Instruction Book
VMC 100
with Emcotronic TM02

Instruction Book
VMC 100

Ref.-No. EN 7750   **Edition 90-10**

emco
innovative machine tools

INDEX

Chapter A: General

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

Chapter C: Description of Machine

Chapter D: Working with the machine

Chapter E: Technological Data

Chapter F: VMC-100 Accessories

Chapter G: Maintenance

Chapter H: Expansions

Chapter I: List of wearing parts

Chapter J: Readjustment works

Chapter A

General

General

1. Safety recommendations
Instructions

* Chip removal may be carried out only with the machine switched off.

* All claims under the gurantee become null and void if you intervere 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
Slide path, transverse (Y)	95 mm
Slide path, vertical (Z)	200 mm
Workpiece dimension (LxWxH)	190x100x60 mm
Useful Z-stroke for working	100 mm
Distance spindle nose - table surface	95 - 195 mm

MILLING TABLE

Clamping surface ((LxW)	425x125 mm
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	3/3/3 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
Machine weight .... approx. 300 kg

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 ⎱ in preperation
M26	Closing clamping device ⎰
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!

A6

Group structure and initial status of the G-functions

Group		
Group 0	*	G00: Rapid traverse G01: Linear interpolation G02: Circular interpolation clockwise G03: Circular interpolation counterclockwise 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 μm/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	▭ ▭	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 blockwise
**   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	▭ ▭	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
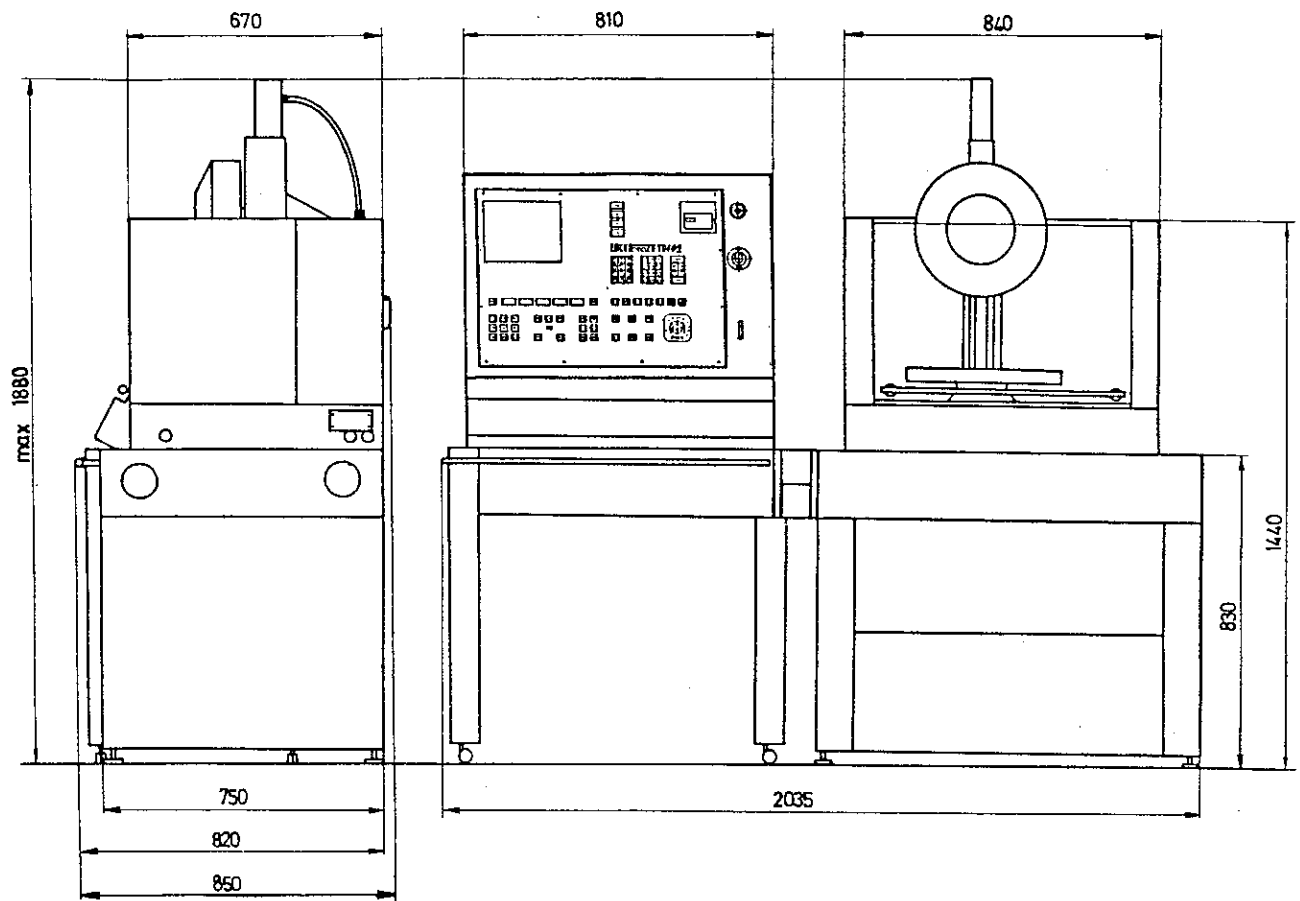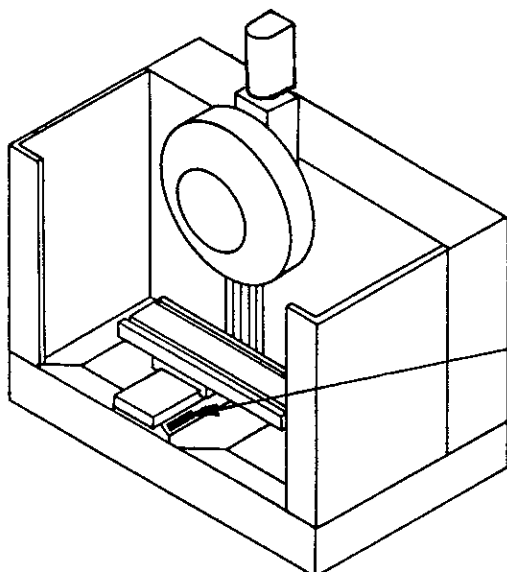
670   810   840

max 1880

1440

830

750

2035

820

850

Machine number
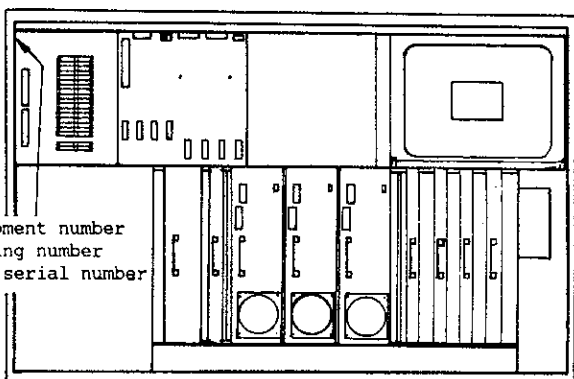
El-Equipment number
El-Housing number
Control serial number

Scope of delivay 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

General instructions:

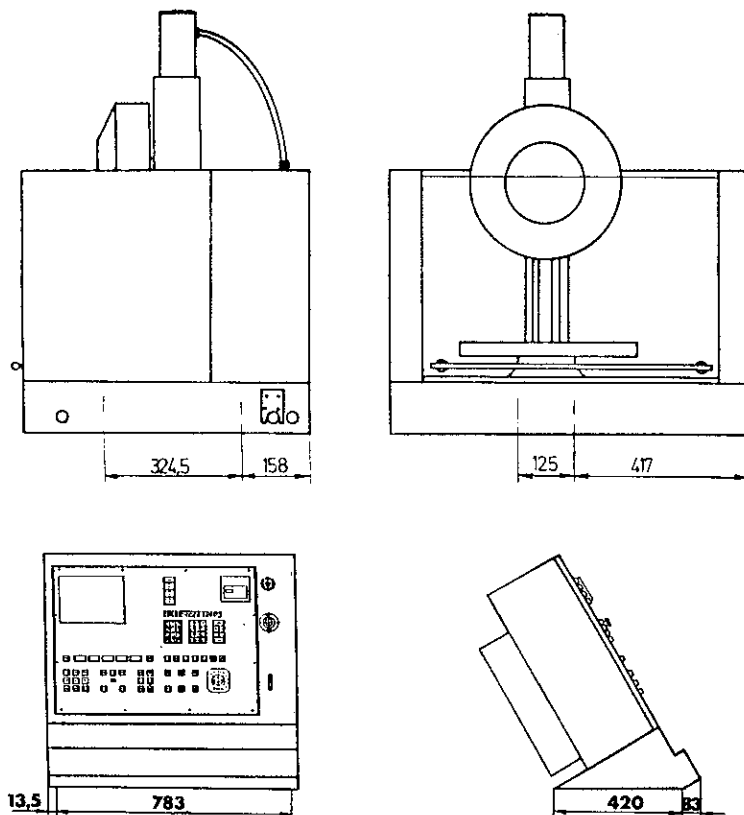### 1. Unpacking machine and control unit

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
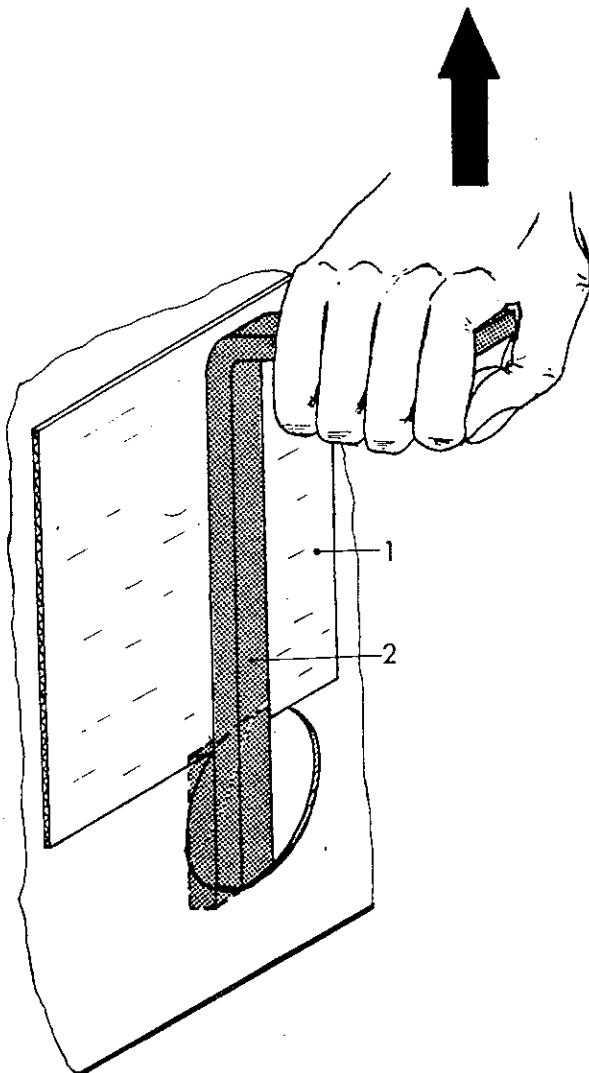
Control:
Approx. weight 127 kg

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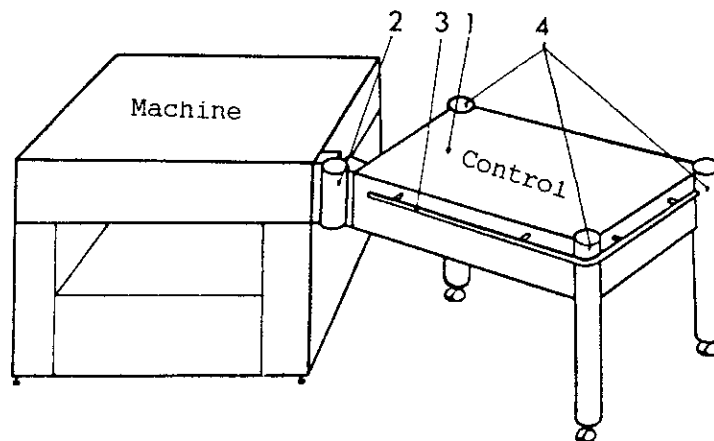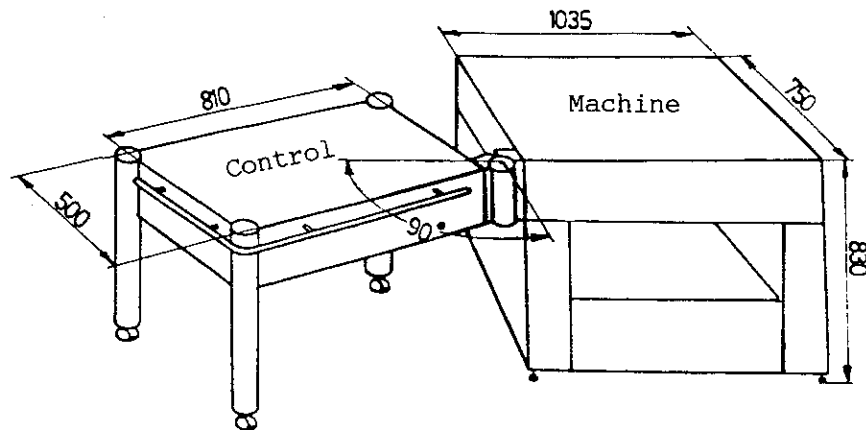
The stand for the control(1) can be mounted to the left or to the right side of the machine stand.
The joint(2), the handle(3) and the legs(4) have to be mounted in the correct way.

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.
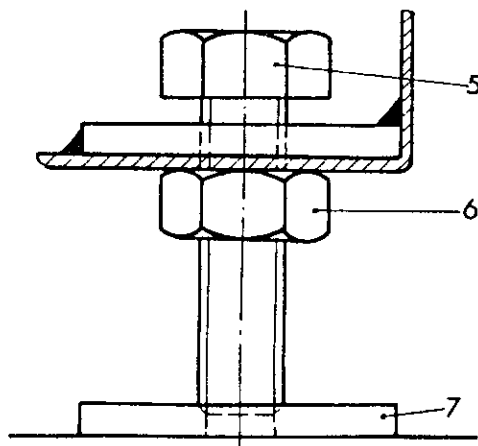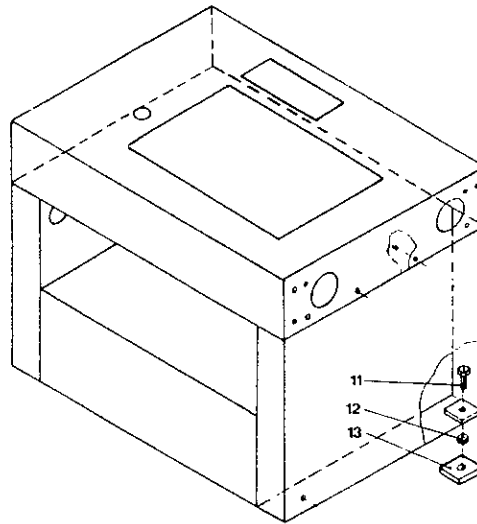
Adjusting the Height of the Machine Stand

- 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 0,5° 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!)
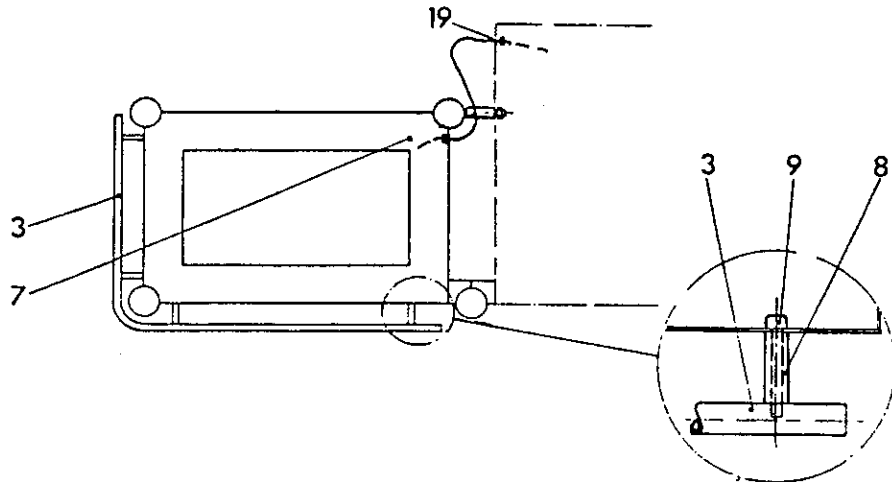
4) Attach joint half (4) in such a way that the closed side
   is on the top. Do not screw tight yet (with
   spring washers B6 and socket head cap screws M6 x 12).

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°)
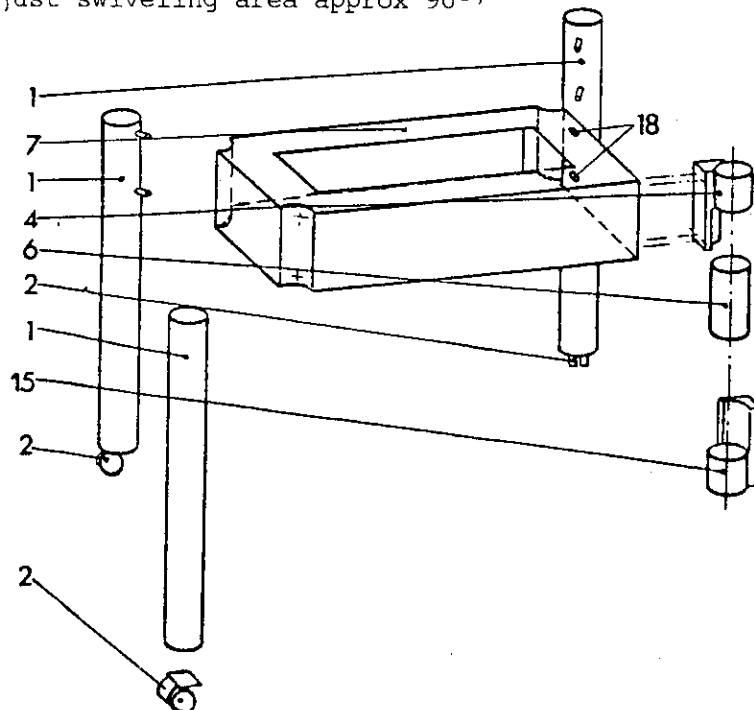
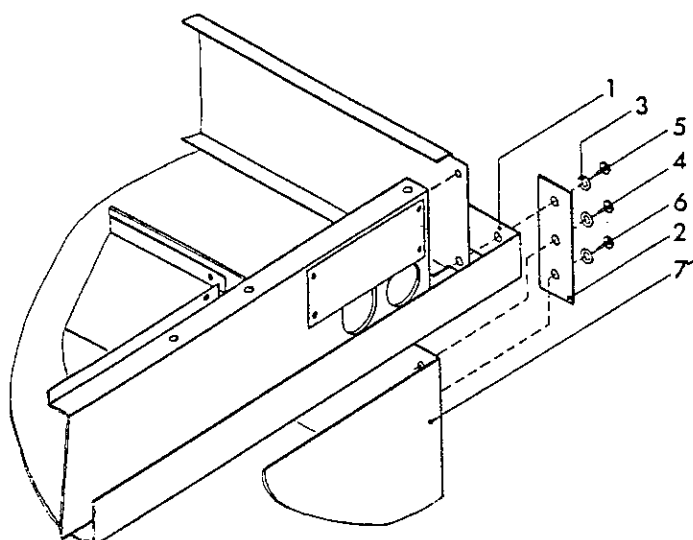# 4. Fastening of machine and control:
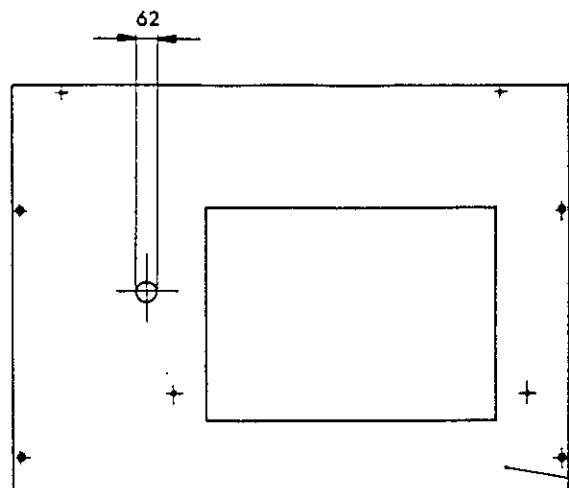
Machine:
For the sealing of the machine against the coolant fluid, a coolant tank (1) is used.

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).
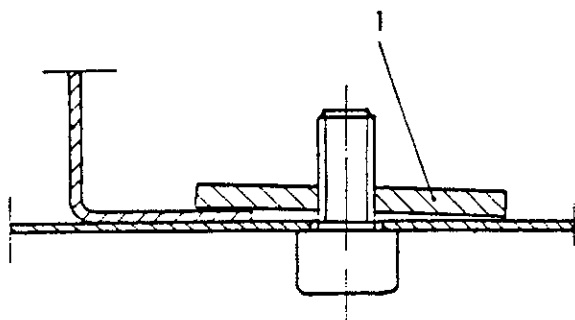● If not existing, there have to be drilled four bores dia. 3,5 mm in the machine base.
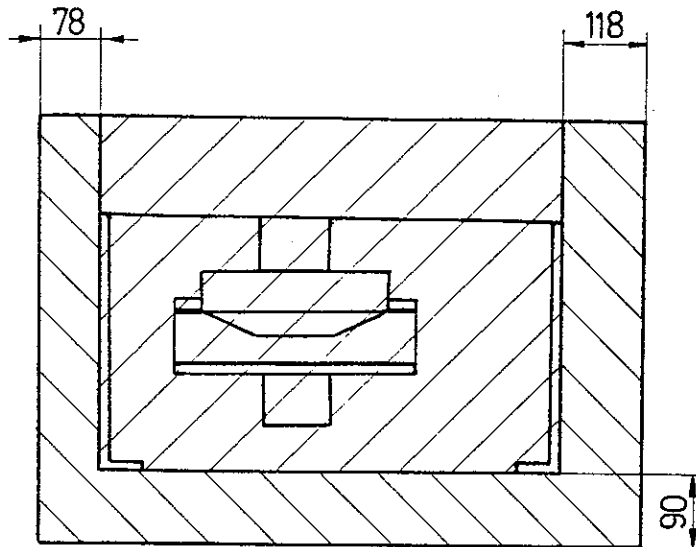● Screw in the sheet metal screws (6 and 4) with the washers (3).
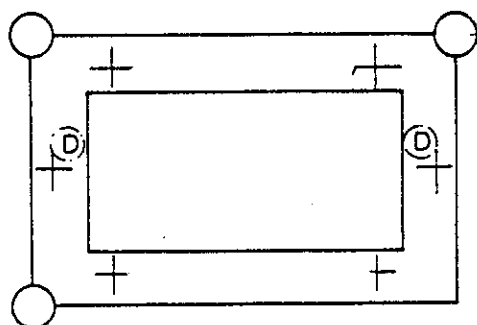
Control:
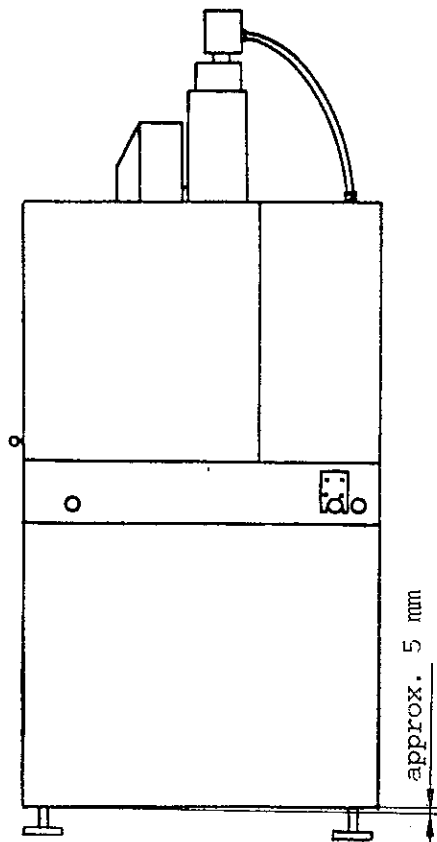VMC-100: D (2 x with clamping plate)

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° (= approx. 5 mm)
forward to ensure complete
discharge of the coolant
(0.5° 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.

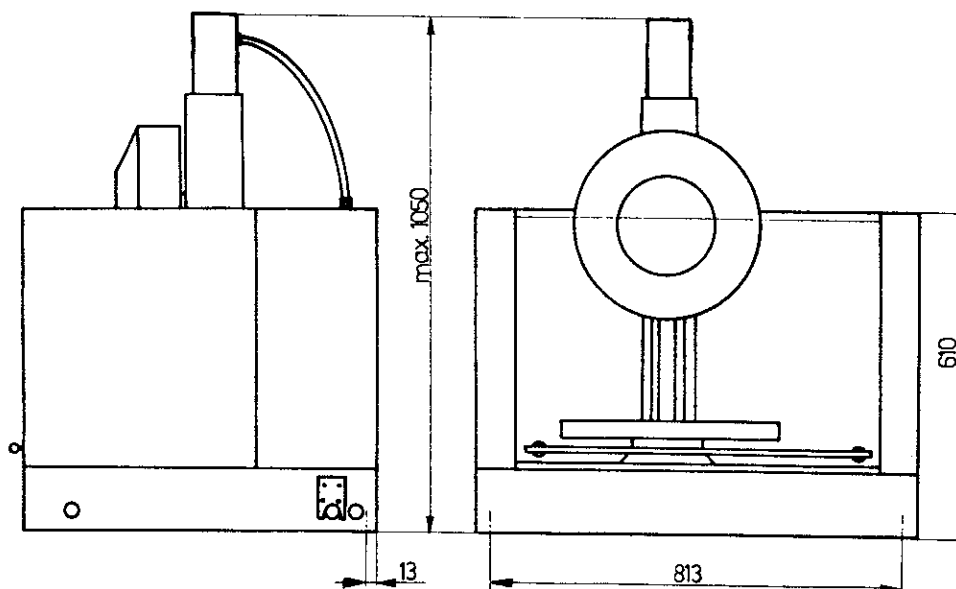### Recommended table sizes for self-made bases:

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
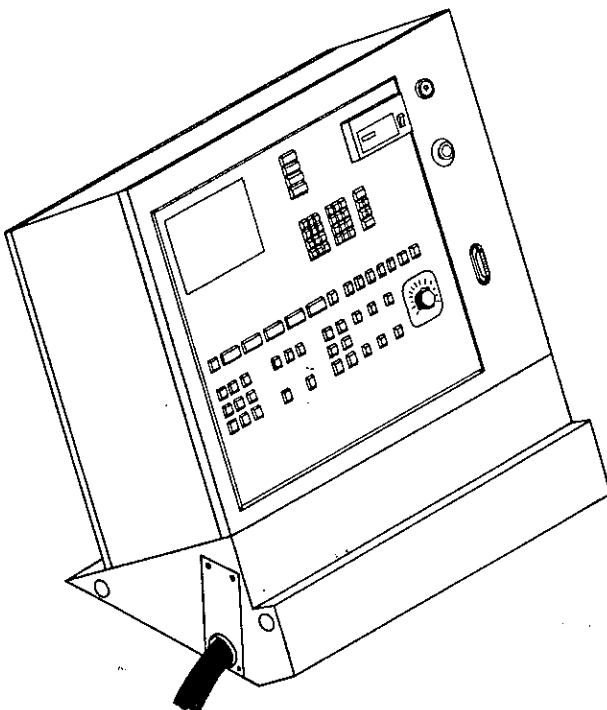Control Unit).

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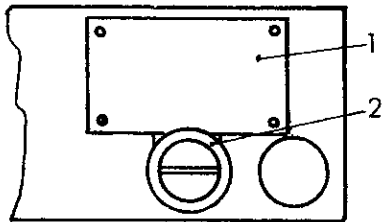
Remove cover of machine. Dismount part (1), insert all plugs. Mount cable into eye (2). Slide eye (2) into slot of housing. Mount part (1).

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

Connecting of plugs to control

> # **Attention!**
>
> When connecting or disconnecting,
> Switch off the the main switch,
> machine is already connected to
> main supply, otherwise electr.
> elements could be distroyed.

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.

RS-232 C

5
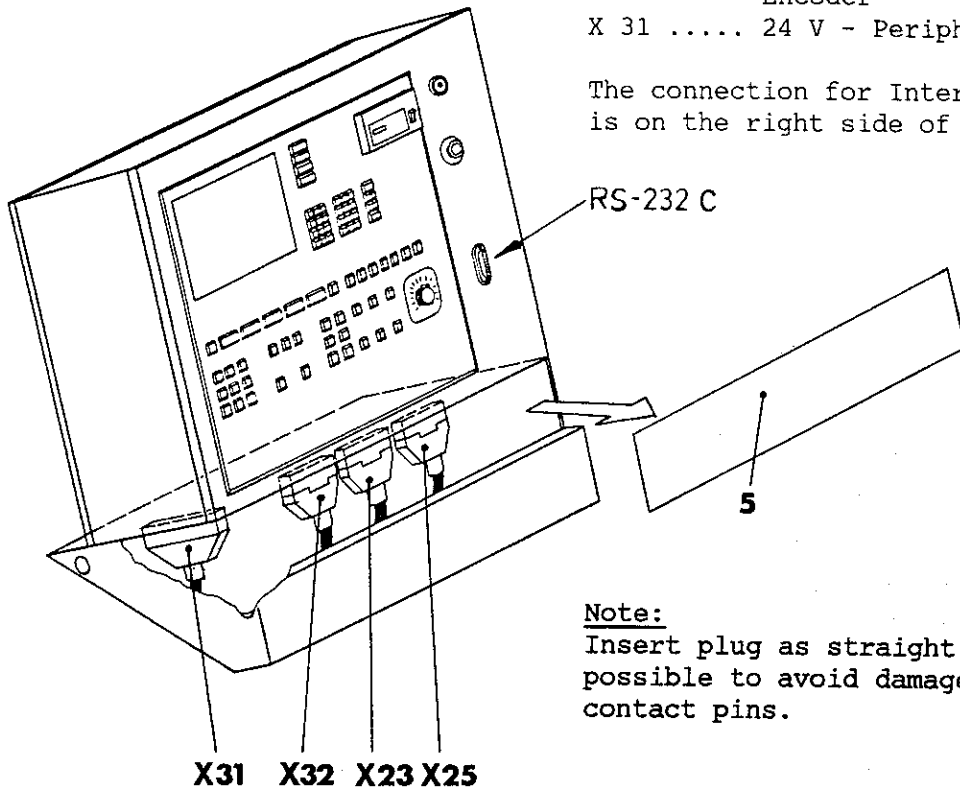
Note:
Insert plug as straight as
possible to avoid damage of the
contact pins.

X31   X32   X23 X25

Main Supply

<u>Dates:</u>

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

Frequency: 50 cy or 60 cy
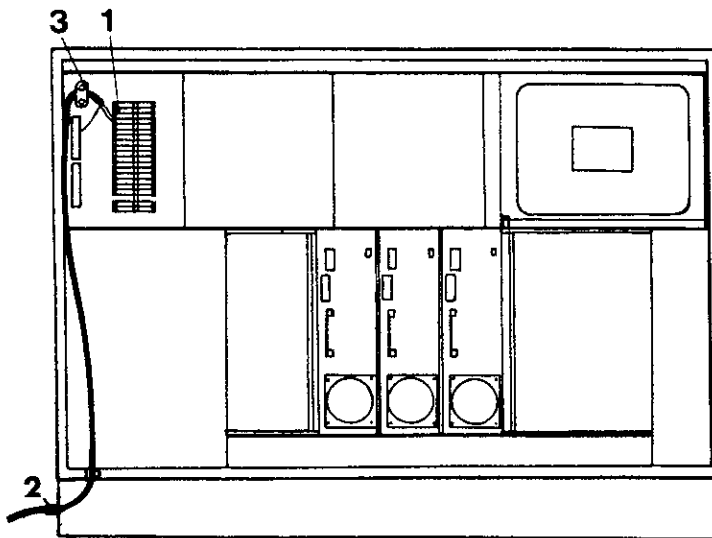
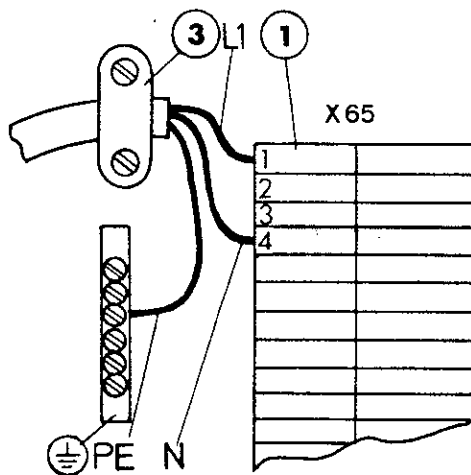Fuse: 12 A slow-blowing

Connection value: 2650 VA

Cable: 3 x 1,5 mm² wire section.

<u>Note:</u>

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 (⏚).

* Clamp lead-in in strain-relief clamp (3).

* Screw cap onto cable screw fitting (2).

Fuses
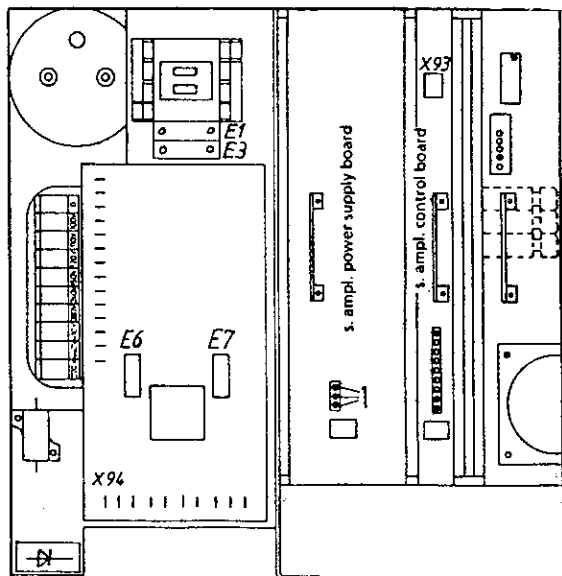
1. Main drive fuse

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.
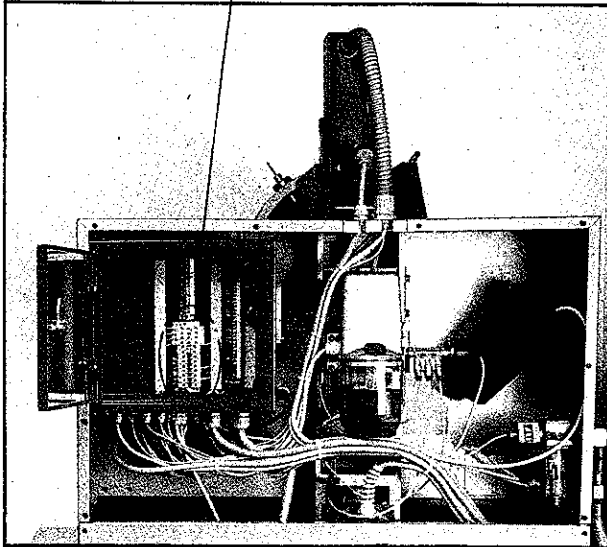
Electrical Connection of Coolant pump

Remove rear cover of machine. Bores are provided in the
terminal box for introducing the cables and making the
cable connections.
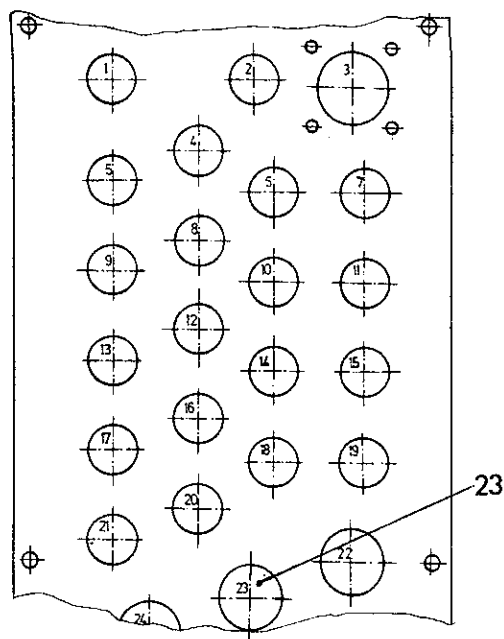
23..... Position of the cable
connection for
inserting of the cable
of coolant pump into
terminal box.

Plate with PG connections VMC-100

X 29

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 trans-
former) 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 change-
able neutral wire is created.
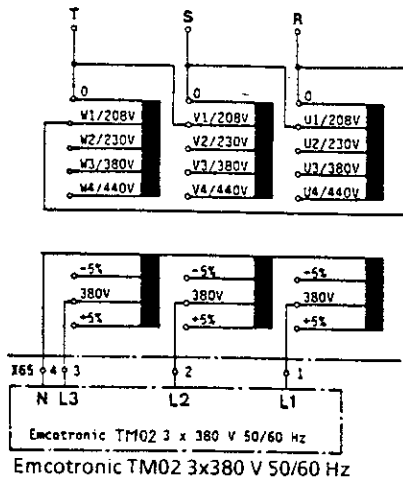A connection instruction comes with above
tranformer.

Ad) item 2:

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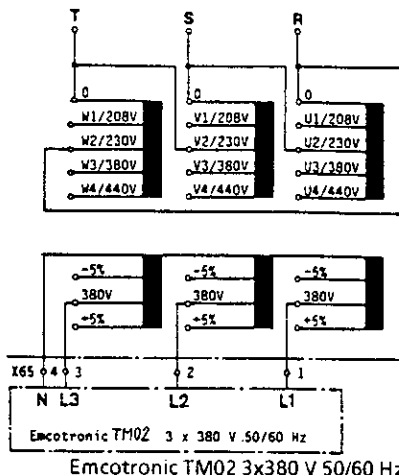voltages on the following pages of the
instruction.

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

3 x 208 V 50/60 Hz

Emcotronic TM02 3x380 V 50/60 Hz

3 x 230 V 50/60 Hz

Emcotronic TM02 3x380 V 50/60 Hz

Hinweise:

- Zwischen 50/60 Hz kein Unterschied im Anschluß
- Beim Emcotronic Anschluß muß ein belastbarer Mittelpunktsleiter vorhanden sein.
- Ein belastbarer Mittelpunktsleiter wird durch den Trafo geschaffen.
- Schlechte Netzverhältnisse: Dauernde Unter- und Überspannungen können durch die ± 5% Voltanschlüsse ausgeglichen werden.
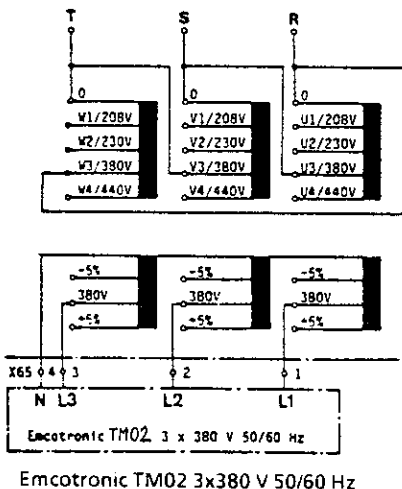
Beispiel:
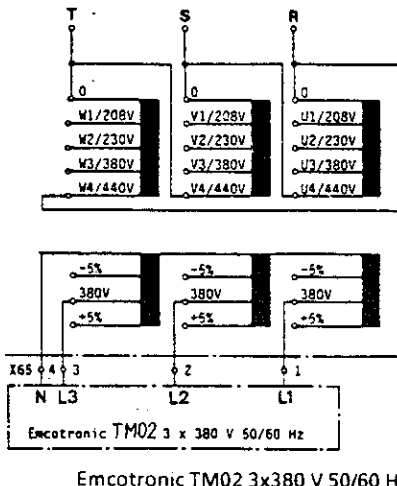3x440 V Nennwert jedoch dauernde Unterspannung von -5%, das heißt effektive Netzspannungen 3x418 V.

Ausgleich:
L1, L2, L3 der Emcotronic an + 5% anschließen.

3 x 380 V 50/60 Hz

Emcotronic TM02 3x380 V 50/60 Hz

3 x 440 V 50/60 Hz

Emcotronic TM02 3x380 V 50/60 Hz

Remarks:

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

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

Compensation: L1, L2, L3 on Emcotronic are connected to + 5%.

Anschlußschema allgemein mit TRAFO
General Connection Scheme with TRAFO

Netz
Power Supply   TRAFO   Emcotronic TM02
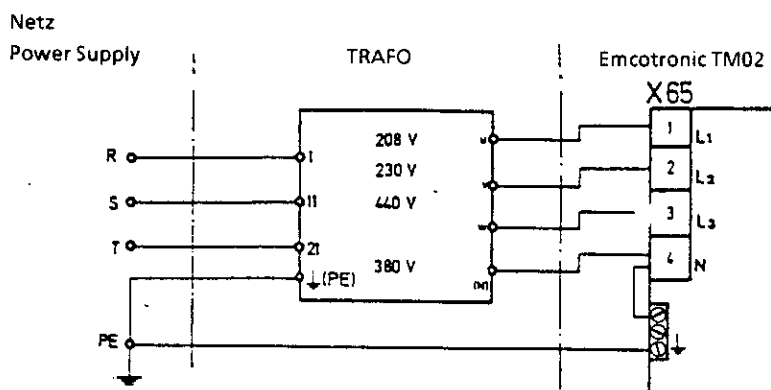
Achtung:
Bei Trafoverwendung muß in der Emcotronic N (4) mit PE (⏚) gebügelt werden.
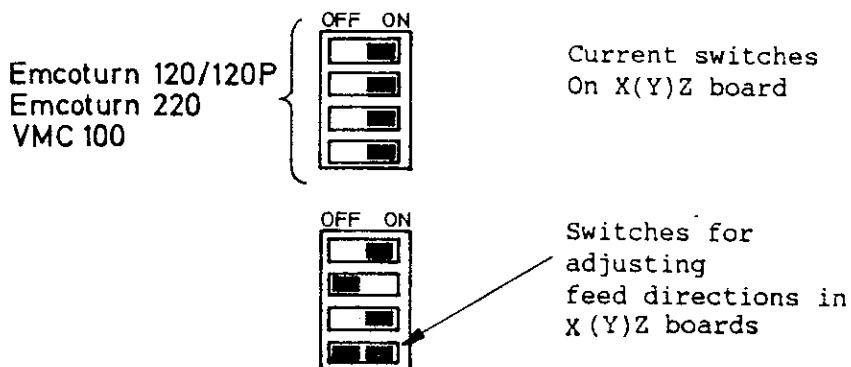Bei Direktanspeisung (3x380 V, N, PE) darf N und PE nicht gebügelt werden.

Attention:
Using the Transformer N(4) and PE (⏚) have to be jumped in the Emcotronic. No jumpering of N (4) and PE (⏚) if no Transformer is used (ie. Direct Power Supply with 3x380 V, N, PE).
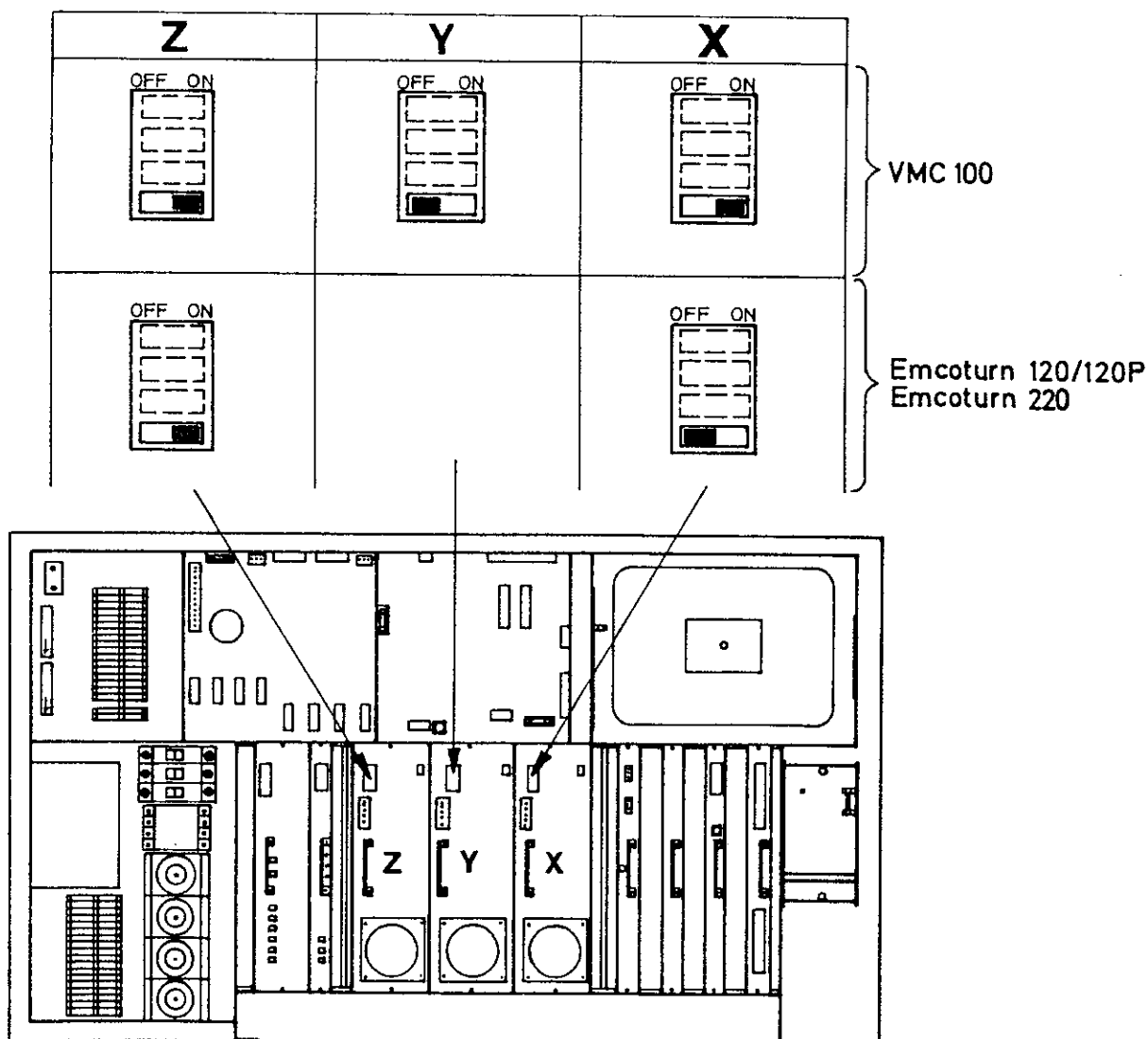
B17

ATTENTION !!!

Changing Stepper Motor Board R3D 413 001

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

Emcoturn 120/120P
Emcoturn 220
VMC 100

Current switches
On X(Y)Z board

Switches for
adjusting
feed directions in
X(Y)Z boards

Adjusting feed directions

Z	Y	X	
OFF ON	OFF ON	OFF ON	VMC 100
OFF ON		OFF ON	Emcoturn 120/120P Emcoturn 220

[Z   [Y   [X

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.
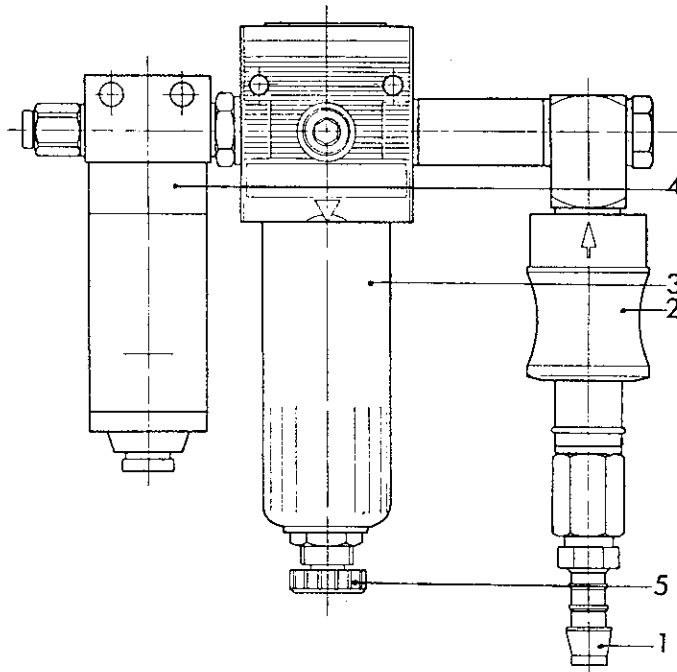
1. Technical data of compressed air supply

Maximum admissible pressure: 10 bar
Recommended working pressure: 6 - 7 bar
Connection: Compressed air hose $\emptyset$ 10 mm

2. Description

1 .... Connection for compressed air hose $\emptyset$ 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.

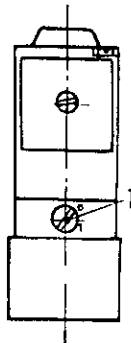### Maintenance:
Check separator tank for water.
Weekly check.

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
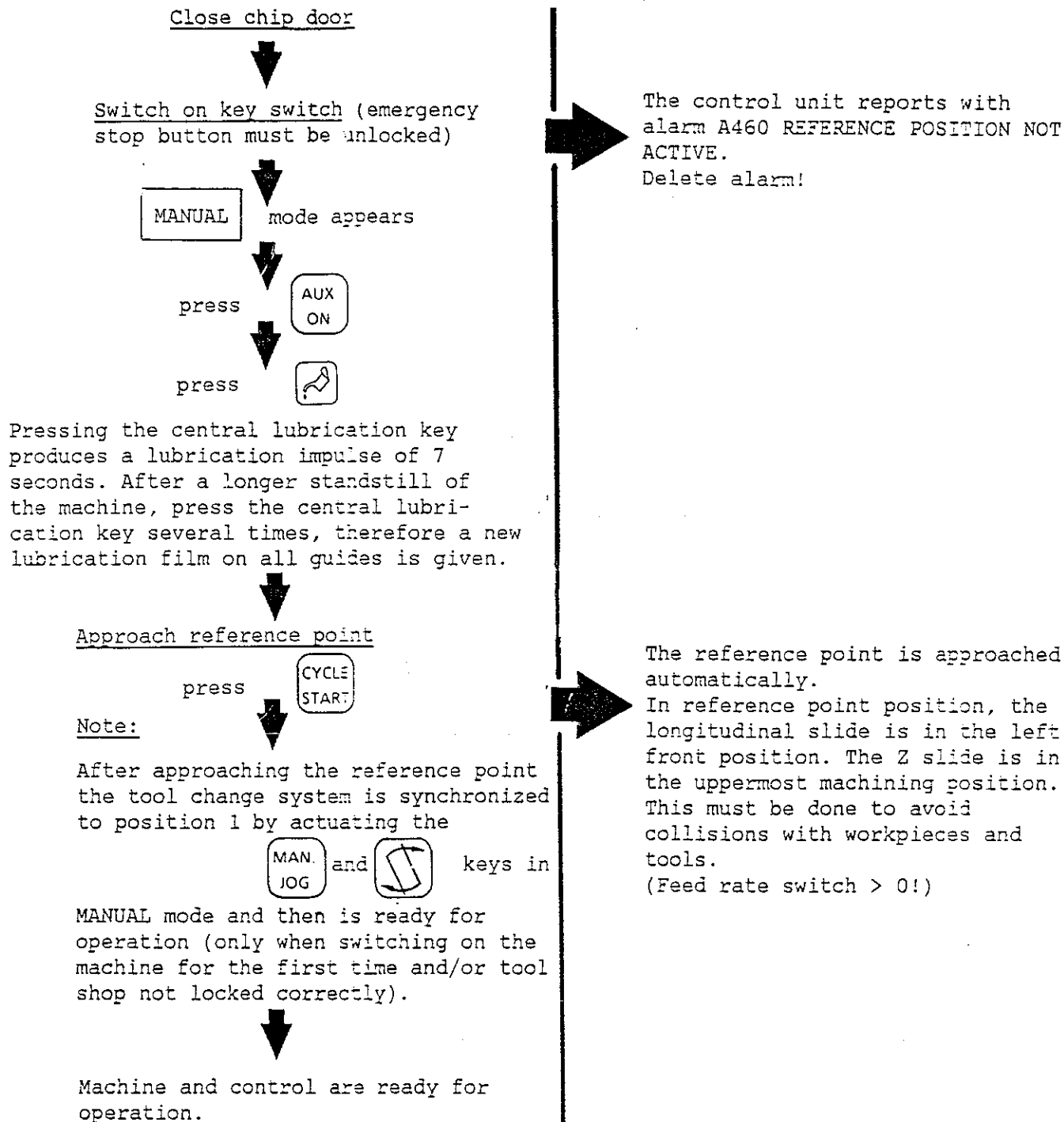position 0 to 1.

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.

<u>Close chip door</u>

▼

<u>Switch on key switch</u> (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 lubri-
cation key several times, therefore a new
lubrication film on all guides is given.

▼

<u>Approach reference point</u>

press   [CYCLE START]

<u>Note:</u>

▼

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

[MAN. JOG] and [◯]   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!)

<u>Possible problems during switch-on</u>

*   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.

<u>Please note:</u>   **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".
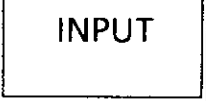The machine is delivered with one machine data cassette containing the MS data.
The cassette with the MSD is set backwards in the electric box door of the basic machine.
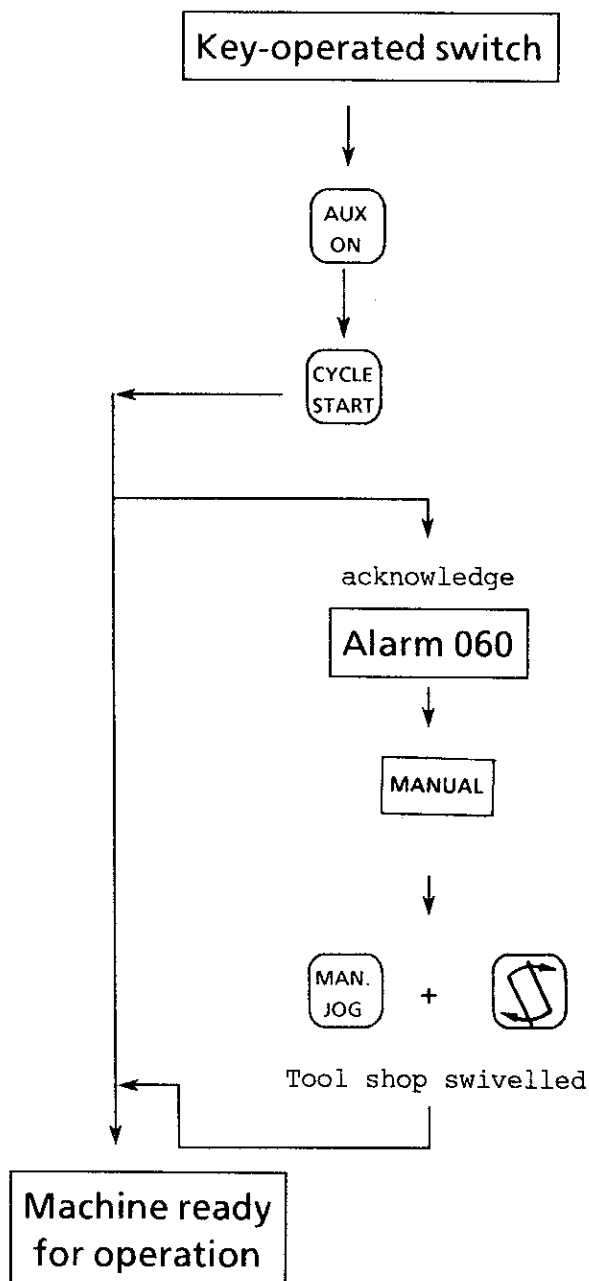During the loading procedure all system data are loaded into the internal machine data memory.

Loading machine data from cassette

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

Loading machine data from punched tape via RS 232:

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

2. Alarm A060 TOOL TURRET NOT READY

```
┌──────────────────────────┐
│  Key-operated switch     │
└──────────────────────────┘
             │
             ▼
          ┌─────┐
          │ AUX │
          │ ON  │
          └─────┘
             │
             ▼
         ┌───────┐
         │ CYCLE │
         │ START │
         └───────┘

        acknowledge

       ┌──────────────┐
       │  Alarm 060   │
       └──────────────┘
             │
             ▼
        ┌──────────┐
        │ MANUAL   │
        └──────────┘
             │
             ▼
      ┌──────┐        ┌──────┐
      │ MAN. │   +    │  ⟳   │
      │ JOG  │        └──────┘
      └──────┘

      Tool shop swivelled

┌──────────────────────┐
│  Machine ready       │
│  for operation       │
└──────────────────────┘
```

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

Using the key $\boxed{\begin{array}{c}\text{AUX}\\\text{ON}\end{array}}$ 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
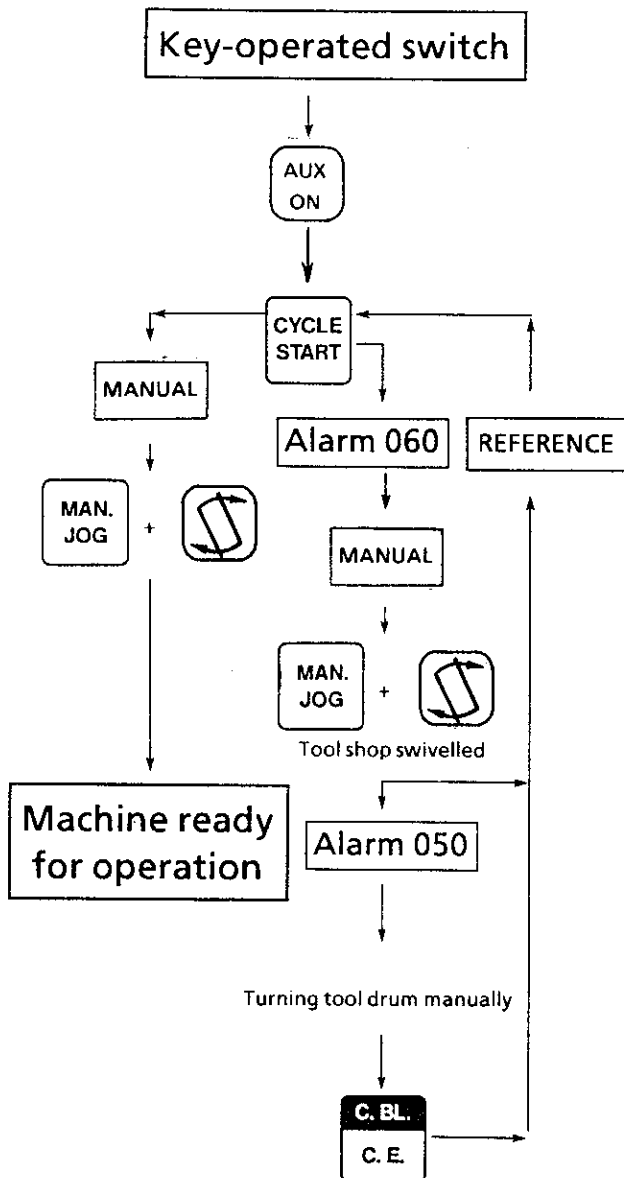
If A050 appears when reference point is approached, the tool shop is not in "clamping position". (Tool bevel regarding main spindle).
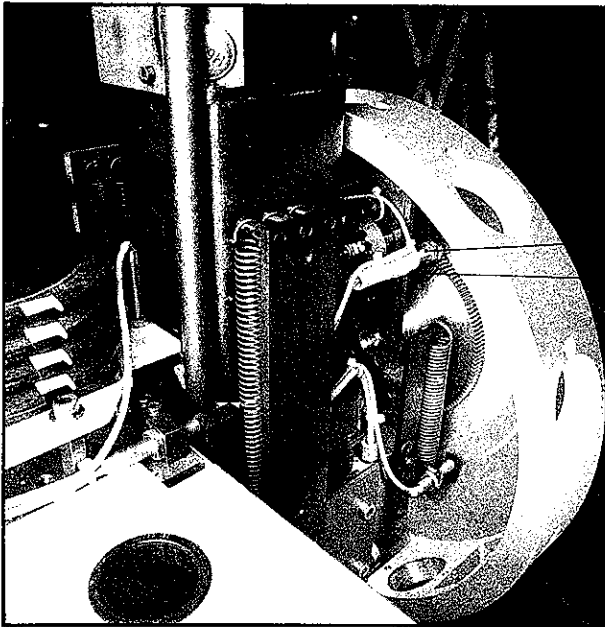
Explanation:
A proximity detector controls the position of the tool shop and triggers alarm 050 if the tool shop is in the wrong position. In this wrong position a Z-movement must not occur, as this might lead to collision in Z-direction.

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).

Key-operated switch

AUX ON

CYCLE START

MANUAL

Alarm 060   REFERENCE

MAN. JOG +

MANUAL

MAN. JOG +

Tool shop swivelled

Machine ready for operation

Alarm 050

Turning tool drum manually

C. BL.
C. E.

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.
<u>Alarm A060 appears!</u>

Remedy:
- Turn tool shop manually, when machine is switched off.

- Switch on machine, approach reference point.

Remarks:
Swivelling in manual mode using keys

| MAN. JOG | + | ⟳ |
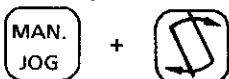
is not possible as long as an alarm is displayed. If necessary, it has to be acknowledged first using

| C. BL. |
| C. E. |

Chapter C

Description of Machine

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, collant 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 MO8 coolant (on) and MO9 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).
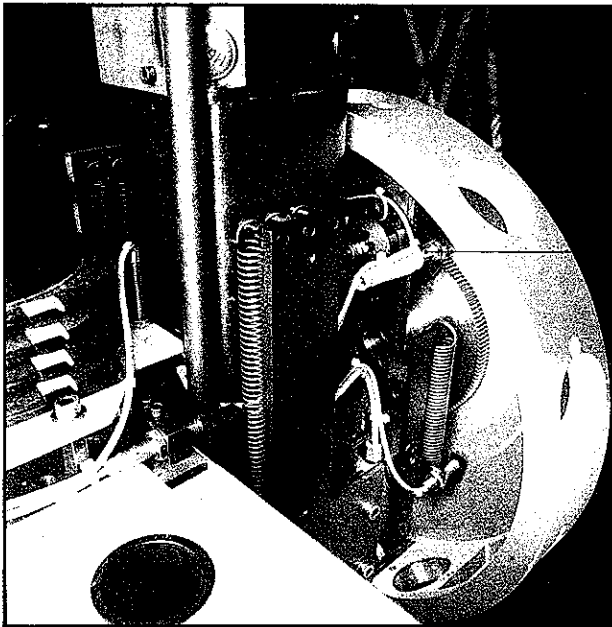
4. Milling head is lowered. Tool is clamped.

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
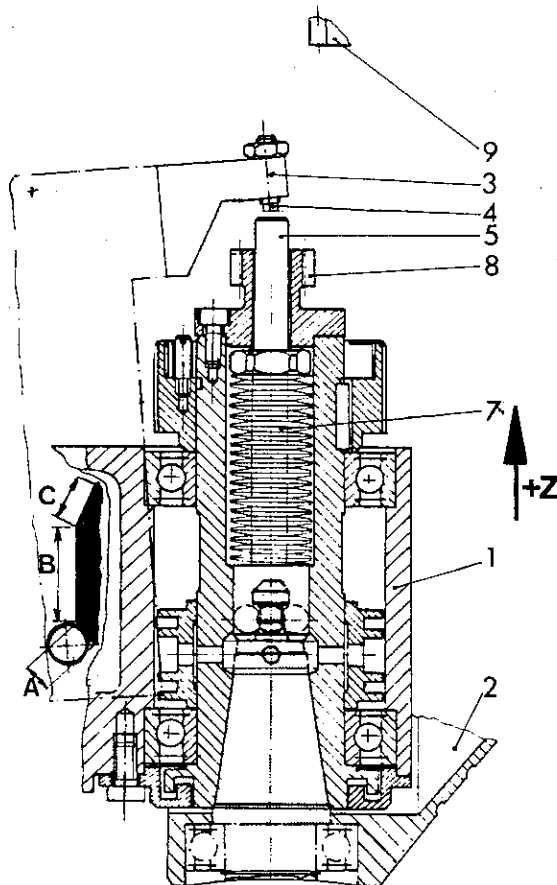
* Via the main motor the pinion (8) is placed in snap-in position for the toothed ring (9) for tool shop swivelling.

* 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).
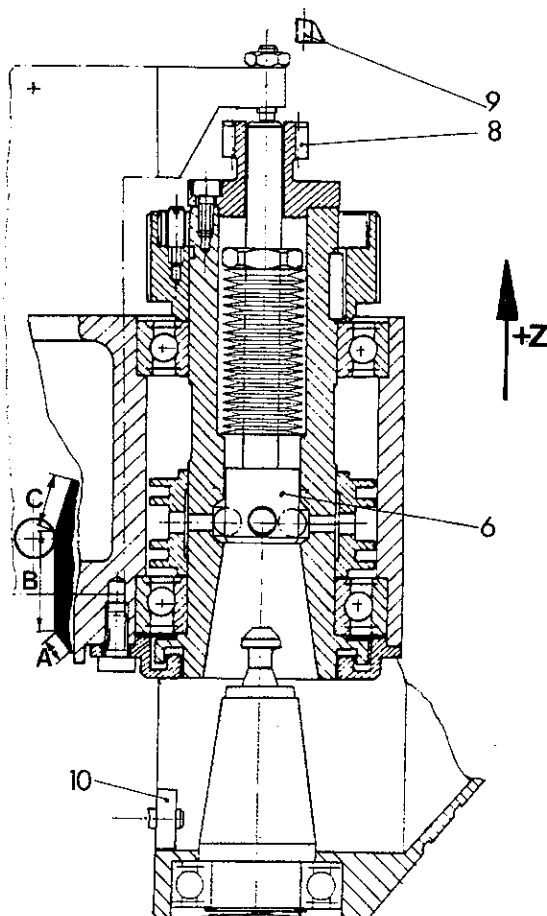
* The spring washer group is clamped entirely from the junction of cam travel A and cam travel B. From this point the the collet is opened completely.

* 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.
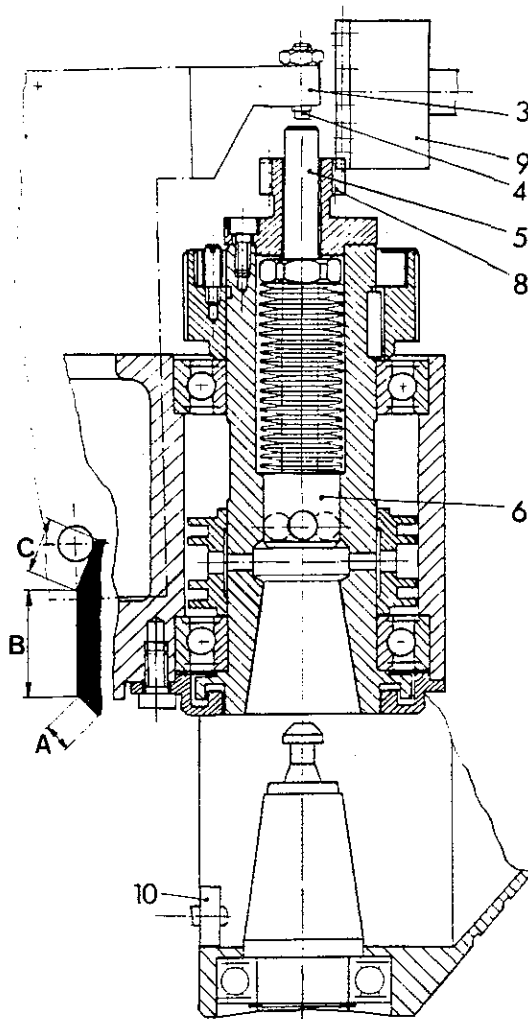
* During the traversing range C of the cam, the collet (6) is closed again and the clamping screw (4) of the clamping hoop (3) rises again from the pressure bolt (5).

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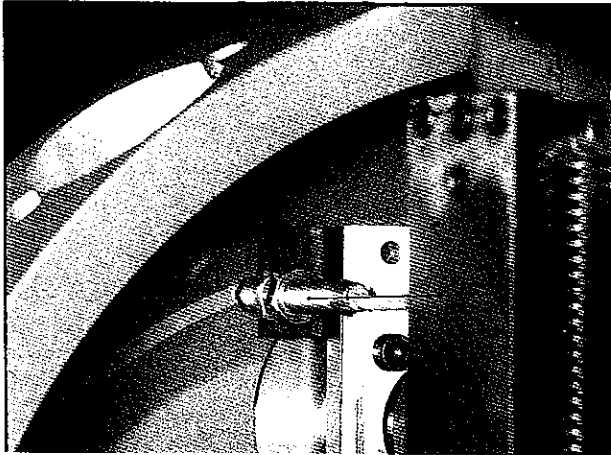
Proximity detector 1:
Proximity detector 1 is used for synchronization of the tool shop position when the machine is initially switched on.

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.
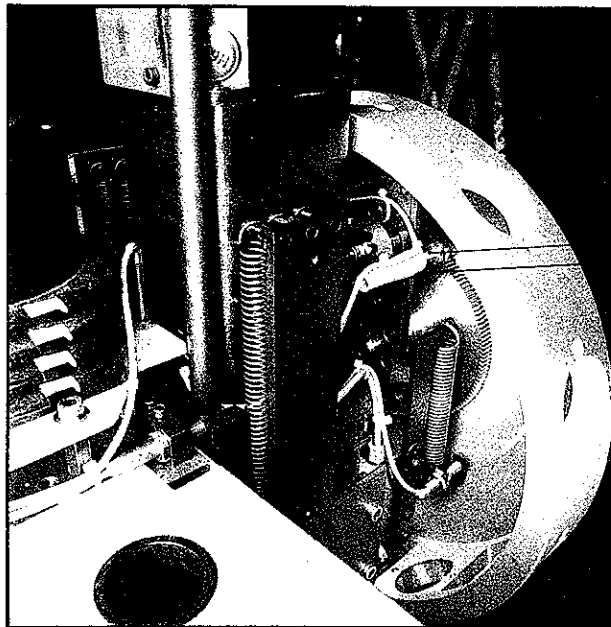
Proximity detector 2:
Proximity detector 2 controls the exact angle position of the tool shop after each swivelling move. If the swivelling position is not reached exactly, alarm A050 appears.
In an alarm 050 position the tool would be in a bevel position with reference to the main spindle. Collisions 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.

—3
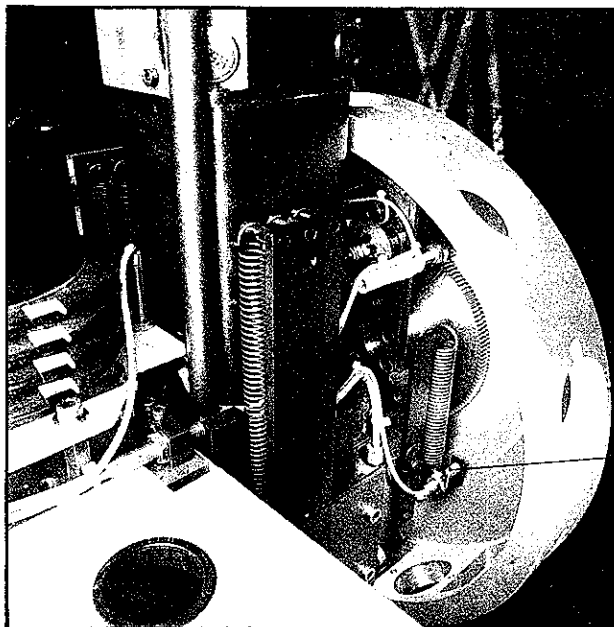
Proximity detector 3:

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
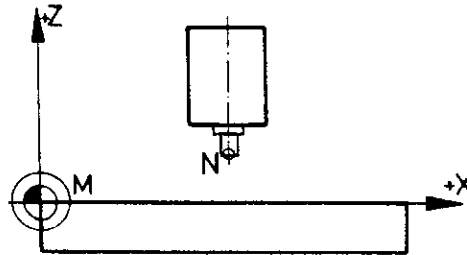
Position of N: ⊕

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.

   <u>Decisive factor for the</u> ⊕
   <u>determination of position M:</u>

   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
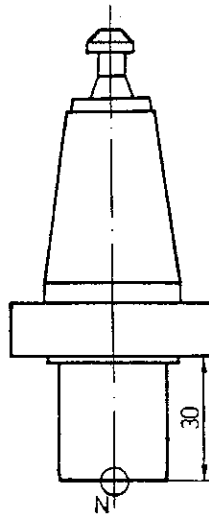
* A reference tool is delivered with the machine.
  Point N is situated in the rotation axis at the front side of the reference tool.

* 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.
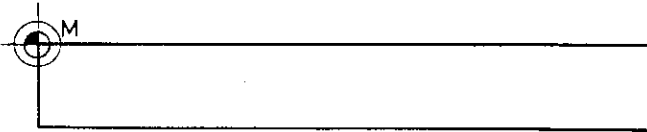
Chapter D

Working with the machine

1. Working area

The sketch shows the possible traversing range in X and Y direction.
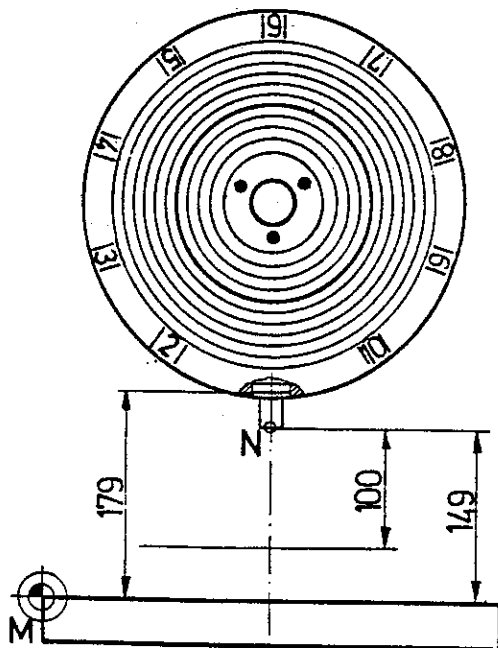
Traversing range in Z-direction:

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, prog-ramming instructions, zero point shift, tool data

Overall view of control unit
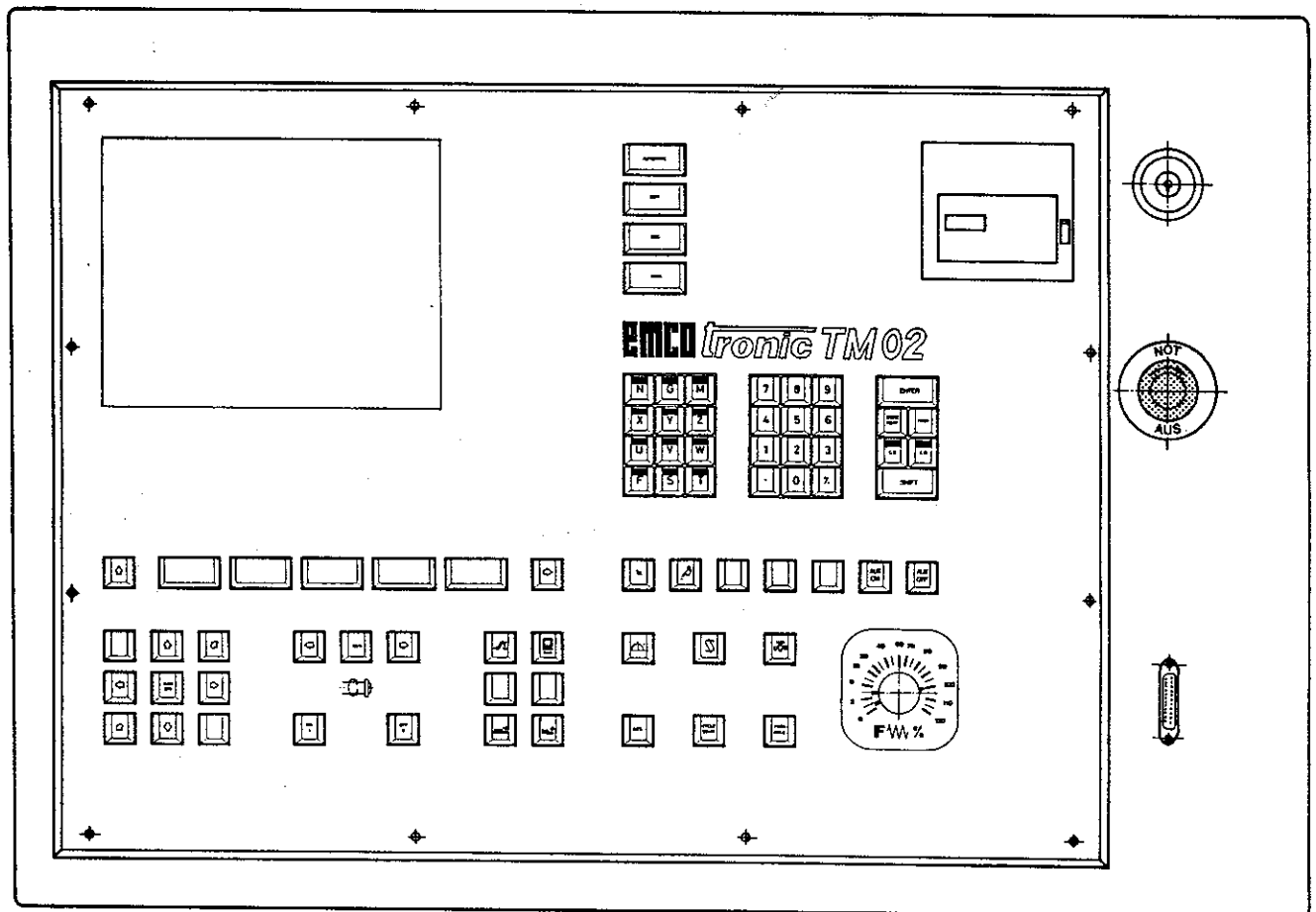
2.1 Operating instructions

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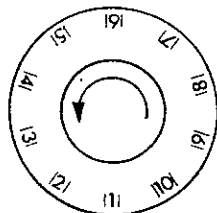
If the SHIFT key is active, the
respective symbol on the symbol
insert lights up - swivelling in
the direction of decreasing
position numbers.
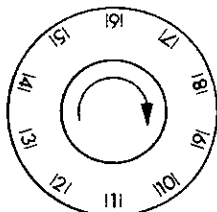
2.1.2 Activation of central lubrication system

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.
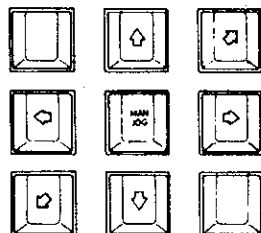
2.1.3 Clamping devices ON - OFF

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. JOG] keys 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.
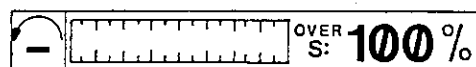
2.1.6 Feed override switch
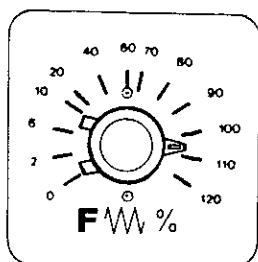
With the feed override switch the feed speed can be modified during traversing slides.

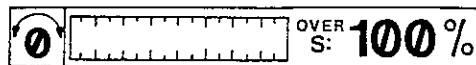## 2.1.7 Determination of rotational direction - main spindle

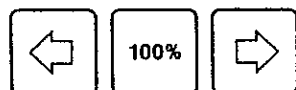### Representation of symbol line
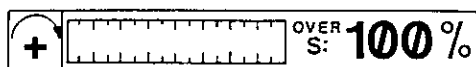
Main spindle ON in clock-wise direction

`ON 1`

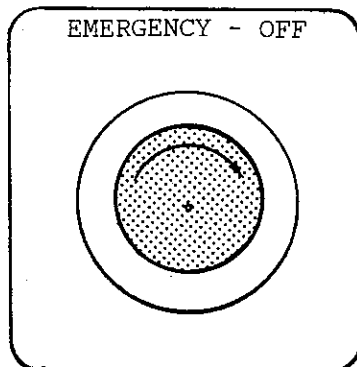Main spindle ON in counter clock-wise direction

`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

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.
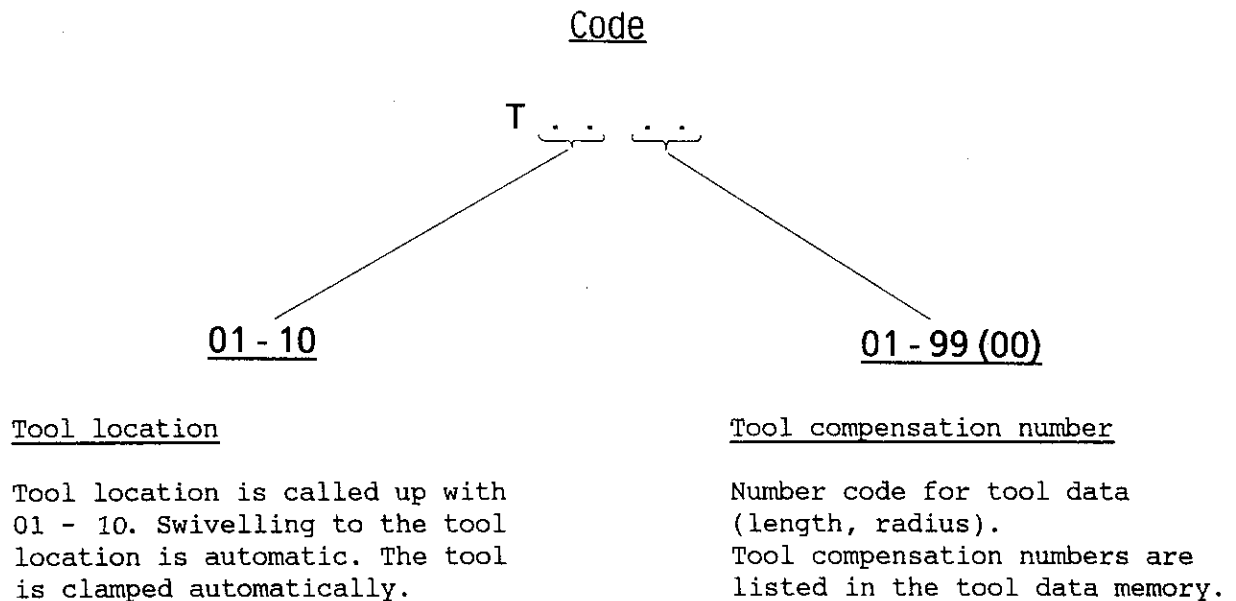- Program jump to N 0000

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.

Code

T ⌣ ⌣

01 - 10   **01 - 99 (00)**

Tool location   Tool compensation number

Tool location is called up with   Number code for tool data
01 - 10. Swivelling to the tool   (length, radius).
location is automatic. The tool   Tool compensation numbers are
is clamped automatically.   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
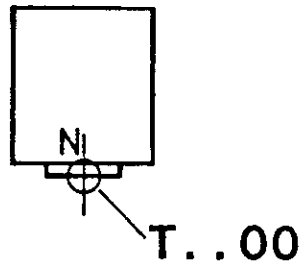
T.. 00
If the reference number T.. 00 is pro-
grammed, the coordinates (measurements)
system refers to the reference point
for the tool mounting.

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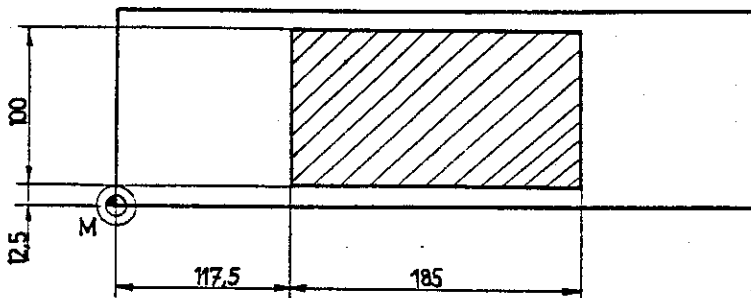
If you mount a clamping device, you have to take care that the clamped workpiece is placed in the traversing range of the milling cutter. The traversing range is illustrated in the opposite sketch.

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.
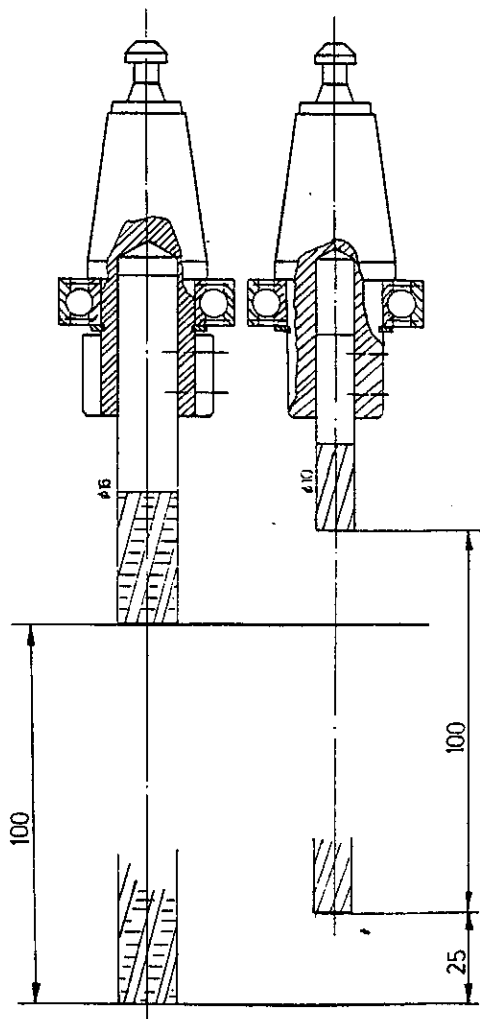
Zero point shift, take-over of data

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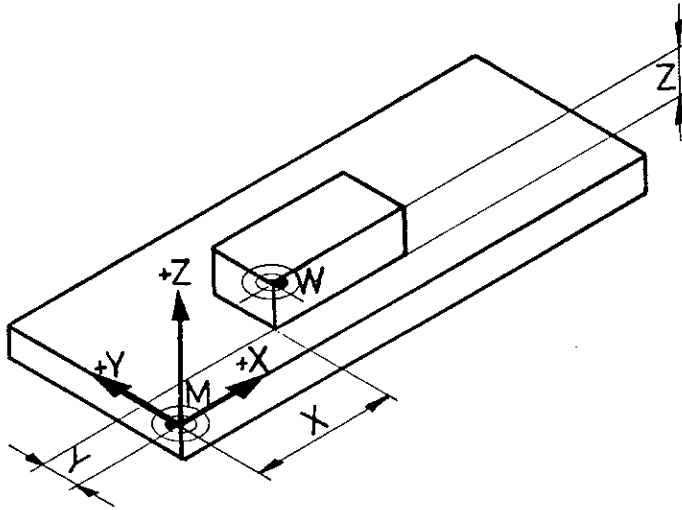
For exact take-over of PSO data you may touch the workpiece.

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.
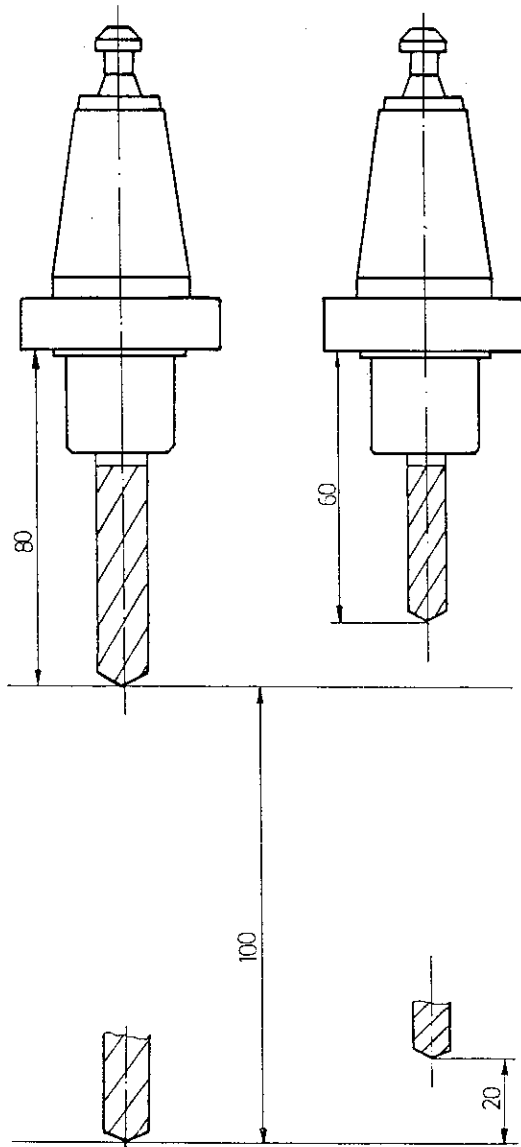
Mounting tool collets on the tool shop plate
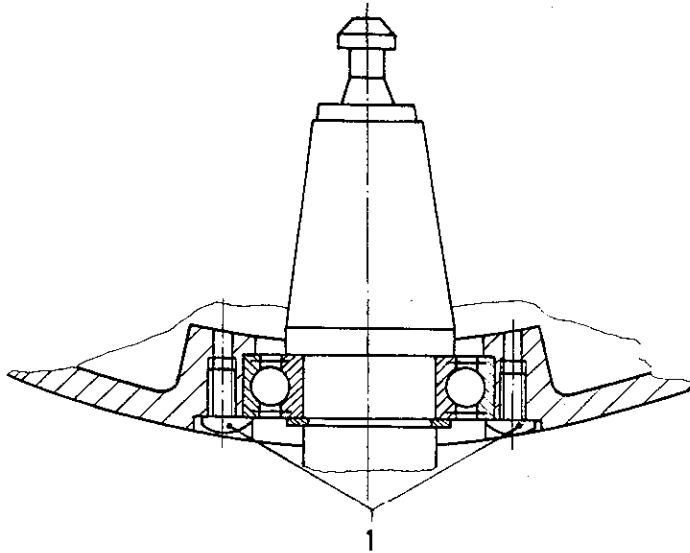
* Turn clamping screws (1) until tool
  collets can be inserted (mind the flat
  screw head).

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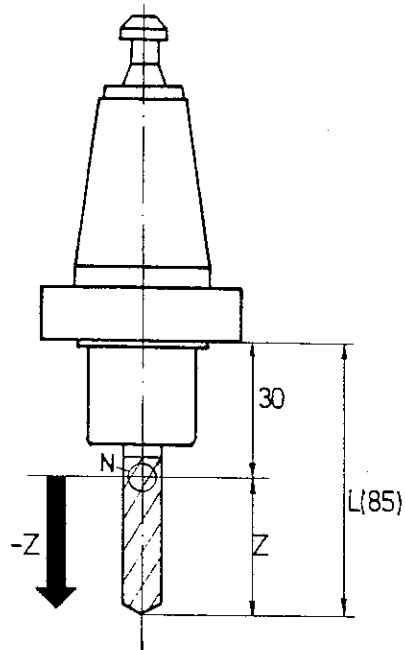
The tool clamping reference point N
lies 30 mm from the lower plane
surface of the ball bearing.

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.

TO   0   0

ENTER

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).

TO   0   1   Tool correction number
              wanted

ENTER

The tool length Z is stored under
tool correction number T..01.
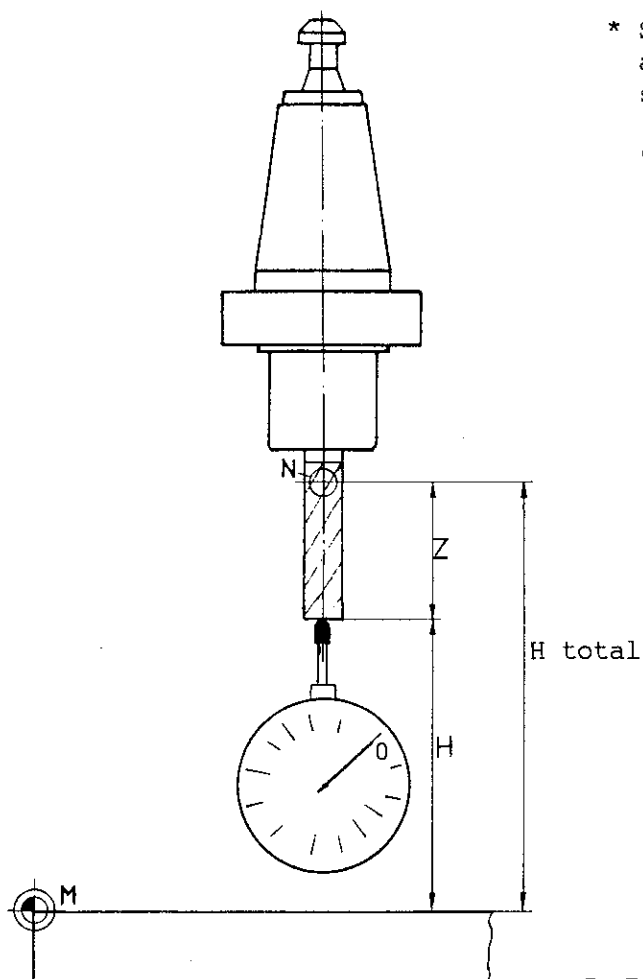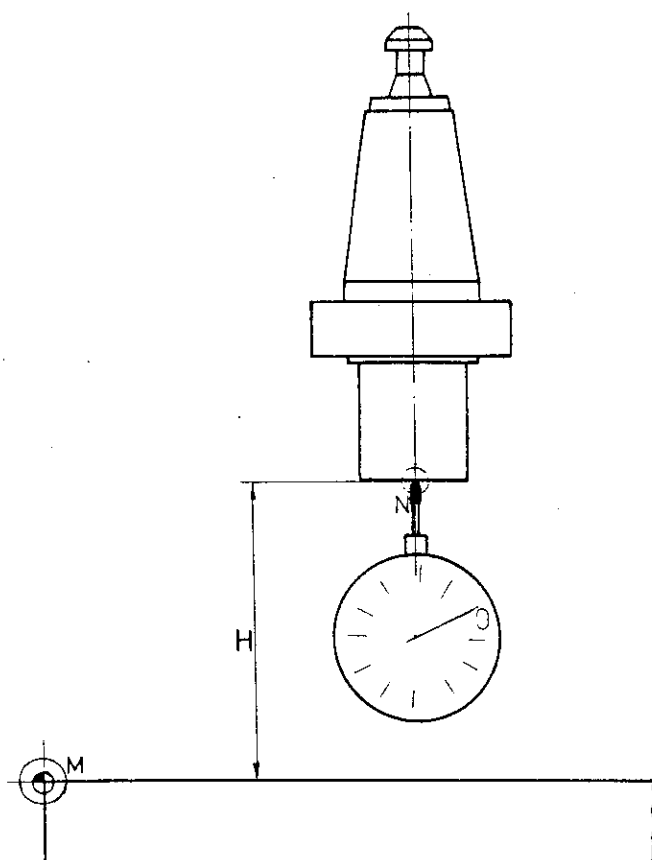
1. Measure the height (H) of the
   trial workpiece which has to be
   scratched.

H=60,24
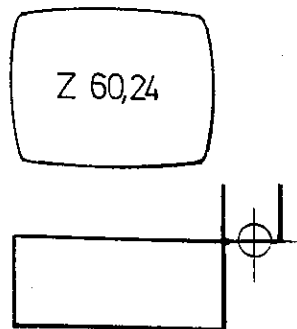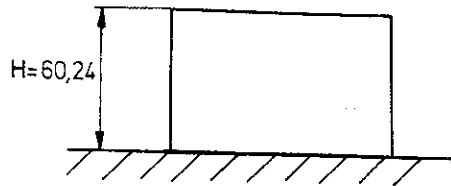
2. Set manual mode.

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

Z 60,24

TO 0 0

ENTER
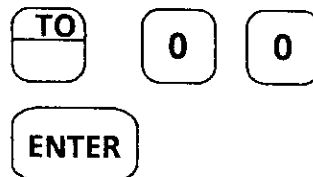
The dimension H is stored.

3. Swivel in tool and scratch
   workpiece surface.

TO 0 1   tool correction number
           wanted

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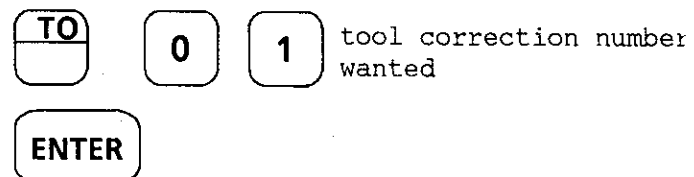
The dimension Z is stored under
correction number T..01.

D16
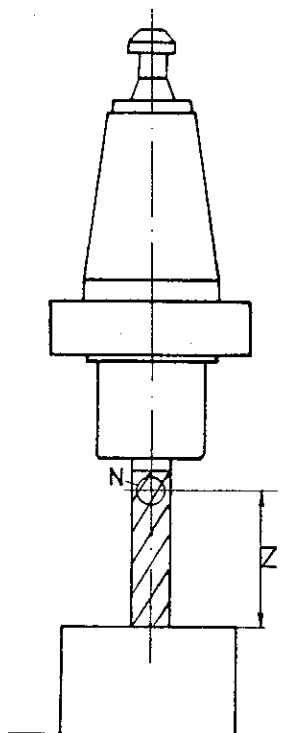
Correction of the length data
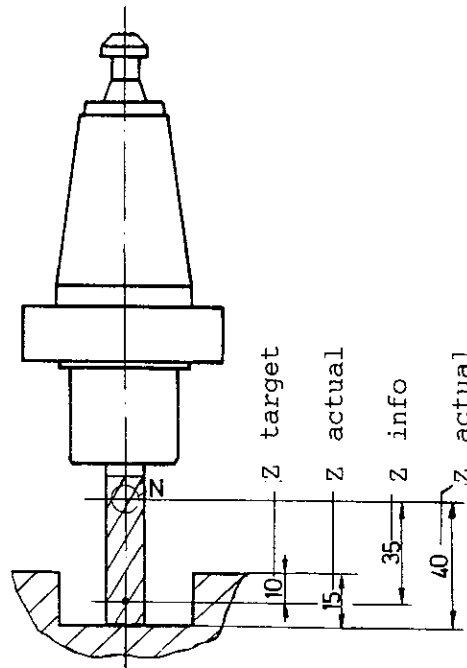
EDIT:

	TOOL DATA			DISTANCES [MM]	
	X		Z	R	L
00:	0.000	:	0.000	:	0.000	:0
01:	0.000	:	-35.000	:	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 mm

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

  Z - 35 mm + (-5mm) = -40 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
01:	0.000	:	-40.000	:	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:
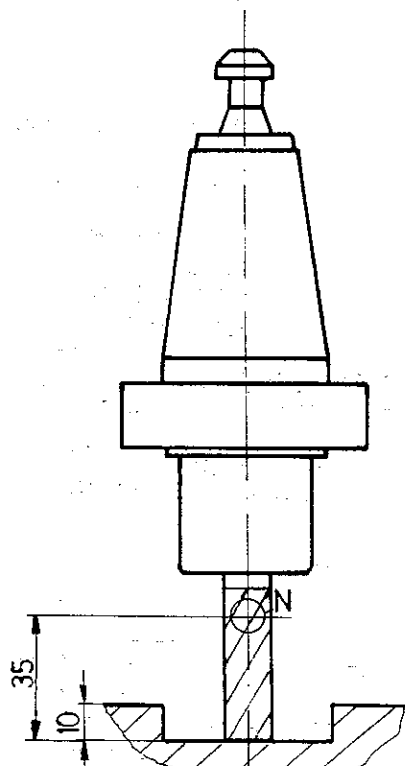
Z actual = 35 mm

Z info = 35 mm

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

Measurement in drawing (10) and on
workpiece must be the same.
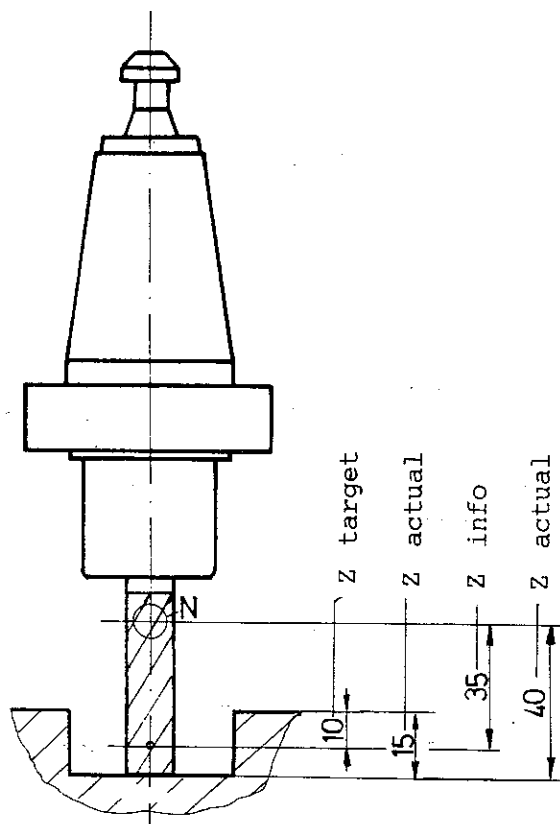
Z actual is not equal to Z INFO:

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

Correction of tool lenghts

By measuring the workpiece, you are able to detect any errors caused by inaccurate tool data.
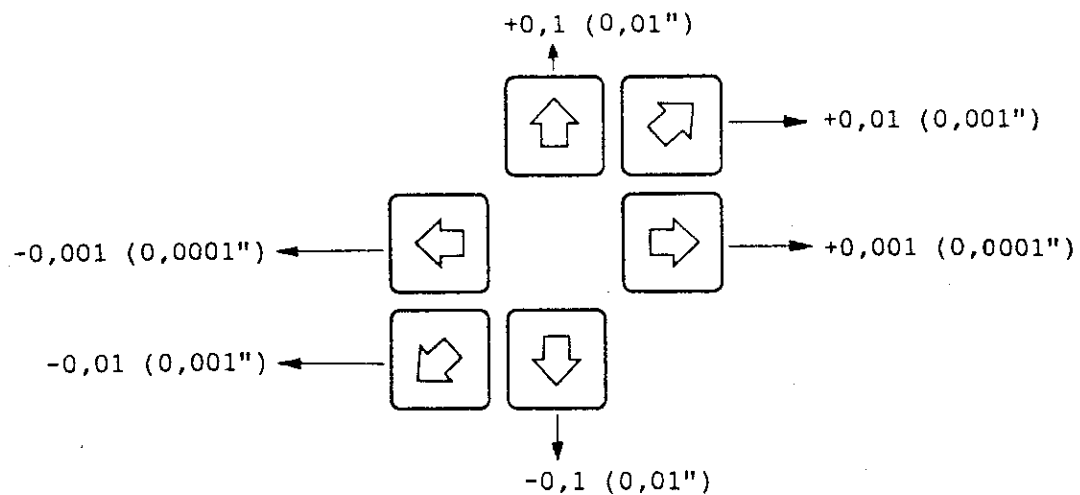
Correction:
* delete values
* enter corrected values
* incremental change of Z-value

Incremental Changing of the PSO and TO Data

If you have selected the respective register (PSO 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)

collet holder

twist drill $\phi 1 \div \phi 8$ u.
center drill $\phi 2,5 \div \phi 6,8$
extra short design
acc. to DIN 1897

slot milling cutter
DIN 327 Form B

$\phi 2$ $\phi 3$ $\phi 4$ $\phi 5$ $\phi 6$ $\phi 7$ $\phi 8$

radius milling cutter

end-milling cutter $\phi 8$
DIN 844 Form A

$\phi 3$ $\phi 4$ $\phi 5$ $\phi 6$

30

twist drill
$\phi 1$ DIN 338

100 – effective stroke in z-axis

150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0

N

milling cutter fixture ⌀10

milling cutter fixture ⌀ 12

slot milling cutter DIN 327 Form B

end-milling cutter for T-slots 12.5 x 6 shaft ⌀10

end-milling cutter for T-slots 16x8 shaft ⌀ 10

angular milling cutter DIN 1833 Form A / Form B shaft ⌀ 12

NC center drill ⌀10

twist drill ⌀10 extra short DIN 1897

⌀10

twist drill ⌀12 extra short DIN 1897

radius milling cutter ⌀12

Form A 60°

Form B 45°

30

N

100 — effective stroke in Z-axis

150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0

D21

milling cutter fixture ⌀ 16

tap holder M3

tap holder M4

tap holder M5

shell end mill arbor

end-milling cutter ⌀16 DIN 844

M3 normal length

M4 normal length

M5÷M8

shell end mill ⌀ 40 × 20

circular saw blade ⌀60

Z

30

150

140

130

120

110

100

90

80

70

60

50

40

30

20

10

0

100 — effective stroke in Z-axis

D22

Chapter E

Technological Data

1. General

1.1 Cutting speed (V)

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

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.

$$S \ (rpm) = \frac{V_S \ (m/min) \ x \ 1000}{d \ (mm) \ x \ \pi}$$

E1

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 m/min

Depth of cut (mm) vs Feed rate (mm/min), with cutter diameter lines D=30, D=40, D=6, D=8, D=10, D=16

```
┌─────────────────────┐              ┌──────────────────────────┐
│   Depth of cut      │              │Cutter diameter  8   mm   │
│      1.5 mm         │              │                          │
└─────────────────────┘              └──────────────────────────┘
              ↘                           ↙
                ┌──────────────────────┐
                │    Feed rate         │
                │   500 mm/min         │
                └──────────────────────┘
```

You can also proceed as follows:

```
┌─────────────────────┐              ┌──────────────────────────┐
│    Feed rate        │              │Cutter diameter 16 mm     │
│   100 mm/min        │              │                          │
└─────────────────────┘              └──────────────────────────┘
              ↘                           ↙
                ┌──────────────────────┐
                │   Depth of cut       │
                │      3 mm            │
                └──────────────────────┘
```
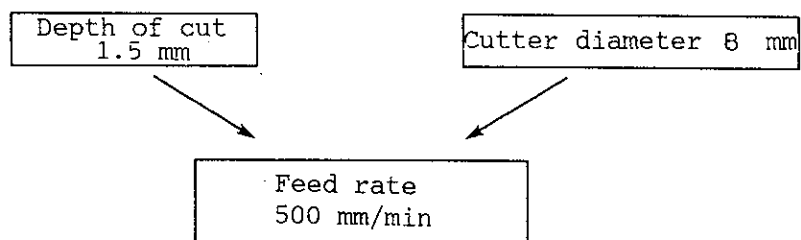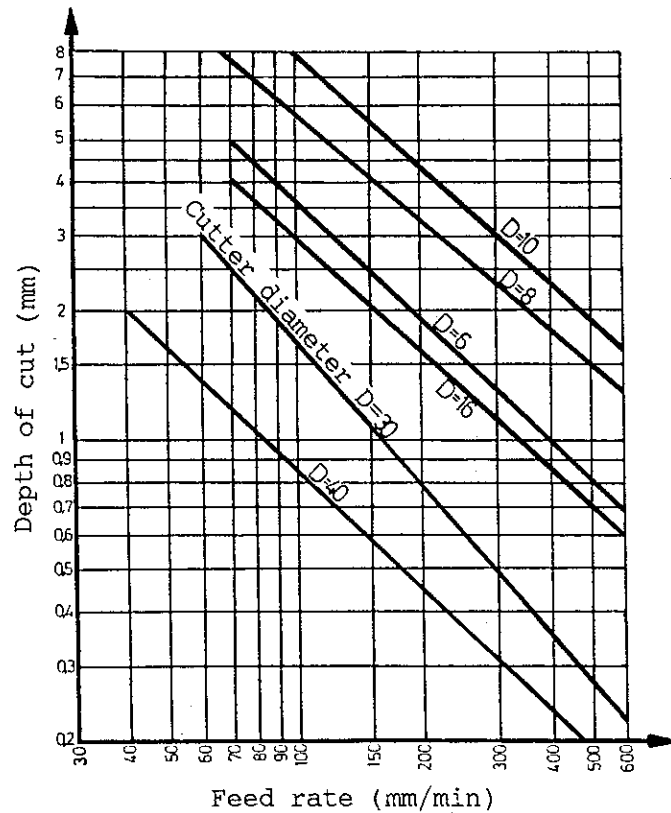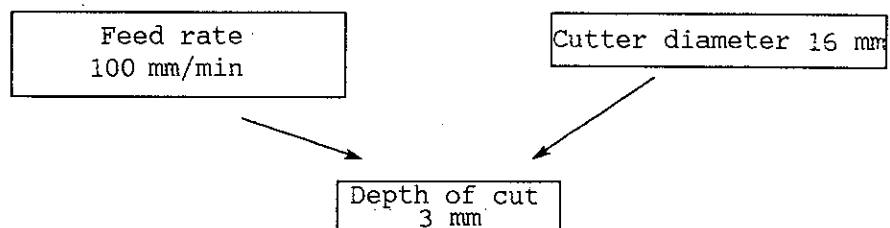
2.2 Face milling of steel (9S20) at v = 35 m/min

Depth of cut (mm) [y-axis]

Feed rate (mm/min) [x-axis]

Labels on chart: D=10, D=8, D=6, D=16, Cutter diameter D= 30

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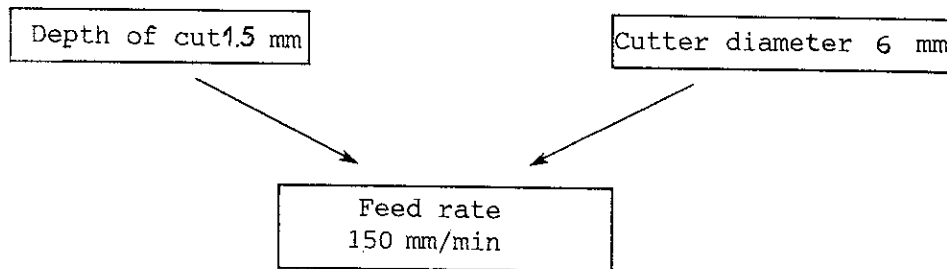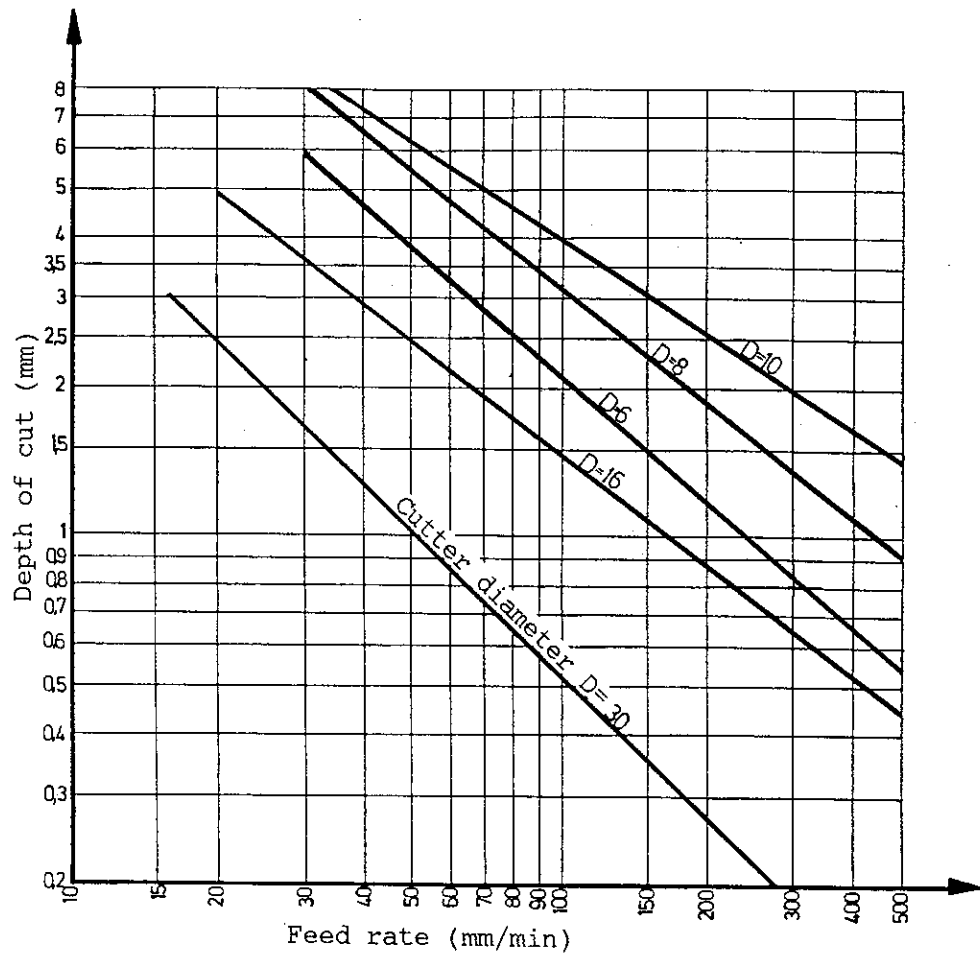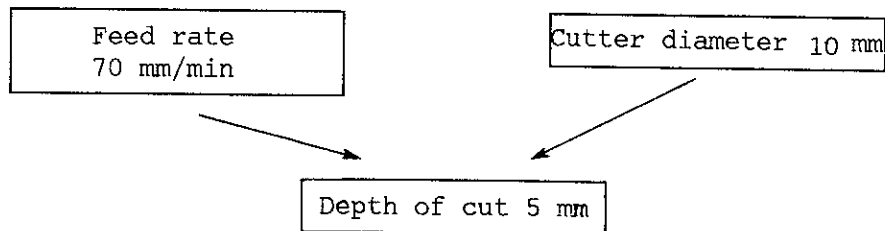
3. Determining the feed rate
during drilling in 9S20 and Torradur B
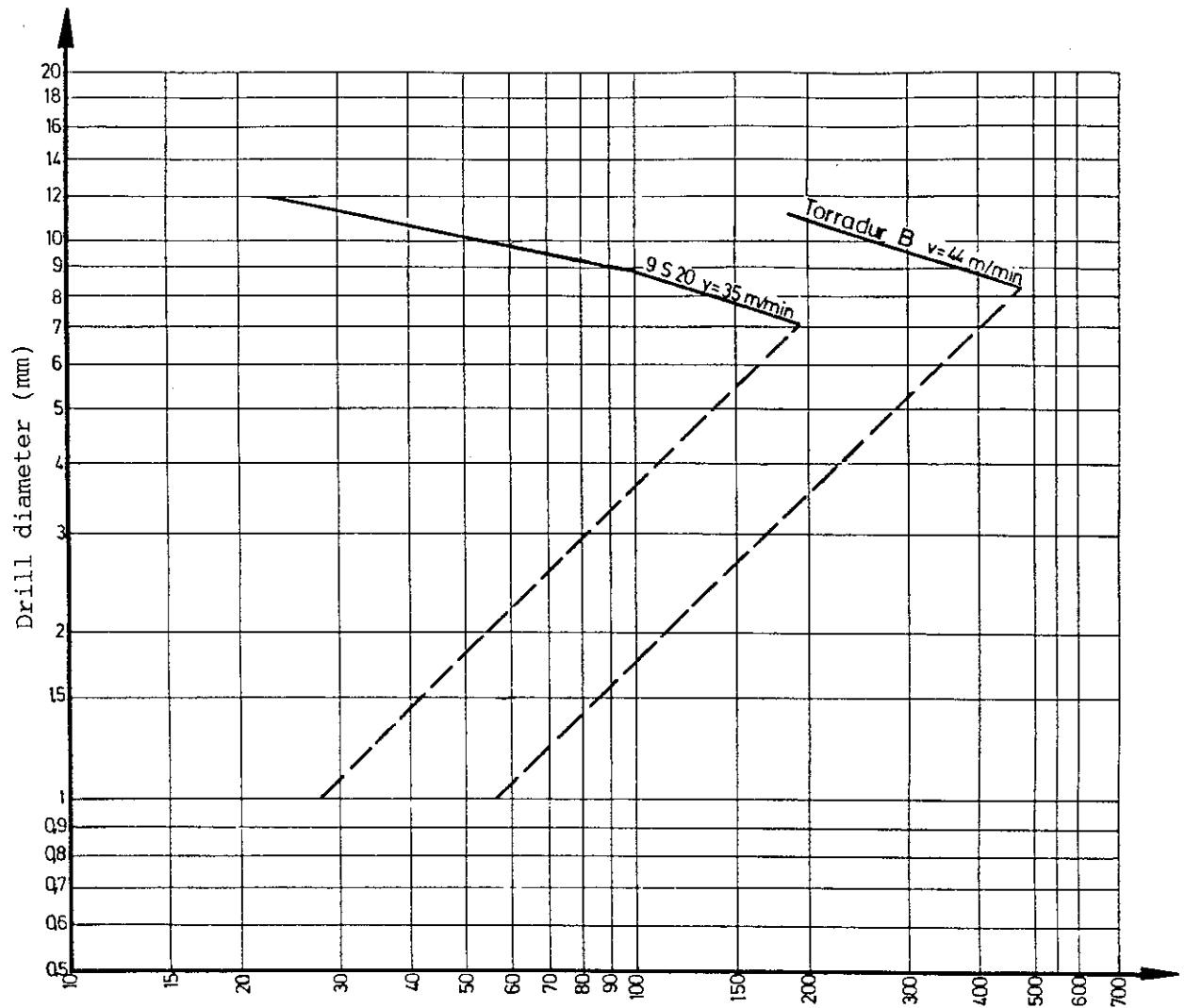
Material: 9S20

Drill diameter = 9 mm

↓

Feed rate = 90 mm/min

4. Determining the speed and cutting speed

Speed (U/min) vs Cutting diameter (mm)

Curves labeled: $v_s = 44 \, m/min$, $v_s = 35 \, m/min$, $v_s = 25 \, m/min$
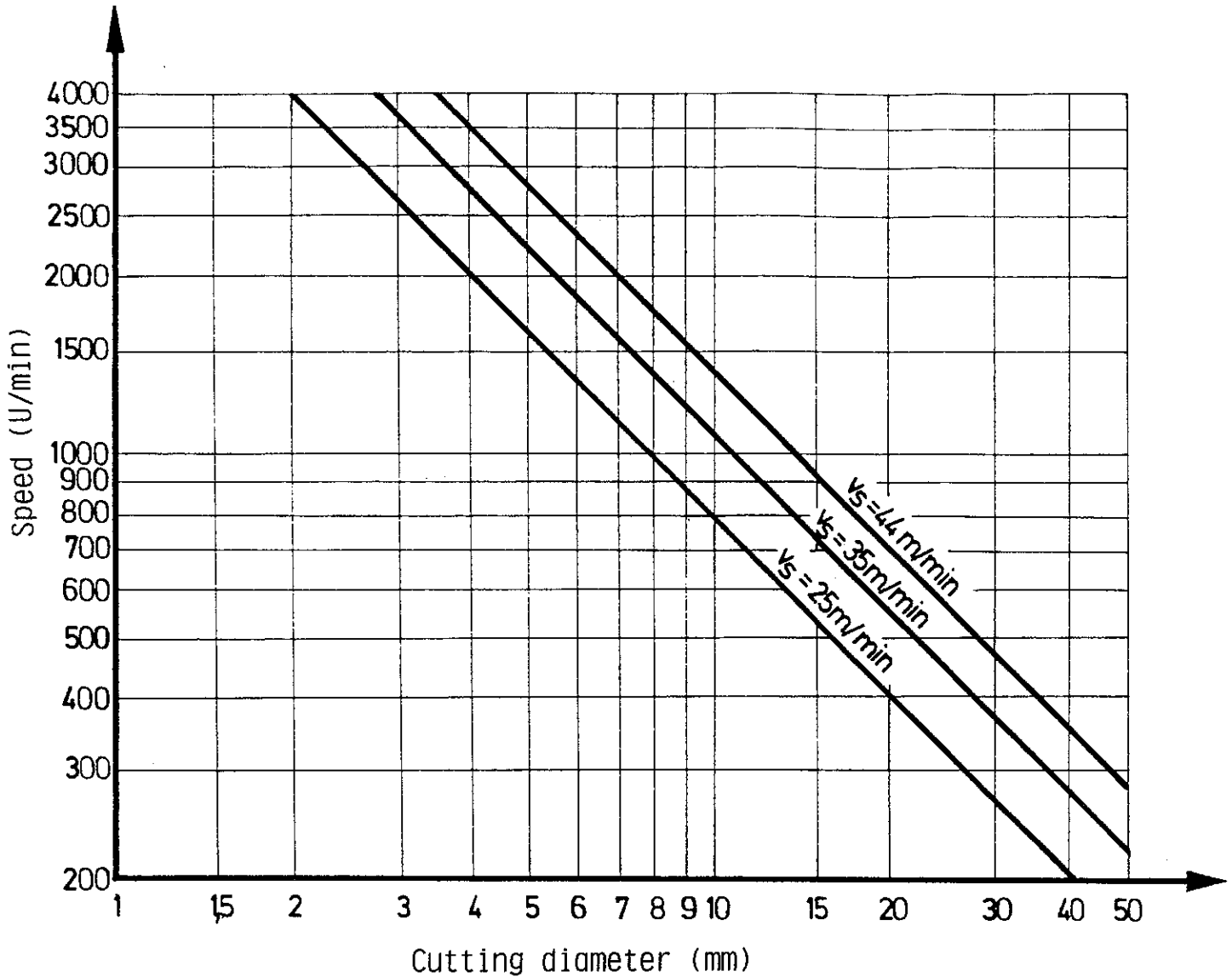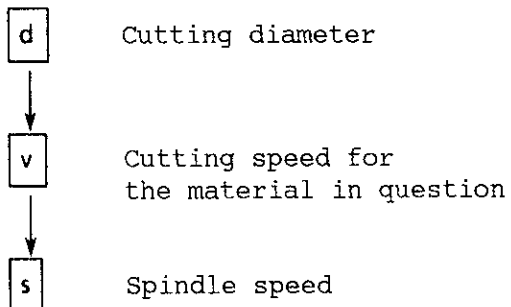
Determining the speed:		Determining the cutting speed:	
d	Cutting diameter	d	Cutting diameter
↓		↓	
v	Cutting speed for the material in question	s	Spindle speed
↓		↓	
s	Spindle speed	v	Cutting speed for the material in question
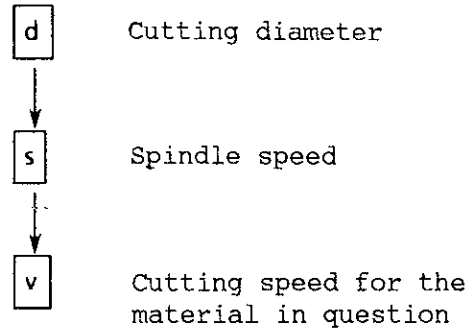
5. Tapping

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

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

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

6. Speed - Rating Chart (Main drive spindle)

Chapter F
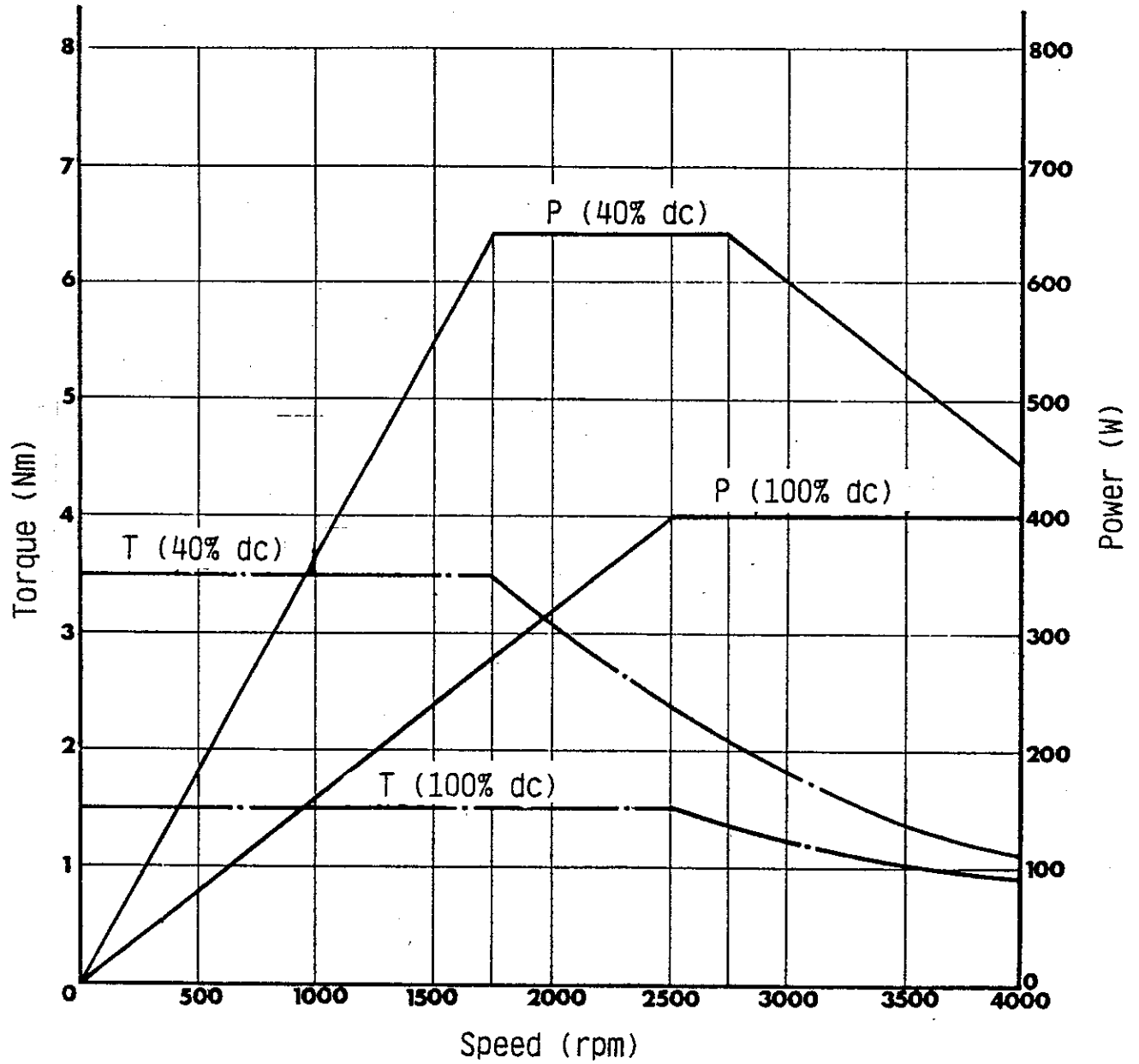
VMC-100 Accessories

VMC-100 Accessories

1. Clamping devices for workpieces

Table area L x B: 420 x 125 mm

Dimensions of the T-slots
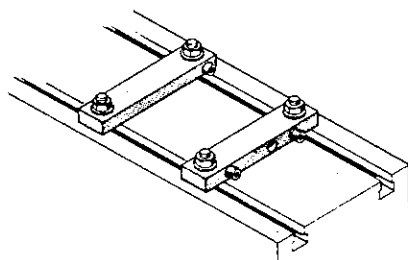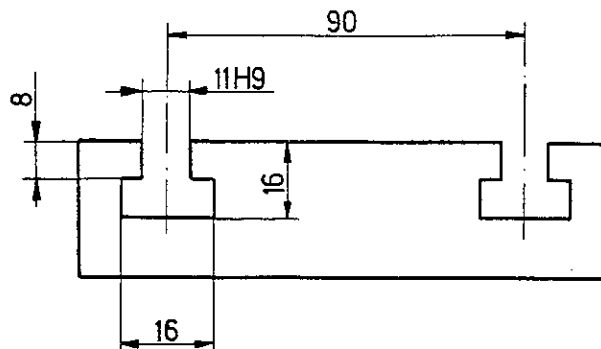
Clamping bars (Basic equipment)

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 boars 12 h 11.
Total height with clamping screws 22 mm.
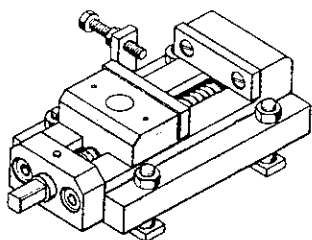
Machine vice with stop

Width of jaw: 60 mm

Clamping capacity: 60 mm

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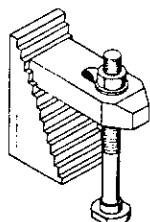
Incremental strap

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.
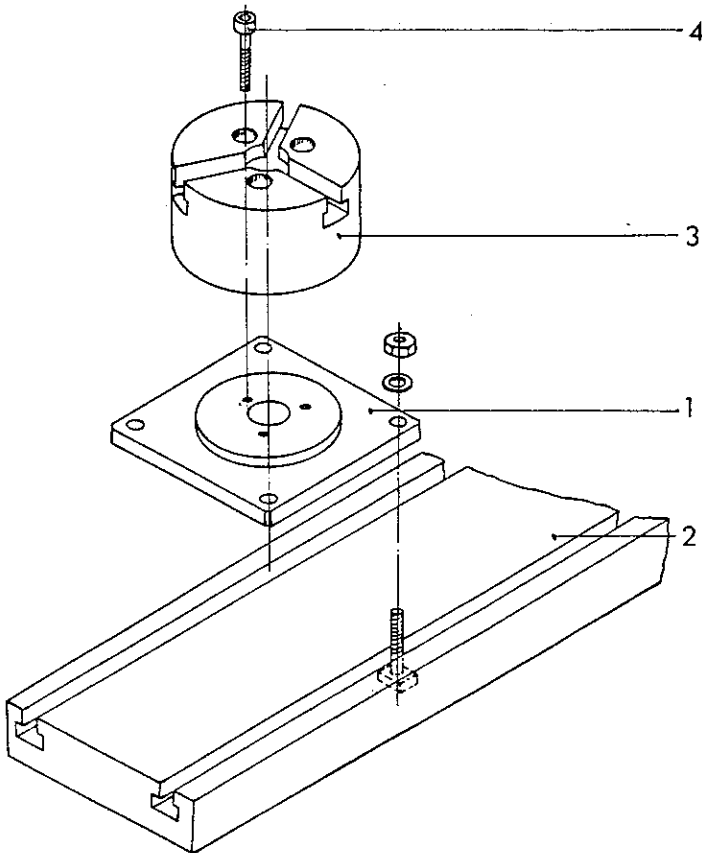
Dimensions, Chucking Devices EMCO Chuck, dia. 85 mm

Outside stepped jaws

3.3+0.3

18
1-29
21-49
45-73
69-97

49.2
46.2
57.7
66.2
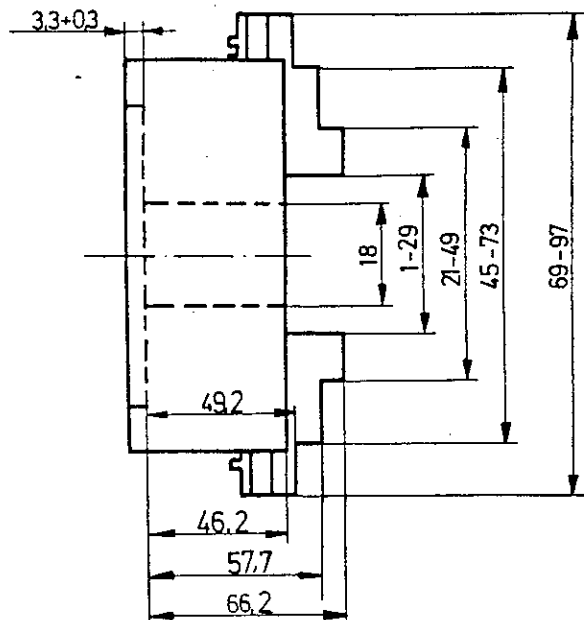
Pay attention to instructions on service and maintenance tips and to safety tips.
An instruction book comes with each chuck.

Soft jaws

3.3+0.3

70 H6

max. 97

46.2   17
63.2

Inside stepped jaws

3.3+0.3

20
25-53
49-77
69-97

46.2
49.2
57.7
66.2
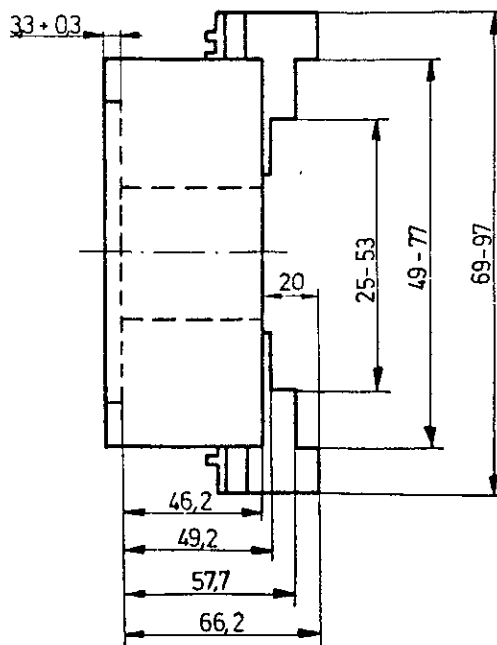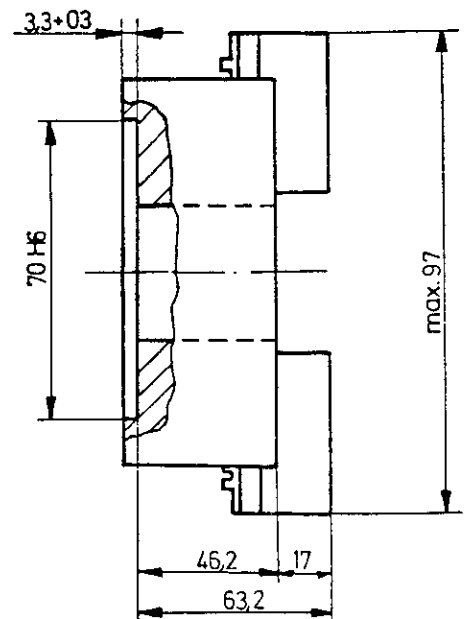
Measures in mm !

2. Clamping devices for tools

Collet holder ESX 16

The collet holder serves to accomodate collets ESX 16.
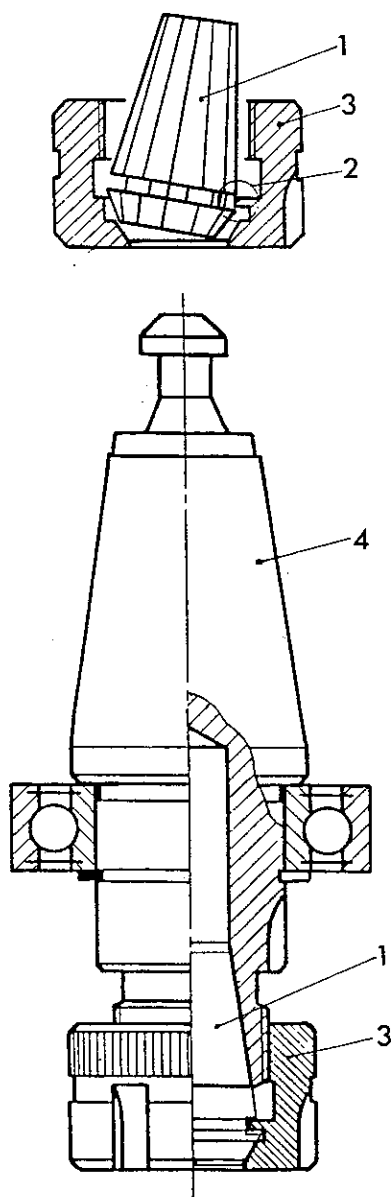
Assembly:

- 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. ∅)	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.
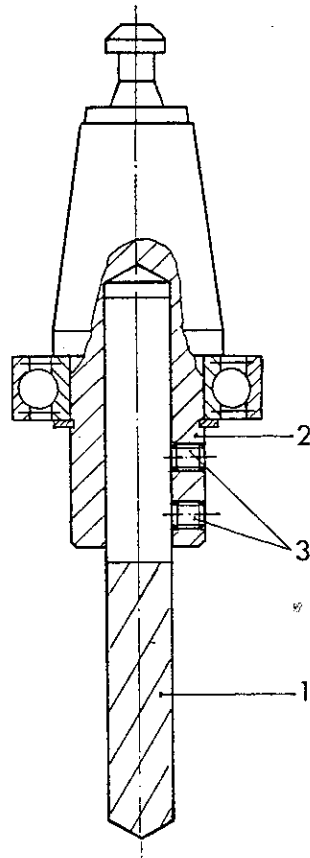
Mounting of tools:

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

milling cutter fixture Ø 12 mm
- spindle drill Ø 12 mm
- radius milling cutter Ø 12 mm
- angular milling cutter 16 x 4,
  form A and B with shaft Ø 12 mm

milling cutter fixture Ø 16 mm
- end milling cutter Ø 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.
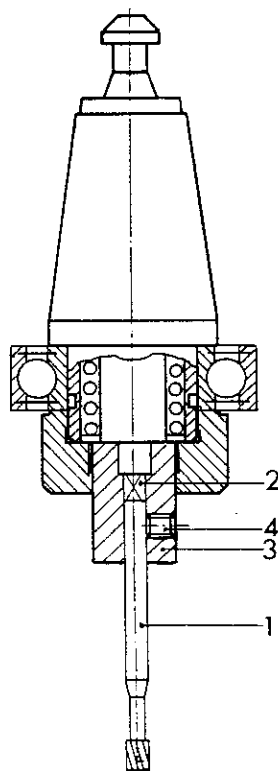
Mounting:

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.
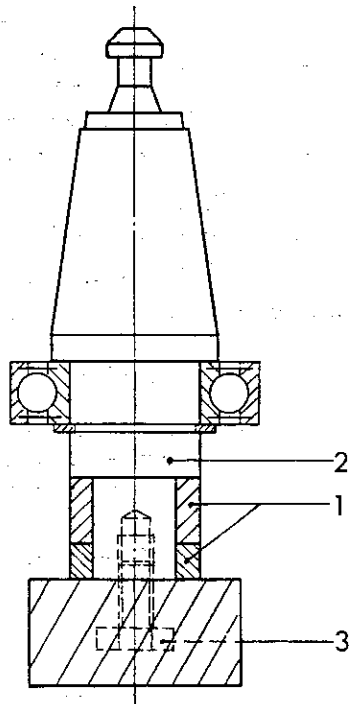
Mounting:

* 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

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).

View: machine from below
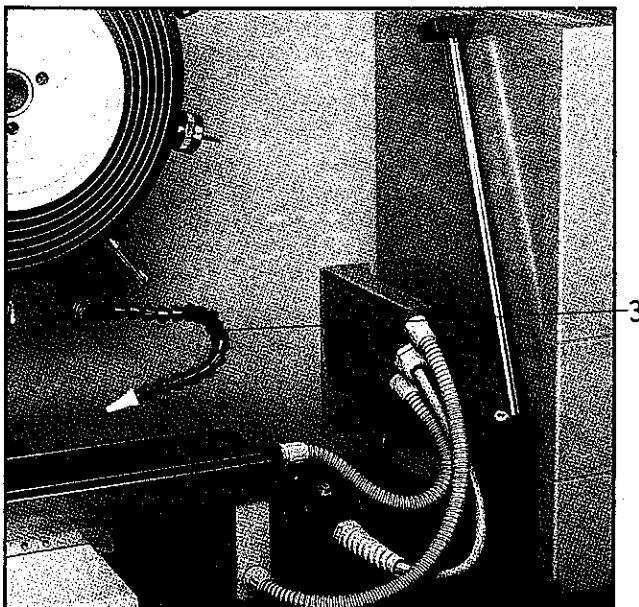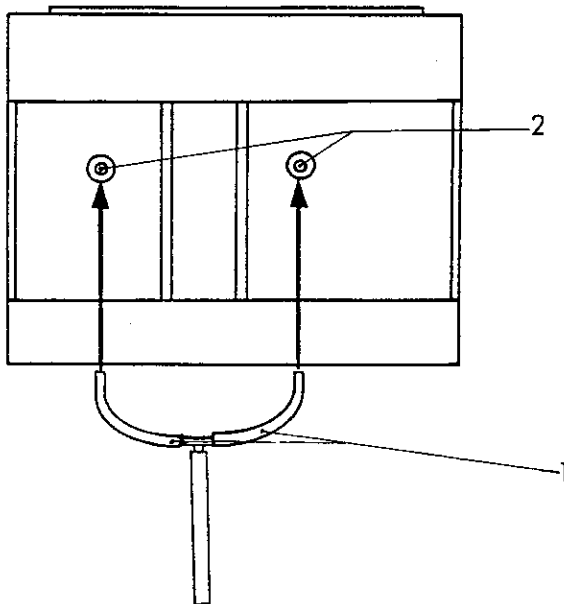
* Take off rear machine cover.

* Take off cover for coolant hose, put
  coolant hose (3) onto open hole
  and tighten from machine interior.
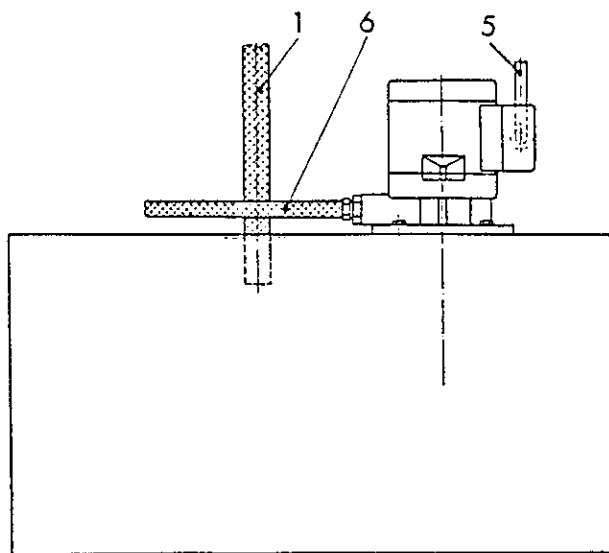
* Insert the belower end of the discharge
  hose (1) into the coolant tank.
  (Shorten discharge hose so that it
  discharges vertically into the
  coolant tank).

* Connect tube (6) on coolant pump and
  coolant tube, (on the back side of the
  machine, there is a breaking through
  to introduce the inflow hose).

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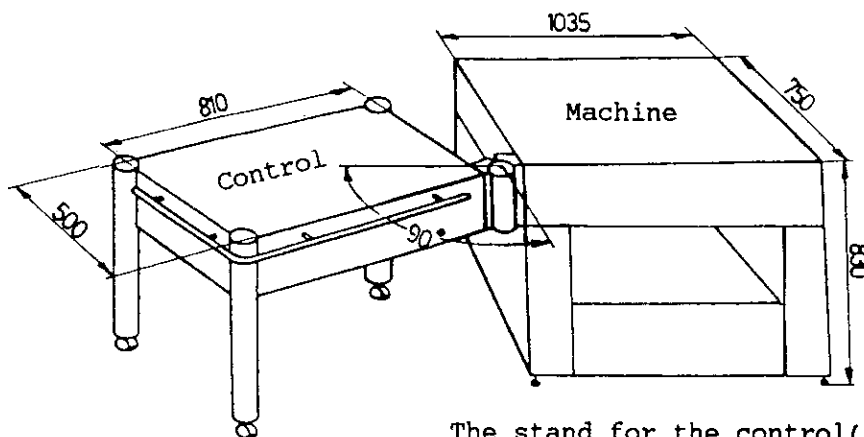
The stand for the control(1) can be
mounted to the left or to the right
side of the machine stand.
The joint(2), the handle(3) and the
legs(4) have to be mounted in the
correct way.
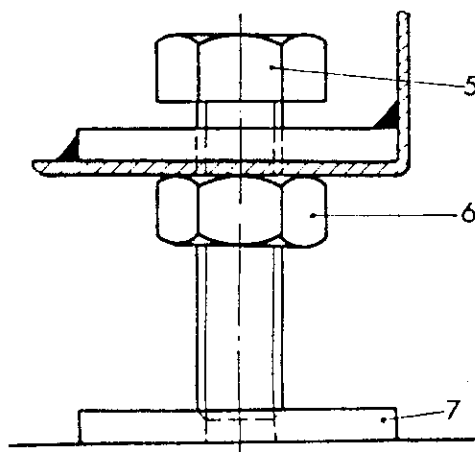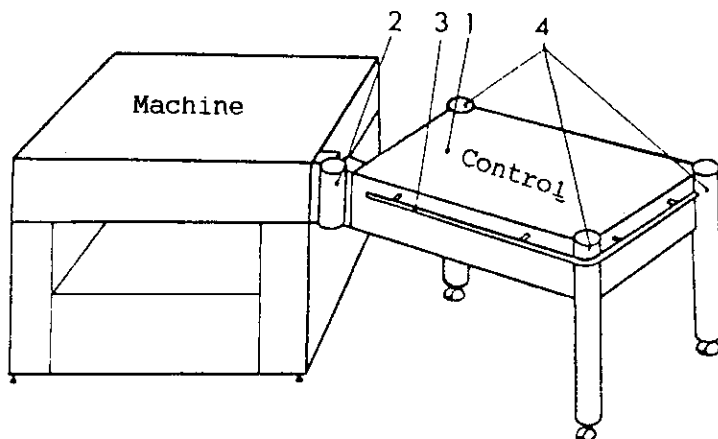
Adjusting the Height of the Machine Stand

- 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

Routine check and maintenance intervals

1.1 Oil tank for central lubrication

    Weekly check (see also following pages).

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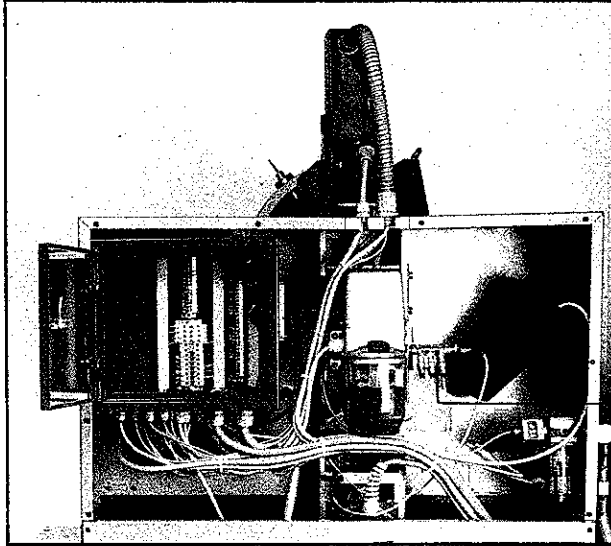
The longitudinal and cross slides are supplied with slideway oil by the central lubrication system. For this purpose the pump for central lubrication is activated at certain intervals and a specific quantity of oil fed to the lubrication points via metering elements (1).

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 filling screw

tank contents:
0,7 l

minimum oil level

Oil Consumption:

Every 10 m of total travel of the slides a lubrication pulse is emitted by the control. Approx. 0,2 cm³ of oil per lubricating pulse are pumped to the lubrication points. The oil consumption per hour depends on the travel of the slides.
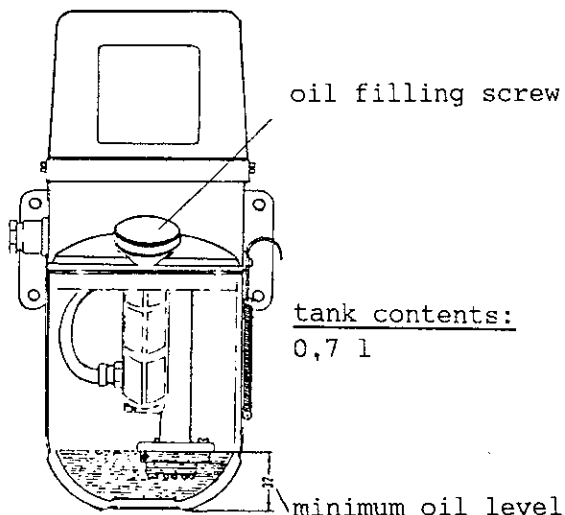
Venting the Lubricant Lines

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 ele-
ments).
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 lubri-
cant 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.
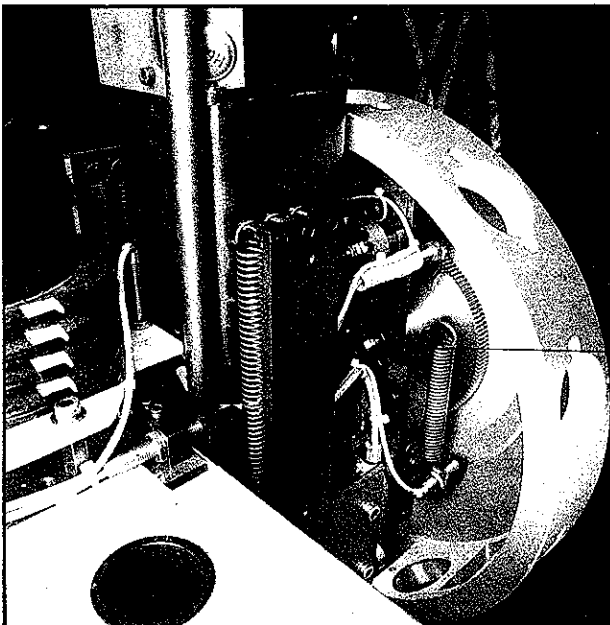
3. Lubricant- and Coolant Liquid Recommendations

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

DIN
CGLP 68
51502

Slideways

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

DIN
KP 2 M
51502

DIN
K 2 K
51502
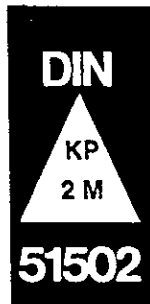
Greasing Points

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.

DIN SE 51502
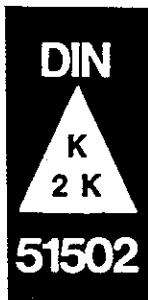
Coolant

CASTROL SYNTILO R – biostabile 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.

DIN SE 51502

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 H

Expansions

Chapter I

List of wearing parts

Chapter J

Readjustment works

Replacing the step motors
(Exchanging the toothed belts)

> Note:
> Disconnect the main plug prior to installation or removal of the step motors.

Removing:
(using X-step motor as example)
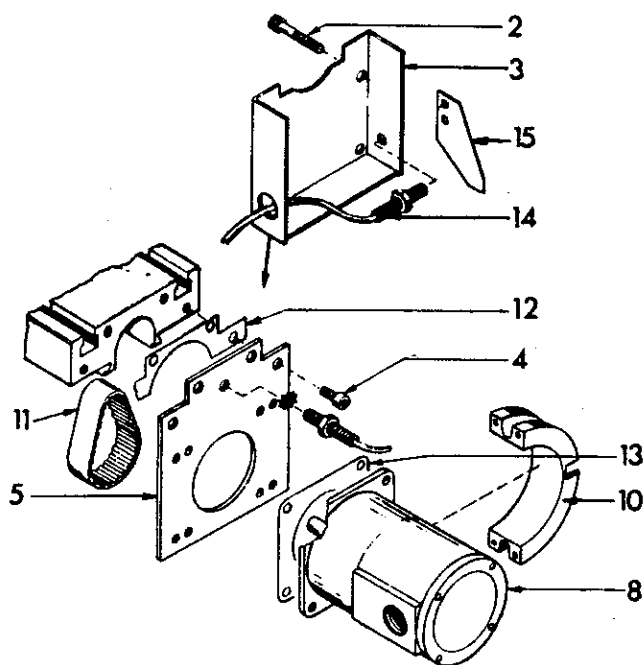
+ Dismount earthing cable (1).*
+ Unscrew the four socket head screws M6 x 40 (2) and remove belt guard (3)
+ Dismount step motor with base plate by unscrewing the four socket head screws M6 x 12 (4).
  (In case of Y-step motor remove back panel and lower side guard before, in case of Z-step motor remove both protection sheets before)
+ Remove belt (11)
+ Unscrew motor from base plate (3).*
+ Loosen set screw M6 x 6(6) and pull off motor pulley (7) from motor stub.*
+ Unscrew step motor cover (8) and disconnect cables below.*
+ Loosen cable screw union (9) and unthread cables.*
+ Dismount cooling element (10) from step motor.*
+ Clean the bearing surfaces adjacent to the two paper seals (12,13).

Attention:
The Y-step motor can only be exchanged as a mounted group consisting of the step motor, motor plate and sealing.

* These items do not apply for belt exchange.
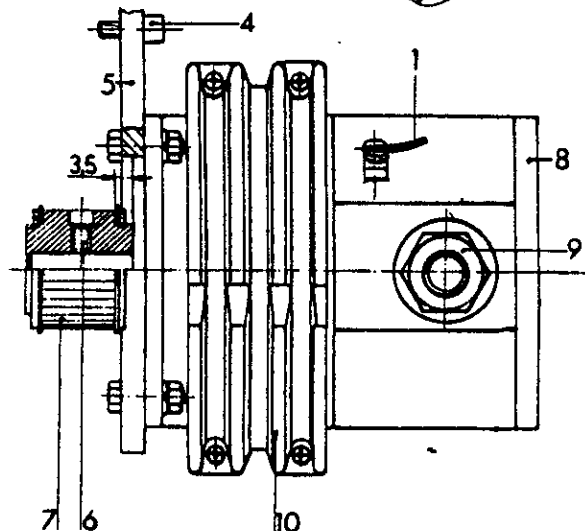
Fitting (by the example Y-step motor)

+ Mount cooling element (10) onto step motor.*
  (Mind: Lubricate cooling element before in any
         case using approx. 2 cm³ heat-conductive
         paste).

+ Screw motor plate (5) onto step motor.*
  (Insert paper seal 13).

+ Place motor pulley (7) onto motor stub and tighter
  with set screw M6 x 6(6).*
  (Set screw M6 x (6) to be secured with Loctite.)*
  Note: During fitting mind the distance from
        shim ring to motor front.
        It is 3,5 mm.

+ Insert cable in step motor and clamp cable screw
  union (9).*

+ Connnect cable in step motor (see table).

Wire Nr. color		step motor X
1	white	0
2	black	8
3	blue	6
4	brown	4
5	green	2
6	red	9
7	violet	7
8	pink	5
9	orange	3
10	transparent	1
green/yellow		earth (protective conductor)

Wire Nr. color		step motor Y
1	white	0
2	black	8
3	blue	6
4	brown	4
5	green	2
6	red	9
7	violet	7
8	pink	5
9	orange	3
10	transparent	1
green/yellow		earth (protective conductor)

Wire Nr. color		step motor Z
1	white	0
2	black	8
3	blue	6
4	brown	4
5	green	2
6	red	9
7	violet	7
8	pink	5
9	orange	3
10	transparent	1
green/yellow		earth (protective conductor)

+ Connect earth cable green/yellow (1) at the
  outside of the step motor.*
+ Screw housing cover (8) onto step motor.*
+ Insert pulley (11).
+ Place down step motor with base plate and screw
  in the four socket head screws M6 x 12 (4). (Do
  not tighten yet; insert paper seal 12)
  Mind: In case of Z-step motor lubricate the two
  support jaws of the motor plate sufficiently on
  top and below with heat-conductive paste.
+ Tension pulley and tighten socket head screws
  M6 x 12(4).
  (For pulley tensioning press the step motor with
  approx. 10 - 15 N).
+ Check the distance between the proximity detector
  (14) and the limit switch sheet (15). This
  distance has to be 0.5 mm (If necessary,
  readjust,tightening torque max. 6 Nm).

+ In case of Y-step motor remount back panel and
  lower side guard, in case of Z-step motor remount
  the two guard plates.
+ Remount pulley guard (3).

+ These items do not apply for belt exchange.

14   15
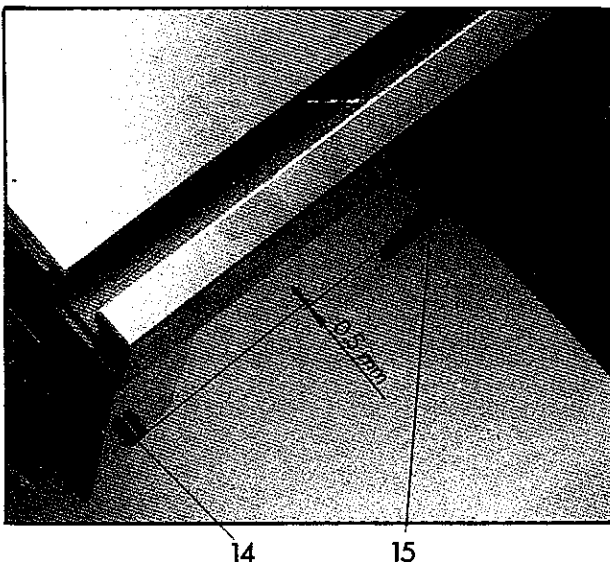
Replacing the X-, Y-, Z-spindles

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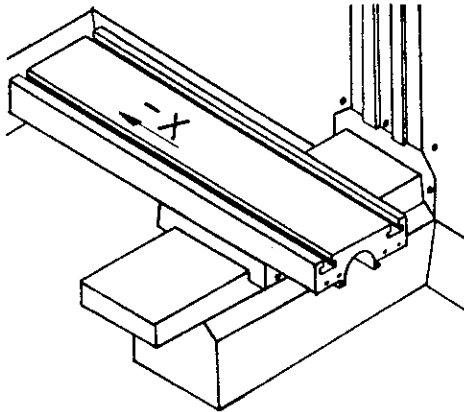the spindles are not bent.

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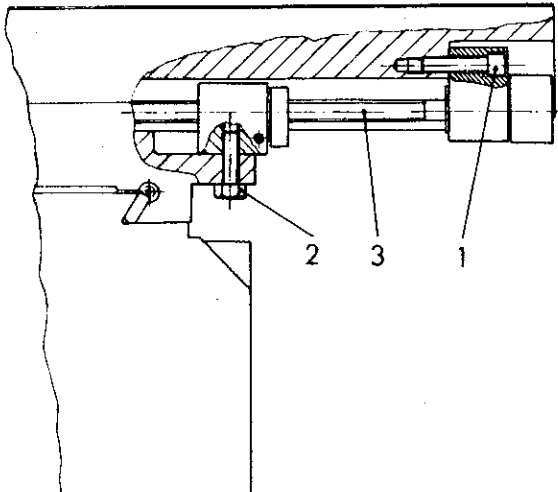the balls to fall out.

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.

2   3   1

+ 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).

Note:

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

2 5 3

5   6   4
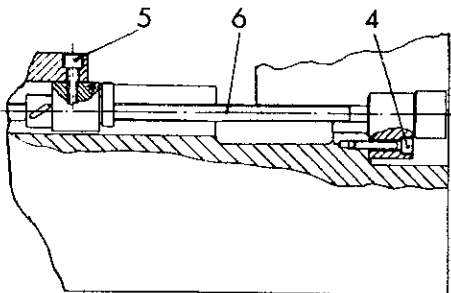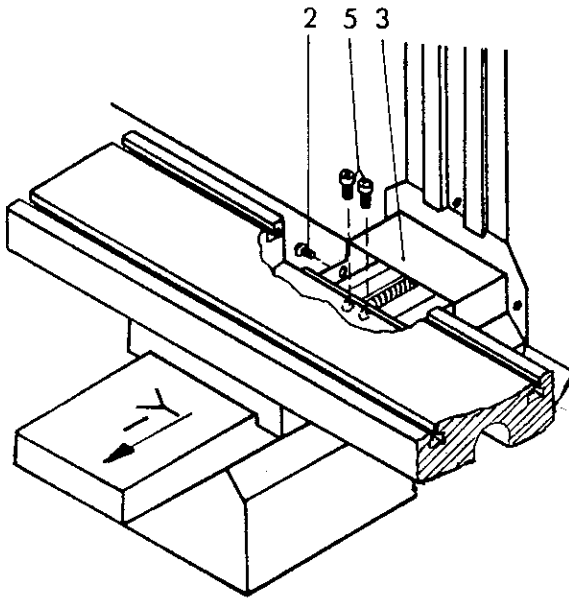
+ Remove back panel.
+ Remove lower side guard.
+ Unscrew the four oval-head screws
  M6 x 10(2) for protective sheet 2 (3) and
  push back the protective sheet.
+ Unscrew socket head screws M5 x 25(4) on
  the bearing pedestal.
+ Unscrew socket head screws M6 x 12(5) for
  nut mount.
+ Pull out spindle (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.
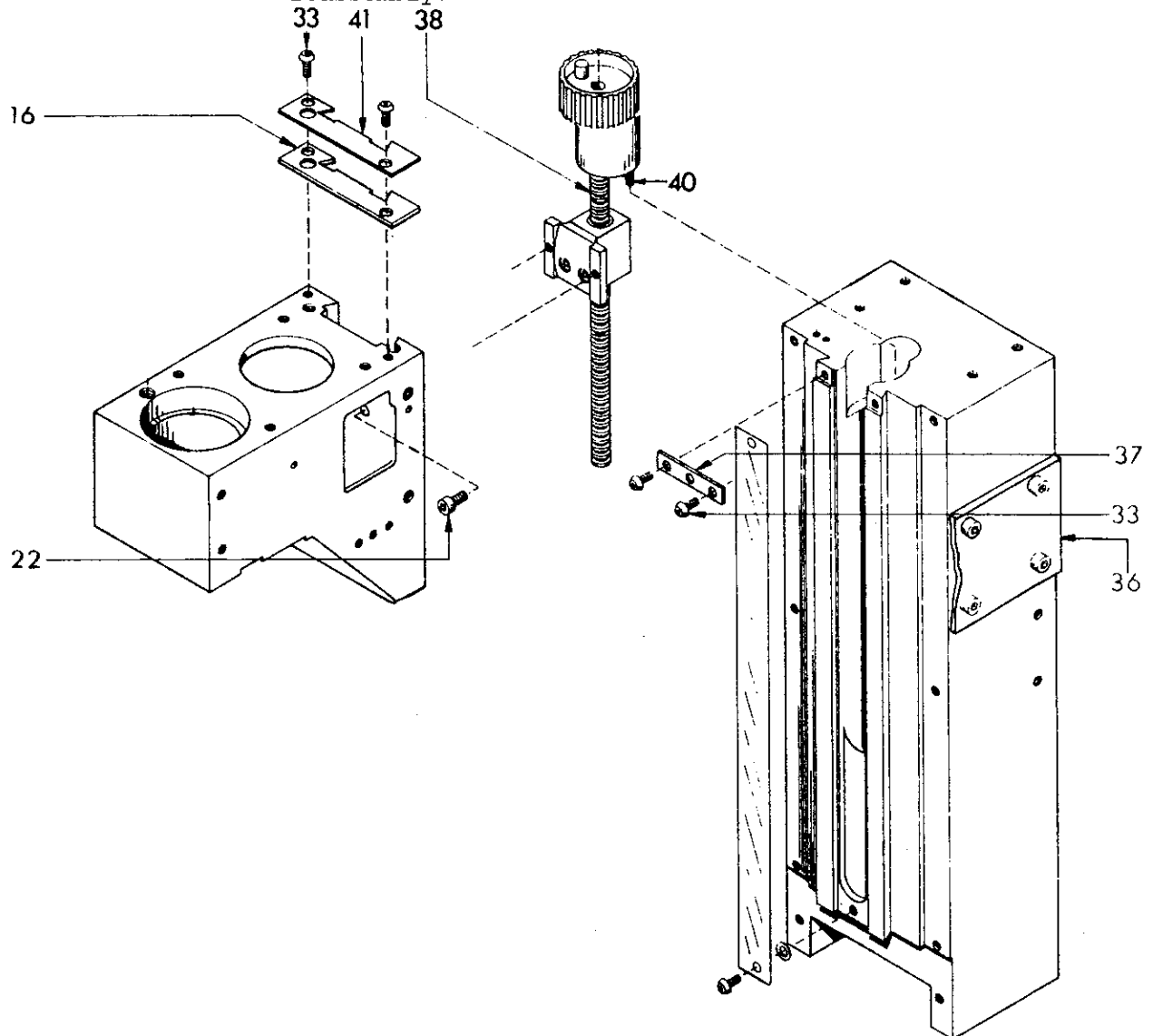
+ Dismount protective sheets for Z-step motor.
+ Unscrew oval-head screws M6 x 10(33) for holding plate (37) and remove the holding plate (37).
+ Unscrew oval-head screws M6 x 10 (33) for stripper plate and remove stripper plate (41) with stripper felt (16).
+ Unscrew the two socket head screws M6 x 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
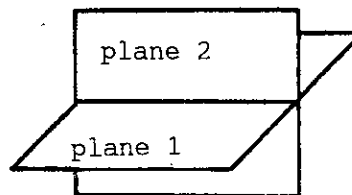
Distortion in plane 1
(plan view)

Distortion in plane 2
(front view)
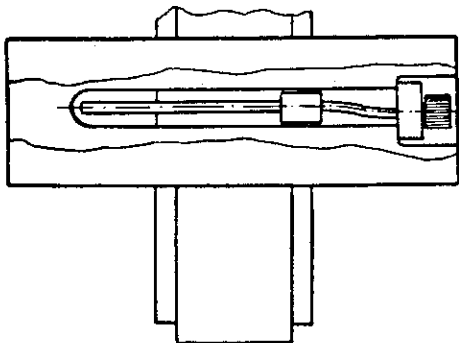
Spindle distorted on the side
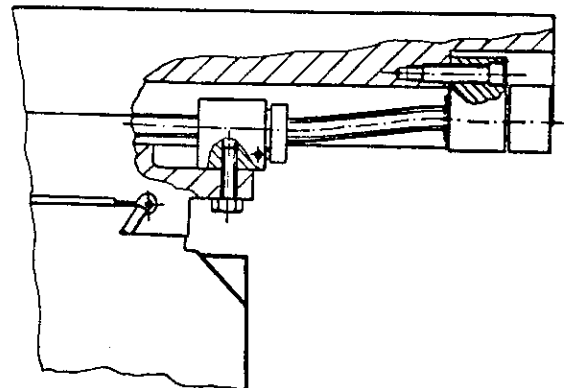
Spindle distorted in height

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

(X spindle example)
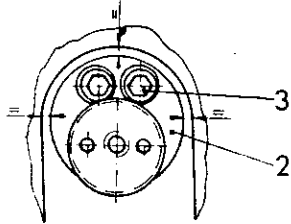
+ Thread spindle, screw bearing
  pedestal (2) with cheese-head
  bolts M5 x 25 (3) firmly, so
  that it is centrically placed
  in the milling out.
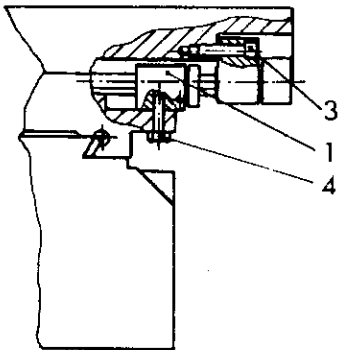
+ Screw the nut mount (1) with
  the hexagonal bolts M6 x 12 (4)
  firmly.
  Move slide or adjust nut mount
  so that it can be fastened with
  the hexagonal bolts.
+ Crank the slide completely to
  the right.
  Keep the distance between the
  nut mount - bearing pedestal,
  as small as possible.
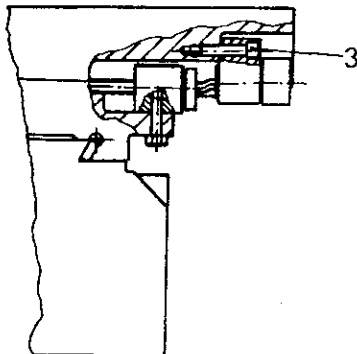
It is now possible that the spindle
is tensioned in the elevation
(level 2).

Remedy:

+ Loosen the bearing pedestal hex-
  agonal 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.

Plan view
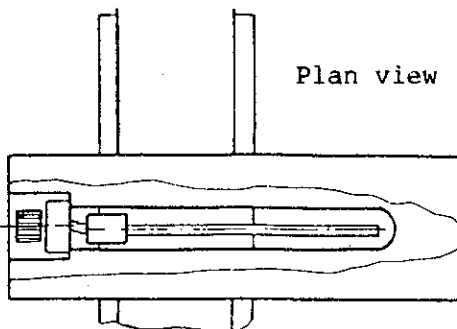
Possibility:

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.

J7

+ 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)
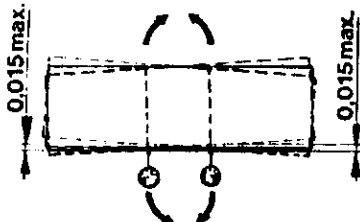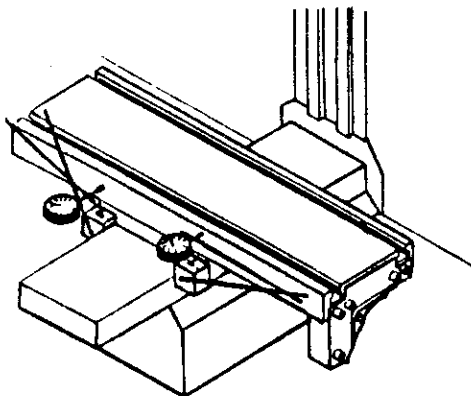
b) Y slide

Gauge on base
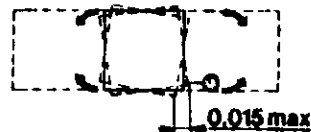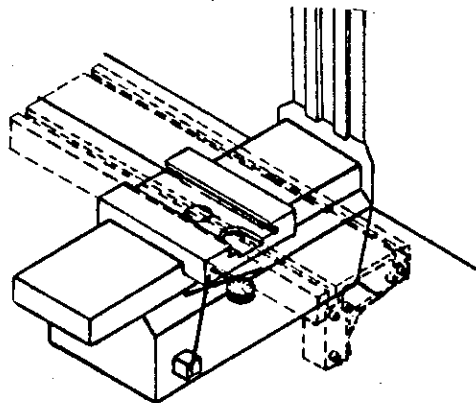
c) Z slide

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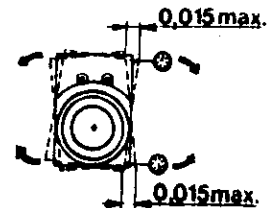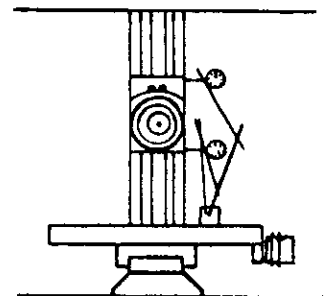
The gauge is only applied at the front, since the slide is guided at the rear by scraper felt.

Readjusting the taper gib strips

The slide clearance is readjusted with the appro-
priate 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.
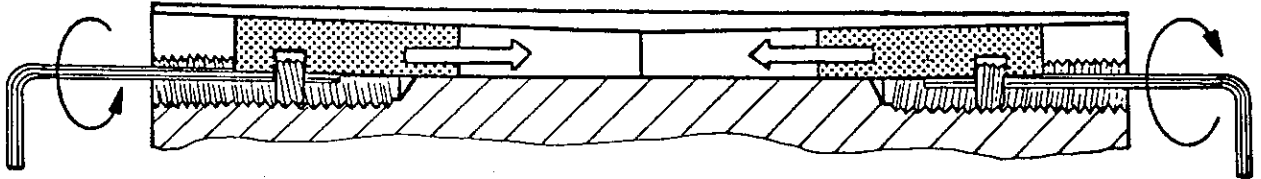
Process:

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
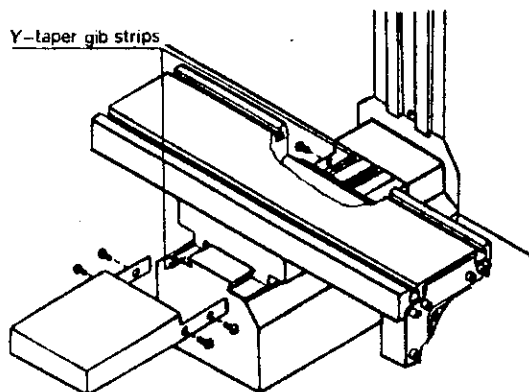the steps (feed force of the step motor is about
1300 N (130 kp).

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

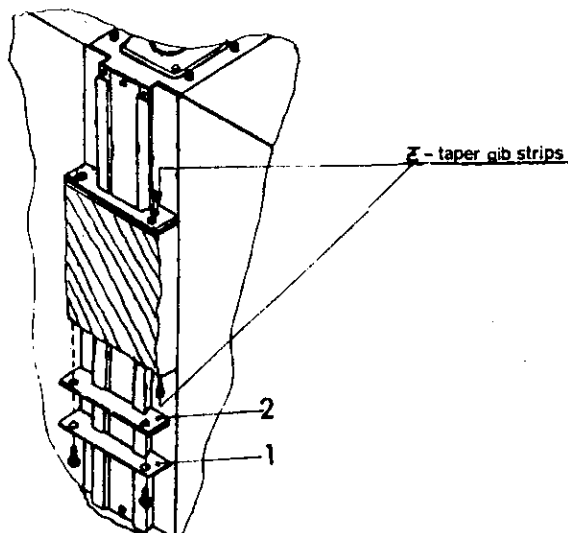## Position of the taper gib strips
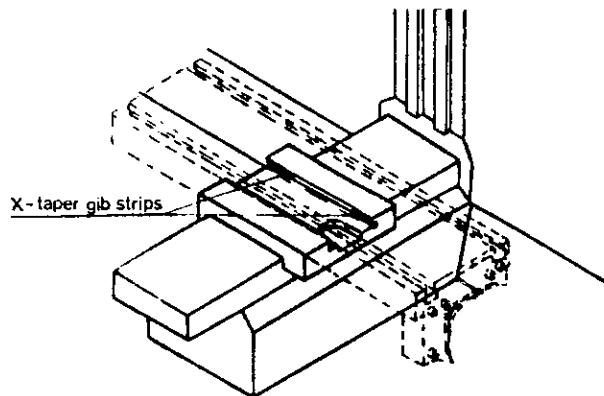
X taper gib strips

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

X-taper gib strips

Y taper gib strips

Remove protective plates
1 and 2.

Y-taper gib strips

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
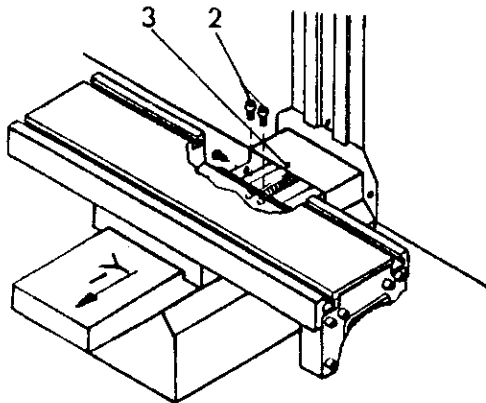plate (1) and stripper felt (2) are to
be dismounted.

Z-taper gib strips

2

1

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
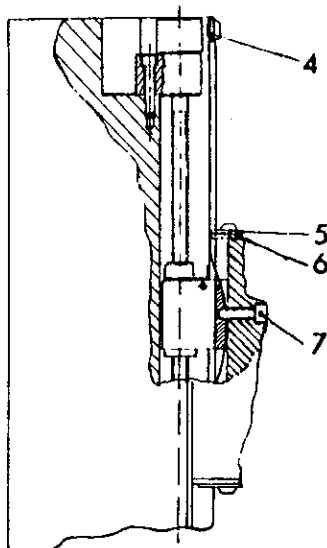movement force should not exceed 150 N (15 kp).
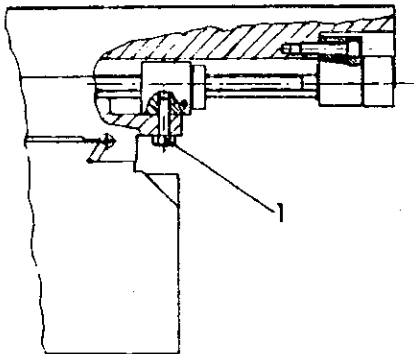
X slide:

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, how-
ever 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 par-
  ticular 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 ex-
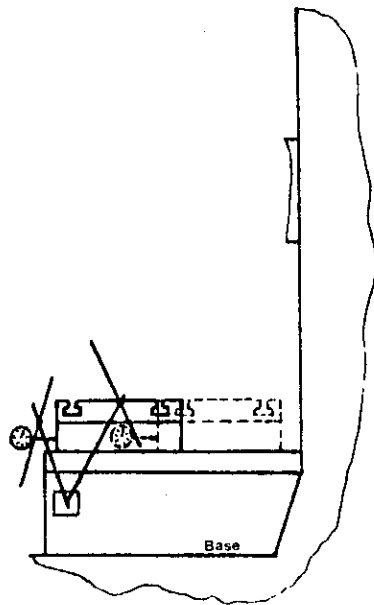ceeded.

Adjustment of the reveral clearance

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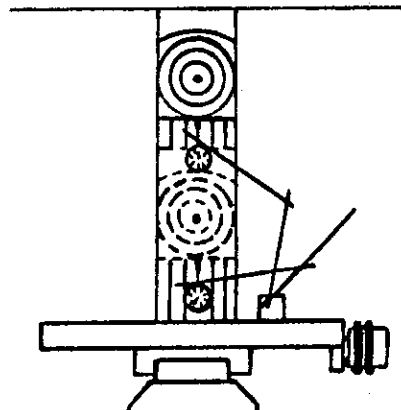gets larger at the same time).
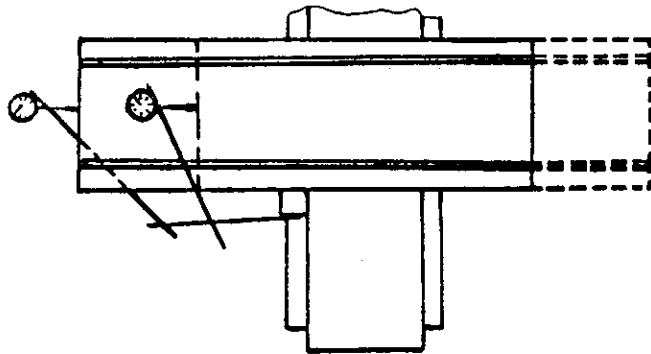
X slide

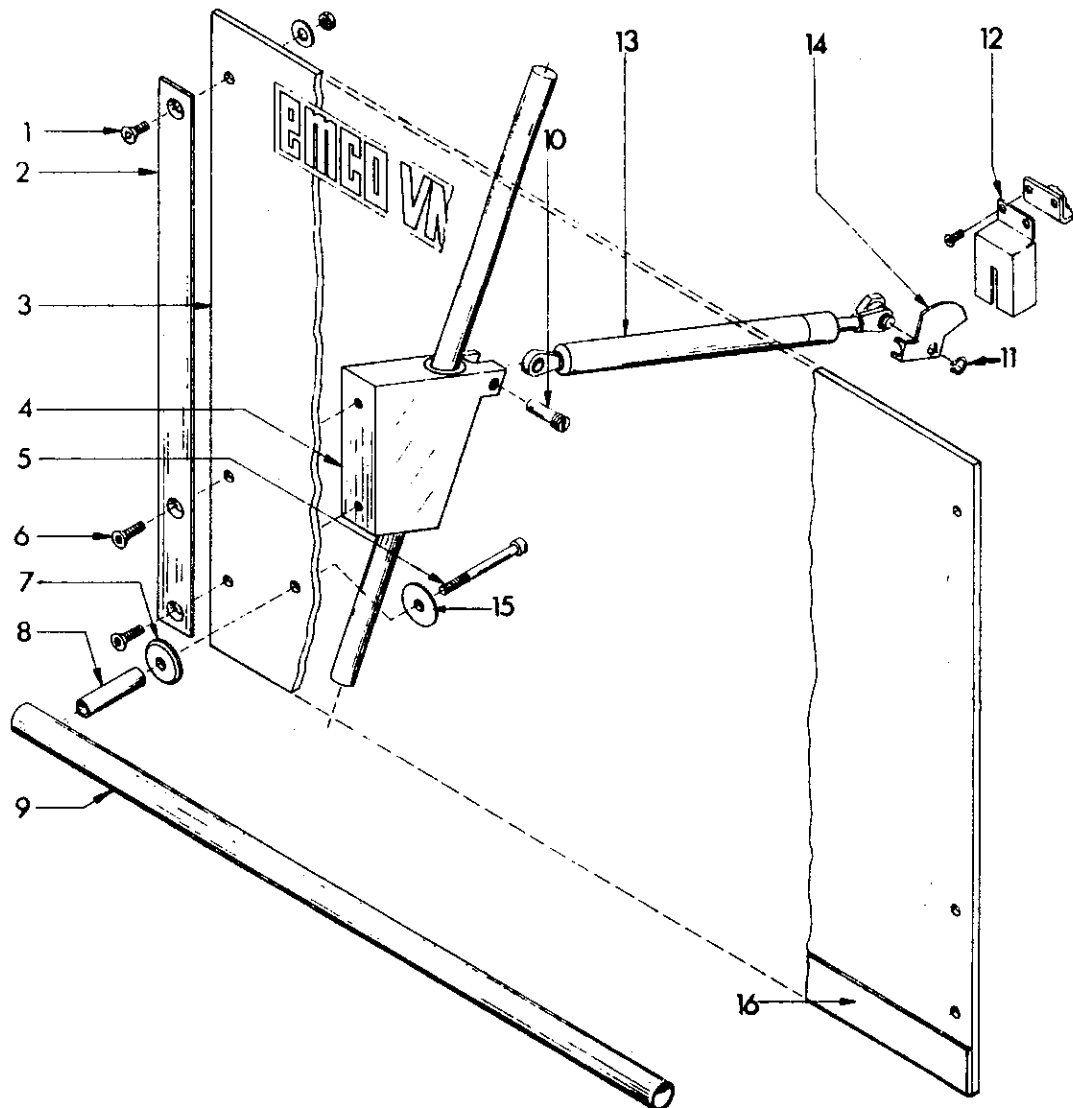Gauge on the Y slide

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
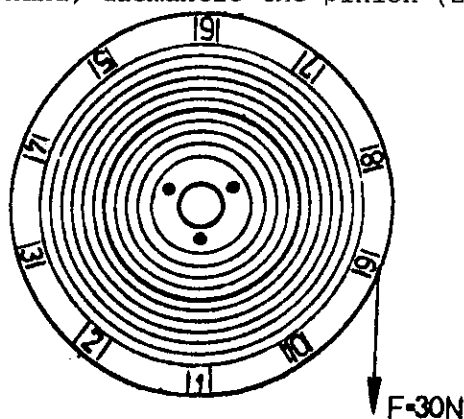has to be adjusted again.
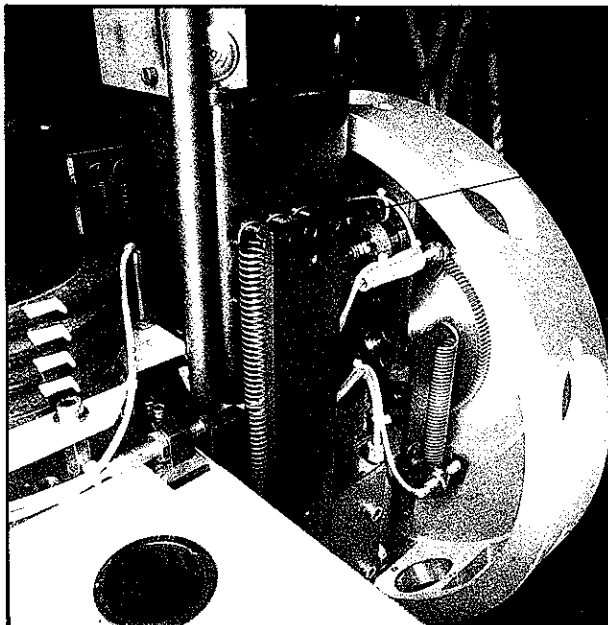
Procedure:

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
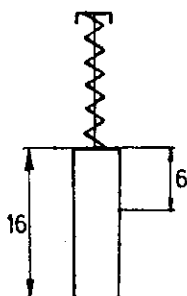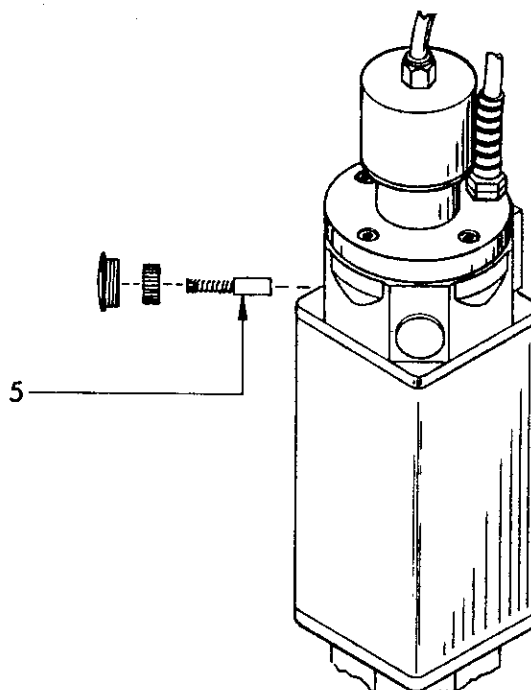will not turn automatically any
more.
(Beforehand, dismantle the pinion (2).

F=30N

Control of carbon brushes
on main drive motor

Mind:
Switch off machine before
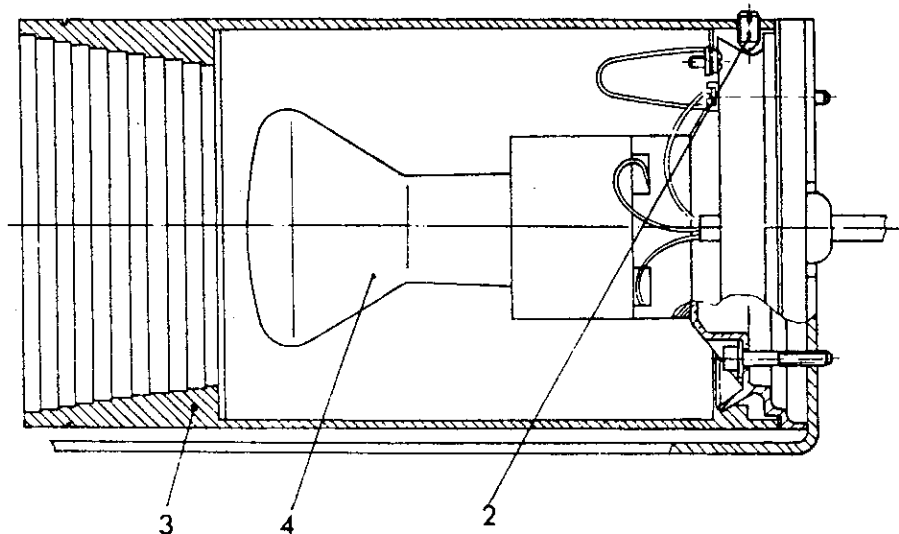checking the carbon brushes.

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.                   │
│                                      │
└─────────────────────────────────────┘
```
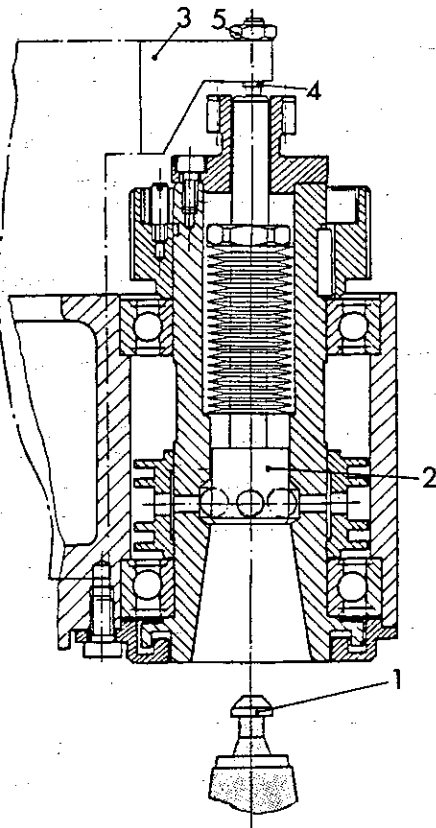

Dismantling:

- 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 accomodated.
- Turn the clamping screw (4) about a further 90° and lock again in this position.