

# **INSTRUCTION BOOK**

## **VMC-100**

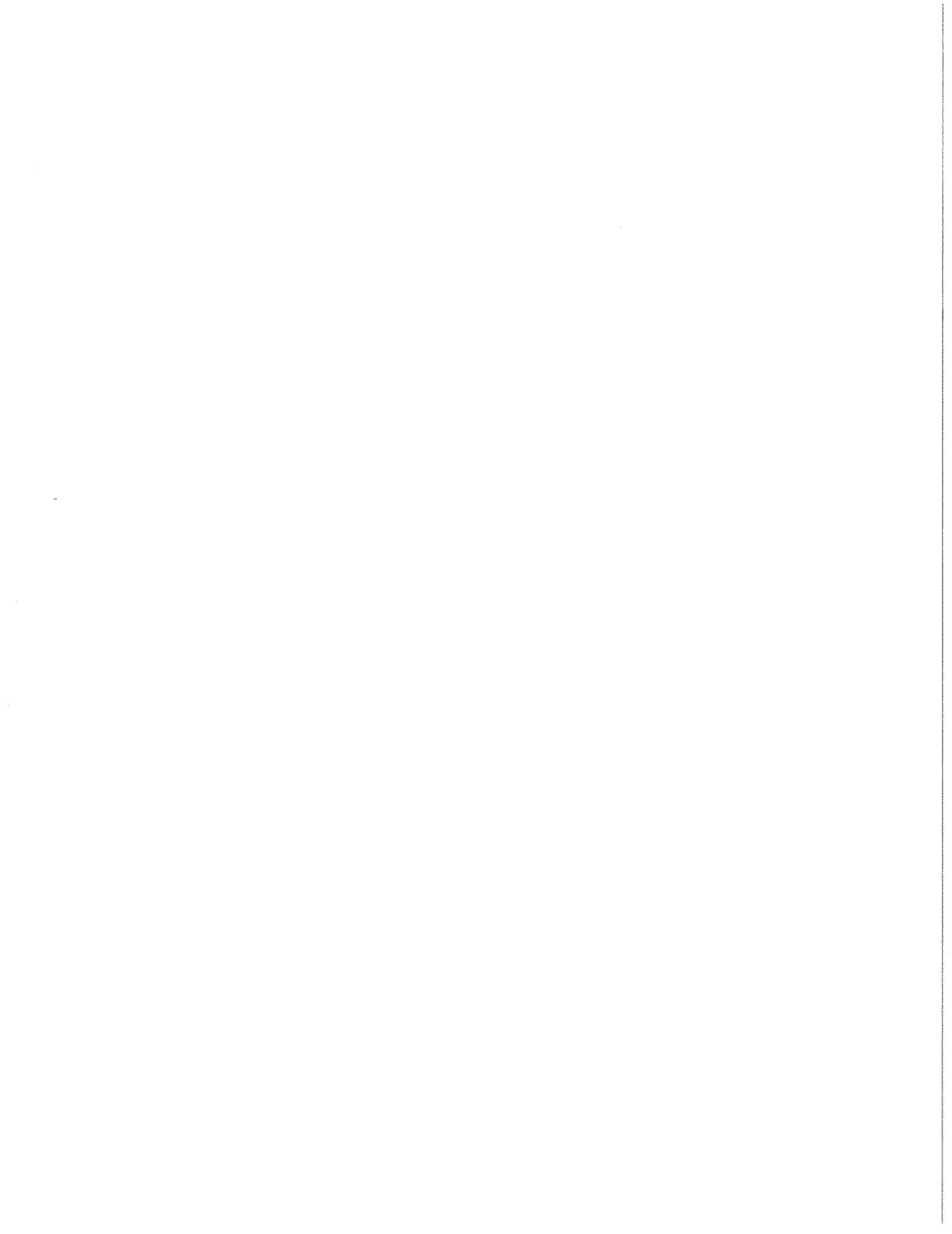
**with**  
**TM 02 control**

**Edition 90-10**

**Ref. No. EN7 750**

**Instruction book  
VMC-100  
90-10    EN7 750**

**2A**



## **Warranty conditions for new EMCO machines**

1. The warranty period for new EMCO machines is, without limitation of operating hours, 12 months after initial shipment of the machine from EMCO or its authorized representative. Should the installation be completed by EMCO or its authorized representative, the warranty period begins with the completed installation of the machine.  
  
If a delay of installation occurs which is not caused by EMCO or its representative, the warranty period becomes invalid 12 months after scheduled installation date.
2. The warranty extends to the elimination of all defects in material or workmanship which affect the regular function of the machine.
3. Occuring defects must be immediately reported to the EMCO resprentative or the next EMCO service department with detailed description of the defect in written or oral form, followed by a written verification.
4. Defects which are correctly reported and under warranty will be corrected by either repair or replacement delivery to the original buyer free-of-charge; defective parts are to be returned to EMCO or the EMCO authorized resprentative, freight prepaid, if requested.
5. Warranty for spare parts: Emco guarantees to the original buyer that, only those parts sold directly by Emco or through an authorized representative will be free from defects, which render part commercially unacceptable in material and workmanship, for a period according to applicable national law, at least three (3) months, but not to exceed six (6) months from the date of initial shipment or installation by Emco or its representative.  
In the case of repeated claims for the same part: Warranty replacement does not extend the period of the original warranty.
6. There is no claim of warranty for defects which occurred by:  
Negligence of operating instruction manuals, safety and handling regulations or other instructions regarding delivery, installation, set-up or usage of the machine, incorrect set-up resp. installation, as well as, unauthorized, not expressed regulated or allowed alterations or modifications of the machine by the original buyer or third parties, natural wear, improper or negligent handling, chemical, electro-chemical or electrical influences, inadequate energy supply or force majeure.
7. Any service performed by EMCO or its authorized representative beyond warranty will be charged at EMCO's or its authorized representative's regular rates.

## Introduction

These operating instructions contain machine-specific information.

Erection of the machine, electrical connections, accessories, instructions, technological data, maintenance and re-adjustment work.

The description for the programming and operation of the control are to be found in the programming instructions and the operating instructions EMCOTRONIC TM 02 - Milling.

Control-specific notes which are only valid for the VMC-100 are described in this instruction.

The basic features can vary and therefore possible accessories are not marked as such. For the exact scope of delivery of the basic model, see brochure or quotation.

### The instructions:

It is assumed that the operator of the machine knows how to clamp the workpieces and tools correctly and securely.

It is further assumed that the user is capable of selecting the correct tools and cutting data for the operation in question.

### Note:

VMC-100 means "Vertical Milling Center"

## INDEX

### Chapter A: General

o Safety recommendations	A1
o Technical data - machine	A2 - A3
o Technical data - control unit	A4 - A8
o Total dimensions of machine with base	A9
o Machine number, control serial number	A10
o Scope of delivery, standard equipment	A11

### Chapter B: Installation of machine and control unit, electrical connection, connection of blow-out device, start-up

1. Installation	B1 - B8
General instruction	B1 - B8
2. Electrical connections	B9 - B15
Mounting of cable from machine to control	B9
Connection of cable to control	B10
Connection of mains	B11 - B12
Fuses	B13
Electrical connection of accessories	B14 - B15
Connection via isolating transformer	B16 - B17
Changing Stepper Motor Board R3D 413 001	B18
3. Connection of blow-out device	B19 - B20
Technical data	B19
Description	B19 - B20
4. Start-up of machine	B21 - B26
Checks before start-up	B21
Switching machine on	B22
Switching machine off	B22
Possible problems during switch-on	B23 - B26

### Chapter C: Description of Machine

o Main elements	C1
o Construction features and functional description	C2 - C8
o Machine zero point M	
Tool fixture reference point N	C9
o Reference tool	C10

## Chapter D: Working with the machine

1. Working area	D1
2. Operating instructions, programming instructions, zero point shift, tool data	D2 - D7
Overall view of control unit	D2
2.1 Expansion in operation	D3
2.1.1 Swivelling of tool shop, clamping tool in MAN mode	D3
2.1.2 Activation of central lubrication system	D4
2.1.3 Clamping devices ON - OFF	D4
2.1.4 Coolant ON - OFF	D4
2.1.5 Manual traversing of slides	D4
2.1.6 Feed override switch	D5
2.1.7 Determination of rotational direction - main spindle	D5
2.1.8 Speed override - main spindle	D5
2.1.9 EMERGENCY OFF	D6
2.2 Programming instructions	D7 - D9
2.2.1 Programming tool change	D7 - D8
2.2.2 Programming direction logic M50, M51	D9
2.2.3 Programming clamping devices ON - OFF	D9
2.2.4 Main spindle status after tool change	D9
3. Clamping workpieces, clamping devices, zero point shift	D10 - D11
4. Setting of tools, mounting in tool turret, entry of tool data	D12 - D19
5. Working range of tools	D20 - D22

## Chapter E: Technological Data

1. General	E1 - E2
2. Determining feed speed and cutting depth	E3 - E4
3. Determining feed speed during drilling in 9S20 and Torradur B	E5
4. Determining rotational speed and cutting speed	E6
5. Tapping	E7
8. Speed - Rating Chart (Main drive spindle)	E8

## Chapter F: VMC-100 Accessories

1. Clamping devices for workpieces	F1 - F3
o Clamping bars (basic equipment)	F1
o Machine vice with stop	F1
o Incremental strap	F1
o 3-jaw chuck Ø 85 mm	F2
o Clamping device plate for chuck Ø 85 mm	F3

2. Clamping devices for tools	F4 - F7
o Collet holder ESX 16	F4
o Milling cutter clamping fixtures	F5
o Holder for taps	F6
o Shell end mill arbor	F7
3. Coolant device	F8 - F9
4. Machine base	F10

## Chapter G: Maintenance

1. Maintenance outline	G1
2. Lubricating and oiling	G2 - G3
3. Lubricant and coolant recommendations	G4 - G5

## Chapter J: Readjustment works

o Replacing the step motors	J1 - J2
o Replacing the X-, Y-, Z-slides	J3 - J7
o Readjustment of the slide clearance	J8 - J11
o Measuring the reversal clearance	J12 - J13
o Replacing the door VMC-100 and exchanging the gas spring	J14
o Readjustment of ball snap for tool turret positioning	J15
o Control of carbon brushes on main drive motor	J16
o Changing of the bulb in the machine lamp	J17
o Re-adjusting the collet strok	J18

## Chapter A

### General

- Safety recommendations A1
- Technical data - machine A2-A3
- Technical data - control unit A4-A8
- Total dimensions of machine with base A9
- Machine Number, control serial number A10
- Scope of delivery, standard equipment A11

## General

### 1. Safety recommendations Instructions

- \* Chip removal may be carried out only with the machine switched off.
- \* All claims under the guarantee become null and void if you interfere with the monitoring equipment!
- \* Bear in mind the general safety rules for machine tools and CNC machine tools.
- \* Only qualified and authorized persons are allowed to use the machine. It has to be protected against unintentional operation (remove switch key).
- \* In case of emergency use mushroom push button.
- \* In the event of a collision contact the general representative or manufacturer.
- \* Chuck workpieces and tools firmly and safely.
- \* Always work with perfectly sharpened tools.
- \* Condensation water of the blow-out device to be discharged weekly.
- \* After working with coolants, those components which have been in contact with the coolant should be cleaned and greased.
- \* Coolant level to be checked regularly.
- \* Never clean the machine with compressed air.
- \* Do not actuate the main switch of the machine during machine operation.
- \* Measuring and chucking work may only be carried out when the machine is at a standstill.
- \* Do not interfere with the electrical/electronical part of the machine.
- \* Read this documentation completely before machine start-up.
- \* Be sure that the machine is in perfectly maintained state before machine start up.
- \* Tool change procedure to be interrupted in emergency cases only (RESET, EMERGENCY-OFF) since otherwise the tool change system will have to be newly synchronized.
- \* Switch off machine only in the defined resting position of the tool change system.
- \* Check oil level in the tank for central lubrication at regular intervals.
- \* Never place your hand on the top of the side cover on the left while the machine is running.

# Technical Data VMC-100

## **WORKING RANGE**

Slide path, longitudinal (X) .....	185 mm	7,28"
Slide path, transverse (Y) .....	95 mm	3,74"
Slide path, vertical (Z) .....	200 mm	7,87"
Workpiece dimension (LxWxH) .....	190x100x60 mm	7,48x3,93x2,36
Useful Z-stroke for working .....	100 mm	3,93
Distance spindle nose - table surface .....	95 - 195 mm	3,74"~7,68

## **MILLING TABLE**

Clamping surface ((LxW) .....	425x125 mm	16,73" x 4,92
Max. table load .....	10 kg	
2 T-slots .....	11 mm	
Difference of the T-slots .....	90 mm	

## **MILLING SPINDLE**

Spindel bearing .....	dia. 40 mm
Type of bearing .....	angular ball bearing
Clamping fixture similar to DIN 2079 .....	SK 30
Tightening bolt .....	standard works
Tool clamping .....	automatic

## **MILLING SPINDLE DRIVE**

Main motor (DC, 100/60% ED) .....	600/800 W
Type .....	Direct drive
Speed range (infinitely variable) .....	10-4000 rpm
Max. torque .....	8,4 Nm

## **MACHINING CAPACITY**

Drilling capacity in steel (9S20) and feed s = 0,01 mm/rev. ....	dia. 10 mm
Thread-cutting capacity in steel (9S20) .....	max. M8x10 mm deep

## **FEED DRIVE**

Stepper motor single drive + ball screw spindle	
Feed in X/Y/Z axis .....	1-2000 mm/min
Rapid feeds in X/Y/Z axis .....	3/3 m/min
Feed force in X/Y/Z axis .....	1800 N

## **TOOL SYSTEM**

A tool shop .....	drum with direction logic
Number of tool posts .....	10
Tightening force .....	1100 N
Max. adm. tool weight .....	0,7 kg
Max. adm. tool diameter .....	60 mm
Cut-to-cut time acc. to VDI 2852	
T1/T2/T3 .....	9,9/9,1/9,1 sec
Tool changing time (without slide operations)	
T1/T2/T3 .....	6,2/5,9/5,9 sec

**LUBRICATING SYSTEM**

Guideways and ball screw spindles ..... automatic central oil lubrication

**COOLANT DEVICE (Option)**

Tank volume .....	80 l
Delivery capacity .....	15 l/min
Delivery pressure .....	0,5 bar

**PNEUMATIC**

Service unit, adjustable for tool turret blow-out unit (with oiler and filter)

Control range .....	5-8 bar
Supply pressure .....	6 bar
Connection service unit .....	dia. 10 mm

**ELECTRICAL SUPPLY**

Main supply .....	200 V N/PE, 50/60 Hz
Allowable voltage fluctuation .....	± 10% / -5%
Connected load .....	2,65 KVA
Protection of feed line .....	12 A

**DIMENSIONS**

Machine dimensions (LxWxH) .....	2035x850x1880 mm <i>80.1" x 33.5" x 74"</i>
Machine weight .....	approx. 300 kg <i>661 lbs</i>

MACHINE ACCEPTANCE ..... acc. to DIN 8615, part 1

**Subject to technical modifications!**

# Technical Data

## EMCOTRONIC TM 02

### **TYPE OF CONTROL**

- \* Microprocessor 3-axis-contour control
- \* Linear and circular interpolation in all 3 axis (2 1/2 D)
- \* Program store for 64 K, open-ended to 128 K (Option)

### **MONITOR**

- \* 9" monochrom monitor to show
  - actual position
  - distance left to traverse
  - spindle rpm
  - tool compensation
  - feed
  - further parameters

### **TECHNOLOGY**

* Input accuracy .....	0,001 mm	(0,0001 inch)
* Thread pitches .....	0,01 - 32 mm	
* Feed override .....	0 - 120 %	
* Spindle rpm override .....	50 - 120 %	
* Range of interpolation .....	± 9999,999 mm	
* Tool memory .....	99 tools	
* Circle interpolation .....	to 360°	
* Circle radius .....	to 20 m	

### **MODES OF OPERATION**

- \* Manual mode (manual traversing of slides)
- \* Execute (working off the input memory)
- \* Edit (program input via keys, interfaces)
- \* Automatic (Working off NC-programs)

### **SUBMODES**

- \* Single block
- \* Skip block
- \* Dry run
- \* Reference point
- \* Tool change mode
- \* Status
- \* Interface

### **PROGRAM FORMAT**

- \* Structure according DIN 66025 (ISO 1056)
- \* Decimal point input

### **DATA INPUT / OUTPUT**

- \* RS 232 C Interface (V24, 150 - 4800 Baud)
- \* Tape recorder (Philips MDCR) 600 signs/sec.

Subject to technical modifications!

## The Addresses

O Program number (00 - 6999) (7000 - 9999 reserved for graphic)

N Block number (0000 - 9999)

G Codes (00 - 99)

G00 = Rapid traverse

G01 = Linear interpolation

G02 } Circular interpolation  
G03 }

G04 = Dwell

G25 = Subroutine call

G27 = Unconditional jump

G33 = Thread-cutting (single step)

G40 = Neutralization of the cutter tool correction

G41 = Cutter path correction left hand

G42 = Cutter path correction right hand

G50 = Scaling factor clear

G51 = Scaling factor calling

G53 = Position shift offset 1 and 2 erase

G54 = Position shift offset 1

G55 = Position shift offset 2

G56 = Position shift offset 3,4 and 5 erase

G57 = Position shift offset 3

G58 = Position shift offset 4

G59 = Position shift offset 5, also changeable in  
program

G70 = Measurements in inch

G71 = Measurements in mm

G72 = Definition of circular drilling pattern

G73 = Call-up of circular drilling pattern

G74 = Definition of rectangular drilling pattern

G75 = Call-up rectangular drilling pattern

G81 = Drilling, centering

G82 = Drilling, spotfacing

G83 = Deephole drilling with withdrawal

G84 = Threading

G86 = Deephole drilling with chip breaking

G87 = Pocket milling cycle

G88 = Circle pocket milling cycle

G89 = T-slot milling cycle

G92 = Set Register

G94 = Data of feed speed in mm/min  
inch/min

G95 = Data of feed in mm/rev.

G98 = Withdrawal to starting plane

G99 = Withdrawal to withdrawal plane

X, Y, Z Absolute coordinates

U, V, W Incremental coordinates

I, J, K Interpolation parameters

P0...P7 } Auxiliary parameters

D0...D7 }

F Feed in mm/min  
μm/revolution  
Thread pitch in μm

S Spindle speed/Spindle position for M19

T Tool call-up, tool correction (four digits)  
 L Subroutine number/repetitions (four digits)  
     jump target  
 M (00 - 99)                          Auxiliary codes  
 M00                                  Programmed stop  
 M03                                  Spindle clockwise direction  
 M04                                  Spindle counterclockwise direction  
 M05                                  Spindle stop  
 M08                                  Coolant on  
 M09                                  Coolant off  
 M17                                  Subroutine end  
 M19                                  Precise spindle stop  
 M25                                  Opening clamping device }  
 M26                                  Closing clamping device } in preparation  
 M27                                  Programming dividing attachment  
 M30                                  Program end with return to program start  
 M38                                  Precise stop on  
 M39                                  Precise stop off  
 M50                                  Calling off the direction logic  
 M51                                  Selection of the direction logic  
 M90                                  Calling off the reflexion function  
 M91                                  Reflexion on X-axis  
 M92                                  Reflexion on Y-axis  
 M93                                  Reflexion on X and Y-axes

We reserve the right to make technical modifications and amendments!

## Group structure and initial status of the G-functions

Group 0	*	G00: Rapid traverse G01: Linear interpolation G02: Circular interpolation clockwise G03: Circular interpolation counter-clockwise G04: Dwell G33: Thread cutting in single step G72: Definition circular boring pattern G74: Definition rectangular boring pattern G81: Drilling, centering G82: Drilling, spot-facing G83: Deep-hole drilling with retraction G84: Tapping G86: Deep-hole drilling with chip breaking G87: Rectangular pocket milling cycle G88: Circular pocket milling cycle G89: Slot milling cycle
Group 2	**	G94: Feed in mm/min or 1/100 inch/min G95: Feed in $\mu\text{m}/\text{rev}$ . or 1/10000 inch/rev.
Group 3	**	G53: Cancellation of offsets 1 and 2 G54: Call-up of offset 1 G55: Call-up of offset 2
Group 4	*	G92: Set offset 5
Group 5	**	G56: Cancellation of offsets 3,4,5 G57: Call-up of offset 3 G58: Call-up of offset 4 G59: Call-up of offset 5
Group 6		G25: Subroutine call-up G27: Unconditional jump
Group 7	<input type="checkbox"/> <input checked="" type="checkbox"/>	G70: Measurements in inches G71: Measurements in mm
Group 8	**	G40: Cancellation of the tool path compensation G41: Cutter path compensation left G42: Cutter path compensation right
Group 11	**	G98: Withdrawal to starting plane G99: Withdrawal to withdrawal plane
Group 12		G73: Call-up circular boring pattern G75: Call-up rectangular boring pattern
Group 15	**	G50: Scaling factor clear G51: Scaling factor calling

\* effective clockwise

\*\* initial status

Initial status can be established in the user monitor (MON) mode.

## Group structure and initial status of the M-functions

Group 0	*	M03: Spindle ON in clockwise direction M04: Spindle ON in counterclockwise direction M05: Spindle stop M19: Spindle precise stop
Group 1	**	M38: Precise stop ON M39: Precise stop OFF
Group 2	*	M00: Programmed STOP * M17: Subroutine end * M30: Program end with return to program start
Group 3	**	M08: Coolant ON M09: Coolant OFF
Group 5	*	M25: Open clamping device * M26: Close clamping device
Group 8	<input type="checkbox"/> <input checked="" type="checkbox"/>	M50: Cancellation of the direction logic with bidirectional tool turret M51: Selection of the direction logic with bidirectional tool turret
Group 10		M90: Cancellation of the mirroring function M91: Mirroring on the X-axis M92: Mirroring on the Y-axis M93: Mirroring on the X and Y-axes
Group 11	*	M27: Programming dividing attachment

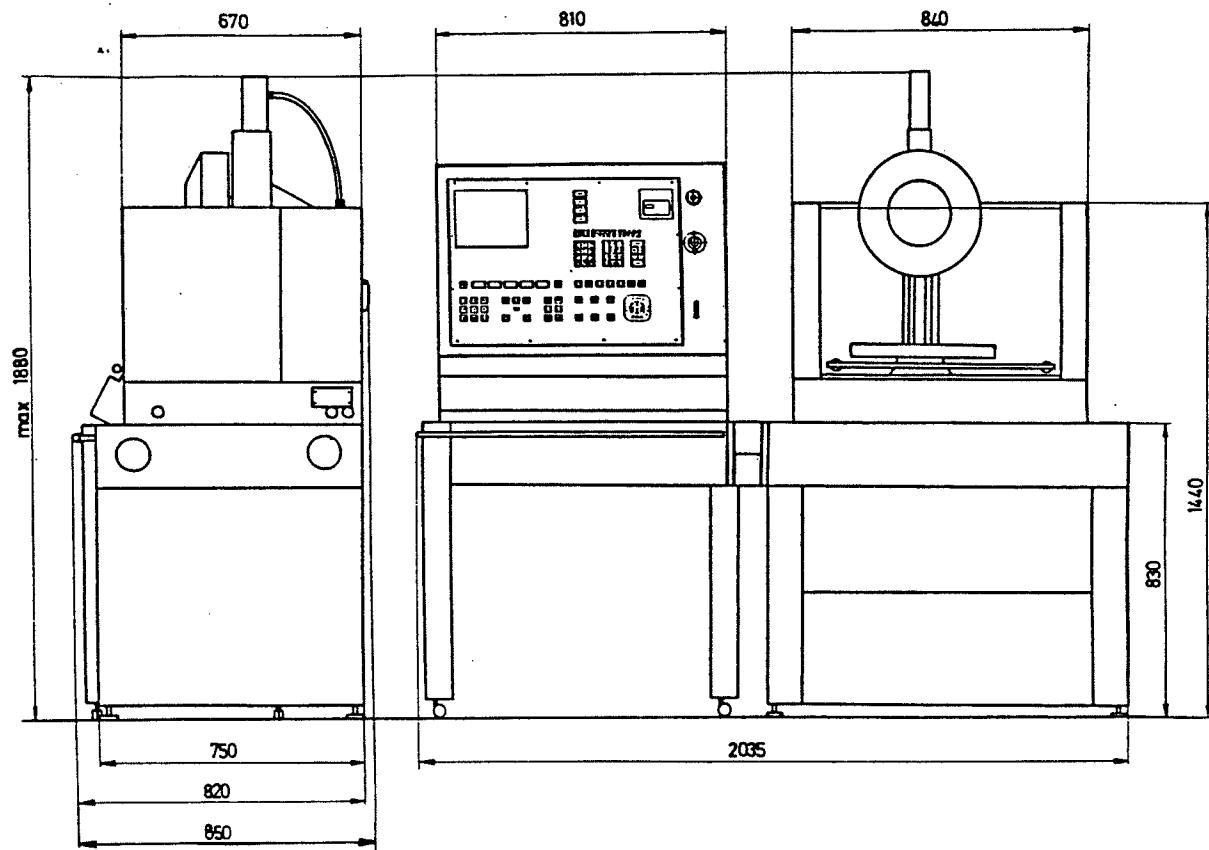
\* effective blockwise

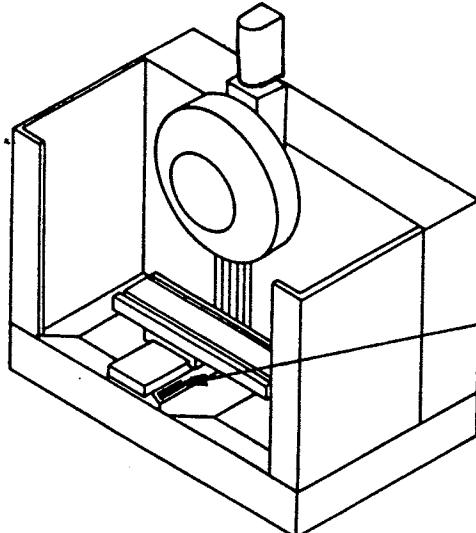
\*\* initial status

Initial status can be established in the user monitor (MON) mode.

Note: The implementation of the individual M-functions depends on the hardware of the machine in question.

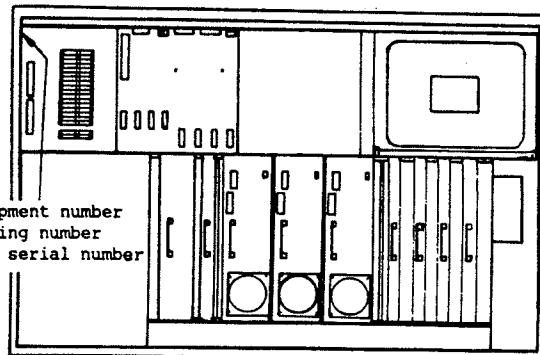
Total dimensions of machine with machine table





Machine Number

If you have claims, service parts orders etc. always indicate the machine number.



El-Equipment number  
El-Housing number  
Control serial number

Control Serial Number

If you order service parts or in case of claims always indicate control number and control serial number.

## Scope of delivery basic equipment

VMC-100 vertical machining center 800 W main motor, speed range 10-4000 rpm., incl. coordinate table vertical column with milling head drive motor, tool shop for 10 tools, stepper motors for 3 axis, sheet metal enclosure, machine lamp taper blow-out device, central lubrication, transparent chip guard door, bench-clamping shoulder, reference tool, handles.

CNC-controlled EMCOTRONIC TM 02 with monochrome screen 9", programming and operating instruction, operating tool.

Basic equipment can differ depending on the country of delivery.

The above mentioned elements are minimal equipment for each country of delivery.

## Chapter B

Installation of machine and control unit,  
electrical connection, connection of  
blow-out device, start-up

1. Installation	B1 - B8
General instruction	B1 - B8
2. Electrical connections	B9 - B15
Mounting of cable from machine to control	B9
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Fuses	B13
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Changing Stepper Motor Board R3D 413 001	B18
3. Connection of blow-out device	B19 - B20
Technical data	B19
Description	B19 - B20
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Switching machine off	B22
Possible problems during switch-on	B23 - B26

## 1. Installation

### General instructions:

#### 1. Unpacking machine and control unit

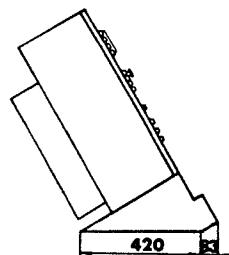
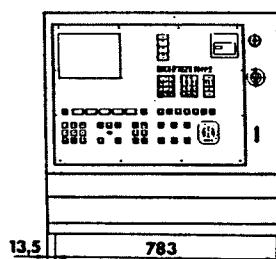
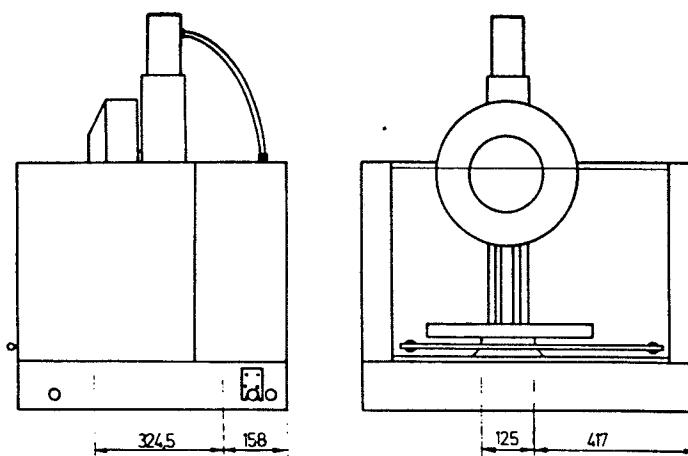
The machine and the control unit are each screwed to the pallet by means of four hexagonal screws SW 17. After unscrewing the hexagonal screws from below, the machine and the control unit may be lifted onto the machine and control tables respectively.

##### Note:

Check machine and control unit for possible transport damage. If you find damages, contact dealer and insurance company.

Check consignment for missing parts - contact dealer if parts are missing (indicate machine number).

If the machine is to be dispatched later, it must be screwed again onto the pallet. In the sketches you can see drilling patterns for screwing machine and control unit onto the pallet.



Dimensions of threaded holes M10 for screwing machine and control unit onto transport pallet.

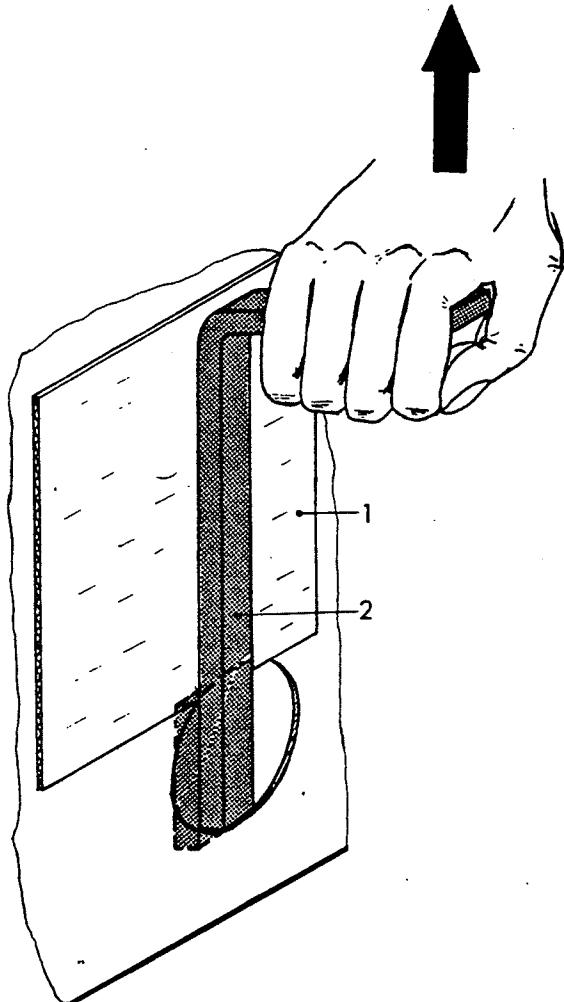
## 2. Lifting machine and control unit

### Machine:

Approx. weight 172 kg 379 lb

### Control:

Approx. weight 127 kg 280 lb



### Transport:

- \* On the left and right side of the machine and control unit there are two bores each, in which handles (2) can be inserted for transporting machine and control unit (see sketch).
- \* To avoid damage of machine or control unit during transport, clamp a piece of cardboard (1) between handle (2) and machine or control unit.

### Note:

- \* Do not insert bars into the bores.

### Caution:

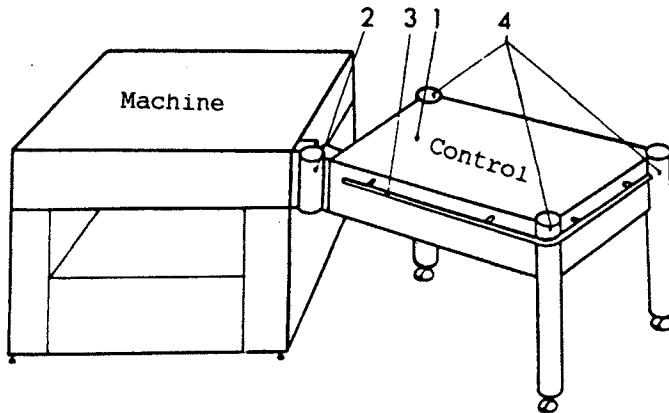
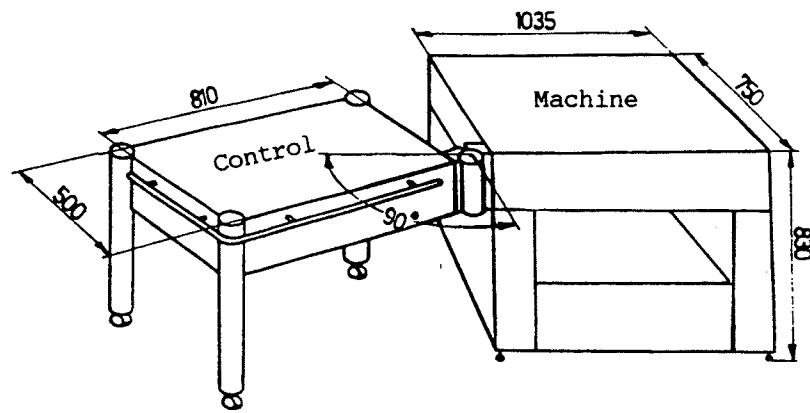
Never lift machine on mechanically moveable parts, slides or cable leads.

### 3. Machine table and control table

#### 3.1 Possible installation of control table

The stand for the control can be turned  
90°.

Sizes of tables: See illustration

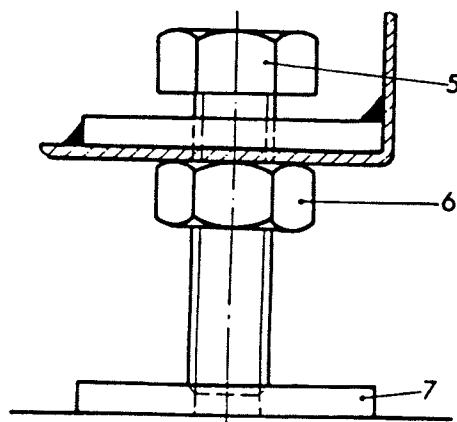
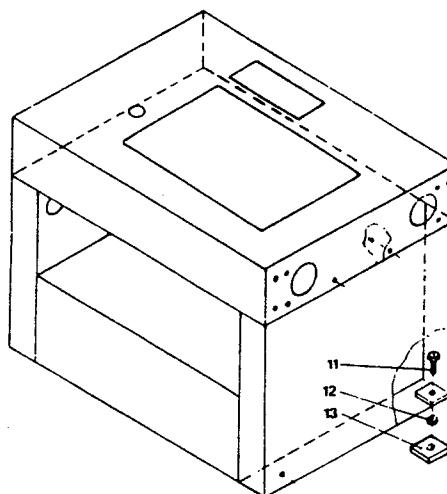


The stand for the control(1) can be mounted to the left or to the right side of the machine stand.  
The joint(2), the handle(3) and the legs(4) have to be mounted in the correct way.

### 3.2 Assembly of machine- and control table

#### Assembly of machine table

- Insert the four foot screws M16 x 60 (11), mount lock nuts M16 (12) and place machine table on supports (13).
- For fastening machine on table use 4 socket head screws M10 x 20 and 2 nuts M10.



#### Adjusting the Height of the Machine Stand

- Adjust the height with the hexagon screws M16 x 60 (5).
- Counter the hexagon screw with the hexagon nut M16 (6).

#### Note:

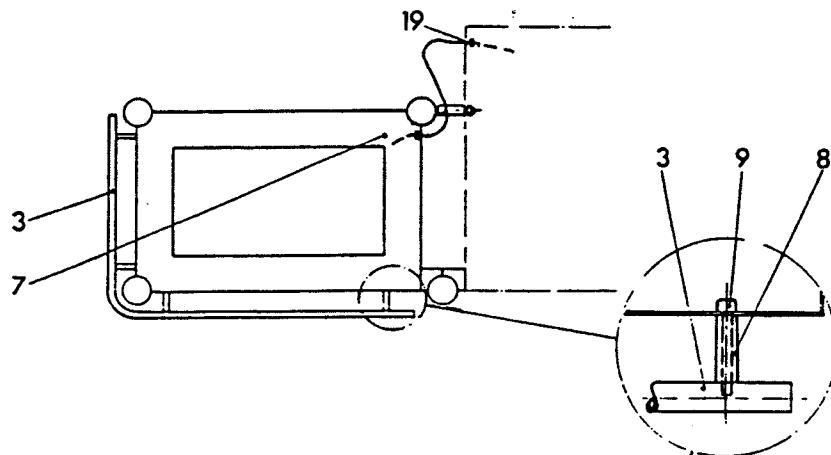
The hexagon bolts can be placed directly on the floor, but it is advisable to place metal sheets (7) underneath.

#### Attention:

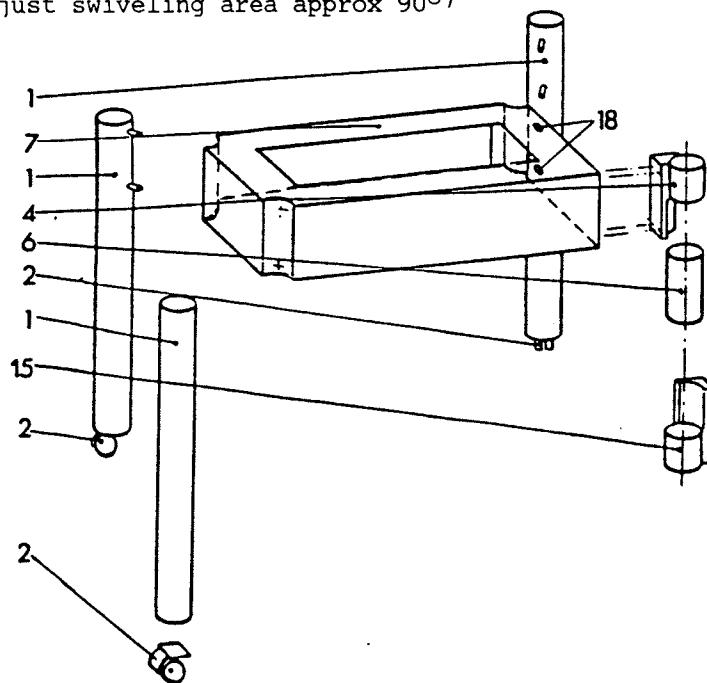
Note . ,5° inclination of table (look page B7).

## Assembly of the control table

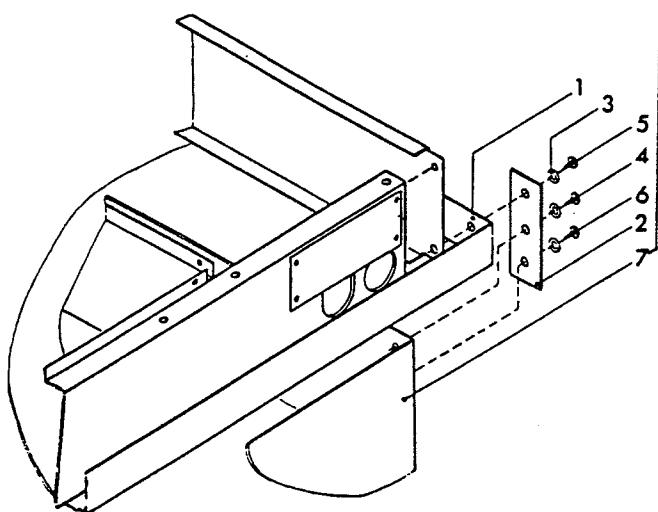
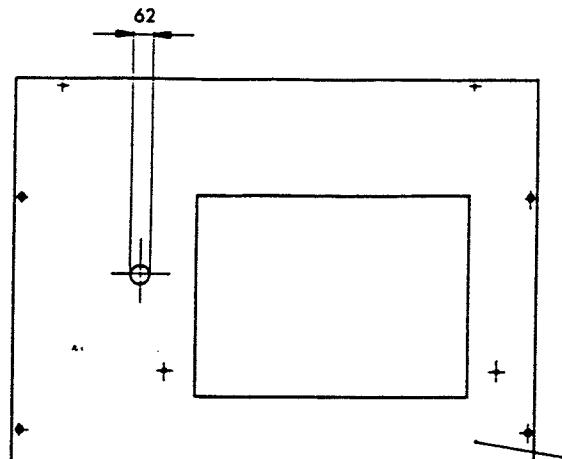
- 1) Mount casters (2) on legs (1). (Sheet metal screws B4.2 x 13).
- 2) Attach legs (1) to table (7). (With spring washer B8 and nut M8).
- 3) Mount handle (3) with spacer sleeves (8) and socket head cap screws M6 x 60 (9) on table (observe correct side!)



- 4) Attach joint half (4) in such a way that the closed side is on the top. Do not screw tight yet (with spring washers B6 and socket head cap screws M6 x 12).
- 5) Adjust machine table to correct height.
- 6) Insert piece of piping (6) and attach control table to machine table.
- 7) Screw joint half (4) tight.
- 8) Insert line through hole (18) and clamp the line with rope-clamper.  
Insert line through one of the four fixing holes (19) and clamp the line with rope-clamper.  
(Adjust swiveling area approx 90°)



#### 4. Fastening of machine and control:



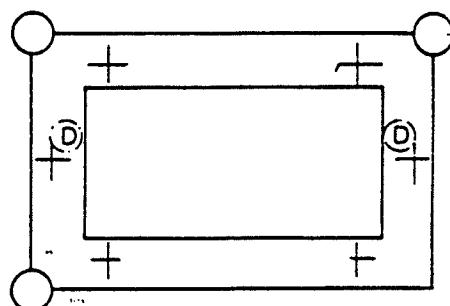
##### Machine:

For the sealing of the machine against the coolant fluid, a coolant tank (1) is used.

##### Mounting of the coolant tank:

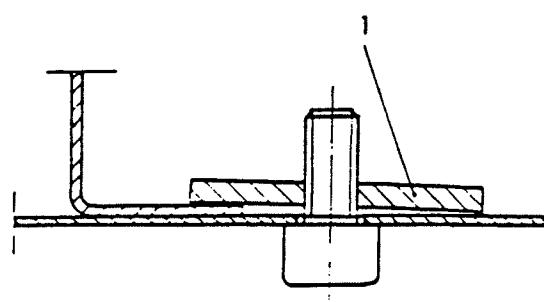
- Set the coolant tank (1) on the mounted machine base (7) (if there is a bore dia. 30 mm in the machine base it has to be rebored to a minimal dia. 60 mm).

- Remove the sheet metal screws (6) and mount the cover plates (2) with the sheet metal screws 4,2 x 13 (5) and the washers (3).
- If not existing, there have to be drilled four bores dia. 3,5 mm in the machine base.
- Screw in the sheet metal screws (6 and 4) with the washers (3).

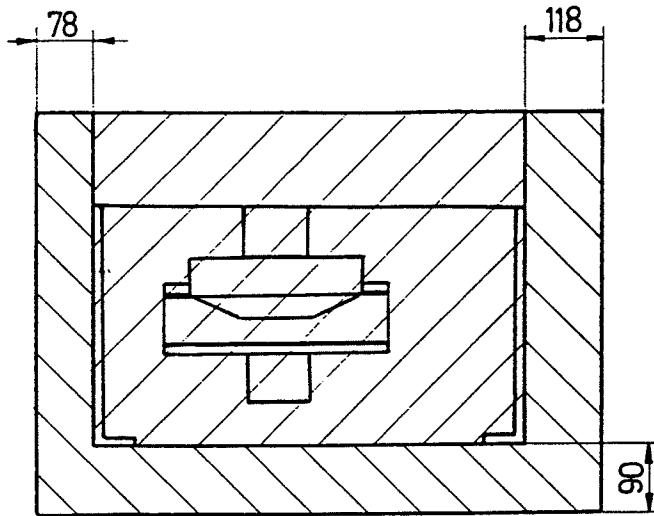


##### Control:

VMC-100: D (2 x with clamping plate)

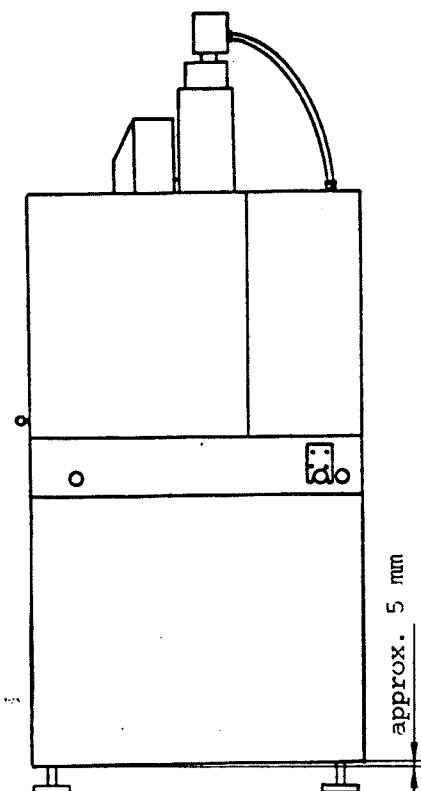


## Notes:



## Marking:

To avoid scratching the table surface of the machine base when placing the machine on the table, it is advisable to make marks on the table surface (see sketch).



## Inclination of the machine base

The machine should be inclined approx.  $0.5^\circ$  (= approx. 5 mm) forward to ensure complete discharge of the coolant ( $0.5^\circ$  to be set with foot screw at the machine base).

The control unit is flush on the left and right side with the machine base.

## 5. Self-made bases

Machine and control unit must be placed on stable bases. If you do not use original bases, please refer to the recommendations for the base sizes and the bore patterns to screw the machine and control unit onto the bases. Make certain that the self-made control table is made to swivel. On a self-made machine table, two bores for the coolant discharge hoses must be provided.

### Recommended table sizes for self-made bases:

Machine:

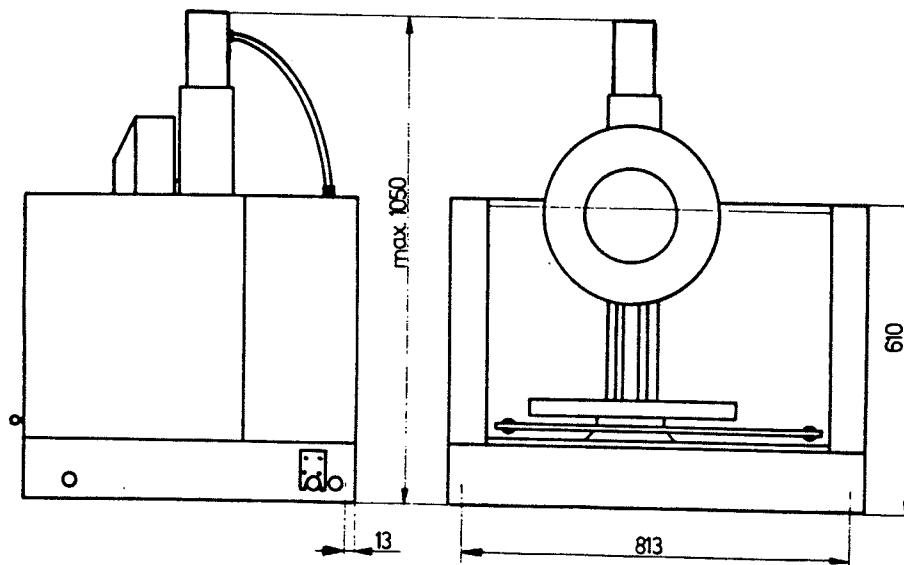
Length x width x height  
1035 x 750 x 830 mm

Control Unit:

Length x width x height  
810 x 500 x 830 mm

Recommended table height: 830 mm

### Tapped bores for mounting the machine



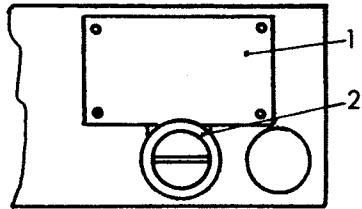
Dimensions for screwing onto the machine base using two socket head screws M 10 x 20 and nut M 10.

The control unit is to be fixed at the control table using two clamping plates (see page B 6: Mounting of Machine and Control Unit).

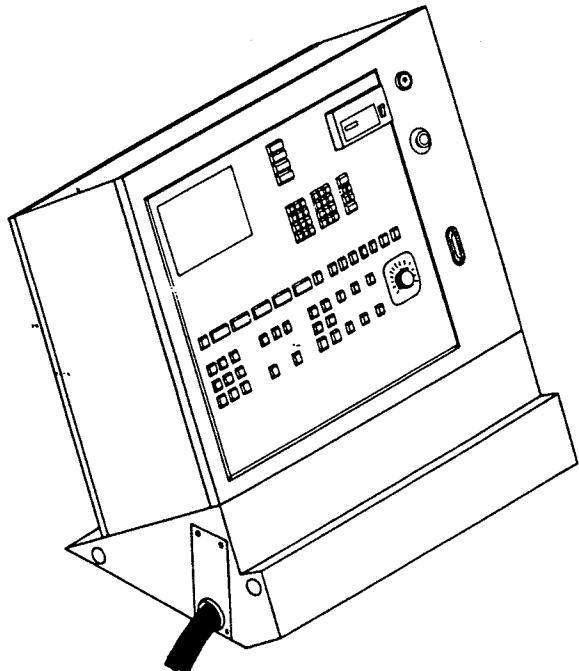
## 2. Electrical Connections

### Lay of cables from machine to control

Depending on the position of the control to the machine, the cable conduit is led out from the machine housing left or right hand side.



Remove cover of machine. Dismount part (1), insert all plugs. Mount cable into eye (2). Slide eye (2) into slot of housing. Mount part (1).



Mount eye with cable conduit in the same way into control.

## Connecting of plugs to control

### Note:

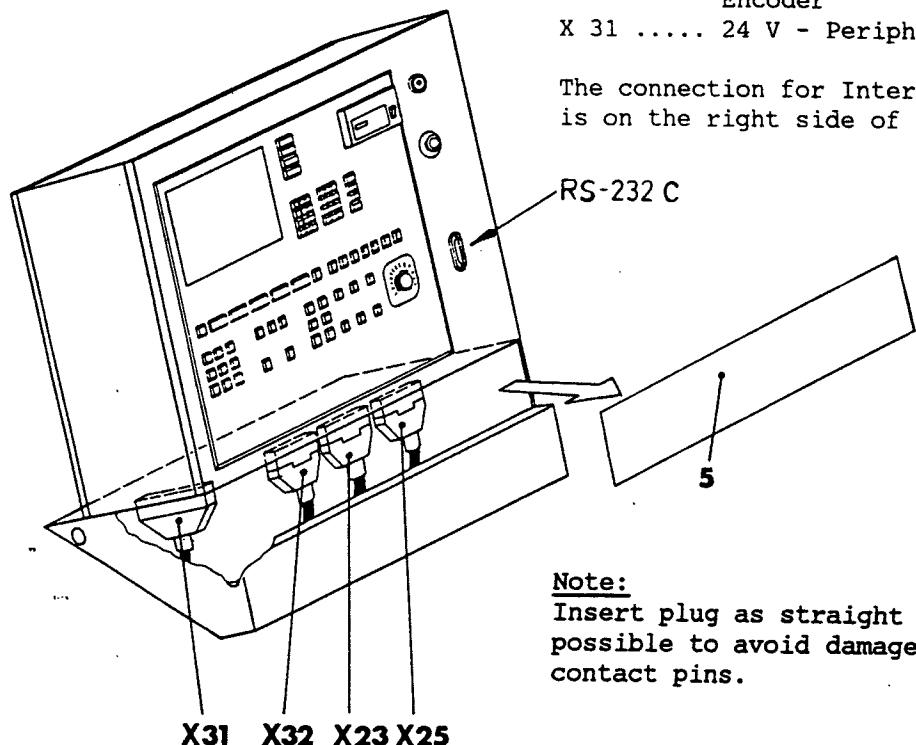
Dismount cover sheet (5) before connecting machine plugs to the control!

### **Attention!**

When connecting or disconnecting, Switch off the the main switch, machine is already connected to main supply, otherwise electr. elements could be destroyed.

X 23 ..... Step motors  
X 25 ..... Main drive + 220 V Periphery  
X 32 ..... Tool turret, Bero Encoder  
X 31 ..... 24 V - Periphery

The connection for Interface RS-232C is on the right side of the control.



### Note:

Insert plug as straight as possible to avoid damage of the contact pins.

## Main Supply

### Dates:

Voltage: 220 V single phase; max. fluctuation  
of the mains voltage  $\pm$  12 V admissible.

Frequency: 50 cy or 60 cy

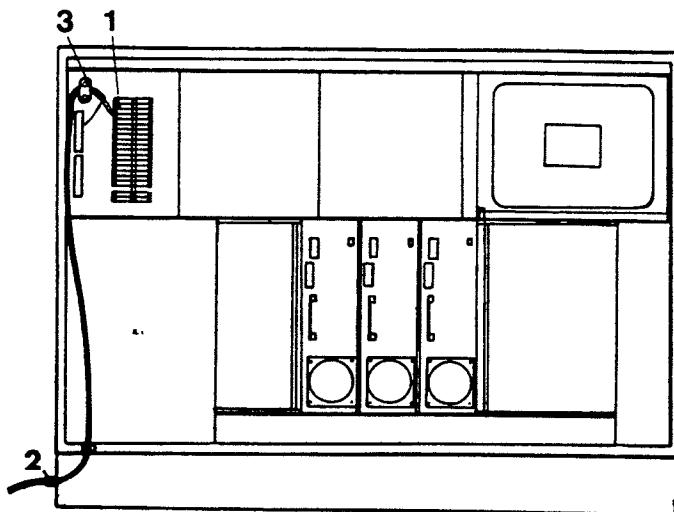
Fuse: 12 A slow-blown

Connection value: 2650 VA

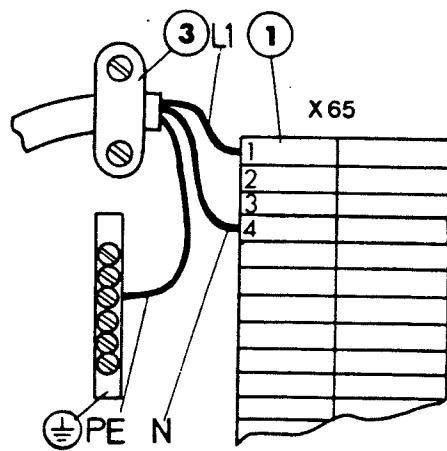
Cable: 3 x 1,5 mm<sup>2</sup> wire section.

### Note:

The el. connection of the machine must  
be done by an authorized expert.

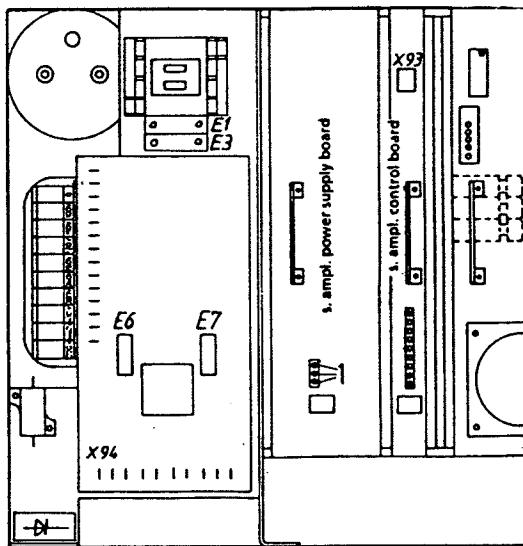


1. Terminal strip for mains connection
2. Screw fitting for mains cable.
3. Strain-relief clamp



- \* Unscrew cap of cable screw fitting (2) and thread onto lead-in.
- \* Pass lead-in through cable screw fitting
- \* Connection:
  - Connect phase L1 to contact 1 of the terminal strip X 65 (item 1).
  - Connect neutral conductor N to the terminal 4 (blue terminal) of the terminal strip X 65 (item 1).
  - Connect yellow-green core (PE) to the earthing terminal ( $\oplus$ ).
- \* Clamp lead-in in strain-relief clamp (3).
- \* Screw cap onto cable screw fitting (2).

## Fuses



### 1. Main drive fuse

#### 24V fuse:

If the control lamps (1) on the power component of the transistor setting device do not light up, the 24V fuse (E22) has probably blown (see circuit diagram).

The reason for this may be too high a fluctuation of the mains voltage (max.  $\pm$  12 V admissible).

#### Power fuse:

Fuses F 1 and F 3 A.C.side  
(type 10 A slow).

Fuses F 6 and F 7 D.C.side  
(type 16 A superfast).

### 2. Fuses on the motor driver card

(see circuit diagram)

From left to right, fuses for:

E 12... plug, position 4

E 13... power supply for computer

E 14... transformer for feed X,Y,Z

## Electrical Connection of the Accessories

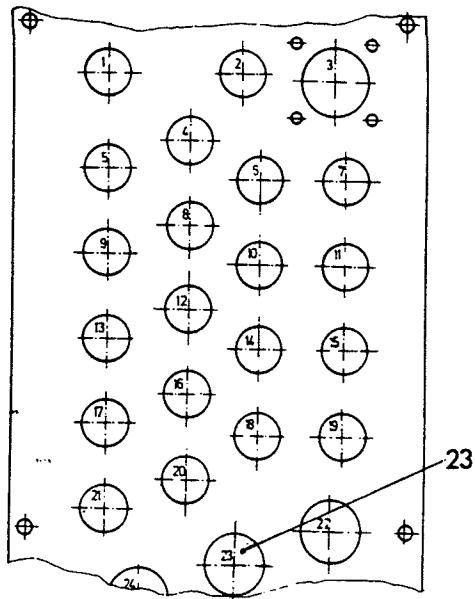
The cables for the accessories are connected in the terminal box. A cable connection is enclosed with the respective accessory.

**Warning:** Before connecting, switch off the machine and pull out the main plug.

The electrical connections may only be made by a specialist.

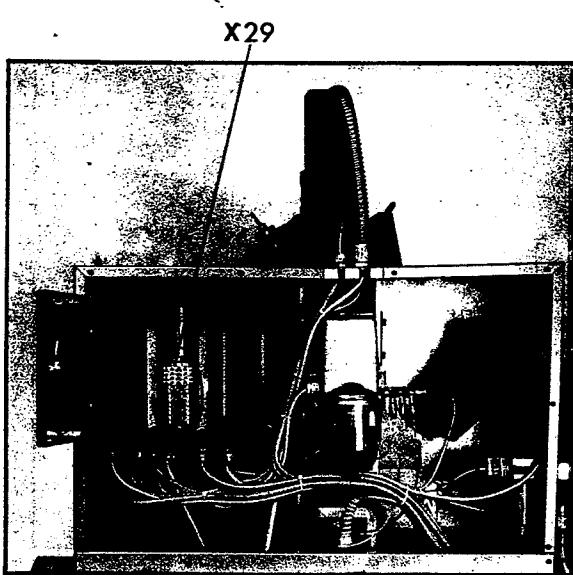
## Electrical Connection of Coolant pump

Remove rear cover of machine. Bores are provided in the terminal box for introducing the cables and making the cable connections.



23..... Position of the cable connection for inserting of the cable of coolant pump into terminal box.

Plate with PG connections VMC-100



Fixing of cable in terminal box

Phase L1 (black) to PIN 1 of terminal strip X 29. Neutral conductor N (blue) to PIN 9 of terminal strip X 29. Earthing cable PE (yellow-green) to PIN 13 of terminal strip X29.

## Connection via isolating transformer

The isolating transformer may serve for

1. Creation of a changeable neutral wire with power supply 3 x 380 V.
2. Transformation of other voltages to 3 x 380 V/220 V.

### Ad) item 1:

The main supply must have a changeable neutral wire Mp (= neutral wire N), because some parts of the control and accessories are supplied with only one phase and the neutral wire.

If there is no changeable neutral wire available in the main supply, it is necessary to create a changeable neutral wire. An isolating transformer (adjusting transformer) has to be built between power source and machine.

Recommended isolating transformer:  
440/380/220/208 Volt.

Ref.No.: 271 030.

With this isolating transformer a changeable neutral wire is created.

A connection instruction comes with above transformer.

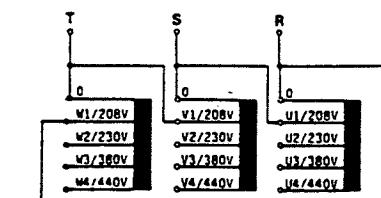
### Ad) item 2:

Compare the connections for the specific voltages on the following pages of the instruction.

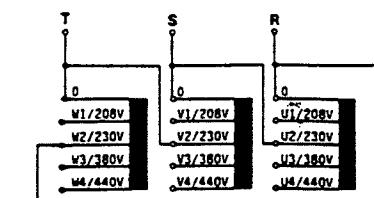
**TRAFO Type DTS 5/5 kVA**  
Ref. No. 271 030

**Transformator Anschlußbeispiele:**  
**Transformer Connection Examples:**

**3 x 208 V 50/60 Hz**



**3 x 230 V 50/60 Hz**



**Hinweise:**

- Zwischen 50/60 Hz kein Unterschied im Anschluß
- Beim Emcotron Anschluß muß ein belastbarer Mittelpunktsleiter vorhanden sein.
- Ein belastbarer Mittelpunktsleiter wird durch den Trafo geschaffen.
- **Schlechte Netzverhältnisse:**  
Dauernde Unter- und Überspannungen können durch die  $\pm 5\%$  Voltanschlüsse ausgeglichen werden.

**Beispiel:**

3x440 V Nennwert jedoch dauernde Unterspannung von  $-5\%$ , das heißt effektive Netzspannungen 3x418 V.

**Ausgleich:**

L1, L2, L3 der Emcotron an  $+5\%$  anschließen.

**Remarks:**

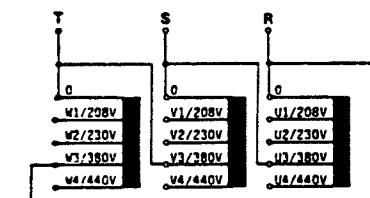
- No difference in 50/60 Hz cycle supply.
- A neutral wire (N) is necessary for Emcotron connection.
- With the Trafo the neutral wire (N) is generated.
- **Bad Voltage Conditions:**  
Permanent high or low voltages can be compensated by connecting the Emcotron to the  $\pm 5\%$  Volt connections of the transformer.

**Example:**

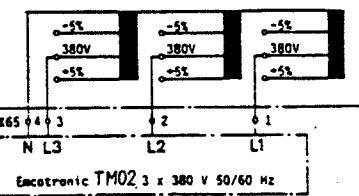
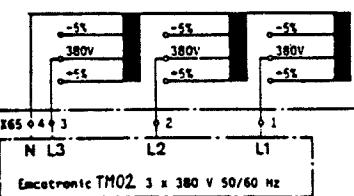
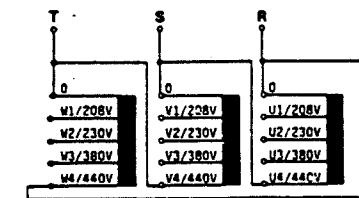
Nominal voltage 3x440 V -5% permanent low voltage therefore effective voltage: 3x418 V.

Compensation: L1, L2, L3 on Emcotron are connected to  $+5\%$ .

**3 x 380 V 50/60 Hz**



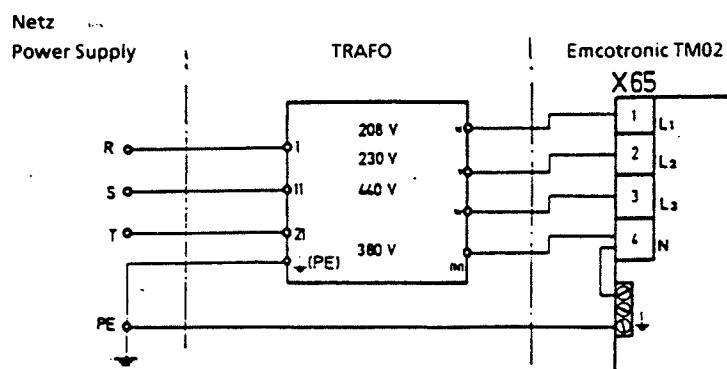
**3 x 440 V 50/60 Hz**



Emcotron TM02 3x380 V 50/60 Hz

Emcotron TM02 3x380 V 50/60 Hz

**Anschlußschema allgemein mit TRAFO**  
**General Connection Scheme with TRAFO**



**Achtung:**

Bei Trafoverwendung muß in der Emcotron N (4) mit PE ( $\ominus$ ) gebügelt werden.

Bei Direktanspeisung (3x380 V, N, PE) darf N und PE nicht gebügelt werden.

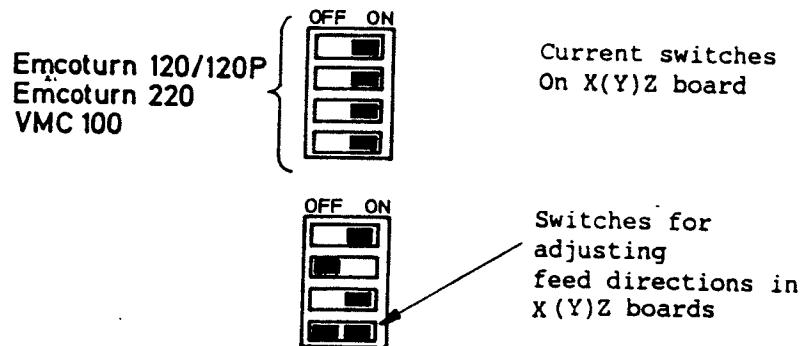
**Attention:**

Using the Transformer N(4) and PE ( $\ominus$ ) have to be jumped in the Emcotron. No jumping of N (4) and PE ( $\ominus$ ) if no Transformer is used (i.e. Direct Power Supply with 3x380 V, N, PE).

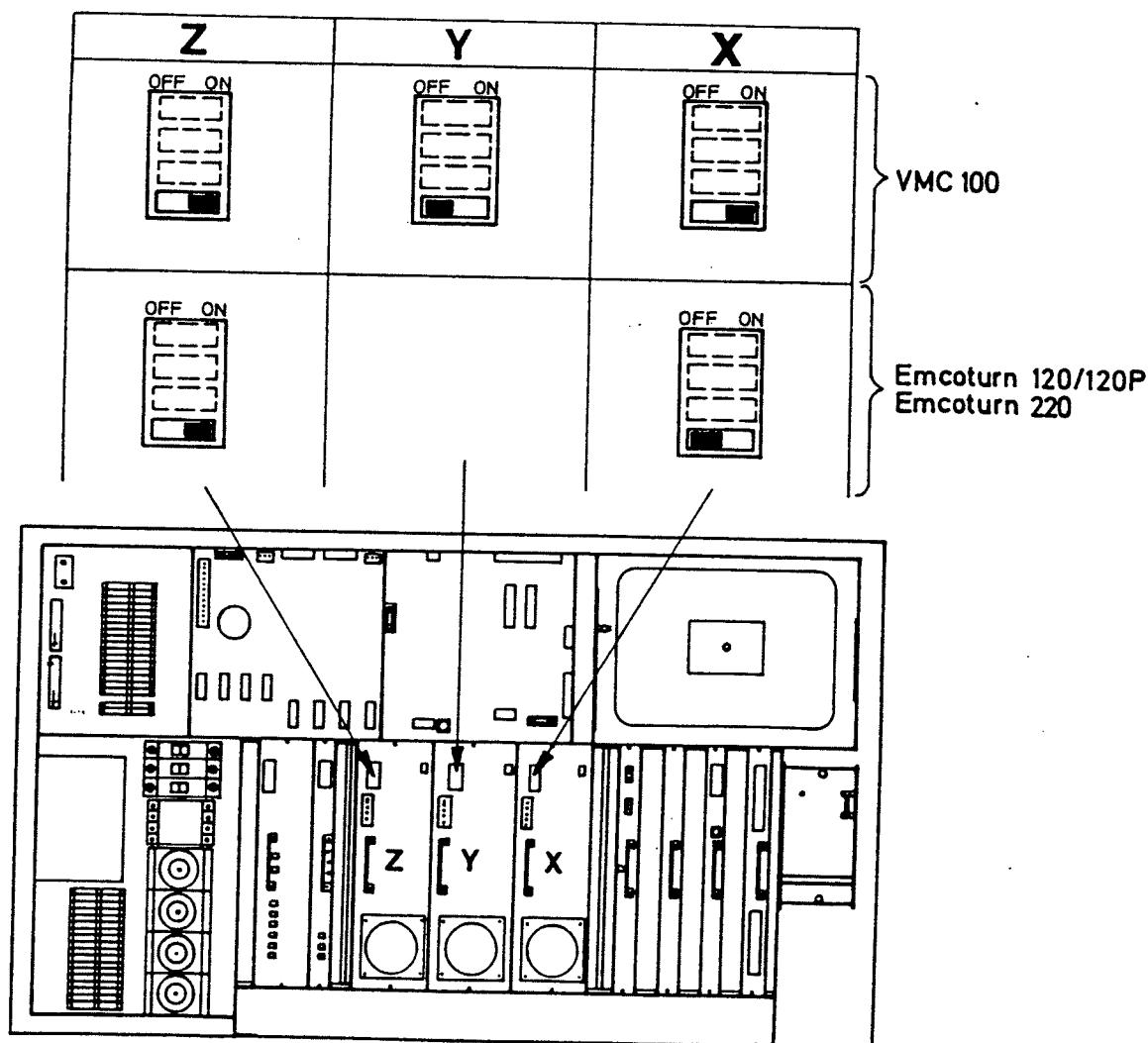
# ATTENTION !!!

## Changing Stepper Motor Board R3D 413 001

Before mounting the board R3D 413 001 the Dip-switches for current adjustment and feed directions have to be set in correct way. Otherwise the board will be disturbed.



## Adjusting feed directions



### 3. Connection of blow-out device

During each tool change the blow-out device blows out the tool taper fixture.

Therefore, dirt in the tool taper fixture and inaccurate clamping of tools is avoided.

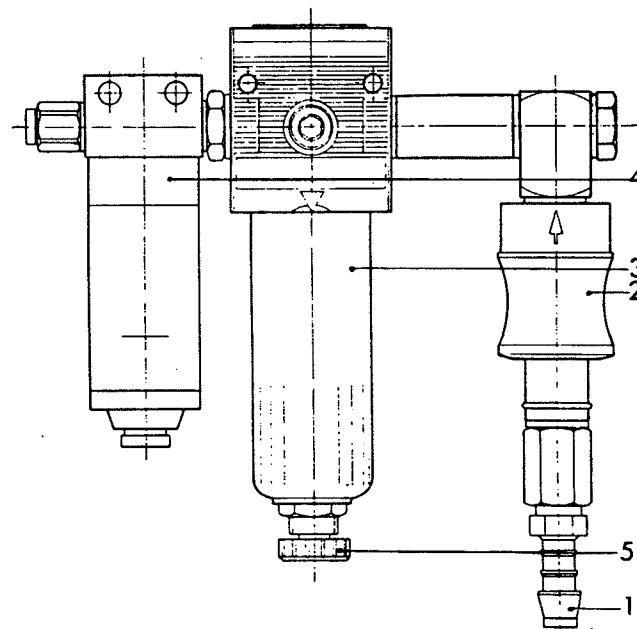
#### 1. Technical data of compressed air supply

Maximum admissible pressure: 10 bar

Recommended working pressure: 6 - 7 bar

Connection: Compressed air hose  $\phi$  10 mm

#### 2. Description



1 .... Connection for compressed air hose  $\phi$  10 mm

2 .... Manual slide valve

3 .... Filter with water separator

4 .... 3/2 valve

5 .... Screw for draining water from the water separator tank

## 2.1. The manual valve:

### Function:

By means of the manual valve, the air supply can be switched on and off.

Slide upward: valve open

## 2.2. The filter with water separator

### Function:

Separation of air from water and dust.

### 2 Options for draining water from separator tank:

#### Option A:

- \* Open screw (5) slightly → water flows out under pressure.
- \* Tighten screw again.

#### Option B:

- \* Switch off compressed air supply (at manual slide).
- \* Completely unscrew the screw (5) - water flows out.
- \* Screw in again screw.

### Maintenance:

Check separator tank for water.

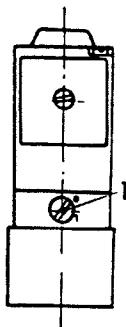
Weekly check.

## 2.3 The 3/2 valve

### Function:

During tool change, the 3/2 valve is actuated electrically and controls air supply for blow-out of tool taper fixture.

The 3/2 valve is equipped with a screw (1) for manual actuation of air supply.



### Procedure:

Press in screw (1) using a screw driver and turn from position 0 to 1.

## 4. Start-up of machine

### Checks before start-up

- \* If the machine is connected electrically, it can be started up. Before initial start-up, eliminate the rust preventive and oil all bare metal parts except spindle taper and tool taper.
- \* Check oil level for central lubrication. If there is no oil in the lubricant tank, the central lubrication system has to be deaerated after filling in the oil.
- \* Check contents of coolant device.
- \* Note all other maintenance instructions (see chapter G).
- \* Press the lubricant button and the slideways will be lubricated.
- \* Switch on air supply (hand slide) for the blow-out device.

## Switching machine on

Close chip door

Switch on key switch (emergency stop button must be unlocked)

**MANUAL**

mode appears

press

**AUX ON**

press



Pressing the central lubrication key produces a lubrication impulse of 7 seconds. After a longer standstill of the machine, press the central lubrication key several times, therefore a new lubrication film on all guides is given.

Approach reference point

press

**CYCLE START**

Note:

After approaching the reference point the tool change system is synchronized to position 1 by actuating the

**MAN** and **JOG**



keys in

MANUAL mode and then is ready for operation (only when switching on the machine for the first time and/or tool shop not locked correctly).

Machine and control are ready for operation.

The control unit reports with alarm A460 REFERENCE POSITION NOT ACTIVE.  
Delete alarm!

The reference point is approached automatically.

In reference point position, the longitudinal slide is in the left front position. The Z slide is in the uppermost machining position. This must be done to avoid collisions with workpieces and tools.

(Feed rate switch > 0!)

### Possible problems during switch-on

- \* ALARM A130 (see loading MS data)
- \* ALARM A050/A060 (see tool turret alarms on the following pages).

## Switching machine off

The machine is switched off by means of a key-operated switch.

Please note:

### Caution!

The key-operated switch may be switched off only if the main spindle is stopped, otherwise the main drive fuses may melt.

Do not switch off during tool change or during a slewing operation, otherwise the drum is in an undefined position when switching on again —  
Alarm 060. See page B 24!

## Possible problems during switch-on

### 1. Alarm A130 (incorrect machine status data for axis control unit)

#### Note:

If the machine has not been switched on for more than three months, the MS data (machine status data) may no longer be available in the buffer memory. In this case, the screen displays alarm 130. The accumulator for puffer action of these data is reloaded only with the machine switched on.

- Furthermore, unintelligible values may be displayed in the position shift offset (PSO) and in the tool data offset (TO).  
In addition, also stored user programs may be lost.

#### Measures:

Load machine data from cassette or punched tape.

### Loading machine status data (MSD)

MS-data (= MSD) - is the abbreviation of the English term "machine status data".

The machine is delivered with one machine data cassette containing the MS data.

The cassette with the MSD is set backwards in the electric box door of the basic machine.

During the loading procedure all system data are loaded into the internal machine data memory.

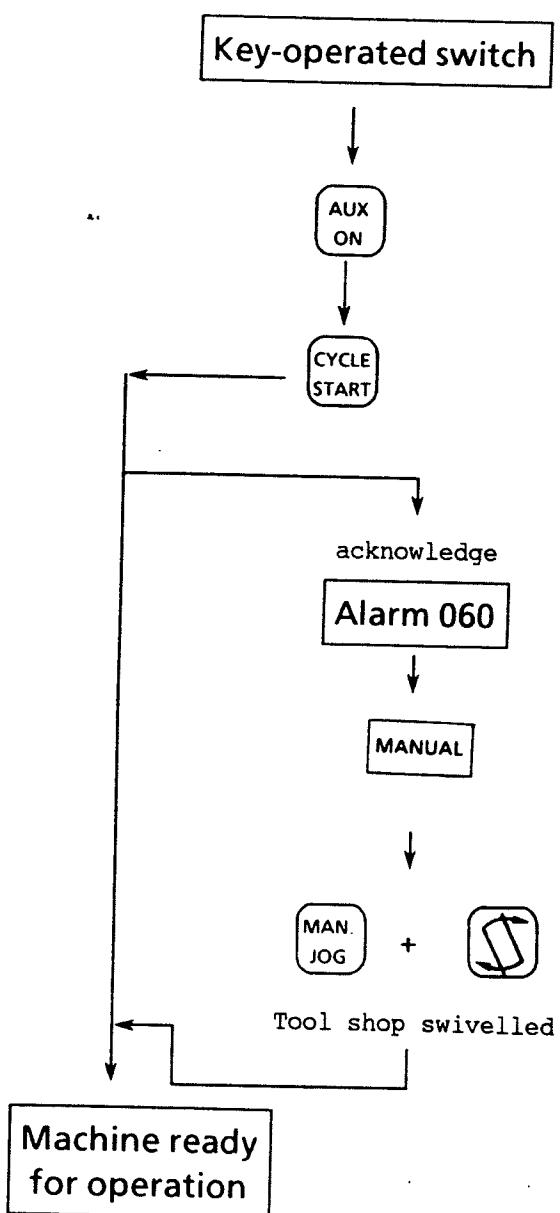
### Loading machine data from cassette

	Switch to EDIT mode, insert cassette.
	Activate soft key CASSETTE PORT. The control reports in cassette operation (interface 0).
	The data are loaded.

### Loading machine data from punched tape via RS 232:

	Switch to EDIT mode, insert punched tape.
	Activate soft key RS 232 PORT. The control reports in RS 232 operation (interface 1).
	The loading procedure is started.

## 2. Alarm A060 TOOL TURRET NOT READY



After switching on the machine, alarm 460 "REFERENCE POSITION NOT ACTIVE" appears and possibly alarm 060 at the same time.

Using the key **AUX ON** the auxiliary drives are switched on.

By pressing the CYCLE START key the reference point is approached.

If alarm 060 "TOOL TURRET NOT READY" also appears during switch-on, the tool positions on the tool shop are unknown to the control unit. Therefore, after approaching the reference point, the following must be noted:

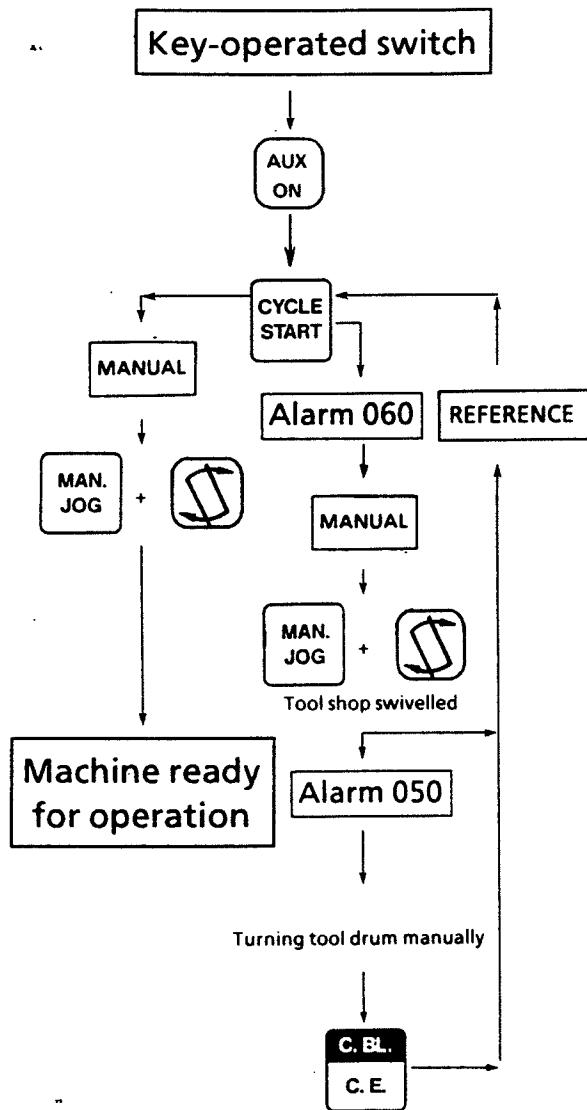
### Measures:

If necessary, acknowledge alarm with C.E. In MAN mode press MAN JOG and swivel button jointly. The tool shop swivels in tool position 1 and is synchronized.

### Note:

After switching off the main switch, the control unit stores the last tool position so that this procedure need not be carried out when the machine is switched on again.

3. Alarm A060 during switch-on followed by alarm A050 during CYCLE START in reference submode



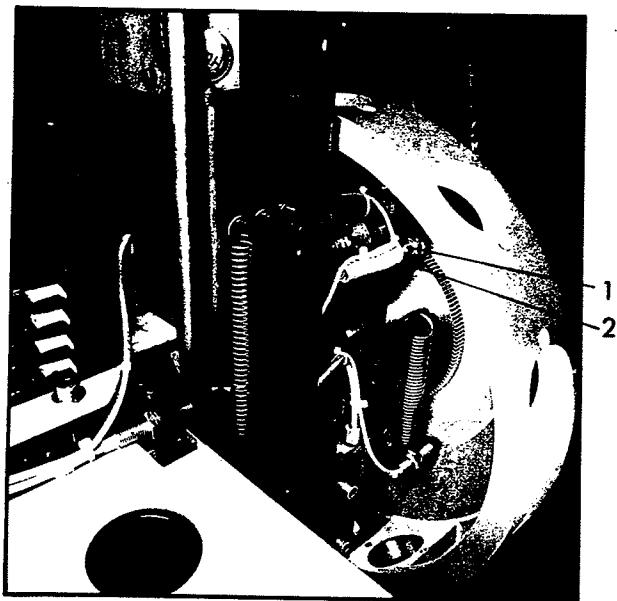
If A050 appears when reference point is approached, the tool shop is not in "clamping position". (Tool bevel regarding main spindle).

Explanation:

A proximity detector controls the position of the tool shop and triggers alarm 050 if the tool shop is in the wrong position. In this wrong position a Z-movement must not occur, as this might lead to collision in Z-direction.

This may happen e.g.:

- \* If you have manually turned the tool drum out of its snap-in position.
- \* If the tool drum was turned by a mechanical collision.
- \* If the swivelling process was interrupted. (EMERGENCY STOP)
- \* If the ball notch was clamped too less, so that the drum is not in the exact position. Adjust ball notch. (see adjustment works).



Measures:

- \* Turn tool shop so that proximity detector (1) is above the slot in the (2) control plate (tool shop snaps in).

- \* Cancel alarm A050 by C.E.
- \* Approach reference point.
- \* The screen displays the dimensions XMN, YMN and ZMN.
- \* Start swivelling procedure in manual mode - position 1 is swivelled in and the tool change system is ready for operation.

Please note:

The reference point N of the tool clamping fixture is in the spindle axis of the front side of the reference tool.

Note:

Never switch off the control unit during the swivelling procedure or in undefined position of the tool shop.

When switched on again, the actual position of the tool shop would be unknown to the control.

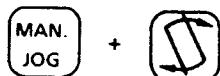
Alarm A060 appears!

Remedy:

- Turn tool shop manually, when machine is switched off.
- Switch on machine, approach reference point.

Remarks:

Swivelling in manual mode using keys



is not possible as long as an alarm is displayed. If necessary, it has to be acknowledged first using

C.BL

C.E.

## Chapter C

### Description of Machine

- Main elements C1
- Construction features and functional description C2 - C8
- Machine zero point M C9
- Tool fixture reference point N C9
- Reference tool C10

## Machine Description

### Main Elements

(Picture in preparation)

- 1 Machine base with chip tray and coolant drains
- 2 Cross slide
- 3 Longitudinal slide
- 4 Vertical slide
- 5 Tool shop
- 6 Main motor
- 7 Coolant line
- 8 Control EMCOTRONIC TM 02
- 9 Machine table
- 10 Control table

## Construction- and function principle

### Machine Base:

Welded metal sheet construction with integrated chip tray, coolant drip pan and workpiece collecting tray.

### The machine stand:

The machine stand is manufactured from high-grade grey cast iron with heavy ribbing. This ensures high stability and vibration-free behavior. The slide units are mounted on the machine stand.

### The slides/slide guides:

The slides are also made of grey cast iron. The ground dovetail guideways of large dimensions guarantee optimum guidance conditions of the slides, little surface pressure and therefore long service life. The vertical slideway is hardened.

Each slide is provided with two adjustable tapered edges to allow easy adjustment of slideways without problems.

The dovetail guideways are oiled automatically by the central lubrication system.

### Feed Drives:

The slides are moved by step motors via high precision ball bearing spindles.

The large-sized spindles together with stiff spindle nuts and play-free axial bearing guarantee high positioning and working accuracy.

### Measuring/Control System

#### of the Feed Drives

By approaching the reference point we fix the position of the machine zero-point M in relation to the tool mount reference point N.

In traverse operation the slide position is controlled each permanent.

If the drive is out of step, an alarm is indicated. The reference point has to be approached.

## Proximity detectors for approaching the reference point

Proximity detectors are mounted in the X-, Y and Z-axis which signal the reference point position of the respective slides to the computer.

Start is effected by pressing CYCLE START in the REFERENCE submode in MANUAL-mode.

## The main motor with torque pick-up

The D.C. motor has a speed range of 10-4000 rpm. A torque pick-up is mounted on the main motor. The torque pick-up has two functions:

1. Controlling the rotational speed of the main spindle
2. Positioning the pinion angle for swivelling the tool shop.

## Main spindle:

The main spindle is mounted in two deep-grooved ball bearings.

The bearings are greased for life and maintenance-free. In the main spindle, bores for blow-out of the tool taper are provided.

The main spindle is directly driven via the D.C. motor by a toothed belt.

## Safety Devices

The main spindle only runs when door is closed (manual mode, automatic mode)

If door is opened during operation, main drive and slide stop.

## The central Lubrication System

The longitudinal and cross slides are supplied with slideway oil by the central lubrication system.

The pump is switched on for 5 seconds after 10 m of slide travel. This interval and the activation period are established by the works.

## The coolant device:

The coolant hose is mounted on the machine. There is a hand slide at the coolant hose for turning the coolant flow on and off. Actuation is via M08 coolant (on) and M09 coolant (off) through the control unit or using the respective key.

## The tool shop

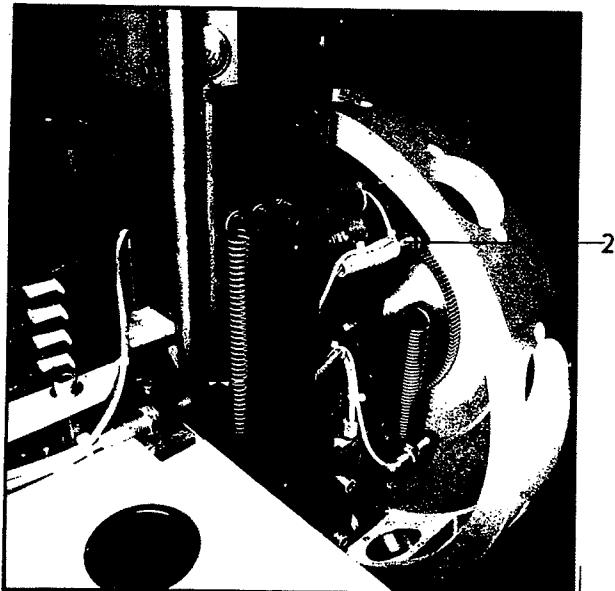
In the tool shop 10 tools may be clamped. The dividing procedure, clamping and releasing of tools can be carried out in the manual mode or via the CNC program. The procedure is described on the following pages.

## Tool change procedure (principle)

Releasing of the tool, swivelling of the tool shop and clamping of the tool is a complete cycle.

### Procedure:

1. The pinion on the main spindle is turned in engagement position to the pinion of the tool shop (control by the torque pick-up on the main motor).
2. The Z-slide moves upward. The clamping device for the tool is opened by a hoop. The tool shop is supported. The slide moves upward until the tool taper is free. The drum can turn around.
3. Swivelling to the tool location selected (command via control unit, command control by means of torque pick-up. Report of exact angle position by proximity detector 2).

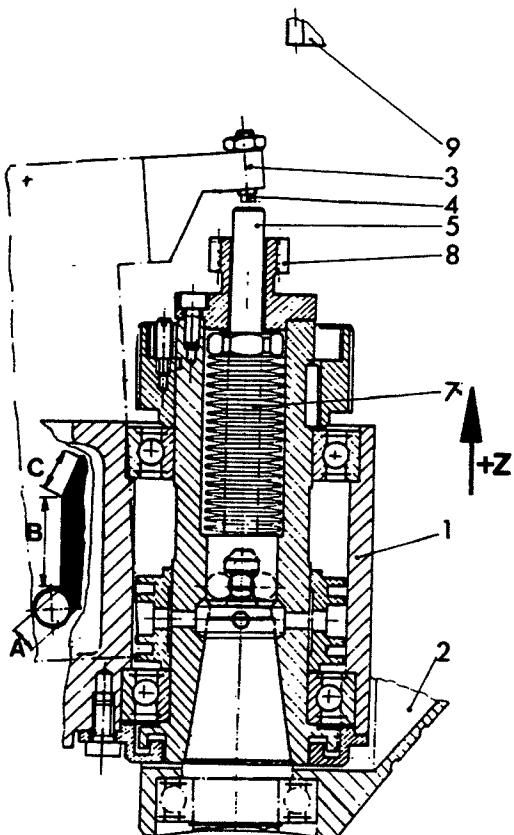


4. Milling head is lowered. Tool is clamped.
5. Tool shop and milling head remain in Z-position (reference point). Tool change is finished.

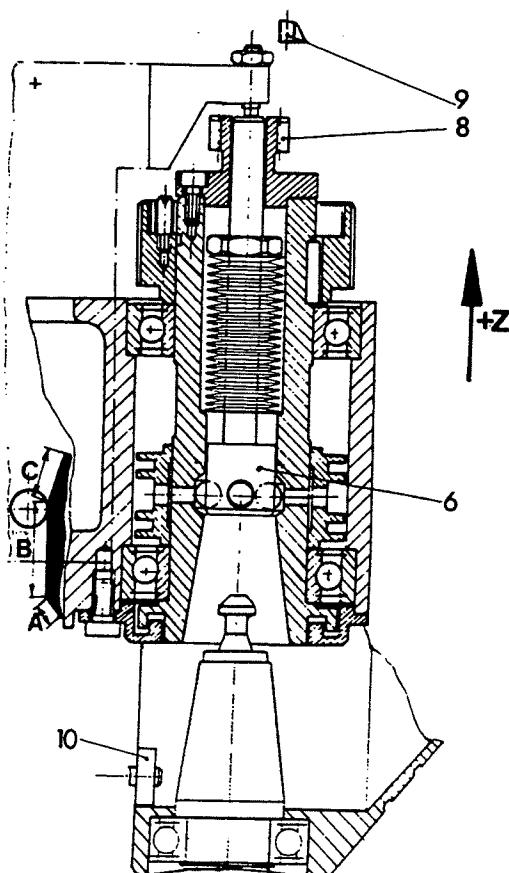
### Note:

The up and down movement of the milling head is controlled by the proximity detector of the Z-feed drive.

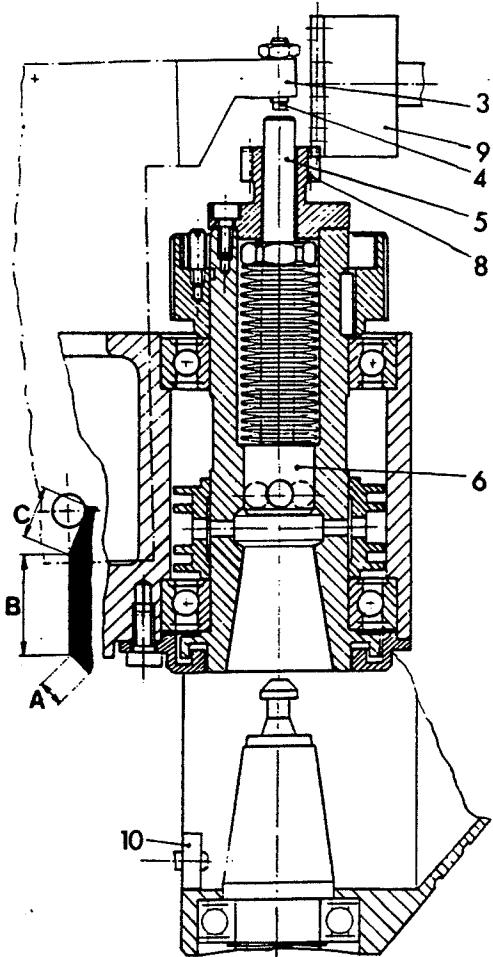
## Clamping process during tool change



- \* Via the main motor the pinion (8) is placed in snap-in position for the toothed ring (9) for tool shop swivelling.
- \* A proximity detector controls the position of the tool shop. If the tool shop is not in clamping position, alarm 050 is given (in any non-clamping position a Z-travel movement must not be carried out).
- \* Milling head (1) and tool shop (2) travel together in +Z-direction.
- \* The clamping hook (3) is then actuated via cam travel A and the clamping screw (4) of the clamping hook presses onto the spring washer group (7) in the milling head via the setbolt (5).

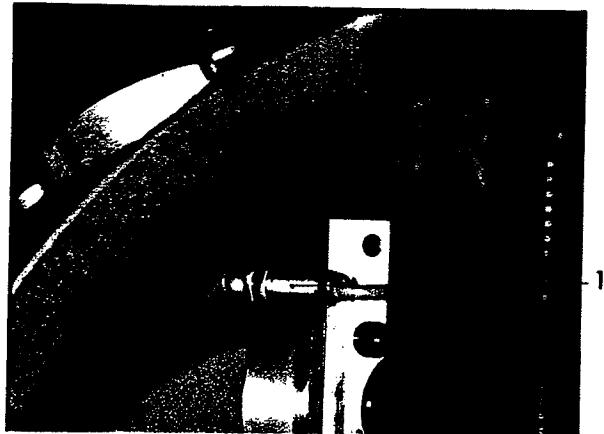


- \* The spring washer group is clamped entirely from the junction of cam travel A and cam travel B. From this point the collet is opened completely.
- \* After the collet is opened completely, the tool shop is supported by two ball bearings (10). The tool shop no longer carries out a traverse movement in +Z-direction.
- \* The milling head moves on in +Z-direction. During the traversing range B of the cam, the collet remains completely open and the tool moves out of the milling spindle.



- \* During the traversing range C of the cam, the collet (6) is closed again and the clamping screw (4) of the clamping hoop (3) rises again from the pressure bolt (5).
- \* In the uppermost position the pinion (8) engages in the toothed ring (9) for tool shop swivelling. Then the tool shop is swivelled via the main motor.
- \* After swivelling the tool shop, the milling head moves downwards again (-Z-direction).
- \* During downward movement, the tool-clamping taper of the milling spindle is blown out to avoid any dirt accumulation in the tool clamping fixture and therefore guarantees perfect clamping of the tool tapers.
- \* The collet is opened again via cam travel C.
- \* During cam travel B, the collet remains completely open.
- \* After the tool taper is moved entirely into the tool clamping taper, the collet is clamped again via cam travel A.
- \* Via a proximity detector it is reported to the control unit if the tool taper fits correctly into the tool taper clamping fixture or not.

## Tool change control by proximity detectors



### Proximity detector 1:

Proximity detector 1 is used for synchronization of the tool shop position when the machine is initially switched on.

#### Procedure:

By pressing the key for swivelling + MAN JOG, the tool shop turns until the cam in the tool shop is above proximity detector 1. Now the angle position of the tool shop and the position of the individual tools is known to the control unit. The cam is arranged in such a way that tool position 1 is in working position. When switching on again, the tool position, which is actually swivelled in, is known to the control unit. Resynchronization is necessary only if the tool shop was turned into an undefined position either manually or by a collision.

### Proximity detector 2:

Proximity detector 2 controls the exact angle position of the tool shop after each swivelling move. If the swivelling position is not reached exactly, alarm A050 appears.

In an alarm 050 position the tool would be in a bevel position with reference to the main spindle. Collisions would result during clamping.

#### Remedy:

- \* Turn tool shop manually so that proximity detector (2) is above the groove in the control plate (4).
- \* Cancel alarm 050 using C.E.
- \* Swivel tool shop.

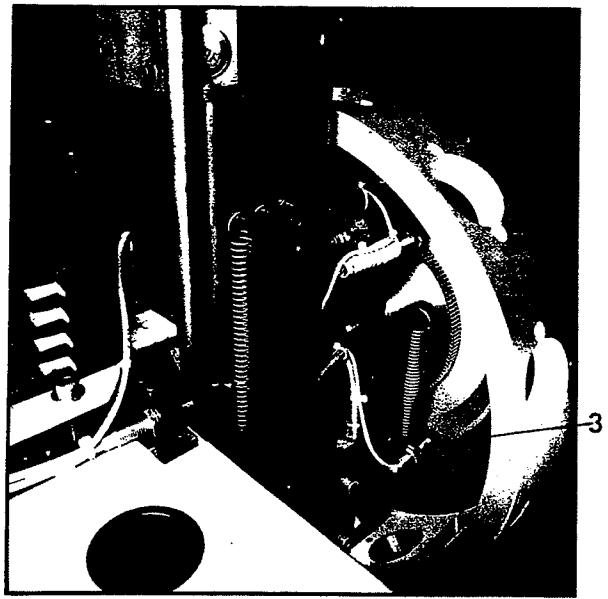
#### Note:

Never switch off the control unit during the swivel process of the tool shop. When switching on again, the actual position of the tool shop will not be known to the control.

#### Alarm A060 appears!

#### Remedy:

- Reset tool shop manually with the machine switched off
- Switch on machine, approach reference point.
- Synchronize tool change system in manual mode in a single swivelling process.



Proximity detector 3:

Proximity detector 3 controls the correct position of the tool shop with reference to the milling head. The tool shop runs on a slide and is supported by springs. In case of spring break the tool shop would fall down. This situation would be reported by proximity detector 3.

Main function of proximity detector 3:

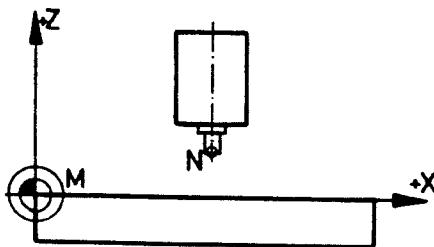
Detecting problems during tool clamping.

The Machine zero point M

The tool-holding fixture reference point N

Position of M:

Left front edge of the  
table surface



Position of N:

N lies in the spindle axis  
at the front of the main spindle.

### Explanations:

- 1) The machine manufacturer determines the position of M and N on the machine.

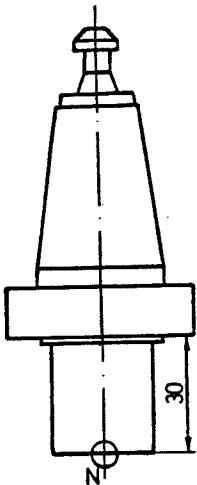
Decisive factor for the  
determination of position M:

It should be possible to easily measure the dimensions up to the workpiece zero point.

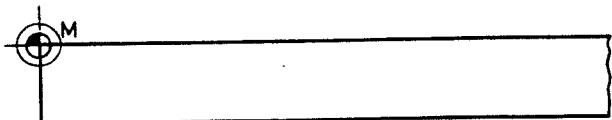
- 2) The machine manufacturer measures the distances between M and N and loads them into the control unit.

Therefore, the control unit recognizes the distances M to N. If the main spindle is freely accessible, point M on milling machines is determined at the front side of the milling spindle. In the case of the VMC-100 the front side is not easily accessible, therefore N is determined at a reference tool.

## Reference tool



- \* A reference tool is delivered with the machine.  
Point N is situated in the rotation axis at the front side of the reference tool.
- \* If no zero point shift is active and no tool compensation is selected, the screen displays the dimensions M → N.
- \* Tool lengths are defined from point N.
- \* This reference tool is necessary for direct tool length take-over when touching a dial gauge.
- \* Point N lies 30 mm below the lower plane surface of the ball bearing.

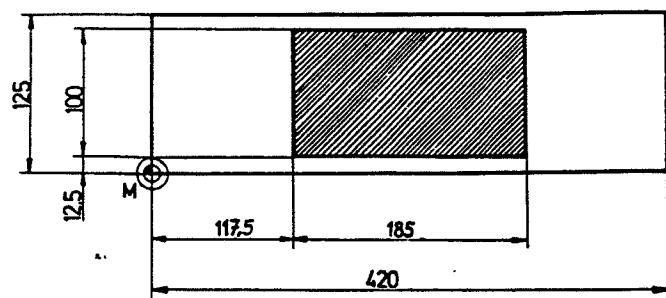


## Chapter D

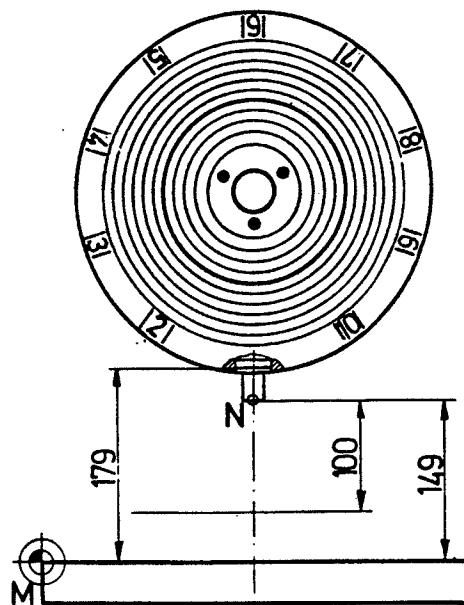
### Working with the machine

1. Working area	D1
2. Operating instructions, programming instructions, zero point shift, tool data	D2 - D7
Overall view of control unit	D2
2.1 Expansion in operation	D3
2.1.1 Swivelling of tool shop, clamping tool in MAN mode	D3
2.1.2 Activation of central lubrication system	D4
2.1.3 Clamping devices ON - OFF	D4
2.1.4 Coolant ON - OFF	D4
2.1.5 Manual traversing of slides	D4
2.1.6 Feed override switch	D5
2.1.7 Determination of rotational direction - main spindle	D5
2.1.8 Speed override - main spindle	D5
2.1.9 EMERGENCY OFF	D6
2.2 Programming instructions	D7 - D9
2.2.1 Programming tool change	D7 - D8
2.2.2 Programming direction logic M50, M51	D9
2.2.3 Programming clamping devices ON - OFF	D9
2.2.4 Main spindle status after tool change	D9
3. Clamping workpieces, clamping devices, zero point shift	D10 - D11
4. Setting of tools, mounting in tool turret, entry of tool data	D12 - D19
5. Working range of tools	D20 - D22

## 1. Working area



The sketch shows the possible traversing range in X and Y direction.



### Traversing range in Z-direction:

Effective working stroke 100 mm. The dimensions 149 (N to table area) and 179 (lower plane surface of ball bearing to table area) refer to the uppermost working position (=reference point position).

### Note:

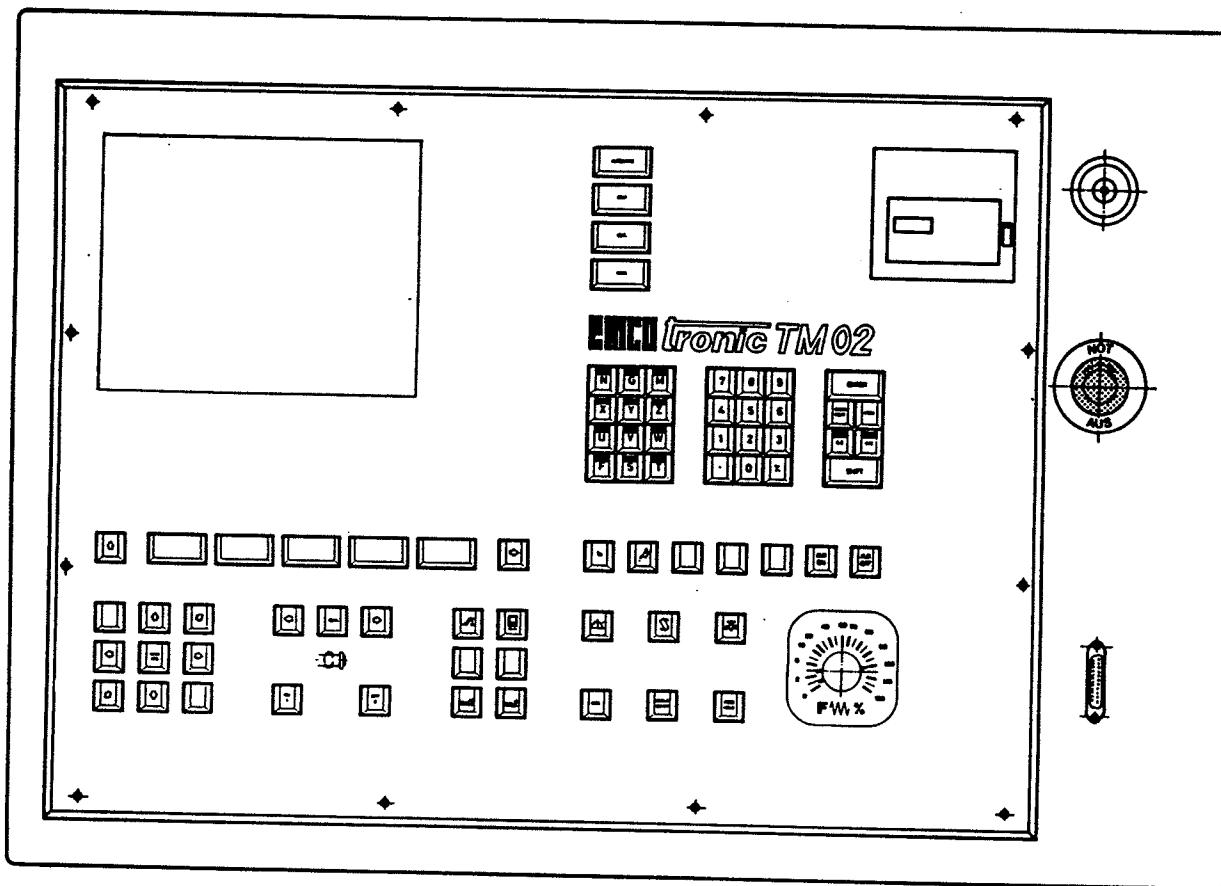
The working area proper of the tools is in accordance with the length of the tools clamped. See pages "Working areas of tools".

### Software limit switch:

In the manual mode the control unit reports "Entered Caution Zone" 10 mm before and up to the reaching of the final length. In this area the slides move with slow safety feed.

## 2. Operating instructions, programming instructions, zero point shift, tool data

Overall view of control unit



## 2.1 Operating instructions

Operation of control and programming is described in the operating instruction Emcotronic TM 02, Ref.No. 7765 and in the programming instruction TM 02 Ref.No. 7766.

### Introductory remark:

On the symbol insert of EMCOTRONIC TM 02 it is shown which state of the manual function keys is activated or deactivated.  
The activated state lights up.

### 2.1.1 Swivelling of tool shop



#### If both key are pressed quickly

- \* the clamped workpiece is released
- \* the tool drum moves on by one position
- \* the tool is clamped

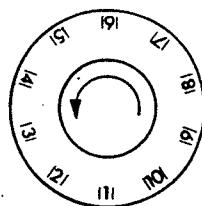
#### Pressing keys longer

- \* the clamped tool is released
- \* the tool drum turns round until you release the keys (or one of the keys)
- \* the tool is clamped

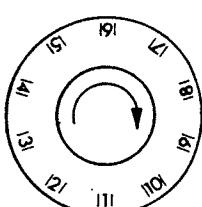
#### Note:

By setting G08 Bit 0 = 1 (High), switch-over to single-key operation may be carried out (see operator monitor in programming instructions TM 02).

#### Direction of rotation:



If the SHIFT key is not active (symbol on symbol insert does not light up) - swivelling in the direction of increasing position numbers.



If the SHIFT key is active, the respective symbol on the symbol insert lights up - swivelling in the direction of decreasing position numbers.

### 2.1.2 Activation of central lubrication system



If you press the lubricating key, the central lubrication system is activated.

The pump switches on for approx. 3 sec. and supplies the guideways with oil.

With an active key the respective symbol lights up on the symbol insert.

Note:

The lubrication system is activated automatically by the control unit every 10 meters of slide travel.

### 2.1.3 Clamping devices ON - OFF



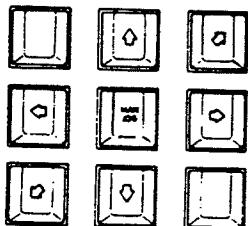
This function is not activated at present.

### 2.1.4 Coolant ON - OFF



By pressing this key the coolant pump is switched on or off. With an active key the respective symbol lights up on the symbol insert.

### 2.1.5 Manual traversing of slides



By pressing the **MAN.** keys **JOG**

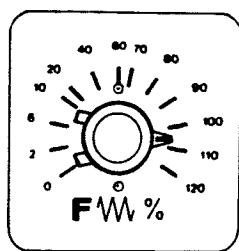
and the respective arrow key the slides can be moved manually into the direction desired.

Note:

\* Mind that in EDIT mode you can change the tool compensation data in the tool data memory (TOOL DATA) by using the arrow keys.

\* By using the arrow keys (1,2) in STATUS submode you can turn the pages forward and backward.

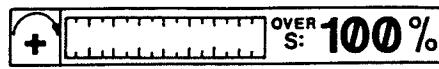
### 2.1.6 Feed override switch



With the feed override switch the feed speed can be modified during traversing slides.

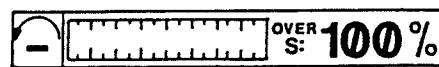
### 2.1.7 Determination of rotational direction - main spindle

#### Representation of symbol line



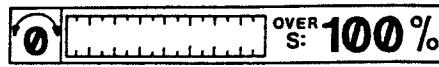
Main spindle ON in clock-wise direction

**ON**  
1



Main spindle ON in counter clock-wise direction

**SHIFT**      **ON**  
                1



Main spindle OFF

**OFF**  
0

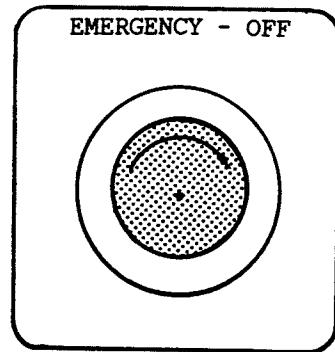
### 2.1.8 Speed override - main spindle



By means of this key you can change the speed (mind the percentage value at the symbol line of the screen).

### 2.1.9 EMERGENCY - OFF

#### Consequences:



- slides stop (also with G33, G84)
- main spindle OFF
- coolant OFF
- tool way compensation called off
- active tool data/PSO data called off.
- Reference point might eventually be lost.
- Program jump to N 0000

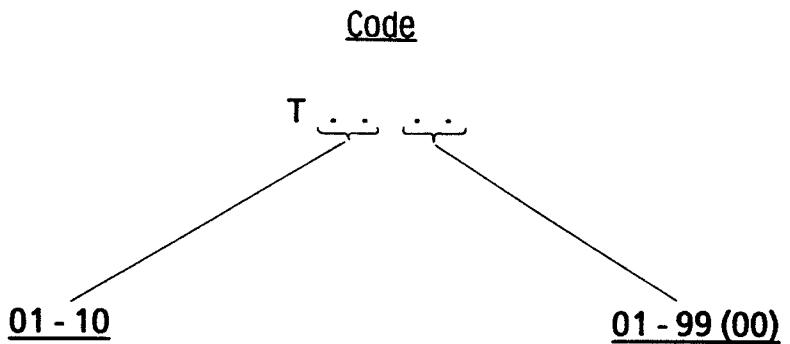
#### Restarting the machine:

- unlock EMERGENCY - OFF key (turn to right)  
Machine and control unit are switched on again.
- If the tool shop is in undefined position (see possible problems during switch-on).
- If necessary, approach reference point (alarm 150/460).
- clear EMERGENCY - OFF situation (set program right, change broken tool etc.)

## 2.2 Programming instructions

### 2.2.1 Programming of tool change

Tools are programmed under the T-address using a 4-digit number.



#### Tool location

Tool location is called up with 01 - 10. Swivelling to the tool location is automatic. The tool is clamped automatically.

#### Tool compensation number

Number code for tool data (length, radius). Tool compensation numbers are listed in the tool data memory.

#### Note:

- \* You may allocate any compensation number to any location.  
E.g.: T03 78  
However, it is clearer for your program if you allocate numbers which are remembered easily.  
E.g.: T03 03 or T 03 13 or T03 23
- \* You may also allocate different compensation values successively to a tool.  
E.g.: T03 03/T03 04/T03 05
- \* When programming T00 00 there is no swivelling, only offset call-off.
- \* If a tool location is programmed larger than 10, an ALARM is given.

## Call-up (Syntax rules)

When calling up a new T-address the next traverse movement has to be a G00 block, otherwise alarm 490 will occur (only valid with actual change of tool offset).

Example: Call-up in the same block with G00

N 100/G00/X.../Y.../Z.../T02 02

Example: After the T-call-up a G00 traverse command follows

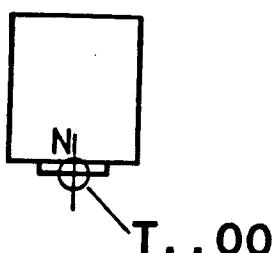
N 100/T02 02

N 110/G94/F 130

N 120/G54

N 130/G00/X.../Y.../Z.../

## Calling-off the Tool(length) Compensation



T.. 00

If the reference number T.. 00 is programmed, the coordinates (measurements) system refers to the reference point for the tool mounting.

## Alarms in connection with tool call-up

1. T-call-up not in connection with G00 transverse instruction.
2. Unacceptable call-up T00 04:
  - Tool number ≠ 01 - 10
  - T02 00 is admissible, the correction values are automatically zero (setting tool).

### 2.2.2 Programming direction logic, M50, M51

M50, M51 belong to group 8 of M-functions. These are self-holding functions. The switch-on status may be determined on the operator screen O11 Bit 3.

#### M50 calling off the direction logic

The tool turret turns in one direction (counter-clockwise).

#### M51 selecting the direction logic

The tool turret swivels in the shortest way to the programmed tool (this switch-on status is set by the manufacturer).

#### Determining the switch-on status on the operator screen

O11 Bit 3 = 0 (LOW) -> M50

O11 Bit 3 = 1 (HIGH) -> M51

The entry of a word for O11 Bit 3 does not effect a change of the actual M50/51 state, only the switch-on state is determined. A modification of the actual M50/51 state can be effected by execution of M50 and M51 EXECUTE mode or directly from the NC program.

### 2.2.3 Programming clamping device open/close

M25 open clamping device

M26 close clamping device

These functions are in preparation.

### 2.2.4 Main spindle status after tool change

#### Example:

N 100 M03 S1000

:

N 150 T02 02

N 160 M04 S500

:

For the tool change procedure the main spindle is required. After termination of the tool change procedure in N 150 the former main spindle status (M03 S1000) is reset automatically, in N 160 (after speeding up the spindle to M03 S1000 in N 150) the desired value M04 S500 is carried out only then.

N 100 M03 S1000

:

N 150 T02 02 M04 S500

:

#### Remedy: (for time optimization)

If prior to tool change M05 is not active and after tool change a modified main spindle status is desired (rotary direction or speed) this new status has to be programmed in the same NC block as the T word in order to avoid needless main spindle operations.

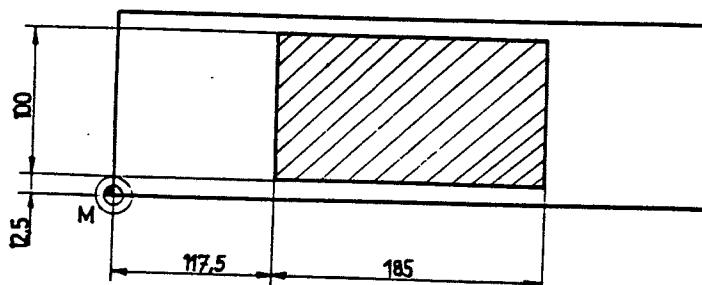
### 3. Clamping of workpieces, clamping devices

#### zero point shift

For clamping workpieces, standard clamping devices (incremental straps, machine vice, clamping bars) are offered.

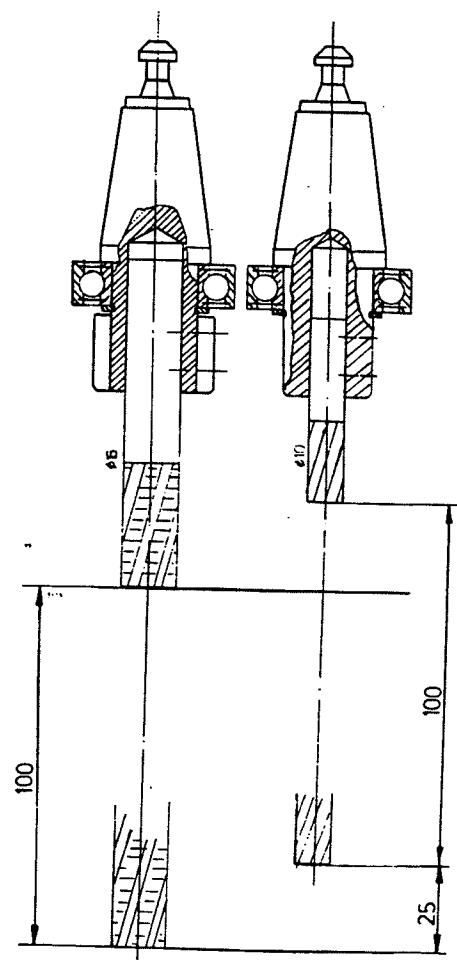
For special kinds of clamping the clamping devices are to be manufactured by you. Table dimensions (T-groove dimensions for mounting special clamping devices on the milling table) are described in the chapter "Clamping Devices for Workpieces".

#### Traversing range of the center axis of the milling cutter with reference to the milling table



If you mount a clamping device, you have to take care that the clamped workpiece is placed in the traversing range of the milling cutter. The traversing range is illustrated in the opposite sketch.

Also note the height of the workpiece in clamped state when mounting the tools (see mounting of tools).



#### Maximum workpiece heights

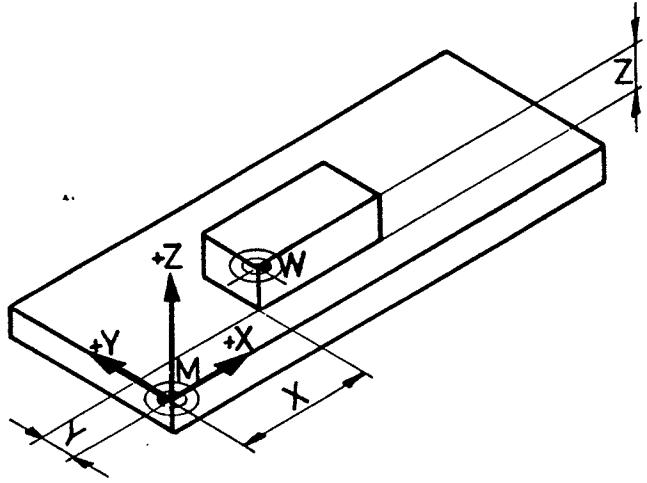
The effective traversing range of the milling cutters in Z-direction is 100 mm.

Maximum and minimum machining height are given for each tool clamped. See illustrations of milling clamping fixtures with milling cutters Ø 16 and Ø 10 mm.

## Zero point shift, take-over of data

The machine zero point is in the position indicated.

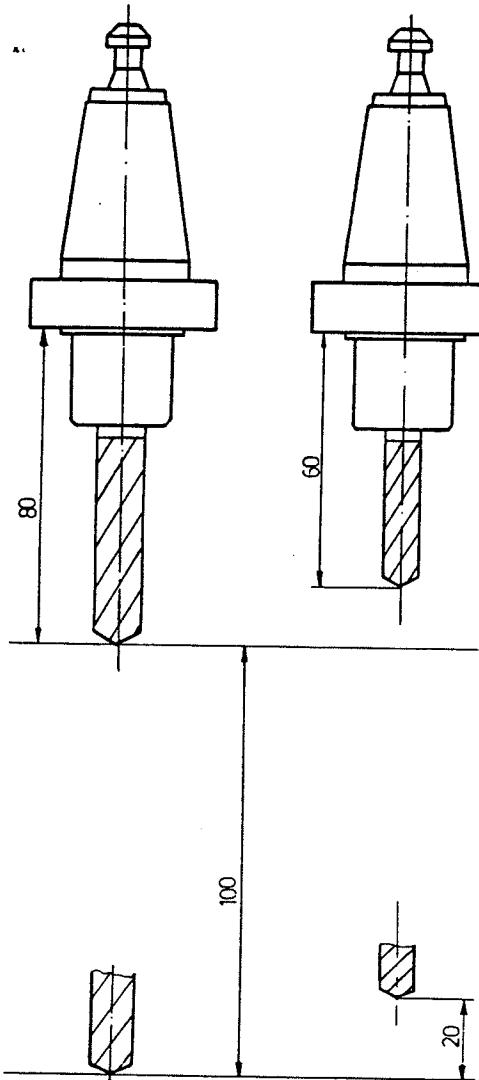
The dimensions for zero point shift may be measured with a ruler, gauge etc. and entered in the position shift offset.



For exact take-over of PSO data you may touch the workpiece.

Input of PSO data is described clearly in the programming instructions EMCOTRONIC TM 02.

#### 4. Setting of tools, mounting in tool turret, entry of tool data



##### Clamping tools in the collets:

Milling and boring tools may be clamped in collet chucks, milling cutter clamping fixtures and shell end mill arbors. Taps are clamped in holders for taps. You can find more detailed information in the chapter "Clamping Devices for Tools".

When mounting tools, mind their different lengths.

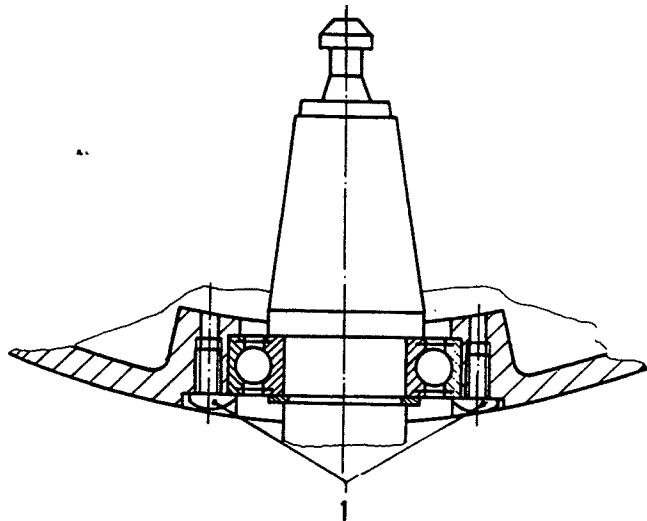
Some hints: The effective working stroke of the Z-axis is 100 mm. If a tool with a protruding length of 80 mm (measured from the lower plane surface of the ball bearing) is clamped, the table area of the machine is reached.

##### Note:

Do not clamp tools longer than 80 mm, otherwise the risk of collisions during swivelling is increased.

See also surveys on pages D20, D21, D22.

## Mounting tool collets on the tool shop plate

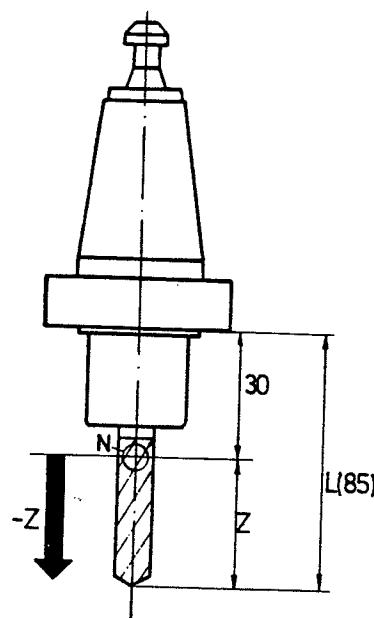


- \* Turn clamping screws (1) until tool collets can be inserted (mind the flat screw head).
- \* Tighten clamping screws.  
Note: If clamping screws are tightened, the collets in the clamping fixture have a small clearance. The clearance is necessary so that there is no overstrain of tool shop plate/milling spindle if the tool is clamped in the milling spindle (to prevent false gripping).
- \* Swivelling the tool shop for mounting collets in manual mode.

### Note:

Never swivel the tool drum by hand while mounting tools on the tool shop. The tool shop might not be in "clamping position" and if the machine is switched on, alarm 060 will be triggered. The tool shop would then have to be turned by hand into the correct position (see Start-up of Machine - possible alarms).

## Measuring the tool length Z using the slide gauge



The tool clamping reference point N lies 30 mm from the lower plane surface of the ball bearing.

Measure from the ball bearing to the tool tip - subtracting 30 mm - to get the Z-measure.

This Z-value is entered in the TOOL DATA register.

### Please note:

Z is always a negative value since the tool tip is always in -Z-direction.

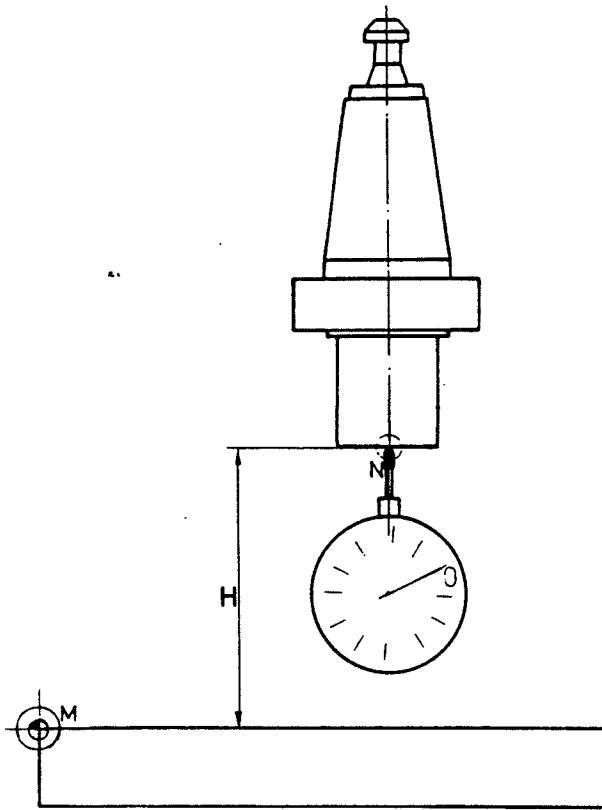
### The drawing example

Z = -55.000 is entered in the TOOL DATA register.

### Note:

This method is not very accurate. You will have to make corrections after measuring a workpiece.

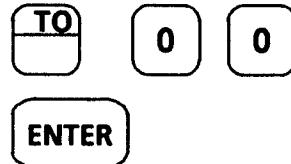
## Direct take-over of tool lengths



With EMCOTRONIC TM 02 it is possible to take over the tool lengths directly. This is a very accurate and comfortable method.

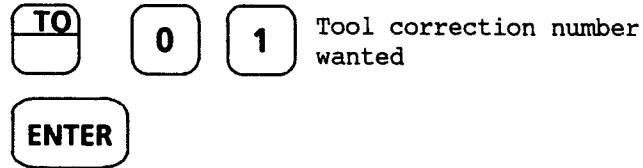
### Option 1: Touching with dial gauge

- \* Select manual mode.
- \* Mount reference tool and swivel in.
- \* Touch dial gauge with reference tool. Set dial gauge to zero.

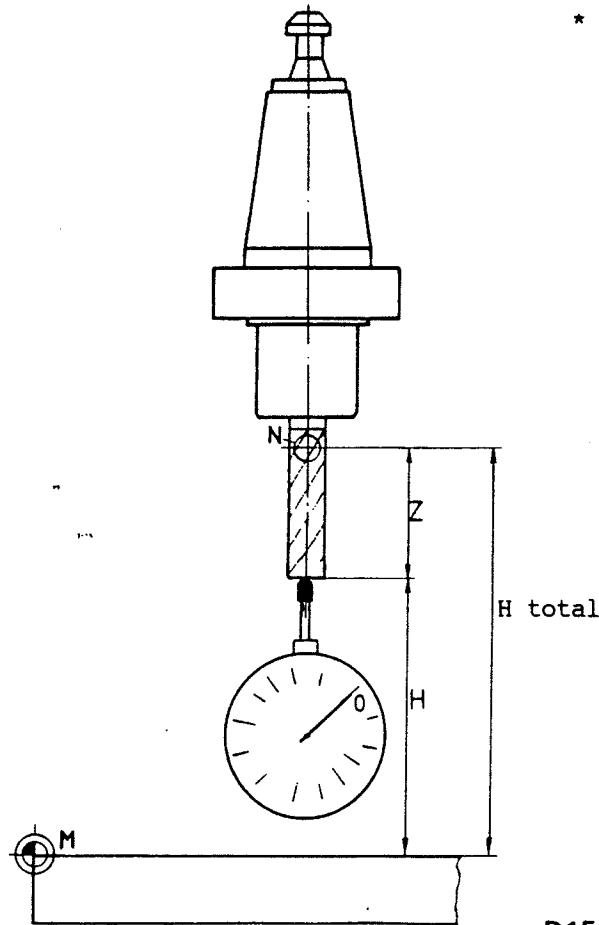


The height H is stored in the control by TO 00 ENTER.

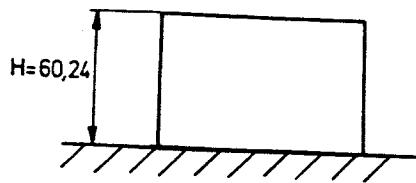
- \* Swivel in the tool to be measured and touch dial gauge (gauge must show 0).



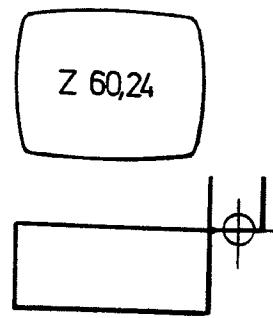
The tool length Z is stored under tool correction number T..01.



Option 2: Scratching a trial workpiece

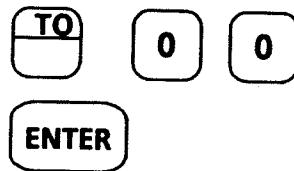


1. Measure the height ( $H$ ) of the trial workpiece which has to be scratched.

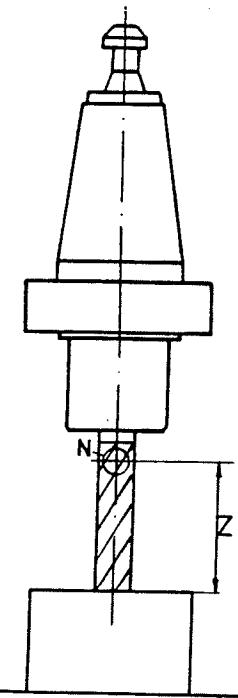


2. Set manual mode.

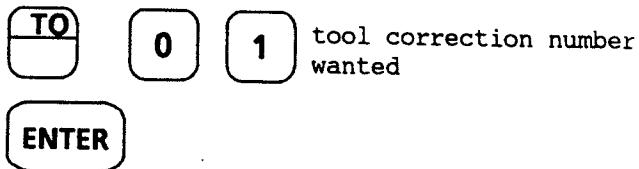
Traverse to distance  $H$  with reference point.  
(screen display)



The dimension  $H$  is stored.

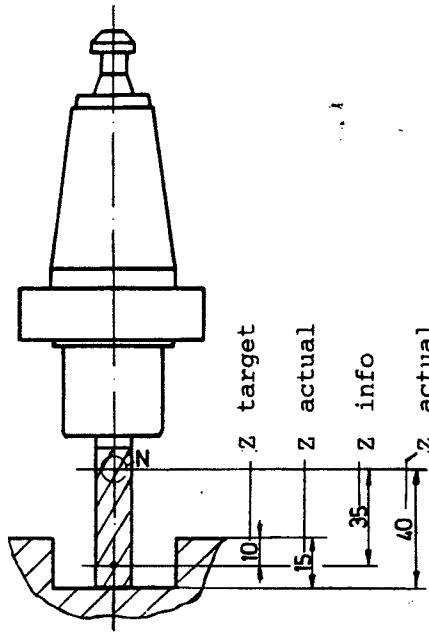


3. Swivel in tool and scratch workpiece surface.



The dimension  $Z$  is stored under correction number T..01.

## Correction of the length data



EDIT:                    TOOL DATA                    DISTANCES [MM]

	X	Z	R	L
00:	0.000 :	0.000 :	0.000 :	0
■:	0.000 :	<u>-35.000</u> :	0.000 :	0
02:	0.000 :	0.000 :	0.000 :	0
03:	0.000 :	0.000 :	0.100 :	0
04:	0.000 :	0.000 :	0.000 :	0

\* Imagine the coordinates system in the target value.

\* Measure difference between target value and actual value:  
 $Z = -5 \text{ mm}$

\* Add this value with the correct sign to the value in the tool data memory.

$Z - 35 \text{ mm} + (-5\text{mm}) = -40 \text{ mm}$

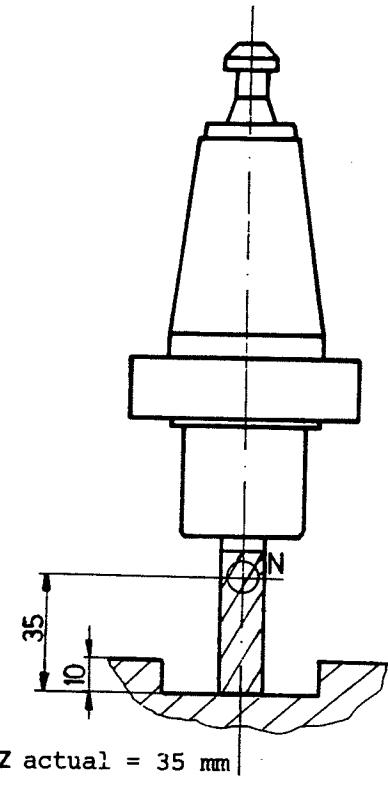
\* Write this value into the tool data memory.



EDIT:                    TOOL DATA                    DISTANCES [MM]

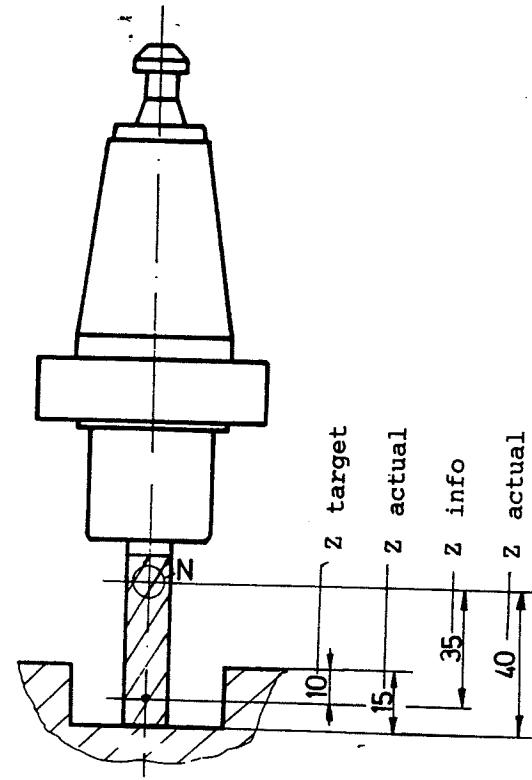
	X	Z	R	L
00:	0.000 :	0.000 :	0.000 :	0
■:	0.000 :	<u>-40.000</u> :	0.000 :	0
02:	0.000 :	0.000 :	0.000 :	0
03:	0.000 :	0.000 :	0.100 :	0
04:	0.000 :	0.000 :	0.000 :	0

Example:



Z actual is the same as  
Z INFO in the tool data memory

Measurement in drawing (10) and on  
workpiece must be the same.



Z actual is not equal to Z INFO:

Consequence: Wrong measurements on  
workpiece (15 mm instead 10 mm)

## Correction of tool lengths

By measuring the workpiece, you are able to detect any errors caused by inaccurate tool data.

### Correction:

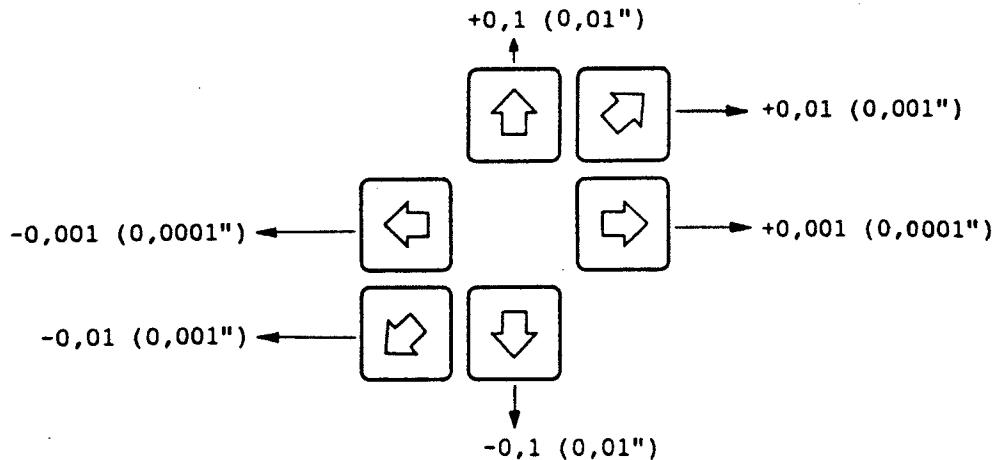
- \* delete values
- \* enter corrected values
- \* incremental change of Z-value

## Incremental Changing of the PS0 and TO Data

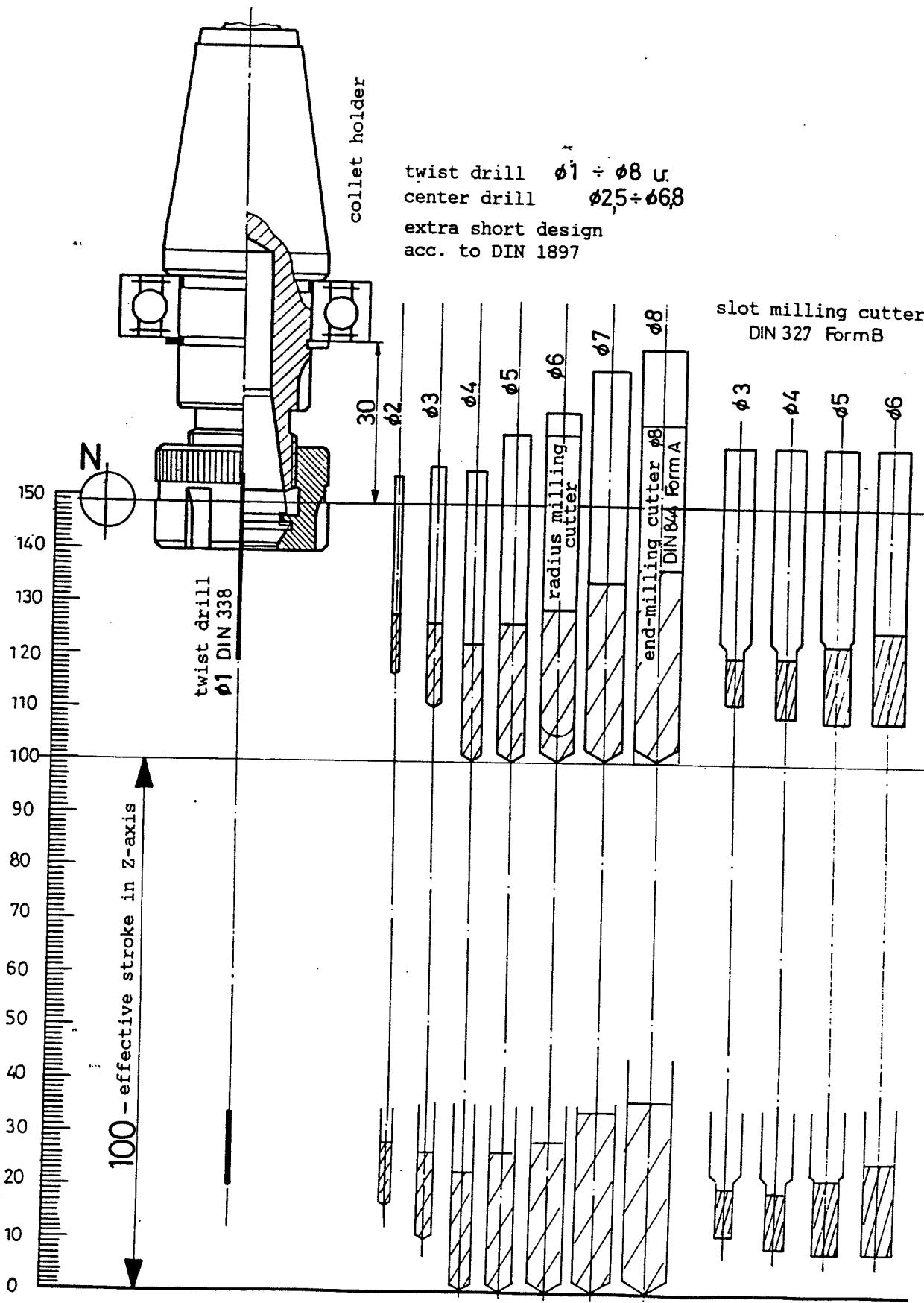
If you have selected the respective register (PS0 or TO) and the offset number or tool number, you can change the X, Y and Z values with the JOG keys.

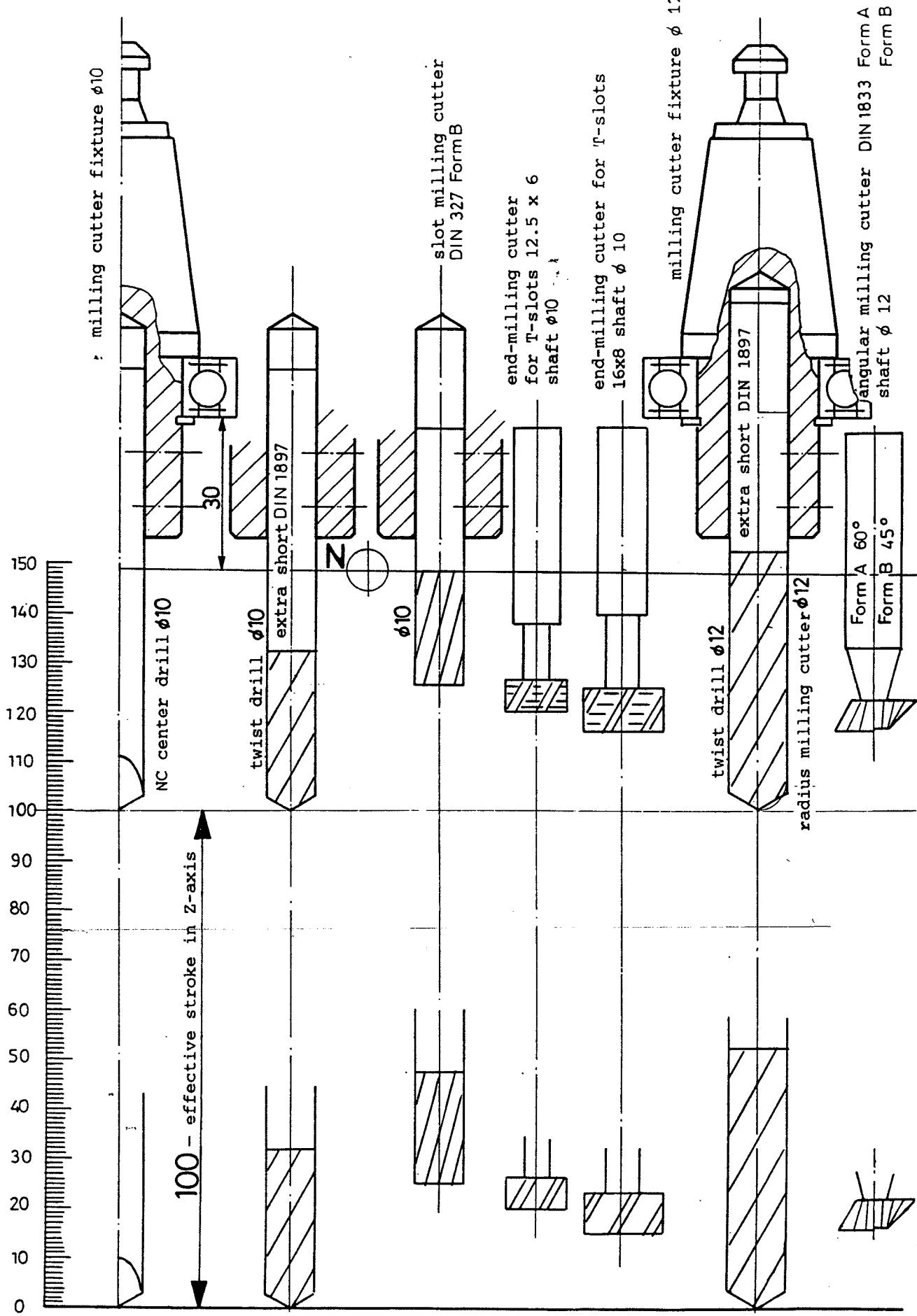
The illustration shows with which keys the values can be changed.

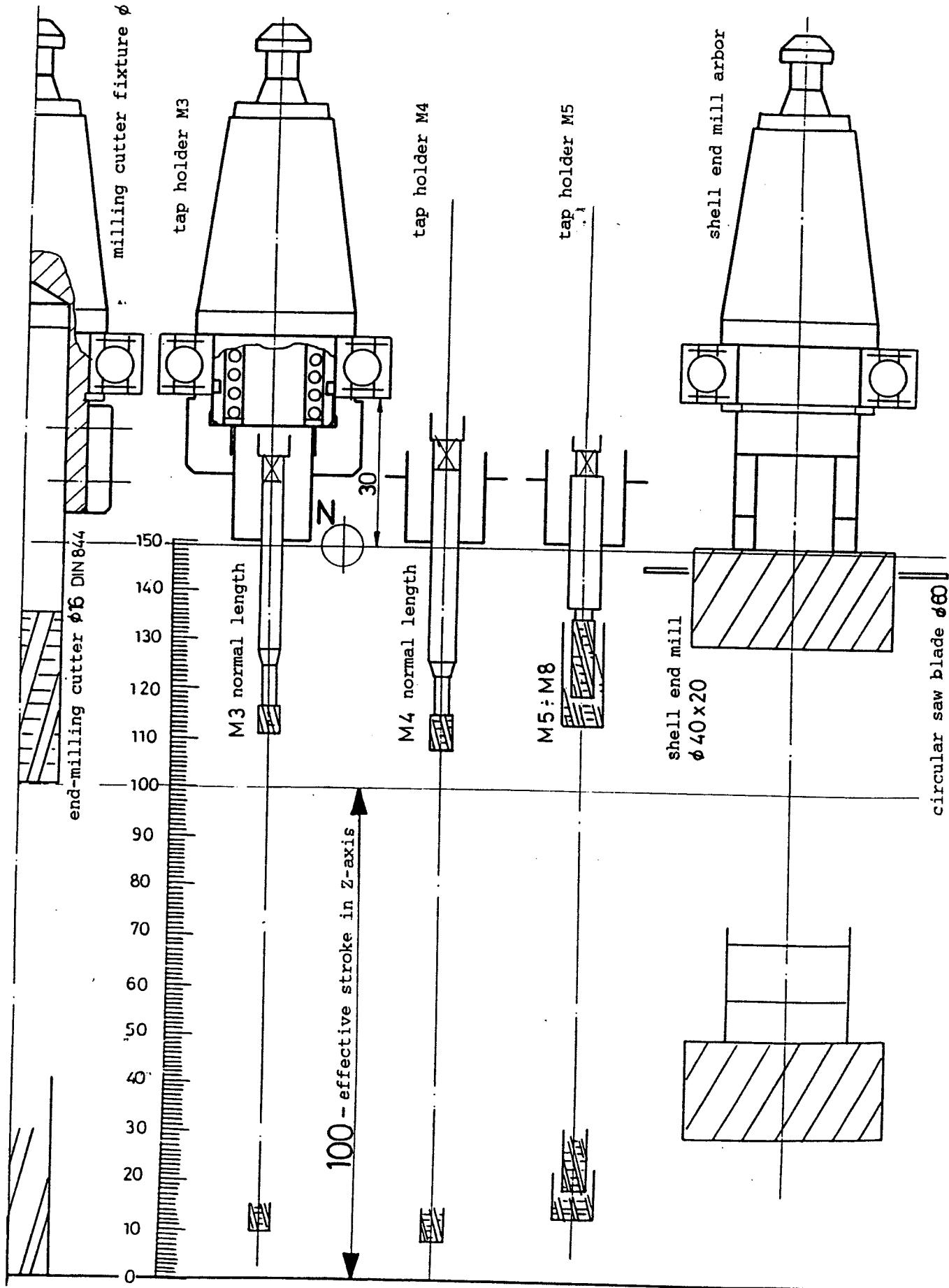
## **MANUAL-JOG (EMCOTRONIC TM02)**



## 5. Working areas of tools







## Chapter E

### Technological Data

- |  |         |
|--|---------|
| 1. General   | E1 - E2 |
| 2. Determining feed speed and cutting depth                        | E3 - E4 |
| 3. Determining feed speed during drilling in 9 S 20 and Torradur B | E5      |
| 4. Determining rotational speed and cutting speed                  | E6      |
| 5. Tapping   | E7      |
| 6. Speed - Rating Chart (Main drive spindle)                       | E8      |

## 1. General

### 1.1 Cutting speed (V)

$$V \text{ (m/min)} = \frac{d \text{ (mm)} \times \pi \times S \text{ (rpm)}}{1000}$$

V = Cutting speed

d = Diameter of workpiece

S = Main spindle speed

The maximum cutting speed depends on

- Material of workpiece:

The higher the strength of the material,  
the lower the cutting speed.

The charts contain the following data:

V = 44 m/min for aluminium (Torradur B)

V = 35 m/min for soft steel  
soft plastics

V = 25 m/min for tool steel  
hard plastics

- Material of tool:

Carbide tools allow higher cutting speed  
than HSS tools.

The values given in the charts are for  
HSS tools.

### 1.2 Speed (S)

You calculate the speed of the milling  
spindle from cutting speed and diameter  
of milling cutter.

$$S \text{ (rpm)} = \frac{V_s \text{ (m/min)} \times 1000}{d \text{ (mm)} \times \pi}$$

### 1.3 Feed rate and depth of cut

F = Feed rate (mm/min)

t = Depth of cut (mm)

Generally: feed rate and depth of cut depend on

- workpiece material
- performance of machine and
- geometry of milling cutter.

#### Material of workpiece:

The higher the strength, the lower the F and t values.

#### Rating of the machine

The higher the rating, the greater the feed and the depth of cut (limitations: cutter geometry).

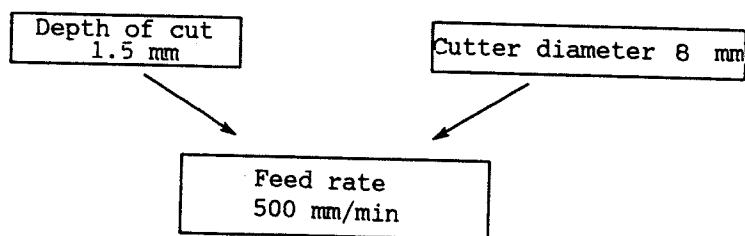
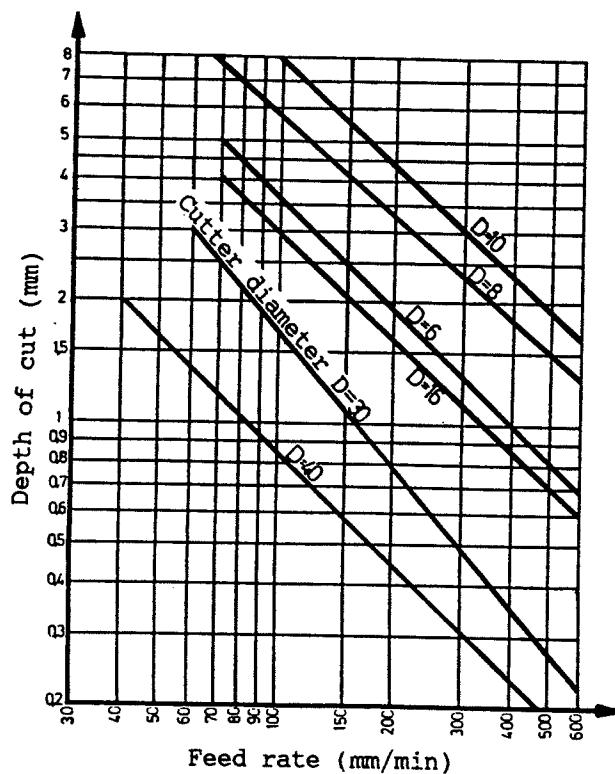
The tables gave guide values for the VMC-100.

#### Relationship between F and t:

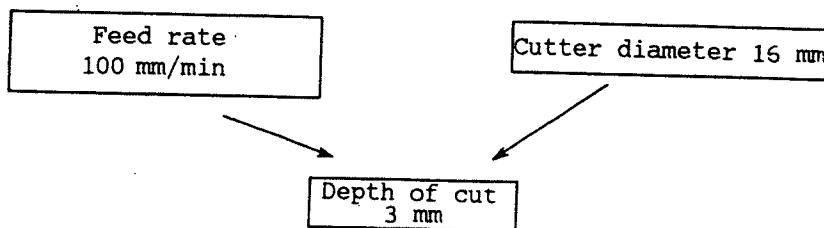
The bigger t is, the smaller F is and vice versa.

2. Determining the feed rate  
and depth of cut during milling

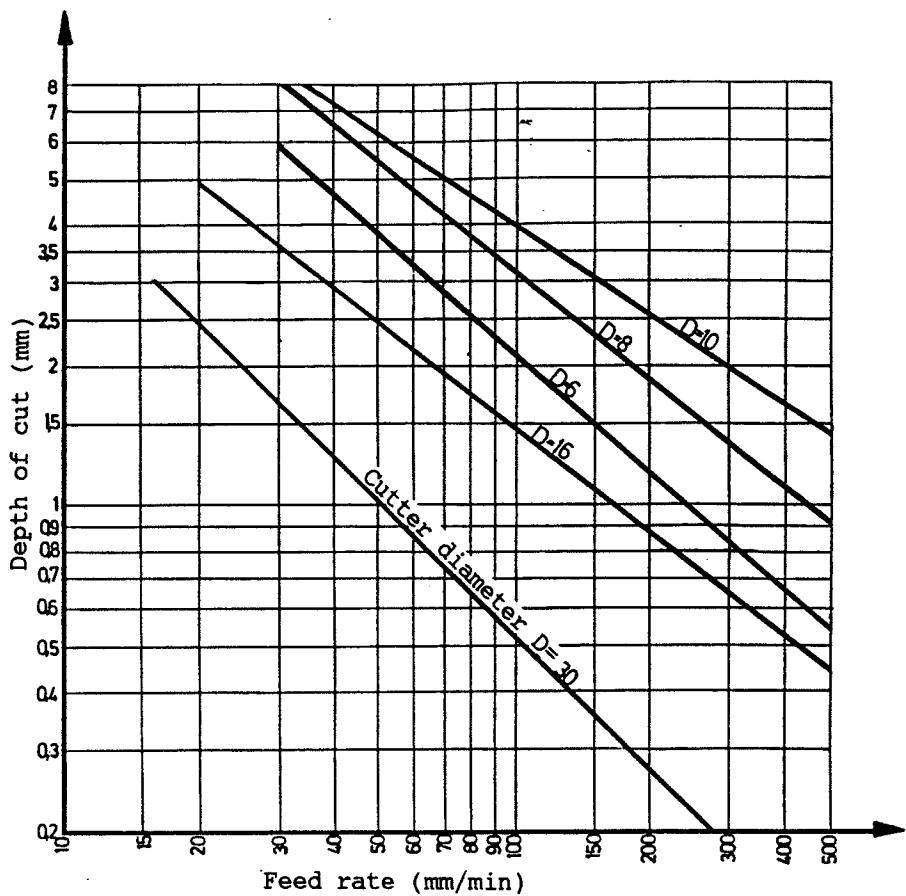
2.1 Face milling of aluminium (Torradur B) at  $v = 44 \text{ m/min}$



You can also proceed as follows:



## 2.2 Face milling of steel (9S20) at $v = 35 \text{ m/min}$



Depth of cut 1.5 mm

Cutter diameter 6 mm

Feed rate  
150 mm/min

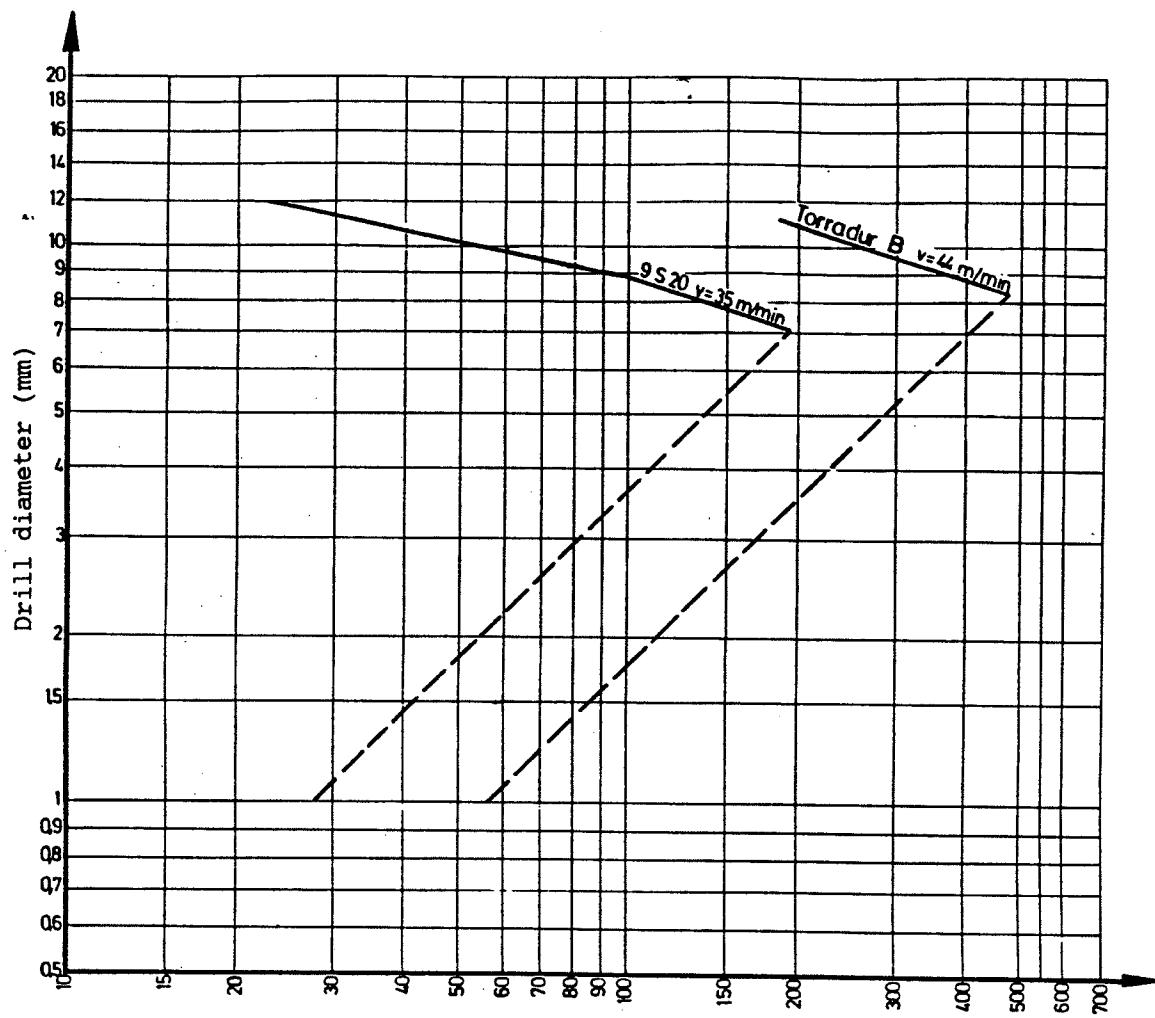
You can also proceed as follows:

Feed rate  
70 mm/min

Cutter diameter 10 mm

Depth of cut 5 mm

3. Determining the feed rate  
during drilling in 9S20 and Torradur B

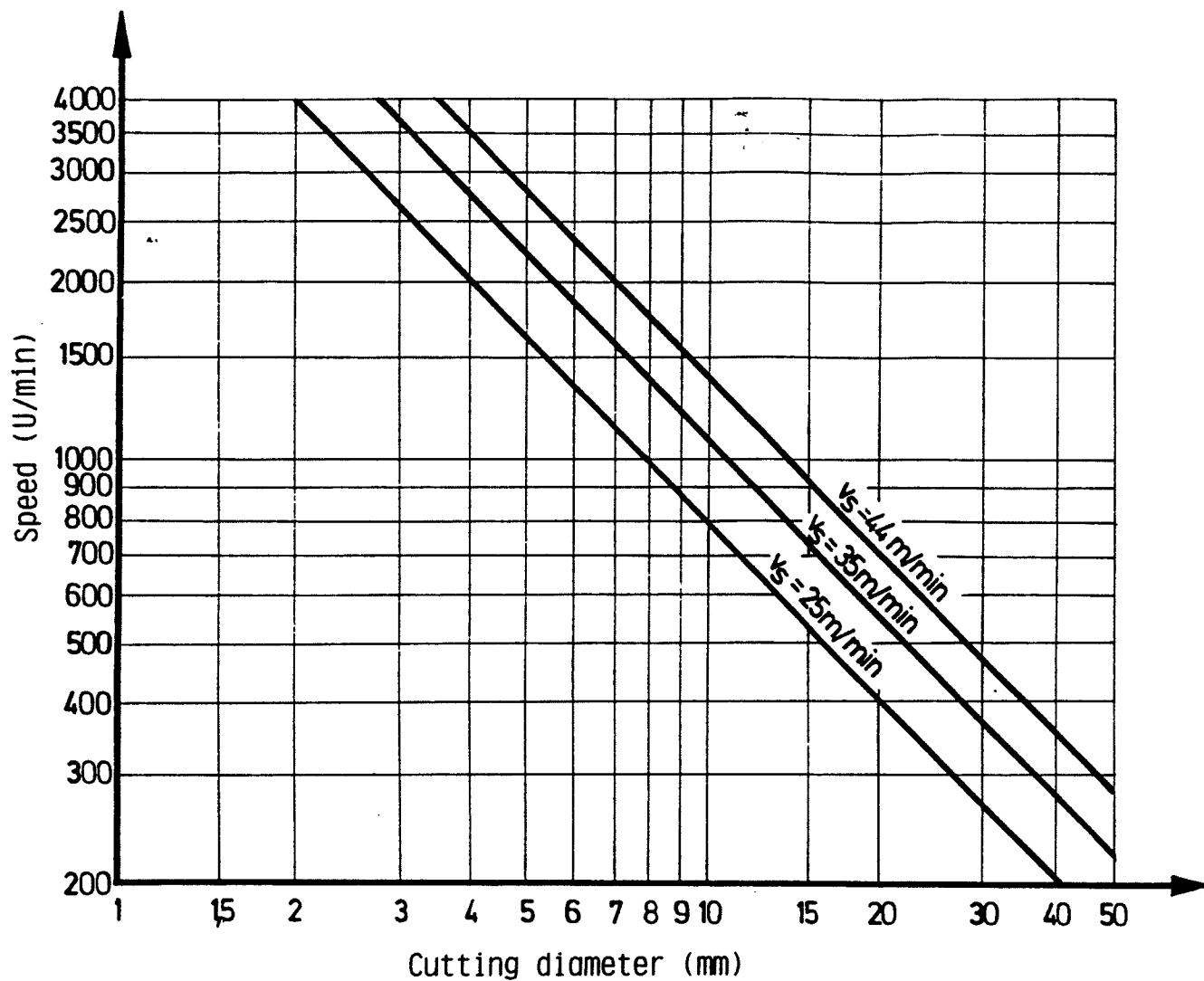


Material: 9S20

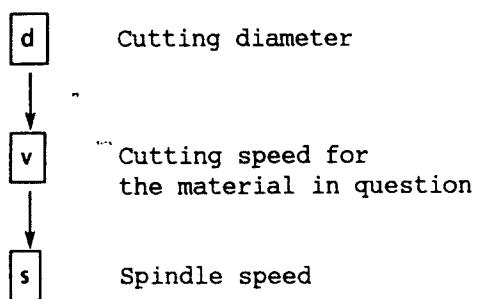
Drill diameter = 9 mm

Feed rate = 90 mm/min

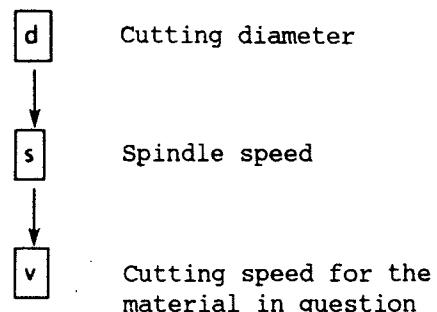
#### 4. Determining the speed and cutting speed



Determining the speed:



Determining the cutting speed:



## 5. Tapping

Threads M3 to M8 can be machined on the VMC-100. With M8 threads the thread depth must not exceed 10 mm.

With all other screw taps you can produce any boring depths desired.

When tapping you must not use feeds higher than 1500 mm/min. With higher feeds the length compensation of the toolholder would be exceeded. So you have to select the spindle speed that way that the feed of 1500 mm/min is not exceeded for the threadpitch used.

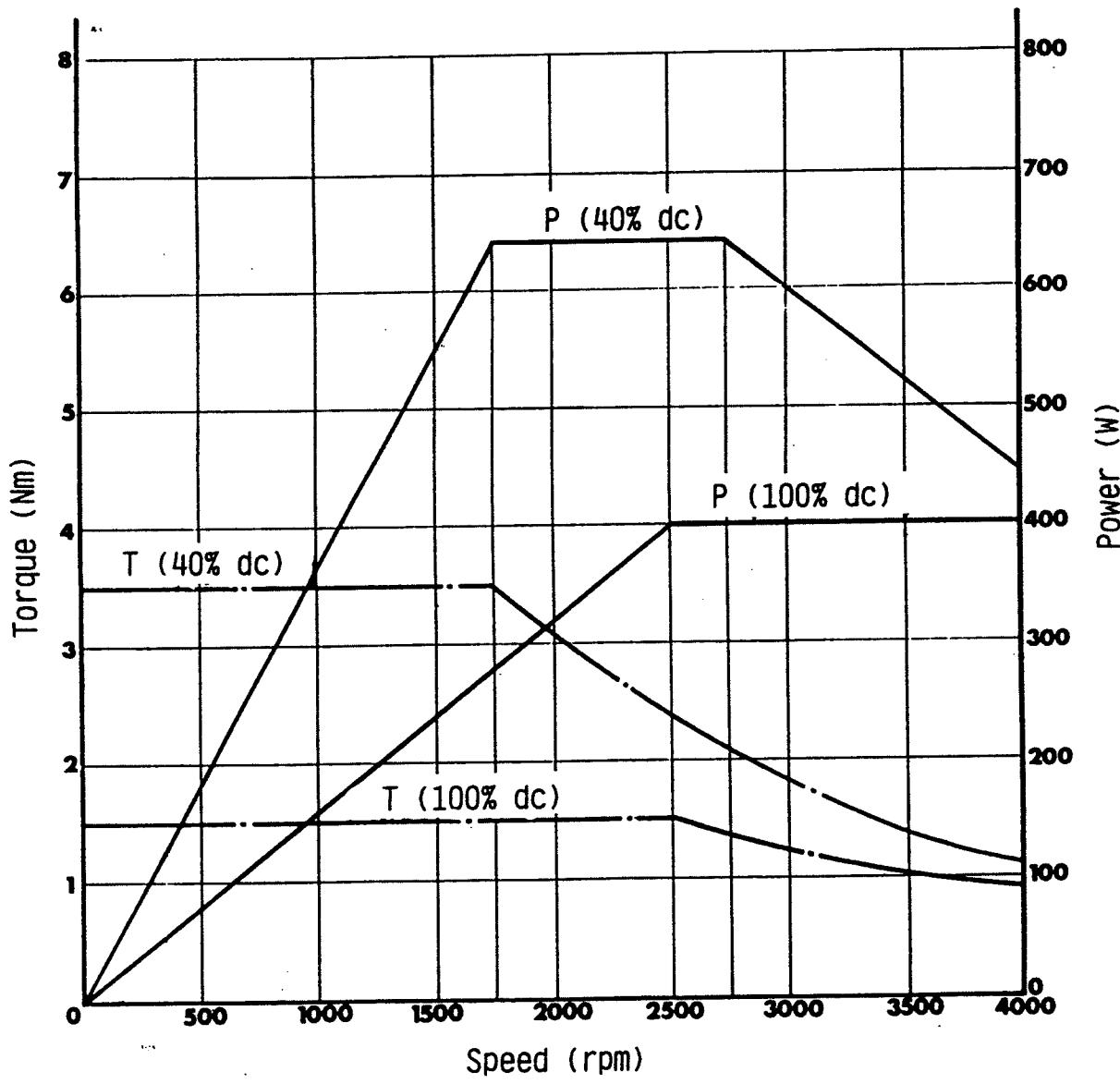
Example:

Thread M8 -> pitch 1,12

$$\text{Spindle Speed } \left[ \frac{\text{U}}{\text{min}} \right] = \frac{\text{Max. feed [mm/min]}}{\text{Pitch [mm]}}$$

$$\text{Spindle Speed} = \frac{1500}{1,25} = 1200 \frac{\text{rev}}{\text{min}}$$

6. Speed - Rating Chart (Main drive spindle)



## Chapter F

### VMC-100 Accessories

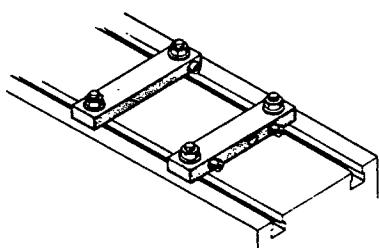
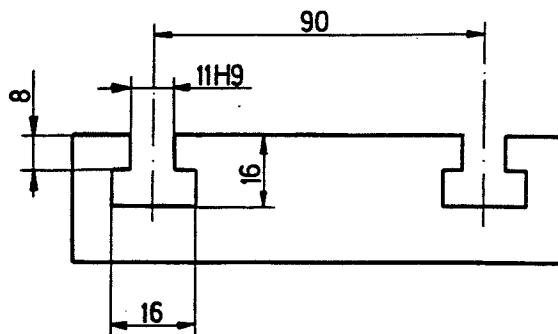
1. Clamping devices for workpieces	F1 - F3
o Clamping bars (basic equipment)	F1
o Machine vice with stop	F1
o Incremental strap	F1
o 3-jaw chuck ø 85 mm	F2
o Clamping device plate for chuck ø 85 mm	F3
2. Clamping devices for tools	F4 - F7
o Collet holder ESX 16	F4
o Milling cutter clamping fixtures	F5
o Holder for taps	F6
o Shell end mill arbor	F7
3. Coolant device	F8 - F9
4. Machine base	F10

## VMC-100 Accessories

### 1. Clamping devices for workpieces

Table area L x B: 420 x 125 mm

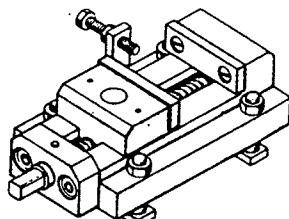
#### Dimensions of the T-slots



#### Clamping bars (Basic equipment)

The clamping bars are mounted directly onto the slide depending on the workpiece in question. The workpiece is clamped with the stud bolts.

Height of clamping bars 12 h 11.  
Total height with clamping screws 22 mm.

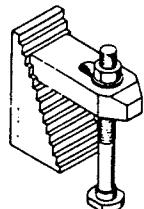


#### Machine vice with stop

Width of jaw: 60 mm

Clamping capacity: 60 mm

Height up to guide way of clamping jaw 20 mm, total height 48 mm



#### Incremental strap

Height: 60 mm

For clamping a workpiece you need at least two incremental straps.

## The 3-jaw chuck Ø 85 mm

The 3-jaw chuck Ø 85 mm allows clamping of cylindrical pieces.

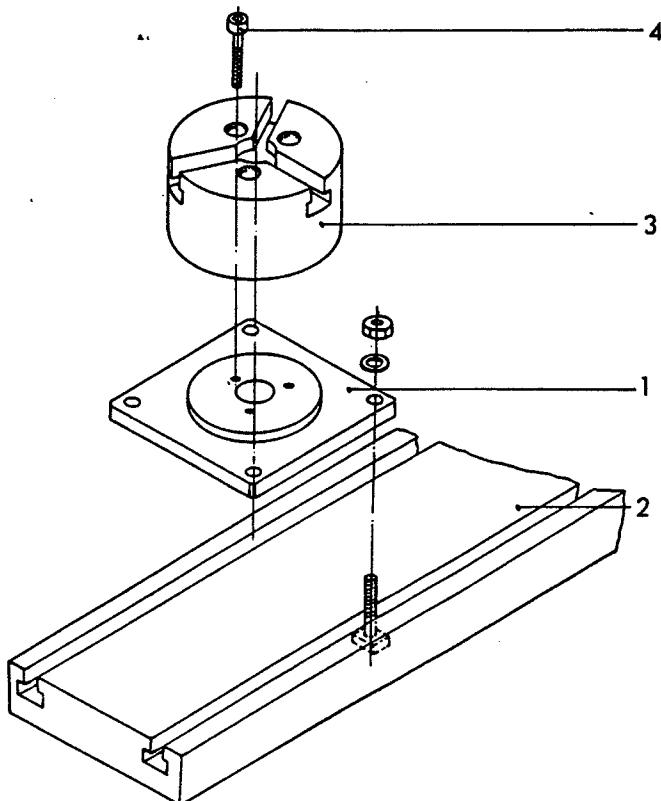
### Mounting:

- \* Screw intermediate plate (1) onto the machine table (2) using enclosed clamping screws (mind the working area of the machine).
- \* Mount the 3-jaw chuck (3) Ø 85 mm on the intermediate plate using the three enclosed flat head screws M 5 x 40 (4).

### Mind:

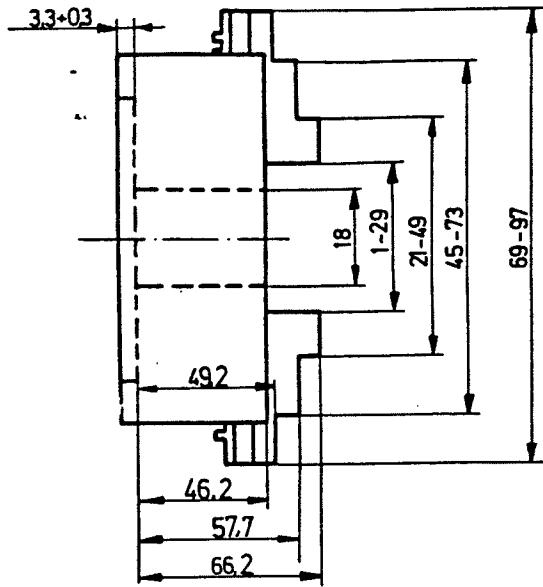
After clamping workpiece, take off clamping wrench.

The machine is provided with one set of jaws stepped inward and one set stepped outward.



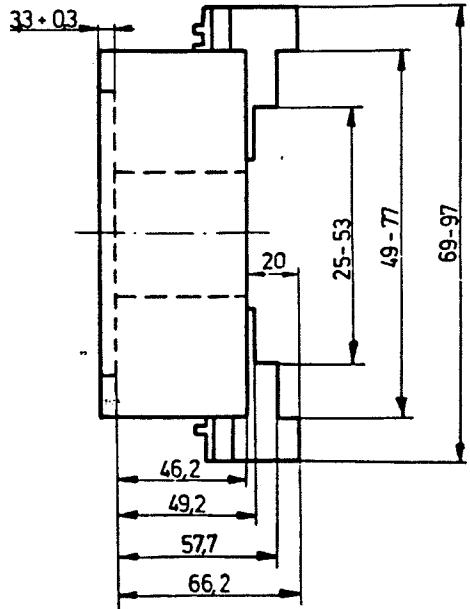
Dimensions, Chucking Devices EMC0 Chuck, dia. 85 mm

Outside stepped jaws

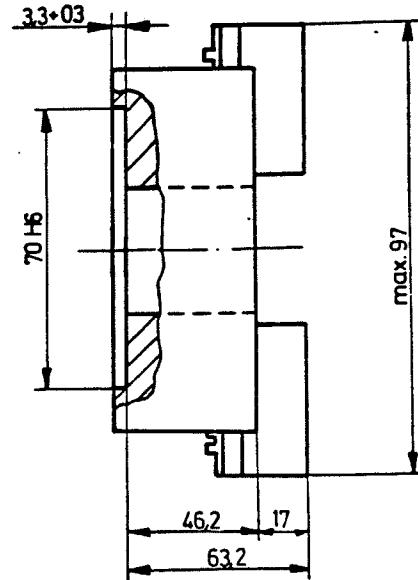


Pay attention to instructions on service and maintenance tips and to safety tips.  
An instruction book comes with each chuck.

Inside stepped jaws



Soft jaws

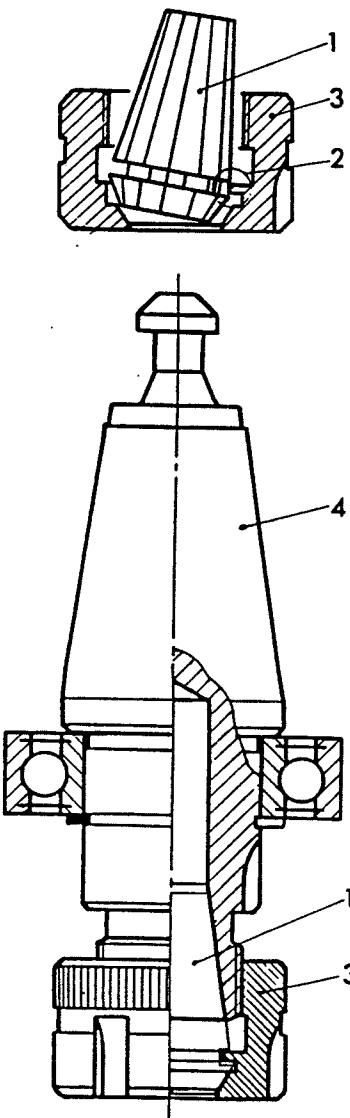


Measures in mm !

## 2. Clamping devices for tools

### Collet holder ESX 16

The collet holder serves to accomodate collets ESX 16.



#### Assembly:

- Insert the collet (1) at an angle into the clamping nut (3) so that the eccentric ring (2) engages the groove of the collet.
- Screw collet with clamping nut onto the collet holder (4).
- Insert tool into collet.
- Tighten clamping nut with sickle spanner.

#### Dismantling the collet:

Undo clamping nut.

While the nut is being unscrewed, the collet is pushed out by the eccentric ring in the clamping nut.

#### Care:

Before and after use clean and oil collets and collet holders. Chips and dirt can damage the clamping taper and cone and reduce precision.

Collet size (nom. $\varnothing$ )	Clamping range
1.0	0.5 - 1.0
1.5	1.0 - 1.5
2.0	1.5 - 2.0
2.5	2.0 - 2.5
3.0	2.5 - 3.0
4.0	3.0 - 4.0
5.0	4.0 - 5.0
6.0	5.0 - 6.0
7.0	6.0 - 7.0
8.0	7.0 - 8.0
9.0	8.0 - 9.0
10.0	9.0 - 10.0

## The milling cutter clamping fixtures

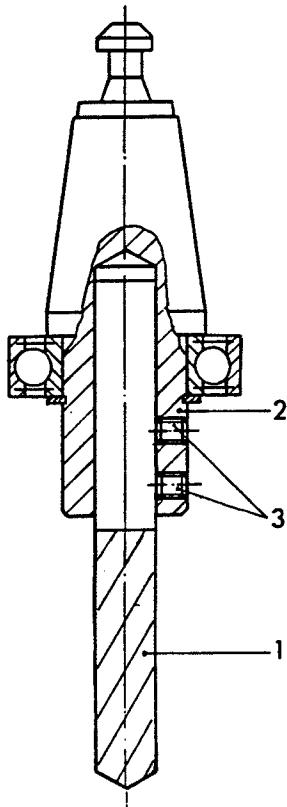
The milling cutter fixtures are used for clamping tools with a shaft diameter of 10, 12 and 16 mm.

### Mounting of tools:

Put tool (1) into milling cutter clamping fixture (2) and tighten with both set screws M 6 x 6 (3).

#### Note:

When clamping tools in the collet mind the correct length of the tool for workpiece machining.



milling cutter fixture  $\phi$  10 mm

- NC-centre dull  $\phi$  10 mm
- spindle drill  $\phi$  10 mm
- slot milling cutter
- end-milling cutter for T-slots  
12.5 x 6  
shaft  $\phi$  10 mm
- end-milling cutter for T-slots  
16 x 8  
shaft  $\phi$  10 mm

milling cutter fixture  $\phi$  12 mm

- spindle drill  $\phi$  12 mm
- radius milling cutter  $\phi$  12 mm
- angular milling cutter 16 x 4,  
form A and B with shaft  $\phi$  12 mm

milling cutter fixture  $\phi$  16 mm

- end milling cutter  $\phi$  16 mm

## Holders for taps

Holders for taps are ready for delivery in three different sizes.

Holders for taps M3

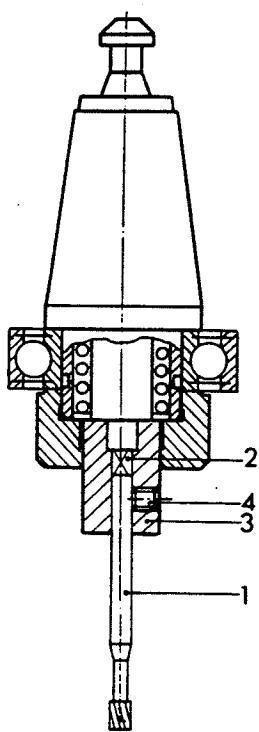
Holders for taps M4

Holders for taps M5, M6, M8

The length compensation (push - pull) is 13 mm.

### Mounting:

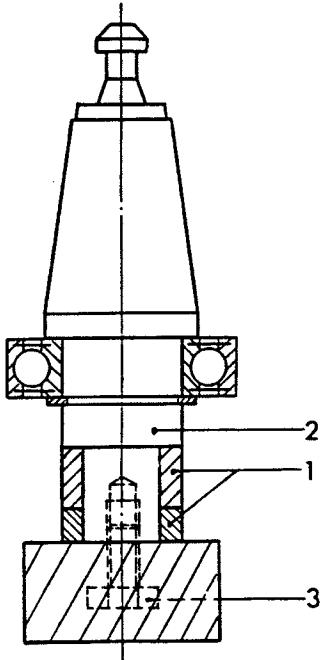
Put tap (1) into the square (2) of the tap holder (3) and clamp with set screw M 5 x 6 (4).



## Shell end mill arbor

The shell end mill arbor is used for clamping the shell end mill Ø 40 x 20 and the circular saw blade Ø 60.

### Mounting:



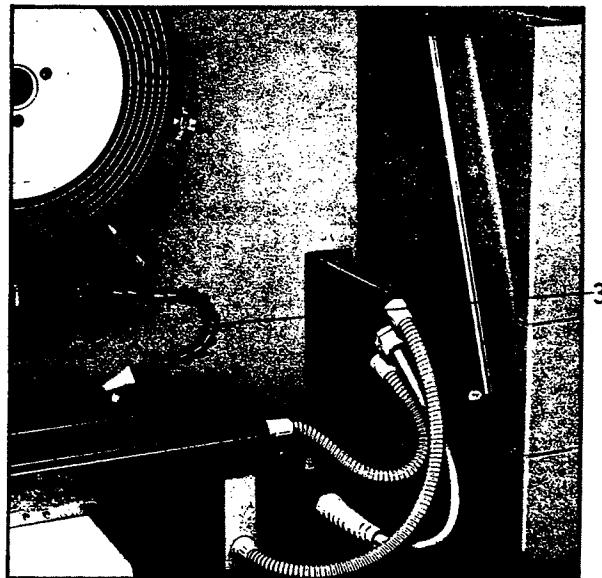
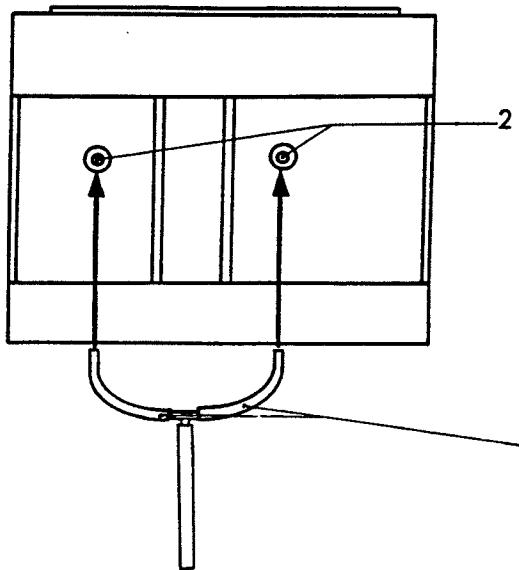
- \* Put spacing collars (1) on shell end mill arbor (2).
- \* Put on tool (clamping screw must contact milling cutter or circular saw blade and not lower end base of the shell end mill arbor).
- \* Tighten clamping screw (3) with wrench.

### 3. Coolant device

Caution:

Prisor to connection switch off  
machine and disconnect power supply.

View: machine from below



The basic equipment contains a  
discharge hose (1) for the coolant.

Procedure:

\* The coolant tank is placed on the  
floor. (When using an Emco machine  
base, place the coolant tank below  
the machine base.)

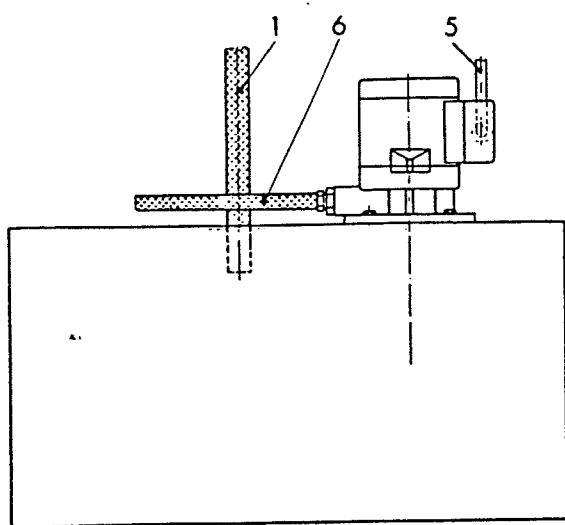
\* Connect discharge hose (1) at the  
outlet holes (2) on the machine base  
(first take off drain plug from  
outlet hole).

Note:

When using an Emco machine base the  
discharge hose must be led trough the  
machine base (bore in table).

\* Take off rear machine cover.

\* Take off cover for coolant hose, put  
coolant hose (3) onto open hole  
and tighten from machine interior.

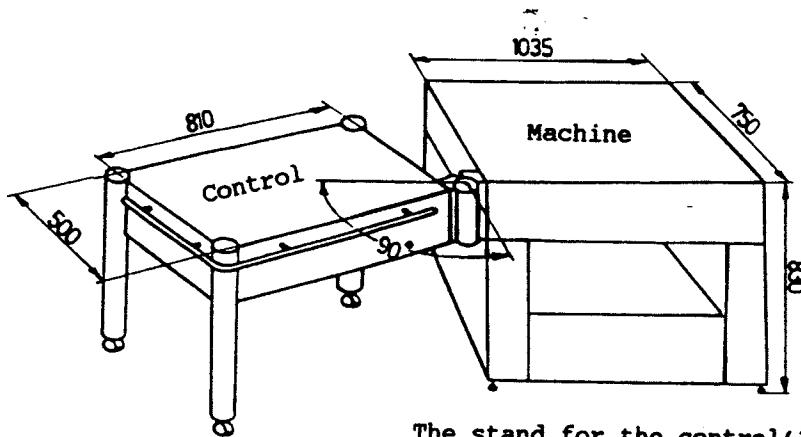


- \* Insert the belower end of the discharge hose (1) into the coolant tank.  
(Shorten discharge hose so that it discharges vertically into the coolant tank).
- \* Connect tube (6) on coolant pump and coolant tube, (on the back side of the machine, there is a breaking through to indroduce the inflow hose and the el. connecting cable.
- \* El. connection instructions to be found in chapter "Electrical connection of accessories"
- \* Position 5 is the cable for el. connection .
- \* Mount rear cover of machine.

#### 4. Machine Base

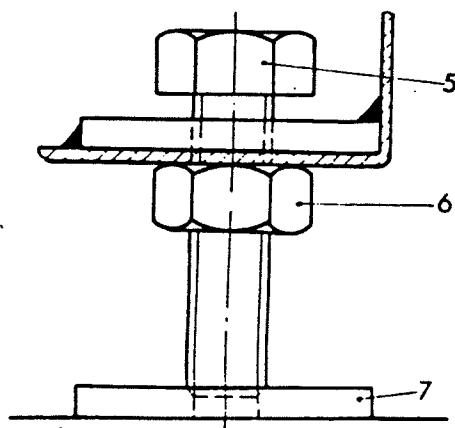
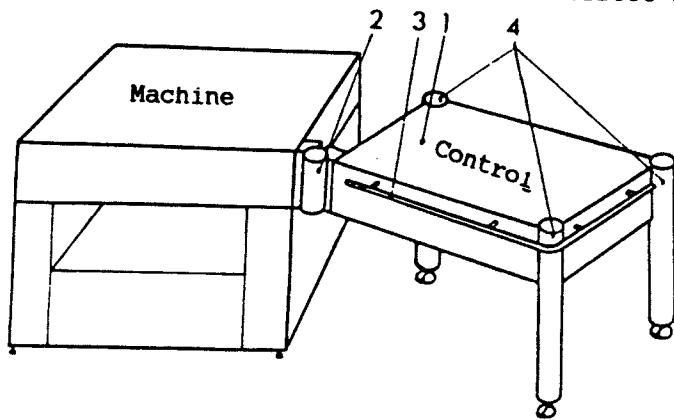
The stand for the control can be turned  
90°.

Sizes of tables: See illustration



The stand for the control(1) can be mounted to the left or to the right side of the machine stand.

The joint(2), the handle(3) and the legs(4) have to be mounted in the correct way.



##### Adjusting the Height of the Machine Stand

- Adjust the height with the hexagon screws M16 x 60 (5).
- Counter the hexagon screw with the hexagon nut M16(6).

##### Note:

The hexagon bolts can be placed directly on the floor, but it is advisable to place metal sheets (7) underneath.

## Chapter G

### Maintenance

- |  |         |
|--|---------|
| 1. Maintenance outline                   | G1      |
| 2. Lubricating and oiling                | G2 - G3 |
| 3. Lubricant and coolant recommendations | G4 - G5 |

## 1. Maintenance outline

### Routine check and maintenance intervals

#### 1.1 Oil tank for central lubrication

Weekly check (see also following pages).

#### 1.2 Water separator for compressed air

Weekly check (see also page B 18).

#### 1.3 Tool shop slide

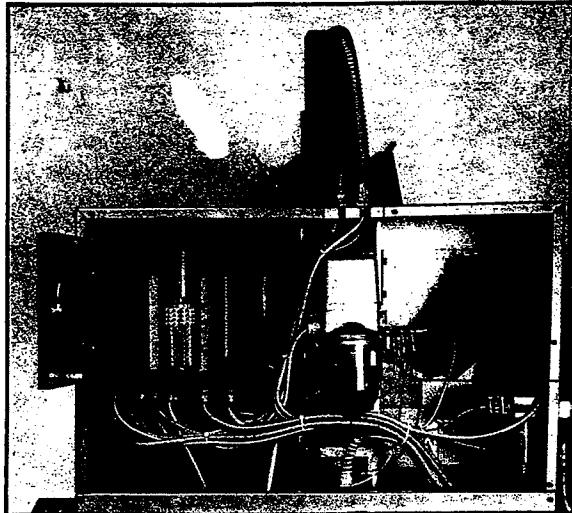
Oil daily (see following pages).

When lubricating the tool shop slide take care  
that oil does not drop on the main driving  
belt.

#### 1.4 Gears

No greasing or oiling.

## 2. Lubrication and Oiling of the Machine



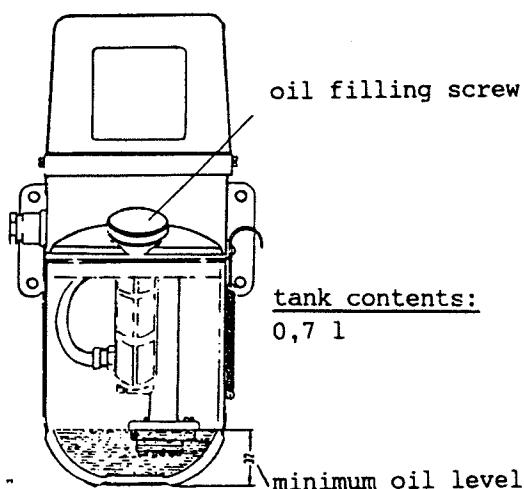
### 1. Cross, longitudinal and vertikal slides

The longitudinal and cross slides are supplied with slideway oil by the central lubrication system. For this purpose the pump for central lubrication is activated at certain intervals and a specific quantity of oil fed to the lubrication points via metering elements (1).  
Oil grade: slideway oil (see lubricant recommendations).

The lubrication intervals and the pump running time is set by the works. After slide travel of 10 m the pump is switched on for 5 sec.

### Oil Consumption:

Every 10 m of total travel of the slides a lubrication pulse is emitted by the control. Approx. 0,2 cm<sup>3</sup> of oil per lubricating pulse are pumped to the lubrication points. The oil consumption per hour depends on the travel of the slides.



### Venting the Lubricant Lines

If air enters the lubricant line owing to too low an oil level in the lubricant tank, the lubricant line must be vented. (air locks can be seen in the lubricant lines downstream of the metering elements).

For venting, unscrew the lubricant line upstream of the metering elements. Switch on lubricant pump and let it run until oil emerges from the unscrewed lubricant line. Retighten lubricant line.

#### Notes on Venting:

After the lubricant pump has been switched on, alarm A03 appears (pressure too low in the lubricant line). Cancel alarm A03.

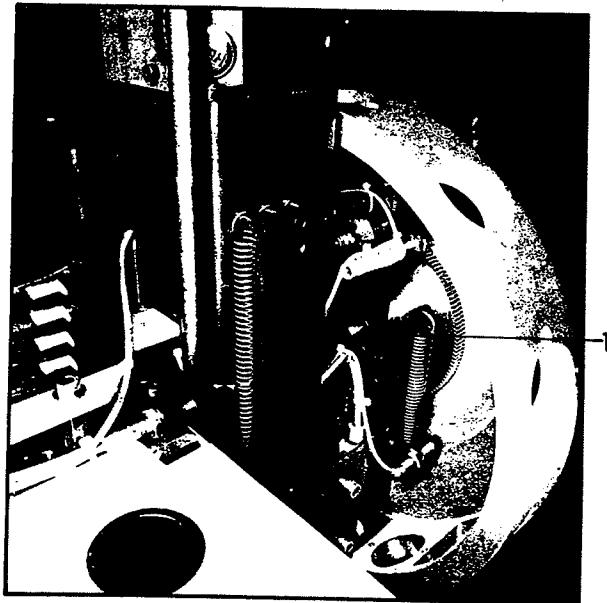
Then activate lubricant pump until the air locks have escaped from the lubricant lines.

### 2.2 Feed spindle

The mounted feed spindles are greased for life time. A new mounted spindle has to be greased. (Grease quality: look lubricant recommendations)

### 2.3 Main spindle bearings

The main spindle bearings installed are greased for their entire service life.



### 2.4 Tool shop slide

Tool shop slide (1) to be oiled daily with slideway oil.  
Take care that no oil drops on the main driving belt.

### 3. Lubricant- and Coolant Liquid Recommendations

The reference temperature for the viscosity details is 40°C (ISO VG), the reference temperature according to DIN is 50°C.



#### Slideways

Slideway oil with adhesive additives and wear-reducing additives. Prevention of the stick-slip effect. 73 mm<sup>2</sup>/sec. (cSt) at reference temperature 40°C  
CASTROL MAGNA BDX 68.  
Complies with Cincinnati Milling Specification P 47.



#### Greasing Points

##### Greasing Points of the Feed Spindle

Lithium saponified multipurpose grease with high dropping point. Penetration about 285. NLGI Class 2.  
CASTROL SPHEEROL EPL 2  
This grease has an operating temperature range of - 30°C to + 110°C.

Or

CASTROL GREASE LM -  
Lithium saponified multipurpose grease of NLGI Class 2.

Coolant



CASTROL SYNTILO R - biostable long-term coolant lubricant. No adhesion, skin compatible, excellent corrosion protection, neutral odour. High wetting and cooling action, can be used for every type of material. Recommended mixing ratio 1 : 30.



CASTROL CLEAREDGE EP - for true-to-size machining with high surface finish, combined with long tool times between overhauls. Recommended mixing ratio 1 : 30.

The products CASTROL VARIO HDX  
CASTROL MAGNA BDX 68  
CASTROL SYNTILO R

are attuned to each other,  
and are available as the  
**COMPLETE CASTROL SYSTEM.**

Special Note:

The required lubricating oil and media can be obtained in the trade (with the particular national or federal organisations of the petroleum companies). These recommended oils and greases differ in principle from the products available at filling stations.

## Chapter J

### Readjustment works

- o Replacing the step motors J1 - J2
- o Replacing the X-, Y-, Z-slides J3 - J7
- o Readjustment of the slide clearance J8 - J11
- o Measuring the reversal clearance J12 - J13
- o Replacing the door VMC-100 and  
exchanging the gas spring J14
- o Readjustment of ball snap for tool  
turret positioning J15
- o Control of carbon brushes on  
main drive motor J16
- o Changing of the bulb in the  
machine lamp J17
- o Re-adjusting the collet stroke J18

## Replacing the X-, Y-, Z-spindles

The spindles are only replaced as a group. The group consists of the spindle, nut mount, bearing pedestal and pulley (see Spare Parts List). With the bearing and mounting, ensure that the spindles are not bent.

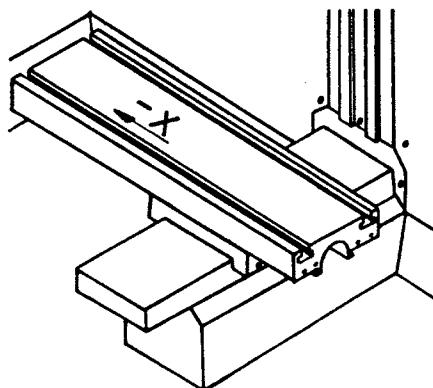
Under no circumstances may the spindles be screwed on by the nuts, since this will cause the balls to fall out.

### Removal:

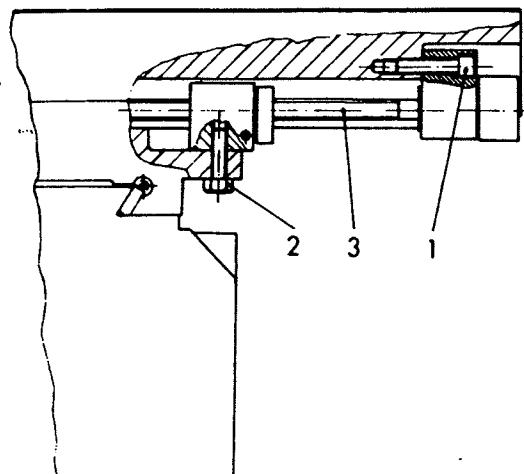
#### General:

Dismantle the particular step motor with the motor plate. On the X step motor, additionally dismantle the belt protection first.

#### Removal of the X-spindle



To simplify spindle disassembly, traverse the X-slide as far as possible in the X-direction.

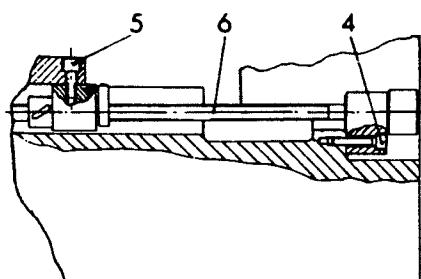
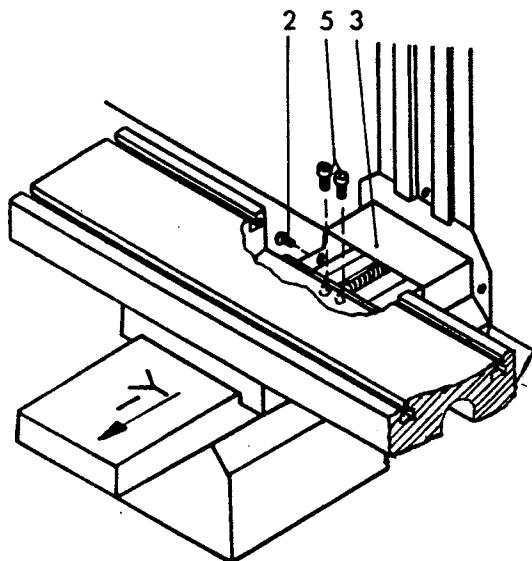


- + Unscrew the cheese-head bolts M5 x 25 (1) on the bearing pedestal.
- + Unscrew the hexagonal bolts M6 x 12 (2) for the nut mount.
- + Withdraw the spindle (3).

### Removal of the V-spindle

#### Note:

To simplify spindle disassembly, traverse the Y-slide as far as possible in -Y direction.



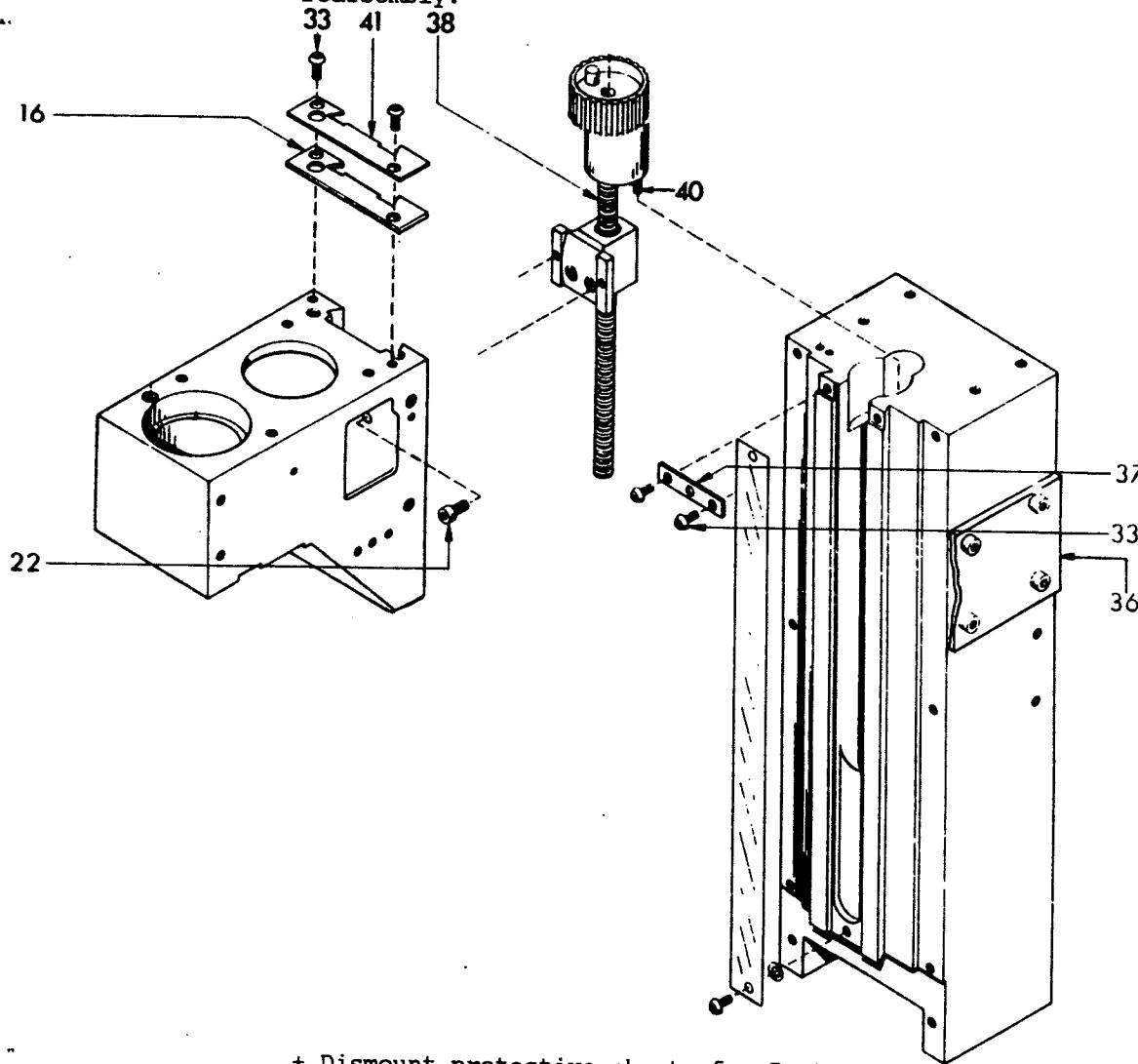
- + Remove back panel.
- + Remove lower side guard.
- + Unscrew the four oval-head screws M6 x 10(2) for protective sheet 2 (3) and push back the protective sheet.
- + Unscrew socket head screws M5 x 25(4) on the bearing pedestal.
- + Unscrew socket head screws M6 x 12(5) for nut mount.
- + Pull out spindle (6).

### Removal of the Z-spindle

Notes: When the step motor of the Z-spindle is removed, the vertical slide might slip away (the ball screws are not self-locking).

For this reason, securely support the vertical slide in the upper position prior to removal of the step motor (also installation and removal aid).

Do not unscrew the support plates (36) of the Z-spindle, otherwise the accuracy is impaired in case of reassembly.



- + Dismount protective sheets for Z-step motor.
- + Unscrew oval-head screws M6 x 10(33) for holding plate (37) and remove the holding plate (37).
- + Unscrew oval-head screws M6 x 10 (33) for stripper plate and remove stripper plate (41) with stripper felt (16).
- + Unscrew the two socket head screws M6 x 12(22) for bearing pedestal.
- + Unscrew socket head screws M5 x 40(40) for nut mount and pull out the spindle (38).

### Installation of the spindles

Grease the spindles prior to installation.

#### Grease quality:

(See operating instructions, chapter "Lubrication".

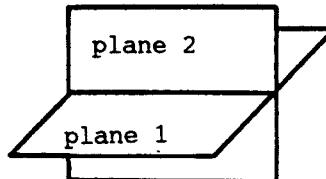
### Installation of the spindles

The spindles must not be installed in distorted state.

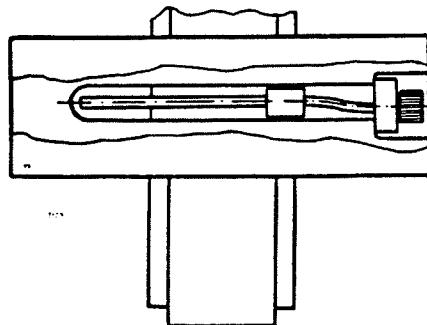
#### Consequences of distorted spindle installation

Rapid wear, damage, balls break out.

#### Possibilities of distortion as in the example of the X-spindle

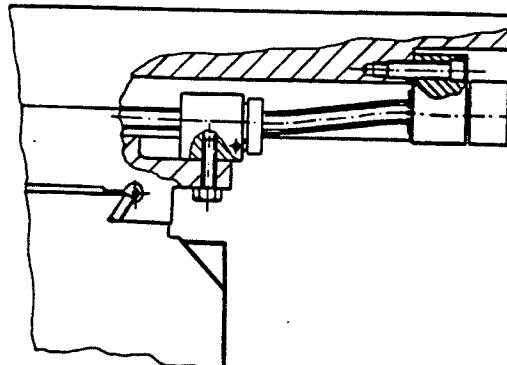


Distortion in plane 1  
(plan view)



Spindle distorted on the side

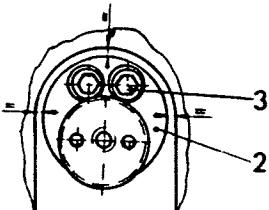
Distortion in plane 2  
(front view)



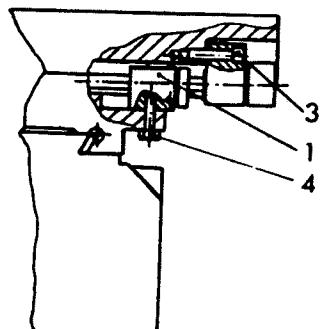
Spindle distorted in height

To prevent tensioning of the spindles during installation,  
the following procedure generally applies

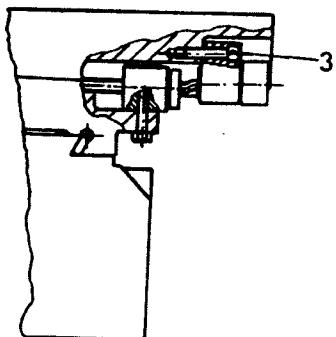
(X spindle example)



- + Thread spindle, screw bearing pedestal (2) with cheese-head bolts M5 x 25 (3) firmly, so that it is centrically placed in the milling out.



- + Screw the nut mount (1) with the hexagonal bolts M6 x 12 (4) firmly. Move slide or adjust nut mount so that it can be fastened with the hexagonal bolts.
- + Crank the slide completely to the right. Keep the distance between the nut mount - bearing pedestal, as small as possible.

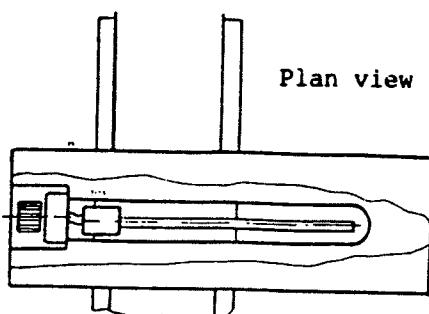


It is now possible that the spindle is tensioned in the elevation (level 2).

Remedy:

- + Loosen the bearing pedestal hexagonal socket head screws (3), which will cause the spindle to align itself in level 2.

Retighten the cheese-head bolts (3) of the bearing pedestal.



Possibility:

Spindle tensioned in level 1.

Therefore:

- + For safety, again loosen the bolts of the nut mount, and then retighten. (possible tensioning of the spindle in level 1)
- + Refit the remaining removed parts.

## Readjustment of the slide clearance

- + Readjust the slide guides after extended use.
- + The wear of the guides on the X, Y, Z slides can differ considerably, since the load normally differs on the slides.
- + Slides with excessive clearance, can cause jerking during machining.
- + The clearance is set with two taper gib strips each per slide.

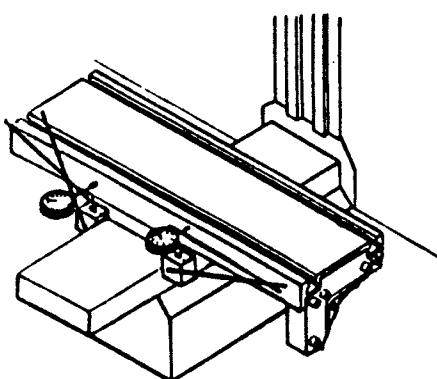
### Checking the guide clearance of the X, Y, Z slide

#### Structure of the gauge:

The slide clearance is measured on both sides of the particular slide, and should not exceed 0.015 mm. During clearance measurement, the slide is swivelled to and fro at the particular measuring point, with a swivel force of 100 N (10 kp).

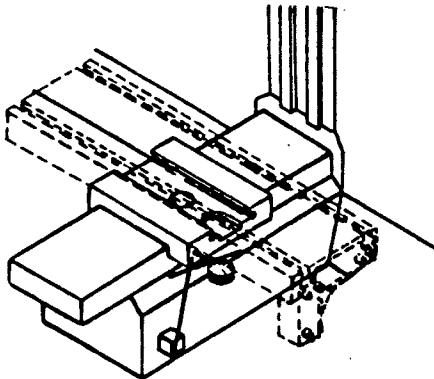
#### a) X slide

Gauge on Y slide  
(If the gauge were fixed to the base, the Y clearance would also be measured)



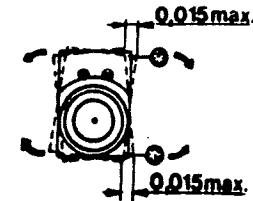
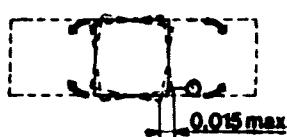
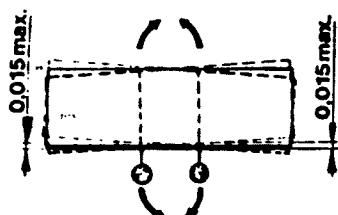
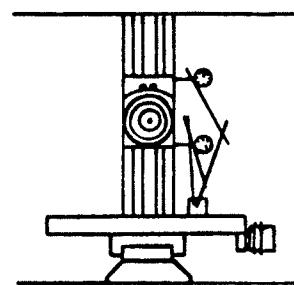
#### b) Y slide

Gauge on base



#### c) Z slide

Gauge on measuring table



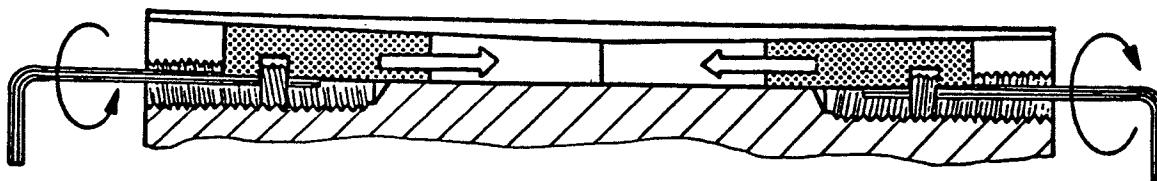
The gauge is only applied at the front, since the slide is guided at the rear by scraper felt.

### Readjusting the taper gib strips

The slide clearance is readjusted with the appropriate taper gib strips on the slide.

The guide way of the taper gib strip, as well as the taper gib strip, are conical.

By screwing in the tapped stud (size 2.5), the taper gib strips are moved in the direction of the arrow. The clearance is reduced.



#### Process:

Readjust the tapped stud slightly.

Measure the slide clearance with a gauge.

Repeat process until the measurement obtained is 0.01 to 0.015 mm.

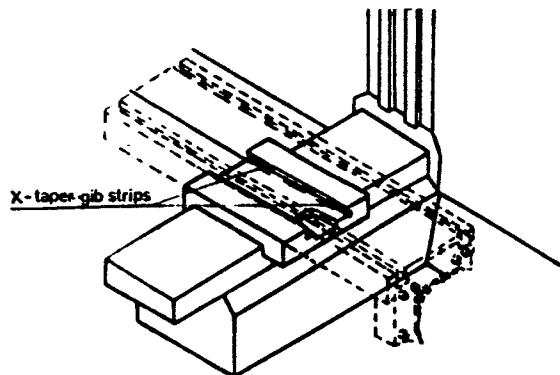
#### Attention:

Where the taper gib strips are excessively readjusted, the table will be clamped or will be very difficult to move.

The torque of the step motor could then be inadequate for traversing the slide. The step motor could lose the steps (feed force of the step motor is about 1300 N (130 kp)).

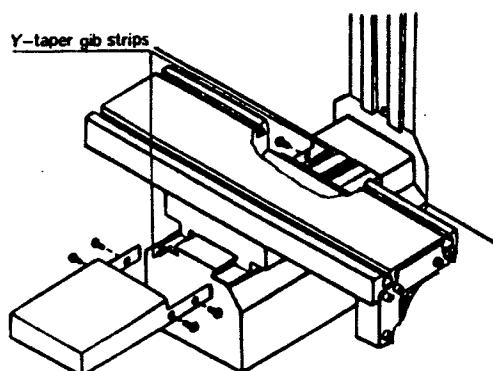
For this reason, unscrew the slide from the appropriate nut mount, and move slide backward and forward by hand.

Position of the taper gib strips



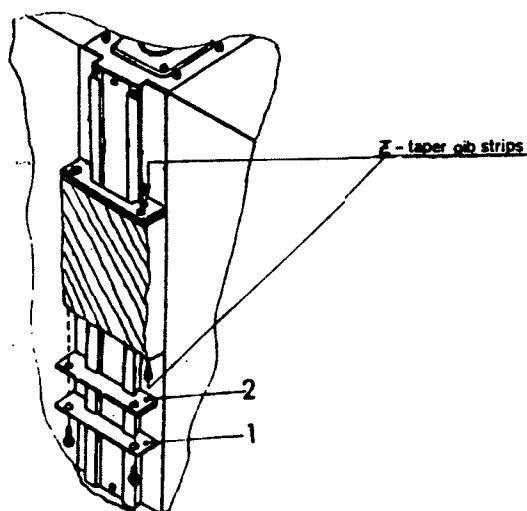
X taper gib strips

The taper gib strips on the X slide are freely accessible.



Y taper gib strips

Remove protective plates 1 and 2.



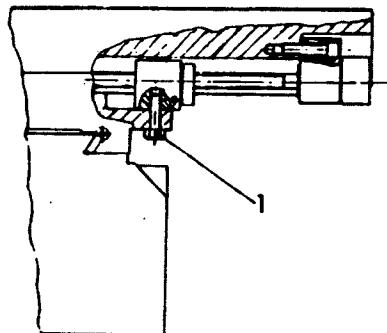
Z taper gib strips

The upper taper gib is freely accessible due to bores at the stripper plate.

To reach the lower taper gib, stripper plate (1) and stripper felt (2) are to be dismounted.

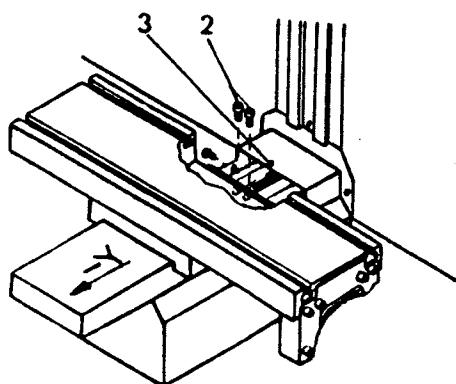
Removing the nut mount for manual movement of the slide:

To measure the slide clearance, unscrew the slides from the nut mount. Move the slides to and fro by hand. The movement force should not exceed 150 N (15 kp).



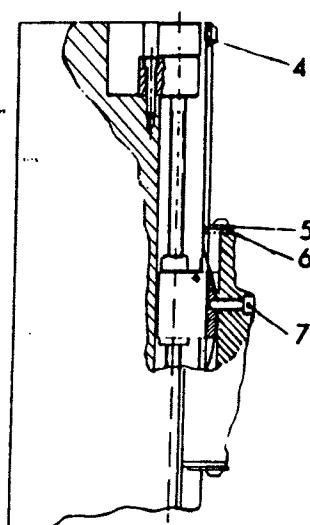
X slide:

Unscrew both hexagonal bolts M6 x 12 (1).



Y slide:

Remove the protective plate 2 (3) and unscrew the hexagonal socket screw of the nut mount (2).



Z slide:

Remove mounting plate (4), scraper plate (5) and scraper felt (6), and then unscrew both hexagonal socket screws of the nut mount (7). (Support Z slide!)

## Measuring the reversal clearance

In addition to the slide clearance, the reversal clearance is important for operating accuracy.

The reversal clearance arises when traversing the slide, e.g. + direction to - direction.

In this case, the control indicates a traverse path, however the slide does not actually traverse (dead path). The reversal clearance is measured about 5 - 30 mm prior to both the limit positions of the particular slide, and should not exceed 0,02 mm.

### Measuring the reversal clearance

- + Fasten gauge with magnetic base.
- + Move slide to gauge.
- + Set gauge at 0.
- + Set display at 0.
- + Move slide about 1 - 2 mm toward the gauge (gauge and display indicate the same traverse path).
- + Move slide with control back to 0.
- + Read off difference (= reversal clearance) on the gauge.
- + Repeat process for the other limit position of the particular slide.

### Attention: Relationship slide clearance - reversal clearance

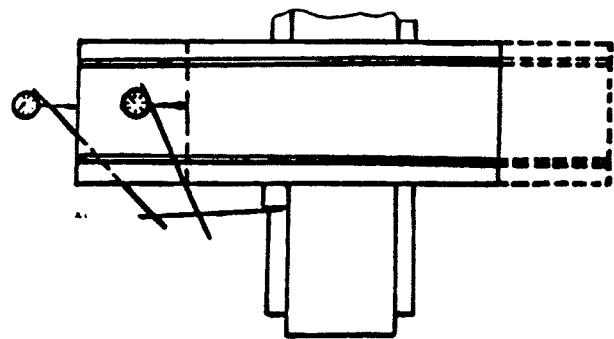
The stronger the setting of the guide strips, the smaller the slide clearance will be, and the larger the reversal clearance.

Accordingly, the slide clearance and reversal clearance must be jointly adjusted. The particular tolerances for slide clearance and reversal clearance, must not be exceeded.

### Adjustment of the reversal clearance

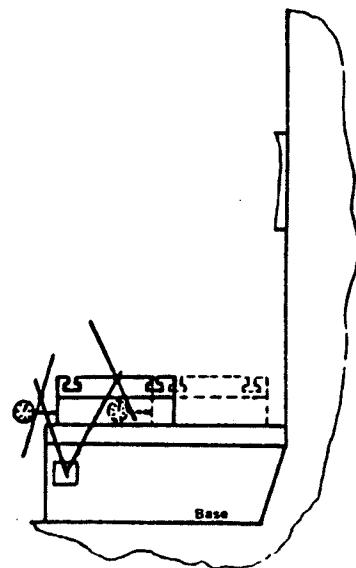
You can reduce the reversal clearance by loosening the taper gib (slide clearance gets larger at the same time).

Assembly of the gauge for measuring the reversal clearance of the slide



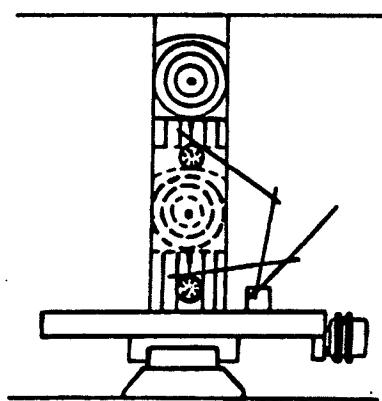
X slide

Gauge on the Y slide



Y slide

Gauge on the base



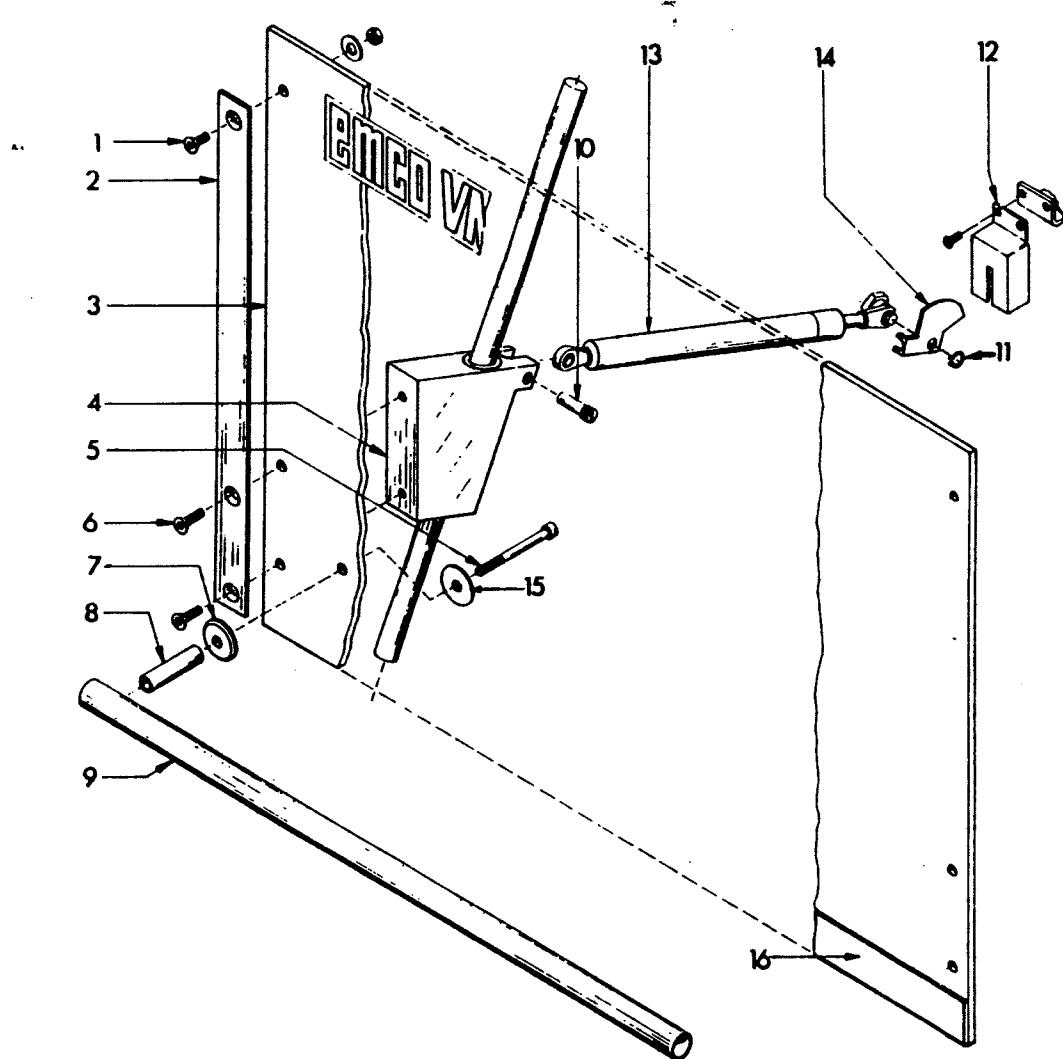
Z slide

Gauge on the table

## Replacing the door VMC-100 and exchanging the gas spring

### Note:

To replace the door and gas spring, move door into uppermost position.



### 1. Replacement of door

#### A) Removal

- + Unscrew the two flat head screws (1).
- + Unscrew the four flat head screws (6) from guide element (4) and remove door (3) together with cover plates (2).
- + Unscrew socket head screws (5), remove plate (15), plate (7), distance sleeve (8) and handle (9).

#### B) Installation

- + According to removal, but in reverse order.
- + Stick on rubber strip (16).

### 2. Exchanging of gas spring

#### A) Removal

- + Unscrew hinge bolt (10).
- + Take off locking ring (11).
- + Remove limit switch protection (12).
- + Remove switch sheet (14).
- + Remove gas spring (13).

#### B) Installation

- + According to removal, but in reverse order.

## Readjustment of ball snap for tool turret positioning

According to the duration of use it might happen that the tool turret will not stop any more in snap-in position. For this reason the ball snap has to be adjusted again.

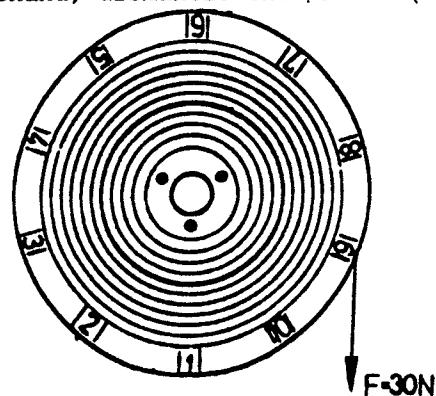


### Procedure:

A weight of 30 N (see sketch) is to be mounted on the tool turret.

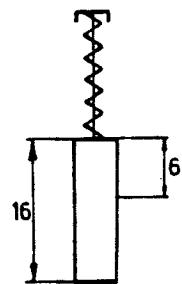
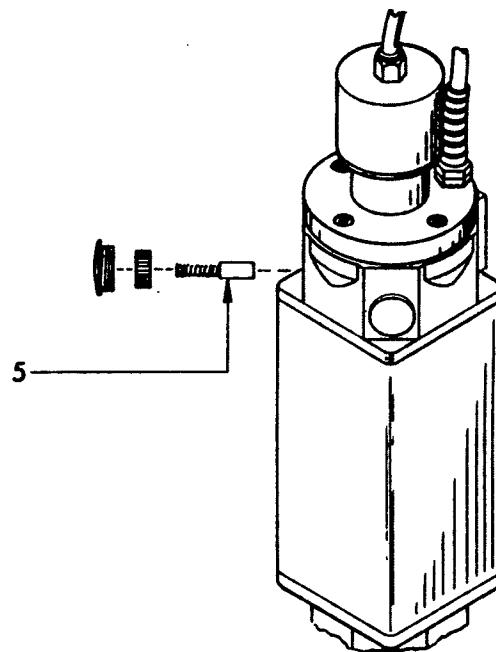
Then adjust set screw M10 x 10 (1) for ball snap until the tool turret including the weight will not turn automatically any more.

(Beforehand, dismantle the pinion (2).



## Control of carbon brushes on main drive motor

**Mind:**  
Switch off machine before  
checking the carbon brushes.



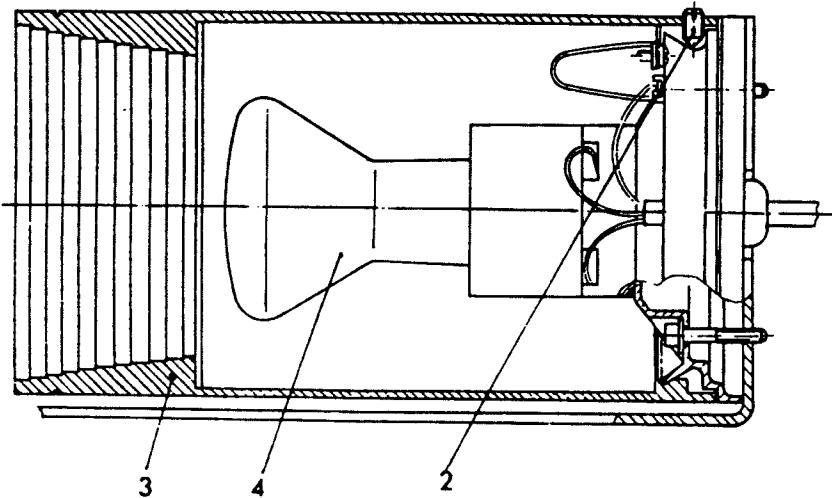
### Interval:

Check the four carbon brushes (5)  
every 6 months.

If the wear limit of 6 mm is achieved  
on one of the four carbon brushes,  
all four carbon brushes have to be  
replaced by new ones.

## Changing of the bulb in the machine lamp

**Warning:**  
Disconnect mains plug before  
changing the bulb.



### Dismantling:

- Remove rear cover of machine.
- Dismantle machine lamp from machine.
- Unscrew setscrew (2) and remove deep bowl reflector (3).
- Change bulb (4).

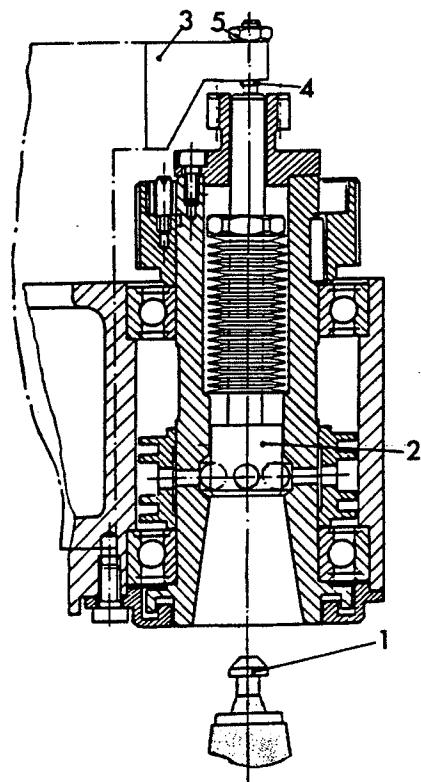
Assembly in reverse order to dismantling.

## Re-adjusting the collet stroke

If the tang (1) can no longer be introduced into the collet (2), the collet stroke must be re-adjusted.

### Procedure:

- Move clamping bracket (3) into lowered position (collet opened).
- Loosen lock nut (5) of the clamping screw (4).
- Re-adjust clamping screw (4) until the plug gauge supplied as a basic accessory is still just accommodated.
- Turn the clamping screw (4) about a further 90° and lock again in this position.



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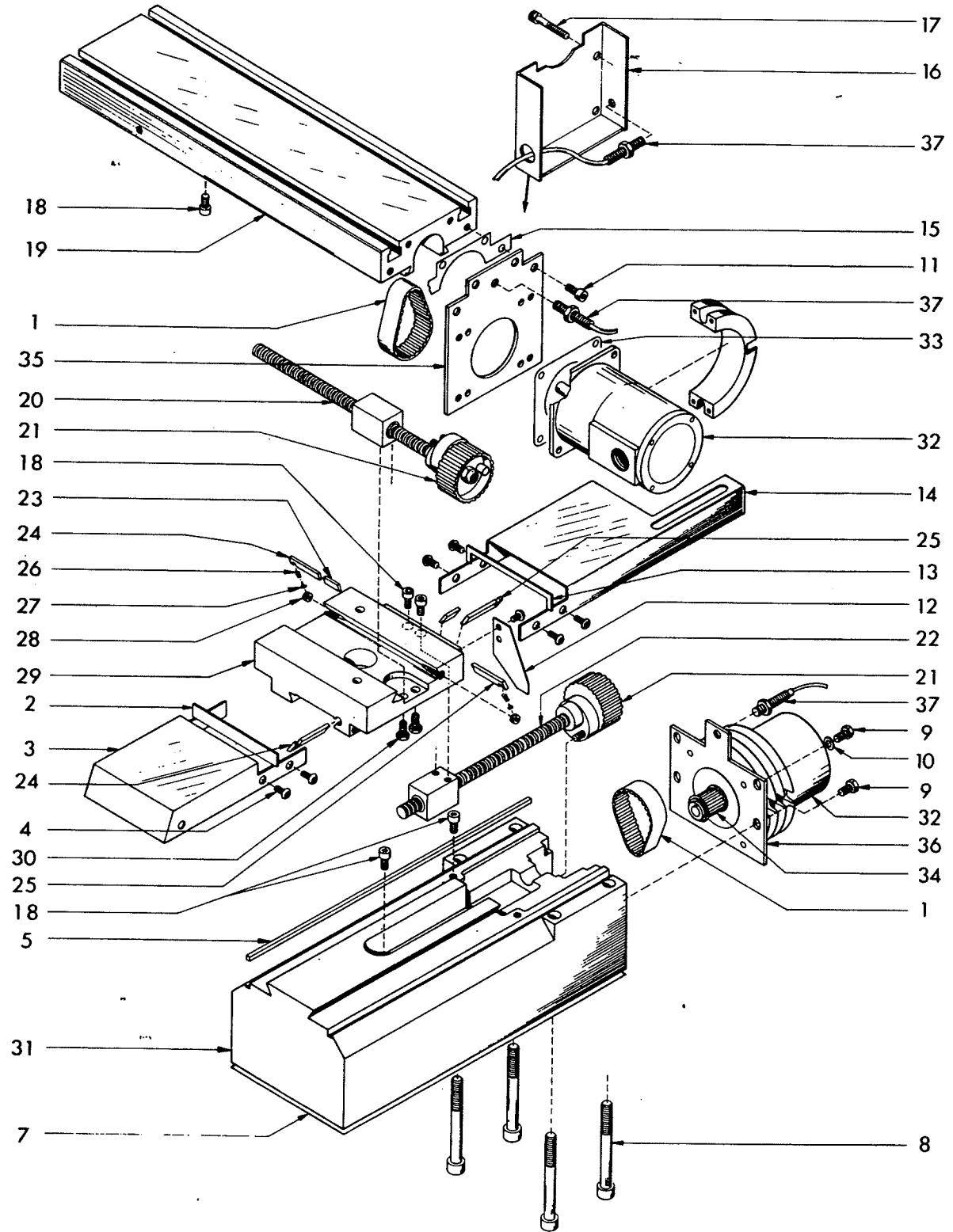
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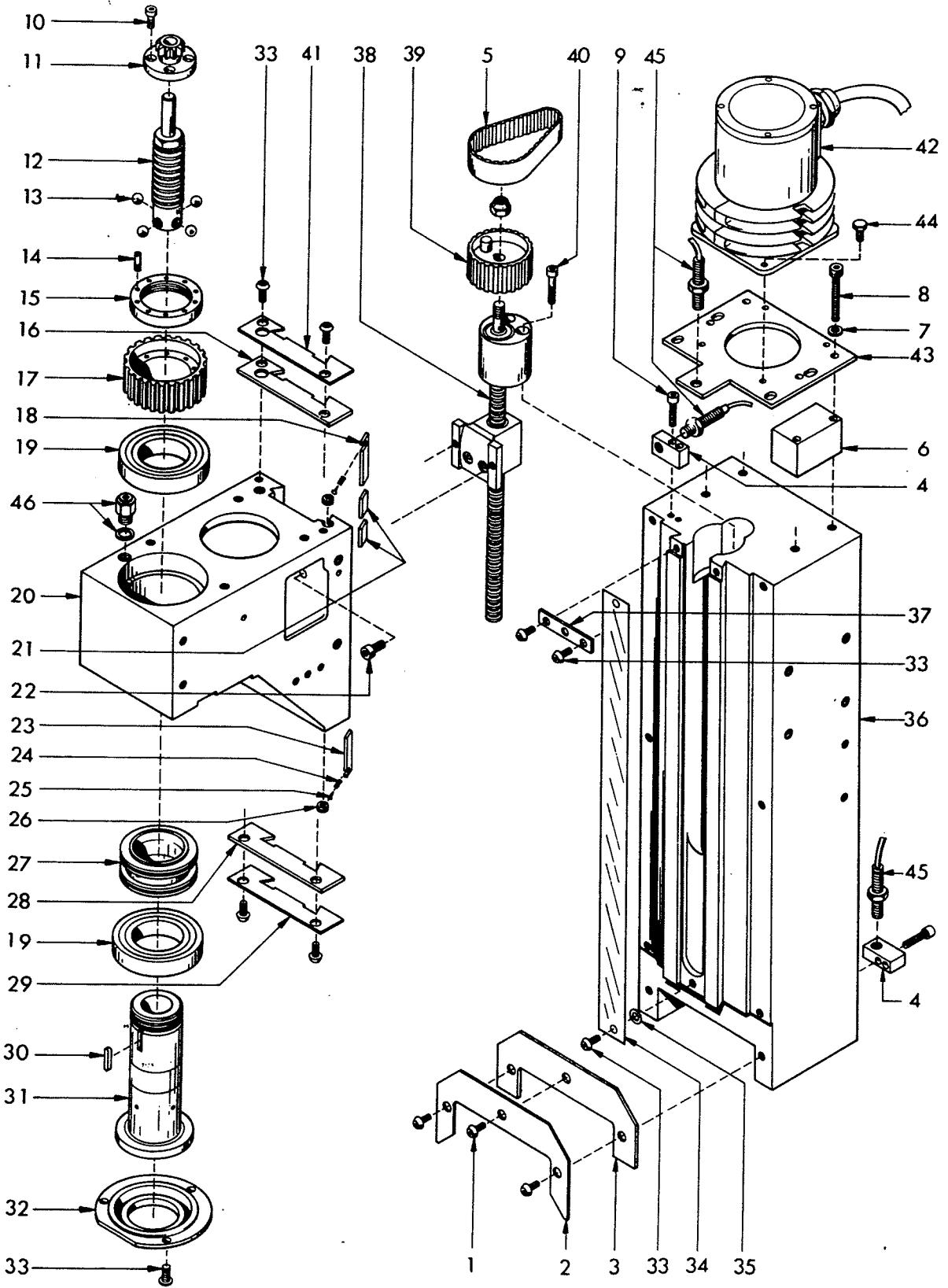
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**Ersatzteilliste VMC 100****Service Parts for VMC 100****Pièces de service pour VMC 100****EMCOTRONIC TM 02****Ausgabe 89/04****Edition 89/04**

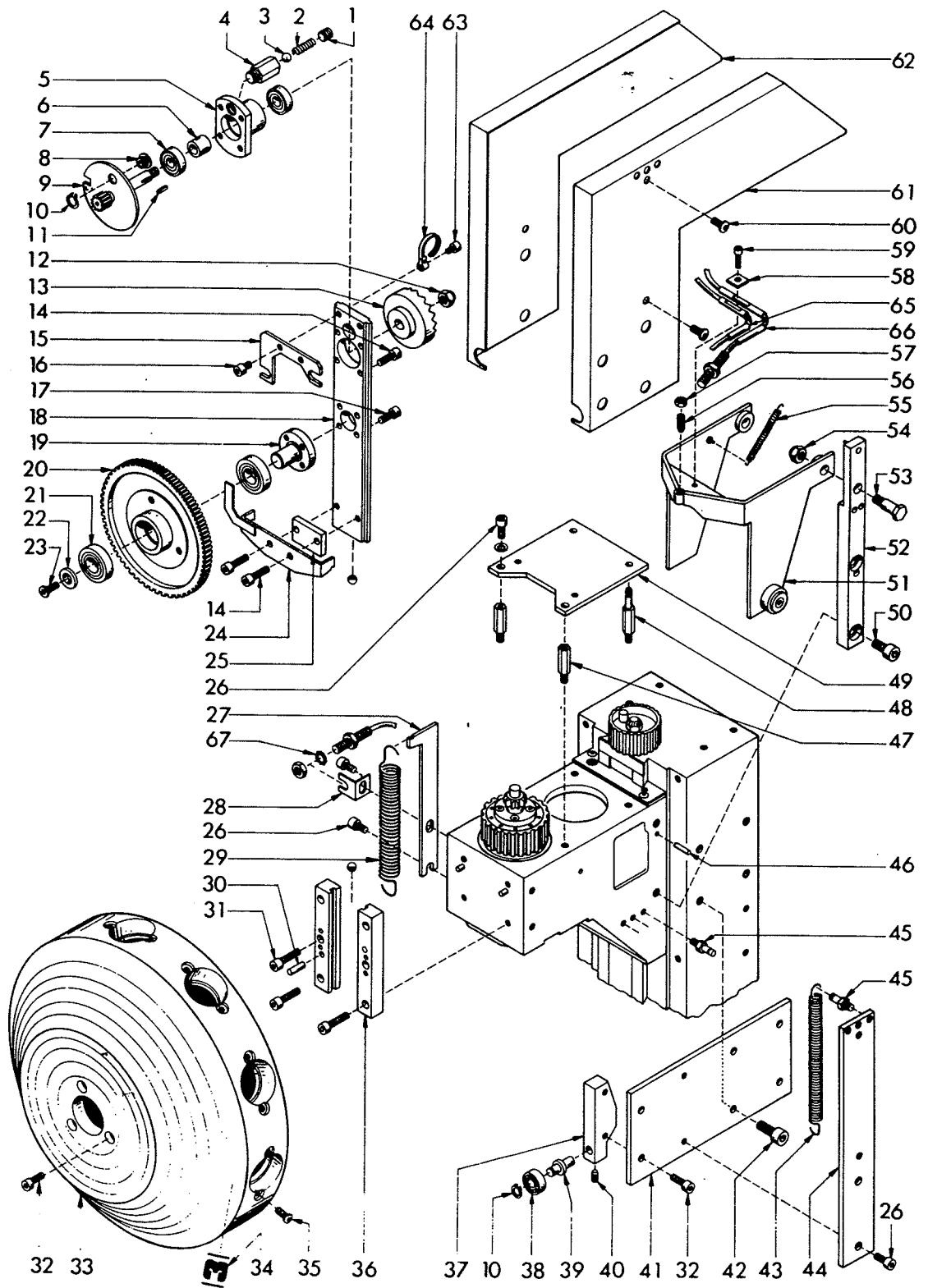
Pos.	Ref. No.	DIN		Benennung	Description	Designation
				<u>Grundausrüstung</u>	<u>Basic Equipment</u>	<u>Equipement de base</u>
1	F1S 450 000			Transportgriff	Handle for transport	Levier d'entraineur
2	F1S 280 000			Meßdorn	Testing mandrel	Mandrin de contrôle
3	ZVR 30 0161			T-Stück *	Pipe "T" *	Raccord en T *
4	ZLT 30 0037			Schlauch *	Hose *	Tuyau *
5	ZWZ 95 1310	13x10 DIN 895		Doppelmaulschlüssel	Open-ended spanner	Clé plate simple
6	ZWZ 11 0250	SW 2,5 DIN 911		Schraubendreher	Hexagonal key	Clé à six pans
7	ZWZ 11 0500	SW 5 DIN 911		Schraubendreher	Hexagonal key	Clé à six pans
	ZWZ 11 0400	SW 4 DIN 911		Schraubendreher	Hexagonal key	Clé à six pans
				* Für Kühlmittelableitung	* For coolant feed-back	* Pour dérivation du réfrigérant



Pos.	Ref. No.	DIN		Benennung	Description	Designation
1	ZRM 73 5114	MXL.114Z-3/4"		Zahnriemen	Timing belt	Courroie crantée
2	F1S 000 700			Dichtung 2	Seal 2	Joint d'étanchéité 2
3	F1A 000 011			Schutzblech 1	Cover sheet 1	Tôle de protection 1
4	ZSR 88 Ø610	M6x10 - 10.9		Linsenschraube	Filister head screw	Vis à tête bombée
5	ZGU 06 0440	4x4x365		Filzstreifen	Felt strip	Feutre
7	F1S 000 400			Dichtung	Seal	Joint d'étanchéité
8	ZSR 12 1090	M10x90 DIN912-10.9		Zylinderschraube	Socket head screw	Vis 6 pans creux
9	ZSR 33 0612	M6x12 DIN 933		Sechskantschraube	Hexagon head screw	Vis hexagonal
10	ZSB 21 0640	A6,4 DIN9021		Scheibe	Washer	Rondelle
11	ZSR 12 0612	M6x12 DIN 912		Zylinderschraube	Socket head screw	Vis 6 pans creux
12	F1S 000 380			Endschalterblech 2	Detector sheet 2	Tôle d'initiateur 2
13	F1S 000 690			Dichtung 1	Seal 1	Joint d'étanchéité 1
14	F1S 000 020			Schutzblech 2	Cover sheet 2	Tôle de protection 2
15	F1S 000 580			Papierdichtung 2	Paper seal 2	Joint d'étanchéité 2
16	F1S 000 140			Riemenschutz	Belt cover	Protection de courroie
17	ZSR 12 0640	M6x40 DIN912		Zylinderschraube	Socket head screw	Vis 6 pans creux
18-31	F1S 030 000			<u>Gruppe Kreuzschlitten</u>	<u>Cross slide compl.</u>	<u>Ens. chariot transversal</u>
18	ZSR 12 0612	M6x12 DIN912-6.9		Zylinderschraube	Socket head screw	Vis 6 pans creux
19	F1P 030 030			Frästisch	Milling table	Table de fraisage
20+21	F1P 031 000			X-Spindel kompl.	X-spindle compl.	Ens. vis-mère X
21	F1P 020 130			Riemscheibe 80	Pulley 80	Poulie 80
22+21	F1P 032 000			Y-Spindel kompl.	Y-spindle compl.	Ens. vis-mère Y
23	F1S 000 710			Filzstreifen	Felt strip	Feutre
24	F1A 020 050	4,68 mm		Keilleiste	Taper gib	Lardon conique
	F1A 020 060	4,55 mm		Keilleiste	Taper gib	Lardon conique
25	F1A 020 110	4,68 mm		Keilleiste	Taper gib	Lardon conique
	F1A 020 120	4,55 mm		Keilleiste	Taper gib	Lardon conique
26	ZFD 20 4061	D-061		Druckfeder	Compression spring	Ressort de pression
27	ZNA 76 0204	2x4 DIN 1476-4.6		Kerbnagel	Rivet	Clou cannelé
28	F1A 020 070			Stellschraube	Adjusting screw	Vis de réglage
29	F1S 030 020			Kreuzschlitten	Cross slide	Chariot transversal
30	ZSR 34 0616	M6x16 DIN933-8.8		Sechskantschraube	Hexagon head screw	Vis à six pans
31	F1A 030 011			Sockel	Base	Socle
32	ZMO 78 0020			Schrittmotor X,Y,Z	Step motor X,Y,Z	Moteur pas à pas X,Y,Z
33	F1S 106 020			Papierdichtung 1	Paper seal 1	Joint d'étanchéité 1
34	F1S 000 190			Motorriemenscheibe X,Y,Z	Motor pulley X,Y,Z	Poulie de moteur X,Y,Z
35	F1S 106 010			Motorplatte X	Motor plate X	Plaque de moteur X
36	F1S 107 010			Motorplatte Y,Z	Motor plate Y,Z	Plaque de moteur Y,Z
37	A7N 511 000			Näherungsschalter	Proximity detector	Initiateur inductif

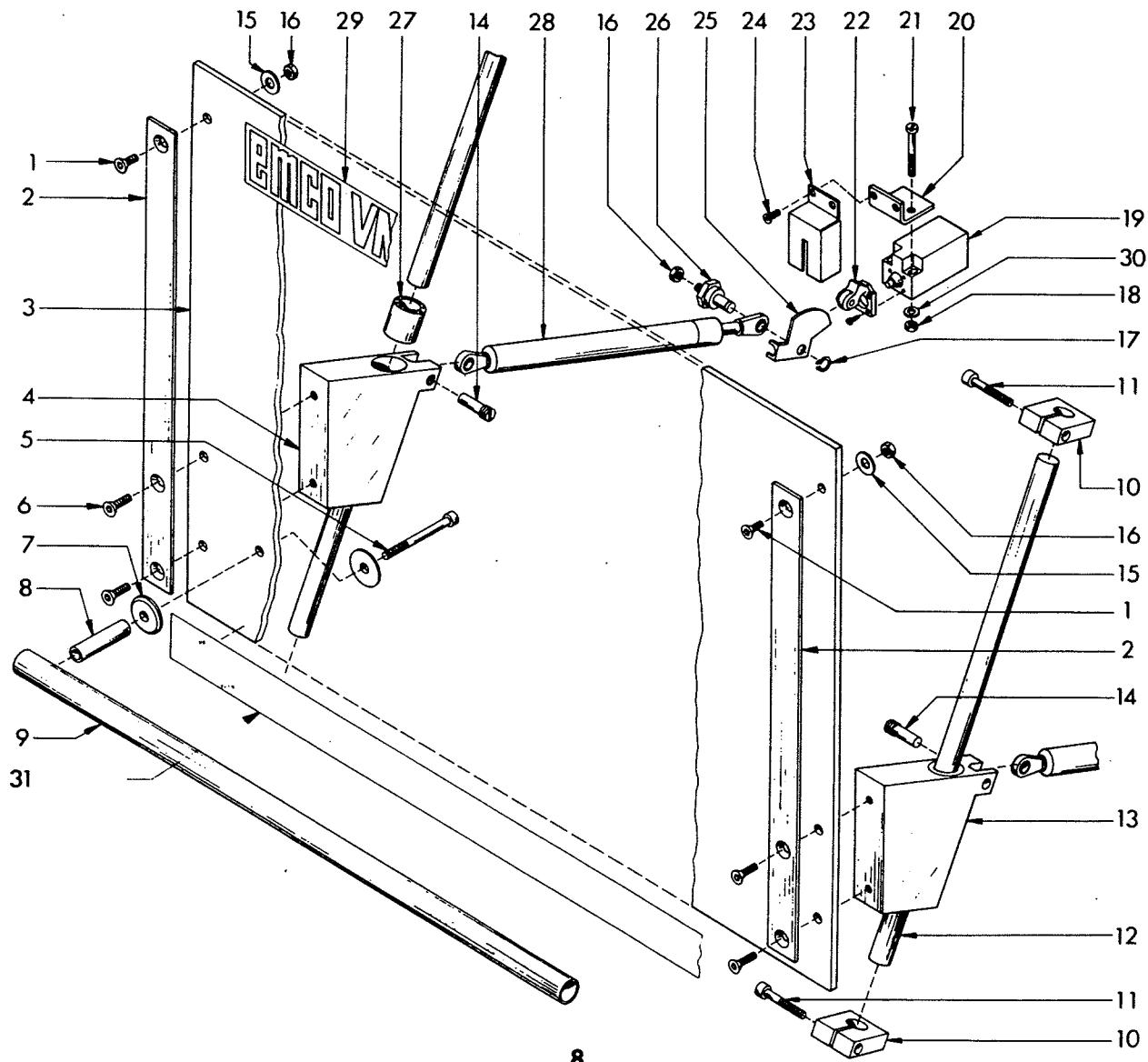


Pos.	Ref. No.	DIN		Benennung	Description	Designation
1	ZSR 88 0610	M6x10-10.9		Linsenschraube	Filister head screw	Vis à tête bombée
2	F1A 000 030			Dichtblech	Wiper plate	Tôle d'étanchéité
3	F1A 000 350			Filzabstreifer	Felt wiper	Feutre racleur
4	F1S 000 160			Endschalterblock	Detector block	Saumon d'initiateur
5	ZRM 73 5114	MXL 114Z-3/4"		Zahnriemen	Timing belt	Courroie crantée
6	F1S 000 760			Distanzklotz	Spacing block	Saumon d'écartement
7	ZSB 25 0640	B6,4 DIN 125		Scheibe	Washer	Rondelle
8	ZSR 12 0645	M6x45 DIN 912-8.8		Zylinderschraube	Socket head screw	Vis 6 pans creux
9	ZSR 12 0420	M4x20 DIN 912		Zylinderschraube	Socket head screw	Vis 6 pans creux
10-41	F1S 020 000			Gr. Vertikalschlitten	Vertical slide compl.	Ens. chariot vertical
10	ZSR 12 0408	M4x8 DIN 912-6.9		Zylinderschraube	Socket head screw	Vis 6 pans creux
11	F1S 020 080			Triebling	Shaft pinion	Pignon arbré
12	F1S 023 000			Federeinheit	Belleville spring ass.	Unité à ressort
13	ZKG 00 1071	Ø 7 GK4 DIN 5401		Stahlkugel	Ball	Bille
14	ZSR 27 0416	M4x16 DIN 427-5.8		Schaftschraube	Set screw	Vis pointeau
15	F1S 020 050			Ringmutter	Ring nut	Ecrou crénélée
16	F1S 020 090			Abstreiffilz	Felt wiper	Feutre racleur
17	F1S 020 040			Riemenscheibe 39	Pulley 39	Poulie 39
18	F1A 020 110	4,68 mm		Keilleiste	Taper gib	Lardon conique
	F1A 020 120	4,55 mm		Keilleiste	Taper gib	Lardon conique
19	ZLG 60 0802			Rillenkugellager	Ball bearing	Roulement à billes
20	F1S 020 020			Fräskopf	Milling head	Tête de fraisage
21	F1S 000 710			Filzstreifen	Felt strip	Feutre
22	ZSR 12 0612	M6x12 DIN 912-8.8		Zylinderschraube	Socket head screw	Vis 6 pans creux
23	F1A 020 050	4,68 mm		Keilleiste	Taper gib	Lardon conique
	F1A 020 060	4,55 mm		Keilleiste	Taper gib	Lardon conique
24	ZFD 20 4061	D-061		Druckfeder	Compression spring	Ressort de pression
25	ZNA 76 0204	2x4 DIN 1476-4,6		Kerbnagel	Rivet	Clou cannelé
26	F1A 020 070			Stellschraube	Adjusting screw	Vis de réglage
27	F1S 020 070			Hülse	Ring	Bague
28	F1A 020 080			Abstreiffilz	Felt wiper	Feutre racleur
29	F1A 020 090			Abstreifblech	Wiper plate	Tôle racleur
30	ZFD 85 4418	A4x4x18 DIN 6885		Paßfeder	Square key	Clavette
31	F1S 020 030			Frässpindel	Milling spindle	Broche de fraisage
32	F1S 020 060			Lagerdeckel	Bearing cover	Couvercle
33	ZSR 88 0610	M6x10-10.9		Linsenschraube	Filister head screw	Vis à tête bombée
34	F1A 020 030			Schutzband	Protection strip	Bande de protection
35	ZSB 12 0605	PS 6x12x0,5		Paßscheibe	Shim ring	Rondelle d'ajustage
36	F1S 020 010			Vertikalsäule	Vertical column	Colonne verticale
37	F1A 020 040			Halteblech	Clamping sheet	Tôle d'arrêt
38-40	F1P 021 000			Z-Spindel komplett	Z-spindle compl.	Ens. vis-mère Z
39	F1P 020 130			Riemenscheibe 80	Pulley 80	Poulie 80
40	ZSR 12 0540	M5x40 DIN912-8.9		Zylinderschraube	Socket head screw	Vis 6 pans creux
41	F1S 020 100			Abstreifblech	Wiper plate	Tôle racleur
42	ZMO 78 0020			Schrittmotor X,Y,Z	Step motor X,Y,Z	Moteur pas à pas X,Y,Z
43	F1S 107 010			Motorplatte Y,Z	Motor plate Y,Z	Plaque de moteur Y,Z
44	ZSR 33 0508	M5x8 DIN 933-5.6		Sechskantschraube	Hexagon head screw	Vis hexagonal
45	A7N 511 000			Näherungsschalter	Proximity detector	Initiateur inductiv
46	ZVR 09 0010			Verschraubung	Hose fitting	Raccord de tuyau

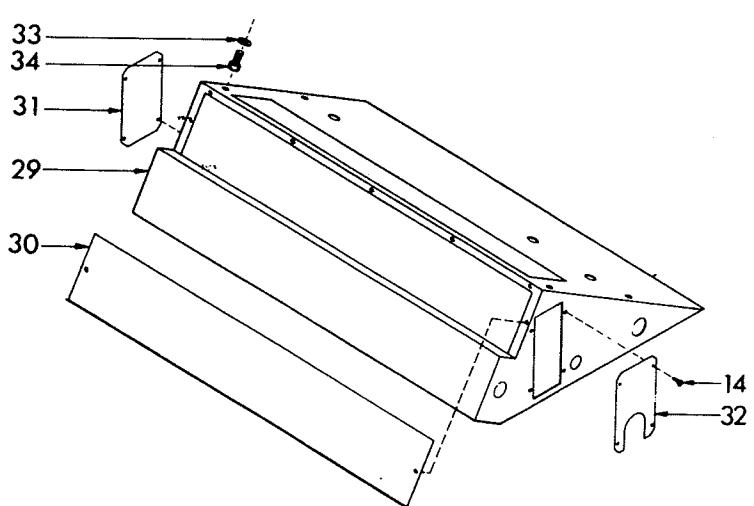
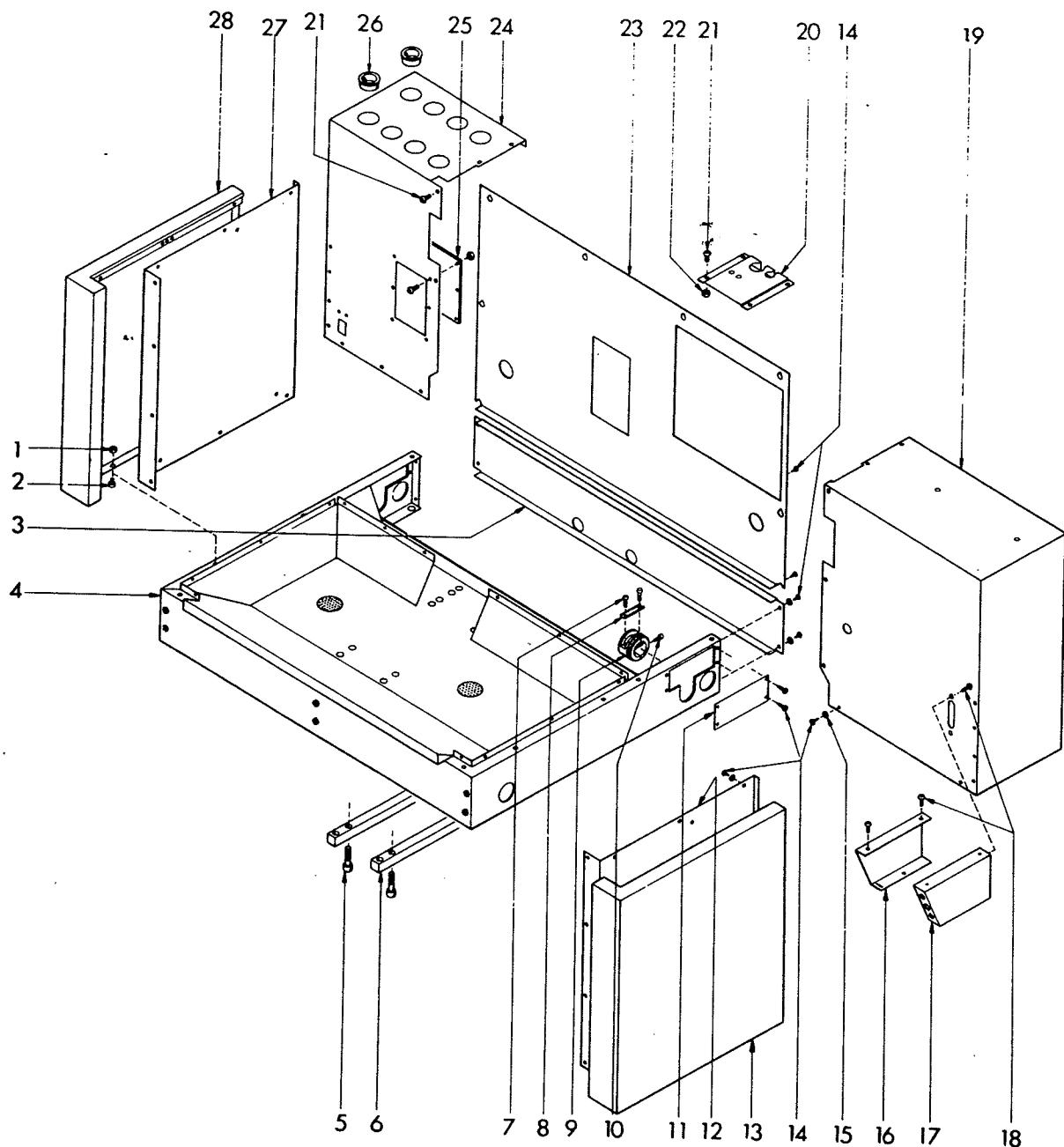


Pos.	Ref. No.	DIN		Benennung	Description	Designation
1-11	F1S 220 000			Gr. Ritzel	Drive pinion compl.	Ens. pignon
1	ZST 13 1010	M10x10 DIN 913		Gewindestift	Set screw	Vis pointeau
2	ZFD 21 4173	D 173 B		Druckfeder	Compression spring	Ressort de pression
3	ZKG 00 1080	8,0 GK3 DIN 5401		Stahlkugel	Ball	Bille
4	F1S 220 040			Federhalter	Spring holder	Porte-ressort
5	F1S 220 010			Lagerhülse	Bearing mount	Palier de roulement
6	F1S 220 030			Distanzhülse	Spacer	Douille d'écartement
7	ZLG 60 0002	6000-2Z		Rillenkugellager	Ball bearing	Roulement à billes
8	F1S 220 050			Kugelraste	Notch	Cran d'arrêt
9	F1S 220 020			Ritzel	Drive pinion	Pignon
10	ZRG 71 0808	W8x0,8 DIN 471		Sicherungsring	Retaining ring	Anneau de retenue
11	ZFD 85 3312	A3x3x12 DIN 6885		Paßfeder	Square key	Clavette parallèle
12	ZMU 80 0800	NM8 DIN 980-8		Sicherungsmutter	Securing nut	Ecrou de sûreté
13	F1S 000 200			Zahnkranz	Internal gear	Roue intérieure
14	ZSR 12 0520	M5x20 DIN 912-8.8		Zylinderschraube	Socket head screw	Vis 6 pans creux
15	F1S 000 030			Endschalterblech	Detector sheet	Tôle d'initiateur
16	ZSR 12 0580	M5x8 DIN 912		Zylinderschraube	Socket head screw	Vis 6 pans creux
17	ZSR 12 0516	M5x16 DIN 912		Zylinderschraube	Socket head screw	Vis 6 pans creux
18	F1S 000 340			Linearführung	Guide rail	Glissière
19-23	F1S 200 000			Gr. Teilrad	Dividing gear compl.	Ens. engrenage de diviseur
19	F1S 200 020			Lagerwelle	Bearing shaft	Arbre de roulement
20	F1S 200 010			Zahnrad 140	Gear 140	Engrenage 140
21	ZLG 60 0202	6002-2Z		Rillenkugellager	Ball bearing	Roulement à billes
22	F1S 200 030			Druckscheibe	Washer	Rondelle
23	ZSR 79 0516	M5x16 DIN 7991-8.8		Senkschraube	Countersunk screw	Vis tête fraise
24	F1S 230 000			Federblech	Spring holder	Porte-ressort
25	F1S 000 360			Zwischenplatte	Distance plate	Plaque d'écartement
26	ZSR 12 0610	M6x10 DIN 912-8.8		Zylinderschraube	Socket head screw	Vis 6 pans creux
27	F1S 000 070			Federblech	Spring holder	Porte-ressort
28	F1S 000 180			Endschalterwinkel	Detector sheet	Tôle d'initiateur
29	F1S 300 000			Zugfeder	Tension spring	Ressort de traction
30	ZST 74 0516	5x16 DIN 1474-6.8		Steckkerbstift	Grooved pin	Goupille fendue
31	ZSR 12 0625	M6x25 DIN 912-6.9		Zylinderschraube	Socket head screw	Vis 6 pans creux
32	ZSR 12 0616	M6x16 DIN 912-8.8		Zylinderschraube	Socket head screw	Vis 6 pans creux
33	F1S 000 010			Trommel	Drum	Tambour
34	F1S 000 620			Positionsziffern	Position numbers	Nombre de positions
35	F1S 000 350			Klemmschraube	Clamping screw	Vis de blocage
36	F1S 000 330			Führungsleiste	Guide gib	Lardon de guidage
37	F1S 000 090			Kulisse	Guide gib	Lardon de guidage
38	ZLG 06 0802	608-2RSR		Rillenkugellager	Ball bearing	Roulement à billes
39	F1S 000 120			Lagerbolzen	Bolt	Boulon
40	ZST 13 0606	M6x6 DIN 913		Gewindestift	Set screw	Vis pointeau
41	F1S 000 290			Trägerblech	Support plate	Plaque de support
42	ZSR 12 0816	M8x16 DIN 912-6.9		Zylinderschraube	Socket head screw	Vis 6 pans creux
43	ZFD 50 0106	Z-106-J		Zugfeder	Tension spring	Ressort de traction
44	F1S 000 060			Federhalter	Spring holder	Porte-ressort
45	F1S 000 110			Federbolzen 2	Bolt	Boulon
46	ZST 06 0624	6m6x24 DIN 7		Zylinderstift	Parallel pin	Tige de serrage
47	F1P 000 640			Distanzbolzen	Spacing bolt	Boulon d'écartement
48	F1S 000 610			Stehbolzen	Spacing bolt	Boulon d'écartement
49	F1S 000 050			Motorplatte	Motor plate	Plaque de moteur
50	ZSR 12 0820	M8x20 DIN 912-6.9		Zylinderschraube	Socket head screw	Vis 6 pans creux

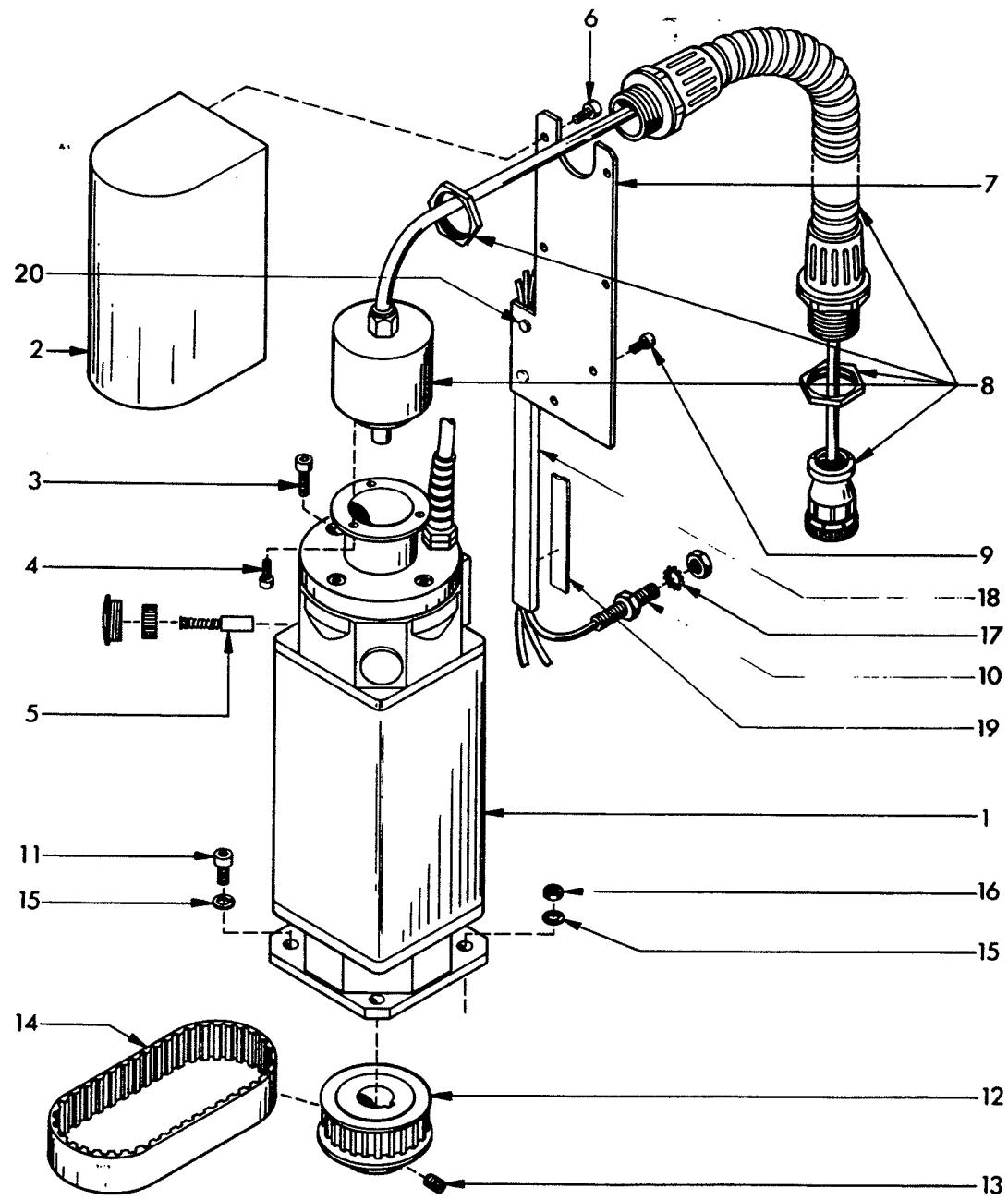
Pos.	Ref. No.	DIN		Benennung	Description	Designation
51-57	F1S 210 000			Gr. Spannhebel	Clamping lever compl.	Ens. levier de serrage
52	F1S 210 060			Steher	Gib	Lardon
53	F1S 210 070			Gelenkbolzen	Bolt	Boulon
54	ZMU 80 0800	NM8 DIN 980-8		Sicherungsmutter	Securing nut	Ecrou de sûreté
55	ZFD 50 0063			Zugfeder	Tension spring	Ressort de traction
56	ZSR 99 0002	M6x20 K6SS		Stiftschraube	Set Screw	Vis pointeau
57	ZMU 34 0600	M6 DIN 934-6		Sechskantmutter	Hexagon nut	Ecrou hexagonal
58	F1S 000 750			Spannplatte	Clamping plate	Plaque de serrage
59	ZSR 12 0412	M4x12 DIN 912		Zylinderschraube	Socket head screw	Vis 6 pans creux
60	ZSR 88 0610	M6x10-10.9		Linsenschraube	Filister head screw	Vis à tête lentiforme
61	F1S 000 670			Schutzblech 1	Cover sheet 1	Tôle de protection 1
62	F1S 000 680			Schutzblech 2	Cover sheet 2	Tôle de protection 2
63	ZSR 12 0510	M5x10 DIN 912		Zylinderschraube	Socket head screw	Vis 6 pans creux
64	ZEK 141 105			Kabelbinder	Cable fitting	Raccord de câble
65	K4E 301 000			Näherungsschalter mit Rohr	Proximity detector with tube	Initiateur inductif avec tube
66	K4E 302 000			Näherungsschalter mit Rohr	Proximity detector with tube	Initiateur inductif avec tube
67	ZSB 98 0850			Fächerscheibe	Serrated lock washer	Rondelle éventail



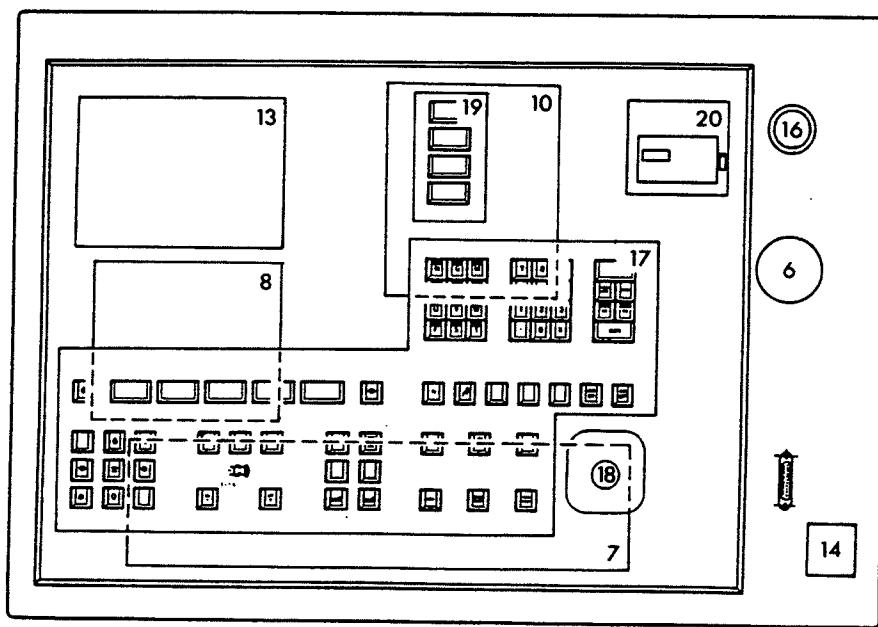
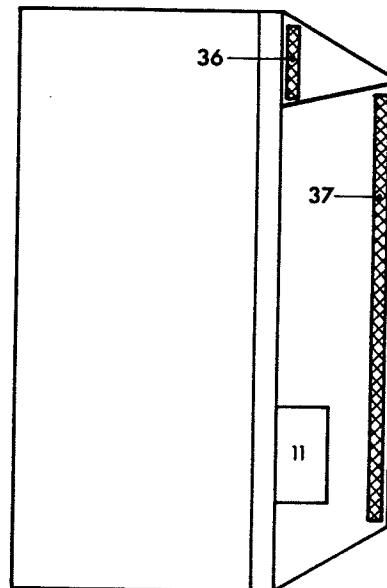
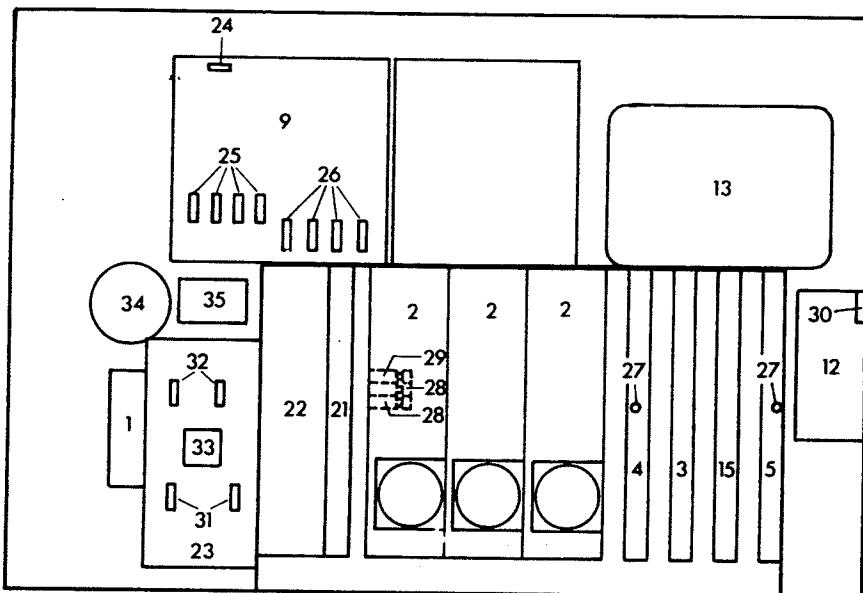
Pos.	Ref. No.	DIN		Benennung	Description	Designation
				Tür	Door	Porte
1	ZSR 79 0616	M6x16 DIN 7991-8.8		Senkschraube	Countersunk screw	Vis tête fraise
2	F1S 000 460			Deckblech	Gib	Lardon
3	F1S 000 240			Tür	Door	Porte
4	F1S 000 720			Führungskörper links	Guide block left	Saumon de guidage à gauche
5	ZSR 12 0670	M6x70 DIN 912-8.8		Zylinderschraube	Socket head screw	Vis 6 pans creux
6	ZSR 79 0620	M6x20 DIN 7991-8.8		Senkschraube	Countersunk screw	Vis tête fraise
7	F1S 000 660			Scheibe	Washer	Rondelle
8	A7Z 230 020			Distanzhülse	Spacer	Douille d'écartement
9	F1S 000 510			Griff	Handle	Poignée
10	F1S 000 570			Klemmstück	Clamping piece	Pièce de blocage
11	ZSR 12 0640	M6x40 DIN 912-6.9		Zylinderschraube	Socket head screw	Vis 6 pans creux
12	ZLF 03 9160			Führungsstange	Guide bar	Barre de guidage
13	F1S 000 520			Führungskörper rechts	Guide block right	Saumon de guidage à droite
14	F1S 000 630			Gelenkbolzen	Joint pin	Axe d'articulation
15	ZSB 21 0640	A6,4 DIN 9021		Scheibe	Washer	Rondelle
16	ZMU 34 0600	M6 DIN 934-6		Sechskantmutter	Hexagonal nut	Ecrou hexagonal
17	ZRG 71 0808	W8x0,8 DIN 471		Sicherungsring	Retaining ring	Anneau de retenue
18	ZMU 34 0400	M4 DIN 934-5		Sechskantmutter	Hexagonal nut	Ecrou hexagonal
19	ZEL 21 2030	ZS 231-My		Endschalter	Limit switch	Interrupteur fin de course
20	F1S 000 490			Einstellwinkel	Adjusting angle plate	Cornière d'ajustage
21	ZSR 84 0450	M4x50 DIN 84-4.8		Zylinderschraube	Flat head screw	Vis à tête cylindrique
22	ZEE 47 0231			Rollenhebel	Roller arm	Levier à galet
23	F1S 000 480			Endschalterschutz	Protection sheet	Tôle de protection
24	ZSR 88 0410	M4x10 - 10.9		Linsenschraube	Filister head screw	Vis à tête lentiforme
25	F1S 000 500			Schaltblech	Switch sheet	Tôle d'interrupteur
26	F1S 000 530			Lagerbolzen	Bolt	Boulon
27	ZLF 06 1160			Kugelbüchse	Bearing bush	Bague de palier
28	ZFD 30 0080			Gasfeder	Gas spring	Ressort de gaz
29	F1S 000 550			Firmenschild	Adhesive label	Etiquette
30	ZSB 25 0430	A4,3 DIN 125		Scheibe	Washer	Rondelle
31	F1S 000 770			Gummistreifen	Rubber strip	Bandette de gomme



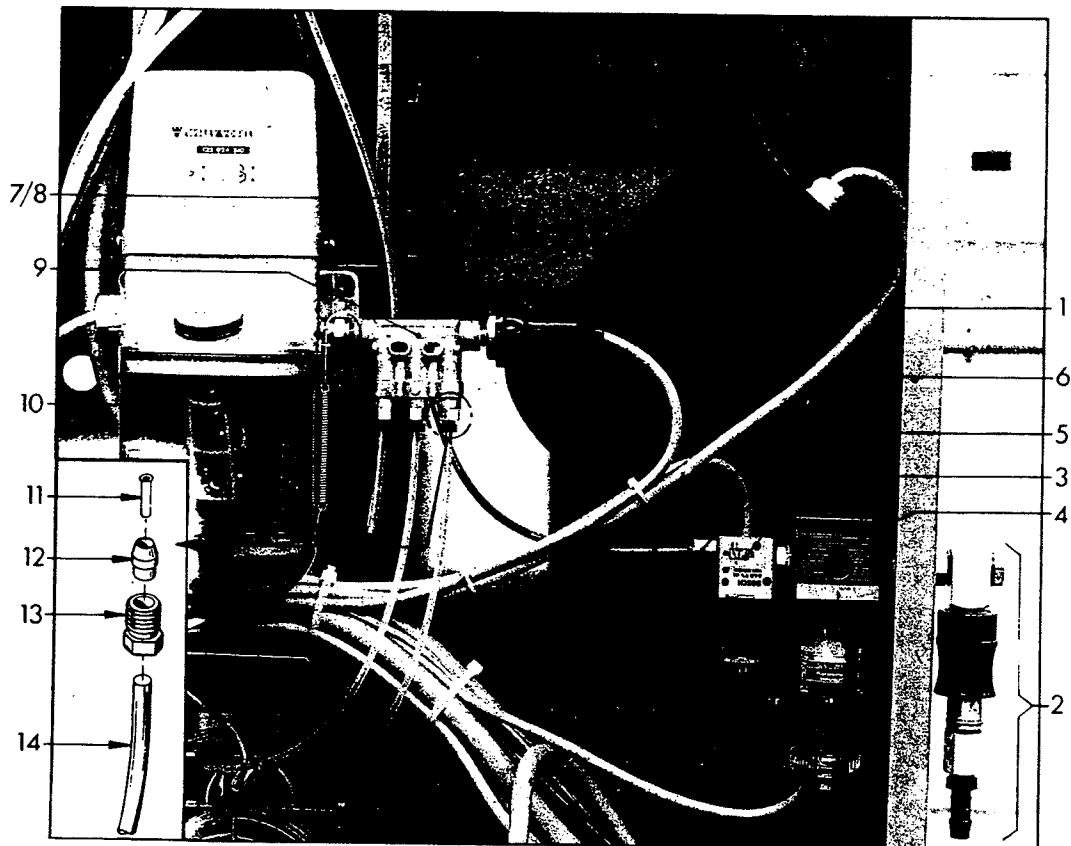
Pos.	Ref. No.	DIN		Benennung	Description	Designation
1	ZMU 34 0500	M5 DIN 934-5		Sechskantmutter	Hexagonal nut	Ecrou hexagonal
2	ZSR 12 0508	M5x8 DIN 912-6.9		Zylinderschraube	Socket head screw	Vis 6 pans creux
3	F1A 000 330			Rückwand 2	Back cover 2	Paroi arrière 2
4	F1S 060 000			Spänetasse	Chip tray	Plateau à copeaux
5	ZSR 12 1040	M10x40 DIN 912		Zylinderschraube	Socket head screw	Vis 6 pans creux
6	F1S 000 410			Spannleiste	Clamping gib	Lardon de serrage
7	ZSR 12 0420	M4x20 DIN 912		Zylinderschraube	Socket head screw	Vis 6 pans creux
8	A7A 000 421			Klemmleiste	Clamping gib	Lardon de blocage
9	F1S 000 590			Kabelschelle	Wire clamp	Collier de câble
10	ZSR 12 0412	M4x12 DIN 912		Zylinderschraube	Socket head screw	Vis 6 pans creux
11	F1A 000 292			Durchführungsblech	Sheet	Tôle de traverse
12	F1S 260 000			Abdeckung 2	Cover sheet 2	Couvercle 2
13	F1S 140 000			Verkleidungsblech 2	Side guard 2	Tôle d'habillage 2
14	ZSR G1 4295	B4,2x9,5 DIN 7981		Blechschorabe	Sheet metal screw	Vis à tôle
15	ZSB 21 0430	4,3 DIN 9021		Scheibe	Washer	Rondelle
16	F1S 000 640			Deckel	Cover	Couvercle
17	F1S 000 650			Kabelschacht	Cable sheet	Tôle de câble
18	ZSR 88 0410	M4x10-10.9		Linsenschraube	Filister head screw	Vis à tête lenticulaire
19	F1S 000 220			Seitenwand 2	Housing 2	Paroi latérale 2
20	F1S 000 470			Verbindungsblech	Compound sheet	Tôle de liaison
21	ZSR 88 0610	M6x10-10.9		Linsenschraube	Filister head screw	Vis à tête lenticulaire
22	ZMU 34 0600	M6 DIN 934-6		Sechskantmutter	Hexagonal nut	Ecrou hexagonal
23	F1S 000 230			Rückwand	Back cover	Paroi arrière
24	F1S 000 210			Seitenwand 1	Housing 1	Paroi latérale 1
25	A7A 000 490			Fensterscheibe	Window	Vitre
26	ZXM 01 2240			Schnappdurchführung	Ring	Traversée
27	F1S 250 000			Abdeckung 1	Cover sheet 1	Couvercle 1
28	F1S 130 000			Verkleidungsblech 1	Side guard 1	Tôle d'habillage 1
29	A7N 170 000			Untersatz	Base for electric box	Socle
30	A7N 400 010			Frontblech	Front sheet	Tôle frontale
31	A7N 400 020			Abdeckblech	Cover sheet	Tôle de protection
32	A7N 400 030			Schellenblech	Cover sheet	Tôle de protection
33	ZSB 21 0840	8,4 DIN 9021		Scheibe	Washer	Rondelle
34	ZSR 12 0820	M8x20 DIN 912-8.8		Zylinderschraube	Socket head screw	Vis à tête cylindrique



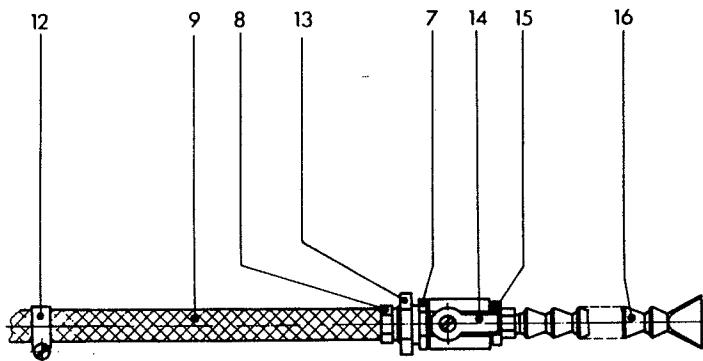
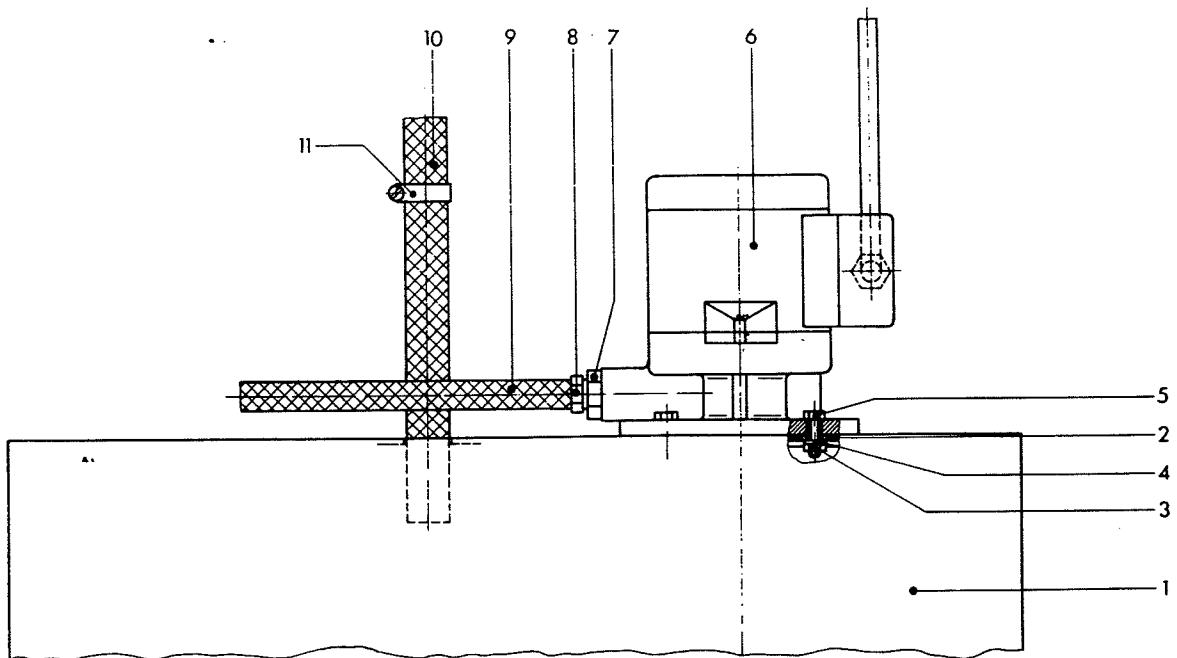
Pos.	Ref. No.	DIN		Benennung	Description	Designation
1-10	F1V 501 000			<u>Motor komplett</u>	<u>Motor compl.</u>	<u>Ens. moteur</u>
1	ZMO 78 1310			Motor	Motor	Moteur
2	F1S 420 000			Kabelschutz	Cover sheet	Tôle de protection
3	ZSR 12 0517	M5x16 DIN 912		Zylinderschraube	Socket head screw	Vis 6 pans creux
4	ZSR 12 0310	M3x10 DIN 912		Zylinderschraube	Socket head screw	Vis 6 pans creux
5	ZME 200 295			Kohlebürste	Carbon brush	Balai charbon
6	ZSR 120 508	M5x8 DIN 912-6.9		Zylinderschraube	Socket head screw	Vis 6 pans creux
7	F1S 410 011			Trägerblech	Support plate	Plaque support
8	F1V 502 000			Drehgeber	Encoder	Capteur rotatif
9	ZSR 12 0410	M4x10 DIN 912		Zylinderschraube	Socket head screw	Vis 6 pans creux
10	A7N 511 000			Näherungsschalter	Proximity detector	Initiateur inductif
11	ZSR 12 0612	M6x12 DIN 912-8.8		Zylinderschraube	Socket head screw	Vis 6 pans creux
12	F1P 090 000			Motorriemenscheibe	Motor pulley	Poulie de moteur
13	ZST 16 06 08	M6x8 DIN 916		Gewindestift	Set screw	Vis d'arrêt
14	ZRM 51 3140	140 XL 075		Zahnriemen	Timing belt	Courroie crantée
15	ZRG 28 0060	B6 DIN 127		Federring	Spring washer	Rondelle-ressort
16	ZMU 34 0600	M6 DIN 934-6		Sechskantmutter	Hexagonal nut	Ecrou hexagonal
17	ZSB 98 0850			Fächerscheibe	Serrated lock washer	Rondelle éventail
18	F1S 501 060			Profilleiste	Profile ledge	Barre profilé
19	ZGU 14 0006			Gummistreifen	Rubber strip	Band de caoutchouc
20	ZSR M3 0506	M5x6		Linsenschraube	Filister head screw	Vis à tête lenticulaire



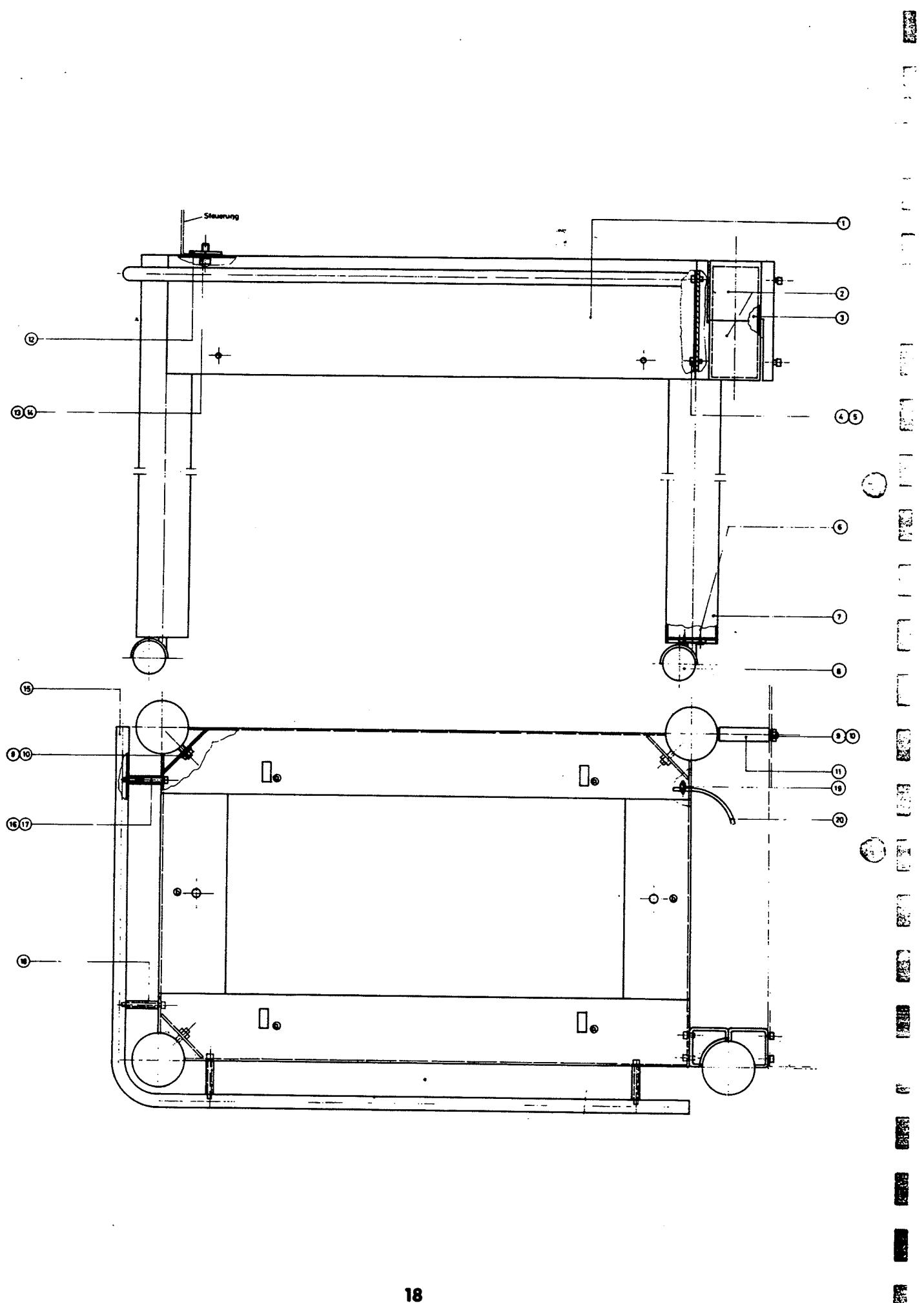
Pos.	Ref. No.	DIN		Benennung	Description	Designation
1	ZET 00 0640			Trafo 100-400 V.	Trafo 100-400 V	Transformateur 100-400 V
2	R3D 413 001			Schrittmotorkarte	Stepper motor board	Carte de moteur pas à pas
3	R3D 414 001			Axis Controller Karte	Axis controller board	Carte de contrôleur d'axe
4	R3D 415 001			Data Controller Karte	Data controller board	Carte de contrôleur de données
5	R3D 425 001			Maschineninterface	Machine interface	Interface de machine
6	ZEL 40 0002			Not-Aus-Schalter	Emergency off switch	Coup-de-poing d'arrêt d'urgence
7	R3D 428 001			Achsbusprint	Axisbus board	Plaquette du bus des axes
8	R3D 429 001			Rechnerbusprint	CPU-bus board	Plaquette du bus du processeur
9	A7B 418 000			Motortreiberkarte	Motor drive board	Carte de l'amplificateur du moteur
10	ZET 04 0010	EI 150 NZ		Trenntrafo	Transformer	Transformateur séparateur
11	ZMO 78 9220			Ventilator	Fan	Ventilateur
12a	R3D 436 001			Netzteil mit Rack	Power Supply with Rack	Alimentation avec rack
12b	R3D 438 000			Netzteil ohne Rack	Power Supply without R	Alimentation sans rack
13	ZEM 10 0901			Monitor	Monitor	Moniteur
14	ZEG 21 1127			Brückengleichrichter	Rectifier	Redresseur de pont
15	Y1A 610 000			Interfacecontroller	Interface board	Carte d'interface
16	ZES 04 1200			Hauptschalter	Main switch	Interrupteur principal
17	ZEG 01 0010			Tastatur 1	Keyboard 1	Clavier 1
18	R3D 422 001			Overrideschalter mit Platine	Override switch with board	Interrupteur d'intervention sur l'avance avec platine
19	ZEG 01 0020			Tastatur 2	Keyboard 2	Clavier 2
20	ZET 30 0001			Recorder Mini DCR mit Platine	Tape recorder with board	Enregistreur de bande avec platine
				Version 1	Version 2	
21	F1V 409 000			Transistorsteller - Reglerkarte	Transistor adjuster - controller pcb	Actuateur à transistor - carte de régulation
22	F1V 470 000			Transistorsteller - Leistungsteil	Transistor adjuster - power stage	Actuateur à transistor - étage de puissance
23	F1V 442 000	—		Transistorsteller - Netzteil (Versorgung)	Transistor adjuster - power supply unit	Actuateur à transistor - alimentation
24	ZEE 75 0011	4A slow 5x20		Glasrohrsicherung	Glass-tube fuse	Fusible à tube de verre
25	ZEE 75 0034	5A slow 6,3x32		Glasrohrsicherung	Glass-tube fuse	Fusible à tube de verre
26	ZEE 75 0042	2,5A superf. 6,3x32		Glasrohrsicherung	Glass-tube fuse	Fusible à tube de verre
27	ZEE 75 0037	4A fast 6,3x32		Glasrohrsicherung	Glass-tube fuse	Fusible à tube de verre
28	ZEE 75 0013	6,3A slow 5x20		Glasrohrsicherung	Glass-tube fuse	Fusible à tube de verre
29	ZEE 75 0014	1A slow 5x20		Glasrohrsicherung	Glass-tube fuse	Fusible à tube de verre
30	ZME 290 617	1,6A 5x20		Glasrohrsicherung	Glass-tube fuse	Fusible à tube de verre
31	ZEE 75 0038	16A superf. 6,3x32		Glasrohrsicherung	Glass-tube fuse	Fusible à tube de verre
32	ZEE 75 0041	16A slow 6,3x32		Glasrohrsicherung	Glass-tube fuse	Fusible à tube de verre
33	ZER 82 0225			Relais	Relay	Relais
34	ZKO 06 5228			Kondensator	Condenser	Condensateur
35	ZEL 53 1006			Schütz	Relay	Relais
36	Y1A 210 040			Abluftfilter	Air filter	Filtre d'air
37	Y1A 210 050			Zuluftfilter	Air filter	Filtre d'air



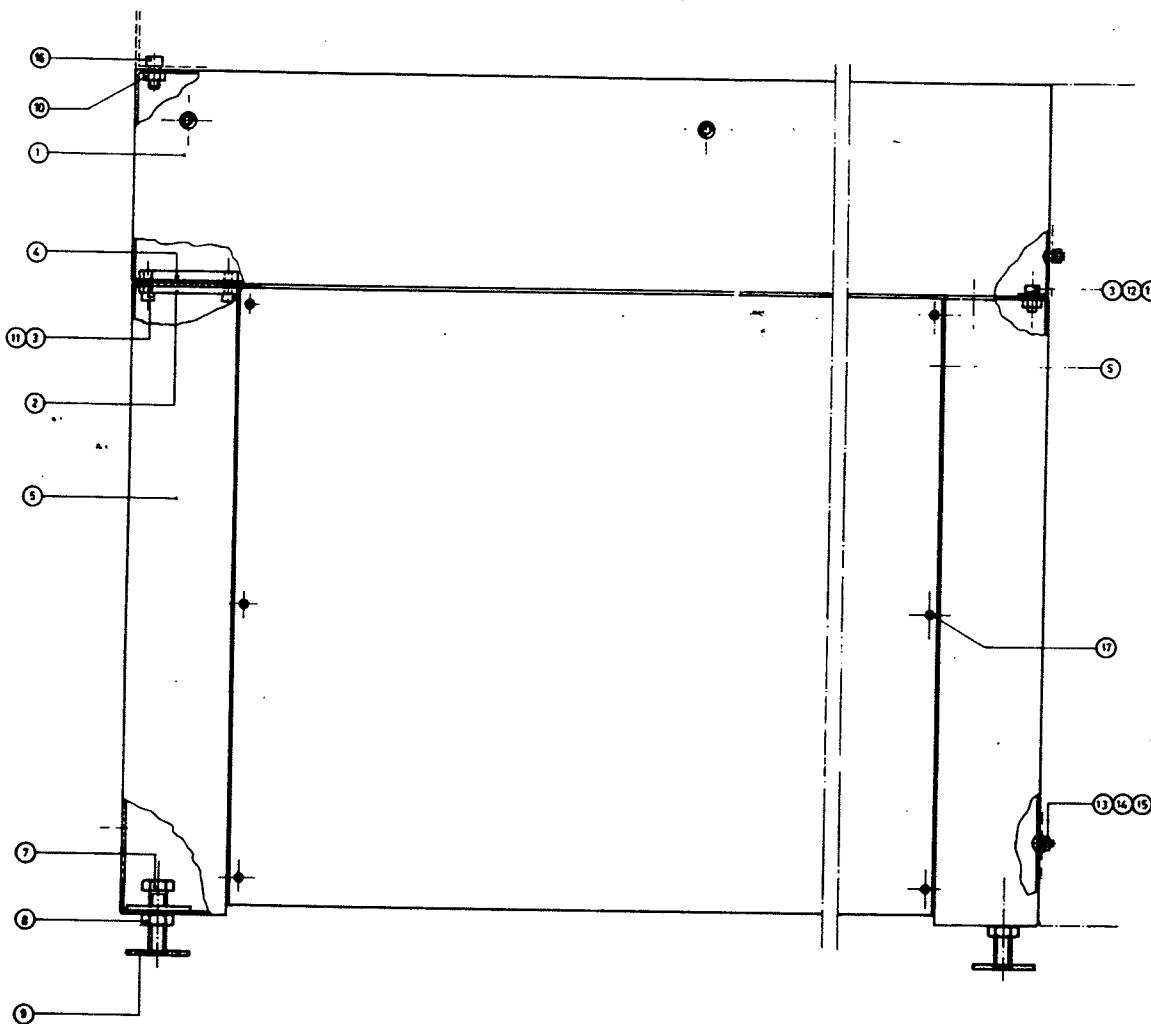
Pos.	Ref. No.	DIN		Benennung	Description	Designation
1	ZEE 53 0060	R 63; 60 W		Glühbirne	Lamp	Ampoule
2-5	FIS 270 000			<u>Ausblasvorrichtung</u>	<u>Pneumatic equipment</u>	<u>Equipement pneumatique</u>
2	ZME 200 401	0 820 405 001		Handschiebeventil kompl	Slide-type valve compl	Ens. robinet à souape
3	ZME 200 460	0 820 019 301		3/2 Wegventil	3/2 valve	3/2 soupape
4	ZME 200 461	0 821 303 400		Filter	Filter	Filtre
5	ZVR 09 0010	1 823 373 010		Verschraubung	Hose fitting	Raccord de tuyau
6	ZLT 99 0059	1700 mm		Kunststoffrohr	Hose	Tuyau flexible
7-14		"		<u>Schmieranlage</u>	<u>Lubrication attachment</u>	<u>Dispositif de graissage</u>
7	ZVE 20 0007	...		Druckschalter	Pressure switch	Initiateur de pression
8	ZVE 20 0008			Gummischutzkappe	Protective cover	Protection en caoutchouc
9	ZVE 20 0100			Kolbenverteiler	Distribution device	Distributeur
10	ZVE 20 0018			Pumpe	Pump	Pompe
11	ZVE 20 0014			Einsteckhülse	Hollow shaft	Arbre creux
12	ZVE 20 0013			Kegelring	Taper ring	Bague conique
13	ZVE 20 0012			Überwurfschraube	Union screw	Vis raccord
14	ZLT 30 0070	1900 mm		Kunststoffrohr	Hose	Tuyau flexible



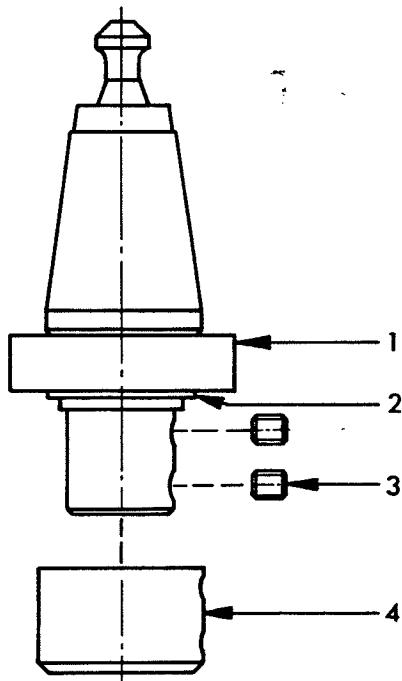
Pos.	Ref. No.	DIN		Benennung	Description	Designation
	<u>770 600</u>			Kühlmitteleinrichtung	Coolant attachment	Dispositif d'arrosage
1	A7Z 601 000			Kühlmittelbehälter	Coolant reservoir	Réservoir du liquide
2	A7Z 600 010			Deckel	Cover	Couvercle
3	ZMU 34 0600	M6 DIN 934-6		Sechskantmutter	Hexagonal nut	Ecrou hexagonal
4	ZSB 98 0640	A6,4 DIN 6798		Fächerscheibe	Washer	Rondelle
5	ZSR 33 0620	M6x20 DIN 933-5.6		Sechskantschraube	Hexagon head screw	Vis hexagonal
6	ZVE 21 0118	EKP 117		Pumpe	Pump	Pompe
7	ZVR 21 1238	R 1/2"A-R 3/8"I		Reduzierung	Adapter	Pièce de réduction
8	ZVR 20 1380	GES 10-R 3/8"		Einschraubstutzen	Pip coupling	Manchon taraudé
9	ZLT 30 0031	10x2,7 1500 mm		Schlauch	Hose	Tuyau flexible
10	ZLT 30 0036	16x3,3 1100 mm		Schlauch	Hose	Tuyau flexible
11	ZLT 60 0010	026/9V		Schlauchklemme	Hose fitting	Raccord du tuyauterie
12	ZLT 60 0030	019/9V		Schlauchklemme	Hose fitting	Raccord du tuyauterie
13	ZMU 90 0120	R 1/2 252J		Sechskantmutter	Hexagonal nut	Ecrou hexagonal
14	ZVE 20 1031	R 3/8"		Kugelhahn + Drehgriff	Plug valve	Robinet à tournant
15	ZVR 21 3814	R 3/8"A - R 1/4"I		Reduzierung	Adapter	Pièce de réduction
16	ZLT 29 2250	R 1/4"		Kühlmittelschlauch	Hose	Tuyau flexible



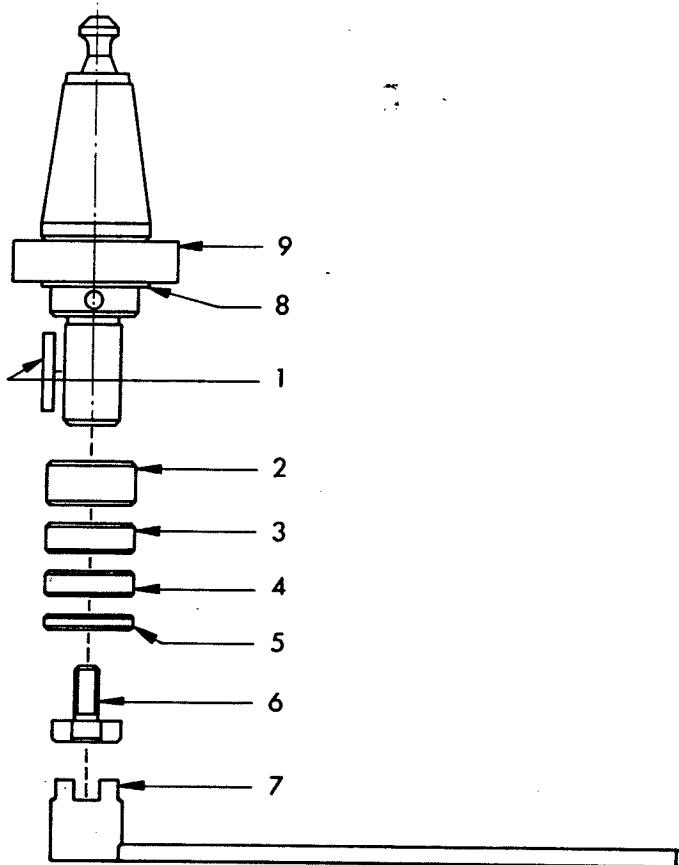
Pos.	Ref. No.	DIN		Benennung	Description	Designation
	270 230			Steuerungsundersatz komplett	Control base complete	Socle de commande complet
1	A7Z 231 000			Tisch	Table	Table
2	A7Z 233 000			Gelenkhälften	Joint	Joint
3	A7Z 230 040			Rohr	Tube	Tube
4	ZSR 12 0612	M6x12 DIN 912-8.8		Zylinderschraube	Socket head screw	Vis 6 pans creux
5	ZRG 28 0060	86 DIN 127		Federring	Spring washer	Rondelle ressort
6	ZSR G1 4213	B4,2x13		Blechschraube	Metal sheet screw	Vis à tôle
7	A7Z 232 000			Fuß	Leg	Pied
8	ZRD 03 1010			Rolle	Wheel	Roue
9	ZMU 34 0800	M8 DIN 934-6		Sechskantmutter	Hexagonal nut	Ecrou hexagonal
10	ZRG 28 0080	88 DIN 127		Federring	Spring washer	Rondelle ressort
11	A7Z 230 050			Anschlag	Stop	Butée
12	A7Z 230 030			Klemmplatte	Locking gib	Lardon de blocage
13	ZSR 12 1020	M10x20 DIN 912-8.8		Zylinderschraube	Socket head bolt	Vis 6 pans creux
14	ZSB 25 1050	B10,5 DIN 125		Scheibe	Washer	Rondelle
15	A7Z 230 010			Griff	Grip	Poignée
16	ZSR 12 0660	M6x60 DIN 912-6.9		Zylinderschraube	Socket head screw	Vis 6 pans creux
17	ZSB 25 0640	86,4 DIN 125		Scheibe	Washer	Rondelle
18	A7Z 230 020			Distanzhülse	Spacer	Bouille d'écartement
19	ZLT 65 0065			Seilklemme	Rope clamp	Borne
20	ZLT 99 1001			Leine 1 m	Rope	Corde



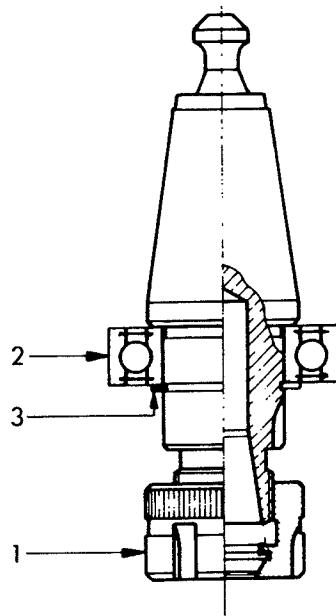
Pos.	Ref. No.	DIN	Benennung	Description	Designation
	<u>270 220</u>		<u>Maschinenuntersatz kom.</u>	<u>Machine base compl.</u>	<u>Ens. socle de la machine</u>
1	A7Z 222 000		Deckplatte	Cover plate	Couvercle
2	A7Z 220 010		Versteifung	Reinforcement	Pièce de renforcement
3	ZSR 12 0820	M8x20 DIN 912-8.8	Zylinderschraube	Socket head screw	Vis 6 pans creux
4	A7Z 220 070		Mutterstück	Nut piece	Pièce d'écrou
5	A7Z 221 000		Ständerfuß	Table leg	Pied
6	A7Z 320 010		Frontblech	Front sheet	Tôle de front
7	ZSR 34 1660	M16x60 DIN 933-8.8	Sechskantschraube	Hexagon head screw	Vis hexagonal
8	ZMU 34 1680	M16 DIN 934-8	Sechskantmutter	Hexagonal nut	Ecrou hexagonal
9	A7Z 220 060		Auflage	Base plate	Base
10	ZMU 34 1000	M10 DIN 934-8	Sechskantmutter	Hexagonal nut	Ecrou hexagonal
11	ZRG 28 0080	B8 DIN 127	Federring	Spring washer	Rondelle ressort
12	ZMU 34 0800	M8 DIN 934-6	Sechskantmutter	Hexagonal nut	Ecrou hexagonal
13	ZSR 88 0616	M6x16-10.9	Linsenschraube	Filister head screw	Vis à tête lenticulaire
14	ZMU 34 0600	M6 DIN 934-6	Sechskantmutter	Hexagonal nut	Ecrou hexagonal
15	ZSB 25 0640	B6,4 DIN 125	Scheibe	Washer	Rondelle
16	ZSR 12 1020	M10x20 DIN 912-8.8	Zylinderschraube	Socket head screw	Vis 6 pans creux
17	ZSR G1 4213	B4,2x13	Blechschaube	Sheet metal screw	Vis à tôle



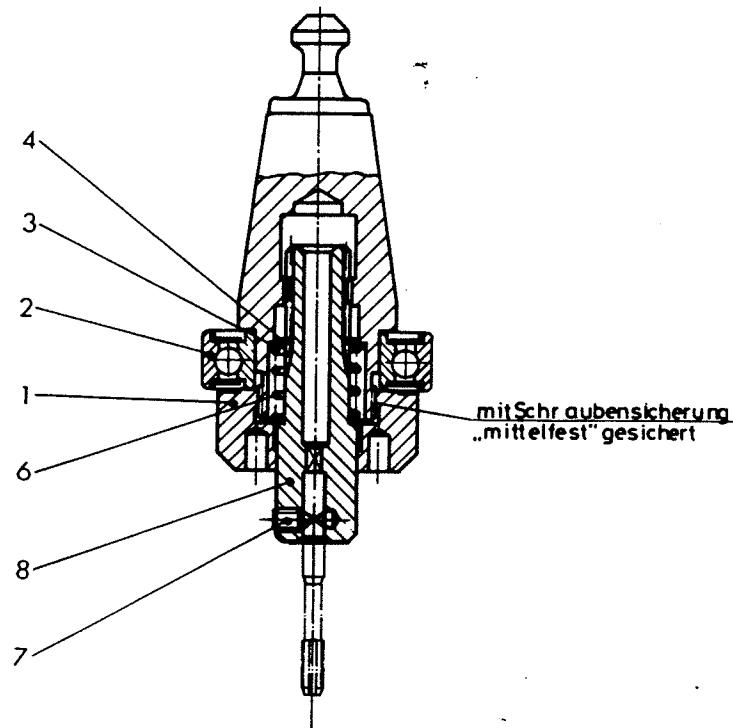
Pos.	Ref. No.	DIN		Benennung	Description	Designation
	<u>770 850</u>			<u>Fräseraufnahme 16 mm Ø</u>	<u>Milling cutter holder 16 mm dia.</u>	<u>Mandrin porte-fraise 16 mm Ø</u>
1	ZLG 60 0502	6005-2Z		Rillenkugellager	Ball bearing	Roulement à billes
2	ZRG 71 2512	W25x1,2 DIN 471		Sicherungsring	Retaining ring	Anneau de retenue
3	ZST 13 0608	M6x8 DIN 913		Gewindestift	Set screw	Vis pointeau
4	F1Z 850 020			Klemmring	Clamping ring	Bague de blocage
	<u>770 830</u>			<u>Fräseraufnahme 10 mm Ø</u>	<u>Milling cutter holder 10 mm dia.</u>	<u>Mandrin porte-fraise 10 mm Ø</u>
	<u>770 840</u>			<u>Fräseraufnahme 12 mm Ø</u>	<u>Milling cutter holder 12 mm dia.</u>	<u>Mandrin porte-fraise 12 mm Ø</u>
1	ZLG 60 0502			Rillenkugellager	Ball bearing	Roulement à billes
2	ZRG 71 2512			Sicherungsring	Retaining ring	Anneau de retenue
3	ZST 13 0606	M6x6 DIN 913		Gewindestift	Set screw	Vis pointeau



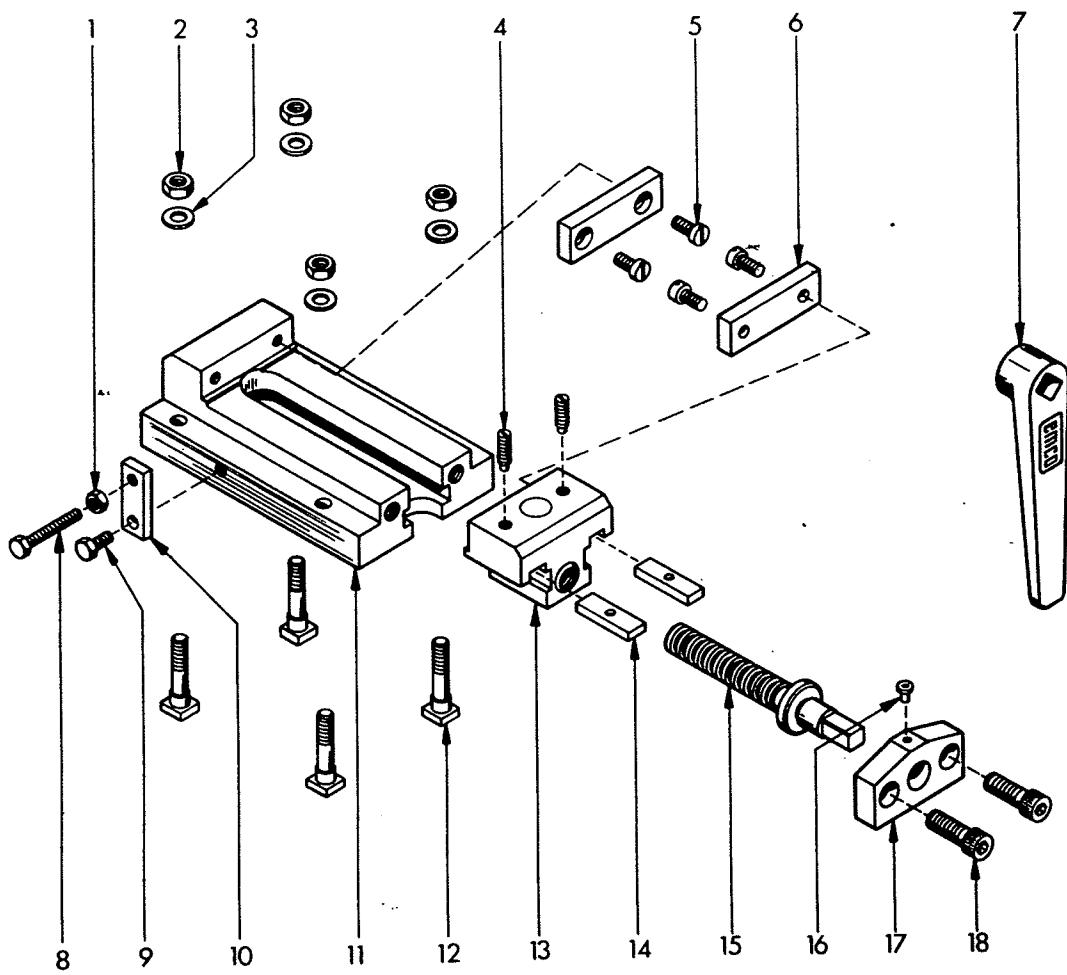
Pos.	Ref. No.	DIN		Benennung	Description	Designation
	770 860			Aufsteckfräsdorn	Shell end mill arbor	Mandrin porte-fraise
1	ZFD 85 4422	A4x4x22 DIN 6885		Paßfeder	Square key	Clavette
2	F1Z 020 050			Fräsdornring 12 mm	Collar 12 mm	Bague de porte-fraise 12 mm
3	F1Z 020 040			Fräsdornring 8 mm	Collar 8 mm	Bague de porte-fraise 8 mm
4	F1Z 020 030			Fräsdornring 6 mm	Collar 6 mm	Bague de porte-fraise 6 mm
5	F1Z 020 020			Fräsdornring 4 mm	Collar 4 mm	Bague de porte-fraise 4 mm
6	ZSR 67 0800	M8 DIN 6367		Schraube	Screw	Vis
7	ZWZ 58 1600	16 DIN 6368		Schlüssel	Key	Clef
8	ZRG 71 2512	W25x1,2 DIN 471		Sicherungsring	Retaining ring	Anneau de retenue
9	ZLG 60 0502	6005-2Z		Rillenkugellager	Ball bearing	Roulement à billes



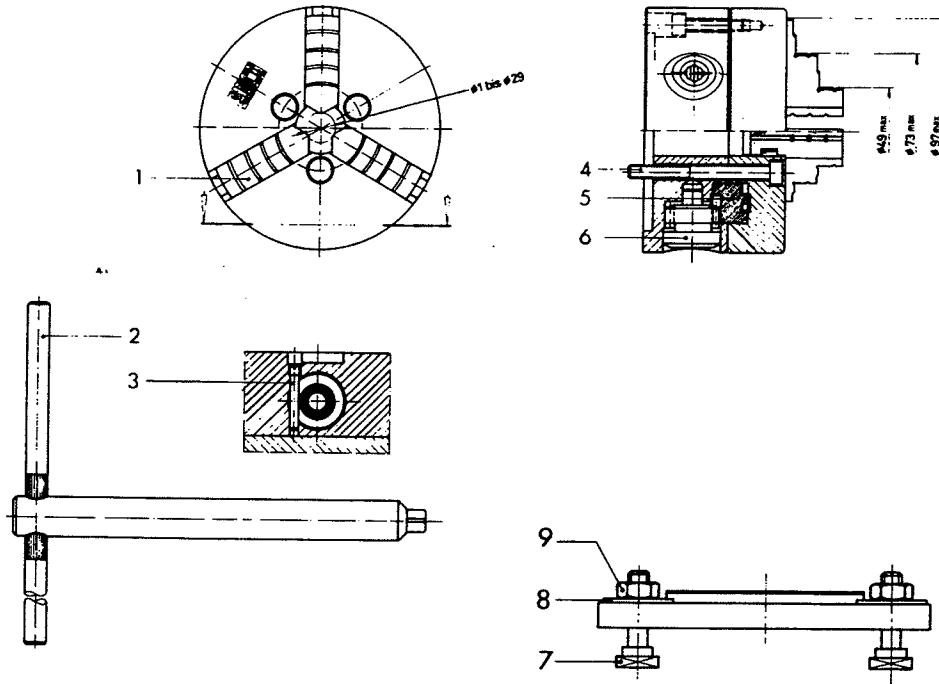
Pos.	Ref. No.	DIN		Benennung	Description	Designation
	<u>770 910</u>			<u>Spannzangenhalter für Spannzangen ESX 16</u>	<u>Collet holder for collets ESX 16</u>	<u>Porte-pince pour pinces ESX 16</u>
1	F1Z 910 020			Spannmutter	Nut	Ecrou de serrage
2	ZLG 60 0502	6005-2Z		Rillenkugellager	Ball bearing	Roulement à billes
3	ZRG 71 2512	W25x1,2 DIN 471		Sicherungsring	Retaining ring	Anneau de retenue
	ZWZ 97 2528			Hakenschlüssel klein	Spanner small	Clef à griffes, petit
	ZWZ 97 3032			Hakenschlüssel groß	Spanner large	Clef à griffes, grand



Pos.	Ref. No.	DIN		Benennung	Description	Designation
	<u>770 870</u>			<u>Gr. Gewindebohrerhalter M3</u>	<u>Tap holder M3 compl.</u>	<u>Ens. porte-taraud M3</u>
	<u>770 880</u>			<u>Gr. Gewindebohrerhalter M4</u>	<u>Tap holder M4 compl.</u>	<u>Ens. porte-taraud M4</u>
	<u>770 890</u>			<u>Gr. Gewindebohrerhalter M5-M8</u>	<u>Tap holder M5-M8 compl.</u>	<u>Ens. porte-taraud M5-M8</u>
1	F1Z 870 030			Ringmutter	Nut	Ecrou
2	ZLG 600 „502	6005-2Z		Rillenkugellager	Ball bearing	Roulement à billes
3	ZSB 121 310	13x19x1		Paßscheibe	Shim ring	Rondelle
4	ZRG 121 310			V-Ring	V-ring	Bague-V
6	ZFD 214 181	D-180 Y-01		Druckfeder	Compression spring	Ressort de pression
7	ZST 130 506	M5x6 DIN 913-45H		Gewindestift	Set screw	Vis pointeau
8	F1Z 870 020			Aufnahme M3	Tap holder M3	Porte-taraud M3
	F1Z 880 010			Aufnahme M4	Tap holder M4	Porte-taraud M4
	F1Z 890 010			Aufnahme M5-M8	Tap holder M5-M8	Porte-taraud M5-M8



Pos.	Ref. No.	DIN		Benennung	Description
	<u>770 310</u>			<u>Maschinenschraubstock</u>	<u>Machine vice</u>
1	ZMU 34 0600	M6 DIN 934-6		Sechskantmutter	Hexagonal nut
2	ZMU 34 0800	M8 DIN 934-6		Sechskantmutter	Hexagonal nut
3	ZSB 25 0840	8,4 DIN 125		Scheibe	Washer
4	ZST 17 0515	M5x15 DIN 417-5.8		Gewindestift	Set screw
5	ZSR 84 0512	M5x12 DIN 84-4.8		Zylinderschraube	Flat head screw
6	B2Z 310 050			Aufsatzbacke	Jaw
7	B2Z 310 080	SW10		Schlüssel	Key
8	ZSR 33 0640	M6x40 DIN 933-5.6		Sechskantschraube	Hexagon head bolt
9	ZSR 33 0612	M6x12 DIN 933-5.6		Sechskantschraube	Hexagon head screw
10	F1Z 310 030			Anschlagplatte	Stop plate
11	F1Z 310 010			Körper	Body
12	F1Z 310 020			Nutenschraube	T-bolt
13	B2Z 310 020			Backe	Moving jaw
14	B2Z 310 060			Einstelleiste	Adjusting gib
15	B2Z 310 040			Spindel	Operating screw
16	ZNP 01 1000			Schmiernippel	Grease nipple
17	B2Z 310 030			Spindelträger	Screw mount
18	ZSR 12 0825	M8x25 DIN 912-8.8		Zylinderschraube	Socket head screw



Pos.	Ref. No.	DIN		Benennung	Description	Designation
	V4W 186			3-Backen-Drehfutter Ø 85 mm	3-jaw lathe chuck dia. 85 mm	Mandrin de tournage à 3 mors, Ø 85 mm
1	ZME 31 0943			Satz von 3 nach außen abgestuften Backen	Set of 3 inside jaws	Jeu de 3 mors intérieurs
	ZME 31 0953			Satz von 3 nach innen abgestuften Backen	Set of 3 outside jaws	Jeu de 3 mors extérieurs
2	VOW 001 000			Schlüssel	Key	Clef
3	VOA 000 060			Sicherungsschraube	Securing screw	Vis de sûreté
4	ZSR 12 0551	M5x50 DIN 912		Zylinderschraube	Socket head screw	Vis 6 pans creux
5	V2U 000 020			Zahnkranz	Scroll	Couronne
6	VOA 000 030			Triebpling	Pinion	Pignon
	770 800			Zwischenflansch 85	Intermediate flange 85	Flasque intermédiaire 85
7	C4Z 030 020			Nutenschraube	T-nut screw	Boulon en T
8	ZSB 25 0840	B8,4 DIN 125		Scheibe	Washer	Rondelle
9	ZMU 34 0800	M8 DIN 934-6		Sechskantmutter	Hexagonal nut	Ecrou hexagonal