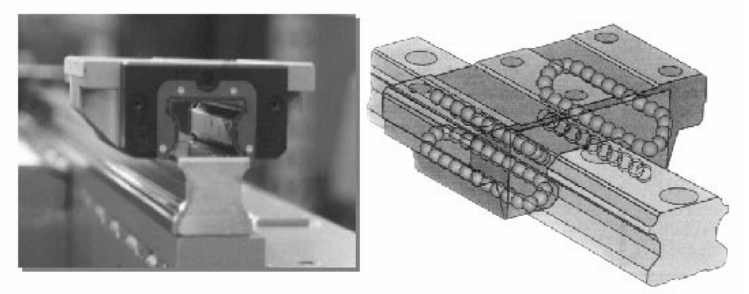
- X-axis:**4300** mm
- Y and W-axis:**1600** mm
- Z-axis:**300** mm

Axis movement speed:

- X, Y and W-axisfrom **0** to **80** m/min.
- Z-axisfrom **0** to **25** m/min.

Motor	Type	Brushless
	Insulation class	F
	Protection	IP 54
Encoder	Type	Incremental photo-electric with square wave output
	Protection grade	IP 54

Mechanical limit-switches	Type	Multiple mechanical with cam movement
	Protection	IP 67 (DIN 40050)



4.3.1 Carriage X

Carriage X is a mechanical structure that travels along the guides of the cross-member to produce the transverse movement of the operating units. The motors for the X and Z-axis, the guides for carriage Z and a support casing for the pneumatic and electrical components are all mounted on carriage X.

4.3.2 Carriage Z

Carriage Z is a mechanical structure linked to carriage X that travels along the vertical Z-axis. It is configured to receive the operating heads (milling and boring machines) mounted on a rack in front of the operator.

Operating unit

The operating unit consists 1 or 2 electro-spindles and a central 12-position magazine set-up for the installation of a boring head.

Each electro-spindle has a system of movement with a pneumatic vertical disengaged tool travel of 320 $^{\pm 1}$ mm controlled by a bistable electrovalve. Movement takes place on prismatic guides with recirculating roller thread travellers. Both heads can float and constitute independent units and, as a result, can perform different operations simultaneously, e.g. one head can be on a tool change while the other is executing a work cycle.

Both heads are fitted with a special flange for mounting angular aggregates. The right electro-spindle can instead also receive the C-axis operating unit.

The operating unit is enclosed in a protective casing which also incorporates the chip extraction system. A special shuttle type device allows a tool change to be executed on the electro-spindle not in operation (tool change in masked time).

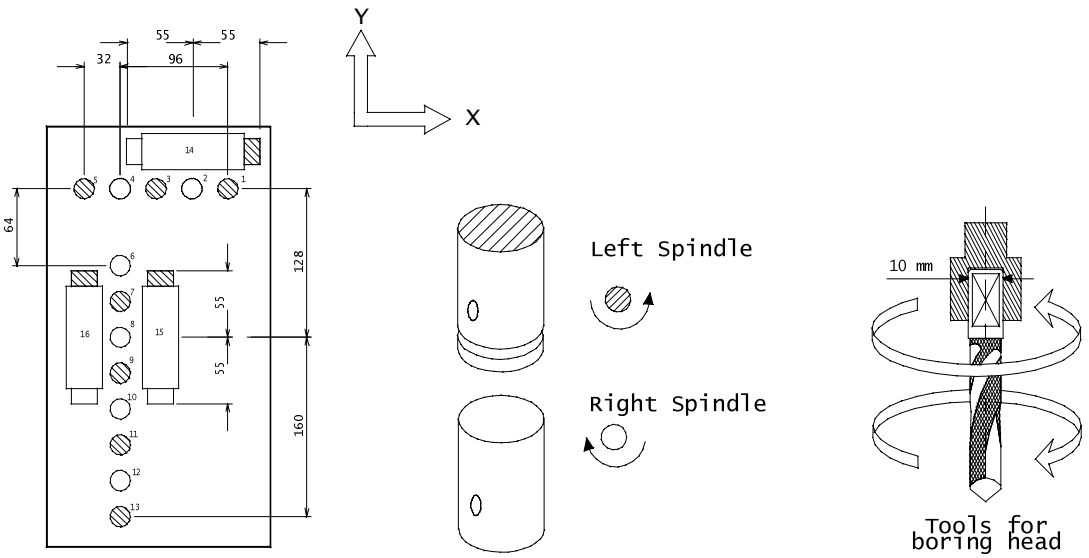
Tools up to a maximum of 160 mm diameter can be placed in any toolholder in the magazine (random positioning), while tools of diameter between 160 and max 200 mm require either a fixed position or a random position with lateral restraints.

The magazine can take universal milling and boring aggregates.

Each individual station can support a maximum weight of 6 Kg, including the toolholder, for a total of 50 Kg max for all 50 Kg stations.

Boring head (optional)

The boring head is the mechanical operating unit on which the vertical and horizontal spindles for single and multiple drilling, an ac motor for transmitting power to the spindles and all the electrical and pneumatic components for the unit itself are mounted. The boring head is also an independent unit, and as such can be used while another procedure, such as a tool change, is being executed.



Number of vertical / horizontal spindles	13 / 6
Standard distance between vertical spindle centrelines.	32 (mm)
Spindle rotation speed	4000 (rpm)
Diameter of tool mounting	10 (mm.)
Type of motor	Asynchronous, three-phase, 2-pole
Motor power supply	380 V / 50 Hz
Motor rating	2.3 HP
Motor insulation class	B
Motor working temperature	120 °C
Motor protection grade	IP 54

4.3.3 Y and W carriages

The Y and W carriages are mechanical structures that, by travelling along guides anchored to the base, effect the longitudinal movement. In practice, this carriage acts as the support for the pallet (described below) and all the electrical and pneumatic devices serving it.

Table

The table can be divided in two parts, the pallet, which is supported on the base, and the worktable, which is connected to the pallet.

Each table has a control panel (described in paragraph on “Table pushbutton panel” page 6 - 22) providing easy access to the main functions.

Pallet

The pallet is a mechanical device that acts as a support for the worktable (described in paragraph “Work table” on page 4 - 8) and is anchored to guides that allow it to slide on the travellers of the carriage. During the operating cycle, the pallet moves together with the carriage that supports it by means of two pins. In addition, when the table is taken to zero height, the pins can be retracted to allow the pallet to slide a further 1000 mm towards the operator. This movement is also controlled by the opening of the front protection door. This procedure has the following advantages:

- There is no risk of the carriage colliding with persons or objects. The outward movement of the table does not create any risks in that it moves at very low speed.
- The workpiece can be positioned easily.

- Prevents the exit of dust being produced during the current machining process.

The movements of the W and Y carriages are controlled by a drive system and as such are identified by their “axes”.

Work table

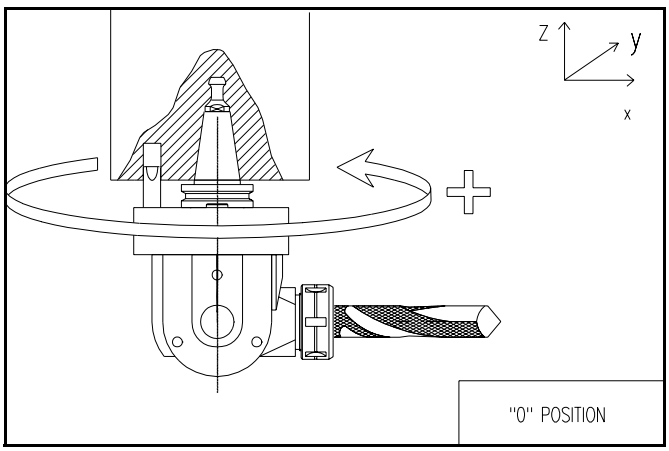
The work table is the area on which the piece to be machined is placed. When machining large components involving both work tables (gantry axes), the work table coincides with the rectangular area made up by the Bakelite surfaces of the tables.

During “reciprocating” type machining, two work tables are involved, each corresponding to the area of one table only. The work table is in plastic, laminated at high pressure with phenolic resin. It incorporates the vacuum operated workpiece clamping system and is machined with a 30 mm pitch grid type structure for rapid positioning of the sealing gasket or standard clamping modules. The entire surface of the table area also incorporates ducts for the vacuum system, located at 150 mm centres with rapid and functional shut-off plugs. It can be configured as required (with pitch from 30 mm upwards) using M8 inserts for fixing templates or eventual clamping equipment.

The front part of the table holds the operating control panel with pushbuttons enabling the various functions: start, stop, emergency, open and close clamps and vacuum gauges to monitor the vacuum pressure reached. The operative dimensions of each table are 1600 x 1600 mm.

4.3.4 Orienting axes

The orienting axes are co-ordinated rotary axes having the function of orienting the operating units during machining. The milling head of the ARROW can be fitted with a rotary axis (called the C-axis) if required, though the machine cannot have more than one. When a second head is installed, it is fitted with a flange with 4 slots that allow an aggregate to be inserted in one of four fixed positions.



INFORMATION

The programmed value can be reached by rotating the axis clockwise or anticlockwise according to the sign (positive or negative) of the current value.

4.3.5 Notes on the definition of the movement of the axes

By convention, it is assumed that the movement of an axis is always that of the tool towards the workpiece. Whether the tool moves towards the workpiece or the workpiece moves towards the tool is irrelevant.

In the milling machine in question, the longitudinal movement (Y-axis and W-axis) moves the workpiece towards the tool. For all the other axes, it is the tool that is moved towards the workpiece.

It should therefore be remembered that a positive movement of the Y or X-axis corresponds to the respective table moving towards the operator. Vice versa, programming a negative movement of the Y or W-axis moves the respective table away from the operator.

DANGER

For each axis, the corresponding movement carriage has an identification plate that reports the name associated to the axis and the direction of the axis itself. Consequently, it must be remembered that the tables move in the opposite direction to the longitudinal axis and that, as a result, they move in the opposite direction to that indicated on the corresponding plate.

4.4 Electro-spindle

The milling electro-spindle has the following characteristics.

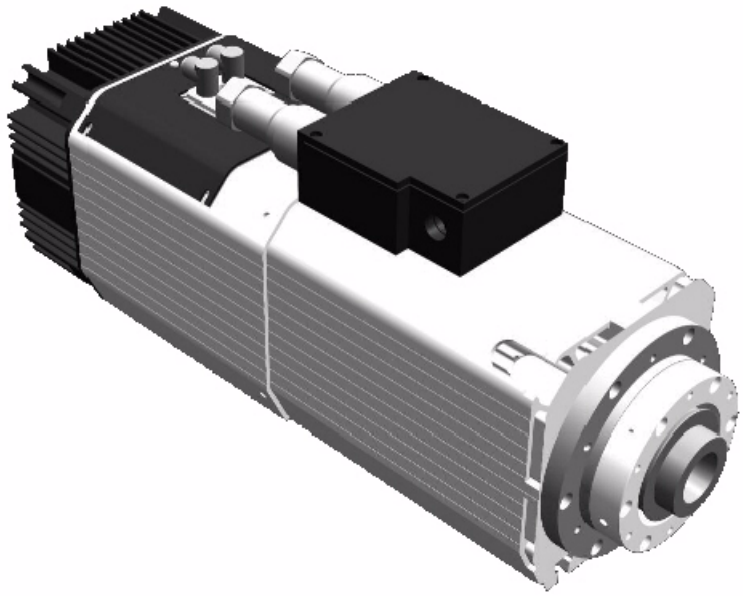
- Internal pressurising circuit with a vent in the front part of the spindle nose to prevent the infiltration of pollutants inside the spindle.
- Ground and dynamically balanced rotating parts.
- Oblique contact bearings for high speeds, mounted as a dual opposed pair, preloaded and lubricated for life.
- “Quick coupling” system (managed in safety by the NC) allowing simple and rapid tool pre-setting with the option to use angular drive chucks. In particular, the quick coupling system has the following characteristics.

  Type ISO 30 (DIN 69871/A) or HSK F63 (DIN 69893) toolholder cone.

  Mechanical locking of the cone using a system of springs that develop an axial pull of 4000 N, guaranteeing precise clamping.

Toolholder cone release through a single-acting pneumatic piston.

- Automatic cleaning of the cone by the injection of compressed air through a special coupling during the tool change phase.
- Cooling by means of an external electric fan run independently of the motor.
- Heat sensor (pair of pads) that detects when the “safety” temperature (~110 °C) has been reached. In practice, it consists of a signalling device that provides the thermal protection. The activation of this protection is signalled by the logic through the message “Spindle overheating”.



Motor type: Brushless	Power at 20000 rpm: 8 / 10.88 (kW/HP)
Insulation class: F	Operating range: 100 – 20000 (rpm)
Protection grade: IP54	Max tool Ø (mm): 160

CAUTION

During any type of machining, the electro-spindle must have a toolholder cone inserted correctly in order to protect the internal parts from the infiltration of dust.

Cleaning the tapered housing of the spindle shaft

The tapered housing of the spindle shaft must be kept perfectly clean always. The presence of dirt will prevent correct positioning and affect the coaxial rotation of the toolholder spindle with the axis of the spindle. The effect of this is to reduce the torque transmittable by the friction between the two tapered surfaces and can damage the surfaces of the housing through seizure. All this will **JEOPARDISE THE SAFETY OF THE USER** and reduce the accuracy of the machining. For

cleaning operations, refer to paragraph “Cleaning the tapered seating of the electro-spindles” on page 7 - 4.

Tool locking

After repeated tool change cycles, there is a gradual reduction in the locking force developed by the springs. This reduction is substantially limited in the Belleville washers used in this type of spindle. If marks appear on the cone indicating slippage of the toolholder cone itself, it is recommended that the force exerted by the springs during the tool clamping phase is checked. Before carrying out any operations, consult the Protect Service Centre.

Running-in

Before being delivered, the electro-spindle is subjected to an automatic running-in cycle, which ensures the correct distribution of lubricant (long-life grease) in the bearing roller tracks. The running-in cycle also includes careful testing of all the control and signalling devices through a bench simulation of various types of machining cycle.

4.4.1 Selecting the toolholder cone

The toolholder cone, when inserted, is the device that forms the direct link between the electro-spindle and the tool.

DANGER

Toolholder cones are available for both clockwise and anti-clockwise rotation: check the direction of rotation of the milling unit on which the tool is to be installed.

As already stated, the machine can be configured with electro-spindles for type ISO 30 or HSK F63 mountings.

DANGER

Use only Protec original toolholder cones, failure to do so will nullify the guarantee. Under no circumstances must types of toolholders be used that do not comply with the above conditions. Otherwise, there is a risk of breakage or incorrect engaging of the toolholder cone, with the resulting SERIOUS RISKS FOR BOTH THE USER AND MACHINE, and for which Protec will not be held responsible. Also check when the shank is mounted for the first time, and periodically during service, that it is tightly screwed into the toolholder.

Toolholder cone HSK F63 (DIN 69893)

The following conditions must be respected:

1. The geometry of the taper must comply with standard DIN 69893.
2. Ensure that there are no inserts or anything else that may upset the dynamic equilibrium of the toolholder.
3. The degree of dynamic equilibrium of the toolholder must have a value suitable for the speed of the electro-spindle.

Toolholder cone ISO 30 (DIN 69871)

The following conditions must be respected:

1. The geometry of the taper must comply with standard DIN 69871.
2. Ensure that there are no inserts or anything else that may upset the dynamic equilibrium of the toolholder.
3. The degree of dynamic equilibrium of the toolholder must have a value suitable for the speed of the electro-spindle.

4.5 OPERATING UNITS

Units fitted with toolholder cones ISO 30 or HSK 63F, for tooling milling heads with the relative mounting.

DANGER

Each specific operating unit is characterised by particular technical specifications regarding: direction of rotation, maximum and minimum height and width, maximum rotation speed, etc. at which it can be used. THE ABOVE CHARACTERISTICS MUST BE RESPECTED.

AGGREGATE DESCRIPTION	Max RPM input	Max RPM output
Angle aggregate ISO30 with 1 horizontal milling/boring spindle.	12,000	8,400
Angle aggregate HSK63 with 1 horizontal milling/boring spindle.	12,000	8,400
Angle aggregate HSK63 with 2 horizontal milling spindles.	12,000	8,400
Angle aggregate ISO30 with 2 horizontal milling spindles	12,000	8,400
Angle aggregate HSK63 with 6 horizontal boring spindles.	6,000	6,000
Angle aggregate HSK63 for hinge boring	6,000	6,000
Angle aggregate ISO30 for hinge boring	6,000	6,000
Angle aggregate ISO30 with 6 horizontal boring spindles	6,000	6,000
Angle aggregate ISO30 "Morari"	12,000	12,000
Angle aggregate HSK63 "Morari"	12,000	12,000
Angle aggregate with blade ISO30 "Morari"	12,000	7,200
Angle aggregate with blade HSK63 "Morari"	12,000	7,200

WARNING:
To obtain an output rotation speed for the spindle (*RPMoutput),* program a value of function S given by the following formula:

$$S = \frac{MaxRPMinput}{MaxRPMoutput} RPMoutput$$

where:

"MAX RPM input" = maximum input speed (rpm);
"MAX RPM output" = maximum output speed;
"RPMoutput"= output speed;
"S"= value to program in the NC with which to indicate the input speed.

4.6 DEVICES AND ACCESSORIES

Copier

The copier is a mechanical device required for machining in “floating” mode. Once applied to the base of the “floating” head and fed by its built-in blower, it creates an air cushion which allows the surface of the semi-worked item to be copied, thus maintaining a constant machining depth.

It is provided with a toolholder cone (ISO30 or HSK63) and can be managed like any other tool, making it possible to insert it in the magazine. The hook-up to the blower is automatic and takes place during the tool change operation. The arm with the final upward movement inserts a pin present on the copier in the mouth of the compressed air pipe.

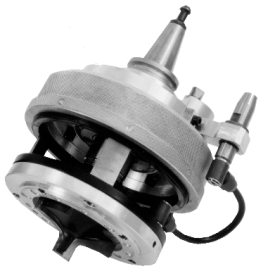
NB: The mouth of the blower can be blocked by dust from the last machining process. When a tool change is effected in order to use the copier, as already stated, the blower is automatically connected to it: the accumulated dust could therefore enter the copier, thus creating a risk of blockage or malfunction. **To prevent any problems, clean the blower by switching it on (allowing air to flow out) for a few seconds before inserting the pin in the compressed air pipe.**

To render this function operative, the following example can be used:

[…]*Previous program blocks*
M32*Blower activation*
(DLY,3)*3-seconds delay*
Txx M6 M7*Tool change (xx is the tool code of the copier)*
[…]*Next program blocks*

Characteristics

Maximum tool diameter: 40 mm, 85 mm, 113 mm (depending on the flange available).



DANGER

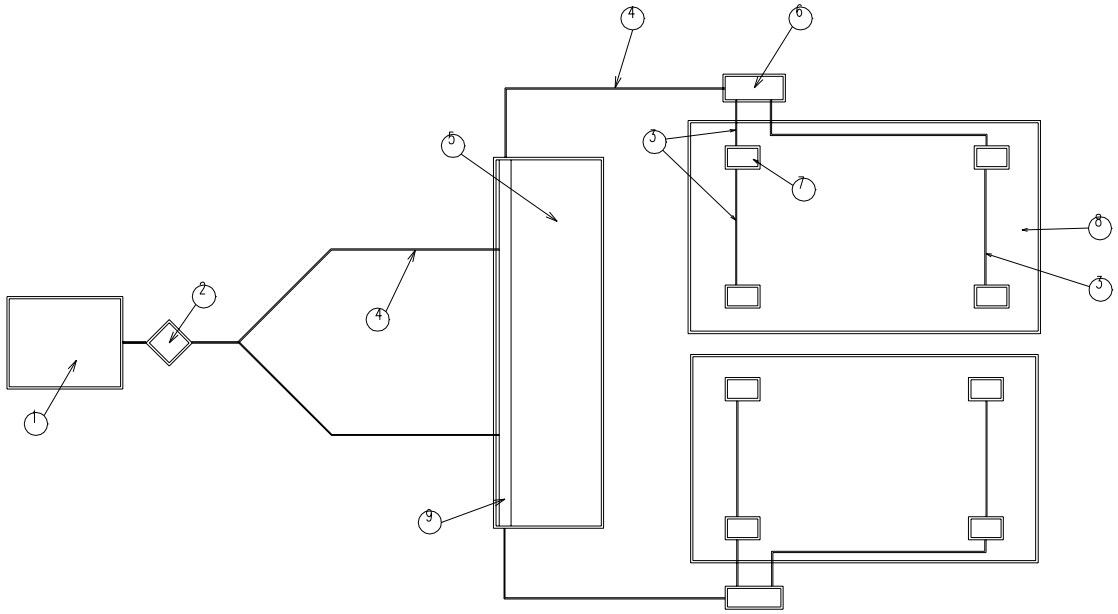
Never use the rotary axis with the copier inserted in the spindle. Before switching on the machine, check that the copier is not inserted in the electro-spindle, in that during the Homing phase (see paragraph 6.4.4 “Zeroing the axes” ***on page*** 6 - 28***) it executes one revolution.***

INFORMATION

When using a copier previously mounted on another head, its reference pin must be re-adjusted in order to prevent insecure locking or excessive play.

4.7 DEPRESSURISING PLANT

Equipment necessary for locking the material being machined in place. The pneumatic circuit diagram shown illustrates the operating principles of the plant. It refers to a machine with two tables, each with just one vacuum area.



COMPONENT	DESCRIPTION
1	Pump with air capacity 250 m^3/h
2	Air filter
3	Pipe diameter 40 mm
4	Pipe diameter 50 mm
5	Base
6	Distribution electrovalve
7	Vacuum distributor
8	Work table
9	Pipe built-in the base

The main part of the plant consists of a vacuum pump which provides the necessary degree of depressurising. This pump does not act directly on the working area, but instead feeds two large plenum chambers (located inside the base) to create a known level of vacuum. These plenum chambers allow a greater clamping force to be exerted on the workpiece.

Two networks of channels have been created in the work table, the deepest of which allows any part of the work table to be isolated from the rest by means of a rubber gasket. The shallower channels transmit the vacuum to the isolated zone (see "Work table" on page 4 - 8).

The following table summarises the main characteristics of the pump used.

Technical data of the BECKER vacuum pump	Model VTLF 250
Type	blade, oil-free operation
Cooling	Air
Air capacity at 50 Hz	250 m^3/h
Absolute pressure	200 mbar
Installed power of the motor	5.5 kW
Speed	950 rpm
Three-phase current motor	380/660 V 50 Hz
Noise level at 1 metre	78 dB (A)
Dimensions (length x width x height)	1092 x 612 x 534 mm
Weight with motor	312 Kg

INFORMATION

For further information on vacuum pumps, refer to the relative manual attached to this document.

4.8 CHIP EXTRACTION PLANT

Equipment necessary for evacuating chips produced during the machining of the material.

The chip extraction plant is equipped with two 250 mm diameter duct connections and is incorporated in the protection. The barrier surrounding the operating unit is fitted with a curtain guard which, during the machining cycle, comes into direct contact with the machine table, thus allowing the suction flow to be concentrated around the tool.

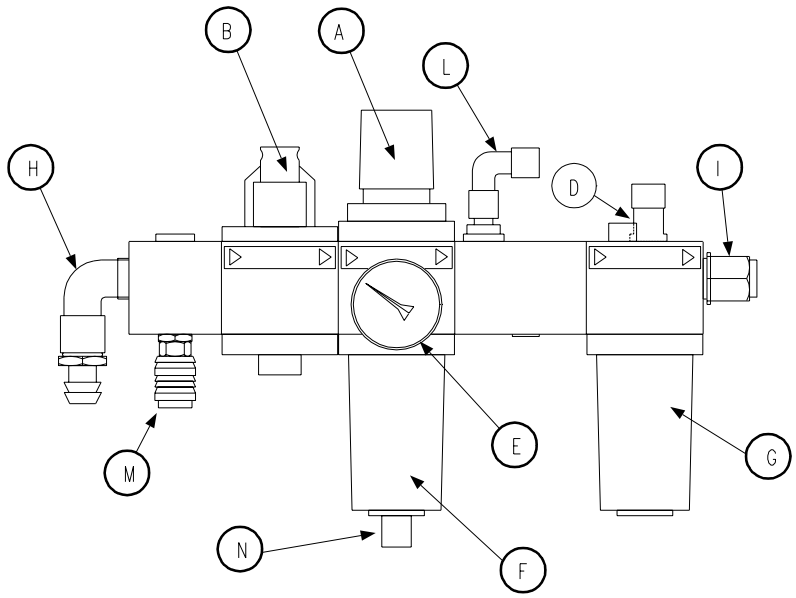
The machine is supplied without the extractor. The customer must therefore provide and install a suitable extractor. The device must possess the characteristics required by the machine (see paragraph 3.5 "CONNECTIONS" on page 3 - 6) and must be coupled to the above connections (the connected pipes must be of sufficient length to prevent being damaged during the movement of the X and Z carriages).

4.9 PNEUMATIC PLANT

The equipment necessary for managing the compressed air supply used to operate the machine.

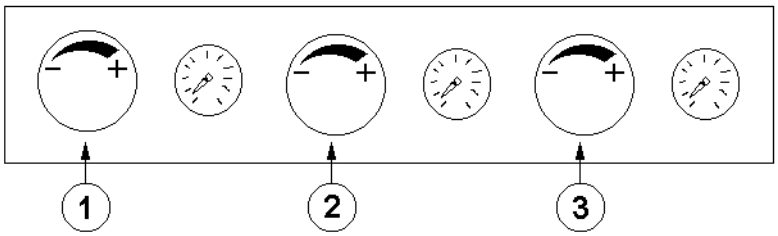
The plant has been designed and manufactured in accordance with standard EN 983 (“Safety of Machinery. Safety requirements for Fluid – Pneumatic energy systems and components”).

The main part of the pneumatic plant consists of the “FRL Unit” which, placed upstream of the plant, controls and distributes the flow from the supply system. In particular, it dehumidifies the air to produce and distribute “dry” air for the blower, for cleaning the cone and for pressurising the spindles and lubricated air for all the pistons (cone release, up/down and floating head movement, carriage Z balancing, etc.). For further information on the operation of the plant, refer to the pneumatic diagrams attached.



A	Pressure regulating knob	B	Shut-off knob
		D	Lubrication indicator
E	Pressure gauge indicating pressure set by A	F	Condensate collection reservoir
G	Lubricator reservoir	H	Compressed air inlet
I	Dry lubricated air outlet	L	Dry air outlet
M	Outlet socket available to the operator	N	Condensate drain valve

Three pressure regulators with associated gauges are mounted on carriage X of the machine and are accessible from the left-hand side of the machine itself for adjustment and checking. Their functions are as follows:



Regulator 1: Used to regulate the pressure at which head n. 1 and head n. 2 release piston upward movement is fed during floating mode.

Regulator 2: Used to regulate the pressure at which head n. 1 and head n. 2 release piston downward movement is fed during floating mode.

Regulator 3: Used to balance the Z-axis. In order to balance its upward and downward movements along the vertical axis, carriage Z is balanced pneumatically by the action of two pistons located downstream of the regulator. This calibration is set at the Protec factory during the inspection phase and does not require any modification.

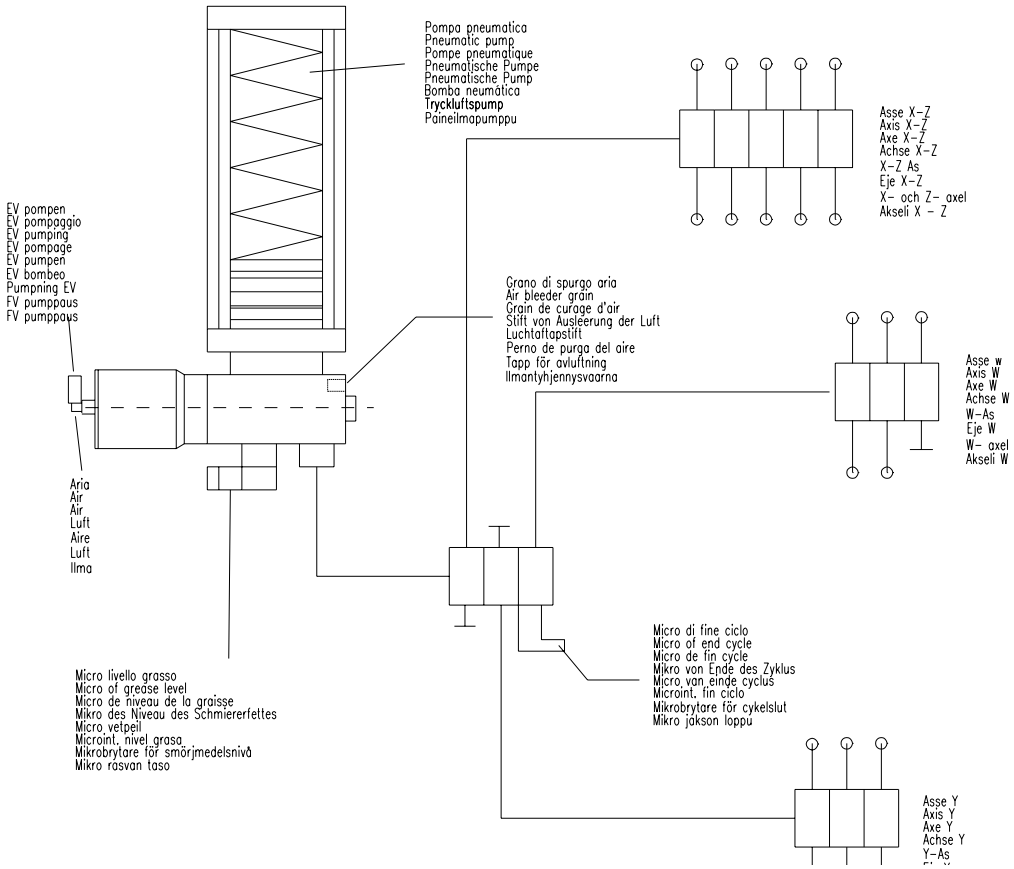
4.10 AUTOMATIC LUBRICATION PLANT

Equipment necessary for the timed lubrication of the moving parts of the axes.

The main part of the plant consists of a lubricator unit that pumps the lubricant through the circuit. This device in turn consists of a reservoir and a series of distributors that lubricate the travellers and the lead screws moving the axis. The lubrication system is controlled by a timer programmed by the manufacturer (in general operating every 10 hours) and run by the numerical control system.

The plant is automatically managed by the PLC through an electrovalve that enables the pumping piston and the two sensors. The first sensor controls the level of grease in the reservoir, while the second checks that the pumping cycles are regular.

The following diagram illustrates the operation of the plant for the X, Y, W and Z axes only.



A photograph of the lubrication unit is shown in paragraph 7.3.3 “Topping up the centralised lubrication tank” on page 7 - 12.

4.11 ELECTRICAL AND ELECTRONIC PLANT

Equipment necessary for managing the supply of electric power required to operate the machine.

The plant has been divided into sections as far as the line terminals in order to guarantee the effective selectivity of the intervention of the protection devices and the immediate diagnosis of any malfunction. The plant has been constructed in accordance with the already mentioned technical standards (see page) and has been subjected to seal and continuity tests as specified in note 1 on page .

This section provides a brief description of the electrical and electronic plat installed on the machine and can be used to identify the principal devices and relative terminology. For a more detailed description of the plant and its components, refer to the electrical manual.

4.11.1 Main electric cabinet

The machine receives its supply of electricity at the main cabinet in which the following components are installed:

Main switch. The switch (see on page 6 - 2) is activated by a lockable external selector. It is also equipped with an internal device for the automatic safety release as described on page 6 - 2.

Thermomagnetic protection device. The plant has been divided into sections as far as the line terminals in order to guarantee the effective selectivity of the intervention of the protection devices and the immediate diagnosis of any malfunction.

Remote switches. Remotely controlled electrical devices.

Numerical control and PLC. See figure on page 4 - 23.

Transformer. The transformer is used to obtain voltages of 230 V, 210 V and 110 V required to feed the conditioner and cooling fans, the drives and the remote switch coils respectively.

Power supply unit**.** The power supply unit generates a voltage of 24V required to feed the input and output lines of the PLC, the remote input/output boards and the safety brake on the vertical axis.

Input/output modules. These are electronic interface modules between the machine and the I/O boards of the numerical control.

Drives. These are electronic devices that pilot the brushless motors of the axes

Speed variators (Inverters). The speed variators, or inverters, are static frequency converters that allow the optimum control of the rotation speed of the spindles and their automatic stopping.

Inverter exclusion selectors. See paragraph “Inverter malfunction (inverter exclusion)” on page 7 - 17.

Safety hardware (emergency chain). Has an internal positive(*) safety circuit which continuously monitors the continuity of a line, called the emergency chain, that reaches all the devices whose malfunction could generate a risk situation for the machine or operator. The absolute reliability of the device ensures that the breaking of the chain corresponds to the safe opening of the power supply lines to some of the remote switches and outputs of the PLC, de-energising the “dangerous” devices and stopping the spindles and axes in the shortest time possible. The status of the emergency chain is also controlled by the PLC which, if the chain breaks, executes an emergency procedure (at the same time as that of the hardware) which is also designed to limit the possible causes of accidents.

(*). If the line is damaged, the machine will be impossible to start, and will stop immediately if it is already running.

Conditioner. When the unit is delivered, the temperature value set on the internal thermostat is 35°C. A pipe is fitted to the outside of the conditioner for draining the condensate from the collection chamber.

Nominal voltage	230 V / 50 Hz
Nominal power L35 L35 / L35 L50	395 / 465 W
Useful chilling power DIN 3168 L35 L35 / L35 L50	800 / 640 W
Refrigerant	R 134 a, 750 g
Max pressure	23 bar
Temperature range	+20 °C to 55 °C
Noise level	62 dB (A)
Protection grade of internal/external circuit	IP 54 / IP34
Dimensions excluding aeration grill	600x340x378 mm
Weight	38 KG

For further information on the conditioner, refer to the manual “assembly instructions” delivered with the machine.

Constructor	Sim
Protection	IP 54
Compliance with CEI standards	CEI 17-13
Compliance with steelwork standards	NEMA 12 / DIN 40050 / IEC 529

4.11.2 Secondary electric cabinet

In order to reduce the number of cables connecting the main cabinet to the machine and to make installation and the diagnosis of any malfunctions easier, some of the electrical and electronic devices have been located in a secondary cabinet positioned at the back of the main cross member. The secondary cabinet contains the following principal components: thermomagnetic protection devices, remote switches, input/output modules. For technical data regarding the cabinet, refer to the technical data for the main electric cabinet.

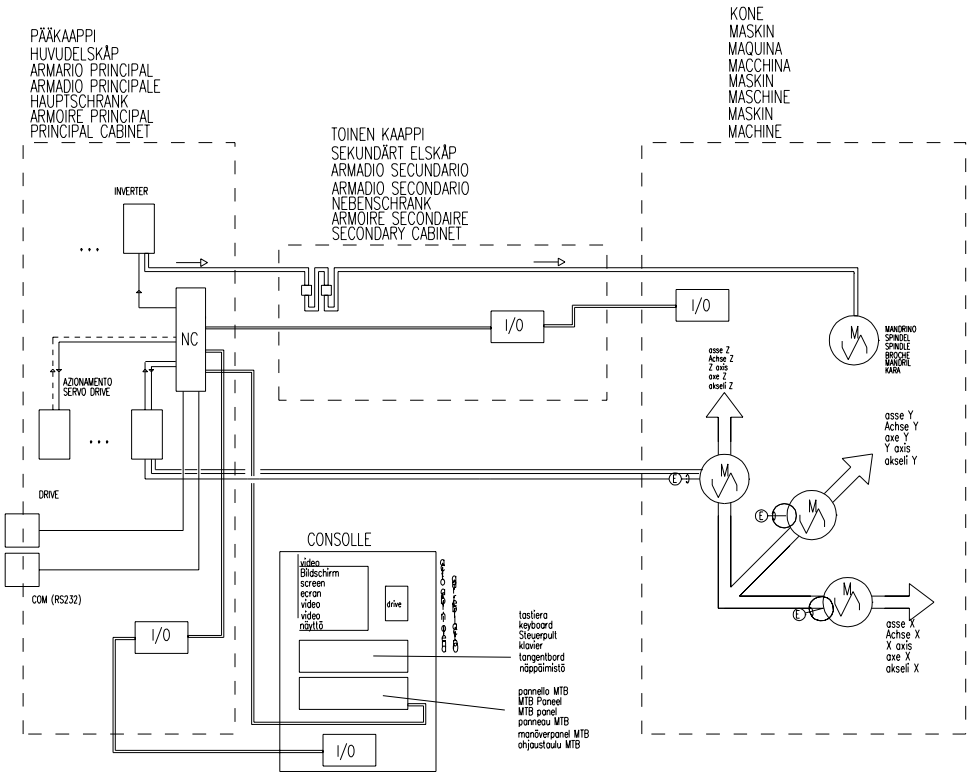
4.11.3 Console

The console is the mobile electric cabinet housing the user-machine interface devices. In particular, it contains the control panel (monitor and keyboard) and the Pilot Panel. Paragraph 6.2.2 “Console” on page 6 - 2 Shows a photograph of the upper part of the cabinet.

For technical data regarding the cabinet, refer to the technical data for the main electric cabinet.

4.11.4 Numerical control

The OSAI CNC Series 10 system integrates the numerical control and the PLC. The following schematic representation shows the distributed architecture of the Series 10 CNC and the principal connections with the other devices.



The figure shows the following devices:

Base unit: this module is made up of the hardware unit and software that manages all the machine's functions.

Control panel: interface module between the machine and the operator, including a monitor on which the messages are displayed and a keyboard for data input.

Pilot Panel: a panel housing switches, selectors and buttons that duplicate or replace some of the functions on the control panel, thus making access easier for the operator.

I/O unit: consists of electronic circuit boards for the management of the inputs and outputs through a communication bus.

The term “control”, used in a general sense in this manual, refers to the actual control and the PLC.

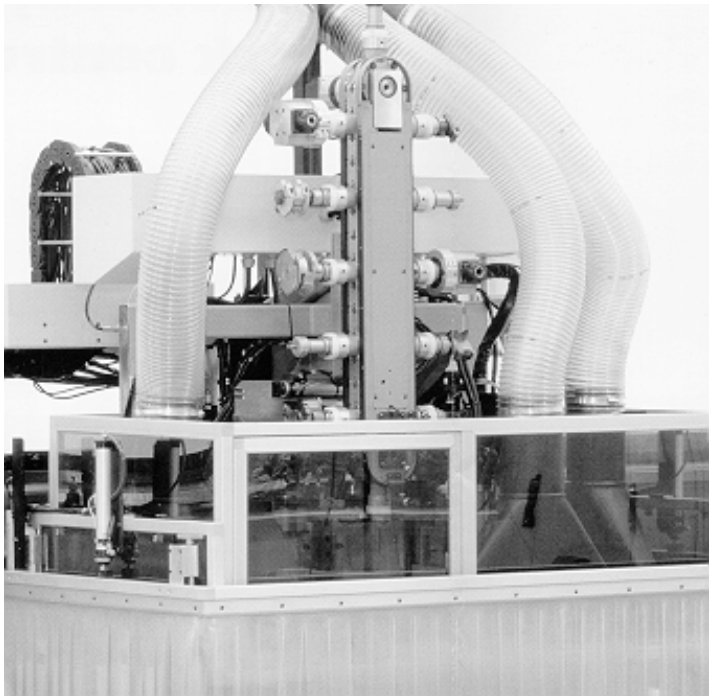
4.12 TOOLHOLDER MAGAZINE

The toolholder magazine is based on a two-directional rotary structure in which 12 “pockets” are inserted, each of which houses a tool of “mixed” typology.

The “mixed” typology of the magazine allows the tools to be managed in fixed or random deposit mode. In other words, a tool can be associated to a particular pocket and always deposited in that pocket, or the tool can be replaced in any free pocket (providing it is suitable) in the magazine, allowing the control to minimise the amount of movement involved and thus reduce waiting time.

According to its profile, a tool can only occupy one position (*Master Pocket*) or it can encroach on the neighbouring stations which, in order to safeguard the integrity of the system, in this case must be left free (*Profile Pocket*). Both the fixed and random deposit management systems allow tools of any dimension to be inserted: depending on its profile, a tool can occupy from 1 to 3 positions. As a result it was decided to introduce a tool class system based on two variables: (fixed or random) deposit and number of positions occupied. In this manner, the random deposit managed

tools can be taken from 1 position and deposited in any of the single tool pocket. Tools occupying 2 pockets can be deposited in any 2-pocket position. The same applies to 3-pocket tools.



4.12.1 Tool change mechanism

This section provides a detailed description of the mechanism through which the tools housed in the magazine and in the electro-spindles are changed over.

The tool change operation can be performed either in automatic or manual mode. The following description refers to a complete tool change cycle executed in manual mode.

One of the features of the ARROW milling machine is that it has been designed to perform tool changes in “masked time”, i.e. replace the tool in one of the heads while the other head is machining, in order not to reduce the useful working time of the operating cycle. For this reason, the tool magazine is shared by the two operating heads.

The manual tool change is effected using the selectors and the pushbuttons on the control panel or special softkeys.

The following description mentions softkeys in the “CU” submenu and “SPINDLE” submenu. To access these menus, select in sequence softkeys “OEM SOFTKEY” and “▮ ▮” to enter submenu “CU” and softkeys “OEM SOFTKEY” and “▮2▮ ▮1▮” to access submenu “SPINDLE”. To pass from submenu “CU” to submenu “SPINDLE”, exit the first using the “EXIT” softkey in order to return to

submenu “OEM SOFTKEY”. From here select softkey “▮2▮ ▮1▮” to access the required submenu. The shuttle is the actual device used for the tool change.

N.B.: manual mode must be selected.

Start conditions: Tool n° 1 on the spindle and tool n° 2 in any pocket of the magazine.

1. Rotate the magazine until tool n° 2 is in position for the tool change. To rotate the magazine, rotate the relative selector on the control panel clockwise or anti-clockwise as required. If the machine is in an emergency situation, press the tooling button “I” and keep it pressed while rotating the selector.

2. Engage the tool in the magazine (softkey “FR” submenu “CU”)

3. Unlock the tool in the magazine (using the selector on the control panel)

4. Extract the tool from the magazine by lowering the shuttle (softkey “DW” submenu “CU”)

5. Move the shuttle towards the head (softkey “RH” or “LH”, depending on the head on which the tool change is being effected, submenu “CU”)

6. Position the shuttle to the correct height for engaging the cone on the spindle (softkey “UP” submenu “CU”)

7. Engage the tool on the spindle (softkey “BK” submenu “CU”)

8. Unlock the tool on the spindle (softkey “1 UL” or “2 UL” (as appropriate) submenu “SPINDLE”)

9. Extract the tool from the spindle by lowering the shuttle (softkey “DW” submenu “CU”)

10. Rotate the shuttle 180° to change the tools (softkey “CC” or “CW”, according to the position of the shuttle, submenu “CU”)

11. Raise the shuttle to insert the cone in the spindle (softkey “UP” submenu “CU”)

12. Lock the tool in the spindle (softkey “1 LC” or “2 LC” (as appropriate) submenu “SPINDLE”)

13. Move the shuttle away from the spindle (softkey “FR” submenu “CU”)

14. Lower the shuttle (softkey “DW” submenu “CU”)

15. Move the shuttle to the centre of the carriage (softkey “MD” submenu “CU”)

16. Raise the shuttle to insert the cone in the magazine (softkey “UP” submenu “CU”)

17. Lock the cone in the magazine (use the selector on the control panel)

18. Move the shuttle away from the magazine (softkey “BK” submenu “CU”)

End conditions: Tool n° 1 in the magazine and tool n° 2 on the spindle.

In an automatic tool change, the operations are carried out following the same principles as the manual tool change illustrated above. In order to eliminate standing time, the automatic tool

change has been designed to optimise the number of manoeuvres carried out. It does this by eliminating any unnecessary movements (e.g. if there is no tool in the spindle, then a tool change is not carried out, instead the system loads a new tool into the spindle).inserire la sequenza del cambio utensile arrow con un disegno e la relativa descrizione, mettendo a fianco di ogni momento la softkey o il selettore per farlo in modo manuale

Chapter 5. RANGE AND LIMITS OF USE OF THE MACHINE

5.1 ENVISAGED USE

The machine has been designed, constructed and protected with safety measures exclusively for the uses provided for by the specifications and information contained in this chapter.

Types and dimensions of materials

The machine can handle semi-worked products in solid wood, fibre-board, chipboard, plywood, MDF, light alloys and plastic materials whose dimensions fall within the travel limits of the relative axes (see page 4 - 4).

The minimum dimensions depend on the clamping method and the type of machining to be carried out. In this respect, refer to that written on page 6 - 35 on the dangers caused by projecting parts of the panel.

Types of machining

These work centres, with their three-dimensional interpolation, are specifically designed for linear routing and milling of semi-products in wood that can be worked both horizontally (parallel to the X-Y plane) and vertically (parallel to the X-Z and Y-Z plane) and boring.

Working method

The semi-product is placed on the worktable of the machine, aligned with the reference stop and locked in position. The operating controls are then used to execute a previously programmed machining cycle.

5.2 IMPROPER USE

The machine has not been designed for the following uses:

- Machining of panels if type and dimensions other than those specified in paragraph 1.1 of this chapter;
- Working methods other than those specified in paragraph 1.1 of this chapter and, in particular, all those trial operations performed with the protections disabled or where the operator has access to the danger zone during panel machining.

The machine is equipped with mechanical, electrical and electronic safety devices that prevent improper use.

DANGER

Interfering with the protection devices to execute machining operations not provided for can lead to serious risk for the operator.

INFORMATION

BIESSE will not be held responsible for damage or injury deriving from improper use of the machine.

INFORMATION

BIESSE will not be held responsible for damage or injury deriving from the deliberate misuse of the machine.

Chapter 6. USE

6.1 TYPES OF OPERATION

The safety level of the machine varies according to the procedures being followed in the use and maintenance of the machine during its entire working life.

Normal operation

Normal operation includes all those procedures during which the machine is protected by passive safety devices, (see paragraph 2.2.1 “Safety devices” on page 2 - 1) ensuring the safety of the operator. Paragraph 6.4 “NORMAL OPERATING PROCEDURES” on page 6 - 25 provides a detailed description of all the procedures.

Special operation

Special operation includes all those procedures during which the machine is protected by active safety devices (see paragraph 2.2.1 “Safety devices” on page 2 - 1) including procedures relating to maintenance. Paragraph 6.5 “SPECIAL OPERATING PROCEDURES” on page 6 - 30 provides a detailed description of all the procedures relating to use.

Levels of safety

Each operator qualified to use the machine must be given a maximum level of safety for which he has received adequate training and within the limits of which he is authorised to carry out work on the machine itself. An operator qualified for normal operation of the machine can only perform those procedures described in paragraph “Normal Operating Procedures”. An operator qualified to carry out special operations on the machine can perform the procedures described in paragraph “Normal Operating Procedures” and in paragraph “Special Operating Procedures”.

DANGER

Special operation involves exposing the operator to residual risks. For this type of operation, the operator must have had the appropriate training.

6.2 CONTROLS

The following section describes the functions of the different switches, pushbuttons and selectors on the machine.

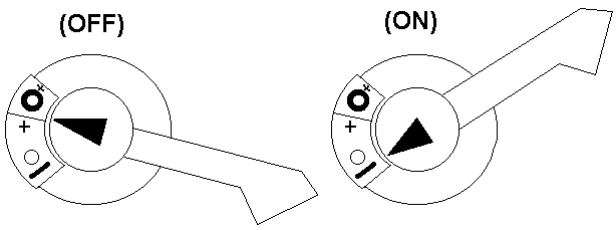
Some of these devices also have one or more indicator lights which display (when they are lit) the activation status of the selected or activated function, or the correct position of a particular element on the machine. For example, the indicator light of the start button is lit when the machine

is executing a cycle. The indicator light of the lock/release vacuum area is lit when the vacuum area lock is active.

6.2.1 Main electric cabinet

Main switch

This device is located inside the main cabinet and switches on the control and consequently the machine itself(*) . The switch can be accessed from outside the cabinet by means of a lockable selector (to prevent unauthorised persons from operating the machine) mechanically coupled to it.



The switches, selectors and pushbuttons on the doors of the main and secondary cabinets constitute a protection system against direct contact with the live elements. The door on which the selector is mounted cannot be opened unless the selector itself is in the “0” position (machine off); the opening of the other doors automatically opens the switch and cuts-off the electricity supply to the inside of the cabinet.

6.2.2 Console

The user interface is the collection of devices that allow user-machine dialogue.

The user interface is fully contained in the CONSOLE and in the control panels installed on the tables.

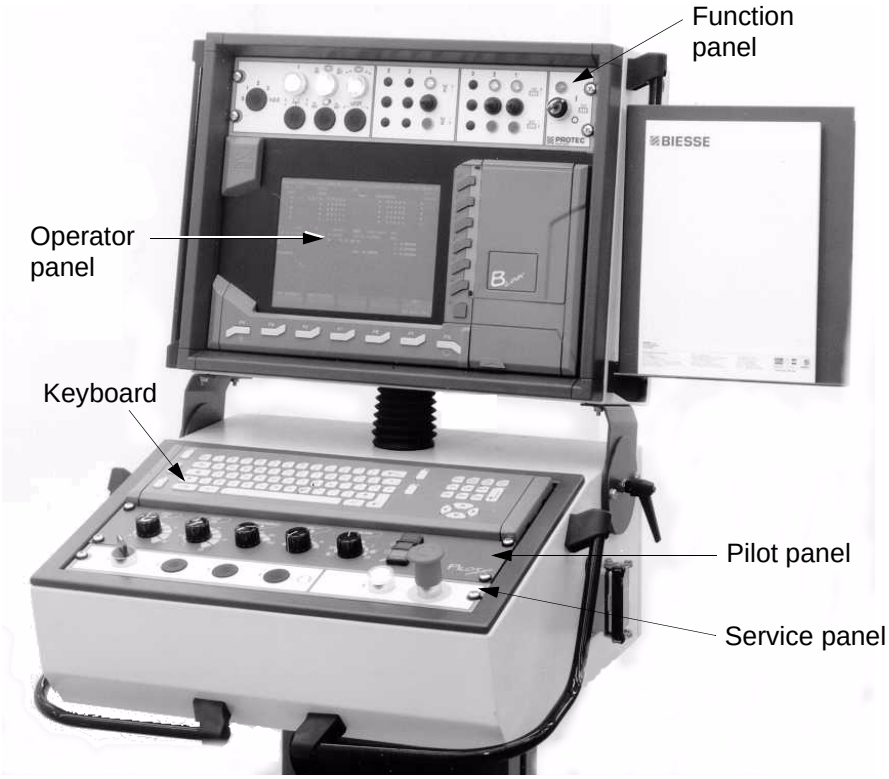
The CONSOLE is made up of four elements:

- Function panel
- Service panel
- Operator panel

(*). Even though the switch in question is the principal device feeding the machine, for operational and safety reasons, the supply to all the devices (in particular, the actuators) is activated in a second phase and under certain conditions as described in paragraph 6.4.1 “Switching on the machine”on page 6 - 26.

- Pilot Panel

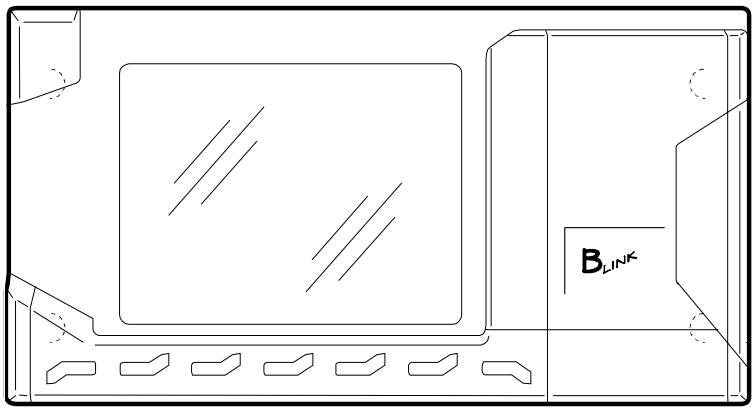
There is also a fifth element (optional) called “Winlink” consisting of a PC workstation integrated in the console which shares the display and keyboard with the NC. In this case, the resources shared by the PC and NC can be switched-over using the yellow button on the bottom right.

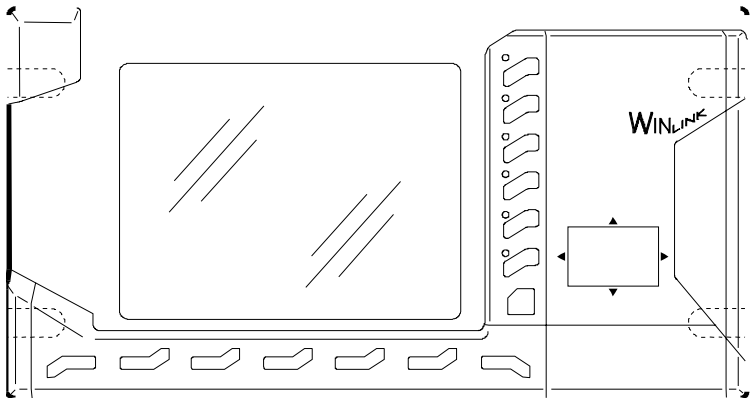


Operator panel

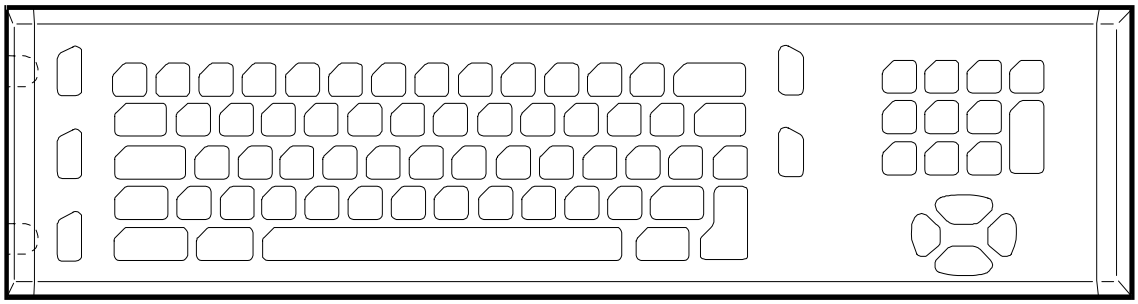
The operator panel or front panel shown in the following figures is the interface between the operator and the system. The panel is used to:

- enter operating commands (using the softkeys) and the start and stop commands;
- display data and all the operating conditions of the system.





Keyboard



The keyboard has the following function areas:

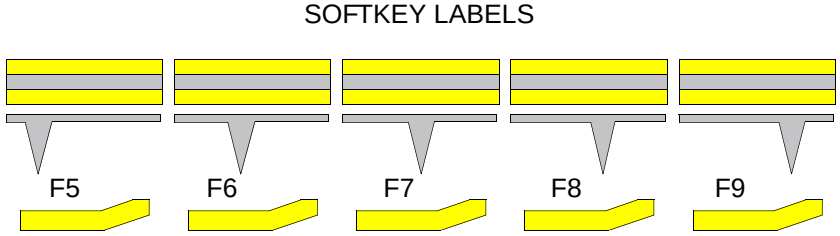
Fixed keys

The fixed keys are located at the ends of the row of softkeys and have the following functions:

	The left fixed key always returns to the main menu and displays the main screen, thus facilitating access to the working environment.
	The right fixed key changes the active line of the softkeys by scrolling the blue bar vertically through the lines of softkeys.

Softkey

The softkeys are made up of 5 keys placed at the top of the keyboard and are used to enter commands directly. The command functions are those shown in the menu displayed at the bottom of the screen directly above the softkeys as shown in the following figure:



A menu consists of three lines of five labels, each corresponding to one of the underlying softkeys. In this way, a large number of functions can be displayed without needing to change the softkey menu.

The functions associated with the softkeys are determined by the active line of the menu. The active line is identified by its blue background, which can be made to move cyclically through the lines using the fixed key on the right. When a new menu is accessed for the first time, the active line is the centre one.

The labels of the softkey menus take on a different colour according to their current status. In particular:

WHITEIndicates that the softkey is available for activation

YELLOWIndicates that the softkey has been pressed or is lit to indicate a particular mode

BLACKIndicates that the softkey is not available (cannot be selected)).

This section describes all the functions of the menu enabled by the **softkey OEM**. The following functions have been defined by BIESSE:

- **Homing**. Executes an automatic zeroing cycle of all the axes on the machine. (see paragraph 6.4.4 “Zeroing the axes” on page 6 - 28).
- **Lubricating**. Executes an automatic lubrication cycle.
- **Work hours res**. Zeroes the incremental counter of the number of CYCLE hours of the machine.
- **Lubricat. set.** Opens the following data entry.

LUBRICAT.SET
Hours of lubricating period: □□

in which, using a number between 1 and 99, it is possible to set the automatic lubricating period in hours.

The default value is 10 hours; this value is automatically set when zero is entered in the data entry.

Selecting the underlying line allows two softkeys to be selected for access to two distinct submenus:

- Softkey for enabling a manual TOOL CHANGE.

INFORMATION

All the descriptions of the functions of the softkeys relating to tool change and magazine management are reported below. To help matters, a summary page is available and can be accessed by pressing softkey NEXT DISPLAY as SCREEN 5 of 5).

1. **FR**Moves the tool change shuttle from the start position towards the tool magazine.
2. **BK**Moves the tool change shuttle to the start/load tool in the spindle position.
3. **LH**Moves the tool change shuttle from the centre position towards spindle number 2 (left).
4. **MD**Returns the shuttle to the centre position (in line with the magazine).
5. **RH**Moves the tool change shuttle from the centre position towards spindle number 1 (right).
6. **UP**Raises the tool change shuttle.
7. **DW**Lowers the tool change shuttle.
8. **CW**Rotates the tool change shuttle clockwise.

INFORMATION

If the shuttle does not move, use CC to effect the rotation

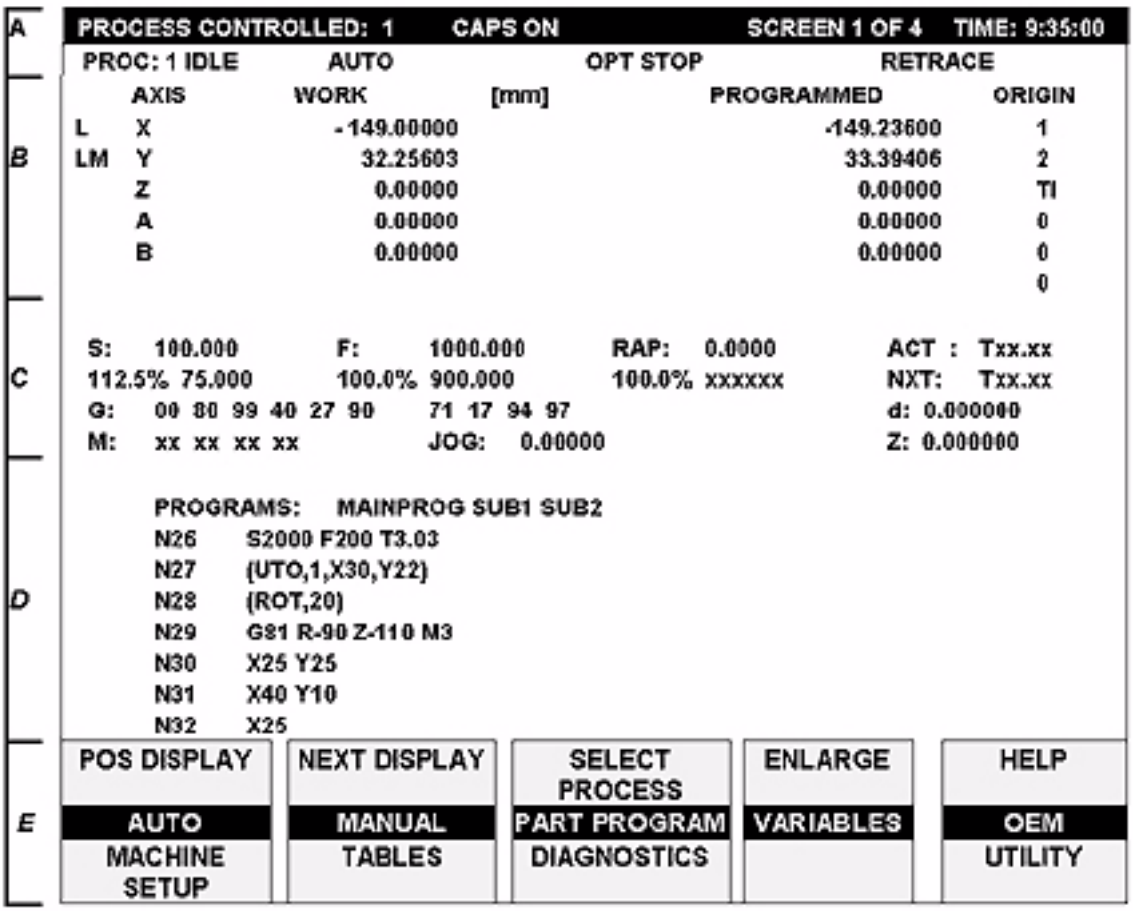
9. **CC**Rotates the tool change shuttle anti-clockwise. Note: if the shuttle does not move, use CW to effect the rotation.

"▮2▮ ▮1▮" Softkey for moving the MAGAZINE manually.

1. **1 LC**Locks the tool in spindle 1.
2. **1 UL**Unlocks the tool in spindle 2.
3. **2 LC**Locks the tool in spindle 2.
4. **2 UL**Unlocks the tool in spindle 2.

Main video panel

This is the video panel normally displayed during a machining process and contains all the information relating to the machining environment of the final user. The video panel has been divided into 5 functional areas, as shown in the figure below.



A status information area

B axis data area

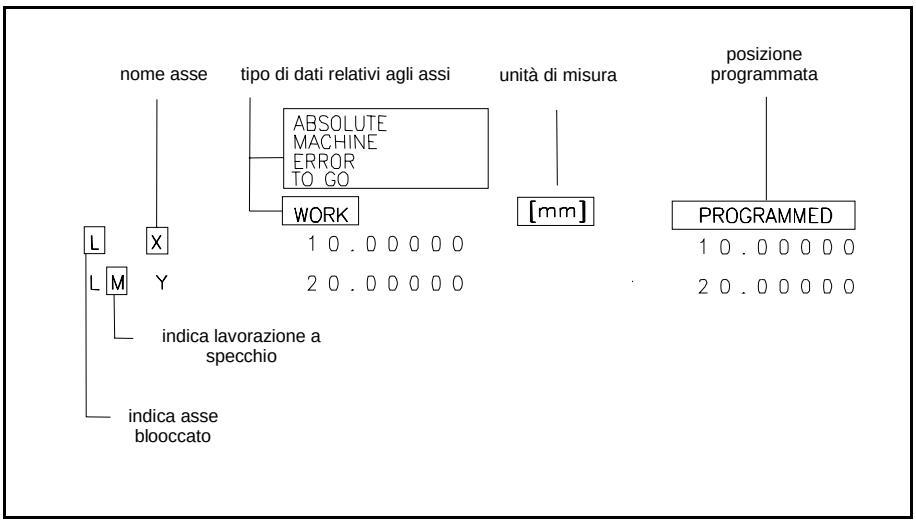
C general data area

D part program area

E softkey area

Axis data area

This area of the main video panel displays data relating to the values of the axes. The figure below illustrates the meanings of the different elements displayed, taking for example the first two axes reported in the previous figure of the video display. A maximum of 9 axes can be displayed:



WORK — This element specifies the type of real time axis value displayed. The name of this element changes if softkey **POS DISPLAY** is pressed. The options are:
WORKdisplays the calculated position of the axis with respect to the current origin
MACHINEdisplays the actual position of the axis with respect to the current origin
TO GOdisplays the distance to travel with reference to the current origin
ERRORdisplays the tracking error, i.e. the difference between the WORK and MACHINE positions.
ABSOLUTEdisplays the distance of the axis with respect to absolute zero.

Value — The values of the axes are displayed with 10 figures in 5.5 format. Locked axes are indicated with the letter **L**, axes for mirror machining are indicated with the letter **M**.

[mm] — Displays the current unit of measurement used in the selected process. This can be either **mm** or **inches**.

PROGRAMMED — This is the last position of the programmed axis or the value entered on the keyboard. It has 10 characters and is displayed in the same format as the preceding element.

ORIGIN — Number and type of the current origin associated to the axis. The following characters may be displayed in this field:
T for temporary origins
I for incremental origins
The absence of both letters indicates an absolute origin.

General data area

This area contains general information on the machining, such as spindle speed, feed speed, rapid speed, G codes active, etc. The values in this area are expressed in the unit of measurement being used by the process (mm/inches), displayed on the video itself and updated at each variation in G70/G71. Taking for example the information shown on the previous video display, these represent:

S	**0.000**
112,5%	**0.000**

This area contains the information relating to the speed of the spindle The reported data indicates in particular:

Top left (S:)	Spindle data
Top right (0.000)	Programmed speed in format 6.3.
Bottom left (112.5%)	Percentage variation in the programmed speed.
Bottom right (0.000)	Actual speed in format 6.3.

When the spindle speed variation function is active, the name of this field is displayed in reverse.

F	0.00000
100%	0.00000

This area contains information relating to the feed speed. The reported data indicates in particular:

Top left (F:)	Feed speed data
Top right (0.00000)	Programmed feed speed in format 5.5.
Bottom left (100.0%)	Percentage variation in the programmed feed speed.
Bottom right (0.00000)	Actual feed speed in format 5.5.

When the feed speed variation function is active, the name of this field is displayed in reverse.

RAP	0.00000
100%	0.00000

This area contains information relating to the transfer speed in manual or rapid according to the programmed mode. The letters RAP appear when the selected mode is AUTO. When in MANUAL mode, the letters become MAN. The remaining data indicates:

Top right (0.00000)	Manual feed speed (MAN) or rapid (AUTO) in format 5.5.
Bottom left (100.0%)	Percentage variation in the programmed manual or rapid feed speed.
Bottom right (0.00000)	Actual manual or rapid feed speed in format 5.5.

When the feed speed variation function is active, the name of this field is displayed in reverse.

G:	00 80 99 40 27 90 71 17 94 97

G codes active. A G code can be displayed for each of the 15 modal groups defined in the system at the time of process configuration (refer to the Programming Manual for the relative details).

M:	xx xx xx xx

M codes active. An M code can be displayed for each of the 12 modal groups defined in the system at the time of process configuration (refer to the Programming Manual for the relative details).

JOG:	0.00000

Value of the increment in manual jog movements.

ACT:	Txx.xx

Number of the tool mounted on the spindle and its active corrector. The field contains the letter T which identifies the tool, followed by 2 groups of numbers separated by a point. The group to the left of the point represents the number oft the tool, the group to the right represents the corrector.

NXT:	Txx.xx

Number of the next tool to be used and its associated corrector. The field contains the letter T which identifies the tool, followed by 2 groups of numbers separated by a point. The group to the left of the point represents the number oft the tool, the group to the right represents the corrector.

d:	0.000000

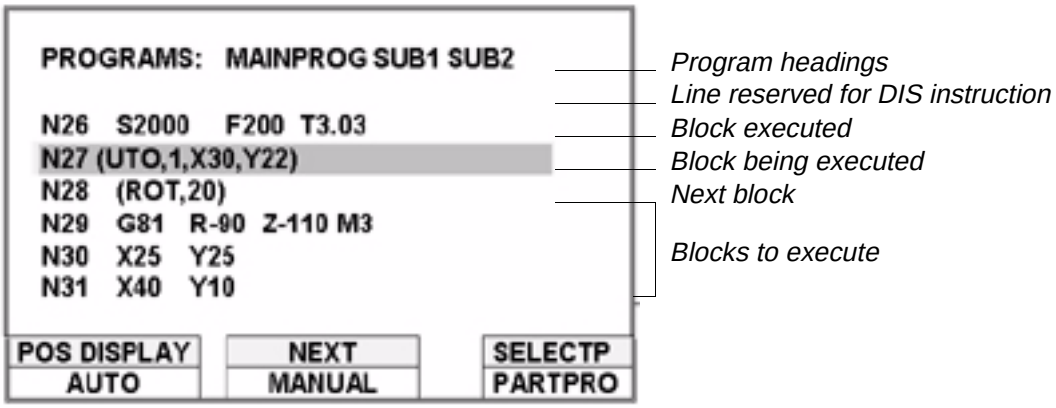
Tool diameter.

Z:	0.000000

The active tool length corrector is displayed in this field and is applied to the axis relating to the tool (normally the spindle axis) This length represents the value of the corrector applied to the axis, and is obtained by multiplying the value in the offset table by the direction of application declared in the sign change configuration.

Part program data area

This area displays the data relating to the part program that is being run. No modifications to the program can be made on these lines. Each block of the part program can occupy one or more lines depending on its length. The display shows, in order, the block of the part program already run, that being run shown in reverse(*) , followed by the blocks yet to be run. The instructions of the part program scroll upwards as they are executed. The following figure illustrates a possible example of the display of a part program being executed:



DANGER

If more than six axes have been configured in the control, the number of lines reserved for displaying the program blocks will be 7-n, where n is the number of axes over the sixth. In the case of nine configured axes, only the first line is reserved for the part program block executed. Consequently, blocks longer than 80 characters are truncated(**) .

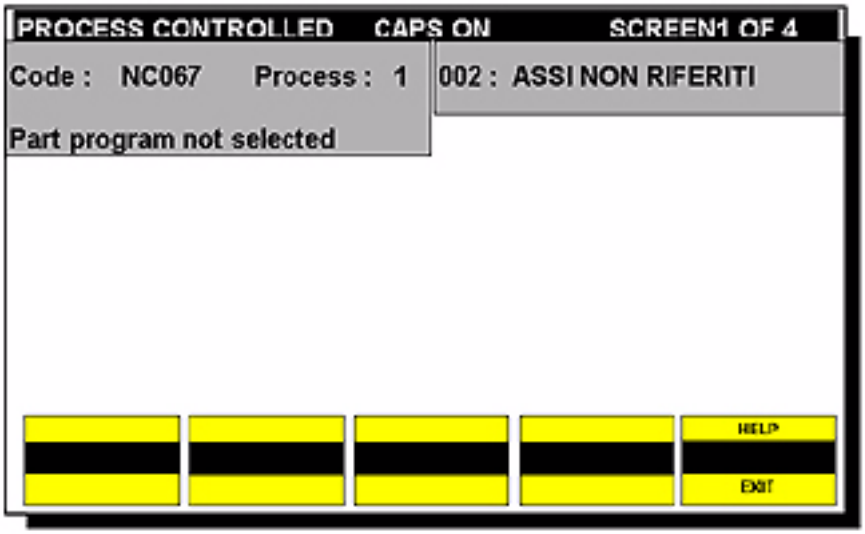
(*). The block displayed in reverse is not necessarily that being executed, in that the control pre-calculates a certain number of blocks (max. 16) according to the interpolation mode and the automatic or block-block function mode..

Data area relating to error messages

When a system error occurs, it is displayed in a red window in the top left part of the video.

If, instead, a PLC error occurs, this is displayed in a red window in the top right part of the video.

It is possible, therefore, for a situation to occur similar to that shown in the figure below:



Monitoring the operating time of the machine

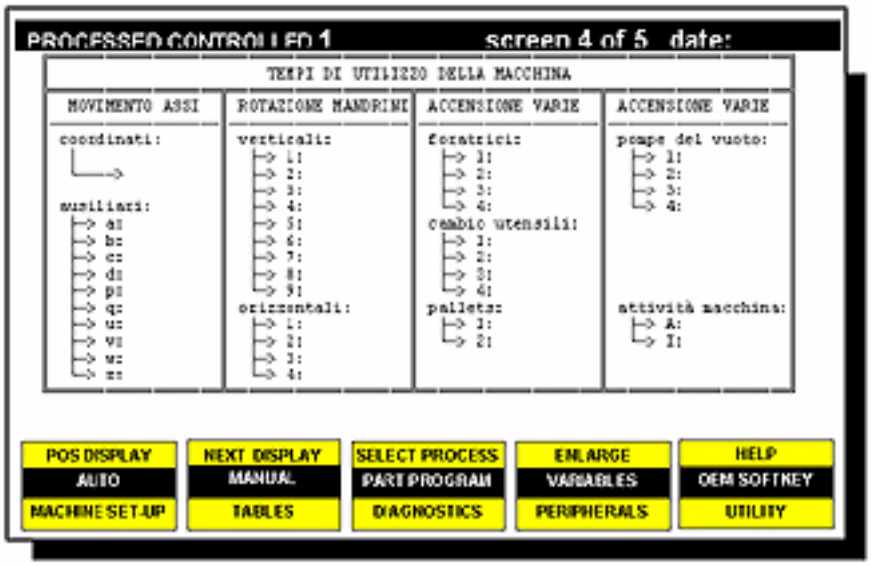
Press softkey NEXT DISPLAY to cyclically select the various machine-operator interface displays. One of these screens (SCREEN 4 OF 5) shows a table of the operating times of the machine, providing a useful reference for managing the maintenance program (see paragraph 7.3 “PROGRAMMED MAINTENANCE” on page 7 - 3).

The times reported in the table are:

- Operating hours of the co-ordinated axes. This value represents the operation of any co-ordinated axis.
- Operating hours of each auxiliary axis.
- Operating hours of each spindle.

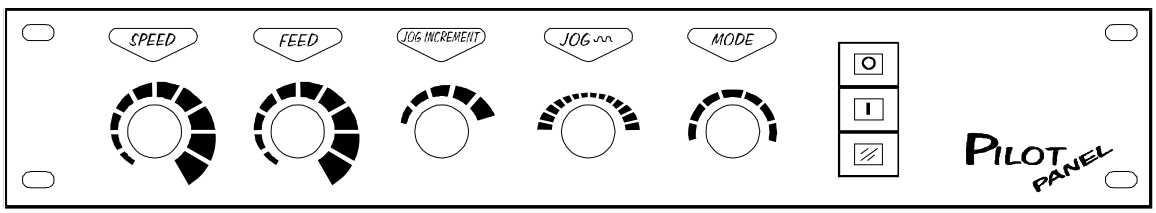
(**). If codes G1, G2 or G3 are active, the line highlighted is not that currently being executed but is the one being pre-calculated. The NC uses the precalculation to read 16 program lines in advance of the line being executed. In this way, any errors in the programming can be intercepted before it is executed

- Operating hours of the boring machine.
- Operating hours of each pallet.
- Operating hours of the vacuum pump.
- Total number of hours of operation of the machine, absolute and incremental.



Pilot Panel

Almost all the Pilot Panel commands duplicate functions that can be carried out through the appropriate operating sequences using the control buttons or softkeys (in order to prevent conflict, these functions are disabled).



The controls mounted on the Pilot Panel are:

SPEED	This selector controls the percentage variation in the electro-spindle rotation speed. The variation possible lies between 75% and 125% of the programmed value.

FEED	This selector controls the percentage variation in the feed speed during automatic machining of the axes. Its function differs according to whether the operating mode is manual or automatic. In particular: Manual. Varies the configured maximum manual feed speed between 0 and 125%. Auto. Varies the programmed feed speed between 0 and 125%. DANGER: the FEED does not have any effect on the rapid movements (G0)
JOG INCREMENT	This selector controls the amount or increment of each single jog in incremental manual axis movement. In addition, rotating the selector towards positive limits the rapid speed in percentages, with steps of 100, 50, 20, 5, 1 and 0 percent.
JOG	This selector determines the speed and direction of movements in manual of the axis selected for the MANUAL JOG and JOG INCR functions. In addition, with the RAPID OVERRIDE CONTROL enabled, rotating the selector towards positive limits the rapid speed in percentages with steps of 100, 50, 20, 5, 1 and 0 percent.

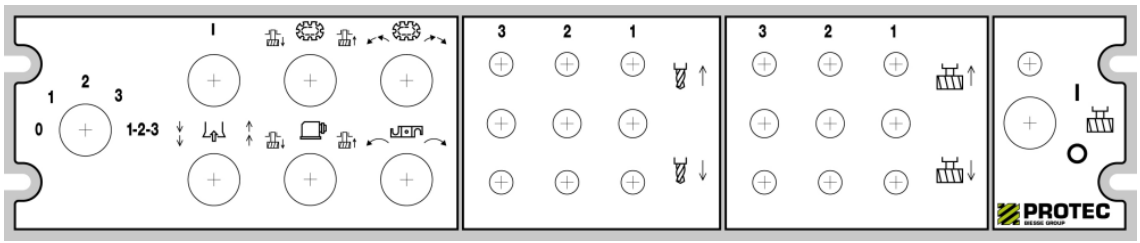
MODE	This selector enables a number of operating modes, i.e.: MDI. Opens the input window for entering data via the keyboard. AUTO. AUTOMATIC mode. BLK/BLK. Executes the part program block by block. MANUAL JOG. Enables the manual movement of the selected axis in the direction defined by the selector. JOG INCR. Enables the manual incremental movement of the selected axis in the direction defined by the Jog selector. If, when CYCLE START is pressed, A has been entered in the SELECT field of the MANUAL SETUP input window, the axis will move the amount defined in the window. If M has been entered in the SELECT field of the MANUAL SETUP window, the CYCLE START button must be kept pressed until the movement has been completed (releasing the CYCLE START button stops the axis). JOG RETURN. Enables the return to the profile after a manual movement. HOME. Enables the axis zeroing procedure. Pressing CYCLE START starts the zeroing sequence of the selected axis (co-ordinated axes only). HPG. Enables the management of the handwheel by the logic when installed.
CYCLE START	The Cycle Start button: ■ Starts the execution of the part program; ■ Enables the zeroing of an axis (when zeroing in manual); ■ Enables manual movements to be executed; ■ Restarts a cycle suspended with the button cycle stop.

CYCLE STOP	Pressing the Cycle Stop button enables a request for entry into the HOLD condition or, if the system is already in HOLD, enables a request for entry into the HRUN condition. The entry into HOLD involves different functions according to whether the system is in Auto or Manual mode. In particular: ■ Automatic stopping of the execution of the part program with controlled deceleration of the movements. ■ Manual stopping of the axis zeroing , incremental JOG movement and automatic return from JOG. As soon as the system has entered HOLD, the logic memorises the status of the machine, stops the movement of the NC stops and the rotation of the electro-spindles and boring machines. To exit the HOLD condition, re-press the Cycle Stop button: the process will enter the HOLD RUN condition. To restore the previous HOLD condition and restart the cycle, press Cycle Start and restart the cycle.
RESET	The Reset command is accepted if there are no axes in movement or if there are no tool change operations in course(*) . When the reset command is accepted, the part program and any active functions are interrupted. In particular it: ■ Stops the rotation of the spindles. ■ Cancels all the data in the program execution buffer. ■ Positions the part program at the start of the file. ■ Resets the default conditions (see paragraph 6.10 “DEFAULT CONDITIONS” on page 6 - 64).

(*). In this case, to reset the control, press button CYCLE STOP followed by RESET.

Function panel

The function panel consists of a series of pushbuttons and selectors dedicated to a number of different functions. The status of each device is displayed by an indicator light.



The panel is divided into sections, the functions of which, from left to right, are described below.

DANGER

When working with the spindles disabled at the selector and a head is lowered, there is a risk of the tool left in the spindle colliding with the material clamped on the table.

Safety button. The purpose of this button is to prevent a dangerous situation in which one of the operator's limbs is inside the tool change area while the magazine or shuttle is moving. When the machine is switched off (i.e. in emergency), the safety button must be pressed before and during any manual movement of the magazine. In particular, after the button has been pressed, the operator must wait for the consent from the control, signalled by the indicator light associated with the safety button.

Magazine lock and release button. A three-position selector in which only the centre position is stable. For operational reasons, the actions commanded by this selector are only performed by the control when the magazine is at a standstill.

Rotating the selector to the right or left locks or unlocks the toolholder cone in the current pocket. The lock or unlock condition of the toolholder cone selected stays active even when the selector is released. The indicator light in the button will light up to indicate the locked status.

Magazine rotation selector. A three-position selector in which only the centre position is stable. For safety and operational reasons the actions commanded by the selector are only executed by the control when the shuttle is in the parked position and the current pocket is locked. The magazine stopped status is displayed by the indicator light.

The rotation of the magazine is managed by the control which, each time a selection is made (rotate right or left selected by the selector), rotates it clockwise or anticlockwise. The rotation stops when the pocket adjacent to the current one occupies the actual tool change position. The selector does not need to be held in the selected position for the movement to be completed but needs to be rotated the same number of times that there are pockets to move in order to have a pocket not adjacent to the current one in the change position.

INFORMATION

The pushbuttons described here are only enabled and therefore operational when the relative indicator light is lit.

Boring head vertical positioner. A three-position selector controls the vertical movement of the boring head. The operation of this selector is identical to that of the milling head positioner. In particular:

- *Up position*: the head with all its spindles is fully raised.
- *Passage from the up position to the central position*: only the selected spindles are lowered while the head remains up.
- *Down position*: the head is lowered together with the selected spindles.
- *Passage from down position to central position*: the head and the selected spindles stay down.

Milling head vertical positioners. Three-position selectors control the vertical movement of the corresponding milling heads (the correspondence is indicated by the numbers of the selectors and the heads). For safety and operational reasons the actions commanded by the selector are only executed by the control when the shuttle is in the parked position. Each selector has two indicator lights, one green and one red, which indicate the up position and down position respectively of the head.

The three positions correspond to:

- *Park* (up position). The head is fully raised and does not respond to any operations requested by the control. In addition, the head is excluded from the normal efficiency controls carried out on it. This will prevent any possible malfunctions from interfering with the operation of the machine as a whole. In this situation, the indicator light is on and fixed.
- *Automatic* (central position). The positioning of the head is managed by the numerical control according to the programmed M functions. In this situation, if the head is operating, the red indicator light flashes. If, instead, it is in the up position (tool change situation or another head is machining), the green indicator light is on and fixed.
- *Down* (down position). The head is lowered, though it is still managed by the NC (for example, it can be raised using the M function). In this situation, the red indicator light is on and fixed.

DANGER

When a head position selector is in the "Down" position, consideration must be given to the possible risk deriving from the execution of a program that does not include this particular head. For example, if the head is not selected and not raised, a risk situation is created due to a possible collision between the non-rotating tool and the workpiece.

Spindle enable. When this two-position key-operated selector is in the "off" position (0), it disables the rotation of all the spindles. The selector also raises the curtain guard to effect a trial cycle

DANGER

In order to guarantee the safety of personnel and machinery, at the end of the tool change section, all the elements must be in the at-rest position (see paragraph below).

All the selectors described up to this point are only active when the machine is stopped on *HOLD* and, at the same time, the mode selector is on *MANUAL JOG* or *JOG INCR.* Otherwise, the switching of the selector does not influence the state of activation of the electro-spindles or the movement of the machine's heads; the last correct setting is therefore memorised.

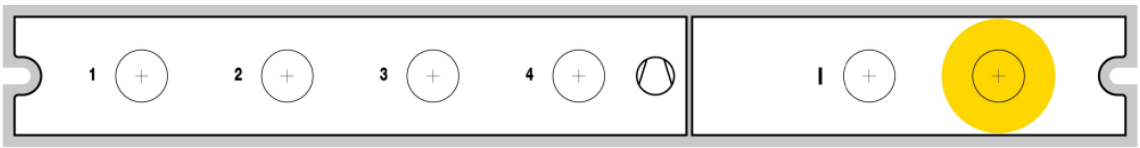
When exiting these modes, the machine logic checks that all the elements for which an *at-rest* or an *not at-rest* condition exists are in fact in the rest condition (indicator light on). If this is not the case, the logic forces the system into a HOLD condition by sending one or more error messages relating to the *not at-rest* condition encountered.

At the end of this situation, the operator must return to manual mode, restore the at-rest condition from the panel and exit from HOLD. In practice, before exiting manual mode, it is advisable to carry out a general check of all these potential error conditions and ensure that all the appropriate indicator lights are lit.

DANGER

When a head is in the "Working" position (down), consideration must be given to the possible risk deriving from the execution of a program in which function M to raise the head is not activated. In this case, in fact, the head stays down, creating a new dangerous situation. Consequently, great care must be taken during manual movements and in the use of the M functions that act on the movement and rotation of the heads.

Service panel



The panel is divided into sections, the functions of which, from left to right, are described below.

Vacuum pump. These are selectors used to activate the individual vacuum pumps. Each selector has an indicator light to display the pump active condition.

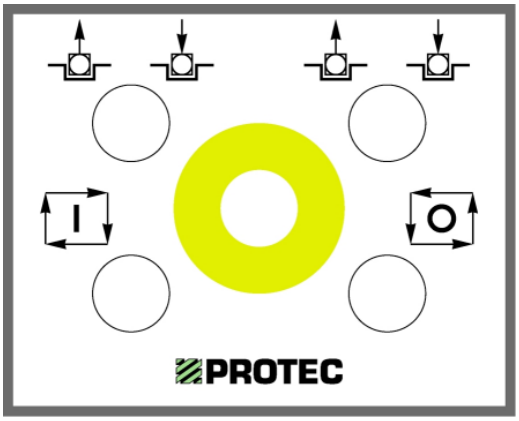
CONTROL/ON button. Switches on the machine in line with that described in paragraph 6.4.1 "Switching on the machine" on page 6 - 26

EMERGENCY-STOP button. Mushroom head system emergency stop pushbutton in accordance with that described in paragraph 6.2.4 "Emergency stop" on page 6 - 24.

6.2.3 Panels on the machine

Table pushbutton panel

Each table is equipped with a pushbutton panel as shown in the figure.



The functions of each element of the panel are described below.

EMERGENCY-STOP button. (See 6.2.4 “Emergency stop” on page 6 - 24).

Start button Pressing this green button performs the same function as the CYCLE START button on the Pilot Panel (see paragraph “Pilot Panel” on page 6 - 15).

Lock/unlock selector. This green selector has three positions, of which only the centre one is stable. The selector is used to activate the vacuum system for locking or releasing the panel on the work area controlled by the particular panel.

The selector also has an indicator light which, when lit, indicates that the locking system is active.

Hold button. Pressing this orange button has the same function as the CYCLE STOP button on the Pilot Panel (see paragraph “Pilot Panel” on page 6 - 15).

Vacuum gauge

The machine is also equipped with a **vacuum** gauge mounted near to the pushbutton panel described above. The **vacuum gauge** provides an analog display of the negative vacuum pressure acting on the panel to be machined (each vacuum gauge indicates the degree of vacuum for the work area connected to it).

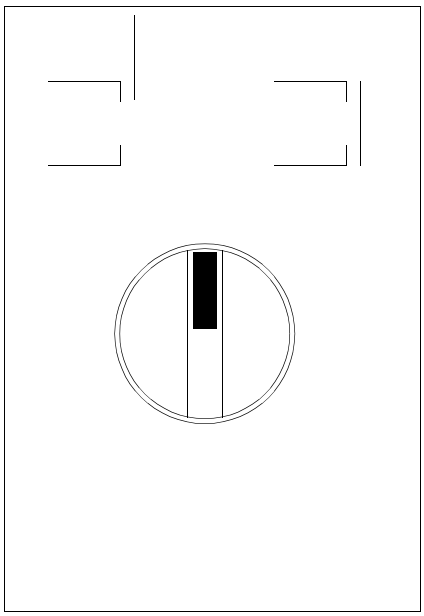
Onboard protection pushbutton panel

The machine has two identical pushbutton panels located to the left and right of the worktable. The selector on each panel (see Figure 1-9), controls the opening and closing of the door.

The activation of the selector by the operator forms a part of the pallet loading/unloading procedure. When the operator has removed the machined piece, loaded the new piece and locked it on the work table (operating the vacuum selector on the relative table), he can command the re-entry of the pallet and the subsequent closing of the door by means of the selector on the protection.

Once a piece is locked in position, the pallet can also be returned and the door closed by means of the Part Program using an M code at the start of each machining cycle (see paragraph “List of M functions” on page 6 - 58)

It is nevertheless advisable that the re-entry of the pallet is controlled by the operator (selector), as this will reduce periods of inactivity during the cycle (for further information, refer to paragraph “Pallet” on page 4 - 7).



6.2.4 Emergency stop

Pressing the EMERGENCY STOP button

When the red EMERGENCY-STOP button is pressed, the machine enters an emergency condition and stops immediately.

This button activates the emergency system (see page 4 - 20) which then:

- De-energises the hardware of the actuators and power units;
- De-energises the hardware of the PLC outputs that could create a dangerous situation on the machine;
- Stops the hardware of the spindles in the shortest time possible;
- Stops the hardware of the axes in the shortest time possible;
- Activates the PLC software procedure which, together with the hardware actions, is designed to prevent any accident risks.

In practice, the machine is in a condition in which none of its parts can move: in general, in other words, the power to the machine has been cut-off.

Restoring normal operation

In order to restore normal operation, the emergency condition must be eliminated, as follows:

1. Release the EMERGENCY-STOP button by rotating it clockwise. The button will then return to its original position;
2. Perform a logic RESET on the machine by pressing the appropriate button on the pilot panel (see paragraph "Pilot Panel" on page 6 - 15).
3. Press button "|" on the service panel to switch on the machine (see paragraph "Service panel" on page 6 - 21).

6.3 SYSTEM STATUS

In order to facilitate consultation of the manual, the system statuses have been summarised in the table reported below(*) .

STATUS	AUT	MAN	DESCRIPTION
IDLE	=	=	The process has stopped and is waiting for a command.
IN CYCLE	=		The process is executing a part program or a command entered via the keyboard in MDI mode.
RUN		=	The process is executing a manual movement.

STATUS	AUT	MAN	DESCRIPTION
CYCLE STOP	=		The execution of a part program or an MDI command has been stopped and the system is on hold.
HOLD		=	The execution of a manual movement has been interrupted by the Cycle Stop button being pressed and the process is on hold.
RUNH	=	=	The process has been stopped during the execution of a part program by the Cycle Stop button being pressed. Switching the process to MANUAL changes the status from CYCLE START to HOLD. If one or more axes are moved manually, the message becomes RUNH and pushbuttons Cycle Start and Cycle Stop are both lit. RUNH informs the operator that a movement is in course.
HRUN	=	=	If the Cycle Stop button is pressed when the process is in the HOLD or CYCLE STOP status, the status switches to HRUN. This means that the process is ready to continue the interrupted machining. The Cycle Stop button is switched off and the process stays on hold waiting for the Cycle Start button to be pressed.
RESET	=	=	Indicates that a process zeroing operation is in course after the Reset button has been pressed.
INPUT	=	=	Indicates that the process is waiting for data to be input from the keyboard (an input window appears on the display.
ERROR	=	=	Indicates that the process has detected an error during operation. The error can either stop the process or be managed by the part program.
EMERGENCY	=	=	The system has detected an anomaly requiring the intervention on the operator. The type of anomaly is indicated on the display by one of the explanatory messages reported in the Appendix “Error messages”.

6.4 NORMAL OPERATING PROCEDURES

DANGER

Avoid wearing items of clothing that may become entangled in the machine.

DANGER

The panel machining process generates dust. Avoid inhaling the dust by wearing an appropriate mask.

(*). The status of the system is always displayed on the second line of the main screen (on the left) together with information on the process, operating mode and process execution.

CAUTION

Check that the tools mounted are suitable for the machining programs to be run.

In addition to the instructions provided in this manual, some particular operating procedures also require the use of the NC. In these cases, the operator must also consult the relative OSAI manual.

6.4.1 Switching on the machine

Before switching on the machine, the following operations must be carried out:

a. Pressurise the factory's pneumatic plant.

b. Start the factory's chip extraction plant. Check that the shut-off plate in the connecting duct is open.

The machine can now be switched on.

1. Place the switch on the line from the factory's power supply system in the 1 (ON) position.

2. Place the main switch on the machine in the 1 (ON) position (see paragraph 6.2.1 "Main electric cabinet" on page 6 - 2) and wait for the NC to complete all the self-diagnostic cycles.

This initial phase places the machine in a status in which only the NC (plus a few sensors) is switched on. The PLC displays the message "001: Machine off", "002: Axes not referred". In order to be able to perform any movements on any part of the machine, the machine itself needs to be started up in order to switch on the various actuators.

This second phase of the machine start up procedure can be started by pressing the white "|" button on the service panel (see paragraph "Service panel" on page 6 - 21).

3. Press button "|" on the operator panel.

6.4.2 System start-up in emergency mode

On the Series 10 system, it is possible to run a "minimum" bootstrap which only starts up some of the system functions, thus allowing operations to be carried out that are only possible in this particular environment.

The minimum bootstrap is run by pressing key <F1> during the start-up phase.

The system will display an EMEGENCY DIAGNOSTIC screen. This start-up mode is for use by Protec for diagnostic purposes only.

6.4.3 Machine characterisation (axes Y and W)

The NC allows a number of machine configurations to be managed, enabling variations to be made in the use of the machine. These characterisations (also called AMP) are realised by the constructor by suitably configuring the parameters of the AMP (Adjustable Machine Parameters). The BIESSE milling machine, in general, can be characterised in three different modes: only the first two characterisations concern the operator, the third (called SERVICE AMP) **is for the exclusive use of the assistance service**.

The two characterisations that concern the operator differ only in the management of the worktables, i.e.,:

- **Normal characterisation**. With this characterisation, the right table corresponds to the Y-axis and the left table corresponds to the W-axis. In practice, the tables are independent axes making it possible to perform “reciprocal” machining. Unless specific reference is made to the gantry characterisation, the contents of this manual refers exclusively to normal characterisation.

- **Gantry characterisation**. With this characterisation, the right and left tables constitute a single axis, the Y-axis. Programming the movement of the Y-axis produces the “synchronised” movement of both tables. In practice, the two tables of the machine constitute one single table.

Characterisation selection method

1. From the main menu, access the *AMP DIRECTORY LIST* with the following selectable softkeys: **UTILITY | AMP.** A display will appear containing information of interest to the operator, i.e.:

   Current characterisation (*RUNNING AMP*; top right box).

   Activated characterisation (*ACTIVATED AMP*; top centre box). This becomes the current characterisation the next time the system is switched on.

   List of usable characterisations (*AMP DIRECTORY LIST*; large centre box).

2. Using the keyboard arrow keys move the selector bar onto the characterisation to activate. The names of the characterisations are abbreviated and appear in the following order:

   normal.

   gantry.

   service.

3. Activate the characterisation selected in the previous point using softkey ACTIVATE. If the operation has been carried out correctly, the name of the selected characterisation will appear in the top centre box.

4. To ensure that the activated characterisation becomes the current one (and consequently displayed top right of the screen) switch off the control and then switch it back on again.

6.4.4 Zeroing the axes

Each time the CN is switched on, the message “002: Axes not referred” appears in the logic messages field. This message will disappear when all the axes (co-ordinated and auxiliary) have been referred. The first operation to carry out is to zero the axes (“*homing*”)

To zero or refer an axis signifies executing a cycle that moves the axis to a microswitch defined as the *“machine zero”.* This allows the zero value of the axis to refer to in all subsequent positioning operations to be defined.

The axis zeroing cycle is managed automatically by the NC in the two modes described below. As the action involves moving the axes, obviously the machine must be switched on (button “|” on the service panel) before this function is used.

Zeroing a single co-ordinated axis

- Rotate the Pilot Panel mode selector to the “home” position;
- Select the axis to zero;
- Press the CYCLE START button

If the CYCLE STOP button is pressed during the zeroing procedure, the cycle is suspended. The zeroing operation can then be annulled by pressing the RESET button or restarted by first re-pressing CYCLE STOP and then CYCLE START.

Zeroing all the axes

Select the HOMING softkey from the OEM SOFTKEY menu.

This procedure automatically performs the same operations described for zeroing one axis, though this time for all the axes. The zeroing takes place following the procedure below:

- Z-axis;
- all the remaining co-ordinated axes together and part of the auxiliaries;
- remaining auxiliary axes.

During this operation, the message “Axis zeroing in course” appears in the logic messages field. If the CYCLE STOP button is pressed during this operation, the logic displays the message “Axis zeroing suspended”. The zeroing can now be annulled by pressing the RESET button or restarted by pressing the CYCLE STOP button.

When the machine is switched on, in order to be able to carry out any type of machining, the zeroing operation must be commanded using the softkey(*) . In all other situations in which only co-ordinated axes must be referred, the operator can select either of the two procedures. Obviously, if all the axes are to be zeroed automatically, the use of the HOMING softkey is much quicker and easier.

(*). In fact, all the axes must be referred, including the auxiliaries, which would not be possible when zeroing a single axis.

CAUTION

When zeroing the orienting axes of a raised head, ensure that there are no tools or angular drives mounted.

INFORMATION

Never perform any axis zeroing (HOMING) with the copier inserted in the spindle. Before switching on the machine, check that the copier is not inserted in the electro-spindle as it will rotate during the Homing phase (see paragraph 6.4.4 “Zeroing the axes” *on page* 6 - 28*).*

6.4.5 Starting-up the power unit

When executing the daily start-up routine of the machine, it is recommended that the power units on the machine are made to perform a short warming-up cycle in order to allow the bearings to gradually reach their running temperatures. This can be done by means of a suitable program in which each electro-spindle is used as follows:

25% of maximum rated speed for 3 minutes;

50% of maximum rated speed for 3 minutes;

70% of maximum rated speed for 3 minutes;

STOP ELECTRO-SPINDLE for 1 minute;

85% of maximum rated speed for 3 minutes;

100% of maximum rated speed for 3 minutes.

DANGER

When running the above program, it is advisable to insert a toolholder cone without tool and without ring nut or collet in the electro-spindle.

6.4.6 Switching-off the machine

Always wait until the machine has completed its operating cycle.

INFORMATION

Before switching off the machine completely, memorise any programs being prepared at the time.

Place the main switch on the machine in position 0 (OFF) (see figure on page 6 - 2).

When switching off the machine at the end of the working day, proceed as follows:

1. Switch off the power supply from the factory system to the machine.

2. Shut-off the pneumatic plant at the connection with the main supply system.

3. Padlock the main switch and remove the key, ensure that the door of the main electric cabinet is locked and remove the key. Make sure that the above keys are only accessible to personnel qualified in the use or maintenance of the machine.

6.5 SPECIAL OPERATING PROCEDURES

DANGER

Tools with cutting edges and high temperatures. Wear safety gloves when carrying out any operations.

DANGER

Avoid wearing items of clothing that may become entangled in the machine.

DANGER

Tooling-up operations must only be carried out by ONE PERSON. Ensure that no other person can approach the machine while the above operations are in progress.

CAUTION

Never leave tools on the machine after completing any works.

In addition to the instructions provided in this manual, special operating procedures also requires the use of the NC. Consequently, the operator must also consult the relative programming manual.

6.5.1 Tools

Recommendations for selecting tools

When selecting tools to install on the machine, the following advice should be followed.

DANGER

Never use deformed or cracked tools. The high rotation speed of the tool during the machining cycle may cause separation of the cutting edge, thus risking the life of the operator.

CAUTION

Ensure that rotating tools are perfectly balanced, sharp and suitable for the machining to be carried out.

DANGER

Never use tools beyond the speed limits stamped on the tools themselves or that indicated by the manufacturer.

CAUTION

Before inserting each tool in its housing, ensure that the guide and centring surfaces are clean and unmarked.

CAUTION

Always check that the direction of rotation of the tool is the same as that of the toolholder in which it is to be installed and use the correct M3 or M4 rotation code for the tool(*) .

DANGER

Before carrying out any tooling-up operations, carefully read the warnings in paragraph 6.5 “SPECIAL OPERATING PROCEDURES” ***on page*** 6 - 30***.***

Inserting tools in the power unit

CAUTION

In order to protect the internal parts from the possible infiltration of dust, the electro-spindle must always be fitted with a toolholder cone.

When tooling-up the power unit, use the operating groups or cone adapters, in line with that described in paragraph 4.4 “Electro-spindle” on page 4 - 9 and in the relative sub-paragraphs, previously tooled-up, as described in next paragraphs.

1. Position the operating unit at a point on the machine where the power unit is most accessible.
2. Press the emergency stop button and wait for the safety button indicator light to light up.
3. Open the perimeter protection door to gain access to the spindle.
4. Release any tools using the relative softkeys.
5. Fully insert the cone of the adapter in the electro-spindle housing.
6. Lock the cone in the spindle by rotating it using the appropriate softkeys.

(*). See paragraph “List of M functions” on page 6 - 58.

7. Release the cone and check that it is correctly engaged for rotation and traction.

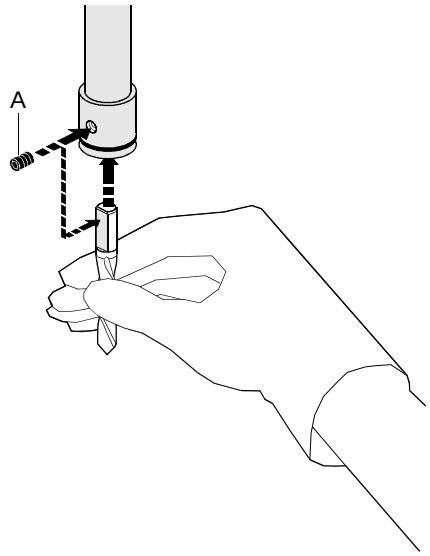
Tooling-up the magazine

DANGER

On completion of the magazine tooling-up operations, check the coherence of the data entered in the current table with the effective tooling-up of the magazine.

1. Position the operating unit at a point on the machine where the power unit is most accessible.
2. Press the emergency stop button and wait for the safety button indicator light to light up.
3. Open the perimeter protection door to gain access to the magazine.
4. Position the pocket in which the tool is to be inserted in the tool change position using the magazine rotation selector while pressing the "ψ" magazine tooling-up button.
5. Release the current pocket by rotating the relative lock/unlock selector to the right.
6. Fully insert the cone of the adapter in the pocket housing and, with the other hand, lock the cone in the pocket by rotating the relative selector to the left.
7. Release the cone and check that it is correctly engaged for traction.

Inserting tools in the boring head



■Position carriage X at the right hand end of the beam.

■Lower the boring head fully and force the descent of the spindles required for tooling.

■Press the emergency stop button.

■Open the right door of the perimeter protection to gain access to the operating unit.

■Insert the tools in the spindles, aligning the flat with locking screw A.

■Lock the tools in position using locking screw A.

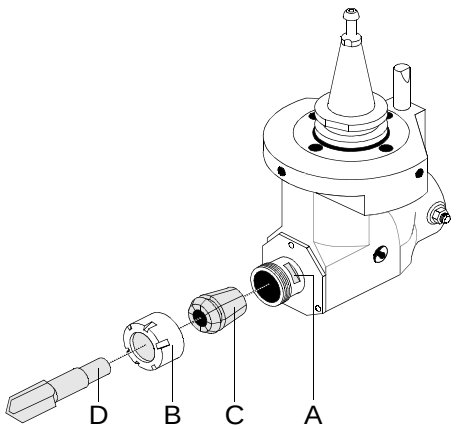
CAUTION

Wear protective gloves during this operation.

Inserting tools in the function units

This paragraph describes an example of a procedure for inserting tools in a function unit.

Chuck with 1 horizontal spindle for milling tools



■Lock the shaft in position using a spanner on flat A.

■Remove lock nut B.

■Position collet C in the relative housing in ring nut B and re-screw the assembly onto the unit, do not tighten. Check that the dimension of the collet is compatible with the dimension of the tool shank to install.

■Insert the shank of the tool D in the collet and tighten the lock nut fully.

CAUTION

All the tools used must comply with the previously described characteristics. Wear protective gloves during this operation.

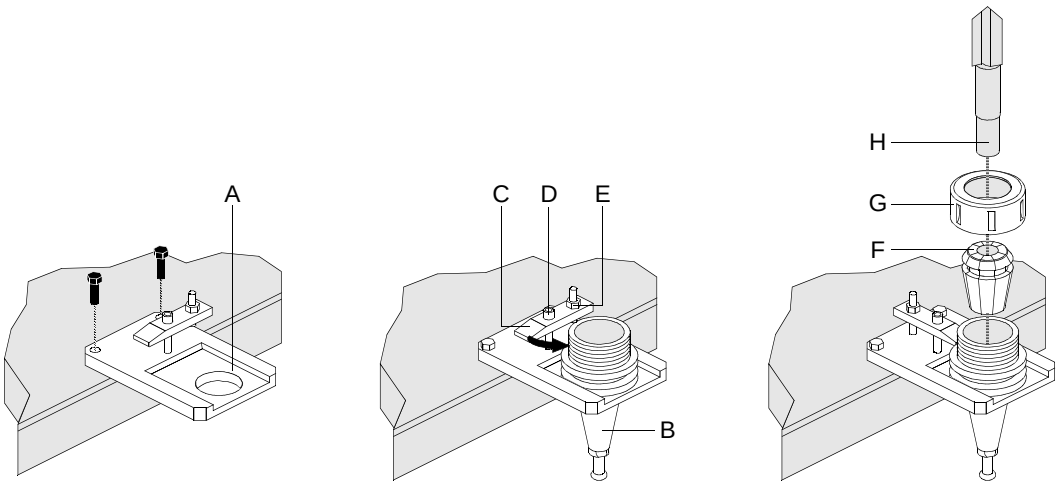
Inserting tools on ISO 30 cone adapters

Referring to the figure below.

CAUTION

Wear protective gloves during this operation.

- Anchor plate A to a firm structure (a workbench for example) using the pre-drilled holes.
- Position bracket C on the adapter.
- Lock the adapter in place using screws D and E.
- Position adapter B in plate A.
- Force collet F into the housing in the lock nut so that the tab on the lock nut enters the cutout in the collet.
- Screw the lock nut onto the adapter (checking that the dimension of the collect is compatible with the dimension of the tool shank to install).
- Insert the shank of tool H in the lock nut-collet assembly and fully tighten the lock nut.



Tooling-up the work table

The semi-worked product can be anchored to the worktable in a number of ways. Nevertheless, the normal clamping method is to use the vacuum system installed on the machine.

Other clamping methods include those that make use of anchor bushes built into the Bakelite table, templates or special modules.

This section describes the normal clamping method. The tooling-up procedure consists of three main phases.

1. Definition of the working area.

2. Locking and releasing the workpiece.

3. Adjusting the level of vacuum and vacuum switch.

In mass production, the definition of the working area and the regulation mentioned in point 3 can only be carried out once.

Definition of the working area

1. Place the table in question in the fully extended position (towards the operator).

2. Press the emergency stop button.

3. Isolate the working area by reproducing the outline of the panel using the gaskets inserted in the table channels.

4. Set up the vacuum holes so that those outside the area covered by the panel are shut-off (use the plugs supplied) and those under the workpiece are open.

Locking the semi-product on the work table

1. Place the panel on the working area defined using the above procedure.

2. Lock the panel in position using the lock/release selector of the panel on the table. The machine must be switched-on (see paragraph “Vacuum area lock/release management” on page 6 - 36).

3. Check that the panel is locked in position.

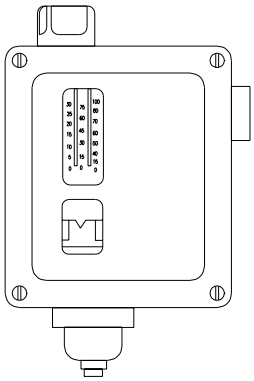
Adjusting the vacuum switch (see figure)

Depending on the type and dimensions of the semi-product to lock onto the worktable, set the minimum value to which the machine will refer throughout the entire machining period to check the clamped status of the semi-product. Below this value, in order to prevent the semi-product or any part of it from being ejected, the machine will stop all movements and enter the emergency or hold condition according to the programming of the control variable @HOLD (see paragraph 6.7.1 “Vacuum area release control” on page 6 - 62).

1. Clamp the semi-product on the table using the procedure described above.

2. Read and note the depression value reached on the vacuum gauge on the pushbutton panel of the working area used.

3. Set the vacuum switch (on the back of the beam) to a depression value **slightly** less than that read at point 2 **though sufficient to guarantee that the semi-product is locked in place**.



DANGER

When assessing pint 2, take into account the actual programmed path of the tool. The current tendency to minimise material waste during cutting quite often leads to small pieces of semi-product being isolated using low depression values with the resulting risk of ejection of the piece by the tool.

Vacuum area lock/release management

The workpiece vacuum clamping system can be managed:

Automatically through suitable programming of the M functions, or manually using the lock/release selectors.

For more information on the vacuum area, refer to paragraph "Tooling-up the work table" on page 6 - 35.

Locking and releasing a vacuum area signifies either manually or automatically activating or de-activating the depression on the area itself and reaching a vacuum value less or higher than the minimum level set on the vacuum switch.

Locking or releasing a vacuum area may not always be successful due to incorrect adjustment of the vacuum switch, incorrect tooling of the worktable or damage to a part of the vacuum system.

Automatic locking and releasing

The automatic locking of a vacuum area is obtained by including the reservation code M in the part program (see paragraph "List of M functions" on page 6 - 58). When the NC executes the

command line containing the above code, the execution of the operating cycle will be suspended until the lock/release selector is activated (see paragraph 1.2.3.1 “Table pushbutton panel” on page 6-5).

From the moment in which the locking mechanism is activated, if the selector is moved and the area is not locked within a pre-set time (a few seconds), the system goes into hold and displays the message “vacuum area lock/release error”. In this condition, the lock command can be repeated without prejudicing the continuation of the operating cycle.

If the lock command is sent by the M function and the vacuum area has already been locked manually, the system confirms the lock but considers it as originating from the M function. **This confirmation of the locking by the M function is very important for safety reasons.**

After successful locking by the M function, the machine logic starts-up the continuous monitoring of the vacuum switch for that vacuum area. If the degree of vacuum falls below the value set on the vacuum switch, the machine is stopped and enters an emergency or hold condition according to the setting of the control variable @HOLD (see paragraph 6.7 “CONTROL VARIABLES” on page 6 - 61).

For safety reasons, when a vacuum area has been locked by the M function, the manual release of the area is only possible when the machine is not executing an operating cycle or when it is in a hold condition.

As with the locking, the release of a vacuum area by the M function must take place within a pre-set time period after the command has been sent. If the area is not released within this time, the system re-locks the area. This behaviour is designed to limit the risks deriving from a situation in which a part of the vacuum plant may not be operating correctly.

Manual locking and releasing

The manual management of the locking and releasing of a vacuum area is used for preparing the piece to machine, during the inspection of a workpiece or to position the semi-product during reciprocal machining.

Contrary to the request made through the M function, the manual locking and release command for a vacuum area does not include a check of the successful implementation of the command within a pre-set time period, or of the effective locking of the piece (if the set-point of the relative vacuum switch is exceeded correctly, the control that the condition reached is maintained is nevertheless activated).

General considerations on the automatic and manual modes.

From the previous descriptions, it emerges that there are differences between the two locking modes. The operator-programmer must pay particular attention to these differences.

- MANUAL LOCKING. The possibility of manual release generates an intolerably dangerous situation.

- AUTOMATIC LOCKING. Release is only possible through the appropriate M function, when the machine is not executing an operating cycle or when it is in the hold condition.

An operator using the vacuum plant correctly will only use manual mode to temporarily position the semi-product, and will use automatic mode for direct locking or to confirm manual locking of the semi-product before it is machined.

The rule that the programmer must always remember is reported below:

DANGER

The M locking functions must always be inserted before the execution of any geometry.

Regulating the pressure for machining in floating mode

Machining in floating mode involves both milling heads.

In order to be able to machine correctly in floating mode, the milling head must be correctly balanced using the regulators and relative pressure gauges (described in paragraph 4.9 “PNEUMATIC PLANT” on page 4 - 18).

The first adjustment can be made by adjusting the downward movement pressure regulator until a value of 1 atmosphere is read on the relative pressure gauge and adjusting the upward movement pressure regulator until a value of 4 atmospheres is read on the relative pressure gauge. A trial machining run will indicate if any corrections are required.

The correct procedure for balancing the head is as follows:

1. Set the control to MDI mode using the mode selector on the Pilot Panel;
2. Program function M11 to work in floating mode;
3. Press EMERGENCY-STOP to enter the emergency condition;
4. Enter the protection and carry out the above adjustment.

Performing a test cycle with the spindles off

The operator can carry out a test cycle of the program that he is about to run on the machine without actually machining the workpiece. If the curtain guards, which normally provide excellent protection for the operator, are lowered, the operator cannot see the effective movement of the head during the test cycle.

To get round this and to allow the test cycle to be executed, a key operated selector has been provided (operated by the operator under his own responsibility) which can be used to de-activate the spindle and lift the curtain guards. **Consequently, each time the curtain guards are raised, the spindle is switched off.**

DANGER

When the operator executes a test cycle with the curtain guards raised, he must ensure that the tool and the workpiece do not come into contact (e.g. raising the head, executing the cycle without the workpiece or moving the origins) to prevent damage to the machine.

6.5.2 Magazine and tool change management

This paragraph describes the management of the machine and workshop tool magazines.

Table management

The *Table editor* is a utility program [TABLES] that allows all the tables necessary for the operation of the control to be managed. The tables involved in this section are:

- Tool Tables (machine tool magazine);
- Tool Data Base (workshop tool magazine);
- Corrector Table (offset);
- Magazine tables.

These tables are normally contained in the system memory (current tables) which stores them even when the machine is switched off. They can be accessed by selecting the item “MEMORY”. In the case where a family contains a number of tables (e.g. for different machining), these can be saved on the hard disk in the form of files, the names of which are displayed on the screen when access to a table is required.

INFORMATION

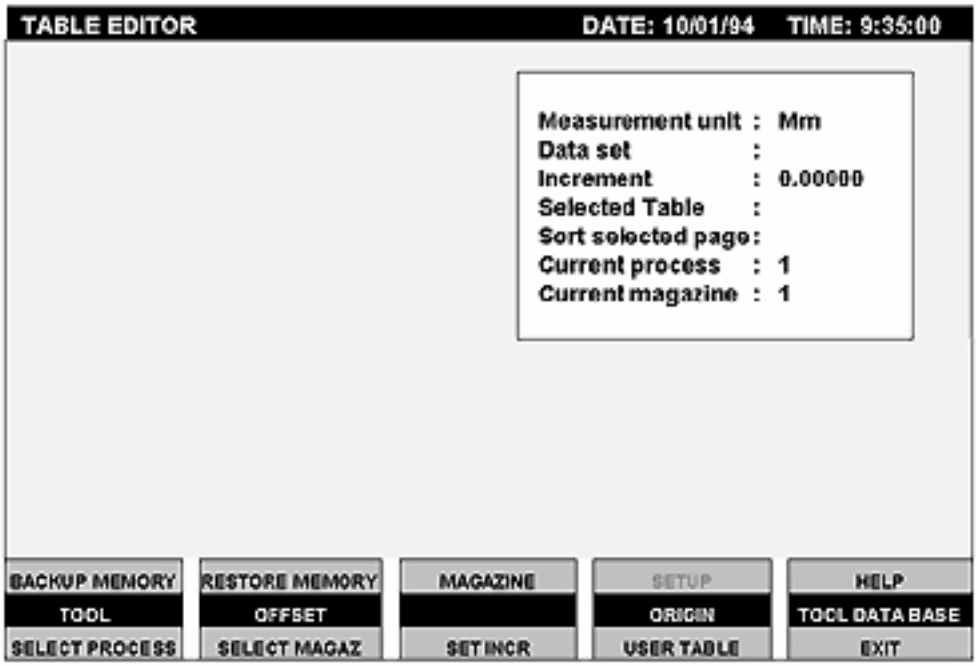
In table management operations, the control always refers to the current table, i.e. that contained in the “MEMORY”.

INFORMATION

Exit the table management utility before executing a part-program.

Activating the table editor

To activate the Table Editor, press softkey **TABLES** in the main softkey menu. The main editor display will appear.



The significance of some of the softkeys in the main table editor display are described in the following table.

SOFTKEY	FUNCTION
BACKUP MEMORY	Makes a backup copy on the hard disk of all the tables memorised in the dual port memory.
RESTORE MEMORY	Restores the backup copy of all the tables to the dual port memory.
MAGAZINE	Allows access to the Magazine Table for entering or editing data.
HELP	Displays an on-line help page for the current input window or the current softkey menu.
TOOL	Allows access to the Tool Table for data input or modification.
OFFSET	Allows access to the Corrector Table for data input or modification.
ORIGIN	Allows access to the Origin Table for data input or modification.
USER TABLE	Enables the management of the user tables by the user (e.g. tool centre point tables).
TOOL DATA BASE	Allows access to the Tool Data Base.
EXIT	Exits the Table Editor and returns to the main softkey menu.

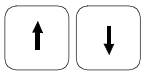
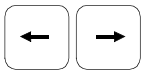
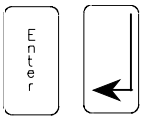
Softkeys common to all Tables

All the tables have a common softkey menu. The softkeys in the menu are:

SOFTKEY	FUNCTION
LOAD MEMORY	Loads the specific table in the dual port memory by taking it from a file on the hard disk.
SAVE MEMORY	Saves a table in the dual port memory to the hard disk.
PRINT	Prints the specified table.
TOOL DATA BASE	Extracts tool data from the Tool Data Base (valid only for the Tool Table being edited).
HELP	Displays an on-line help page for the current input window or current softkey menu.
INSERT	THIS SOFTKEY IS ONLY ACTIVE IN THE TOOL TABLE AND IN THE TOOL DATA BASE. IT ALLOWS A NEW TOOL TO BE INSERTED IN THE TOOL TABLE OR IN THE TOOL DATA BASE.
EDIT	Opens an input window that displays all the fields of a record in the table concerned, allowing any modifications to be made.
DELETE	Deletes the record selected in the current table in the case of a Tool Table or Tool Data Base. Zeroes the fields of the records selected in the User Tables, Corrector Tables and current Origin Tables.
FIND	Searches for the element specified in the first column of the table.
SORT	Allows modification of the criteria governing the order of the selected table.
EXIT	Abandons the current table and returns to the main menu of the Table Editor.

Keys used in the Table Editor

When the Table Editor is active, the following keys can be used for inputting data, moving the cursor and displaying more pages of the table:

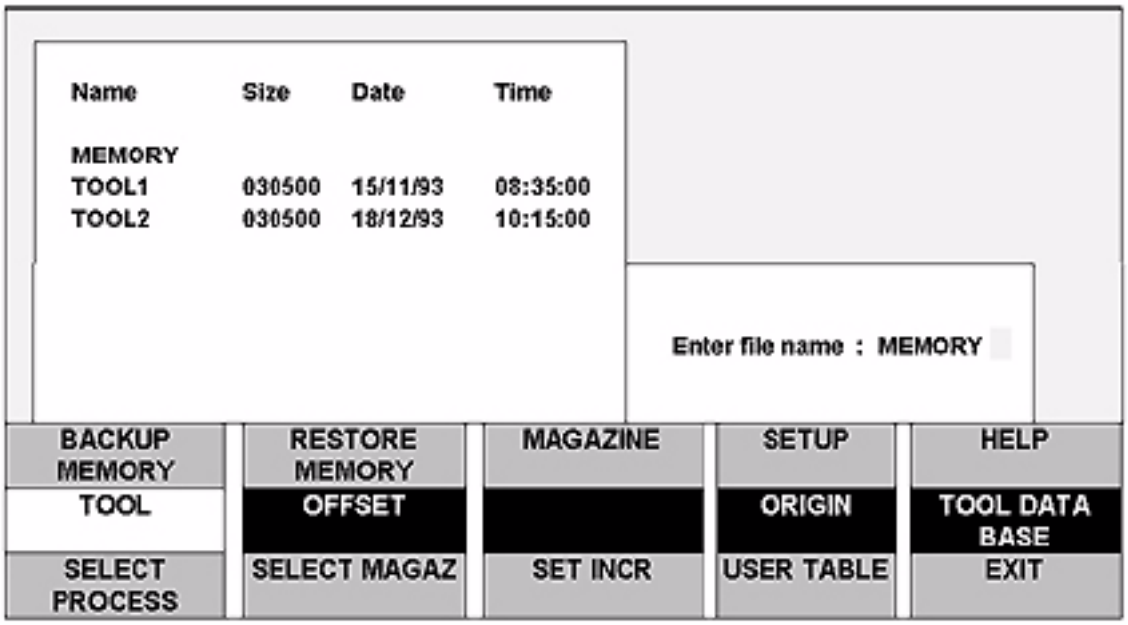
KEY	FUNCTION
PgUp	Displays the previous page of the open table.
PgDn	Displays the next page of the open table.
	Moves the cursor from one field to the next.
	Moves the cursor inside a field
Esc	Exits the EDIT status of a record and returns to the current table without saving any modifications made. Also abandons the window of directories and returns to the main editor display window.
	Confirms an input window.

Opening a Table

To open a table, proceed as follows:

1. Press the **TABLES** softkey in the main softkey menu. The main window of the editor will be displayed.

2. Select the type of table to open (Tools, Correctors, User, Origins) using the relative softkey. The directory window will be displayed. To select the required table, move the selector bar using the arrow keys or type in the name in the data input field.



To open a table stored in the dual port memory, select MEMORY.

To open a table stored on the fixed disk, select the name of the required table in the directory or type in the name in the data input field. Typing in the name of a non-existent table will create a new one.

3. Press **Enter.**

Loading a Table

To load a table stored on disk in the dual port memory, proceed as follows:

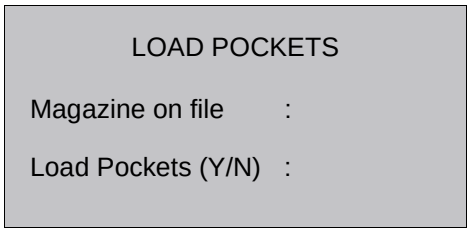
1. Open the table to load using the relative softkey (**TOOL, ORIGIN,** etc.) selecting MEMORY in the directories field.

2. Press softkey **LOAD MEMORY**. The system will display the directory window.

3. Select the name of the required table in the directory window or type in the name in the input window.

4. Press **Enter**.

The system will ask for confirmation to load the file selected. If the answer is N, the table will not be loaded, if the answer is Y the data entry **LOAD POCKETS** will be opened and the table will only be loaded after its fields have been compiled:



The field **MAGAZINE ON FILE** represents the number of the active magazine, while **LOAD POCKETS** allows the pockets recorded in the file to be selected and loaded or otherwise.

Editing a Table

To modify the records of a table, proceed as follows. During the procedure, the window shown on the following page will be displayed (the example proposed relates to editing the table present in the dual port memory).

1. Select MEMORY in the directory window of the table concerned.

2. Select the record to edit by placing the selector bar on it.

3. Press softkey **EDIT**. The fields of the selected record will be displayed in the appropriate window (the figure shows the Tool Table fields):

The fields in the window can be complied and edited following the rules applicable to all the input windows.

- Press **Enter** to confirm the data entered in the table and close the input window.

- Press **Esc** to close the input window and annul the modifications made. This method can also be used when the data of the records needs to be displayed only.

To modify a table stored on disk, replace the word MEMORY in point 1 with the name of the required table.

Magazine Table

Use the following sequence of softkeys and selections(*) :

(*). For a description of the selection sequences, use the following conventions: the softkeys to select are written in capital letters; the selections from the table (using the arrow keys) are written in lower case; “<Enter>“ indicates pressing the enter key; the “|” bars separate the single operations.

[TABLES|MAGAZINE|select “MEMORY”]

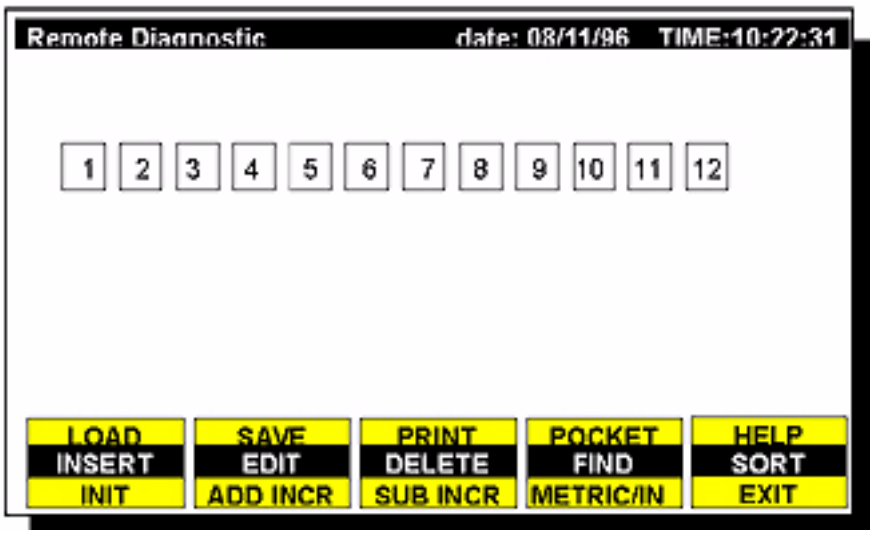
to access the magazine table preconfigured by BIESSE.

The Magazine Table is used to configure the magazine (type, pocket number, etc.) and “reserve” the pockets with regard to characterisation (master pocket or size pocket, allocation of the size pocket with respect to the master, etc.).

To use the machine correctly, the operator must manage one magazine only, i.e. that configured by BIESSE. It must always be active (selected) and must never be modified except in the case of “reserving” pockets".

Reserving a pocket signifies declaring the class of tool that it can hold.

Pressing softkey POCKET displays a window similar to that shown below(*) . The figure represents a 12-pocket magazine.



The following conventions are used in this display:

- Black with white number – free or non-initialised pocket;
- Green with white number - pocket defined as master type;
- Green with black number – size type pocket;

(*). If softkey POCKET is disabled, load file MAGAZ.MAG (using softkey LOAD), exit (EXIT) and restart the magazine editor.

- Red with black number – definition not compatible.

Single or groups of pockets can be “reserved” in the following manner:

Press softkey INIT POCKET. The following input window will appear.

Start pocket	:0
End pocket	:0
Pocket type	:0
Pocket mode	:0

The various fields appearing in the window are described below:

- Start pocket and End pocket: these are the numbers of the first and last pockets of a group that will be defined as belonging to a single type. Start pocket is the number of the first pocket occupied by the tool (master or size).

- Pocket type: this is the type of pocket assigned to the group defined by the Start pocket and End pocket. The following choices are possible:

0. Free pocket

1. Master pocket

2. Master pocket with size pocket to the left

3. Master pocket with size pocket to the right

4. Master pocket with size pockets to the right and left

Pocket mode: the pocket mode can be either 0 or 1:

1. pocket destined for random type tools

2. pocket destined for fixed position type tools

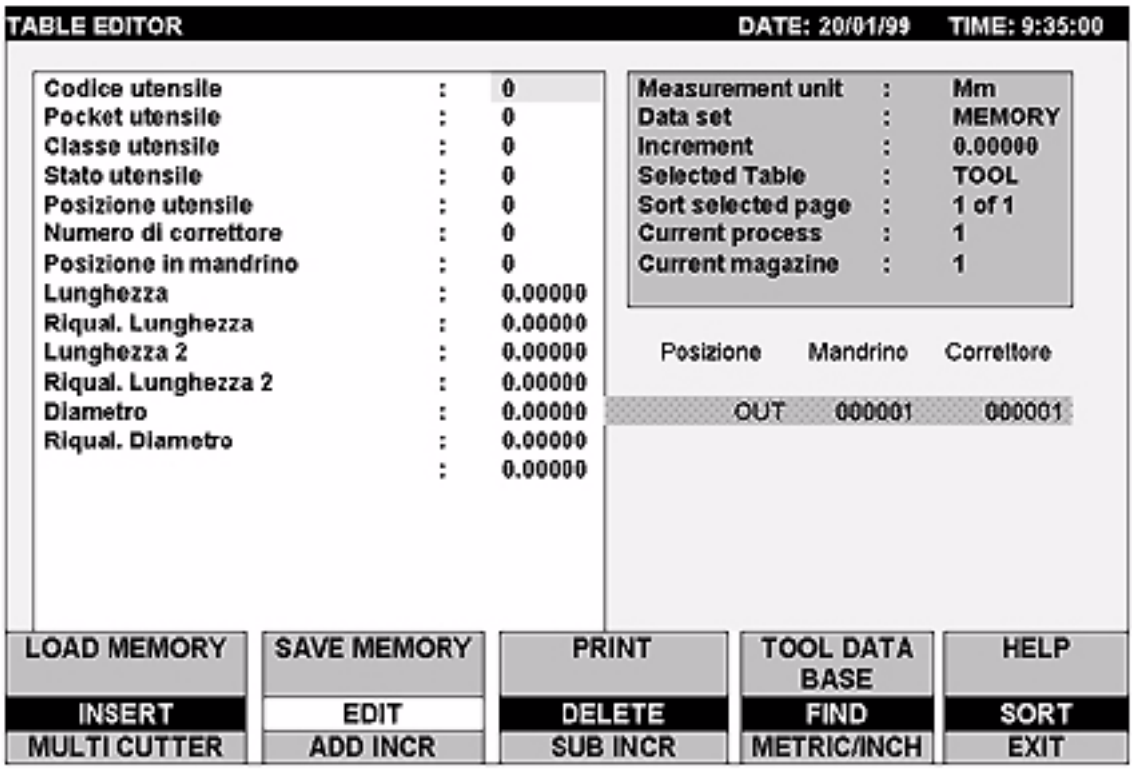
If any pockets have been previously reserved, before characterising the magazine ex novo, all the existing reservations must be cancelled: the *start pocket* must be the first in the magazine, the *end pocket* must be the last in the magazine and the *pocket type* must be 0 (free pocket).

Tool table (machine tool magazine)

Use the following sequence of softkeys and selections

[TABLES|TOOLS|select table|<Enter>|select tool|EDIT]

to access a tool in the **Tool Table.** In the table, the tool will be defined by the merging of the two records, the fields of which describe the functional and geometric characteristics respectively.



Tool code: This is a 12-figure number without any signs that identifies the tool. Some of the figures may be used to indicate the tool family.

Tool pocket: This is a number between 1 and 12 used to identify the position of the tool in the magazine.

Tool class: This number specifies the class of the tool in the magazine, i.e. if the position is random or fixed, and the type of tool (1, 2 or 3 positions). The following table defines the class of tool to enter in the *tool class* field on the basis of either random or fixed type and position occupied (TP indicates the position declared in the *tool pocket* field; Prec. indicates the previous tool position; Succ. indicates the next tool position.

Class	Random	Prec.	TP	Succ.
0	NO			
1	NO		=	
2	NO	=	=	
3	NO		=	=

4	NO	=	=	=
5	YES		=	
6	YES	=	=	
7	YES		=	=
8	YES	=	=	=

Class 0 indicates that the tool is not in the magazine.

INFORMATION

The declared classes must be compatible with the characterisations of the type of pocket occupied.

Tool status: is a number identifying the current status of the tool:

0:	Tool not ready
1:	Tool ready

When a tool is declared as being not ready, it is no longer seen by the logic. If a “not ready” tool is requested, the error message “TOOL CODE ERROR” is displayed. Vice versa, a “ready” tool is always usable.

The status can be used to keep more than one tool with the same code in the magazine, declaring each one “ready” as it is required.

Tool position: This number specifies the current position of the tool with respect to the magazine. If the tool is in the magazine, the number is 1, otherwise it is 0.

Position in spindle: This value specifies in which spindle the tool is inserted if it is not in the magazine. The values possible are 0 (tool in magazine), 1 (tool mounted on spindle 1) and 2 (tool mounted on spindle 2)

Corrector number: A number between 1 and 300 that defines the corrector automatically associated with the tool if it has not already been specified in function “T”. Corrector number 0 does not associate any corrector.

N.B.: The remaining fields in the table are linked to the corrector table (offset). Any new values entered will also be reported in the above table. Refer to paragraph “Corrector table (offset)” on page 6 - 48 for the relative description.

Corrector table (offset)

Use the following sequence of softkeys and selections

[TABLES|OFFSET|select table|<Enter>|select tool|EDIT]

to access a corrector in the offset table.
This paragraph describes the fields that can be used by the machine, i.e.:

- **Length1**. This is the nominal value of the length of the tool. By default, when the machine is switched-on or after a reset, this corrector is associated to the Z-axis. This means that when the offset is active, the value is added to the programmed Z value.

- **Length2**. Has the same characteristics and meaning as **length1** but, by default, is associated to the X-axis.

- **Diameter**. This is the nominal diameter of the tool.

Different associations between length 1, length 2 and the co-ordinated axes can be obtained in ISO programming using the three letters AXO.
Other fields in active offsets include:

- **Length1 requalification**. This is the current requalification value that is added to the nominal length 1 value. This value, when added to the nominal value, supplies the actual length of the tool considered by the system for the correction calculations.

- **Length2 requalification**. As **Length1 requalification** but valid for the second axis.

- **Diameter requalification**. This is the current requalification value that is added to the nominal diamter value. This value, when added to the nominal value, supplies the actual diameter of the tool considered by the system for the correction calculations.

Tool data base (workshop tool magazine)

Use the following sequence of softkeys and selections

[TABLES|TOOL DATA BASE|select table|<Enter>|select tool|EDIT]

to access a tool in the **Tool Data Base.** This is a form of catalogue in which it is possible to insert up to 500 tools and memorise some of the characteristics already seen in the Tool Table. In this environment, it is possible to load or delete tools, modify the characteristics of those already existing or transfer data to the Tool Table.

Updating the tables

During machining, the current table is updated at each tool change. This updating actually takes place when the cycle has been completed.

This information becomes very important when the operator has to intervene manually after an unsuccessful tool change cycle,. For example, if the cycle is interrupted before the end, the manual reset operations must restore the conditions prior to the change, in that the table has not yet been updated (it is nevertheless advisable to check the congruence of the data).

If a tool is managed in random, in general the position occupied after a few tool change cycles is no longer that which it occupied at the time of tooling-up. Therefore, once again, it is advisable to check the coherence of the data in the table and the effective tooling-up data of the machine. Particular attention must also be paid each time the current table is accessed for whatever reason.

The following explanation describes how the table is updated at each tool change. The fields in the tool table to consider are: Tool code, Tool pocket, Position, Spindle and Ready, the meanings of which have already been described in the previous pages.

Let's assume we have tool n°2 in spindle 1 and we want to replace it with tool n° 8 which is in the magazine. The situation before the change is as follows:

Tool code	Tool pocket	Position	Spindle	Ready
...	...	...	…	...
2	4	out	1	1
...	....	...	…	...
8	5	magaz.	0	1

After the tool change, the table will be updated as follows:

Tool code	Tool pocket	Position	Spindle	Ready
...	...	...	…	...
2	5	magaz.	0	1
...	....	...	…	...
8	5	out	1	1

It can be seen that, while all the fields of the tool returned to the magazine have been updated, the tool loaded in the spindle maintains the same position in the pocket even though it has been defined as out.

Therefore, we repeat, all manual operations must be carried out paying maximum attention.

During the tooling-up phase, there is no reason why a specific pocket cannot be given the same tool number. This characteristic is useful when machining materials other than wood, though can create problems in magazine management.

For all the above reasons, during the tooling-up phase and when carrying out any manual intervention, IT IS NOT ADVISABLE TO:

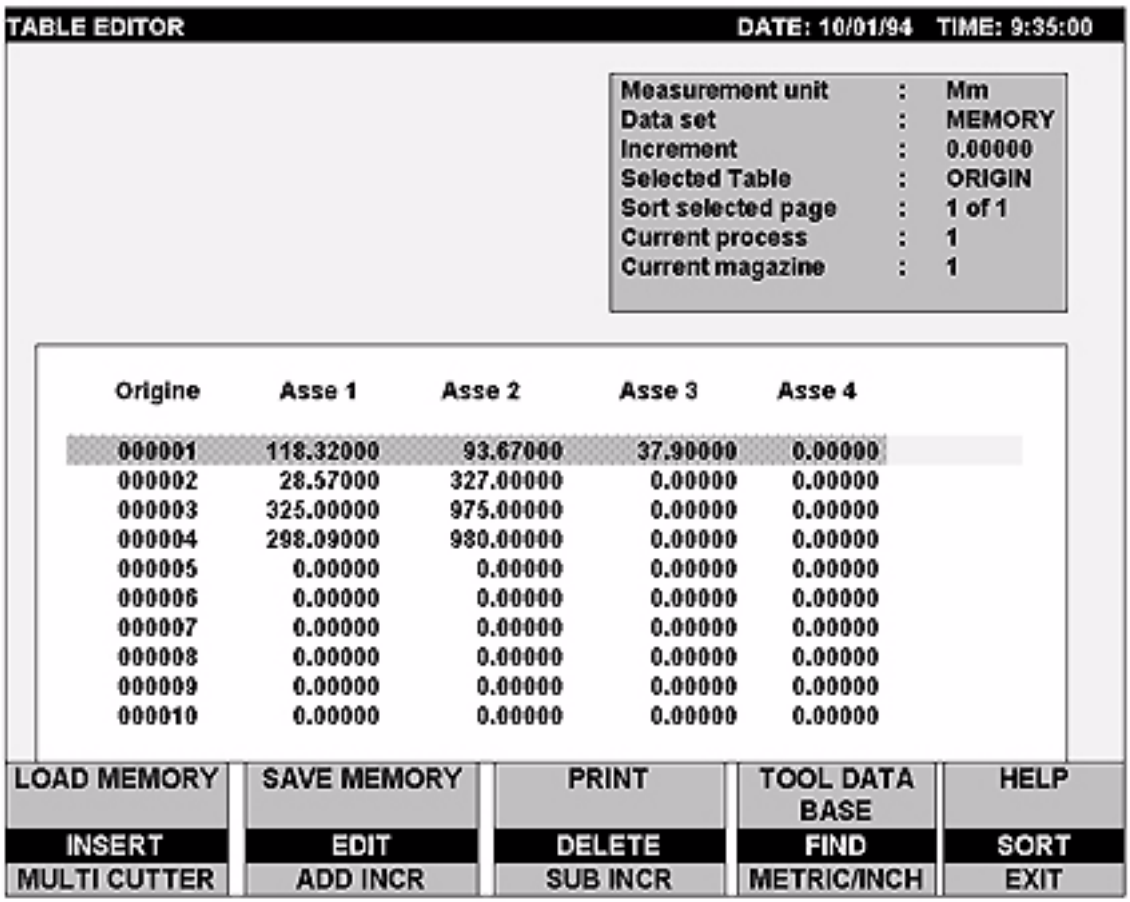
Associate the same tool number to a different pocket;

Tool-up the magazine with a tool already loaded in the spindle.

Origin tables

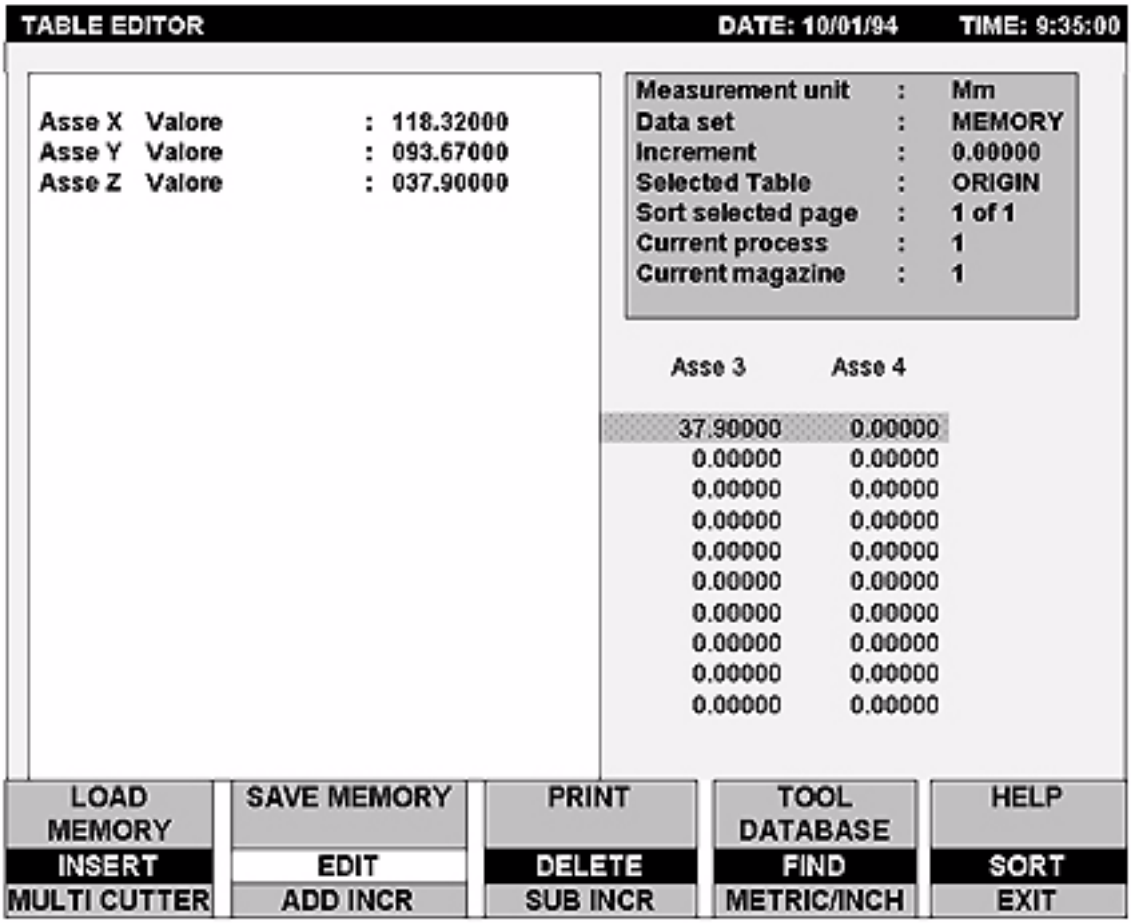
While all the other tables are common to all the processes, the Origin Tables are specific to the process. Up to ten origins can be defined for each of the configured processes. To activate the required origins required by the part program, type-in the instruction UAO with the number

indicating the origin for that process. To disable the origins, enter 0. When the Origin Table is opened (refer to "Opening a table " in this chapter), the following window is displayed:



The selector bar is positioned on the first record, which is the first origin with values relating to four different axes. To modify the values relating to the axes of an origin, select the origin required

using the selector bar and press softkey **EDIT**. A window will appear similar to the one shown below displaying all the parameters (refer to paragraph "Editing a Table" on page 6 - 44).



The input window shows the origins associated to the axes defined in the selected process.

M and T functions (automatic tool change)

The M and T functions are discussed in the chapter dedicated to programming. This particular paragraph shows a few examples through which it is possible to understand how the tool change is requested in a program or by an MDI command.

To change a tool currently machining from inside a program:

Call-up the new tool using the T function;

Activate the tool change using function M7 and the offset associated to it or specified in function M6.

Examples:

T1 M6 M7	Load tool n°1 and activate the associated offset;
T1.3 M6 M7	Load tool n°1 and activate specified offset n°3;
T.2 M6, T0.2 M6	Activate offset n°2 without changing the current tool;
T0 M6 M7, T0.0 M6 M7	Remove the tool (without replacing it with another) and annul the offset;
T.0 M6	Annul the offset while maintaining the tool.
T1.0 M6 M7	Load tool n°1 and annul the offset.

The tool change can be carried out at the same time as other machine functions are executed (e.g. using the boring machine).

In some cases, the conditions of use of the machine and the dimensions of the tools being changed may be incompatible and generate a collision condition (e.g. tooling-up the tracer unit while the boring machine is lowered).

The operator is responsible for programming function M7 in line with the functions that the machine is executing at the time.

NB: The execution of the tool change temporarily disables the following M functions: (M3, M4, M5 if activated for spindles undergoing a tool change), M7, M10, M11, M20, M30, M32, M91, M92, M93, M94 and commands to move axes A, B, C and D (if appertaining to the spindle undergoing a tool change).

INFORMATION

Refer to paragraph 8.2 “SEMANTIC CHECKS EFFECTED BY THE PLC” *on page* 8 - 19 *for greater clarification on the use of the above functions.*

Manual tool change procedure

The automatic management of the actual tool change also includes controls and synchronisms aimed at ensuring its correct execution. For example, the control releases the tool after the shuttle has gripped it and before unloading it. It relocks the tool after insertion and before starting the shuttle. At the end of the cycle, it leaves the shuttle in the precise position.

In the manual management of the same operation, the controls are limited. As for the rest, the manual operations need to be free of the control in order to prevent any blocking by the control itself prejudicing a manual reset.

DANGER

The manual tool change operation takes place under the full responsibility of the operator who must only execute it as a remedy for a machine block situation. The operator must also have read and fully understood the contents of all the paragraphs describing the commands, spindle and toolholder magazine management and the mechanics of the tool change operation.

INFORMATION

When training personnel, it is recommended that the first trial runs are effected without any tools mounted. This will allow the movements of the shuttle and the actions of the commands to be checked.

In order to carry out a manual tool change, the exact sequence of operations described in paragraph 4.12.1 “Tool change mechanism” on page 4 - 25 must be repeated.

In particular:

1.	Position the mode selector on the Pilot Panel in MANUAL mode.
2.	Move the magazine using the appropriate selector on the function panel to position the tool to mount in the pocket required by the tool change.
3.	Engage the tool in the magazine (softkey “FR” submenu CU).
4.	Release the tool from the magazine (function panel selector).
5.	Extract the tool from the magazine by lowering the shuttle (softkey “DW” submenu CU).
6.	Move the shuttle towards the head (softkey “RH” for head 1 or “LH” for head 2).
7.	Raise the shuttle to the cone engaging height of the spindle (softkey “UP” submenu CU).
8.	Place the tool on the spindle (softkey “BK” submenu CU).
9.	Release the tool in the spindle (softkey “1UL” if spindle.1 or “2UL” if spindle 2 in the submenu SPINDLE).
10.	Extract the tool from the spindle by lowering the shuttle (softkey “DW” submenu CU).
11.	Rotate the shuttle 180° to change the tools (softkey “CC” o ”CW” submenu CU).
12.	Raise the shuttle to insert the cone in the spindle (softkey “UP” submenu CU).
13.	Lock the tool in the spindle (softkey “1LC” o”2LC” submenu SPINDLE).
14.	Move the shuttle away from the spindle (softkey “FR” submenu CU).
15.	Lower the shuttle (softkey “DW” submenu CU).
16.	Move the shuttle to the centre of the carriage (softkey “MD” submenu CU).
17.	Raise the shuttle to insert the cone in the magazine (softkey “UP” submenu CU).
18.	Lock the cone in the magazine (selector on function panel).
19.	Move the shuttle away from the magazine (softkey “BK” submenu CU).

DANGER

The manual tool change does not update or modify the tool table.

6.6 PROGRAMMING FUNCTIONS

The basic instructions for writing a program and starting the operating cycle are listed in the “Programming Manual”.

In order to fully understand the directions of the axes, refer to that written in paragraph 4.3.5 “Notes on the definition of the movement of the axes” on page 4 - 9.

DANGER

Do not attempt to modify the machine management programs or the control configurations. BIESSE S.p.A. will not be held responsible for damage or injury caused by any modifications made without prior consent.

6.6.1 Function S

Function S specifies the speed of rotation of the electro-spindle expressed in rpm..

This function is set by typing the letter “S” followed by a positive whole number, which must be greater than or equal to 100 and less than or equal to 20000.

This function is input via the keyboard or read by the program before the spindle rotation function (M3 - M4).

If, in the program, the function M3 (or M4) is not preceded by an S function, an error situation will be generated.

6.6.2 Function T

Function T is entered by typing the letter “T” followed by two values separated by a point, e.g. T X.Y.

The value X must be a positive whole number. Y must be a positive whole number greater than or equal to 0 and less than or equal to 300. This value identifies the OFFSET contained in the appropriate table (see “Programming manual”). Each program will have one of these tables containing the offsets of the tools used in that machining.

A previously programmed OFFSET can be annulled with the function T.0.

After setting the T function, enter the function M7, which activates the tool change, and function M6 for the OFFSET value identified by function T. If, in the programming, function M6 or M7 is not preceded by a T function, an error situation will be generated.

INFORMATION

For proper management of the correctors, refer to that written in paragraph "Corrector table (offset)" *on page* 6 - 48.

6.6.3 Function F

Function F defines the feed speed of the axes. This function is programmable between +0.00001 - +99999.99999. However, if the programmed speed is higher than the maximum speed of the axes, the control will display the effective programmed speed but will work at the maximum allowed speed.

The G codes, which are used in the interpretation of function F, are:

- G70 programming in inches
- G71 programming in millimetres
- G93 feed speed expressed as the inverse of the execution time of the entity (in this case the function)
- G94 feed speed in millimetres/minute or in inches/minute
- G95 feed speed in millimetres/revolution or in inches/revolution

A value of "t" can be expressed to specify the time in seconds required to complete the movement defined in the block. This is only valid within the block in which it is programmed.

6.6.4 Function M

Function M activates a number of machine operations. This command is programmed by typing the letter M followed by a numerical code, which can be between 0 and 999.

No more than 4 M functions can be inserted on one line.

The M function is explained in greater detail in the following paragraphs.

CAUTION

Not all the M functions can be activated when the machine is on HOLD.

Modal and non-modal M functions

An M function can be MODAL or NON-MODAL.

If an M function is MODAL, it will remain displayed on the monitor of the numerical control until another MODAL function of the same category is read (M functions are divided by category) and which will take its place. This is not the case for non-modal M functions.

Some M functions, however, behave in a different manner. The function M5 (spindle stop), for example, is modal and of the same category as M3 or M4 (spindle rotation clockwise or anticlockwise respectively), but after being read and executed, only remains displayed on the monitor for a few seconds before disappearing.

Prelude and postlude M functions

An M function can be a PRELUDE or POSTLUDE type. If a movement block is entered in the program line in which the prelude function M appears, the M function will be activated before the movement block. Vice versa will occur if the M function is the postlude type, in other words it will only be activated on completion of the programmed movement.

Subjects and actions of the M functions

Consider the following M functions (see paragraph “List of M functions” on page 6 - 58)

M35 Activates optional bistable electrovalve 1

M501 Selects head 1

M3Clockwise spindle rotation

M35 specifies the action (activation of a bistable electrovalve) and the subject (optional bistable electrovalve 1).

M501 identifies the subject, head 1.

M3 requests an action, spindle rotation.

In general, as regards subject and action, three types of functions are possible:

1. Functions in which a specific action is requested on a specific subject;

2. Functions in which one or more subjects are identified;

3. Functions requiring actions.

Type C functions require a compatible subject to be identified in the procedure on which the action can be performed. For example, if head n° 2 is to be lowered, then program:

.....
M502
.....
M10
.....

When a type C function requires an action and no subject has been specified, the logic will display an error message (e.g. “spindles not selected”).

List of M functions

The M functions have been programmed by BIESSE and perform physical and logical operations, the precise description of which can only be found in this manual.

The table reported below, together with the relative notes, constitutes the only source officially recognised by Protec. The table also describes a few M functions that refer to functions or devices not included on the machine to which this manual refers. These functions must be interpreted in line with the following considerations.

The machines produced by BIESSE include milling machines differ from each other with respect to dimensions or devices and functions implemented.

In these machines, the same functions are obtained by programming the same M codes.

As the table supplied reports the functions of all standard milling machines produced by BIESSE, the following notes will provide more detailed information on the reading and interpretation of the descriptions.

- The head selection codes (milling or boring) only act on the heads present on the machine. Therefore, for example, if function M 535 is programmed (selection of heads 1, 3, 5 and 7) on a machine that only has one head, the corresponding action will select head n°1 only
- For the axis identification codes, refer to the table on page 4 - 3.
- Some units (e.g. boring head or some types of stops) may not be present on the machine, in which case the corresponding functions are of no interest to the operator.

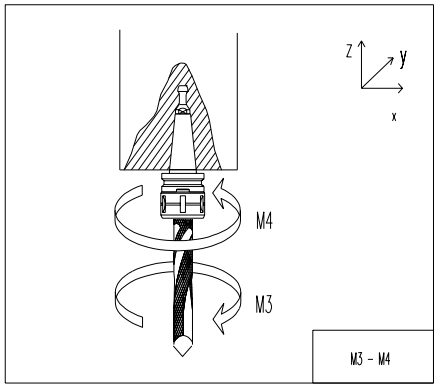
IN GENERAL, CONSIDERATION MUST BE GIVEN TO THE FACT THAT: “the programming of a code dedicated to a function or command for a device that the machine is not equipped with does not generate any errors in the interpretation of the part program. It is simply ignored by the machine logic”.

M	Prelude	Hold	Description
M0	NO	NO	Stop program
M3	YES	NO	Rotate spindle clockwise(*)
M4	YES	NO	Rotate spindle anticlockwise (see note n.9)
M5	NO	NO	Stop spindle rotation

M	Prelude	Hold	Description
M6	NO	NO	Activate new offset(**)
M7	YES	NO	Change tools (see note n.10)
M8	YES	NO	Switch on boring machines(***)
M9	NO	NO	Switch off boring machines
M10	YES	YES	Lower heads
M11	YES	YES	Lower floating heads(****)
M12	YES	YES	Lower boring machines
M20	NO	SI	Raise heads
M22	NO	SI	Raise boring machines
M30	NO	NO	Reset end of program(*****)
M31	YES	YES	Couple locking selectors(******)
M32	YES	NO	Activate blower(*******)
M33	YES	NO	Enable head selection code composition
M41	NO	YES	Uncouple locking selectors (see note n.14)
M42	NO	NO	De-activate blower
M43	YES	NO	Disable head selection code composition
M57	NO	YES	Open right table door
M58	NO	YES	Open left table door
M67	YES	YES	Close right table door
M68	YES	YES	Close left table door
M70	YES	NO	Vacuum lock area 1 and 2
M71	YES	NO	Vacuum lock area 1
M72	YES	NO	Vacuum lock area 2
M74	YES	NO	Vacuum lock area 3 and 4
M75	YES	NO	Vacuum lock area 3
M76	YES	NO	Vacuum lock area 4
M80	NO	NO	Vacuum release area 1 and 2
M81	NO	NO	Vacuum release area 1
M82	NO	NO	Vacuum release area 2
M84	NO	NO	Vacuum release area 3 and 4
M85	NO	NO	Vacuum release area 3
M86	NO	NO	Vacuum release area 4

M	Prelude	Hold	Description
M100	NO	YES	Raise boring bits
M101	YES	YES	Select boring bit 1
M102	YES	YES	Select boring bit 2
M103	YES	YES	Select boring bit 3
M104	YES	YES	Select boring bit 4
M105	YES	YES	Select boring bit 5
M106	YES	YES	Select boring bit 6
M107	YES	YES	Select boring bit 7
M108	YES	YES	Select boring bit 8
M109	YES	YES	Select boring bit 9
M110	YES	YES	Select boring bit 10
M111	YES	YES	Select boring bit 11
M112	YES	YES	Select boring bit 12
M113	YES	YES	Select boring bit 13
M114	YES	YES	Select boring bit 14
M115	YES	YES	Select boring bit 15
M116	YES	YES	Select boring bit 16
M199	YES	YES	Lower selected boring bits
M500	YES	NO	Select all vertical spindles
M501	YES	NO	Select vertical spindle 1
M502	YES	NO	Select vertical spindle 2
M700	YES	NO	Select all boring machines
M701	YES	NO	Select boring machine 1

(*). **M3, M4**. These functions are only accepted if:
a head selection is active;
the spindles are stationary;
a speed greater than or equal to 100 rpm and less than or equal to 20000 rpm has been programmed;
a toolholder cone is inserted in each selected spindle;
the spindles have been enabled using the appropriate key operated selectors and not forced up.



(**). **M6, M7**. If a T function has not been previously programmed, the logic does not have the data to perform the action and therefore function M6 or M7 is rejected ("M function not allowed"). If a T function has been programmed which involves a tool change, function M7 is only accepted if: the spindles are stationary, a selection has been made and the orienting axes (if present) are at 0. For more detailed information on tool change programming, refer to paragraph 6.6 "PROGRAMMING FUNCTIONS" on page 6 - 55.

(***). **M8**. Accepted if a boring machine is selected.

(****). **M11**. If a head is lowered, it can be floated (selecting it then calling M11) without having been previously raised. The contrary, however, is not possible. In order to pass from floating head to head lowered, first raise the head.

(*****). **M30**. This is equivalent to pressing the RESET button.

(******). **M31 M41**. If the simultaneous activation is required of the vacuum in areas 1 and 2 or areas 3 and 4, function M31 only allows one lock selector to be activated, either 1 and 2 or 3 and 4, instead of all of them. Function M 41 disables this operation.

(*******). **M32 M42**. These functions only activate and de-activate the blower on the head selected by the relative code M (M500.. M502).

6.7 CONTROL VARIABLES

The control variables are user variables that can be used as the machine-operator/program logic interface to activate or de-activate controls effected during the execution of the part program. The values of these variables can be defined inside the part program as MDI instructions or through the utility "VARIABLES|PLUS VARIABLES".

A reset returns all user variables to their default values.

6.7.1 Vacuum area release control

@HOLD = 0	This is the default condition. If a piece is released during a machining cycle, the machine enters an emergency condition.
@HOLD = 1	If a piece is released during a machining cycle, the machine enters a hold condition.

After the locking of a vacuum area has been requested and obtained – or confirmed – through an M function, the machine logic checks the status of the relative vacuum switch. If the value of the vacuum falls below the value set on the relative vacuum switch, it identifies a potentially hazardous situation: the ejection of the semi-product caused by the thrust from the tool and axes. In order to prevent this dangerous situation from occurring, the logic forces the machine to stop in the mode selected by the operator in the variable @HOLD.

The shutdown of the machine in an emergency condition (default condition) is preferable to the hold condition, in that the former is quicker and de-activates all the power actuators.

The shutdown in hold condition may be necessary under particular circumstances when, during the initial locking stages, the value of the vacuum is not stationary and generates situations that are incorrectly interpreted by the logic. In this case, the hold status does not prejudice the continuation of the machining.

DANGER

The management of the release in hold must only be used in cases where it is not possible to suitably regulate the vacuum switch.

6.7.2 Pallet movement control

@UDAPALLET = 0	Default condition.
@UDAPALLET = 1	Each movement of the pallets (exit or entry) is preceded by their locking in gantry state (see tapered stem piston) and terminates with the release of the latter.

The condition necessary to make “dual” pallet movement possible is that the machine must have been zeroed and the Y and W axes (right and left table) must be at precisely the same value (in addition to the previous condition for the exit of the pallets, i.e. that the table must be at 0). Obviously, there is no difference as to whether the request for pallet movement comes from the programmed M code or from the selector. If, however, the above condition is not met and the movement request comes from code M, a message will be displayed: *064: “M function not allowed”,* while the request made by the selector is simply ignored. The operation of the pallets with the variable at its default value or with the machine on in Gantry status remains unchanged. The value of the variable remains unaltered until it is re-programmed; a reset of the NC returns the value to default.

6.7.3 Rapid movement control

@ASYNC = 0	Default condition.
@ASYNC = 1	The machine PLC does not wait for the termination of any head raising movement (spindles and/or boring machines) in course before effecting the rapid movement of the X, Y and W axes (if the programmed rapid movement consisted of raising only the Z-axis, there is no waiting anyway).

This means that the programmer can activate this control variable (to save time in positioning the next machining process) only if he is sure that he has programmed the raising of the Z-axis to a “safe” height that prevents the heads from colliding while moving the X, Y and W axes even when the heads are lowered. The value of the variable remains unchanged until it is re-programmed; a reset of the NC returns the value to default.

6.8 MACHINING

When a larger working area than that provided by a single table is required, both tables can be used together and moved as if they were one axis. This is called dual mode machining, which can be achieved utilising two different techniques:

1. *Normal configuration of the machine and use of the UDA code in the part-program*. For a summary and description of this code, refer to paragraph “Axis Programming” in the simplified programming manual.

2. *Configuring the machine in gantry mode*. As already described, when the machine is configured in gantry mode, it behaves as if it were a larger single table machine. This table is regarded by the programmer as the Y-axis.

In dual mode machining, the gantry configuration of the machine guarantees greater precision in table alignment. Trial runs on the workpiece will determine whether it is sufficient to use the UDA code under normal configuration for a particular machining operation.

6.9 NOTE ON THE USE OF ORIENTING AXES

For reasons of size, a tool mounted in the electro-spindle with the head in the raised position (maximum pneumatic travel) cannot be oriented to all positions, in that the tool may collide with carriage Z or with the tool change arm.

In order to reduce the risk of collision, the machine logic limits the movement of the head and orienting axis. These limits are described in the following paragraphs.

- If the height of the orienting axis is not 0, the manual head raising function is disabled and the programming of the M20 and M7 functions is refused (“M function not allowed”).

- The orienting axis of a head that has been forced up is locked. This condition is indicated by the letter “L” alongside the value of the axis. The programming of a locked axis does not result in any movement or any error messages.

DANGER

When a head is in the raised position but has not been forced up, the orienting axis is not blocked. Any programmed movements of the axis are therefore executed, leading to a possible risk of collision.

DANGER

When zeroing the orienting axis of a raised head, ensure that it does not contain any tools or angular aggregate.

When the machine enters an emergency condition, the axes move away slightly from the position they were occupying: an orienting axis set at value zero will lose this position and may induce the conditions mentioned above.

INFORMATION

When using an angular aggregate previously fitted to another head, its reference pin must be re-adjusted to prevent unsafe locking or excessive play.

6.10 DEFAULT CONDITIONS

The following list shows the default conditions of the machine. These conditions are automatically restored after each RESET.

Axis movement

G0	Rapid axis positioning
CET = 0.01	Precision tolerance within which the difference between the initial radius and the final radius of the circle must stay;
FCT = 0.001	Threshold of the complete circle expressed in millimetres;
ARM = 0	Definition of the arc normalising mode;
CRT = 10	Threshold radius for the automatic reduction of the speed in the arcs;
CRK = 1	Automatic reduction factor in the arcs;
G27	continuous operation with automatic reduction of the speed at the corners;
DLA = 1	“Look Ahead” deceleration in dynamic mode G27;
MDA = 90	maximum angular offset of the axis in dynamic mode G27;
VEF = 0.8	factor used to perfect the calculation of the speed at the corners in dynamic mode G27;
ODH = 1	checks the existence of continuous mode movements G28 in the part program with excessive programmed profile speeds;
IPB = 0.02	axis positioning tolerance;
VFF = 0	“Velocity Feed Forward” control of speed and position;
MOV = 2	non-linear acceleration and deceleration ramps;
JERK = 1.875	non-linear ramp execution time;

Origins and control of the co-ordinates

G17	Circular interpolation and profile correction on the XY plane (1^{st} and 2^{nd} axis);
G71	Programming in mm;
G90	Absolute programming;
G94	Feed speed in mm/min or inches/min;

Modification of axis reference system

(SCF)	Scale factor de-activated on all axes;
(MIR)	Specular inversion of the figure disabled on all axes;
(ROT,0)	Interpolation plane rotation disabled;
(UAO,0)	Axes referred to machine zero (home);

Limit switches and protected areas

SOL	Reset limit switch software specified in AMP;
(PAD,n)	Disable protected areas without eliminating definitions (PAD,n).

Virtualising

All virtualising (UPR, UVP, UVC, TCP) is disabled.

Tool programming

T.0	Tool corrector de-activated;
(AXO,-Z,-X)	The first axis is Z, the second axis is X;

Tool diameter compensation

TPO = 1	Path optimisation at corners activated;
TPT = 0.1	Threshold of offset from corner with TPO = 1;

Spindle functions

G97	Rotation speed of the spindle in rpm.

Auxiliary M functions

All selections made using the M function are annulled.

Modification of the program execution sequence

DSB = 0	The barred blocks are executed;

Multi-process management commands

(GTA,X1,Y2,...,Z4,.../-Z,-X)	Restores the normal configuration (contained in AMP);
(RDV,A)	Releases access to drive A:

Control variables

@HOLD = 0	The release of a workpiece during machining causes an emergency condition;
@ASYNC = 0	rapid movement is only allowed with the heads raised;
@UDA PALLET = 0	pallet movement is not preceded by blocking them;

6.11 MACHINE PARAMETERS

The system has a series of user accessible parameters that modify its operation in line with the values set. These parameters, defined as machine parameters, are:

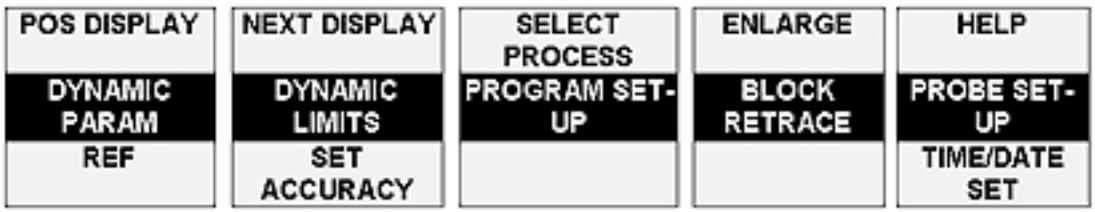
- VFF (Velocity Feed Forward) which defines the behaviour of the system at the corners of the machining.
- Dynamic limits. These are three parameters concerning:

  Automatic deceleration at the corners of the trajectory (DLA)

  Maximum deviation angle (MDA) in G27

  Speed factor (VEF) in G27 at the corners of the trajectory
- Spindle speed limits
- Percentage of return speed in G84
- Tracer parameters
- Axis reference
- Circular interpolation precision
- Hold time for G04
- Time and date.

These parameters are accessed by pressing softkey **MACHINE SET-UP.** The following submenu will be displayed:

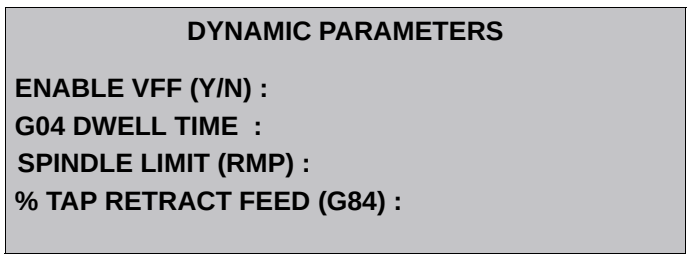


The single parameters and the procedures to apply in order to modify their values and consequently their functions are described below.

Each of the input windows shown is opened by the corresponding softkey in the menu displayed previously. The modifications made in the input windows are confirmed by pressing **Enter** or the same softkey. Press **Esc** to close the window without saving any changes made.

6.11.1 Dynamic Params

The softkey **DYNAMIC PARAMS** opens a window similar to that shown below:



The significance of the fields:

ENABLE VFF (Y/N) can have the following values:

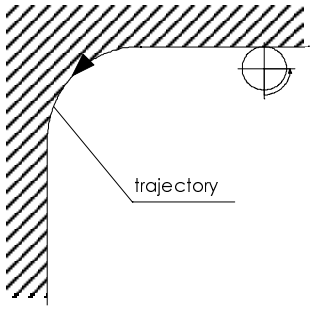
- **Y.** Enables the VFF in the execution of a part program. With VFF enabled and a constant axis speed, the tracking error is almost zero.
- **N.** Disables the VFF in the execution of a part program. With VFF disabled, the tracking error is proportional to the speed of the axis and the ring gain (which is configurable in AMP). Therefore, at constant speed, the tracking error is also constant.

Parameter VFF (Velocity Feed Forward) modifies the value of the tracking error. This error is displayed in the data area of the axes when the ERROR option is selected with softkey **POS DISPLAY**.

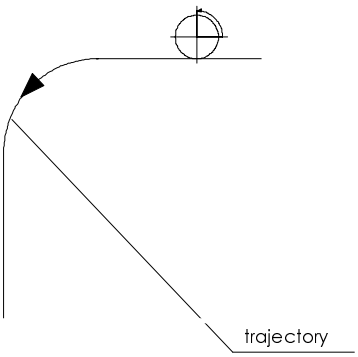
When a part program is active and the movements are executed without any deceleration at the corners (G28), the path followed by the axes changes in accordance with whether VFF is enabled or disabled and can result in errors of form at the corners of the profile:

- Machining with VFF enabled causes trajectory errors, in that the corner is exceeded.
- Machining with VFF disabled causes trajectory errors, in that the corner is cut.

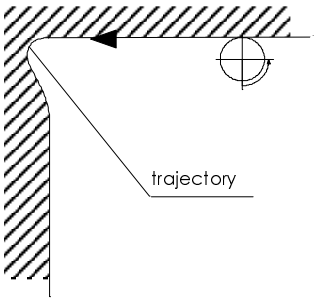
The following figures illustrate four examples of the application of VFF.



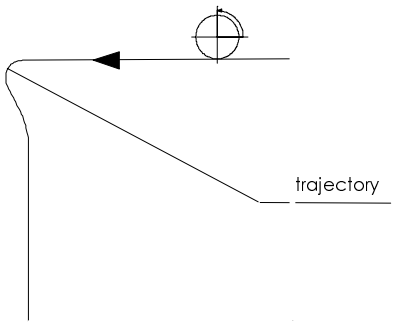
EXTERNAL BLANK WITHOUT VFF



INTERNAL BLANK WITHOUT VFF



EXTERNAL BLANK WITH VFF



INTERNAL BLANK WITH VFF

G04 DWELL TIME

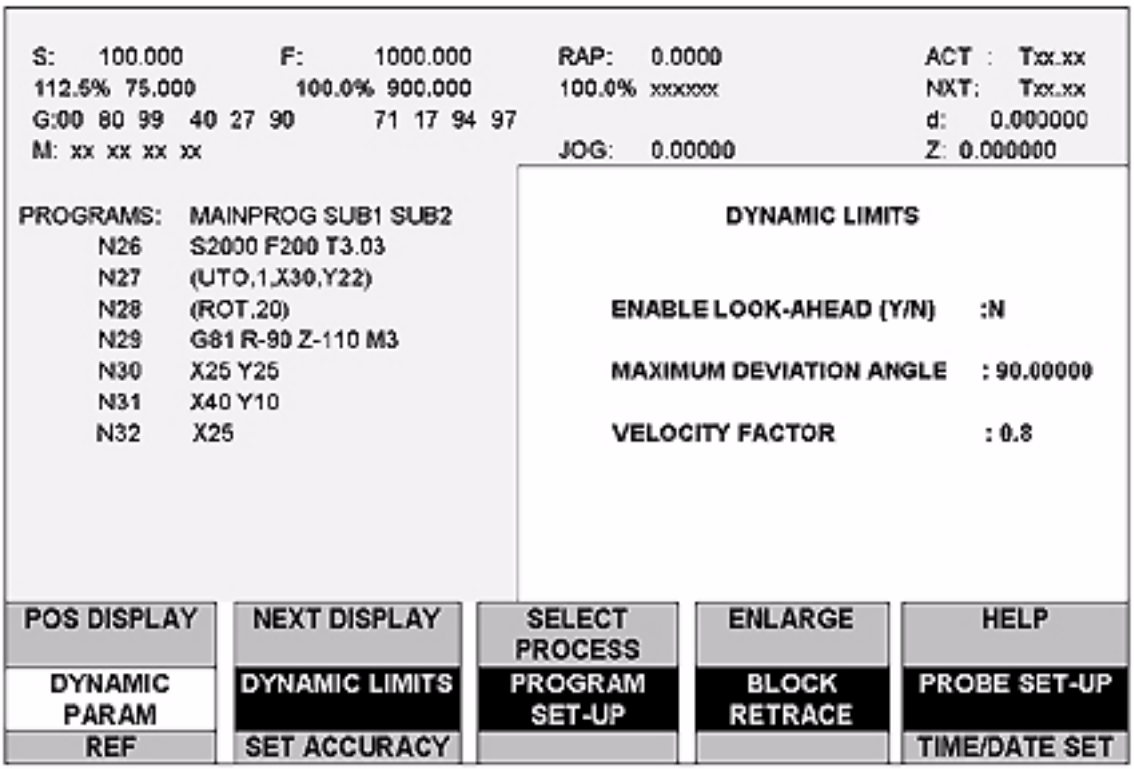
Defines the hold time at the end of the block (G04).

This time is used in G04 and in the following fixed cycle blocks:

- In G94 the hold time is expressed in seconds.
- In G95 the hold time is expressed in revolutions.

For more detailed information on this subject, refer to the Programming Manual.

6.11.2 Dynamic limits



ENABLE LOOK-AHEAD (Y/N)

Automatic deceleration at the corners. This parameter can have the following values:

Y Enables the automatic deceleration at the corners when executing a part program.

N Disables the automatic deceleration at the corners when executing a part program.

If N is selected, any DLA instructions by the current program will be ignored.

MAXIMUM DEVIATION ANGLE	MDA (Maximum Deviation Angle) is the maximum angular deviation of the axis in which G27 is active. The selected angle represents the operative limit for G27. An angular deviation greater than this value will be executed in G29 or point to point mode. The admissible value is between 0 and 180 degrees. The default value is 90 degrees.
VELOCITY FACTOR	The velocity factor (VEF) is a parameter used to regulate the speed at the corners in G27 mode. Small values of VEF cause large reductions in the speed at the corners. The admissible value is between 0 and 999999999999.0. The default value is 8.

For more detailed information on DLA, MDA and VEF, refer to the “Programming Manual ".

6.11.3 SET-UP program

Softkey **PROGRAM SET-UP** opens a data entry window, which allows some of the parameters controlling the execution mode of the part programs to be configured:

- Delete block
- Optional stop
- *Feedrate bypass*
- Rapid speed control
- Rotation
- *Stock allowance*

The following parameters can be configured for each axis:

- axis standstill mode
- Mirror mode

- Scale
- Scale factor

For further information, refer to the on-line Help of the NC using the relative softkey.

Chapter 7. MAINTENANCE

7.1 TYPES OF OPERATION

Machine maintenance operations (ordinary, programmed and extraordinary) constitute special operating conditions.

In addition to the instructions supplied in this manual, the special operating conditions also require the use of the NC. The operator must therefore also refer to the Chapter 6. “USE” on page 6 - 1.

7.1.1 Safety levels

Each operator qualified in the maintenance of the machine must be given a safety level for which he has received adequate training and within which he is authorised to work on the machine.

Minimum safety level is that linked to ordinary maintenance. The operator qualified to carry out ordinary maintenance cannot perform any programmed or extraordinary maintenance.

Maximum safety level is that linked to extraordinary maintenance. The operator qualified to carry out extraordinary maintenance can also perform ordinary and programmed maintenance.

7.1.2 Recommendations

DANGER

Before carrying out any maintenance operations, the personnel concerned must have thoroughly read and understood all that contained in this chapter. Follow the instructions and respect this warning, including when training personnel in the maintenance of the machine. The correct assessment of personnel suitable for the work is the responsibility of the manager of the department in which the machine will be used, in that he is aware of the qualifications of the available personnel. In addition, the maintenance manager must be able to impart his skills to other personnel.

INFORMATION

For lubricating operations, use the products specified by BIESSE in compliance with the relative standards governing handling (see paragraph 10.1 “LUBRICANTS” on page 10 - 1). If the specified lubricants cannot be readily obtained, only use the equivalents as indicated by BIESSE. Do not replace or mix the indicated products with others.

DANGER

Avoid wearing items of clothing that may become entangled in the machine.

DANGER

Do not leave tools on the machine once any work has been completed.

7.1.3 Opening the perimeter protection

The door or window open condition means that the machine enters or is in an emergency condition, i.e.:

If the door or window is opened, the machine enters the emergency condition;

If the machine is in an emergency condition and a door or window is open, the emergency condition cannot be exited.

The doors in the perimeter protection cannot be closed from the inside.

DANGER

Before closing the doors or windows of the perimeter protection, ensure that there is nobody inside.

DANGER

Before entering the protected area, ensure that the tool has stopped completely.

7.2 ORDINARY MAINTENANCE

Ordinary maintenance consists of those operations performed:

- At no particular pre-set time interval but as required by the good sense of the operator;
- Following the normal accumulation of a typical problem linked to normal operation of the machine.

CAUTION

Ordinary maintenance operations can only be performed by suitably qualified personnel.

7.2.1 Cleaning the machine

A properly cleaned machine makes the working environment more pleasant and safe, allowing commands and signals to be identified easily and without error. Follow the recommendations below.

DANGER

Chips produced by the machining process can make the floor slippery. Clean it periodically.

DANGER

The cable chains constitute a risk of finger crushing.

CAUTION

An excessive accumulation of chips can obstruct the movement of the mobile parts of the machine. Clean periodically.

CAUTION

An excessive accumulation of chips in the vacuum pump zone can cause overheating and damage to the pump.

DANGER

The accumulation of dust and chips around hot parts constitutes a potential fire risk.

7.3 PROGRAMMED MAINTENANCE

Programmed maintenance consists of operations carried out at predetermined time intervals as specified by BIESSE. For checking the effective hours of operation of axes, spindles and boring machines, refer to paragraph "Monitoring the operating time of the machine" on page 6 - 14.

DANGER

Programmed maintenance operations can only be carried out by suitably qualified personnel.

Hours of operation	Maintenance operation (with reference to the specific paragraph in the manual)
24	■ Draining condensate from the compressed air tanks on page 7 - 13
	■ Draining water from the electric cabinet conditioner on page 7 - 16

Hours of operation	Maintenance operation (with reference to the specific paragraph in the manual)
50	■ Topping up the lubricant in the FRL unit on page 7 - 15
	■ Cleaning the tapered seating of the electro-spindles on page 7 - 4
	■ Regulating the compressed air pressure on page 7 - 14
	■ Cleaning the electric cabinet cooling filter on page 7 - 16
100	■ Cleaning the operating unit protection on page 7 - 8
	■ Lubricating the function units on page 7 - 10
	■ Topping up the centralised lubrication tank on page 7 - 12
	■ Regulating the compressed air atomiser on page 7 - 14
150	■ Lubricating the tool change shuttle on page 7 - 12
200	■ Cleaning the boring head spindles on page 7 - 8
500	■ Cleaning the head slide guides on page 7 - 5
	■ Lubricating the pallet sliding blocks on page 7 - 10
	■ Cleaning the carriage Z slide guides on page 7 - 6
2000	■ Lubricating the head sliding blocks on page 7 - 9
	■ Lubricating the boring head on page 7 - 11
2500	■ Cleaning the carriage X slide guides on page 7 - 6
	■ Cleaning the pallet slide guides on page 7 - 7

7.3.1 Cleaning

Cleaning the tapered seating of the electro-spindles

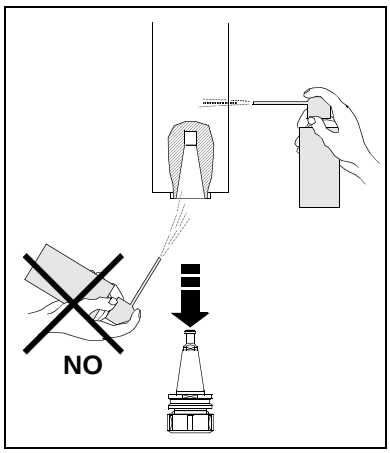
When maintaining the electro-spindle, also refer to that written in paragraph 4.4 “Electro-spindle” on page 4 - 9.

Normally, the tapered seating of the spindle shaft is cleaned automatically with a jet of compressed air during the tool change operation. However, this may not always be sufficient after some machining procedures. Consequently, it is advisable to clean the tapered surfaces of both the spindle shaft (female) and the toolholder cone (male).

Carry out the following operations every 50 hours of operation.

- Position carriage X at the left hand end of the beam.
- Press the emergency stop button.

- Open the left door of the perimeter protection and the door of the extraction box.
- Clean the outside of the head using compressed air. Never clean it without the toolholder code inserted in the electro-spindle.
- Release the toolholder cone from electro-spindle using the appropriate softkey (see paragraph 4.12.1 “Tool change mechanism” on page 4 - 25 for more information on the release command) and remove it slowly using one hand (wear protective gloves and beware of the tool’s cutting edges). Take care not to damage the tapered seating.
- Use a cloth soaked in denatured alcohol or trichloroethylene to clean the surfaces of the tapered seating and toolholder cone.
- After cleaning, in order to prevent the cone from becoming jammed in the electro-spindle, spray the surface of the cone using the product **KLÜBER LUSIN PROTECT G 31**, as shown in Figure 1-1.



Cleaning the slide guides

Cleaning the head slide guides

Carry out the following operations every 500 hours of operation.

- Position carriage X at the left hand end of the beam.
- Raise the heads fully.
- Press the emergency stop button.

- Open the left perimeter protection door and the operating unit protection door.
- Use a clean dry rag to remove any accumulation of grease or dust from the end of the slide guides behind the heads.
- Close the perimeter protection doors.
- Release the emergency stop button.
- Eliminate the machine emergency condition, lower the heads completely and move carriage X onto a table.
- Press the emergency stop button.
- Open one of the two lateral sliding doors in the perimeter protection and enter the protected area.
- Use a clean dry rag to remove any accumulation of grease or dust from the end of the slide guides behind the heads, accessible from above the operating unit protection.

Cleaning the carriage Z slide guides

Carry out the following operations every 500 hours of operation.

- Position carriage X at one end of the beam
- Use the NC to fully raise carriage Z.
- Press the emergency stop button.
- Open one of the two lateral sliding doors in the perimeter protection and enter the protected area.
- Use a clean dry rag to remove any accumulation of grease or dust from the end of the slide guides behind carriage Z.
- Exit the perimeter protection and close the door.
- Release the emergency stop button.
- Fully lower carriage Z.
- Press the emergency stop button.
- Open one of the two lateral sliding doors in the perimeter protection and enter the protected area.
- Use a clean dry rag to remove any accumulation of grease or dust from the upper end of the slide guides behind carriage Z.

Cleaning the carriage X slide guides

Carry out the following operations every 2500 hours of operation.

- Use the NC to position carriage X at the left hand end of the beam.
- Press the emergency stop button.
- Open the sliding door on the left of the perimeter protection and enter the protected area.
- Use a clean dry rag to remove any accumulation of grease or dust from the end of the slide guide on the beam in front of the operator.
- Exit the perimeter protection and close the door.
- Release the emergency stop button.
- Use the NC to position carriage X at the right hand end of the beam.
- Press the emergency stop button.
- Open the sliding door on the right of the perimeter protection and enter the protected area.
- Use a clean dry rag to remove any accumulation of grease or dust from the end of the slide guides on the beam in front of the operator.

Cleaning the pallet slide guides(*)

Carry out the following operations every 2500 hours of operation.

- Place the table in the loading position(**) .
- Press the emergency stop button.
- Use a clean dry rag to remove any accumulation of grease or dust from the end of the slide guides located under the pallets.
- Eliminate the machine emergency condition and reposition the tables in the working position.
- Press the emergency stop button.
- Open one of the two lateral sliding doors in the perimeter protection and enter the protected area. Move behind the beam to reach the rear of the slide guides.
- Use a clean dry rag to remove any accumulation of grease or dust from the end of the slide guides located under the pallets.

(*). These are guides that allow the table to exit the protection when the carriage is at zero height (for more details on the operation of the carriage, pallet and table, refer to paragraph 4.3.3 “Y and W carriages” on page 4 - 7.

(**). The loading position is when the Y/W axis is at zero (0) and the tables are outside the protection (see paragraph “Pallet” on page 4 - 7).

DANGER

Before restarting the machine after it has been idle for a few weeks, clean all the slide guides on the machine following the procedures described above.

Cleaning the boring head spindles

Carry out the following operations every 200 hours of operation.

- Position carriage X at the right hand end of the beam.
- Lower the boring head completely.
- Use the NC to lower all the spindles on the boring head.
- Press the emergency stop button.
- Open the sliding door on the right of the perimeter protection and enter the protected area.
- Check and clean any oxidation from the sliding parts of the spindles (accessible through the relative door), then spray Teflon around the zone.

Cleaning the operating unit protection

Carry out the following operations every 100 hours of operation(*).

- Position carriage X at the left hand end of the beam.
- Press the emergency stop button.
- Open the left door of the perimeter protection and the head protection door.
- Use a powerful suction device(**) to carefully remove any dust that has accumulated in the protection. This will prevent any damage to the action of the moving parts.

7.3.2 Lubrication

Before carrying out any lubrication operations, ensure that there are no air bubbles in the pump to be used. Pay careful attention when filling the pump with lubricant in order to prevent air or

(*). When machining dusty materials, the box may need to be cleaned more frequently.

(**). Never use a blower (not even low output) to remove dust.

impurities from entering which may prejudice the correct lubrication of the moving parts. After filling the pump, activate the pump once or twice to expel any air from the nozzle.

DANGER

Do not overfill; overfilling will cause overheating and damage the components

Lubricating the head sliding blocks

Carry out the following operations every 2000 hours of operation.

- Position carriage X at the left hand end of the beam.
- Fully lower the machine heads.
- Press the emergency stop button.
- Open the sliding door on the left of the perimeter protection and enter the protected area.
- Prepare the lubricating pump (supplied) and connect it to the nipple of the lower sliding block of a head accessible through the relative door.
- Inject grease using the pump until the grease is seen exiting from the gasket of the block in question.
- Repeat the last two operations for the other head.
- Exit the perimeter protection and close the door.
- Eliminate the machine emergency condition, raise the heads fully and position carriage X on a table.
- Press the emergency stop button.
- Open one of the two lateral sliding doors in the perimeter protection and enter the protected area.
- Prepare the lubricating pump (supplied) and connect it to the nipple of the upper sliding block of a head accessible from above the operating unit protection.
- Inject grease using the pump until the grease is seen exiting from the gasket of the block in question.
- Repeat the last two operations for the other head.

Recommended lubricant: **AGIP EP 0**

Lubricating the pallet sliding blocks

Carry out the following operations every 500 hours of operation.

- Position the tables in the loading position.
- Press the emergency stop button.
- Prepare the lubricating pump (supplied) and connect it to the nipple of the distribution block(*) located under a pallet.
- Inject grease using the pump until the grease is seen exiting from all the sliding blocks of the relative pallet.
- Repeat the last two operations for the other pallet.

Recommended lubricant: **AGIP EP 0**

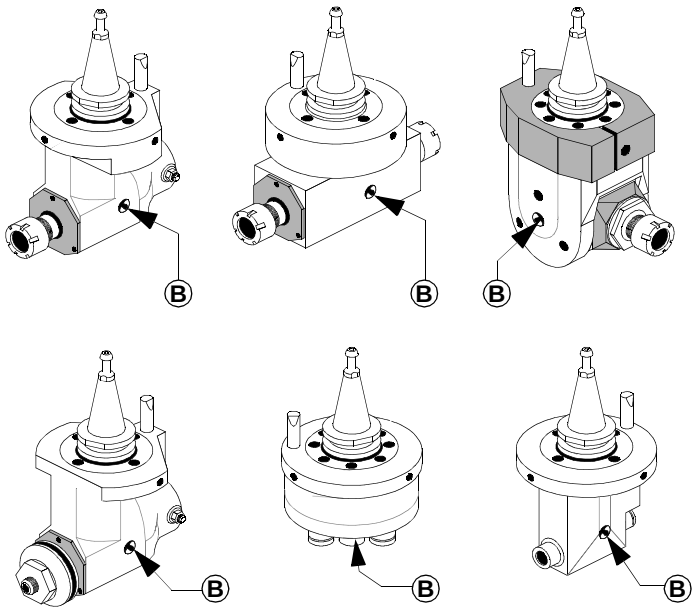
Lubricating the function units

Carry out the following operations every 100 hours of operation.

- Place the unit on a flat stable surface, taking care not to damage any of its components. Wear protective gloves during these operations.
- Connect the pump to the grease nipples on the unit (the grease nipples are indicated with the letter “E” in the figure) and inject approximately 5 grams of lubricant (2 or 3 pumps). Clean the cone.

(*). Each block has four pipes that carry the grease to the pallet slides.

- After cleaning, prevent the cone from jamming in the electro-spindle by spraying the surfaces with the product **KLÜBER LUSIN PROTECT G 31**, as shown in Figure 1-1.



Recommended lubricant: **KLUBER ISOFLEX NBU 15**

Lubricating the boring head

Carry out the following operations every 2000 hours of operation.

- Position carriage X on a table.
- Fully raise carriage Z and the boring head.
- Press the emergency stop button.
- Open one of the two lateral sliding doors in the perimeter protection and enter the protected area.
- Connect the grease pump to the grease nipple accessible over the operating head protection and inject approximately 8 grams (3 or 4 pumps) of grease.

Recommended lubricant: **MOBIL TEMP SHC 100**

DANGER

In the case where spindles are not used too frequently, their free movement may become difficult as a result of oxidation. In this case, it is strongly recommended that the oxide is

removed from the spindle and the spindle sprayed with tri-flow Teflon or an equivalent product.

Lubricating the tool change shuttle(*)

Carry out the following operations every 150 hours of operation.

- Position carriage X at the left hand end of the beam.
- Fully lower carriage Z.
- Press the emergency stop button.
- Open the left door of the perimeter protection and the operating unit protection door.
- Connect the pump to the grease nipple of a shuttle slide block.
- Inject grease until the lubricant is seen exiting from the gasket of the relative slide block.
- Repeat the last two operations on the other shuttle slide blocks.

Recommended lubricant: **AGIP EP 0**

7.3.3 Topping up the centralised lubrication tank

The grease must be injected into the tank using a round head grease pump, taking care not to inject dirty grease or any other impurities which may prejudice the operation of the pump and distributors.

This procedure must be followed every 100 hours of operation and when the message “Low grease level(**) ” appears on the monitor of the NC.

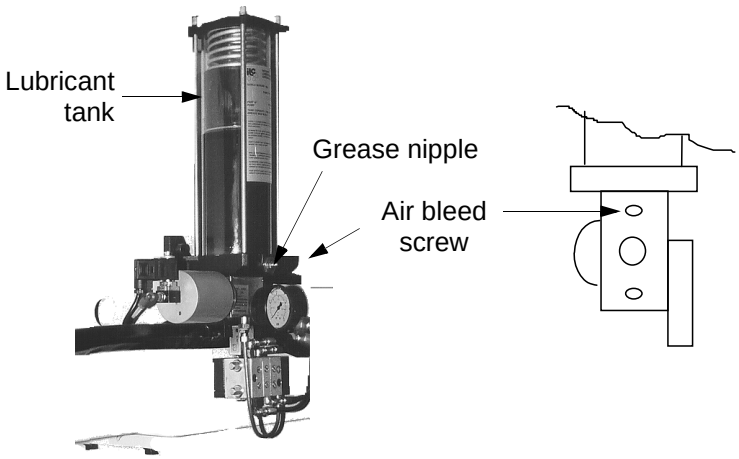
- Press the emergency stop button.
- Open one of the two lateral sliding doors in the perimeter protection and enter the protected area.
- Connect the pump to the grease nipple of the tank and inject lubricant up to the maximum level when the grease can be seen leaking from the drain hole.

(*). The tool change shuttle is the mechanical arm necessary for removing and inserting the cones in the heads during the automatic tool change.

(**). See paragraph 8.1.1 “Error messages” on page 8 - 2 (message number.) for more information.

- Slacken the air bleed screw on the pump body and use the NC to effect a few lubricating cycles.

Recommended lubricant: **AGIP EP 0**



7.3.4 Pneumatic plant

For the FRL unit, the instructions provided in the following descriptions refer to the figure on page 4 - 18.

Draining condensate from the compressed air tanks

Manual

Carry out the following operations every 24 hours of operation.

- Press the emergency stop button.
- Open one of the lateral sliding doors in the perimeter protection and enter the protected area.
- Place a container under valve “N”.
- Press the valve upwards until all the condensate has drained out.

Automatic

To allow the condensate to drain automatically, leave drain valve “N” under the collection sump “F” in the open position. Carry out this operation if there is no pressure in the pneumatic system.

DANGER

Use the NC to fully raise the Z-axis. Then use the appropriate selectors to manually lower all the spindles and the boring machine to prevent them falling under their own weight when the compressed air is shut-off (if the ports are closed they will be broken).

Regulating the compressed air pressure

Every 50 hours of operation, check that the pressure indicated on pressure gauge “E” on the main filter unit (FRL) is between 6-7 bar; otherwise proceed as follows:

- Press the emergency stop button.
- Open one of the two lateral doors in the perimeter protection and enter the protected area.
- Lift bayonet valve “A” located above the FRL unit and rotate it clockwise to increase the pressure, or rotate in anticlockwise to decrease the pressure.
- When the adjustment is complete, press the bayonet valve to return it to its original position and lock it in place.

Regulating the compressed air atomiser

The compressed air atomiser is set by Protec during factory testing of the machine. The atomiser is set so that one drop of oil falls into chamber “D” of the lubricator every 7-8 tool change cycles. Check that this frequency is correct every 100 hours of operation, proceeding as follows:

- Create a small part program that instructs the machine to perform repetitive tool change cycles.
- Start the program.
- Stand at the side of the machine and watch the FRL unit to monitor the frequency of the drops of oil.

If the oil flow is not correct, re-adjust as follows:

- Press the emergency stop button.
- Open one of the lateral sliding doors in the perimeter protection and enter the protected area.
- Slacken or tighten the black screw located above chamber “D” in small steps.
- Exit the protected area, close the door and eliminate the emergency condition.
- Run the test program created to run the machine in continuous tool change cycles.
- Stand at the side of the machine and watch the FRL unit to monitor the frequency of the drops of oil.

- Repeat this procedure until the required result is obtained.

Recommended lubricant: **MOBIL DTE 24**

Topping up the lubricant in the FRL unit

Every 50 hours of operation, check the level of oil in the lubricator sump located below the indicator chamber. If the level is at minimum, proceed as follows:

DANGER

Use the NC to fully raise the Z-axis. Then use the appropriate selectors to manually lower all the spindles and the boring machine to prevent them falling under their own weight when the compressed air is shut-off (if the ports are closed they will be broken).

- Press the emergency stop button.
- Open one of the lateral sliding doors in the perimeter protection and enter the protected area.
- Shut off the compressed air supply by pressing knob “B”
- Pull knob “A” upwards and unscrew it completely to eliminate any residual pressure. The indicator on the pressure gauge should read 0 (zero) bar.
- Unscrew lubricator cup “G”.
- Top up with lubricant up to maximum level.
- Replace the cup and tighten it back to its original position.
- Rotate knob “A” until a pressure of 6.5 bar is read on the pressure gauge.
- Press the knob to lock it in position.
- Lift knob “B” to fed the FRL unit.

7.3.5 Vacuum plant

Refer to the instructions on the vacuum pump in the “Becker” manual.

7.3.6 Electrical plant

Cleaning the electric cabinet cooling filter

Carry out the following operations every 50 hours of operation.

- STOP THE MACHINE.
- Remove the filter protection cover.
- Check that the part of the filter in contact with the cover is not discoloured and free of dust. Otherwise, blow compressed air from the part not in contact with the filter cover towards the part in contact. Do not blow air in the reverse direction as this will damage the filter.
- When cleaning is complete, replace the filter and cover in their original positions.

Draining water from the electric cabinet conditioner

Every 24 hours of operation drain the water from the container under the electric cabinet conditioner.

7.4 EXTRAORDINARY MAINTENANCE

Extraordinary maintenance consists of operations carried out following a breakdown or for foreseeable technical updating.

Extraordinary maintenance operations can only be carried out by suitable qualified personnel (see paragraph 7.1.1 “Safety levels” on page 7 - 1).

Do not replace any parts of the machine without first contacting the BIESSE S.p.A assistance service.

BIESSE will not be held responsible for any damage or injury resulting from extraordinary maintenance work being carried out by not suitably qualified personnel and/or by non-compliance with the specified safety precautions for that particular operation. Neither will BIESSE be held responsible for damage or injury resulting from modifications made to the machine not provided for by PROTECT during the design stage.

On completion of each extraordinary maintenance operation, make a note of the nature of the work, the date and the person responsible on the machine job card. This card must be kept by the person responsible for the machine.

For any spare parts or unified industrial components (replaceable with others of identical characteristics) contact the BIESSE assistance service.

7.4.1 Inverter malfunction (inverter exclusion)

The inverters have internal self-diagnostic circuits and software that intervene on both the auxiliary safety circuit of the machine and on the PLC. A malfunction in the inverter is therefore detected by the machine at hardware level (by the auxiliary safety circuit) and at software level (by the PLC) and places itself in an emergency condition. The exit from the emergency condition is only possible if the inverter starts to function correctly or is excluded.

The exclusion of the inverter is a temporary solution that, even with the exclusion of the spindle it controls, allows the machine to be used with the remaining spindles. This is achieved by using the selector located inside the main cabinet to the left of the main switch. The exclusion is effective at hardware and software level, as a result of which both the auxiliary safety circuit and the PLC no longer consider the inverter, making any attempt to power it impossible and preventing any emergency situation resulting from its malfunction from arising.

7.5 EMERGENCY PROCEDURE

In the case of fire, check that the fire has been completely extinguished and that there are no residual hot spots in other parts of the machine.

Ascertain the damage to the machine.

Formulate a program for restoring the machine back to a safe operating condition.

Note the event and the relative consequences on the machine card.

If the machine has been damaged, shut it down and affix a clearly visible sign prohibiting its use.

Instigate the programmed repair procedures.

Remove the sign and enable the machine for normal operation.

Note the repairs carried out on the machine card.

7.5.1 Fire extinguishers

In the case of fire, use the following types of extinguisher:

- If the panels being machine are on fire, use Class A (21 A) extinguishers.
- If the fire involves electrical equipment on the machine, use Class E extinguishers.

DANGER

Do not use water to extinguish a fire involving the machine's electrical equipment.

7.6 MAINTENANCE AND REPAIR INSTRUCTIONS

DANGER

In the case of a malfunction in the axis drive motors, do not intervene but call the BIESSE S.p.A. Assistance Service immediately.

Thermomagnetic switches

If one of these switches trips, press the appropriate reset button.

If a thermomagnetic switch continues to trip, proceed as follows:

- If the trip is instantaneous when the switch is reset or when the POWER ON button is pressed, this means that there is a short circuit in the line or in a device protected by that switch. Eliminate the short circuit;
- If the trip is repeated some time after reset (varying from a few seconds to a few minutes), this means that the device protected by the switch is absorbing more than its nominal current. Check the compliance of the measured current with that on the device rating plate or on the wiring diagram. If the calibration current is correct, contact the BIESSE S.p.A Assistance Service.

DANGER

Do not interfere with or modify the calibration of the thermomagnetic protectors.

Chapter 8. TROUBLESHOOTING

8.1 LOGIC MESSAGES

There is a permanent field (red background) in the top right of the screen dedicated to messages that the machine logic sends to the operator cyclically. These messages consist of an identification code and a string of 34 characters summarising the content.

The following table shows the error messages, some possible cause of the error and some actions that can be taken to remedy the problem signalled by the logic.

DANGER

The remedy operations described in the table must be carried out by personnel qualified in line with that specified in the maintenance manual.

The last column of the table contains a number or character appertaining to each logic message, the meanings of which are as follows:

1: the message will be cancelled when exiting HOLD (or RESETTING);

2: the message is cancelled with RESET;

3: the message is self-managed by the NC;

4: the message can only be cancelled by switching off the NC;

*: the message is recorded in the system history(*) .

(*). The **SYSTEM HISTORY** (accessible through softkeys [**DIAGNOSTICS**|**SYSTEM HISTORY**]), loads the display containing all the service messages and error messages received from the PLC, displaying the time sequence and the moment of generation. The last 200 messages are displayed.

8.1.1 Error messages

C.	PLC MESSAGE	CAUSE	REMEDY	
0	Initialising logic	•Appears when the control is switched on when the main page is displayed.	•Information message: wait.	3
1	Machine off	•Machine not switched on.	•Switch on the machine.	3
2	Axes not referred	•The axis zeroing cycle has not been executed.	•Activate the axis zeroing procedure.	3
3	SERIOUS EMERGENCY: Switch off the NC	•Error in the control.	•Switch off the machine and restore normal operation. If required, call for assistance.	4
4	NC emergency	•Error in the control.	•Reset the control.	2
5	Co-ord axes interp. emergency.	•Axis interpolator error.	"	2
6	Inverter emergency	•Inverter operation error.	•Reset the control. If required, call for assistance.	2
7	Unit 1 drive emergency	•The control is executing a RESET.	•Information message: wait.	3
8	Unit 2 drive emergency	"	"	3
9	Unit 3 drive emergency	"	"	3
10	Emergency stop/doors activated	•An EMERGENCY-STOP button has been pressed. •Perimeter protection door has been opened.	•Reset the emergency stop button. •Close the doors.	2
11	Thermomagnetic trip	•Thermomagnetic trip in electric cabinet.	•Reset thermomagnetic switch and switch on cabinet.	1
12	Switching on in course	•The control is executing the switch on procedures.	• Information message: wait.	3
13	Reset in course	•The control is executing a RESET.	• Information message: wait.	3
14	Axis zeroing in course	The machine is executing the axis zeroing cycles.	• Information message: wait for procedure to end.	3

C.	PLC MESSAGE	CAUSE	REMEDY	
15	Axis zeroing suspended	•Zeroing cycle has been interrupted by the CYCLE-STOP button being pressed	•To continue the cycle, re-press CYCLE-STOP followed by the START button.	3
16	Phase error: re-zero X-axis	•Axis encoder count error.	•Reset the control, repeat axis zeroing.	2
17	Phase error: re-zero Y-axis	"	"	2
18	Phase error: re-zero W-axis	"	"	2
19	Phase error: re-zero Z-axis	"	"	2
20	Phase error: re-zero A-axis	"	"	2
21	Phase error: re-zero B-axis	"	"	2
22	Phase error: re-zero C-axis	"	"	2
23	Phase error: re-zero D-axis	"	"	2
24	Phase error: re-zero P-axis	"	"	2
25	Phase error: re-zero Q-axis	"	"	2
26	Phase error: re-zero Magazine 1	"	"	2
27	Phase error: re-zero Magazine 2	"	"	2
28	Phase error: re-zero Magazine 3	"	"	2
29	Phase error: re-zero Magazine 4	"	"	2
30	Phase error: re-zero preset u	"	"	2
31	Phase error: re-zero preset v	"	"	2
32	Phase error: re-zero preset w	"	"	2
33	Phase error: re-zero preset z	"	"	2

C.	PLC MESSAGE	CAUSE	REMEDY	
34	Emergency from spindle interpolator.	•Spindle interpolator error.	•Reset the control.	2
35	Emergency from P-axis interpolator	•Interpolator error.	"	2
36	Emergency from Q-axis interpolator	"	"	2
37	Emerg. from interpolator Magazine 1	"	"	2
38	Emerg. from interpolator Magazine 2	"	"	2
39	Emerg. from interpolator Magazine 3	"	"	2
40	Emerg. from interpolator Magazine 4	"	"	2
41	Emerg. from interpolator preset u	"	"	2
42	Emerg. from interpolator preset v	"	"	2
43	Emerg. from interpolator preset w	"	"	2
44	Emerg. from interpolator preset z	"	"	2
45	Spindle overheat vert. 1	•Excessive spindle temperature. •Incorrect operation of temperature sensor. •Incorrect operation of cooling fan.	•Allow the head to cool down; check operation of the cooling electro-valve and temperature sensor; if required, call for assistance.	1
46	Spindle overheat vert. 2	"	"	1
47	Spindle overheat vert. 3	"	"	1
48	Spindle overheat vert. 4	"	"	1
49	Spindle overheat vert. 5	"	"	1
50	Spindle overheat vert. 6	"	"	1
51	Spindle overheat vert. 7	"	"	1
52	Spindle overheat vert. 8	"	"	1
53	Spindle overheat vert. 9	"	"	1
54	Spindle overheat horiz. 1	"	"	1

C.	PLC MESSAGE	CAUSE	REMEDY	
55	Spindle overheat horiz. 2	"	"	1
56	Spindle overheat horiz. 3	"	"	1
57	Spindle overheat horiz. 4	"	"	1
58	Excessive cabinet temperature	•Excessive temperature inside the electric cabinet.	•Allow the electric cabinet to cool down and check the cleanliness of the conditioner on the cabinet. If required, call for assistance.	1
59	Low compressed air pressure	•Compressed air pressure below the minimum.	•Check the efficiency of the pneumatic plant. •Check that the pressure gauge registers 6 bar.	2
60	Low grease level.	•Low grease level in the centralised automatic lubrication system tank.	•Top-up tank with grease.	* 3
61	Grease pump inefficient	•Malfunction in the centralised automatic lubrication system.	•Check that the grease distribution pump is working properly. •Check for the presence of air bubbles and then attempt a lubricating cycle using the appropriate softkey manually (see paragraph 7.3.3 “Topping up the centralised lubrication tank” on page 7 - 12).	
62	No lubrication: grease tank empty	•Automatic lubrication cycle not executed due to lack of grease in the centralised automatic lubrication system tank	•Top-up tank with grease.	* 1
63	S function not allowed	•The S function has not been used correctly. •Code G96 active.	•Delete code G96 from the program. •Consult paragraph 8.2 “SEMANTIC CHECKS EFFECTED BY THE PLC” on page 8 - 19 to check which error has been made.	2

C.	PLC MESSAGE	CAUSE	REMEDY	
64	M function not allowed	•The M function in question has not been used properly.	•Check the M function application rules.	2
65	Maximum speed limit exceeded	•Spindle rotation speed requested is higher than 20000 rpm.	•Enter a spindle speed value of less than 20000 rpm.	2
66	Speed lower than 100 rpm	•No spindle rotation speed request before spindle rotation function M.. •Requested spindle rotation speed lower than 100 rpm.	•Enter the S function spindle rotation speed request. •Enter a spindle rotation speed value of not less than 100 rpm.	2
67	Incorrect tool code	•Requested tool code not present in the table or in the spindle. •Declared tool not usable. •Tool table still open.	•Compile a correct tool table or request a tool code present in the table. •Check the value of the status field. •Ensure that the tool table is closed.	2
68	Tool offset error	•Requested offset code higher than 300. •Offset associated to the requested tool incorrect.	•Enter correct offset code. •Correct the table or request different offset code.	2
69	Offset update error	•Control error when activating requested offset (tool correction).	•Reset the control. If the problem persists, call for assistance.	2
70	Incongruent magazine	•Refer to paragraph 8.2 “SEMANTIC CHECKS EFFECTED BY THE PLC” on page 8 - 19 to determine which error has occurred.	•Eliminate the problem and repeat the operation.	2
71	Tool change safety active	•Spindle inertial rotation safety active.	•Wait 4 minutes.	2
72	Spindles not selected	•Head selection code M missing.	•Enter the head selection code M before the M code requesting it.	2
73	Boring machines not selected	"	"	2
74	P-axis positive software limit	•Programmed value higher than maximum axis travel.	•Modify the value entered.	2

C.	PLC MESSAGE	CAUSE	REMEDY	
75	P-axis negative software limit	•Programmed value lower than minimum axis travel.	"	2
76	Q-axis positive software limit	• Programmed value higher than maximum axis travel.	"	2
77	Q-axis negative software limit	• Programmed value lower than minimum axis travel.	"	2
78	Collision with P-axis	•Software has identified possible collision between NC rear stop and tool.	•Program rear stop movement to avoid collision.	2
79	Collision with Q-axis	"	"	2
80	Piece released area 1 or 5	•Sudden vacuum loss during machining	•Check the correct operation of the vacuum pump and relative circuit. •Check piece clamping seal (gaskets, cleanliness, size of vacuum area, vacuum outlets).	2
81	Piece released area 2 or 6	"	"	2
82	Piece released area 3 or 7	"	"	2
83	Piece released area 4 or 8	"	"	2
84	Piece lock/release error area 1 or 5	•Unsuccessful locking. •Unsuccessful release or vacuum switch set too low.	•Repeat operation. •In the case of release command, if the piece is actually released, set the vacuum switch higher.	1
85	Piece lock/release error area 2 or 6	"	"	1
86	Piece lock/release error area 3 or 7	"	"	1
87	Piece lock/release error area 4 or 8	"	"	1
88	Lock vacuum area pieces	"	"	1
89	Inverter not working correctly	•Inverter malfunction. •Excessive spindle force.	•Reset the control. If the problem persists, call for assistance.	1/ 2

C.	PLC MESSAGE	CAUSE	REMEDY	
90	Spindle movement error vert. 1	•Head raise / lower error. •Head moves without the appropriate command. •Sensors damaged.	•Check head raising and lowering. •Reset the control; if required call for assistance.	1/2
91	Spindle movement error vert. 2	"	"	1/2
92	Spindle movement error vert. 3	"	"	1/2
93	Spindle movement error vert. 4	"	"	1/2
94	Spindle movement error vert. 5	"	"	1/2
95	Spindle movement error vert. 6	"	"	1/2
96	Spindle movement error vert. 7	"	"	1/2
97	Spindle movement error vert. 8	"	"	1/2
98	Spindle movement error vert. 9	"	"	1/2
99	Spindle movement error horiz. 1	•Head raise / lower error. •Head moves without the appropriate command. •Sensors damaged	•Check head raising and lowering. •Reset the control; if required, call for assistance.	1/2
100	Spindle movement error horiz. 2	"	"	1/2
101	Spindle movement error horiz. 3	"	"	1/2
102	Spindle movement error horiz. 4	"	"	1/2
103	Spindle vert. 1 without tool	•A spindle rotation M function has been used without a toolholder cone inserted.	•Insert a toolholder cone in the spindle.	1
104	Spindle vert. 2 without tool	"	"	1

C.	PLC MESSAGE	CAUSE	REMEDY	
105	Spindle vert. 3 without tool	"	"	1
107	Spindle vert. 5 without tool	"	"	1
106	Spindle vert. 4 without tool	"	"	1
108	Spindle vert. 6 without tool	"	"	1
109	Spindle vert. 7 without tool	"	"	1
110	Spindle vert. 8 without tool	"	"	1
111	Spindle vert. 9 without tool	"	"	1
112	Toolholder cone released spindle vert.1	•The toolholder cone is released. •The toolholder cone presence sensor is not working.	•Check that the toolholder cone is engaged. •Check the correct operation of the sensor; if required, call for assistance.	2
113	Toolholder cone released spindle vert.2	"	"	2
114	Toolholder cone released spindle vert.3	"	"	2
115	Toolholder cone released spindle vert.4	"	"	2
116	Toolholder cone released spindle vert.5	"	"	2
117	Toolholder cone released spindle vert.6	"	"	2
118	Toolholder cone released spindle vert.7	"	"	2
119	Toolholder cone released spindle vert.8	"	"	2
120	Toolholder cone released spindle vert.9	"	"	2
121	Tool released spindle vert.1	•The tool is not locked in the spindle. •Incorrect operation of the sensor detecting the position of the locking screw in the electro-spindle.	•Lock the tool in the electro-spindle. •Check the operation of the position sensor.	1

C.	PLC MESSAGE	CAUSE	REMEDY	
122	Tool released spindle vert.2	"	"	1
123	Tool released spindle vert.3	"	"	1
124	Tool released spindle vert.4	"	"	1
125	Tool released spindle vert.5	"	"	1
126	Tool released spindle vert.6	"	"	1
127	Tool released spindle vert.7	"	"	1
128	Tool released spindle vert.8	"	"	1
129	Tool released spindle vert.9	"	"	1
130	Tool locking error spindle. vert.1	•Spindle tool locking error.	•Reset and repeat locking or tool change cycle manually.	2
131	Tool locking error spindle vert.2	"	"	2
132	Tool locking error spindle vert.3	"	"	2
133	Tool locking error spindle vert.4	"	"	2
134	Movement error boring machine 1	•Boring machine raise / lower error. •Boring machine moving without the appropriate command. •Sensors damaged.	•Check head raising and lowering. •Reset the control; if required, call for assistance.	1/2
135	Movement error boring machine 2	"	"	1/2
136	Movement error boring machine 3	"	"	1/2
137	Movement error boring machine 4	"	"	1/2

C.	PLC MESSAGE	CAUSE	REMEDY	
138	Tool release magazine 1	•Toolholder cone release in the magazine by the release device.	•Check engaging of toolholder cone. •Check correct operation of the sensor; if required, call for assistance.	2
139	Tool release magazine 2	"	"	2
140	Tool release magazine 3	"	"	2
141	Tool release magazine 4	"	"	2
142	Tool locking error magaz. 1	•Error locking or unlocking toolholder cone in the magazine.	•Reset; repeat the operation or the tool change cycle manually.	2
143	Tool locking error magaz. 2	"	"	2
144	Tool locking error magaz. 3	"	"	2
145	Tool locking error magaz. 4	"	"	2
146	Movement error Spindle/tool change magaz.1	•Error in the movement of the tool change shuttle from the spindle to the magazine. •Movement of the tool change shuttle without the appropriate command. •Sensors damaged.	•Check the movement of the tool change shuttle from the spindle to the magazine. •Reset the control; if required call for assistance.	2
147	Movement error Spindle/tool change magaz.2	"	"	2
148	Movement error Spindle/tool change magaz.3	"	"	2
149	Movement error Spindle/tool change magaz.4	"	"	2
150	Extraction/insertion error tool change 1	"	"	2
151	Extraction/insertion error tool change 2	"	"	2
152	Extraction/insertion error tool change 3	"	"	2

C.	PLC MESSAGE	CAUSE	REMEDY	
153	Extraction/insertion error tool change 4	"	"	2
154	Up/down movement error tool change 1	"	"	2
155	Up/down movement error tool change 2	"	"	2
156	Up/down movement error tool change 3	"	"	2
157	Up/down movement error tool change 4	"	"	2
158	Clock./anti-clock movement error tool change 1	"	"	2
159	Clock./anti-clock movement error tool change 2	"	"	2
160	Clock./anti-clock movement error tool change 3	"	"	2
161	Clock./anti-clock movement error tool change 4	"	"	2
162	Tool change 1 interrupted	•Tool change procedure unsuccessful.	•Reset; repeat the tool change cycle; if required, call for assistance.	2
163	Tool change 2 interrupted	"	"	2
164	Tool change 3 interrupted	"	"	2
165	Tool change 4 interrupted	"	"	2
166	Reset tool change position.	•Tool change not in the rest position.	•Restore the tool change to the rest position.	1
167	Movement error suction hood 1	•Hood movement error. •Sensors damaged.	•Check hood movement. •Reset the control; if required, call for assistance.	2
168	Movement error suction hood 2	"	"	2
169	Movement error suction hood 3	"	"	2

C.	PLC MESSAGE	CAUSE	REMEDY	
170	Movement error suction hood 4	"	"	2
171	Tooling-up procedure in course	•The control is executing the machine tooling-up procedure.	•Informative message.	3
172	Movement error front RIGHT stop	•The stop in question has not moved out or in correctly. •The stop positioning sensor is damaged.	•Repeat the stop movement, remove any obstacles. •Check that the stop movement sensors are working properly; if necessary call for assistance	1
173	Movement error front LEFT stop	"	"	1
174	Front RIGHT stop out	•The stop in question has moved out during machining without the appropriate command. •The stop positioning sensor is damaged.	•Reset the control and check that the stop is working properly. •Check that the stop positioning sensors are working properly; if necessary, call for assistance	2
175	Front LEFT stop out	"	"	2
176	Reset front stop position	•Stop position is different with respect to entry into HOLD.	•Re-position the stop as it was prior to entry into HOLD.	1
177	Movement error rear RIGHT stop	• The stop in question has not moved out or in correctly. • The stop positioning sensor is damaged.	• Repeat the stop movement, remove any obstacles • Check that the stop movement sensors are working properly; if necessary call for assistance	1
178	Movement error rear LEFT stop	"	"	1
179	Rear RIGHT stop out	• The stop in question has moved out during machining without the appropriate command. •The stop positioning sensor is damaged.	• Reset the control and check that the stop is working properly. •Check that the stop positioning sensors are working properly; if necessary, call for assistance	2

C.	PLC MESSAGE	CAUSE	REMEDY	
180	Rear LEFT stop out	"	"	2
181	Reset rear stop position.	• Stop position is different with respect to entry into HOLD.	• Re-position the stop as it was prior to entry into HOLD.	1
182	Switching error bistable ev 1	•Switching error in the optional bistable electrovalve. •Electrovalve switches without the appropriate command. •Sensors damaged.	•Check electrovalve switching. •Reset the control; if required, call for assistance.	1/2
183	Switching error bistable ev 2	"	"	1/2
184	Switching error bistable ev 3	"	"	1/2
185	Switching error bistable ev 4	"	"	1/2
186	Reset bistable ev status	•Different status with respect to entry into HOLD.	•Restore the status as it was prior to entry into HOLD.	1
187	Switching error monostable ev. 1	• Switching error in the optional monostable electrovalve. •Electrovalve switches without the appropriate command. •Sensors damaged.	• Check electrovalve switching. •Reset the control; if required, call for assistance.	1/2
188	Switching error monostable ev 2	"	"	1/2
189	Switching error monostable ev 3	"	"	1/2
190	Switching error monostable ev 4	"	"	1/2
191	Reset monostable ev status	• Different status with respect to entry into HOLD.	• Restore the status as it was prior to entry into HOLD.	1
192	Lock/release error arc 1	•Locking failure. •Release failure. Sensor damaged.	•Repeat the operation. Check the integrity of the cables, sensors and connectors.	2
193	Lock/release error arc 2	"	"	2

C.	PLC MESSAGE	CAUSE	REMEDY	
194	Anomaly in locking system 1	•Incorrect locking system movement. •Connectors disconnected.	•Check the operation of the locking system.	2
195	Anomaly in locking system 2	"	"	2
196	Restore arc locking	•Different locking status with respect to entry into HOLD.	• Restore the locking as it was prior to entry into HOLD.	2
197	Movement error RIGHT pallet	•Pallet movement error. •Pallet movement without the appropriate command. •Sensors damaged.	•Check pallet movement. •Reset the control; if required, call for assistance.	2
198	Movement error LEFT pallet	"	"	2
199	Locking error RIGHT pallet	•Pallet lock/release error. •Sensors damaged.	•Check pallet locking. •Reset the control; if required, call for assistance.	2
200	Locking error LEFT pallet	"	"	2
201	RIGHT pallet in loading position	•Pallet is ready for loading: the table cannot be moved.	•Move the pallet back.	1
202	LEFT pallet in loading position	"	"	1
203	RIGHT pallet overrun	•The pallet has exceeded its allowed travel limit. •Sensors damaged.	•Check pallet movement. •Move the pallet to the correct position; if required, call for assistance.	2
204	LEFT pallet overrun	"	"	2
205	Movement error RIGHT door	•Door movement error. •Door movement without the appropriate command. •Sensors damaged.	•Check door movement. •Reset the control; if required, call for assistance.	1/2
206	Movement error LEFT door	"	"	1/2

C.	PLC MESSAGE	CAUSE	REMEDY	
207	Movement error curtain guards	•Curtain guard movement error. •Curtain guard movement without the appropriate command. •Sensors damaged.	•Check curtain guard movement. •Reset the control; if required, call for assistance.	2
208	Gantry lock/release error	•Lock or release failure. •Sensors damaged.	•Repeat the operation. • Check the integrity of the cables, sensors and connectors.	2
209	Tracer switched-off or inefficient	•Tracer cycle with tracer radio transmission off or inefficient. •Battery completely flat.	•Check tracer switch-on device. •Replace batteries.	1
210	Tracer batteries flat	•Tracer batteries flat.	•Replace batteries.	3
211	Simult. zero/overrun micro.	•Overrun limit switch malfunction.	•Check the correct operation of the safety microswitch; if required, call for assistance.	2
212	Simult. vacuum lock/release sel..	•Workpiece lock/release selector malfunction.	•Identify the selector and check its operation; if required, call for assistance.	2
213	Spindles operating but stationary	•Malfunction of inverter in detecting the spindle rpm.	•Reset the control; if the problem persists call for assistance.	2
214	Simult vert. spindle up/down sensor.	•Malfunction or incorrect positioning of one of the positioning sensors installed on the release piston.	•Check the position and correct operation of the positioning sensors; if required call for assistance.	2
215	Simult horiz. spindle up/down sensor.	"	"	2
216	Simult vert. man. insert/extract sensor.	"	"	2
217	Simult vert. man. tool lock/release sensor.	•Error in detection of tool lock/release sensor.	•Check the position and correct operation of the toolholder cone locked/released sensors; if required, call for assistance.	2

C.	PLC MESSAGE	CAUSE	REMEDY	
218	Simult. vert. spindle up/down sel.	•Head positioning selector malfunction.	•Identify the selector and check its operation; if required, call for assistance.	2
219	Simult. horiz. spindle up/down sel..	• Head positioning selector malfunction.	• Identify the selector and check its operation; if required, call for assistance.	2
220	Simult. boring machine up/down sensors.	• Malfunction or incorrect positioning of one or both positioning sensors installed on the release piston.	• Check the position and correct operation of the positioning sensors; if required call for assistance.	2
221	Simult boring machine up/down sensor.	• Boring machine positioning selector malfunction.	• Identify the selector and check its operation; if required, call for assistance.	2
222	Simult. magaz. tool lock/ release sensor.	• Error in detection of tool lock/release sensor.	• Check the position and correct operation of the toolholder cone locked/released sensors; if required, call for assistance.	2
223	Simult. magaz. tool lock/ release selector.	•Malfunction of toolholder cone lock/release selector in the tool magazine.	• Identify the selector and check its operation; if required, call for assistance.	2
224	Simult. magaz. fwd/rev. rotation selector.	•Malfunction of magazine rotation selector.	"	2
225	Simult tool change posit. sens.	•Error in operation or detection of tool change shuttle position sensors.	• Check the position and correct operation of the positioning sensors; if required call for assistance.	2
226	Simult. front stop up/down sensor.	• Malfunction or incorrect positioning of one or both positioning sensors installed on the release piston.	• Check the position and correct operation of the positioning sensors; if required call for assistance.	2
227	Simult. bistable ev, on/off sens.	• Malfunction or incorrect positioning of one or both positioning sensors installed.	• Check the position and correct operation of the positioning sensors; if required call for assistance.	2

C.	PLC MESSAGE	CAUSE	REMEDY	
228	Simult. opposite pallets micro.	•Malfunction of overrun microswitch.	•Check the correct operation of the safety microswitch; if required, call for assistance.	2
229	Simult pallet lock/release sensors.	• Error in operation or detection of pallet lock/release sensor.	• Check the position and correct operation of the pallet locked/released sensors; if required, call for assistance.	2
230	Simult door open/closed sens.	• Error in operation or detection of door lock/release sensor.	• Check the position and correct operation of the doors locked/released sensors; if required call for assistance.	2
231	Simult door open/closed sel.	•Malfunction of tool magazine doors open/ closed selector.	• Identify the selector and check its operation; if required, call for assistance.	2
232	Simult. gantry lock/release sensors.	•Error in operation or detection of gantry lock/release sensor.	•Check the position and operation of the gantry locked/released sensors; if required, call for assistance.	2
233	Simult. hatch open/closed sensors.	•Error in operation or detection of hatch lock/release sensors.	• Check the position and operation of the door hatch locked/released sensors; if required, call for assistance.	2
234	Simult. spindle selection sel..	•Malfunction of spindle selection selector from tool magazine.	• Identify the selector and check its operation; if required, call for assistance.	2
235	Simult suction hood up/down sel..	•Malfunction of suction hood level selector.	"	2
236	Simult. spindle tool lock/release sel.	•Malfunction of toolholder cone in electro-spindle lock/release selector.	"	2
237	Simult tool change fwd/rev rotat. sel.	•Malfunction of tool change arm rotation selector.	"	2
238	RIGHT mat activated	•Safety mat not free with RIGHT table in loading position.	•Free the mat and reset the machine.	2

C.	PLC MESSAGE	CAUSE	REMEDY	
239	LEFT mat activated	• Safety mat not free with LEFT table in loading position.	"	2

8.2 SEMANTIC CHECKS EFFECTED BY THE PLC

The following table shows a list of the semantic checks that the PLC performs when the execution of an M, S or T code or the movement of a PSEUDOAXIS (NC stops) is called for.

8.2.1 M code semantic checks

The first column shows the M code called, the second column describes the semantic check effected by the PLC and the third column shows the error message code (see paragraph 8.1.1 “Error messages” on page 8 - 2) displayed on the NC monitor when the result of the check is negative.

M CODE	PLC CHECKS	CODE
M3	Spindle selection defined	**72**
	Speed selection defined	**66**
	Selected spindles off or, if already on, rotating clockwise and congruent with the inverter sharing	**64**
M4	Spindle selection defined	**72**
	Speed selection defined	**66**
	Selected spindles off or, if already on, rotating anti-clockwise and congruent with the inverter sharing	**64**
M5	Spindle selection defined	**72**
	All spindles selected or congruent with the inverter sharing	**64**
M6	Offset selection function T defined	**64**
M7	Tool selection function T defined	**64**
	Selected spindles off	**64**
	Selected spindles with C-axes at rest	**64**
M8	Boring machine selection defined	**73**
M9	Boring machine selection defined	**73**
M10	Boring machine selection defined	**72**
M11	Spindle selection defined	**72**

M CODE	PLC CHECKS	CODE
M12	Boring machine selection defined	**73**
M13	Spindle selection defined	**72**
	Selected spindles not inclined negatively	**64**
M14	Spindle selection defined	**72**
	Selected spindles not inclined positively	**64**
M20	Spindle selection defined	**72**
	Selected spindles with C-axes at rest	**64**
M22	Boring machine selection defined	**73**
M23	Spindle selection defined	**72**
M32	Spindle selection defined	**72**
M42	Spindle selection defined	**72**
M57	Right-hand table in loading position (Y=0)	**201**
M58	Left-hand table in loading position (W=0)	**202**
M91	Spindle selection defined	**72**
M92	Spindle selection defined	**72**
M93	Spindle selection defined	**72**
M94	Spindle selection defined	**72**
M96	Axes referred	**2**
M97	Axes referred	**2**
M98	Axes referred	**2**
M100: M199	Boring machine selection defined	**73**

8.2.2 S code semantic checks

The first column describes the semantic check effected by the PLC when a code S is called, the second column shows the error message code (see paragraph 8.1.1 “Error messages” on page 8 - 2) displayed on the NC monitor when the result of the check is negative.

PLC CHECKS	CODE
Machine on	**1**
Spindle selection defined	**72**
Selected spindles off or, if already on, rotating anti-clockwise and congruent with the inverter sharing	**63**

PLC CHECKS	CODE
Speed selection within the allowable limits (greater than or equal to 100 RPM and less than or equal to 18000 or 20000 RPM)	**65 o 66**
G97 (G96 not admissible)	**63**

8.2.3 T code semantic checks

The first column describes the semantic check effected by the PLC when a code T is called, the second column shows the error message code (see paragraph 8.1.1 “Error messages” on page 8 - 2) displayed on the NC monitor when the result of the check is negative.

PLC CHECKS	CODE
Machine on	**1**
Machine on tool change if tool selection	**67**
Spindle selection defined and congruent with tool change if tool selection	**72 or 70**
Spindle selection congruent with tool magazine number (see shared magazines)	**70**
Axes referred if tool selection	**2**
Offset number less than or equal to 300 if offset selection	**68**
Tool selected existing and “ready”	**67**
Selected tool in pocket coherent with spindle/selected if tool is in magazine	**70**
Pocket free with class coherent with selected tool if spindle tool unload	**67**
Number of tools out of the magazine less than or equal to spindles with tool change	**70**
Tools out of magazine with spindles of origin congruent with magazines (see “parallel” or “reciprocal”)	**70**
Tools out of magazine not in non-existent spindles (including spindle 0)	**70**
Tools out of magazine not in the same spindle	**70**
Tool in spindle or in magazine not in tool table	**70**

8.2.4 PSEUDOAXES semantic checks (NC stops)

The first column describes the semantic check effected by the PLC when a movement of a pseudoaxis (NC stops) has been programmed. The second column shows the error message

code (see paragraph 8.1.1 “Error messages” on page 8 - 2) displayed on the NC monitor when the result of the check is negative.

PLC CHECKS	CODE
Machine on	**1**
Axes referred	**2**
Values programmed within software limits	**74 ÷ 77**

Chapter 9. DEMOLITION

DANGER

All the operations described in this chapter must be carried out by suitably qualified personnel.

DANGER

Compressed air tanks. Release residual pressure.

DANGER

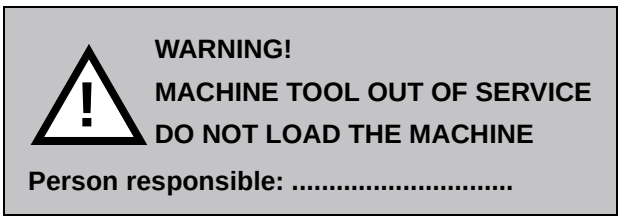
Do not smoke when using flammable products.

DANGER

When using products that may be harmful to health, wear suitable plastified gloves and protective mask.

DANGER

Never place any loads or objects on the machine. Affix one or more signs of the type indicated in the figure to the machine in a clearly visible position.



Demolishing the machine

When the machine has reached the end of its useful working life, it must be put out-of-service in a manner that makes it totally unusable for the purpose for which it was designed and constructed. The demolition must also be carried out with a view to the possible re-use of its components and raw materials. Any re-use of components or raw materials must be different to that for which the individual parts and the machine as a whole were designed and constructed.

Responsibility

BIESSE will not be held liable for any damage or injury deriving from the re-use of individual parts of the machine for functions or in assembly configurations different from the original. BIESSE will not recognise any implicit or explicit suitability of any parts of the machine re-used for any specific purposes after the machine itself has been permanently shut down for eventual demolition.

Permanent shutdown

To permanently shut down the machine, proceed as follows:

Remove and store any tools still on the machine.

Place the main switch on the machine and the isolating switch on the factory supply line to which the machine is connected in the OFF position.

Disconnect the machine from all its power supplies.

Clear the perimeter area around the machine to allow sufficient space for manoeuvring.

Lock the operating unit in position.

Discharge any residual pressure from the pneumatic plant.

For packing and loading the machine, refer to the INSTALLATION chapter in this manual.

Residual risks

If the shutdown procedure has been executed in the correct manner, there should not be any particular risks, and the machine can be mothballed and stored or dismantled. Nevertheless, there are some residual risks that may be encountered during the period between the last time the machine was used for normal purposes and its actual shutdown.

Direct risks

Pressurised air in the tanks. Discharge the residual pressure.

Parts which may be mobile due to the effect of inertia or gravity. Fix all moving parts in a suitable manner.

Environmental risks

The machine uses lubricating oils and greases. In order to neutralise non-recoverable lubricating fluids adhering to parts of the machine, use approved type degradable solvents. To drain recoverable lubricating fluids, drain the relevant tanks and entrust the disposal of the fluids to a recognised used oil recovery specialist.

Chapter 10. APPENDIX

10.1 LUBRICANTS

DANGER

When handling lubricants, do not smoke, eat or drink. Furthermore, comply with all standards in force governing the handling of mineral oils and greases.

Protective clothing

Before handling lubricants, to prevent irritation or allergy, always wear protective goggles or an anti-splash mask, oil-proof gloves and overalls.

Lubricant storage standards

Store lubricants in a naturally ventilated location away from sources of heat, electric panels and naked flames.

Incompatibility with other products

Avoid direct contact with pure oxygen and acids.

Lubricant disposal methods

All lubricants destined for disposal must be entrusted to authorised used-oil collection centres.

Cleaning-up operations in the case of lubricant spills

Wear suitable protective clothing. Absorb the lubricant using sand or pick it up with a spatula. Wash the surface with solvents (chlorines or aliphatics) taking care not to soak the working environment with vapours. Entrust the material used for the cleaning-up operation to an authorised disposal body for incineration as SPECIAL WASTE. In addition, notify the relevant public body of the event.

Toxic and harmful effects of lubricants

People with particular sensitivity towards lubricants may suffer an allergic reaction, including oil acne, especially if the skin has been previously damaged by abrasion (e.g. hand cleaning paste, minor wounds, etc.) or by chemicals (e.g. solvents, alkaline detergents, high strength surface-active agents). Contact with the eyes can cause irritation.

The effects of overexposure may also be felt in the form of a slight irritation in the eyes and moderation irritation of the skin caused by mishandling of the lubricant. In this case, move away from the area of exposure and seek medical advice.

Emergency procedures and first aid

In the case of contact with the skin, wash with soap and water.

In the case of contact with the eyes, wash with water only.

If an “oil” category lubricant described in the table is ingested, do not induce vomiting and seek medical help immediately.

If a small quantity of “grease” category lubricant described in the table is ingested, call for medical assistance immediately. If the quantity of lubricant is greater than 1/2 litre, administer 1 or 2 glasses of water and call for medical assistance immediately. Do not induce vomiting in a unconscious patient or administer anything by mouth.

PRODUCT USED BY BIESSE S.p.A.	CHEMICAL/PHYSICAL CHARACTERISTICS	EQUIVALENT PRODUCT
KLUBER ISOFLEX NBU 15	■ category: GREASE ■ density with respect to water: 0.9 g/cm3 at 20°C ■ melting point:> 200°C	■ PRODUCT HAS NO EQUIVALENT
KLUBER AMBLYGON - TA 15/2	■ category: GREASE ■ flammability COC-ASTM D92°C:>220°C	■ PRODUCT HAS NO EQUIVALENT
MOBILTEMP SHC 100	■ category: GREASE ■ volumetric mass: 1.0 kg/dm3 at 15°C ■ vapour pressure: 0.1 mm HG at 20°C ■ viscosity: 87 cSt, at 40°C;13 cSt at 100°C ■ dropping point: >260 °C ■ boiling point: > 315 °C	■ MOBILTEMP SHC 32
AGIP EP 0	■	■ ESSO BEACON EP 0 ■ KLUBER TRIBOSTAR 0 EP(*) ■ KLUBER CENTOPLEX 0 EP(**)

PRODUCT USED BY BIESSE S.p.A.	CHEMICAL/PHYSICAL CHARACTERISTICS	EQUIVALENT PRODUCT
AGIP EP 1	■	■ AGIP GR LP 1 ■ BP GREASE LTX EP 1 ■ ESSO BEACON EP 1 ■ SHELL EP 1 ■ TAMOIL TAMLITH GR EP 1 ■ TOTAL MULTIS EP 1
MOBIL DTE 24	■ category: OIL ■ volumetric mass: 0.869 kg/dm3 at 15°C ■ vapour pressure: 0.1 mm HG at 20°C ■ viscosity: 32.5 cSt, at 40°C: 5.5 cSt at 100°C ■ pour point: -27°C ■ boiling point: > 315 °C	■ AGIP OSO 32 ■ BP ENERGOL HLP 32 ■ CASTROL HYPIN AWS 32 ■ ELF ELFOLNA 32 ■ ESSO NUTO H 32 ■ IP HYDRUS OIL 32 ■ KLUBER LAMORA 32 ■ Q8 HAYDN 32 ■ ROL LI 32 ■ SHELL TELLUS OIL 32 ■ TAMOIL HYDRAULIC OIL 32 ■ TEXACO RANDO OIL HD 32 ■ TOTAL AZOLLA ZS 32

(*). Limited to the Italian market.

(**). International market.

10.2 MINI DNC

MINI DNC is a program that allows file operations to be carried out remotely through a network of numerical controls and computers(*) . The connection can be made through an Ethernet(**) network or through a serial interface(***) depending on the configuration chosen by the client. In the second case, only two machines can be linked together, either a PC and a Series 10 system or two Series 10 systems.

This section of the appendix only deals with the installation of the software on the PC. The installation of the communication software in the numerical control is effected by PROTECT during machine inspection and is therefore not included.

Each machine in the network is identified with a name (for example, the NC is identified with the name NC0001 and the PC with the name PCHOST for a PC with a DOS serial connection, and PC1 for a PC with an Ethernet connection). It can offer and request services to and from the network.

Offering a service means sharing a local resource(****) so that all the other network users (personal computers and/or numerical controls) can see it as a remote drive for reading and writing data.

For example, the NC is configured by BIESSE so that partition F: of the hard disk is accessible through the DISKF service.

Requesting a service signifies the need to access a service offered by a machine in the network. For example, the NC is configured by BIESSE so that it can request the DISKC service offered by the PCHOST(*****) (or PC1) and identify this service as K.

The connection of a machine in the network is effected manually or automatically by switching it on (see “Starting the connection”). During this phase, the machine searches the network for the

(*). These connections offer many obvious advantages, such as a centralised PP archive on a personal computer and the immediate transfer of PP products to the numerical control (for example using CAD-CAM).

(**). For the Ethernet connection, only the Mini Dnc communication software is available for the MS-SOS operating system. Computers running Windows 95, Windows 98 or Windows NT, do not require any special software in that the operating system itself already incorporates network resources.

(***). In the case of a serial connection, two file transfer programs can be installed on the computer: one for a 16 bit (MS-DOS) operating system and one for a 32-bit operating system (Windows 95, Windows 98, Windows NT). The two programs can co-exist on the same personal computer but cannot be used outside the operating system for which they have been designed. For example, the serial communication software Mini-Dnc for MS-DOS, cannot function in a 32-bit system such as Windows 95, Windows 98, Windows NT, OS/2 etc.

(****). The entire hard disk or part of it (directory/file), the floppy disk drive, CD-ROM reader, etc.

(*****). The PCHOST machine (personal computer) must be configured by the client in order to be able to share local DISKC resources.

services it requires and then configures the accessible units (providing they are made available by active machines on the network).

If the machine has a WinLink(*) type operator panel and an Ethernet connection, BIESSE will also configure the PC inside the console. This PC constitutes the machine WLNEW: it offers the DISKC service which makes its hard disk accessible for reading and writing and requests the DISKF service offered by machine NC0001, identifying it as unit K. The NC is configured as described previously with the addition of the request for the DISKC and DISKA service offered by the machine WLNEW. These services are identified by the letters J and I respectively.

10.2.1 Installing MINI-DNC on the personal computer (MS-DOS operating systems)(**)

DANGER

The following procedure helps to configure the MINI-DNC software (serial and Ethernet) on a personal computer running the 16-bit MS-DOS(***) operating system.

INFORMATION

The Ethernet connection between the PC and NC with a 16-bit MS-DOS operating system is only guaranteed if the PCL-843N card (obtainable from Protec) is installed in the PC. Protec will not be held liable in the case of malfunction of the connection if a network card other than that specified above is installed in the PC.

The following procedure is only effective for the MINI DNC Ethernet if a PCL-843N 16-bit JUMPER-LESS ETHERNET CARD (obtainable from Protect) is installed in the PC, otherwise read the note at the end of the paragraph.

INSTALLATION FROM DISK

1. Insert the MINI DNC COMUNICATION (FOR PC HOST) disk in drive **A**(****) and type in A:\INSTALL;

(*). The WinLink operator panel is a normal operating panel that integrates a PC by sharing a keyboard and monitor. With regard to the MINI DNC, this is equivalent to an external PC.

(**). The installation and use of the “MINI DNC” program for 32-bit operating systems is not covered by this manual; the complete documentation is delivered with the software to customers possessing this option on their machines.

(***). The recommended MS-DOS version is 6.22 (even if compatibility can still be guaranteed with versions 3.30a onwards). To check the version of the operating system installed on the computer, at the command prompt, type in **VER**. If the installed version is not 6.22 (or earlier), and the message string “**Windows 95. [Version X.XX.XXXX]**” appears, the PC is not using the correct operating system.

2. select the language required;

3. when the request SELECT CARD TYPE appears, select configuration **2 PCL-843** (for Ethernet installations only);

4. when the request SELECT PROTOCOL TYPE appears, select configuration **1 NETBEUI** (for Ethernet installations only);

5. when the request SELECT DLL VERSION appears, select configuration **1 MS WINDOWS 3.1 / 3.11** (for Ethernet installations only);

6. remove the disk when the installation is complete;

7. add the command **LASTDRIVE=K** in file **CONFIG.SYS**; if this command already exists, check that the drive letter is at least K;

8. using the command VER, check the DOS version on the personal computer;

9. if the DOS version is later than 3.30a, type in **SETVER PSPRINT.EXE 3.30** (ignore the messages displayed and confirm the operation);

10. if the DOS version is later than 4.0, type in **SETVER OSYREDID.EXE 4.0** (ignore the messages displayed and confirm the operation);

11. if one or both commands in points 9 and 10 have been executed, insert the command **DEVICE=SETVER.EXE** in file **CONFIG.SYS**;

12. restart the computer. The installation is now complete.

POSSIBLE CORRECTIONS FOR A NON-PCL843 CARD

If the network card in the PC is of a different type, in addition to using the installation disk it will also be necessary to modify the two files STARTNET.BAT and PROTOCOL.INI.

MODIFYING STARTNET.BAT:

- replace "**ETHER16.DOS**" (name of the card driver available from Protec) with the correct driver for the card used (see card manual).

MODIFTING PROTOCOL.INI:

- in the section "**[NETBEUI]**" replace line "**BINDINGS=ETHER16.DOS**" with line "**BINDINGS=******.***"** where "********.*****" represents the name of the correct driver for the card present in the PC (see card manual)

delete the entire section "**[ETHER16.DOS]**" and replace it with the section specified in the card manual (the card driver control variables are specified in this section together with the relative addresses, tests, etc…)

(****). More generally, if X is the name of the drive to be used for reading the disk, type in X:\INSTALL.

CONFIGURING THE DNC

The configurable objects are divided into 3 categories:

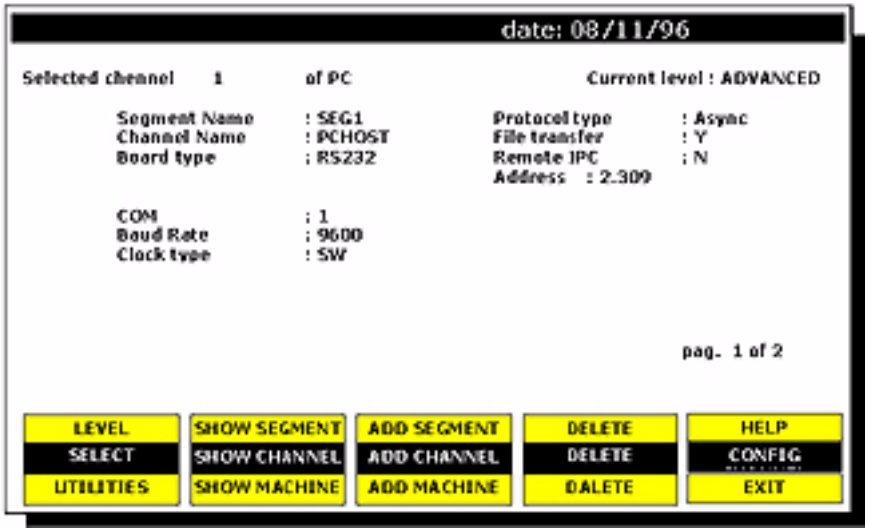
- *Machines*. A machine is a NC or PC connected in a network. The machine (PC) does not need to be configured as it is configured correctly by default.
- *Channels*. A means that allows each node to connect to the network.
- *Segments*. A segment is a portion of the network that uses a given protocol. The segment does not need to be configured as it is configured correctly by default.

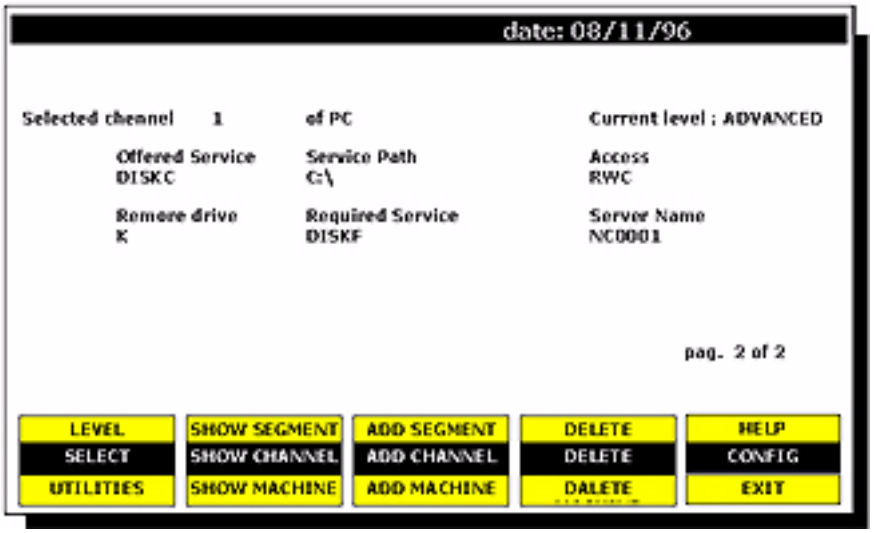
In practice, following the procedure below is sufficient.

1. If configuring a serial connection, select the directory DECNET by typing **CD C:\DECNET**; If configuring an Ethernet connection, select directory ABNET by typing **CD C:\ABNET**
2. start the configuration by typing **CFNET**; a number of softkeys similar to those on the control will be displayed on the screen; the first is F5, the second F6, the third F7, the fourth F8, the fifth F9 and that used to scroll the selector bare is F10;
3. if, in the upper left part, there is a message “Select channel 1 of PC” pass to the next point, otherwise press sk **SELECT CHANNEL**; the window CHANNEL SELECTION will appear in which the name of the PC and number 1 must be entered in the MACHINE NAME and CHANNEL ID fields;
4. select the level by pressing sk **LEVEL A** : in the upper right part of the screen the message “Current level advanced” will be displayed;
5. select sk **CONFIG CHANNEL**;
6. select sk **PHYSICAL;**
7. if configuring a serial connection, in the data entry type in **COM 1** or **COM 2, 9600 BAUD RATE, SW CLOCK TYPE**, then re-press **sk PHISICAL**;
8. select sk **SERVER** inserting in the first data entry SERVICE NAME **diskc**, DELETE **n** and, after having pressed enter on the left, in the second data entry ACCESS **rwc**, service path **c:**, then re-press sk **SERVER**;
9. select sk **CLIENT** inserting in the first data entry REMOTE DRIVER **k** and DELETE **n** and, after having pressed enter on the left, in the second data entry SERVICE NAME **diskf**, SERVER NAME **NC0001**, password ,automatic connection **n**, then re-press sk **CLIENT**
10. select sk **EXIT**;

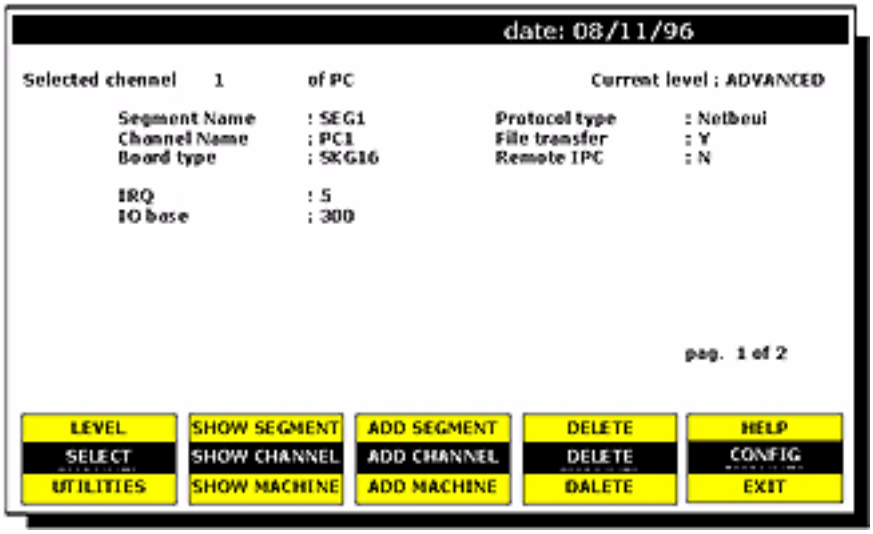
11. Check the data entered by selecting sk **SHOW CHANNEL**(*) ; if configuring a serial connection, the display shown in Figure 1-1 should appear; if configuring an Ethernet connection, the display shown in Figure 1-2 should appear.

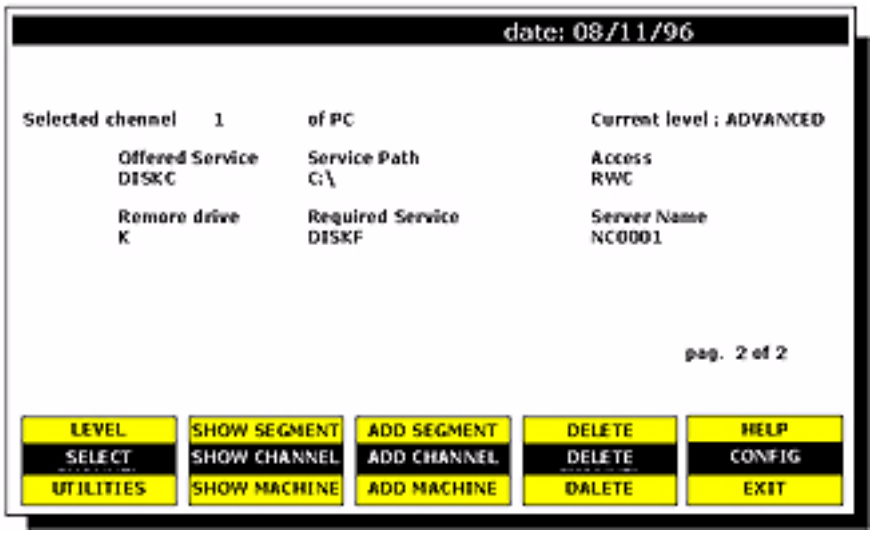
12. press sk EXIT.





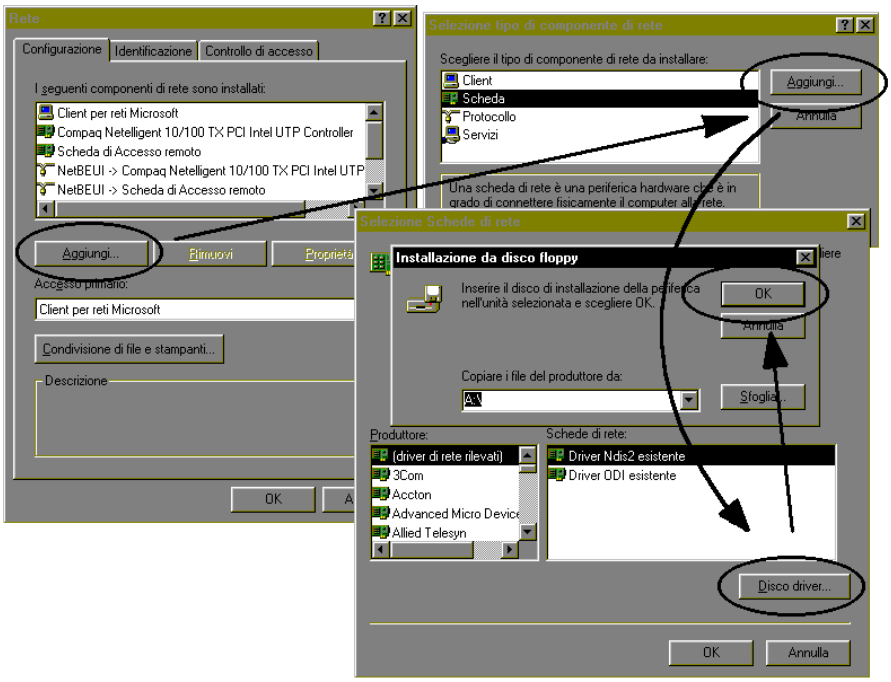
(*). In practice, only the channel configuration is checked, in that the machine and the segment are correctly configured by default. If the data displayed does not correspond to that reported in the figure, intervene directly in the relative fields. These fields are accessible using softkeys CHAN GENERAL, PHYSICAL or SERVER.


date: 08/11/96
Selected chennel 1 of PC
Current level : ADVANCED
Segment Name : SEG1
Channel Name : PC1
Board type : SKG16
IRQ : 5
IO base : 300
Protocol type : Netbeui
File transfer : Y
Remote IPC : N
pag. 1 of 2
LEVEL
SELECT
UTILITIES
SHOW SEGMENT
SHOW CHANNEL
SHOW MACHINE
ADD SEGMENT
ADD CHANNEL
ADD MACHINE
DELETE
DELETE
DALETE
HELP
CONFIG
EXIT

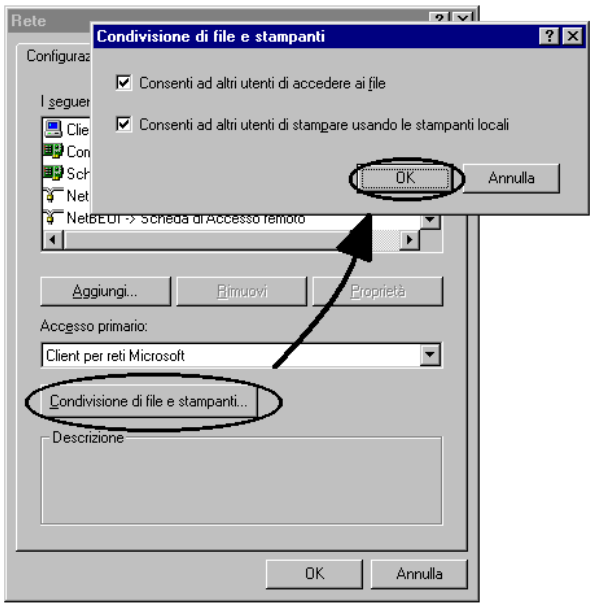

date: 08/11/96
Selected chennel 1 of PC
Current level : ADVANCED
Offered Service
DISKC
Service Path
C:\
Access
RWC
Remore drive
K
Required Service
DISKF
Server Name
NC0001
pag. 2 of 2
LEVEL
SELECT
UTILITIES
SHOW SEGMENT
SHOW CHANNEL
SHOW MACHINE
ADD SEGMENT
ADD CHANNEL
ADD MACHINE
DELETE
DELETE
DALETE
HELP
CONFIG
EXIT

10.2.2 PROCEDURE FOR INSTALLING THE ETHERNET NETWORK ON A PC RUNNING WINDOWS 95

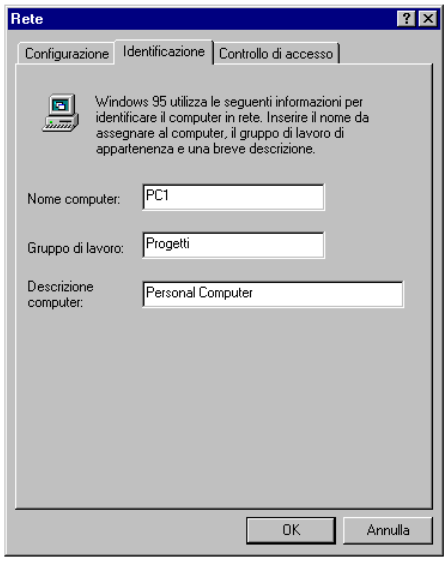
- Insert the network card in a free slot in the computer (for more information, refer to the card documents or those supplied with the personal computer).
- Re-start the PC.
- Install the driver for the network card so that it is correctly recognised by the system. To do this, click on **START**, move the mouse to **SETTINGS** on the menu displayed; select **CONTROL PANEL** from the opened list. Click twice on the **NETWORK** icon in the open **CONTROL PANEL** window. Click on the add button in the **NETWORK** window, select item **CARD** from the list displayed and then click again on **ADD**. Select the proper card from the list displayed on the monitor or click the button **DRIVER DISK** if you have a driver installation disk for a card not in the list. Some Windows 95 files may be requested, in this case use the operating system installation disk or CD-ROM. On completion of the installation, new components will appear in the **NETWORK** window. If the NetBEUI protocol is not among the components listed, it must be installed: click on **ADD**, select **PROTOCOL** and click **ADD** again. From the window **PRODUCER** select **MICROSOFT** and in the **PROTOCOL** window select **NetBEUI** and click **OK**; other Windows 95 files may be requested from the installation disk or CD-ROM. The **NETWORK** window will re-appear.



- Share the resources of the system by clicking the button **SHARING FILES AND PRINTERS**, select the two items present in the window displayed and click on **OK**.

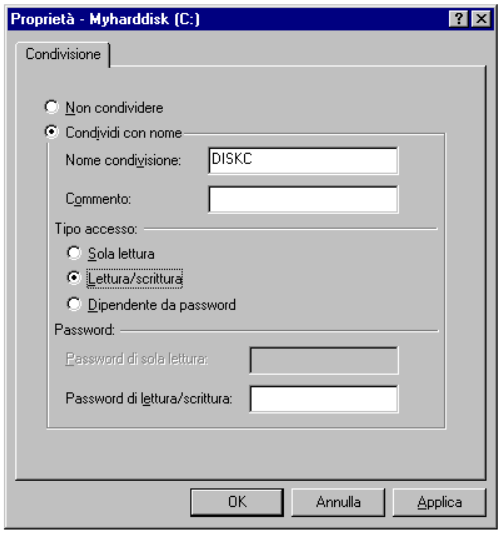


- Click on the **IDENTIFICATION** tab in the **NETWORK** window. In the first field (**Computer name:**) type in PC1 and a description in the other two fields, then click on **OK**. Re-start the computer (even if not requested).



- The hard disk must be partitioned in order that the NC can be seen by the PC. To do this, open **RESOURCE MANAGEMENT** and place the mouse on the hard disk icon and right click

on the mouse. Select the item **PARTITION** from the menu displayed. Select the option **PARTITION WITH NAME**, insert *DISKC* in **NAME OF PARTITION**: and select the option **READ/WRITE**.



- Make a network connection to display the service offered by the NC on the PC. Right click the mouse on the **COMPUTER RESOURCES** icon and select the item **CONNECT NETWORK UNIT**. In the next window, in the field <**UNIT:**> select a letter not used by any of the current devices, in the field <**PATH:**> type "\\NC0001\DISKF" and select option **RECONNECT ON STARTUP**. At this point, it is possible to view the services offered by the NC as if they were on a drive in the PC from which data can be copied or cancelled.

PROBLEM SOLVING

DATA INPUT INCORRECT

If the display obtained by pressing sk **SHOW CHANNEL** does not coincide with that shown in one of the two figures in paragraph "DNC CONFIGURATION" on page 10 - 7, one or more of the fields can be changed until the problem is resolved.

If the fields are Channel name, File transfer, Remote IPC or Address, then:

1. Press sk **CONFIG CHANNEL**;
2. press sk **CHAN GENERAL**;
3. position the cursor in the field containing the incorrect data;
4. type in the correct data;
5. save the modifications by re-pressing sk **CHAN GENERAL** or **enter**;
6. check the data entered by pressing sk **SHOW CHANNEL**;
7. if the data is correct press sk **EXIT,** otherwise repeat the procedure.

If the fields are Baud rate or Clock type, then:

1. Press sk **CONFIG CHANNEL**;
2. press sk **PHYSICAL**;
3. position the cursor in the field containing the incorrect data;
4. type in the correct data;
5. save the modifications by re-pressing sk **PHYSICAL** or **enter**;
6. check the data entered by pressing sk **SHOW channel**;
7. if the data is correct press sk **EXIT,** otherwise repeat the procedure.

If the fields are Offered service, Service path or Access, then:

1. Press sk **CONFIG CHANNEL**;
2. press sk **SERVER**;
3. position the cursor in the field containing the incorrect data;
4. type in the correct data;
5. save the modifications by re-pressing sk **SERVER** or **enter**;
6. check the data entered by pressing sk **SHOW channel**;
7. if the data is correct press sk **EXIT,** otherwise repeat the procedure.

CONNECTION DzIAGRAM

The serial communication programs for the 16-bit or 32-bit operating systems use different connections. The two cables are different because the “MINI DNC” for MS-DOS does not use synchronism, contrary to the software used for 32-bit Windows. In both cases, use a multi-core shielded cable with 0.22 mm^2 conductors

The following tables show the cable configurations.

NC SIDE			PERSONAL COMPUTER SIDE			
25 pole female			9 pole female		25 pole female	
3	RXD	◄——►	**3**	TXD	**2**	TXD
2	TXD	◄——►	**2**	RXD	**3**	RXD
5	CTS	◄——►	**7**	RTS	**4**	RTS
4	RTS	◄——►	**8**	CTS	**5**	CTS
6	DSR	◄——►	**4**	DTR	**20**	DTR
20	DTR	◄——►	**6**	DSR	**6**	DSR
7	GND	◄——►	**5**	GND	**7**	GND

NC SIDE			PERSONAL COMPUTER SIDE			
25 pole female			9 pole female		25 pole female	
3	RXD	◄——►	3	TXD	2	TXD
2	TXD	◄——►	2	RXD	3	RXD
7	GND	◄——►	5	GND	7	GND

CONNECTION START-UP

BIESSE configure the NC such that the connection is made automatically each time the machine is switched on.

If the machine installs a Winlink type operator panel, the internal PC starts up automatically with the machine. The time required to start-up Windows 95 is such that the command "startnet" is launched when the NC initialisation has been completed. In this way, the PC searches for the DISKF service on machine NC0001 (numerical control) when the service is accessible.

The following procedure is used to start the connection from an external PC (serial or Ethernet) with the MINI DNC for per MS-DOD(*) program installed on it

If the connection is serial, type in **CD C:\DECNET** followed by **STARTNET** (alternatively, in order not to have to repeat this operation at each start-up, in the file AUTOEXEC.BAT insert the commands **PATH C:\DECNET** followed by **STARTNET**). If the connection is through an Ethernet, type in **CD C:\ABNET** followed by **STARNET** alternatively, in order not to have to repeat this operation at each start-up, in the file AUTOEXEC.BAT enter the commands **PATH C:\ABNET** followed by **STARTNET**). If the message CONNECTION REFUSED does not appear , the connection is active;

(*). When starting-up the connection of a PC fitted with an Ethernet card and 32-bit operating system, no action need be taken in that the operating system itself searches for the connection to the remove drive on start-up.

in this way, the personal computer is the MASTER and can see, receive or send files to the control by means of the respective DOS commands on drive K.

10.3 Remote diagnostic

The REMOTE DIAGNOSTIC option allows diagnostics to be performed on a *machine* equipped with the Series 10 NC using a *remote PC.*

The NC is put in contact with the *remote PC* and, via a modem, exchanges the following information:

- Messages between operators
- Active displays on the NC
- File transfer

BIESSE provide a REMOTE DIAGNOSTIC option which is already installed in the CNC. The option utilises the serial port COM2(*) . The client needs only to make the connection and select the modem.

The modem must be of the Hayes compatible type. If the modem is already equipped with a 25-pole female personal computer connection, this can also be used for the REMOTE DIAGNOSTIC. However, if no suitable connection cable is available, it is possible to connect direct using pins 1,2,3,4,5,6,7,8 and 20.

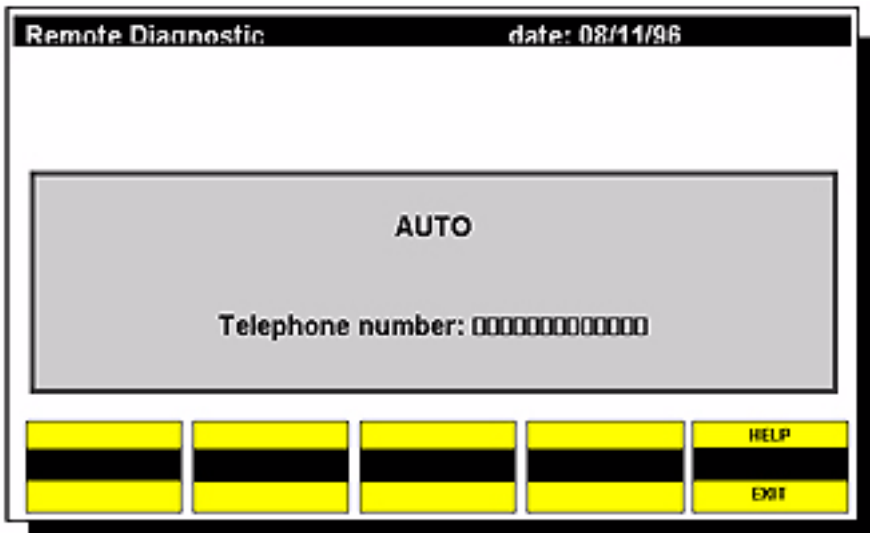
10.3.1 Executing a REMOTE DIAGNOSTIC

The remote diagnostics must only be used after prior consultation with the assistance service. After having considered the problem described by the client, the assistance service will decide whether it is necessary to perform a remote diagnostic; in this case, the service will provide the client with a telephone number to use for the connection.

In addition, it should be remembered that despite the possibility to exchange messages (written) between operators, if the diagnostics requires a large number of operations these should be communicated by voice over a second telephone line.

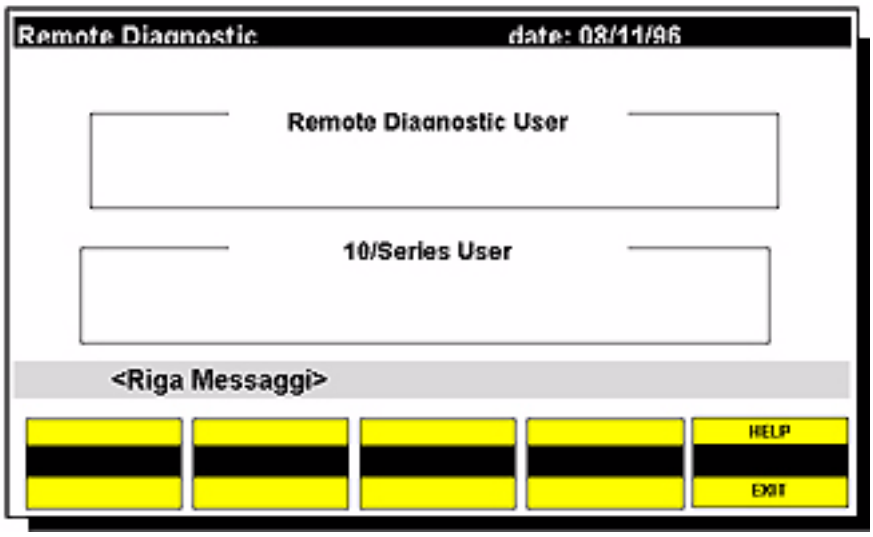
(*). In general COM1 is used by the MINI DNC and COM2 by the REMOTE DIAGNOSTIC. In other cases (for example, when a laser projector is installed on the machine) the destinations of the serial ports may change and/or be dependent on the activated AMP, refer to paragraph 6.4.3 “Configuring the machine (Y and W axes)” on page 6 - 28. The client can nevertheless change the port destinations.

To execute the REMOTE DIAGNOSTIC utility on the NC, press the left 〉 firmkey until the start page of the utility appears.



At this point, the client must call the assistance service by dialling the telephone number and pressing enter (↵). When the assistance service calls the client, there is no need to dial the number. The client just presses enter (↵) and wait (the telephone number is replaced by the keyword AUTO).

Once the connection is activated, the softkey menu and the dialog zone between the two users are displayed. The display appears as shown in the following figure:



The <Message line > contains any error messages generated during the connection with the remote PC and explanations of the actions being taken by the REMOTE DIAGNOSTIC program requested by the remote PC.

The “10/Series User” area identifies the zone in which the user working on the Series 10 types in the response to send to the remote PC (i.e. the assistance service). This zone is always available unless there is an activity in course requested by the assistance service. In this case, a warning message appears on the <Message line >. To send the message to the user of the remote PC, press enter (↵).

As the REMOTE DIAGNOSTIC on the Series 10 is a slave to the remote PC and has no operative possibilities, the only usable softkeys (as can be seen in the figure) are HELP and EXIT.

- **HELP**. Activates and/or de-activates the help pages.

- **EXIT**. Terminates the diagnostics without terminating the program and returns to the first page display (connection request).

The REMOTE DIAGNOSTIC application on the Series 10 also activates two special keys that can be pressed at any time regardless of the console present on the video at the time:

- **PAUSE**. Removes and/or re-displays the window of messages arriving from the remote PC.

- **PRINTSCREEN**. Allows rapid confirmation of an operation requested by the remote PC operator. This avoids the user having to pass through the REMOTE DIAGNOSTIC console to write a message of operation carried.

BIESSE S.p.A.
Unità (1) Centri di Lavoro
Sito: Chiusa di Ginestreto
Via della Meccanica, 16
61100 Pesaro (Italy)
Tel. +39 0721 439100
E-mail: sales@biesse.it
WEB Site: http://www.biesse.it