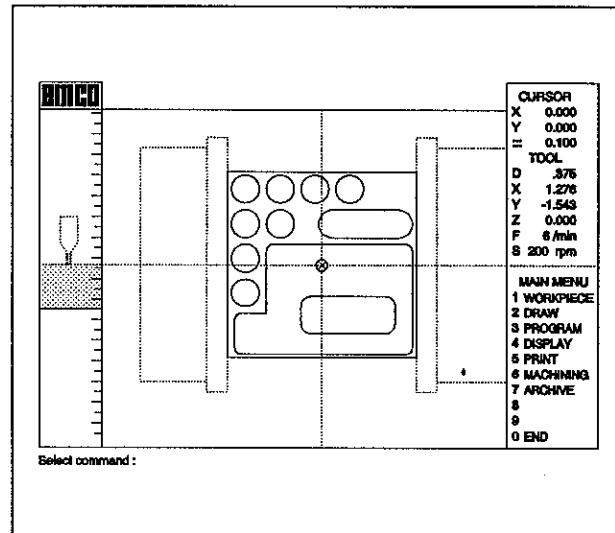
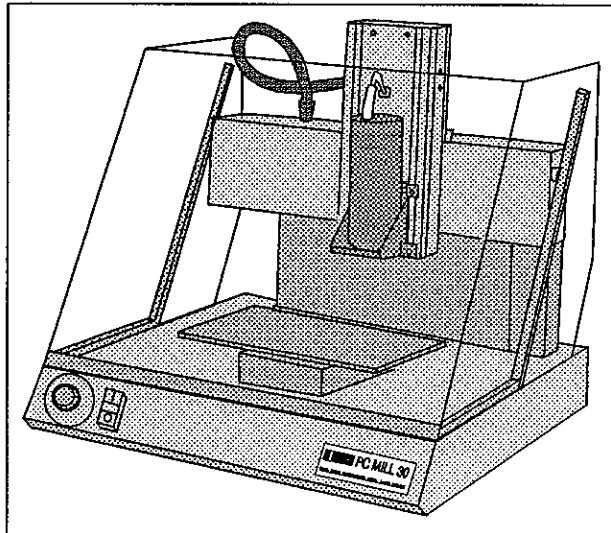


# Manual

# EMCO PC MILL 30

# PC Controlled Milling Machine

Edition 1995  
Ref. No. EN 4300



Manual  
EMCO PC MILL 30  
A95-2            EN4300



## Preface

For more than four decades EMCO has been developing wood and metal working machines and has also been successfully on the market since 1980 with computer controlled machine tools (CNC machines), particularly on the training sector.

This high degree of experience is a profit for the turning and milling machines of the PC-TURN and PC-MILL model series.

The newly designed compact machines meet entirely today's requirements in construction and set up as well as safety.

The PC machines are operated via a conventional personal computer (PC). The programming station software is used for the simple, convenient and rapid creation of CNC programs for controlling the EMCO PC MILL 30. This software is generated on the basis of didactic principles and imparts basic CAD/CAM knowledge in conjunction with a CNC programming language (according to DIN 66025).

The software consists of an easy-to-operate CAD/CAM section and an editor for the manual generation of CNC programs with subsequent graphic simulation. This offers the possibility of either generating the CNC-program automatically or entering the CNC blocks manually.

One of our more than 100 general representatives worldwide will inform you on particular new developments (e.g. clamping options for workpieces or tools, new softwares, etc.) and their fitting possibilities.

In the present operating instructions you will find a complete description of safety hints, transport, set-up, operation and maintenance of the machine. Therefore read this instructions completely before machine start-up.

**EMCO MAIER Gesellschaft m. b. H.  
Department Technische Dokumentation  
A-5400 Hallein, Austria**

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## Adequate Use

The machine is designed for milling and drilling work of machinable synthetic materials (plexiglass, recommended: cured polyurethane resin as e.g. CIBA-GEIGY CIBATOOL BM 5500) and to a limited degree machinable aluminium and brass .

Machining of other materials is not admitted and may be carried out in particular cases only after consultation with the machine manufacturer.

Adequate use also includes compliance with the operating, maintenance and repairing instructions indicated by the manufacturer.

The machine may exclusively be operated and maintained by persons familiar with operation, maintenance and repair and who know about the hazards.

All regulations for the prevention of accidents and safety instructions for work with machine tools and CNC machine tools have to be complied with at any time.

In case of inadequate use of the machine the manufacturer renounces any liability and the responsibility is transferred exclusively to the user.

## Safety Recommendations

### **Read documentation**

Read this documentation completely before you start up the machine.

### **Electrical connection**

The electrical connection of the machine must only be carried out by electrics experts.

### **Authorized operation**

The machine may only be operated by authorized persons.

Protect the machine against unauthorized start-up.

### **Start-up**

Make sure that prior to each start-up the machine is in perfect maintenance state and that no safety features have been removed.

### **No modifications on machine**

Modifications on your own on safety features, bridgings of control features as well as any interference with the electric/electronic part of the machine is prohibited.

### **In case of hazards EMERGENCY-OFF**

In case of hazards immediately actuate the EMERGENCY-OFF button to stop the machine.

### **Safe clamping**

Prior to start of operation check if workpiece and tool are clamped safely.

### **Observe speed limits**

Clamping devices and tools are subject to speed limits.

Thus observe the maximum speed of the clamping devices and tools used by you.

### **Use chip hook/brush**

Remove chips only with machine switched off and by means of a chip hook/brush.

### **Do not reach into running machine!**

### **Tool change**

Change machining tools only during standstill of machine.

### **Measurement work**

Carry out measurement work only during standstill of the machine and with EMERGENCY-OFF key actuated.

### **Wear body protection**

Mind that your hair does not get caught in the machine-hair protection to be worn.

Protect your eyes with safety-glasses.

Do not wear loose working clothes. Mind that the working clothes are tight around the wrists and hips.

### **Machine supervision**

Never leave running machine unattended.

Before leaving the working place switch off machine.

### **Maintenance and readjustment work**

All maintenance and readjustment work may be carried out only with machine switched off and EMERGENCY-OFF key actuated.

### **Claim**

In the event of a collision or instance of damage, contact the representative or manufacturer.

In case of complaints, damage, confusions and spare parts orders always indicate the machine number.

For parts not supplied by EMCO, EMCO will not assume liability.

## Technical Data of the Machine

<b>Working area</b>		
Slideway longitudinal (X-axis)	[inch / mm]	12,2 / 310
Slideway cross (Y-axis)	[inch / mm]	8,7 / 220
Slideway vertical (Z-axis)	[inch / mm]	3,5 / 90
<b>Milling table</b>		
Max. table load	[lb / kg]	4,5 / 2
Clamping surface (L x D)	[inch/mm]	13 x 8,7 / 330 x 220
Number of tapped bushes for clamping (L x D)		7 x 5
Grid of tapped bushes for clamping	[inch / mm]	1,97 x 1,97 / 50 x 50
<b>Milling spindle</b>		
Type of bearing		roller bearing
Tool clamping device		collets
Tool clamping procedure		manual
<b>Milling spindle drive</b>		
<b>AC Motor</b>		
Power	[hp / W]	0,8 / 600
Speed (infinitely variable)	[rpm]	10000 – 30000
<b>Feed drives</b>		
Step resolution	[inch / mm]	0,0004 / 0,01
Max. feed force	[lbf / N]	112 / 500
Operating feed in X/Y/Z (infinitely variable)	[inch/min / mm/min]	O-33 / O-850
Rapid feed in X/Y/Z	[inch/min / mm/min]	33 / 850
<b>Electrical connection</b>		
Voltage	[V]	110
Max. voltage fluctuation		+10% / -10%
Frequency	[Hz]	60
Connected load	[kVA]	1
Main fuse	[A]	10 slow
<b>Machine dimensions</b>		
total length x total depth x total height	[inch] [mm]	23,6 x 24,8 x 21,7 600 x 630 x 550
total weight of machine	[lb / kg]	88 / 40

*Subject to technical modifications!*

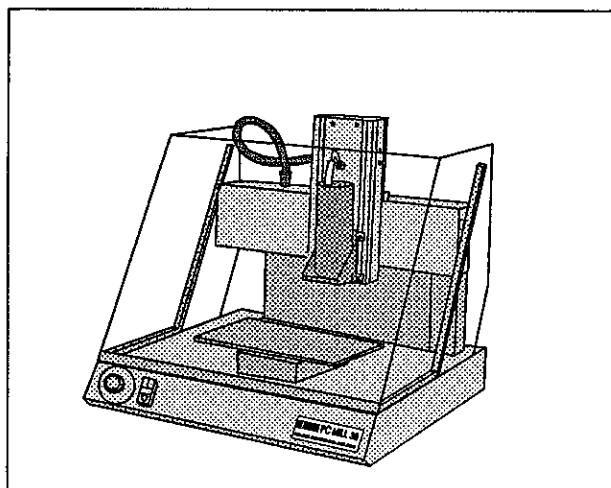
## PC Configuration

	minimum configuration	recommended configuration
IBM or IBM compatible	PC 80286	PC 80386DX
Hard disk	20 MB	100 MB
Disk drive	3.5"	
Operating system	MS DOS version 5.0	
Main storage	1 MB	4 MB
Graphics card	EGA	VGA
Display	EGA display 14"	color display 17"
Serial interface	1	2

*Subject to technical modifications!*

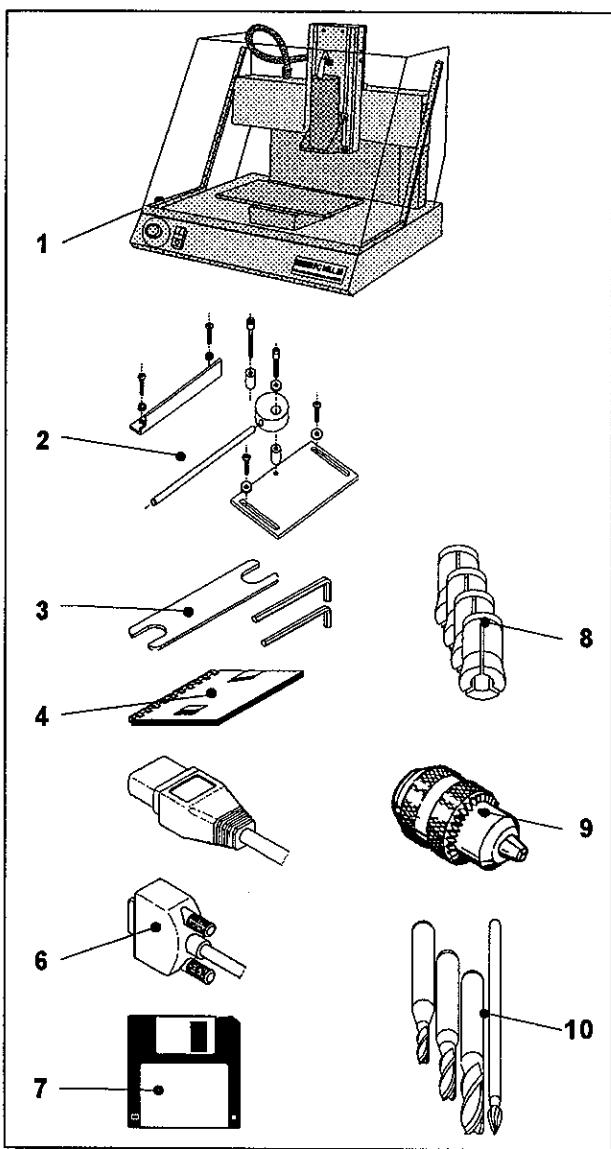


## A Machine Installation



### Machine Acceptance

- Check the machine for any transport damage and completeness of the delivery.
- If you find any defects, please contact the transport company, the dealer or the insurance company.

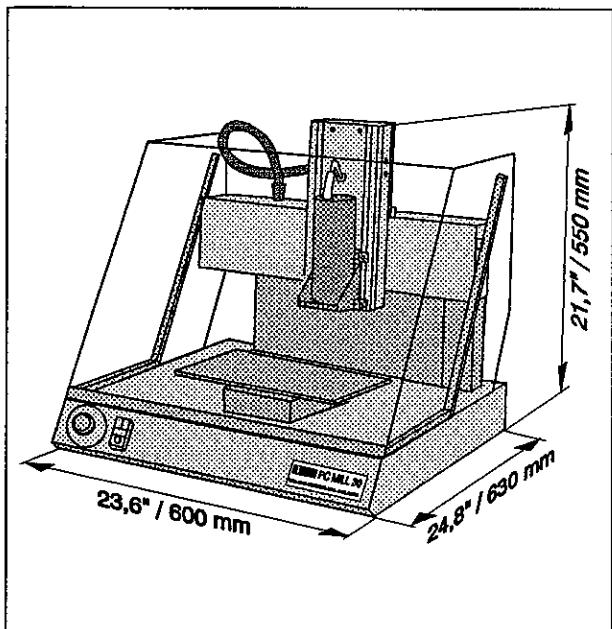
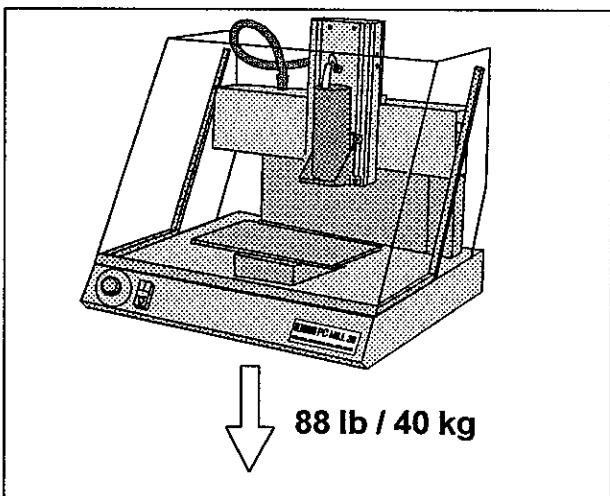


Scope of supply

### Scope of Supply

1. Milling machine EMCO PC MILL 30 with complete electric equipment, chip guard door and safety package.
2. 1 set split vice
3. 1 hexagonal key SW 17/19 mm  
2 hexagonal socket screw keys
4. 1 manual
5. 1 power cable
6. 1 9-pole interface cable (RS 232, fix mounted)
7. 1 floppy disk with CAD/CAM software
8. 4 collets
9. 1 drill chuck
10. 1 set of tools  
end mill 1/16 "  
end mill 1/8 "  
end mill 1/4 "  
engraving tool

*Subject to modifications!*

*Dimensions of the machine**Transport of machine*

## Dimensions of the Machine

Length .....	23,6"
Width .....	24,8"
Height .....	21,7"

## Transport of the Machine

For transporting the machine can be carried by two persons.

Weight of machine ..... approx. 88 lb



### DANGER

#### Safety instruction:

For transporting the machine always disconnect it from power supply, remove chips and fix loose parts before.

## Installation Requirement

The machine has to be placed on a stable table.

Weight of machine ..... 88 lb

Ideal table height ..... approx. 26"

Installation width x depth ..... 23,6" x 24,8"

#### Note:

Mind that the ventilation slots on the electric cabinet are not blocked or covered.

In case of insufficient ventilation disturbances on the machine due to too high temperature might occur.



## Electrical Connection of the Machine

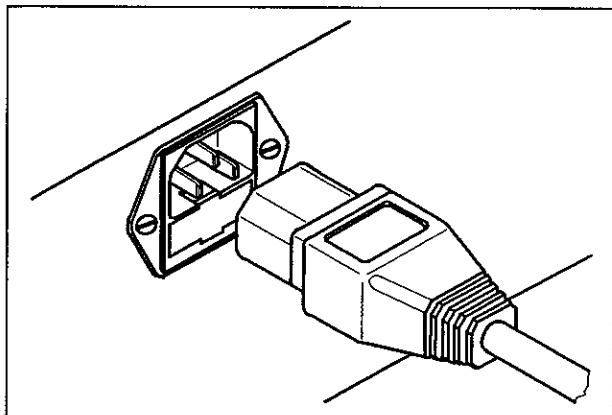


### DANGER

#### Safety instruction:

A ground wire contact must be available at the socket.

Voltage:	110 V 1/N/PE~60 Hz
Connected load:	1.0 kVA
Main fuse:	10 A slow
Max. voltage fluctuations:	+10% / -10%



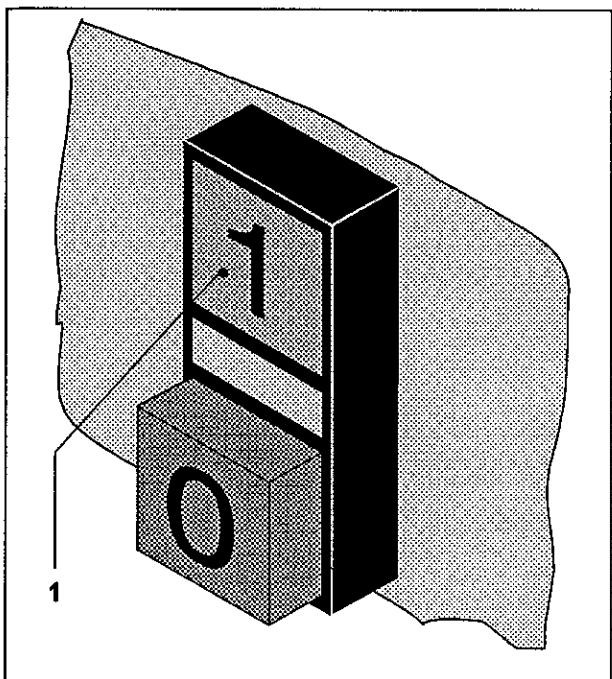
*Power connection of the machine*

### Connection of the power cable

- Plug in the power cable (1) at the back side of the machine and the other end at a socket with ground wire contact.

## PC Connection to the Machine

- Plug the interface cable (fix mounted at the machine) into the 9 pole serial interface connector of the PC (RS 232).
- For PC's with only 25 pole serial connectors a 9-25-pole adapter is necessary.



Main switch on the machine

### Initial start-up

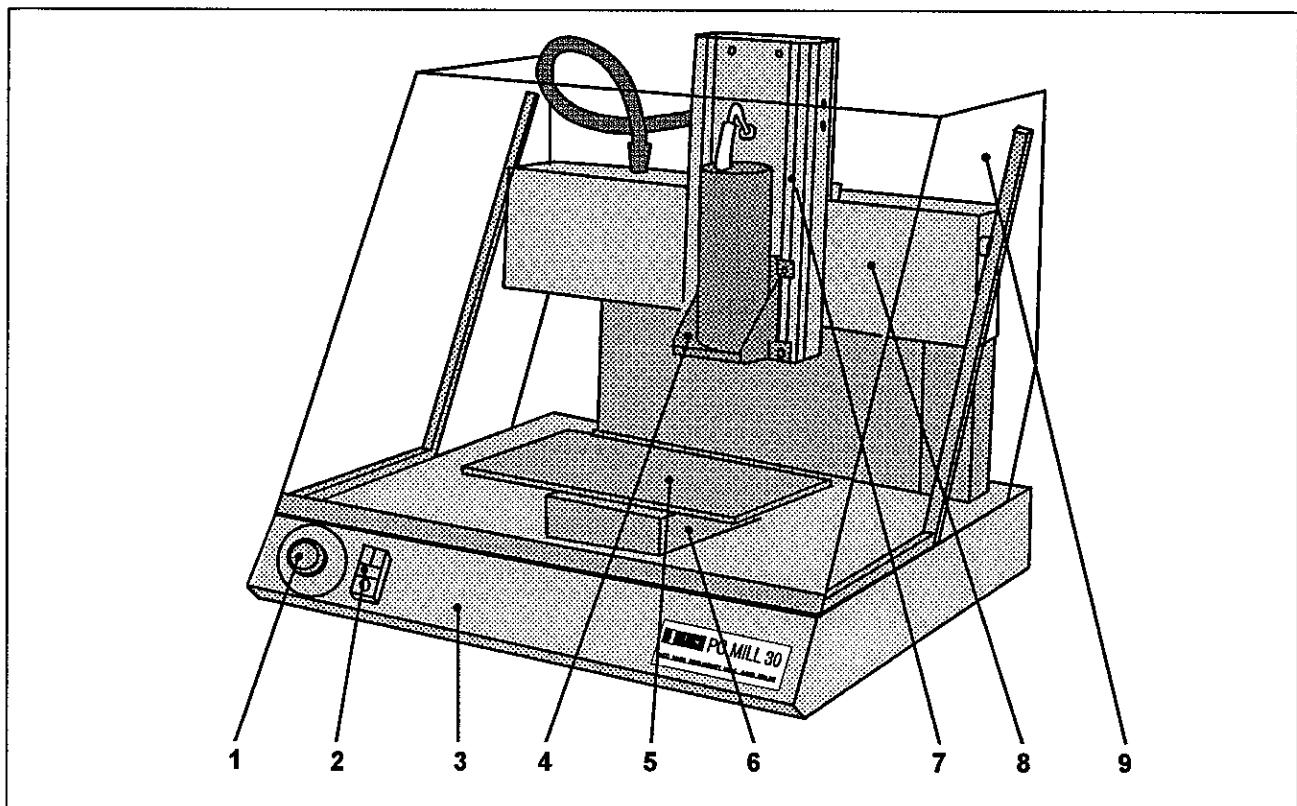
- Machine is to be cleaned from rust preventive agent with a clean cloth.
- Establish power connection.
- Release the EMERGENCY OFF key if actuated.
- The ventilation fan starts to run.
- Switch on machine at main switch (1).

**Note:**

If the machine is not used for a longer period of time, slightly oil blank parts, protect machine against unauthorized start-up and cover the machine with a dust protection.



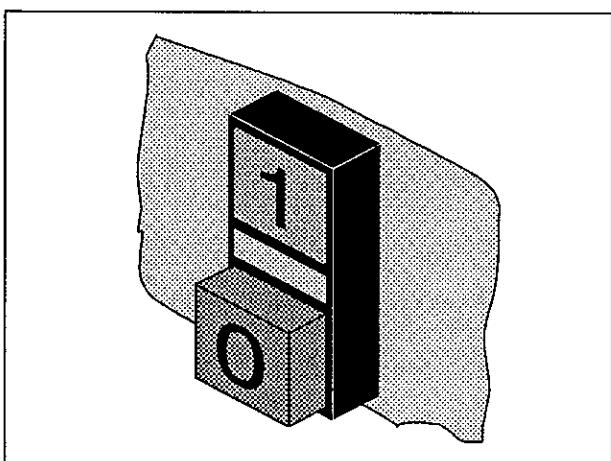
## B Description of the Machine



EMCO PC MILL 30

- |                                     |                    |
|-------------------------------------|--------------------|
| 1. EMERGENCY-OFF key                | 6. Y-slide         |
| 2. Main switch                      | 7. Z-slide         |
| 3. Electric cabinet                 | 8. X-slide         |
| 4. Drive motor with milling spindle | 9. Chip guard door |
| 5. Milling table                    |                    |

## Operating Elements



Main switch

### Main Switch

The ON button is set back to avoid accidentally switching on. The Off button is set forward to ensure easy switching off.

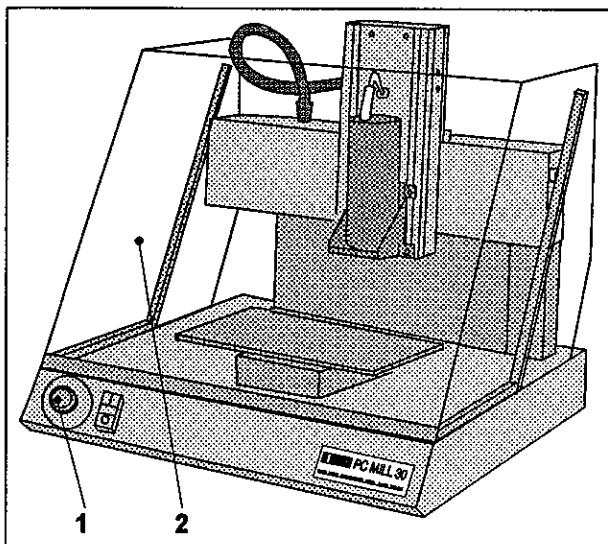
#### DANGER

##### Safety instruction:

Always protect the machine against unauthorized switching on.



Press the main switch "1" at released EMERGENCY-OFF key to make the machine is ready for operation. The main and feed motors are supplied with power.



Safety package

**EMERGENCY-OFF Key****DANGER****Safety instruction:**

The EMERGENCY-OFF key is to be actuated immediately in any hazard situation.

When actuating the EMERGENCY-OFF key (1) the powersupply to the main and feed motors is interrupted. For unlocking turn knob in clockwise direction.

**Safety Package****DANGER****Safety instruction:**

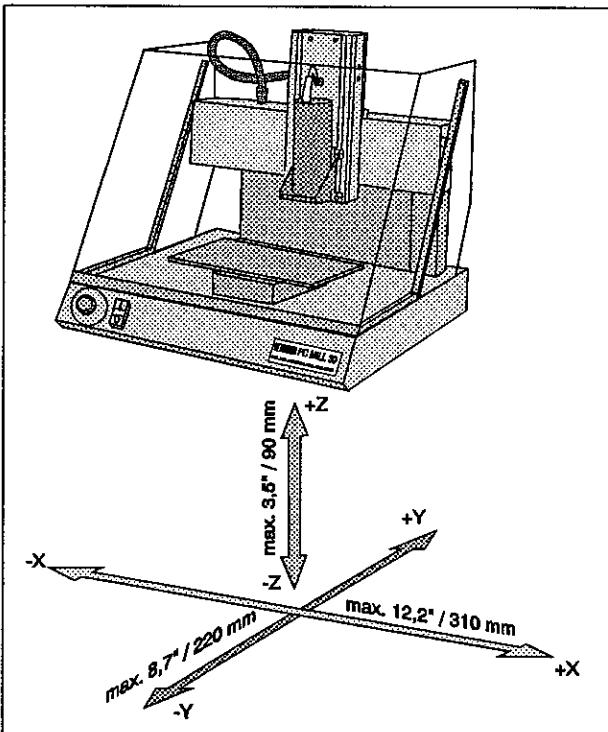
Modifications on safety devices as well as bridgings of control devices are prohibited!

The safety package is contained in the base machine and facilitates generally risk-free operation of the machine.

By opening the chip guard door the powersupply to main and feed motors is interrupted.

**The safety package comprises:**

- EMERGENCY-OFF key (1)
- Chip guard door with limit switch (2)



Traversing areas of the slides

**The step motors**

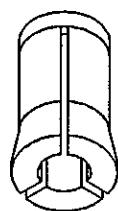
The step motors are used for driving the slides in X-, Y- and Z-direction.

Feed speed X/Y/Z .....	0-33"/min
Traversing path X-slide .....	12,2"
Traversing path Y-slide .....	8,7"
Traversing path Z-slide .....	3,5"
Step resolution .....	0,0004"
Max. feed force .....	112 lbf

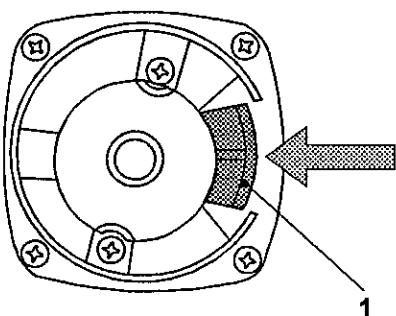
**Limitation of traversing paths**

The limitation of traversing paths is effected by means of the "software limit switch". When reaching a software limit switch the respective feed motor stops.

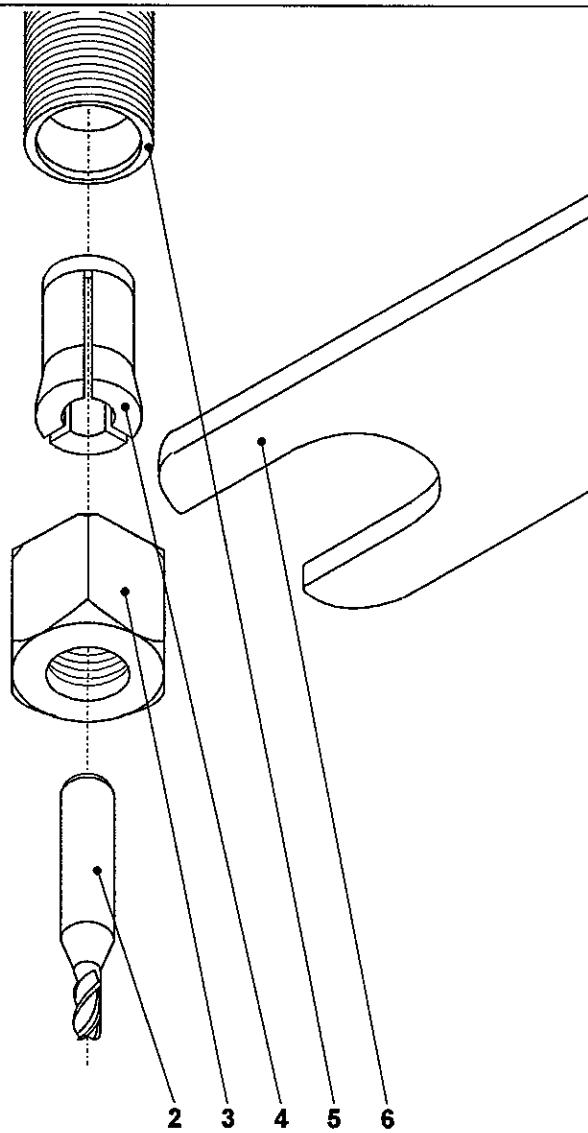
By means of the software limit switches a mechanical overload of the axis spindles due to fixed stops is avoided.



Collet



Spindle blocker (bottom view)



Tool clamping

## Tool Clamping

The tools are clamped with collets.

Instead of a tool also a drilling chuck can be mounted with a collet. Clamping devices like collets or chucks are not delivered with.

### Fitting Collet Type:

Use only collets which are delivered by EMCO.



#### DANGER

##### Safety instructions:

- Mounting and dismounting of the tools or other tool clamping devices may only be carried out during machine standstill.
- Always pay attention to the maximum speed of tools or clamping devices

## Unclamping Tools

- Push spring-weighted spindle blocker (1) and turn the spindle with your hand until the blocker snaps in. Keep the blocker pushed in.
- With opening the tool could fall down. Put a piece of cardboard or wood under the tool.
- Open the hexagonal spindle screw (3) with the hexagonal key SW 17 mm (6).
- Screw down the spindle screw completely.
- Take out the tool (2) and the collet (4).

## Clamping Tools

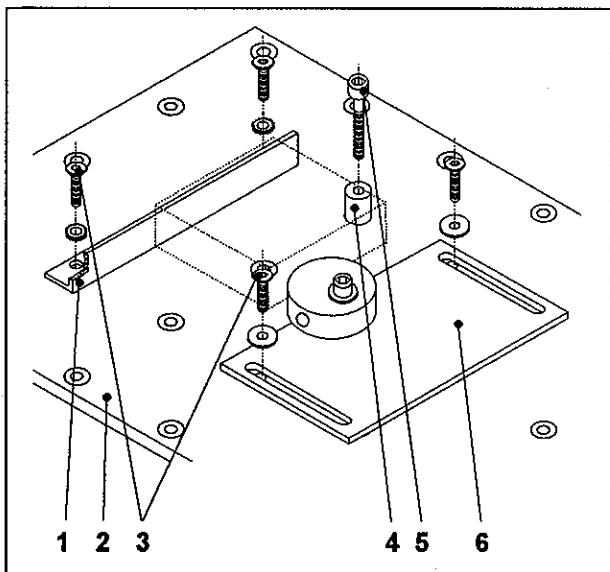
- Remove the spindle screw (see Unclamping Tools).
- Push the fitting collet (4) and the hexagonal spindle screw (3) on the tool (2). Take care of the maximum outstanding length of the tool.
- Put the tool with collet and spindle screw into the spindle end (5).
- Screw (counterclockwise) the spindle screw on the milling spindle.
- Push the spring-weighted spindle blocker (1) and turn the spindle with your hand until the blocker snaps in. Keep the blocker pushed in.
- Close the hexagonal spindle screw (3) with the hexagonal key SW 17 mm (6) until the tool is clamped tightly.

#### Note:

When mounting, the tool, the collet and the inner cone of the milling spindle must be free of dirt, chips and grease.



## The Split Vice

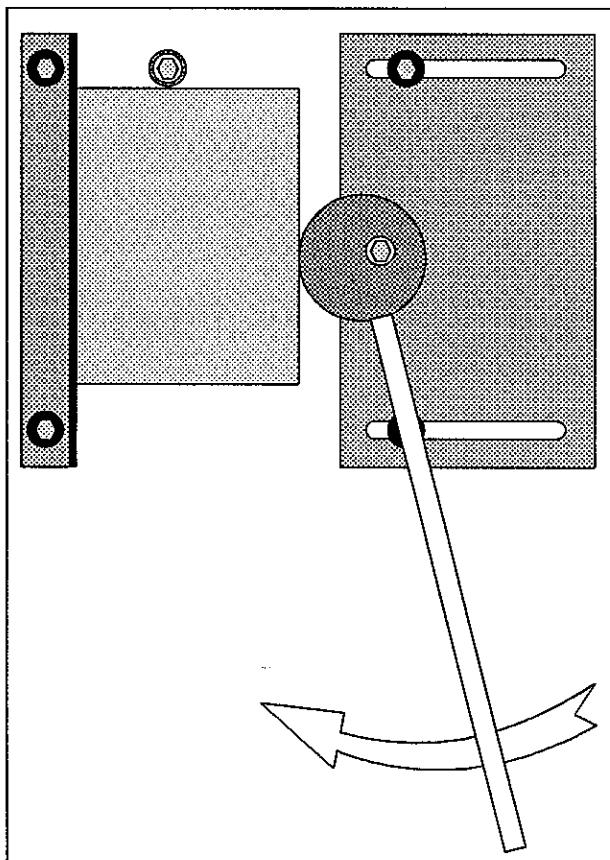


*Mounting the split vice*

The split vice is included in the scope of supply of the machine.

### Mounting the Split Vice

- Screw down the angular stop bar (1) at the milling table (2) with 2 oval head hexagon screws M5 x 15 (3) and the serrated lock washers. Use a hexagon socket screw key SW 3 mm.
- Mount the stop shaft (4) with the screw M5 x30 (5). Use a hexagon socket screw key SW 3 mm.
- Put the workpiece on the milling table touching the angular stop bar and the stop shaft.
- Attach the ground plate (6) with the excentric disk to the work piece. Screw down the ground plate at the milling table (2) with 2 oval head hexagon screws M5 x 15 (3) and the washers. Use a hexagon socket screw key SW 3 mm.



*Clamping the workpiece*

### Clamping the Workpieces

- Put workpiece between the angular stop bar, stop shaft and the excentric disk.
- Put the clamping lever in the side boring of the excentric disk.
- Clamp the tool by turning the excentric disk toward the work piece.

#### DANGER

##### Safety instructions:

- Clamping of the workpieces may only be carried out during machine standstill.
- The workpieces must be clamped tightly and safely.
- Do not turn the excentric disk over the excentric maximum. The clamping force would decrease.
- Take care of the proper condition of all clamping devices. Replace worn parts immediately.



##### Note:

To avoid clamping marks you can put a bar of wood between excentric disk and workpiece.



## C Maintenance and Service of the Machine



### DANGER

#### Safety instruction:

All adjustment and maintenance work may only be carried out with the machine switched off and the tools removed out of the working area.

Clean the machine carefully from chips and other dirt after each operation.



#### Note:

Never clean the machine with compressed air since chips get jammed in the guides and this could cause damages at the guides.

Slightly oil the milling table and the blank parts every day with slideway oil.

Main spindle bearing and ball screws of the slide guides are maintenance-free.

## Lubrication

Lubricate the spindles every 40 working hours.

Use a thick slideway oil.

DIN designation: CGLP DIN 51 502 ISO VG 68

e.g.:

BP Maccurat 68

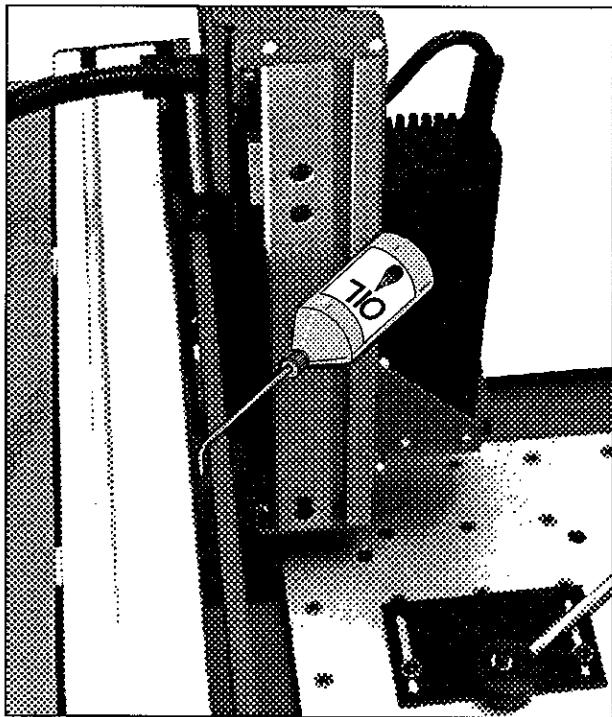
CASTROL Magna BTH 68

ESSO Febis K 68

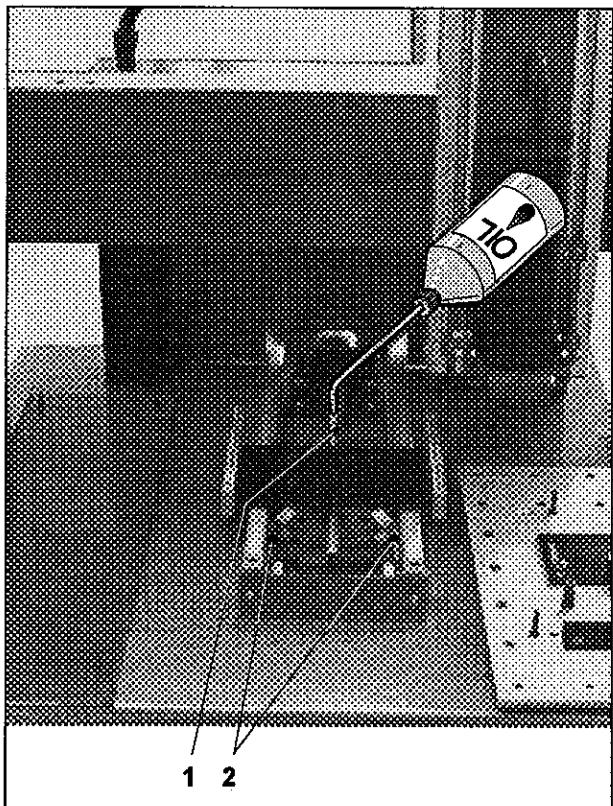
KLÜBER Lamora Super Pollad 68

### X-Spindle

- Traverse the X slide completely to the right.
- Use an oil bottle with a long (ca. 3") thin pipe.
- Insert the pipe of the oil bottle in the slot between front cover sheet (red) and upper slide profile (blank). Put some drops of oil on the whole length of the screw spindle.
- Traverse the X slide to the left end and back to the right to spread the oil.



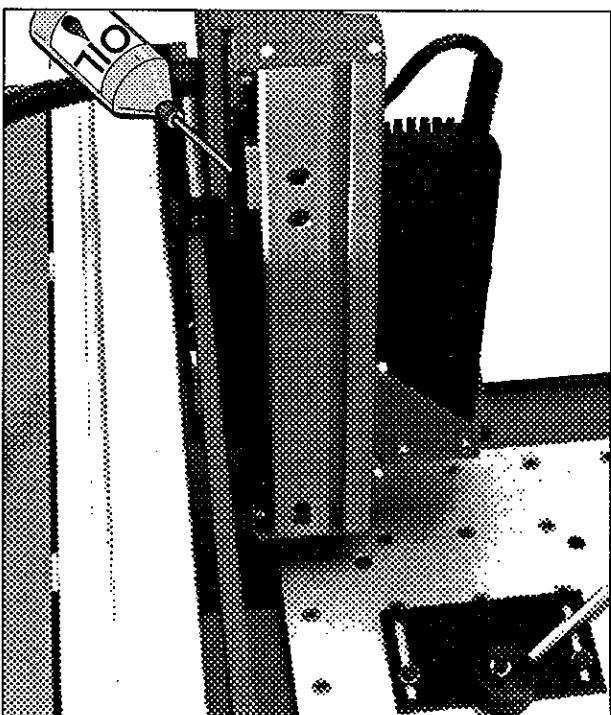
*Lubricating the X spindle*



*Lubricating the Y spindle*

#### Y-Spindle

- Traverse the Y slide completely forward.
- Remove the milling table (four screws). Use a hexagon socket screw key SW 3 mm.
- Remove the cover sheet (red).  
Two screws are at the front end, two screws are at the backside of the machine. Remove all four screws, pull the cover sheet forward and lift it off.
- Clean the inner from chips and dirt.  
Do not use compressed air!
- Put some drops of oil on the whole length of the screw spindle (1).
- Clean the guiding shafts (2).
- Mount the removed parts in opposite order.
- Traverse the Y slide backward and forward to spread the oil.

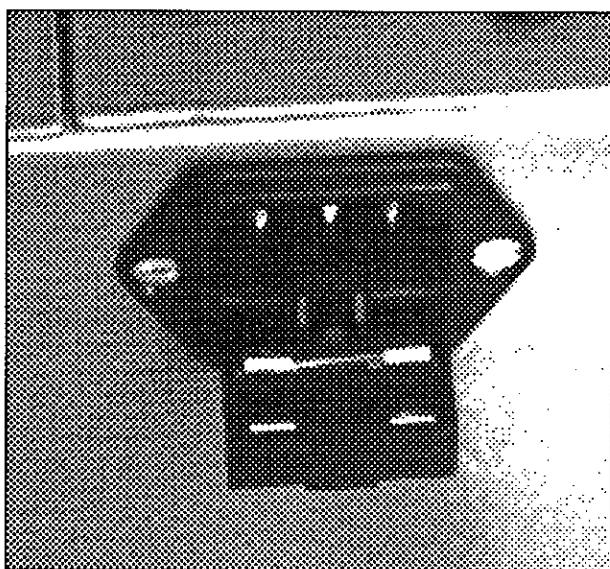


*Lubricating the Z spindle*

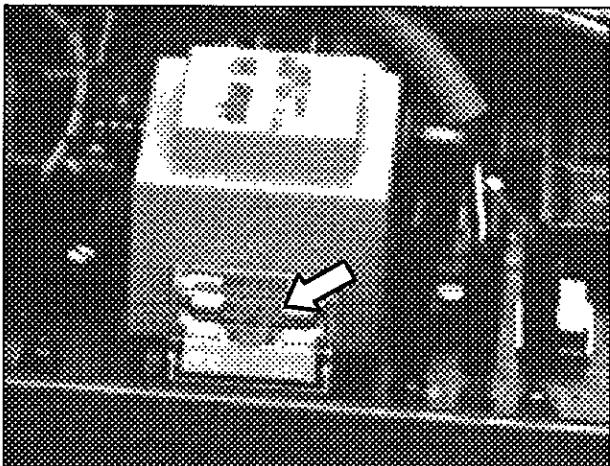
#### Z-Spindle

- Traverse the Z slide completely down.
- Remove one of the the two side cover sheets (red).  
One screw is at the top end, one at the bottom end. Use a hexagon socket screw key SW 3 mm. Remove both screws, pull up and twist the cover sheet to remove it.
- Insert the pipe of the oil bottle in the slot between slide profile (blank) and back cover sheet (red).
- Put some drops of oil on the whole length of the screw spindle.
- Mount the side cover sheet.
- Traverse the Z slide up and down to spread the oil.

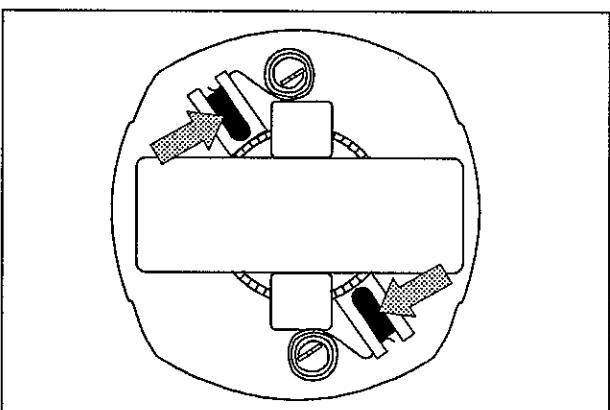
## Fuses and Brushes



Main fuse and reserve fuse in fuse drawer



Board fuse in transparent cover



Motor brushes (top view)

### Main Fuse 10 A slow

The main fuse is in a drawer under the connector at the backside of the machine.

- Unplug the machine.
- Eliminate the possible cause of the burned fuse.
- Pull back the fuse drawer.  
The inner fuse is the active one, the outer is a spare part.
- Replace the burned fuse and close the fuse drawer.
- Reconnect the machine.



#### DANGER

##### Safety instruction:

If the fuse melts again within a short time, a serious fault could be the cause.

Unplug the machine to avoid hazards by electrical shock or heat development.

Call a qualified service technician!

### Board Fuse 5 A fast



#### DANGER

##### Safety instruction:

This is no user sevicable part! Opening of the machine cover only by a qualified service technician!

The board fuse is in a transparent cover at the left side of the main board.

- Unplug the machine.
- Eliminate the possible cause of the burned fuse.
- Remove the machine cover (8 screws).
- Replace the burned fuse and close the machine cover.
- Reconnect the machine.

### Motor brushes (1/4" x 1/4" x 1/2")



#### DANGER

##### Safety instruction:

This is no user sevivable part! Opening of the motor cover only by a qualified service technician!

- Unplug the machine.
- Remove the motor cover (3 screws).
- Replace the worn out brushes and close the motor cover.
- Reconnect the machine.



## D Technological Data

### Cutting Speed V

$$V \text{ [ft/min]} = \frac{12.9 \times D \text{ [inch]} \times \pi \times S \text{ [rpm]}}{100000}$$

$$V \text{ [m/min]} = \frac{D \text{ [mm]} \times \pi \times S \text{ [rpm]}}{1000}$$

**V** [m/min / ft/min] .... cutting speed  
**D** [mm / inch] ..... dia. of workpiece  
**S** [rpm] ..... speed of main spindle

The max. admissible cutting speed depends on:

- Material of workpiece**  
The higher the strength of the material, the lower the cutting speed.
- Material of tool**  
Hard metal tools allow for a higher cutting speed than HSS-tools.
- Feed value**  
The larger the feed the lower the cutting speed.
- Depth of cut**  
The larger the depth of cut the smaller the cutting speed.

#### DANGER

##### Safety instruction:

Cutting speeds which are given in workpiece material sheets can not be used with small tools, otherwise the tools would break.

**Breaking tools are like gun bullets.**

For small tools lower cutting speeds (depending on tool stability) must be selected.

### Spindle Speed S

$$S \text{ [rpm]} = \frac{V \text{ [ft/min]} \times 100000}{12.9 \times D \text{ [inch]} \times \pi}$$

$$S \text{ [rpm]} = \frac{V \text{ [m/min]} \times 1000}{D \text{ [mm]} \times \pi}$$

The cutting speed and the tool diameter enable you to calculate the speed of the main spindle.



#### DANGER

##### Safety instruction:

Every tool has a maximum speed given by the tool producer.

You must not exceed this speed, otherwise the tool could be splitting.

### Feed F

On the EMCO PC MILL 30 the feed F is programmed in [inch/min].



#### DANGER

##### Safety instruction:

With small tools also the feed rate must be reduced, otherwise the tools would break.

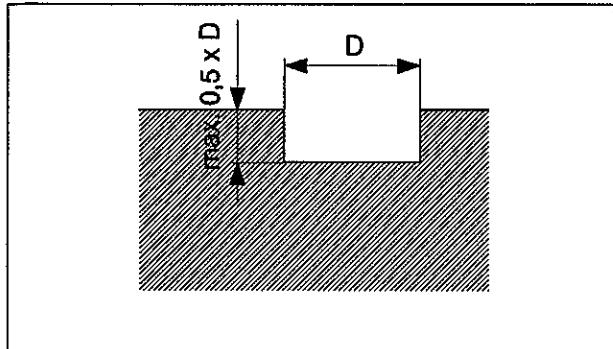
**Breaking tools are like gun bullets.**

The longer the outstanding length of the tool the smaller the feed rate must be.

## Recommended Cutting Values

The following values are valid for:

- premium high-speed tools
- Cutting depth  $t < \frac{1}{2}$  tool diameter D
- Tool diameter D:  $.06'' < D < .3''$



### Cured Polyurethane Resin

(e.g. CIBA-GEIGY CIBATOOL BM 5500)

This is the recommended material for machining with the EMCO PC MILL 30.

Spindle speed: 10 000 rpm  
Feed rate: 20 inch/min

### Plexiglass

Spindle speed: 15 000 rpm  
Feed rate: 6 inch/min

### Soft Plastics

Soft plastics can be used to a limited degree only. Some kinds of these plastics will melt or burn while machining.

### Hard Plastics

Hard plastics can be used to a limited degree only. Some kinds of these plastics will be too hard for normal machining (e.g. bakelite, reinforced resin plastics, compound plastics) or produce too much dust while machining.

For other tools or workpiece materials consider the specific properties of these materials.  
Find the best values with test runs (be careful!).

For diving-in in the workpiece use only tools which are designed for dive-in operation and reduce the feed down to ca. 30 %.

## E Software Description

### 1. Vocabulary Explanations

- bit (b)** ..... Binary sign = smallest memory unit of the computer (e.g., current - not current or magnetic - not magnetic)
- Byte (B)** ..... Memory unit to store a letter, a number or a sign (1 byte = 8 bit)  
**Kilobyte (K, kB):** usual unit (measurement) for the memory capacity of a computer (1 kilobyte=2<sup>10</sup> bytes=1024 bytes)  
**Megabyte (MB):** 1 megabyte = 1024 kilobytes
- CAD** ..... Computer Aided Design
- CAM** ..... Computer Aided Manufacturing
- CNC** ..... Computer Numerical Control
- Compatibility** ..... Two devices are compatible, if they can operate with each other without any additional equipment or can be exchanged for each other
- Coprocessor** ..... Additional arithmetic unit as a support for the microprocessor
- Disk** ..... Exchangable, magnetic plastic disk, to store data (memory capacity, e.g., 5½ inches disk with 360+kB or 1.2 MB or 3½ inches disk with 720 kB or 1.44 MB)
- Graphics card** ..... Shapes the computer signals for the screen
- Hard disk** ..... Magnetized disks permanently located in the computer, to store data (memory capacity for PC, e.g. 100 MB)
- Hardware** ..... Apparative parts of the computer (microprocessor, screen, cables...)
- Interface** ..... Connection element for connecting external devices to the PC  
**Serial interface:** processes 1 bit  
**Parallel interface:** processes 1 byte (= 10-fold information flow speed)
- Menu** ..... List of the possibilities offered
- Microprocessor** ..... Central arithmetic unit of the PC
- NC program** ..... List of all information, which a machine tool needs to manufacture a workpiece
- PC** ..... Personal Computer = multi-purpose, small computer for one person
- RAM** ..... Random Access Memory = operational memory = component, which loses information, when the device is switched off
- Software** ..... The software is a thought-defined product (e.g., a program which controls the computer).  
**System software:** basic, administrative program; contains the operating system (e.g., DOS = Disk Operating System) and facilitates the running of the application software.  
**Application software:** special operational program (e.g., EMCO software). The hardware can carry out the tasks given by this program.

## 2. Software Installation, Access Into Program

### 2.1 Minimum PC configuration

In order to operate with this EMCO software, you require a PC with the following minimum capabilities:

- IBM compatible (PC/AT, PC-386, PC-486)
- Operating system MS-DOS from version 5.0
- 1 MB RAM (main memory)
- EGA colour graphics card
- EGA colour screen
- 1 disk drive (1,44 MB) + hard disk with 20 MB
- 1 serial interface

An arithmetic coprocessor is not absolutely necessary.

#### Example:

IBM compatible PC-386 with

- 5120 kB RAM
- 1 disk drive 1.44 MB + hard disk 100 MB
- 1 VGA graphics card + 17" VGA screen
- Operating system MS-DOS version 5.0
- 2 serial interfaces
- mouse

#### Compatibility problems

The software runs on all 100 % IBM compatible PCs.

#### Hint:

This program requires about 590 kB working memory. If this working memory is not available, parts of the program may not work.

#### Remedy:

- Make a secure copy of the CONFIG.SYS file.
- Load the CONFIG.SYS file in an editor (e.g. EDLIN).
- Delete all drivers and devices (DEVICE=..., IN-STALL=...).
- Restart the system (Ctrl+Alt+Del).

When you use software on your computer which does not work without this drivers and devices do the following sequence:

- Make a secure copy of the CONFIG.SYS file.
- Create the file CONFIG.SSS:

```
CONFIG.SSS
FILES = 20
BUFFERS = 20
BREAK = ON
```

- Create the file CHANGOVR.BAT:

```
CHANGOVR.BAT
COPY CONFIG.SYS    CONFIG.BBB
COPY CONFIG.SSS    CONFIG.SYS
COPY CONFIG.BBB    CONFIG.SSS
DEL CONFIG.BBB
```

- Every run of the program CHANGOVR.BAT causes a change over between the CONFIG files. You must restart the system to make the changes effective.

### 2.2 Installation

Start DOS (Disk Operating System). If necessary, consult the DOS manual, which was supplied with your computer.

When the DOS prompt "C:\>" appears, insert the installation disk into the drive A.

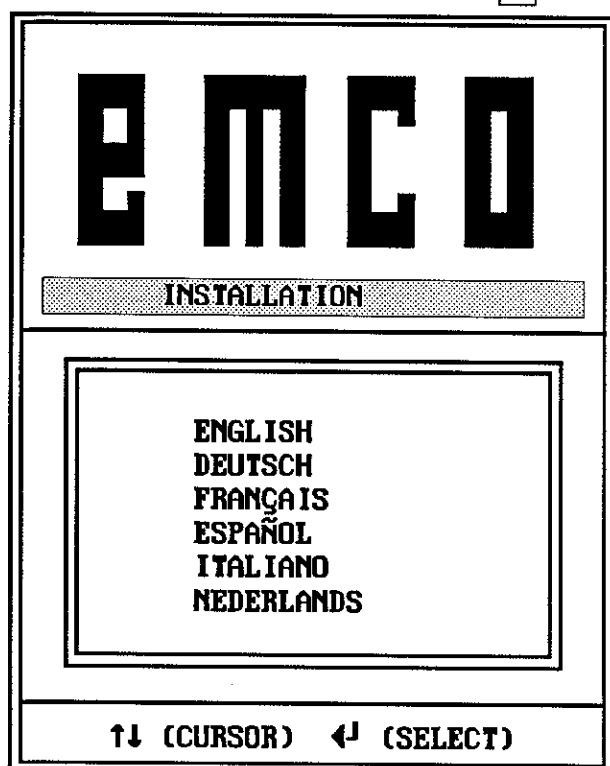
Enter the following command:

Screen display	Entry	Explanation
C:\>	<input type="text"/> A <input type="text"/> : <input type="text"/> ↙	Change to drive A
A:\>	<input type="text"/> I <input type="text"/> ↙	Call up installation program

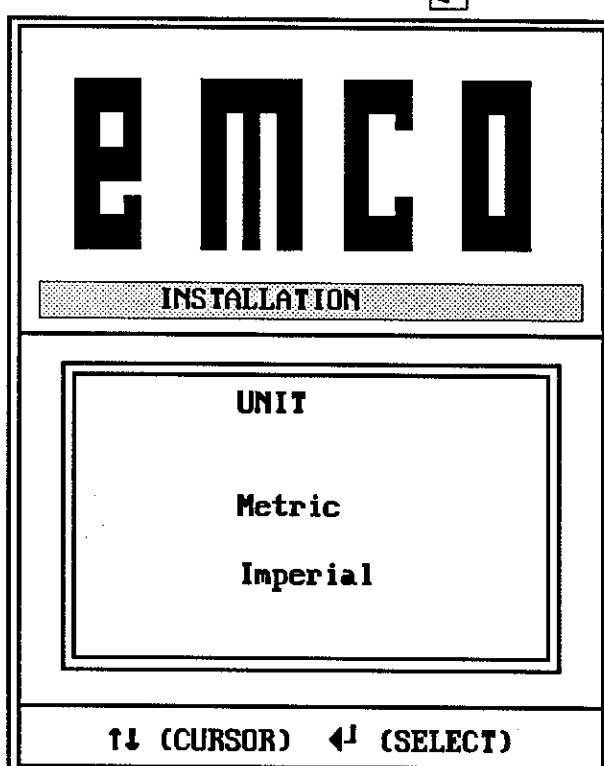
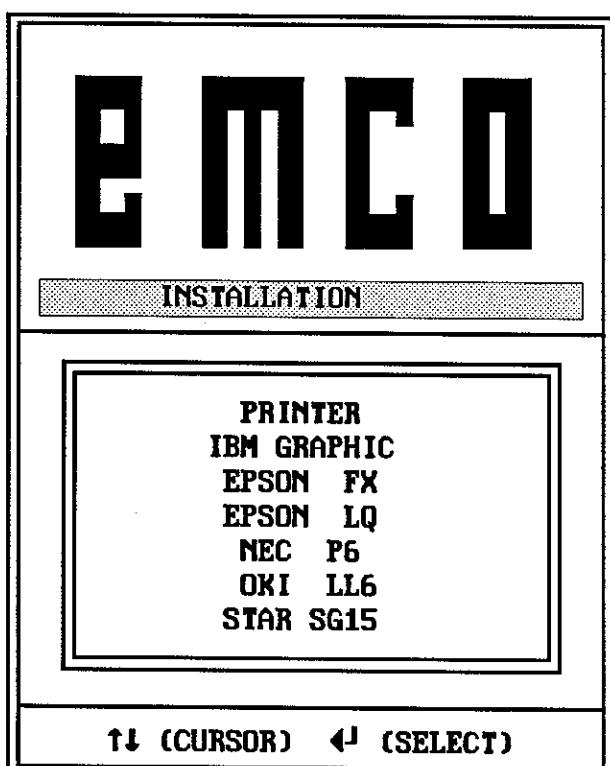
After entering the command "I" and pressing the ENTER key the inquiries for system settings appear.

**Setting the Language**

Move the light beam with the arrow keys to the desired language and confirm it with .

**Choose Unit**

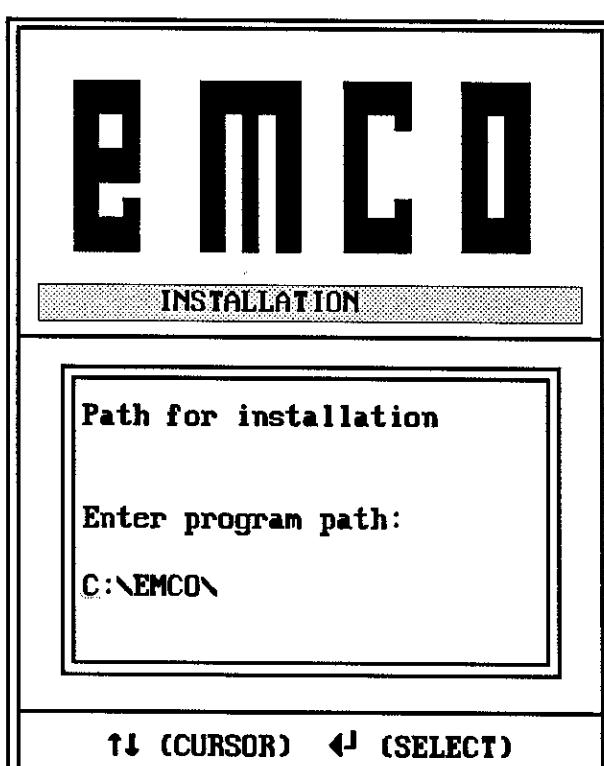
Move the light beam with the arrow keys to the desired unit and confirm it with .

**Choose Printer**

At the screen some more printers are displayed. Choose the right printer of your work station. If you don't use a printer, just press .

**Input of the Program Path (subdirectory)**

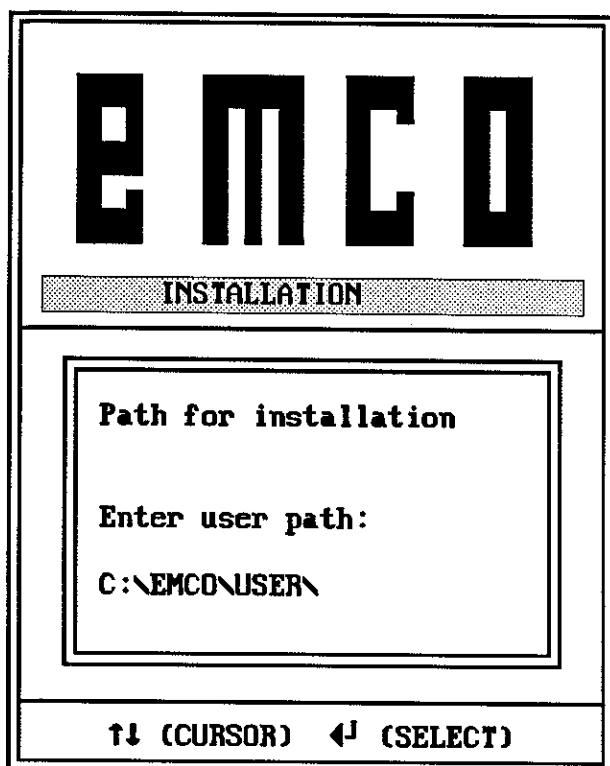
In the program path the files of the EMCO software will be installed.



The EMCO software is installed in the subdirectory \EMCO by pressing .

**Input of the User Path (Subdirectory)**

In the user path the files created by you (NC programs, drawings) will be stored.



The EMCO software is installed in the subdirectory \EMCO\USER by pressing .

**Altering the program path / user path:**  
You can also install this EMCO software or store the files created by you (NC programs, drawings) in a sub-directory determined by you.

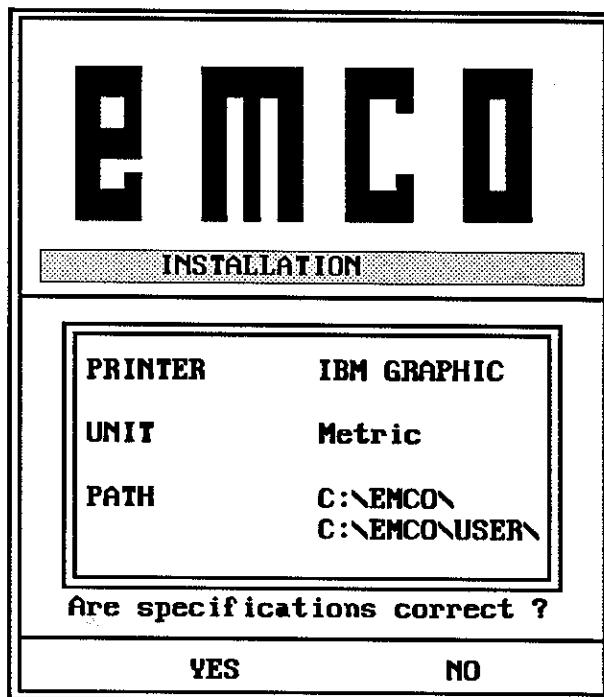
**Procedure:**

- You can delete the suggested sub-directory name letter by letter with the key .
- Enter a new sub-directory name.

**Example:** Determining a new program path

C: \ training \

This EMCO software is installed in the sub-directory "training"

**Control Menu:**

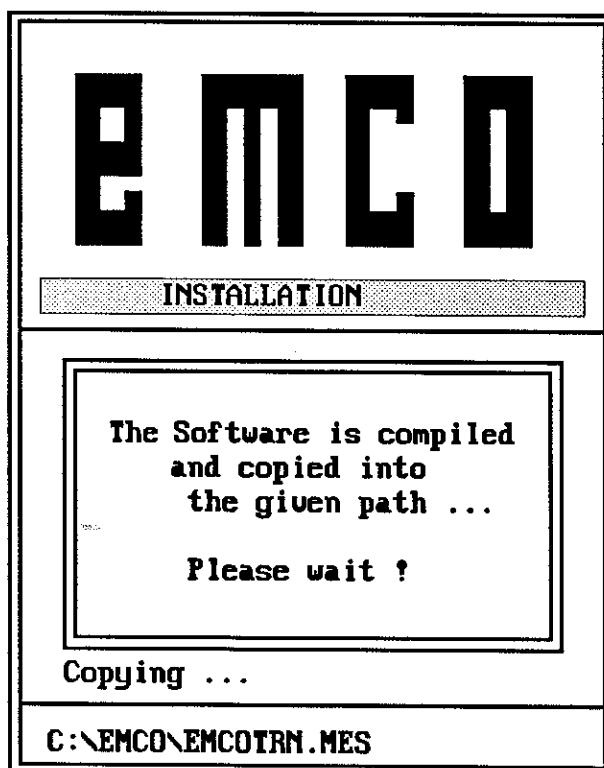
The previous specifications are displayed:

YES ..... The previous specifications are correct, the software is installed.

NO ..... The previous specifications are incorrect, the installation begins again with "Entering the type of printer".

Select the desired menu point with the arrow keys and confirm it.

If the menu point YES was selected and confirmed, the following appears on the screen:



The individual files are copied from the drive A into the sub-directory determined by you.

If the software was installed correctly in the PC, the following appears:



The PC registers with drive A.

Changing the drive:

Screen display	Entry
A : \>	C : <input type="button" value=" "/> <input type="button" value=" "/> <input type="button" value=" "/>
C : \>	

The software can be called up.

## 2.3 Access

After the DOS prompt "C:\>" appears, enter the following commands:

Screen display	Entry
C : \>	C   D   <input type="button" value=" "/> E   M   C   O   <input type="button" value=" "/> * Space bar
C : \EMCO >	

In this way, you change to the subdirectory EMCO.

Calling up the program:

If you have altered the program path (=subdirectory) during the installation of the software, you must enter your selected sub-directory name (here EMCO).

Screen display	Entry
C : \EMCO >	M   <input type="button" value=" "/>

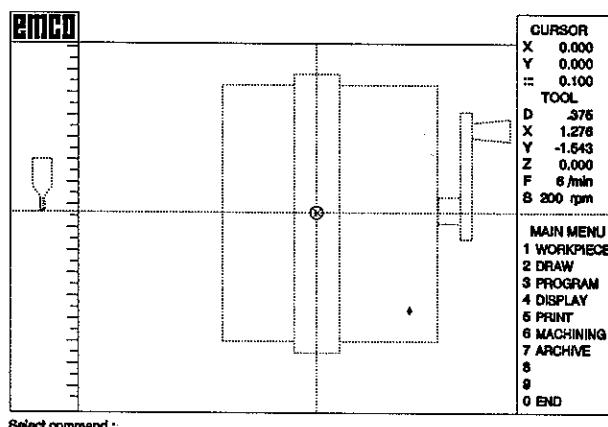
The title screen appears:



### 3. Programming

After the entrance into the software, the menu point "PROGRAMMING" is displayed with a background bar.

Press to call up "programming". The following image appears:



### 3.1 Important Key Functions

#### SHIFT Key

If the SHIFT key is pressed at the same time as the desired key, the upper case of the respective key is selected.

#### Example

 If the SHIFT key is not active, the lower case (+) is selected.

  If the SHIFT key is pressed, the upper case (\*) is selected.

#### Note

Only the selected key case is shown in these instructions for easier reading.

#### Preceding Zeros

#### Following Zeros

Zeros before a number and after the comma can but do not need to be entered.

#### Plus/Minus Sign

Plus signs (+) are not entered. The minus sign (-) must be entered before the number.

#### Entering Large, Small letters

Letters can be entered as large or small letters.

#### Enter Key

 Inputs are confirmed or stored with the "ENTER" key.

#### Decimal Point

 The decimal point is entered with this key.

#### Separating Two Entries

 Two subsequent entries are separated with the comma key.

#### Example

For a workpiece defining, the PC requests:

Length, width of blank:

Input: 3.5, 4

#### Error Correction

 The entry can be corrected with this key.  
The previously entered character is deleted.

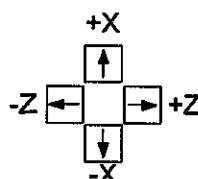
#### Interrupting Selected Commands

 The selected command is interrupted with this key.  
The previously selected menu level can also be returned to with the Esc. key.

### 3.2 Screen Cursor

A cursor (graticule) is shown on the screen. This cursor can be moved on the screen.

#### Moving the screen cursor



The cursor is moved on the screen by means of the 4 arrow keys.

#### Further key functions

- PgUp** Doubling the step size of the cursor
- PgDn** Halving the step size of the cursor
- Pos 1** The cursor jumps to the middle of the screen
- End** The cursor jumps to the reference point

Step size .... distance of movement each time the arrow key is pressed

#### Showing the screen cursor

There are two ways of showing the cursor on the screen:



1. Cursor as a graticule  
Normal representation of the cursor



2. Reduced cursor  
A reduced cursor is shown, when the key "<" is pressed.

The cursor is shown as a graticule again, when the key ">" is pressed.

#### Mouse Operating



The software also can be operated with a mouse. With program start the software acknowledges automatically a correct mouse.

#### Note

A graphic capable mouse driver must be used.

#### Left Mouse Button

The left button has the function of the ENTER key. A position will be acknowledged as point in the CAD drawing area or a menu point in the menu display will be selected.

#### Right Mouse Button

The right button switches over between:

- Moving of the graticule in the CAD drawing area with the mouse
- Moving of the menu bar in the menu display with the mouse

#### Middle Mouse Button

With three button mice the middle button selects the function „search point“. The cursor jumps to that point of the drawing which is next to the cursor.

#### Hotkey "#"

By pressing the key "#" the drawing gets an invisible background raster. Cursor movements with the mouse occur stepwise from raster point to raster point. The raster width is the same as the cursor step width and can be set with the keys PgUp and PgDown. Deselection of the raster by repeated pressing of "#".

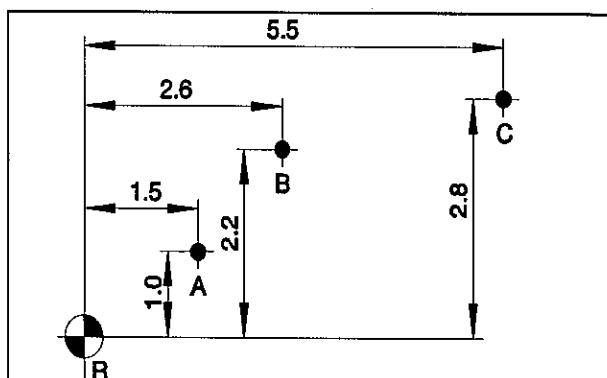
#### Cursor Programming Methods

You can describe the path of the screen cursor in the program: there are generally two ways of describing this path.

#### Absolute value programming (reference value programming)

The points, to which the screen cursor is to proceed, are given starting from a zero point (reference point R).

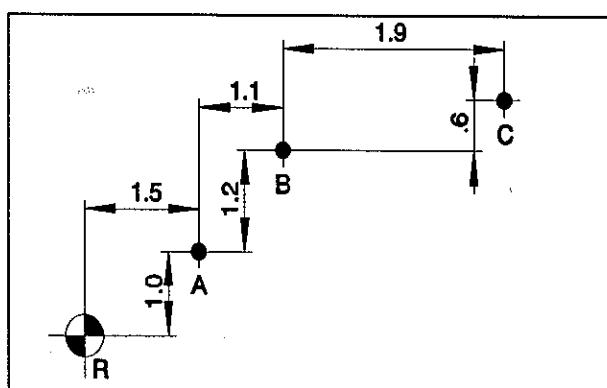
#### Example



#### Incremental value programming

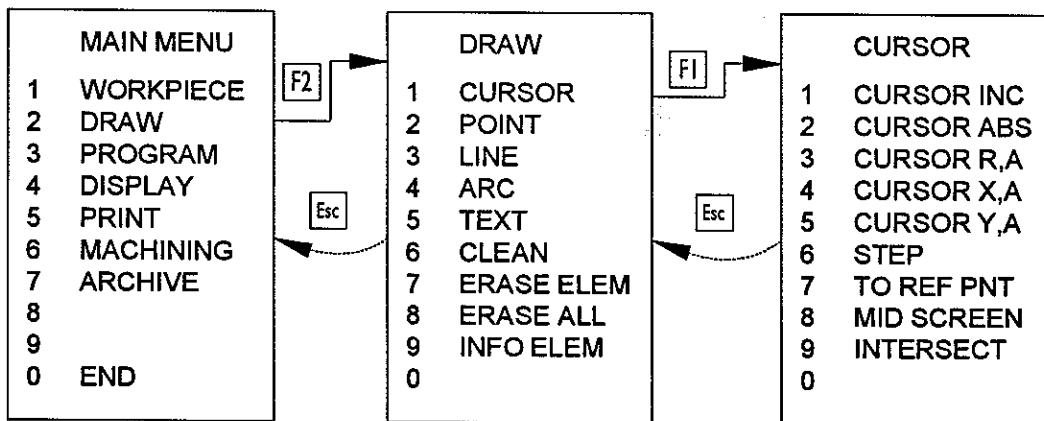
Chain dimensions are entered for the incremental value programming. The current position of the screen cursor is the starting point for every path description.

#### Example



### 3.3 Menu Structure

This EMCO software is divided into menus (= selection possibilities). Some menu points contain menus again. Jumps back- and forwards between these individual menus can be made without limitations.



**F?** Select menu point

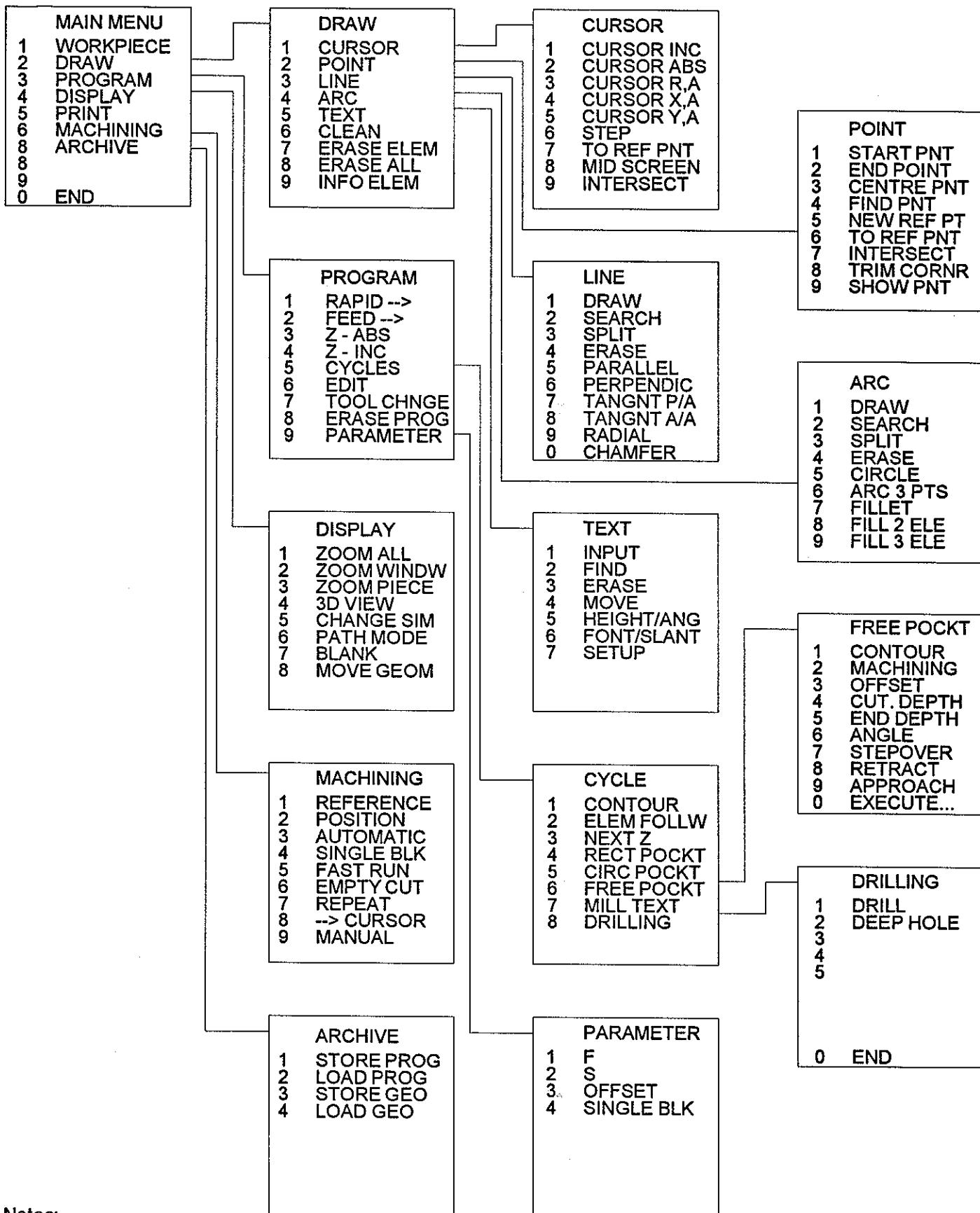
**Esc** Return to the previous menu level

Select menu point with mouse:

The right button switches over between:

- Moving of the graticule in the CAD drawing area with the mouse and
  - Moving of the menu bar in the menu display with the mouse
- Select the highlighted menu point by pressing the left mouse button.

## Menu Summary

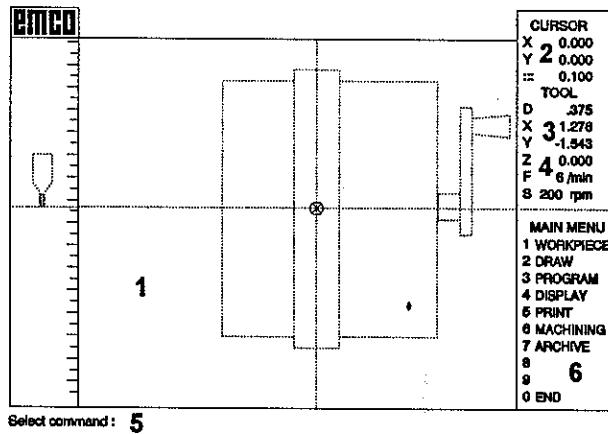


## Notes:

You can activate the individual menu points with the function keys F1 to F10, with the space bar and ENTER or with the mouse.

A command can be interrupted or a return to the previous menu level activated with the key Esc.

### 3.4 Screen Display

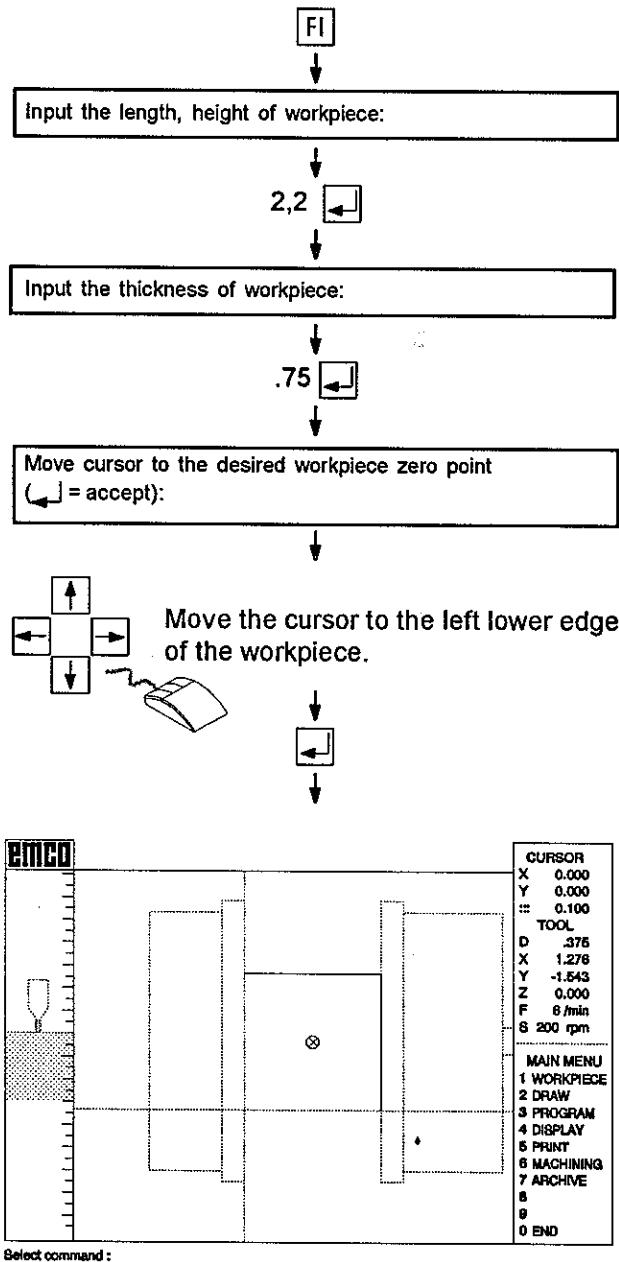


- 1 Diagrammatic representation of the working area
- 2 Displaying the cursor position [inch]  
X, Y ... Position of the cursor  
... Step size of the cursor (distance travelled every time a key is pressed)
- 3 Displaying the tool data  
D ... Tool diameter  
X,Y,Z ... Position of the tool [inch]
- 4 Displaying the cutting values  
F ... Feed rate [inch/min]  
S ... Main spindle speed [rpm]
- 5 Displaying the screen messages
- 6 Menu display

### 3.5 Workpiece

This menu point defines the size of the workpiece, the position of the origin of the coordinates and shows the workpiece clamped in the vice. After its definition the workpiece can not be altered. You can only delete it with ERASE PROG in the menu PROGRAM.

Example:



Note: The origin of the coordinates is on the surface of the workpiece.

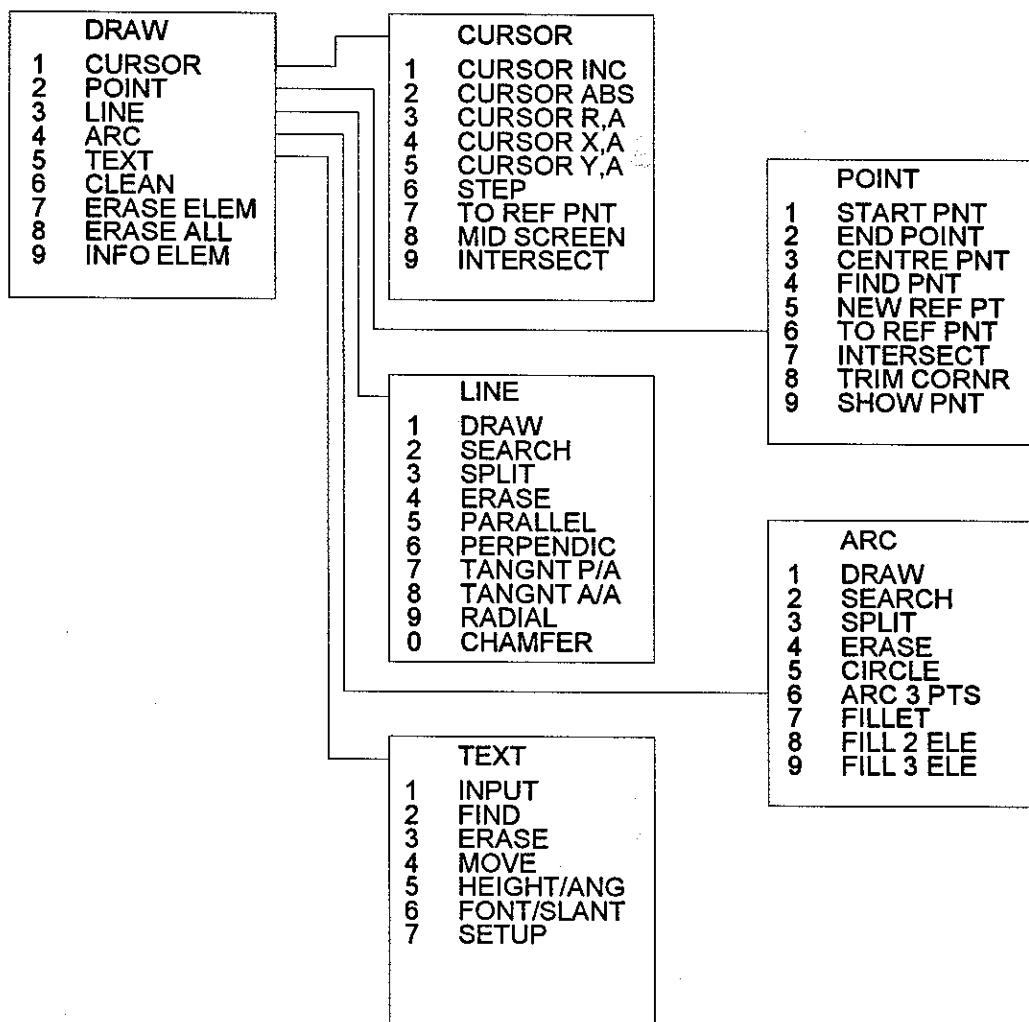
If the split vice at the left side is higher than the workpiece it is better to determine the right lower edge point as workpiece zero point.

The workpiece zero point must be reached by the tool tip because with machining you have to scratch on the workpiece zero point (touch it with the tool tip).

### 3.6 Draw

The contours of the workpiece are determined in this menu.

#### Summary of Sub Menus

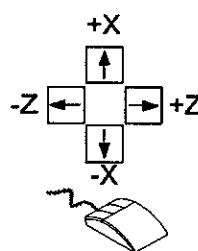


### 3.6.1 Cursor

In this submenu, it is determined, how the cursor is to be positioned on the screen.

CURSOR	
1 CURSOR INC	6 STEP
2 CURSOR ABS	7 TO REF PNT
3 CURSOR R,A	8 MID SCREEN
4 CURSOR X,A	9 INTERSECT
5 CURSOR Y,A	

#### Moving the Screen Cursor



The cursor is moved on the screen by means of the 4 arrow keys.  
The cursor can also be moved with a mouse.

#### Further Key Functions

- PgUp Doubling the step size of the cursor
- PgDn Halving the step size of the cursor
- Pos 1 The cursor jumps to the middle of the screen
- End The cursor jumps to the reference point

Step size .... distance of movement each time the arrow key is pressed.

#### Showing the Screen Cursor

There are two ways of showing the cursor on the screen:

- 1. Cursor as a graticule  
Normal representation of the cursor
- 2. Reduced cursor  
A reduced cursor is shown, when the key "<" is pressed.

The cursor is shown as a graticule again, when the key ">" is pressed.

#### Calculating functions in the CURSOR submenu

For every menu point in the CURSOR submenu, where a number is prompted, there are many calculating functions available to you for the entry of arithmetical functions. In this way, you possess an aid capable of performance, which gives valuable help, especially for coordinate entries and angle calculations.

The following signs or mathematical functions can be used:

Entry	Function
+	Addition
-	Subtraction
*	Multiplication
:	Division
**	To the power of
(	Open bracket
)	Close bracket
SIN	Sin
COS	Cos
TAN	Tan
DSIN	Sin in degrees
DCOS	Cos in degrees
DTAN	Tangent in degrees
ASIN	Arc sin
ACOS	Arc cos
ATAN	Arc tangent
DASIN	Arc sin in degrees
DACOS	Arc cos in degrees
DATAN	Arc tangent in degrees
SQRT	Square root
PI	3.1415927

Any arithmetical function can be entered instead of a simple number for numerical entries (= numbers). The use of brackets is allowed. These can be nested as much as is required.

#### Note

Entered functions must be written in brackets (see example).

#### Example

You are in the CURSOR submenu. An incremental coordinate is to be calculated.

$$X = 10 \times \sqrt{3} / 2, \quad Y = 5$$

Therefore, enter the following:

F1

10 \* SQRT (3) : 2, 5

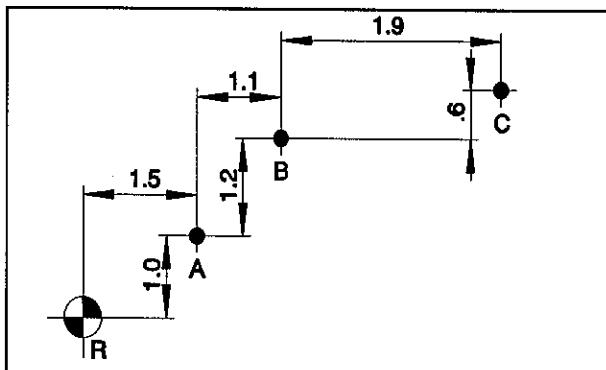
A cursor step of 8.66 in X and 5 in Y is the result.

**Positioning the Cursor Incrementally**

Select F1 CURSOR INC.

Unit: [inch]

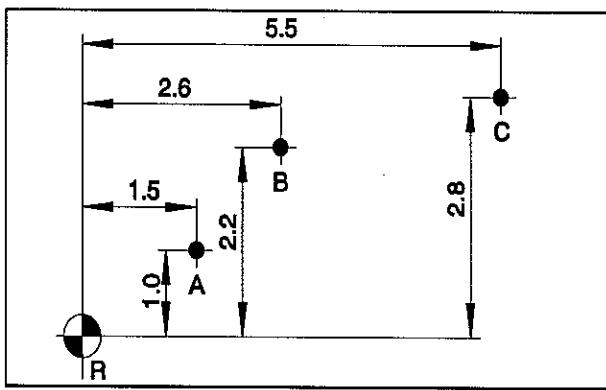
The cursor is shifted from the present position by the entered values.

**Positioning the Cursor Absolutely**

Select F2 CURSOR ABS.

Unit: [inch]

The cursor is shifted by the values entered (always measured from the reference point).

**Positioning the Cursor with Radius and Angle**

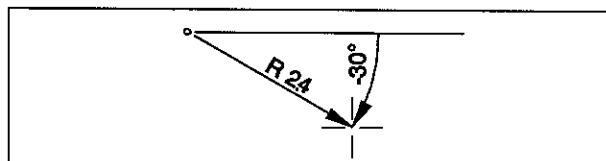
Select F3 CURSOR R,A.

Unit: [inch], [°]

The cursor is shifted from the present position by the radius and angle entered.

Example:  $R = 2.4$  inch,  $A = -30^\circ$  (clockwise)

Screen message	Entry
	<input type="button" value="F3"/>
Radius, angle movement from the cursor?	2.4, -30 <input type="checkbox"/>



Note: Angle entry

Positive (+) sign = angle in the anti-clockwise direction.

Negative (-) sign = angle in the clockwise direction.

**Positioning the Cursor with X Value and Angle**

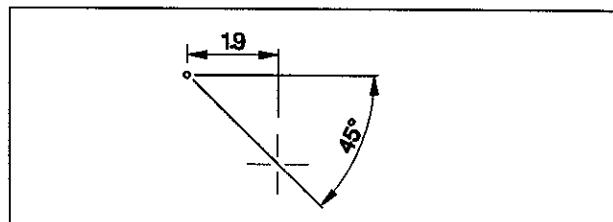
Select F4 CURSOR X,A.

Unit: [inch], [°]

Entering the X dimension incrementally

Example:  $X = 1.9$  inch,  $A = -45^\circ$ 

Screen message	Entry
	<input type="button" value="F4"/>
X, angle movement from the cursor?	1.9, -45 <input type="checkbox"/>

**Positioning the Cursor with Y Value and Angle**

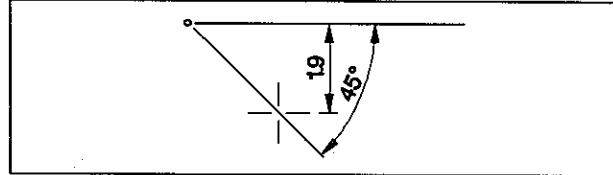
Select F5 CURSOR Y,A.

Unit: [inch], [°]

Entering the Y dimension incrementally

Example:  $Y = 1.9$  inch,  $A = -45^\circ$  (clockwise)

Screen message	Entry
	<input type="button" value="F5"/>
Z, angle movement from the cursor?	1.9, -45 <input type="checkbox"/>

**Determining the Step Size of the Cursor**

Select F6 STEP SIZE.

Unit: [inch]

The step size is the distance the cursor moves every time a key is pressed.

The step size of the cursor is .1 inch when you call up the software.

Example: Cursor step should amount to .25 inch

Screen message	Entry
	<input type="button" value="F6"/>
Cursor step 0.100 New step (ENTER = no change)	.25 <input type="checkbox"/>

**Cursor to the Reference Point**

Select F7 TO REF PNT.

The reference point is the origin of the coordinate system shown on the screen (reference point = position X = 0 / Y = 0 of the coordinate system).

The cursor jumps to the reference point, when the key F7 is pressed.

**Cursor to the Middle of the Screen**

Select F8 MID SCREEN.

The cursor jumps to the middle of the screen, when the key F8 is pressed.

**Find the Point of Intersection**

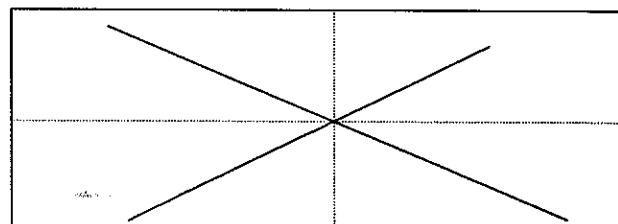
Select F9 INTERSECT.

Position the cursor by means of the arrow keys near to the point of intersection to be found.

The cursor jumps to the neighbouring point of intersection, when the key F9 is pressed.

Possibilities for the point of intersection

- two lines
- two circles
- a line and a circle



### 3.6.2 Point

Secondary points for drawing the workpiece contour are determined on the screen in this submenu. The basis of the definition of the geometry (= contour of the workpiece) are secondary points. E.g., a line is defined by a starting point and an end point.

POINT	
F1	START PNT
F2	END POINT
F3	CENTRE PNT
F4	FIND PNT
F5	NEW REF PT
F6	TO REF PNT
F7	INTERSECT
F8	TRIM CORNR
F9	SHOW PNT
F10	

#### Determining the starting point

Select F1 START PNT.

The point, on which the cursor is located, is defined as the starting point of an element of geometry (line, circle or arc) by pressing the key F1.

The active starting point is shown on the screen by the symbol ">".

#### Determining the end point

Select F2 END POINT.

The point, on which the cursor is located, is defined as the end point of an element of geometry (a line, circle or arc) by pressing the key F2.

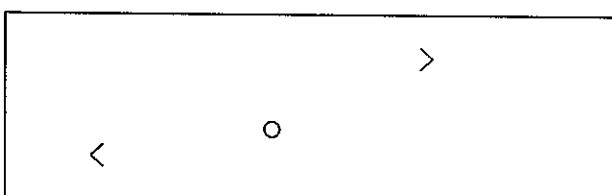
The active end point is shown on the screen by the symbol "<".

#### Determining the centre point

Select F3 CENTRE PNT.

The point, on which the cursor is located, is defined as the centre point of a circle or an arc by pressing the key F3.

The active centre point is shown on the screen by the symbol "o".



Representation of a starting point, centre point and end point.

#### Find Point

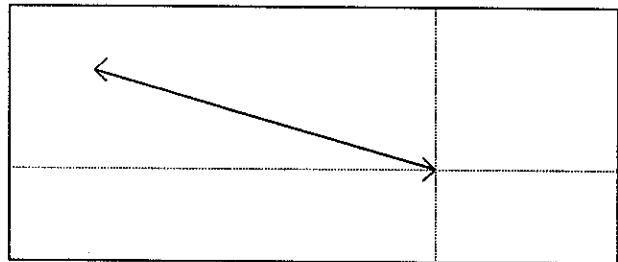
Select F4 FIND PNT.

Position the cursor by means of the arrow keys near to the point found.

The cursor jumps to the neighbouring point, when the key F4 is pressed.

#### Purpose:

If working is to continue from an available point, this must be approached exactly with F4.



#### Example:

The cursor is located at the starting point of the line.

#### Re-defining the Reference Point

Select F5 NEW REF PT.

The point, on which the cursor is located, is defined as the new reference point by pressing the key F5. Reference point (R) = origin of the coordinate system ( $X = 0 / Y = 0$ ).

#### Cursor to the Reference Point

Select F6 TO REF PNT.

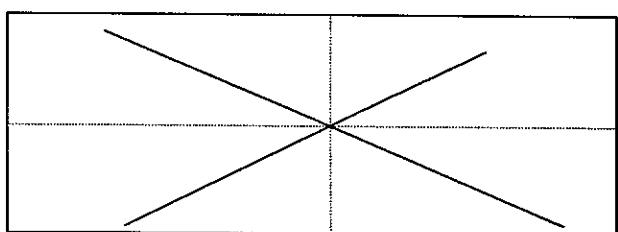
The cursor returns to the reference point, when the key F6 is pressed.

#### Find the Point of Intersection

Select F7 INTERSECT.

Position the cursor by means of the arrow keys near to the point of intersection to be found.

The cursor jumps to the neighbouring point of intersection, when the key F7 is pressed.



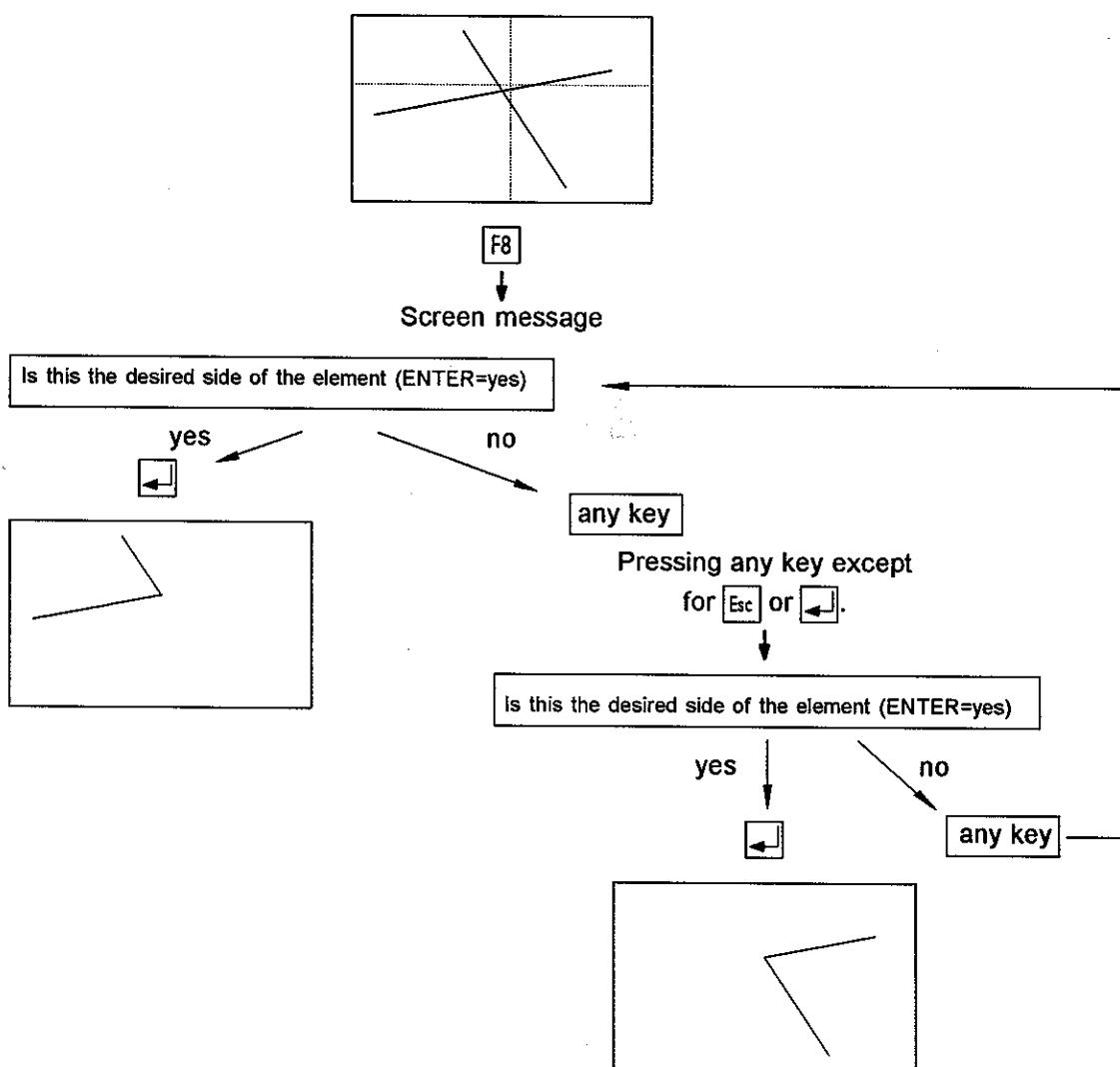
**Trim Corner**

Trim corner = deleting protruding parts of an element of geometry

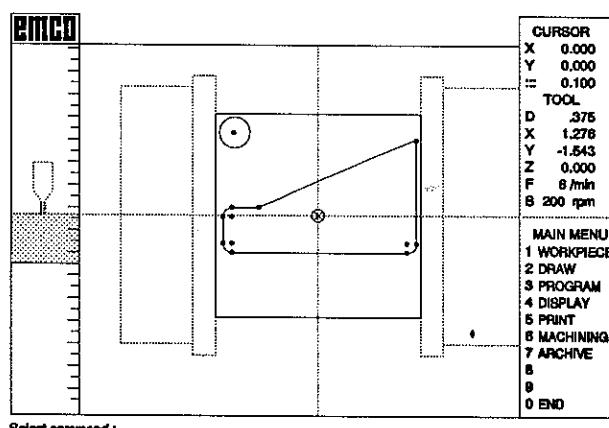
**Example**

Two intersecting lines should result in a corner.

Position the cursor by means of the arrow keys near to the bit to be trimmed.

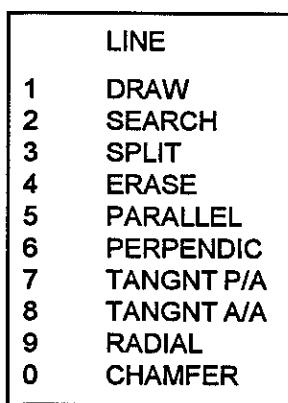
**Show points**

Pressing F9 shows start, end and centre points.



### 3.6.3 Line

Lines are drawn, altered or erased in this submenu.



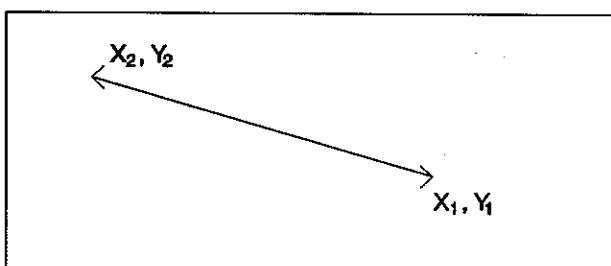
#### Drawing a Line

A line is drawn, whose starting and end points are already determined.

##### Example

Starting point  $X_1, Y_1$ , end point  $X_2, Y_2$

A line between the two points is drawn by selecting F1 DRAW.



#### Searching for a Line

Position the cursor by means of the arrow keys near to the line to be searched for.

The cursor jumps to the neighbouring line, when the F2 SEARCH is selected.

Purpose: If a line is to be worked further, it must first be determined with F2.

#### Splitting a Line

Position the cursor by means of the arrow keys on the splitting point of the line.

This line is divided into two lines, when F3 SPLIT is selected. (The point of splitting is invisible.)

Purpose: If only a part of a line is to be worked further, this part must be split from the rest.

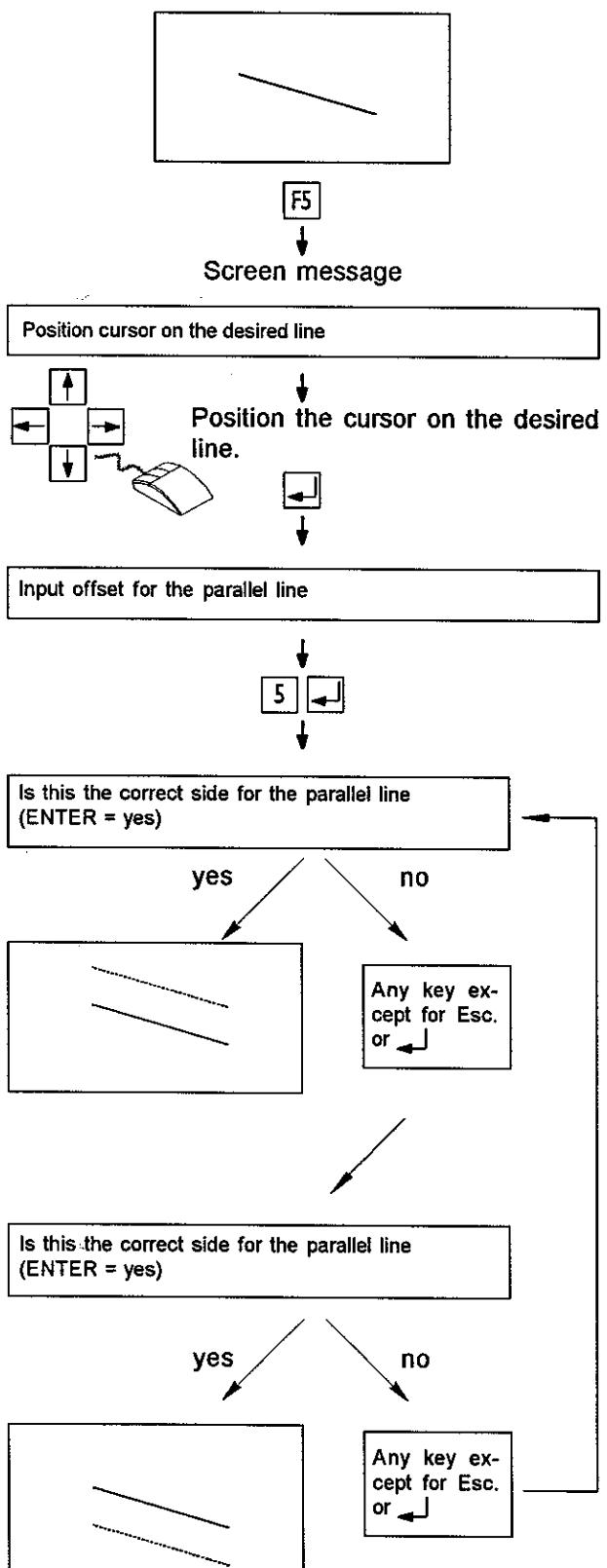
#### Erasing a Line

Position the cursor by means of the arrow keys near to the line to be erased and select F4 ERASE.

#### Drawing a parallel line

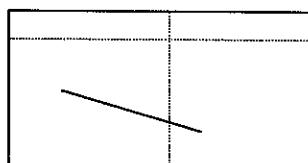
Unit: [inch]

A parallel line is drawn to an existing line (e.g., distance = 5 inch).



**Drawing a Perpendicular (90°) to a Line**

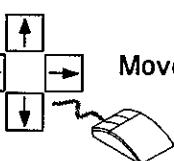
A perpendicular (90°) is drawn to an existing line.  
Move the cursor to the point, where the perpendicular should start.

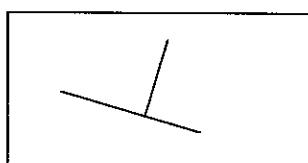


F6

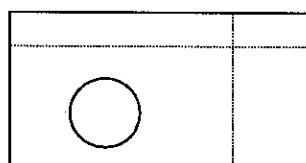
Screen message

Position cursor on the desired line

Move the cursor near to the line.  


**Drawing a Tangent Point/Arc**

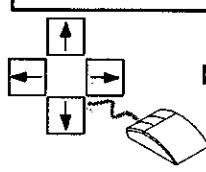
A tangent from the current cursor position to an arc is drawn.



F7

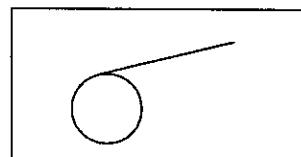
Screen message

Position cursor on the desired arc

Move the cursor on the desired arc.  


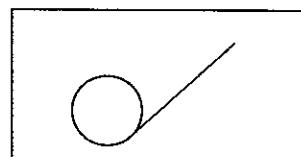
Is this the desired tangent (ENTER = yes)

yes

Any key ex-  
cept for Esc.  
or ↵

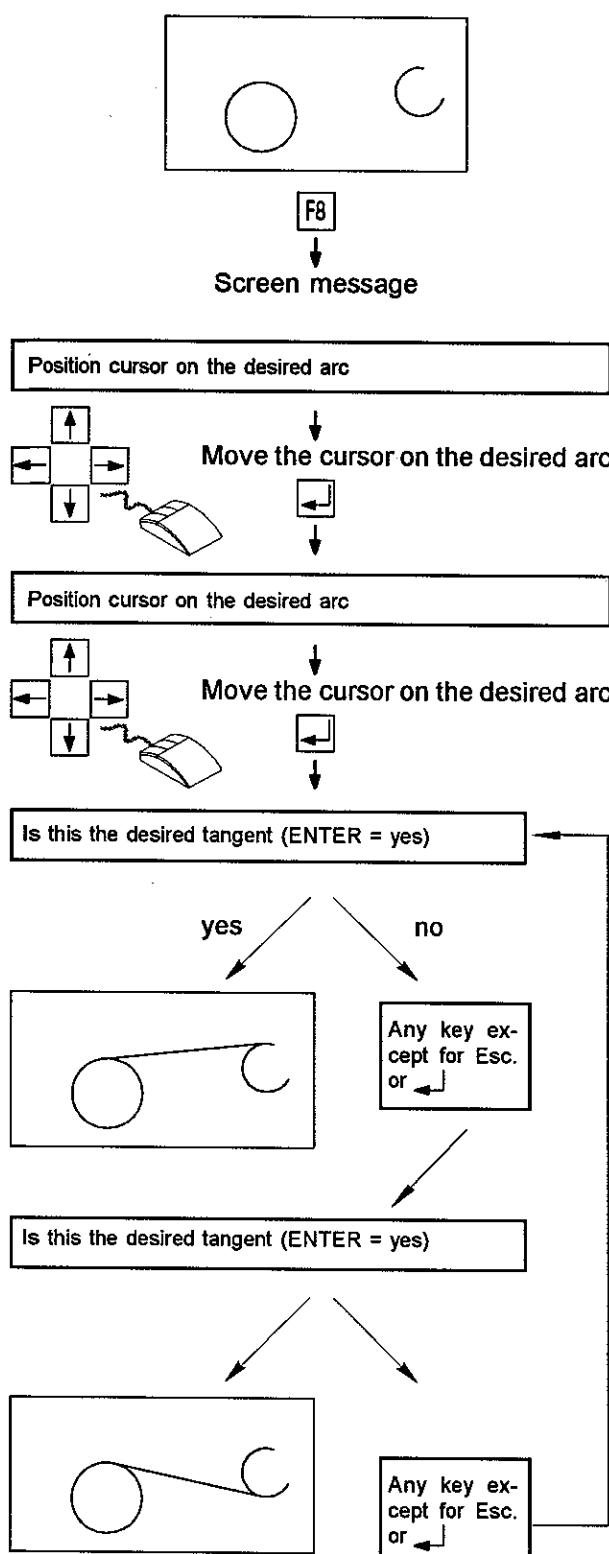
no

Is this the desired tangent (ENTER = yes)

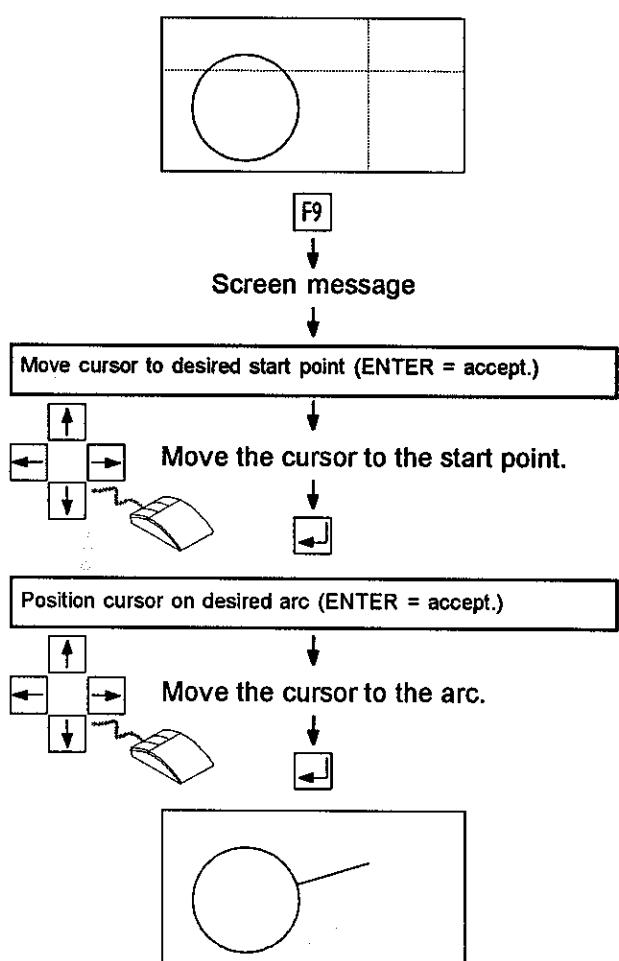
Any key ex-  
cept for Esc.  
or ↵

**Drawing a Tangent Arc/Arc**

A tangent from an arc to a second arc is drawn.

**Drawing a Radial Line**

A radial line from a point to an arc is drawn.



**Adding a Chamfer (45°)**

Unit: [inch]

Condition:

1. Both lines contact each other at this point (do not intersect).
2. The cursor must be positioned near to this bit.

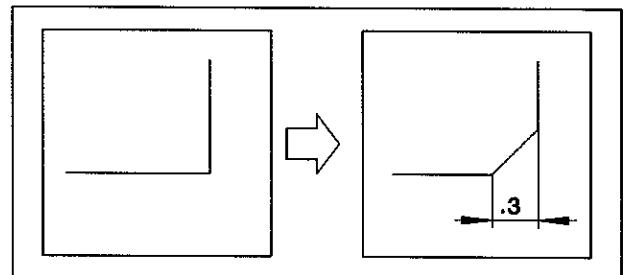
Example: chamfer = .3 x .3 inch

Screen message	Entry
	F10
Size of the chamfer	.3 <input checked="" type="checkbox"/>
Is the chamfer correct (ENTER=yes)	<input checked="" type="checkbox"/>

**Possibilities:**

ENTER = Confirming the desired chamfer

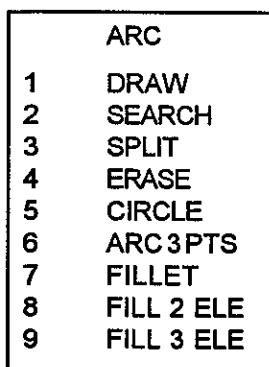
Any other key = interruption

**Note:**

Pressing the blank key causes the drawing of a fillet.

### 3.6.4 Arc

Arcs are drawn, altered or erased in this submenu.



### Searching for an Arc

Position the cursor by means of the arrow keys near to the arc to be searched for.

The cursor jumps to the neighbouring arc, when the key F2 SEARCH is selected.

#### Purpose

If an arc will be worked further, this must be defined with F2 first.

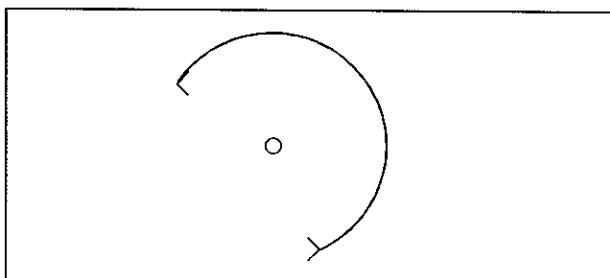
### Drawing an Arc

An arc is drawn, whose starting, centre and end points are already determined.

#### Example:

Starting point: X = 3.5 inch, Y = 6.6 inch  
 Centre point: X = 3.0 inch, Y = 5.8 inch  
 End point: X = 2.5 inch, Y = 5.5 inch

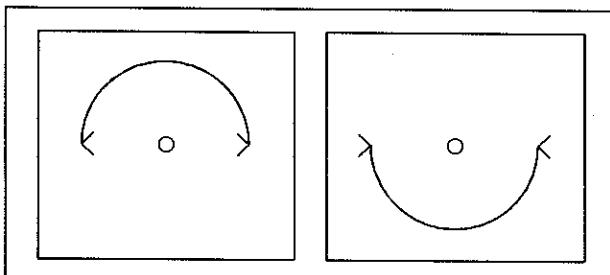
An arc (clockwise) is drawn from the starting point to the end point by selecting F1 DRAW.



#### Note:

Arcs are always drawn clockwise.

You can define the position of the arc by the selection of the starting and end points.



### Splitting an Arc

Position the cursor by means of the arrow keys on the splitting point of the arc.

The arc is split, when F3 SPLIT is selected. (The splitting point is not visible.)

#### Purpose:

If only a part of an arc is to be worked further, this part must first be split from the rest.

### Erasing an Arc

Position the cursor by means of the arrow keys near to the arc to be erased and select F4 ERASE.

#### Attention!

The command "Erase" can no longer be reversed, after it has been carried out!

**Drawing a Complete Circle (360°):**

Unit: [inch]

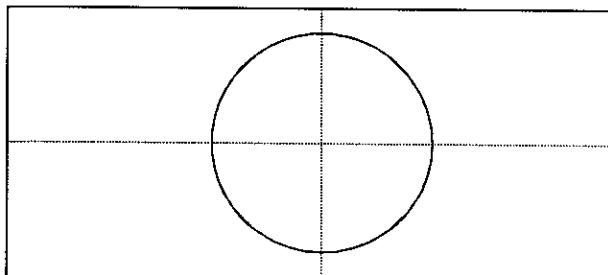
Position the cursor by means of the arrow keys on the centre point of the desired complete circle.

Select F5 CIRCLE, enter the radius of the circle and confirm it.

Example:

Constructing a complete circle R = 1.5 inch

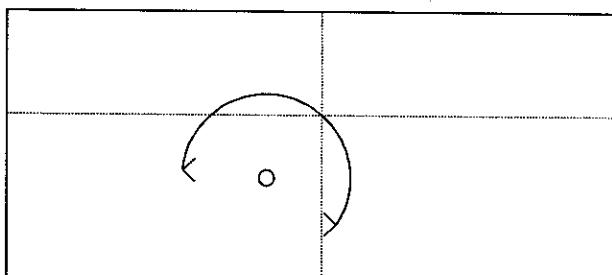
Screendisplay	Entry
	F5
Circle radius 10.000 (ENTER = no change):	1.5 <input type="button" value="←"/>

**Drawing an Arc with Three Points**

Determine the starting point and the end point.

Position the cursor on the circumference of the desired arc (= third point).

An arc is drawn through the starting, end point and cursor position, when F6 ARC 3 PTS is selected.

**Adding a Fillet**

Unit: [inch]

- Both lines must contact at this point.
- The cursor must be positioned near to this bit.

Example:

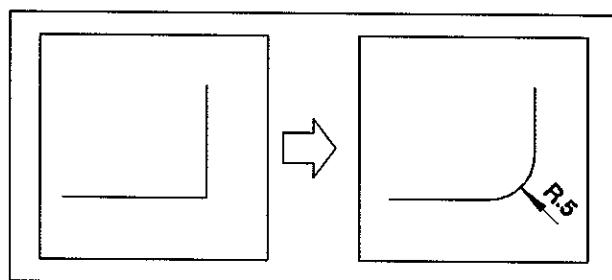
Radius = .5 inch

Screendisplay	Entry
	F7
Radius for the corner?	.5 <input type="button" value="←"/>
Is the radius correct (ENTER = yes)	<input type="button" value="←"/>

Possibilities:

ENTER = confirming the desired radius

Any other key = interruption of this command "Adding the fillet".

**Note:**

Pressing the blank key causes the drawing of a chamfer.

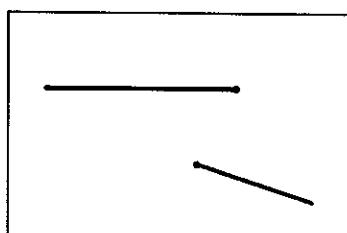
**Fill Two Elements**

Select F8 FILL 2 ELE.

Geometric elements (points, lines, circles or arcs) are filled tangentially by an arc.

**Example 1**

Filling the point of one line with a point of another line.



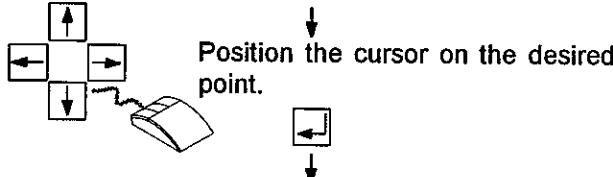
F8

Screen message

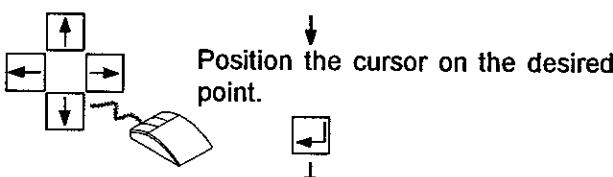
Radius (inch)	1.000 ( $\leftarrow$ = no change)
---------------	-----------------------------------

.	6	$\leftarrow$
---	---	--------------

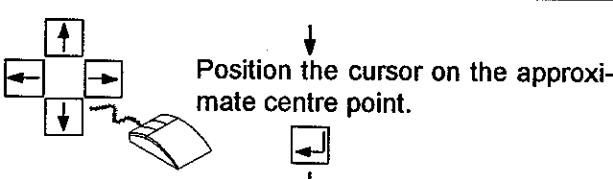
Define element nr. 1



Define element nr. 2



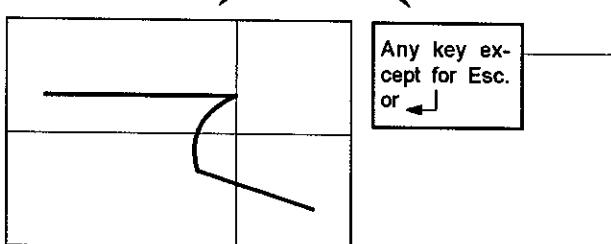
Position the cursor in the approximate centre



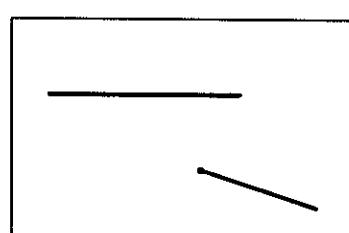
Is this the desired side? (ENTER = yes)

yes

no

**Example 2**

Filling the point of a line with a line.



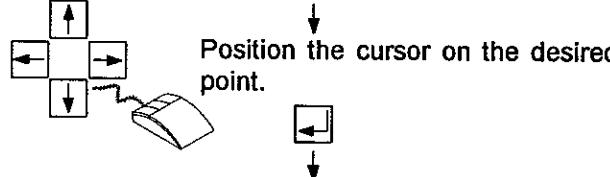
F8

Screen message

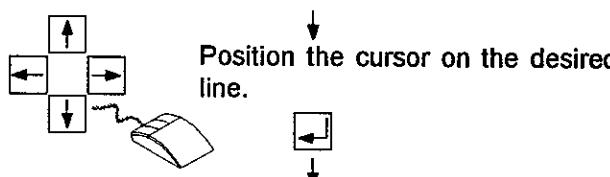
Radius (inch)	1.000 ( $\leftarrow$ = no change)
---------------	-----------------------------------

.	6	$\leftarrow$
---	---	--------------

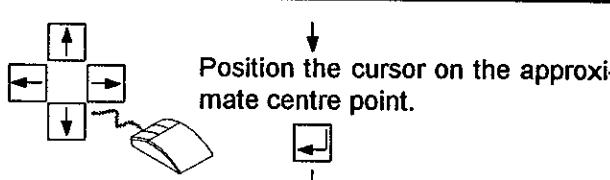
Define element nr. 1



Define element nr. 2



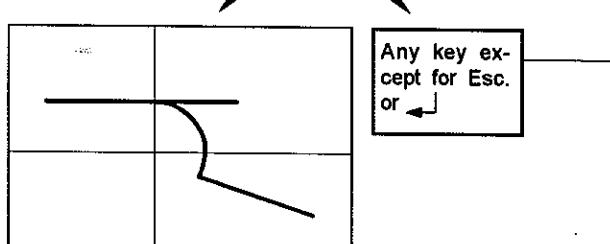
Position the cursor in the approximate centre



Is this the desired side? (ENTER = yes)

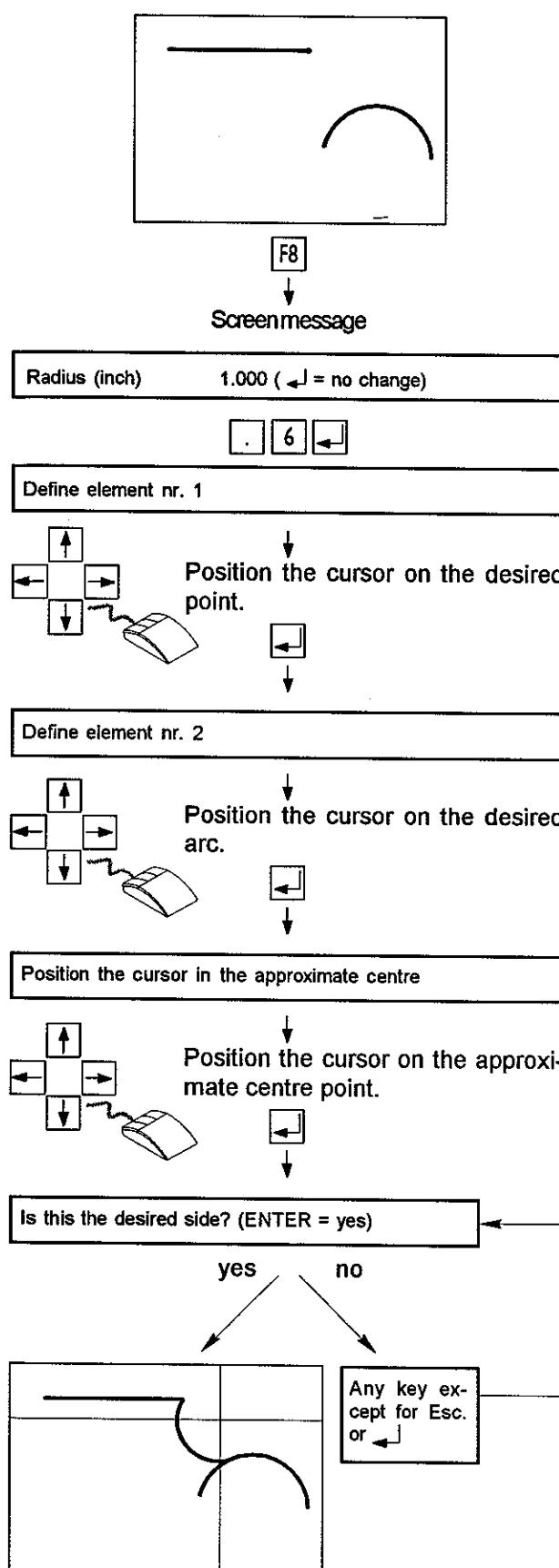
yes

no

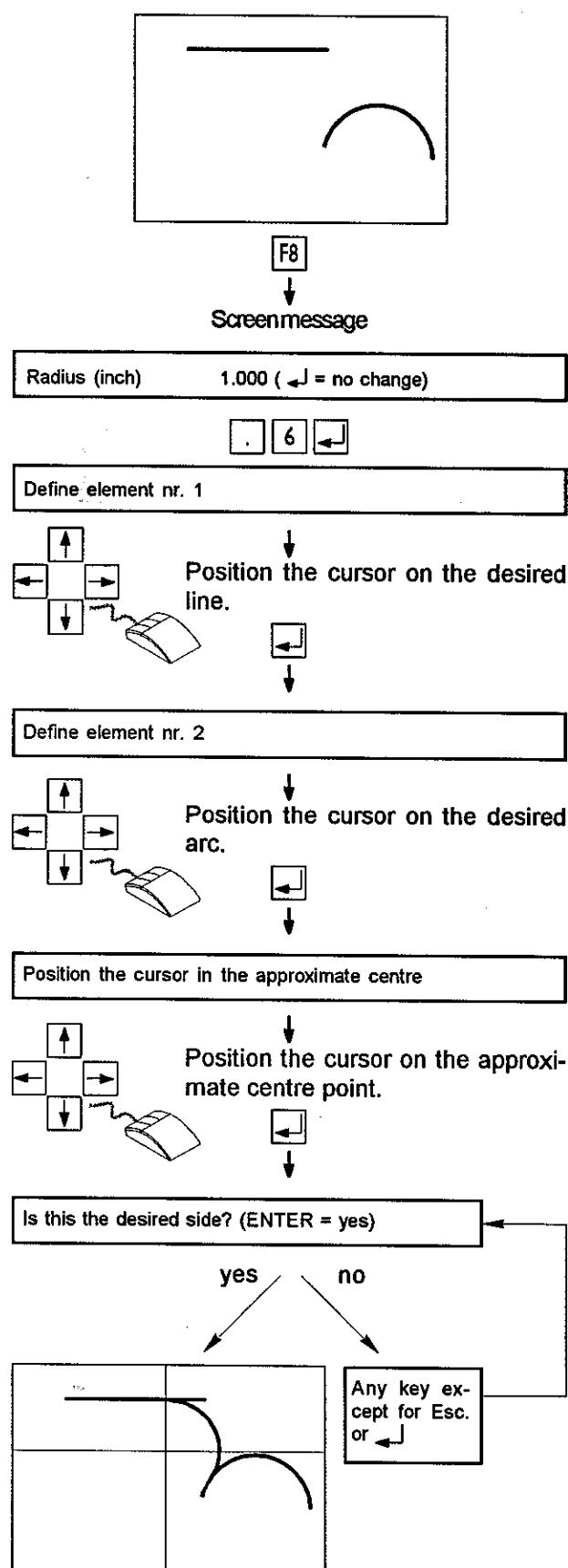


**Example 3**

Filling the point of a line with an arc.

**Example 4**

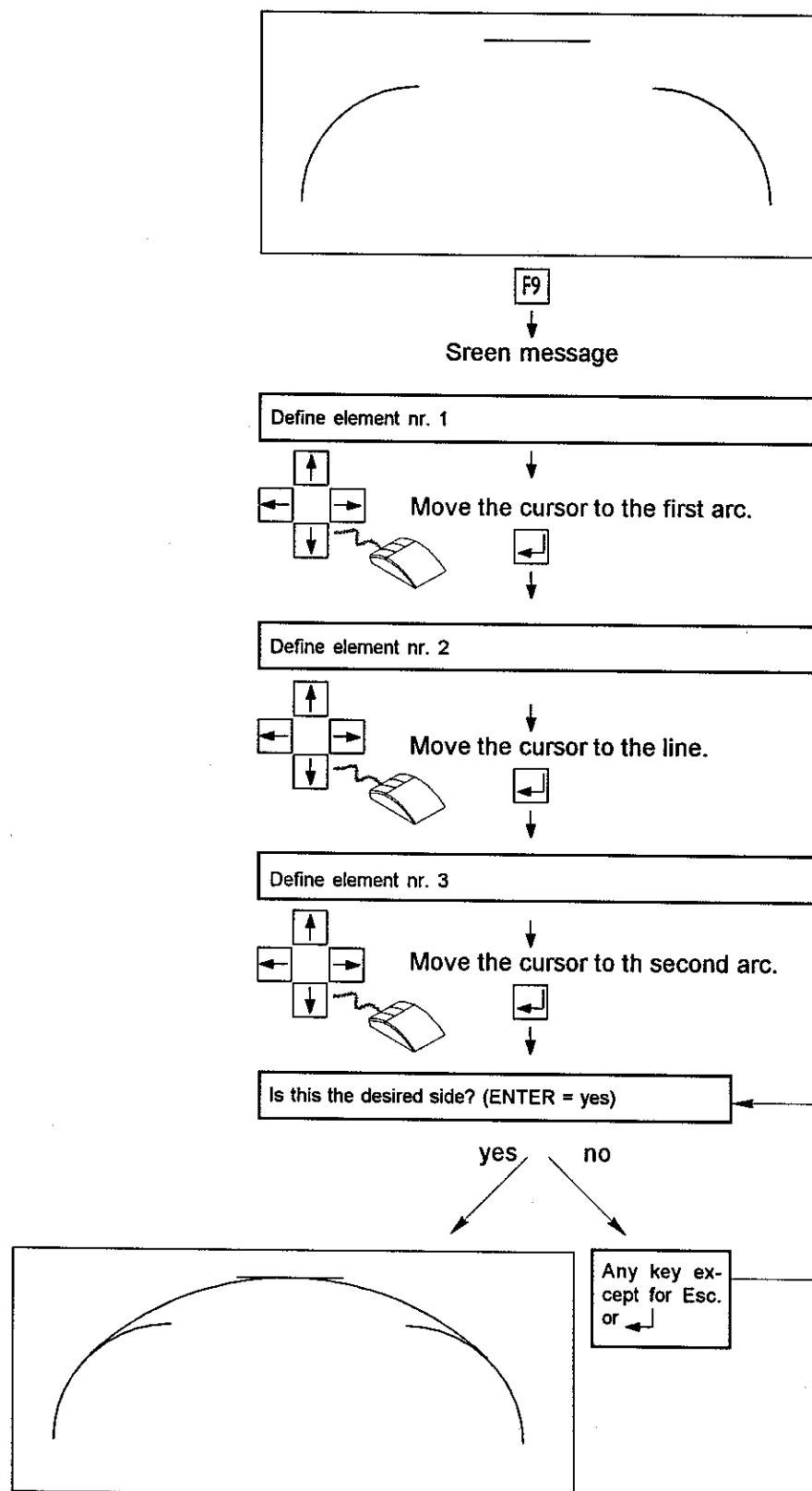
Filling a straight line with an arc.



**Fill Three Elements**

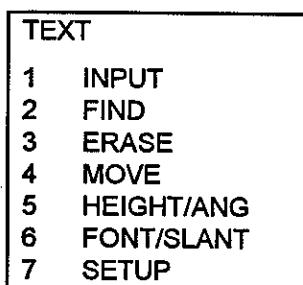
Select F9 FILL 3 ELE. A tangential arc between three elements will be drawn. These elements may be points, lines or arcs. Identify the elements according to the system requests and choose one of the offered possibilities (any key). Working with points you have to identify the point first by using the hotkey P (search point).

Example: Filling two arcs and a line



## 3.6.5 Text

With this function you can insert text in drawings.



### Text Input

Place the cursor on the left lower edge point of the text line which should be put in.

Select F1 INPUT.

You can enter the text in the command line or select the shown elements in the menu box with the function keys.

The cursor jumps in the next line by pressing ENTER.

Finish the text input by pressing the ENTER key twice.

### Find Text

Select F2 FIND.

The cursor jumps to the next text box.

### Erase Text

Select F3 ERASE.

Move the cursor to the text line which should be deleted and press ENTER. The text will be deleted.

### Move the Text

Select F4 MOVE. Identify the text by moving the cursor on it and pressing ENTER.

Move the cursor to the desired position and press ENTER.

### Alter Height and Angle of the Text

Select F5 HEIGHT/ANG. Identify the text by moving the cursor on it and pressing ENTER.

Enter the height value and press ENTER.

Enter the text angle and press ENTER.

Confirm the correctness-query with ENTER or abort with ESC.

### Alter Font and Slant of the Text

Select F6 FONT/SLANT. Identify the text by moving the cursor on it and pressing ENTER.

Highlight the desired font (style) in the menu box (with cursor keys, scrolling possible) and press ENTER.

Enter the slant and press ENTER.

### Text Setup

Select F6 SETUP. The menu box shows the following points:

- 1 Alignment
- 2 Text / Box
- 3 Text angle
- 4 Text hght
- 5 Line offset
- 6 Slant
- 7 Char-Font
- 8 Cut. depth
- 9 Retraction
- 0 END

#### Alignment

Press F1 Alignment. Select right, left or centre alignment.

#### Text / Box

Select F2 TEXT / BOX to switch over between text and box display. Box display saves redraw time.

#### Text angle

Select F3 Text angle. Enter the text angle in the command line and press ENTER.

#### Text height

Select F4 Text hght. Enter the text height in the command line and press ENTER.

#### Line offset

Select F5 Lineoffset. Enter the distance between two text lines and press ENTER.

#### Slant

Select F6 Slant. Enter the character slant in the command line and press ENTER. The slant defines the angle difference of the letters to the line vertical.

#### Character font

Select F7 Char-Font. Highlight the desired font (style) in the menu box (with cursor keys, scrolling possible) and press ENTER.

#### Cutting depth

Select F8 Cut. depth. Enter the cutting depth for machining in the command line and press ENTER.

#### Retraction height

Select F9 Retraction. Enter the retraction height for machining in the command line and press ENTER.

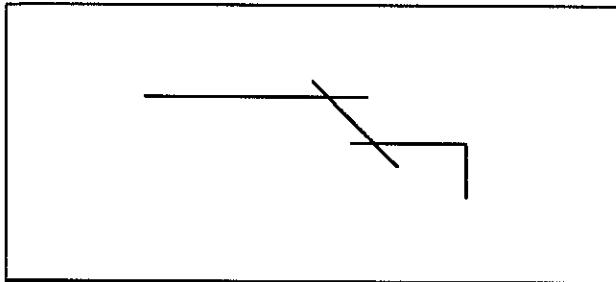
### 3.6.6 Cleaning the Workpiece Contour

At the beginning of a geometric definition, it will often happen that two or more contour elements are cut uncleanly. For the machining of the workpiece, however, continuous contours are required. The points of intersection must be "cleaned" (for example, see next page).

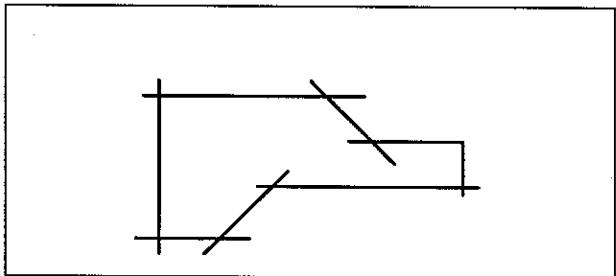
Note:

The prompt from the system for the type of contour appears during the cleaning. There are two possibilities.

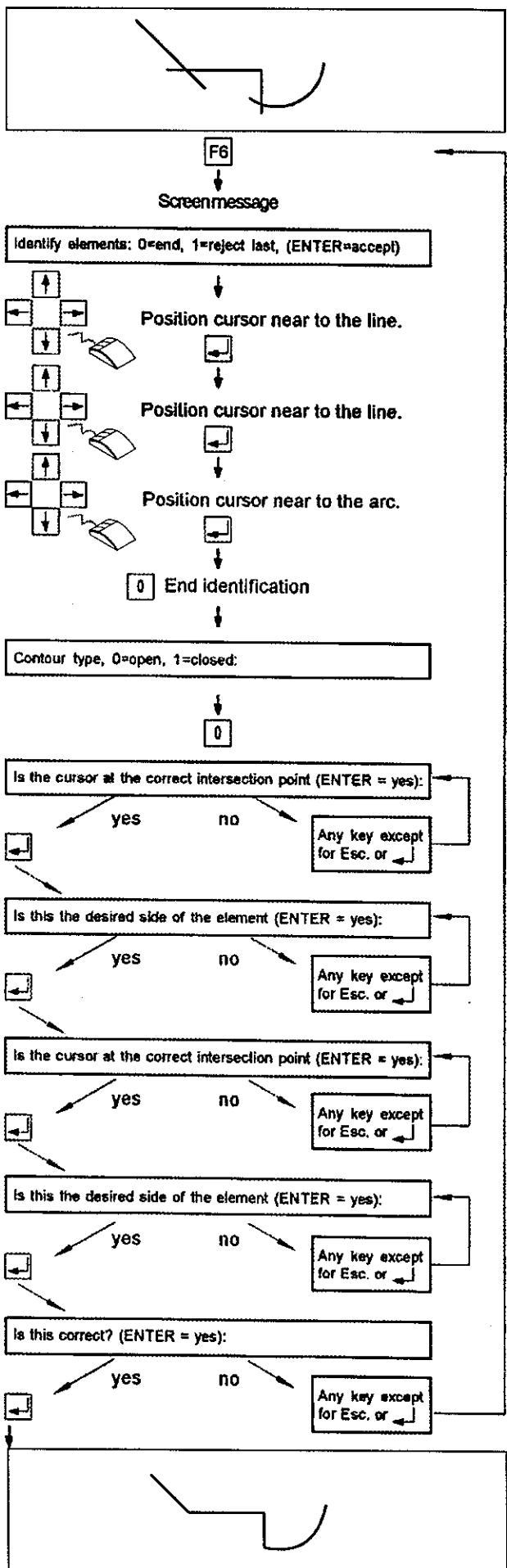
Possibility 1: open contour



Possibility 2: closed contour



### Example: Cleaning



### 3.6.7 Erasing the Geometric Element

The cursor was positioned near to the element to be erased (line, circle or arc).

The neighbouring geometric element is erased, when the key F6 is pressed.

Attention!

The command "Erase" can no longer be reversed, after it has been carried out.

### 3.6.8 Erasing All

All the drawing elements shown on the screen are erased.

Attention!

The command "Erasing all" can no longer be reversed, after it has been carried out.

Screen message	Entry
	<input type="button" value="F8"/>
Are you sure? (ENTER = yes)	<input type="button" value="◀"/>

Possibilities:

ENTER = drawing is erased

Any other key = erasure command is interrupted

### 3.6.9 Information About the Geometry Element

Move the cursor on an element of the drawing and select F9 INFO ELEM.

All information about the element will be displayed in the menu box.

### 3.6.10 Hotkeys for Drawing

In order to facilitate a more efficient programming, so-called "hotkeys" were introduced in this software. Hotkey = single-key commands, which are effective in every menu level. You can display a workpiece contour on the screen more quickly with the use of these hotkeys.

Example: Constructing a line

**Possibility 1 - Menu**

1. F2 Recall-menu DRAW
2. F2 Recall-submenu POINT
3. Moving the cursor to the starting point
4. F1 Determining the starting point
5. Moving the cursor to the end point
6. F2 Determining the end point
7. Esc. Exit from the submenu POINT
8. F3 Recall-submenu line
9. F1 Drawing a line

**Possibility 2 - hotkeys**

1. Moving the cursor to the starting point
2. S Determining the starting point
3. Moving the cursor to the end point
4. + Drawing the line to the cursor position, a new starting point at the same time

#### Summary - hotkeys

Key	Cursor commands
I	Position the cursor incrementally
Q	Position the cursor by entering the radius and angle
Pos 1	Cursor to the middle of the screen
End	Cursor to the reference point
D	Cursor to left lower corner of the work piece
PgUp	Doubling the step size of the cursor
PgDn	Halving the step size of the cursor
#	Switch on/off background grid for mouse operation

Key	Searching commands
P	Searching the point
L	Searching the line
A	Searching the arc
X	Searching the point of intersection

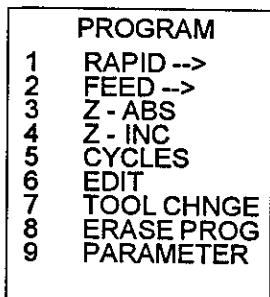
Key	Point commands
S	Determining the starting point
E	Determining the end point
M	Determining the centre point

Key	Screen commands
N	Redrawing the screen contents
W	Zooming a screen window
Z	Zooming the workpiece
>	Cursor as a graticule
<	Reduced cursor

Key	Geometric commands
R	Adding a fillet
C	Adding a chamfer
Y	Trim bit
+	Drawing a line to the cursor
-	Erasing an element
O	Show information about element

## 3.7 Program

The machining cycle is determined for a workpiece drawn and simulated on the screen in this menu. The tool path is shown graphically. The machining program is compiled automatically.



**Note:**

The programs are limited to max. 500 tool movements.

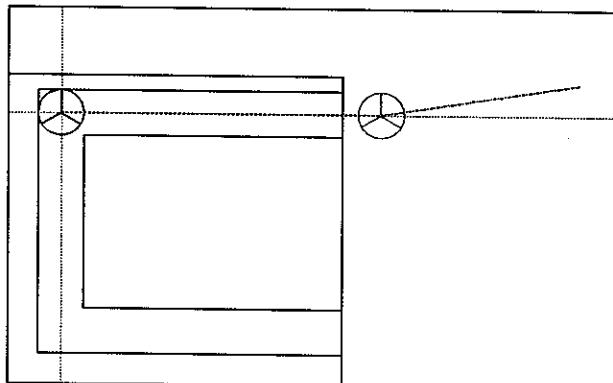
If more movements are necessary you must work off the work piece with two or more programs.

### 3.7.2 Moving with feed speed

The slides move with the programmed feed speed (= machining movement, see F9).

Representation on the screen: -----

The tool moves to the cursor position with the feed speed set to the time (see F9), when the key F2 is pressed.



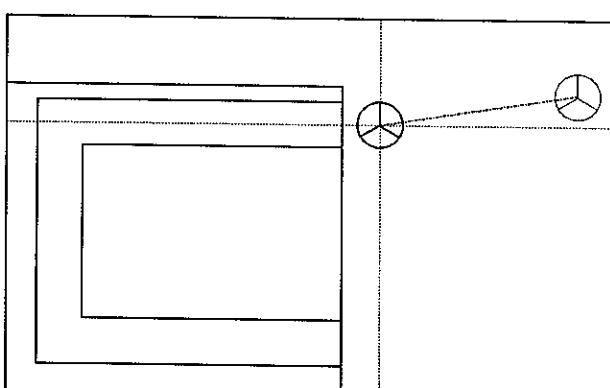
### Possibilities PROGRAM

#### 3.7.1 Moving in the rapid

Moving in the rapid is a movement without chip removal and only serves to position the tool. The slides move with the highest possible speed.

Representation on the screen: -----

The tool moves to the cursor position in the rapid, when the key F1 is pressed.



#### 3.7.3 Absolute infeed in Z

Select F3 Z-ABS

Input new Z-value. Currently 0.200 (← = no change)

Enter the desired height (related to the origin of the coordinates = surface of the workpiece). The tool moves with feed speed to the given height.

#### 3.7.4 Incremental infeed in Z

Select F4 Z-INC

Input Z-value from the current position (← = 0)

Enter the desired height (related to the actual tool position). The tool moves with feed speed to the given height.

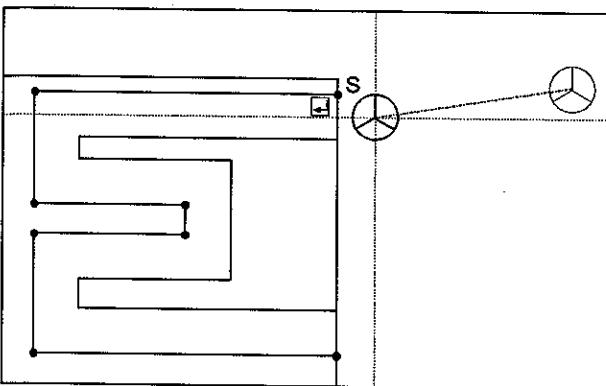
### 3.7.5 Cycles

#### Contour Milling Cycle

With this cycle the tool follows a contour. The milling depth can be reached in one or more runs.

Sequence:

Move the tool to a functional start point (S) and press F1-CONTOUR.



The parameters of this cycle are displayed in the menu field.

##### Approaching path height (F1)

Enter the height for approaching to the contour start.

##### Depth of single cuts (F2)

The infeed from the approaching path height down to the cutting depth is divided in several parts. The size of these parts is the depth of single cuts.

##### Cutting depth (F3)

This is the infeed from the workpiece surface down to the cutting ground.

##### Return traverse height (F4)

Enter the height for non-machining movements.

##### Machining side (F5)

Enter 1 for machining at the right side and 2 for the machining at the left side - seen in tool movement direction.

##### End of cycle definition (F10)

The following inquiries appear:

APPROACH

DIRECT

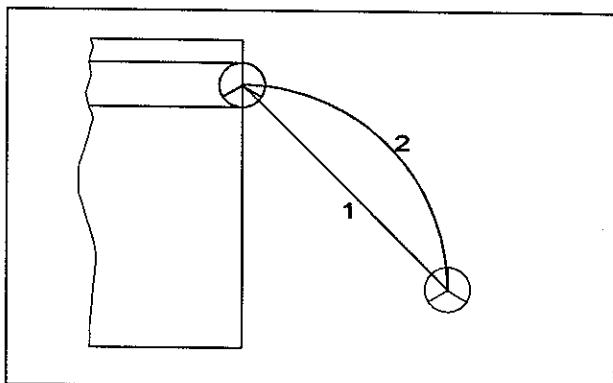
TANGENTIAL

RETRACT

DIRECT

TANGENTIAL

Determine direct (1) or tangential (2) moving.



The software asks for using the tool compensation.

Travel with tool compensation switched on ? ( = yes)

This determines whether G41 / G42 will be used in the CNC program. Select YES with ENTER, NO with any other key.

For defining the contour the software asks for the contour points:

Is the cursor on the desired start point of the contour? ( = yes)



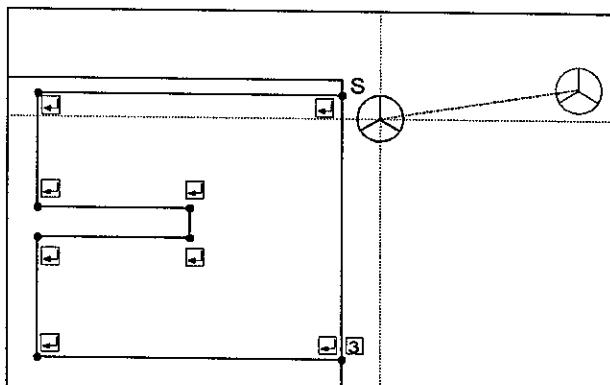
Confirm the starting point



Another point is suggested as the starting point.

##### Determining the contour points

After the starting point has been determined, the contour points (1, 2, ..) of the workpiece contour drawn must be determined. These contour points are suggested to you one by one.



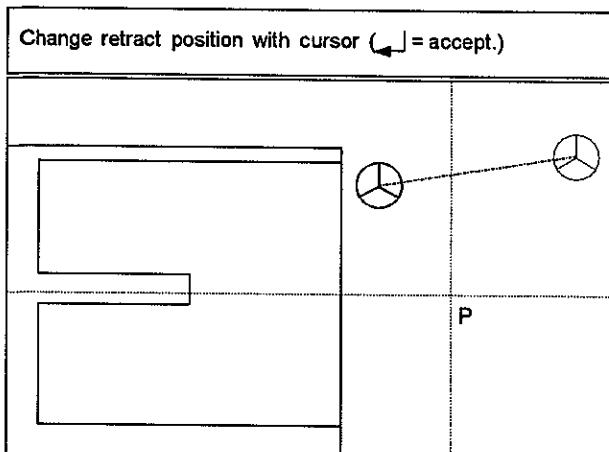
##### Possibilities

... Confirm the contour point

... Display the next contour point in the opposite direction

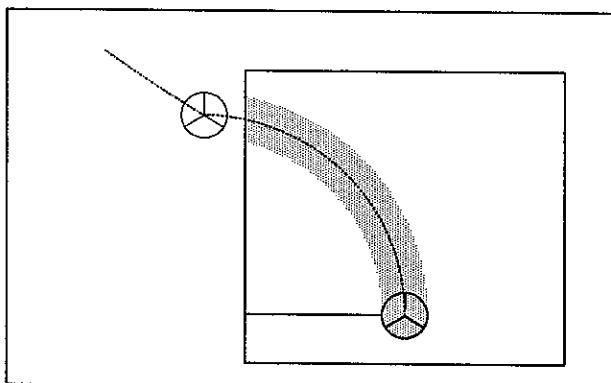
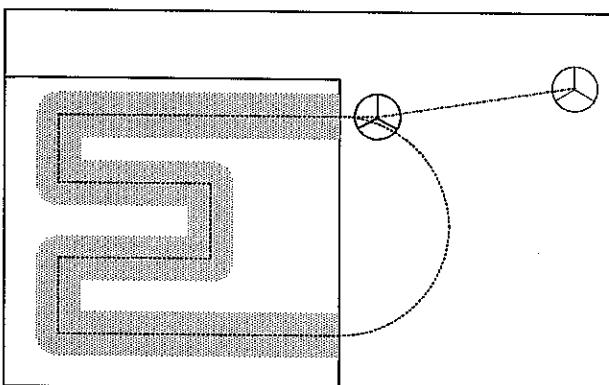
... Omit the suggested contour point

... End of the contour point determination, if all contour points have been made known to the program.



Move the cursor to the position for move-out (P) and press ENTER.

The cycle will be executed.



### Next Z

This command is used in combination with the element following cycle.

Place the tool on the start point of an element.

Place the cursor on the element.

Select F3 NEXT Z and enter Z value which should be reached at the end point.

Select F2 ELE FOLLOW.

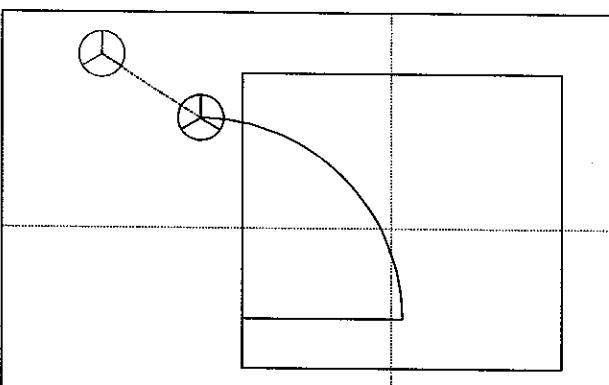
The tool will follow the selected element and at the same time approach to the entered Z-value.

This would result e.g. in a helix curve, if the element to be followed is an arc.

### Element Following Cycle

With this cycle the centre of the tool follows a desired element of the drawing.

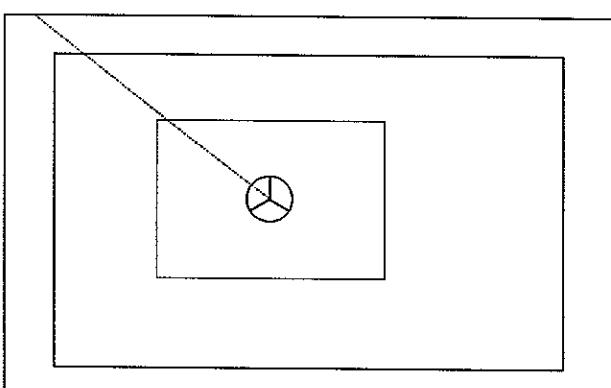
- Move the tool on the start point of the desired element.
- Move the cursor near the desired element.



- Set infeed with Z-ABS or Z-INC.
- Select ELE FOLLW. The tool centre moves on the geometrical element to the end point.

### Rectangular Pocket Cycle

- Move the tool in a corner of the rectangular pocket.



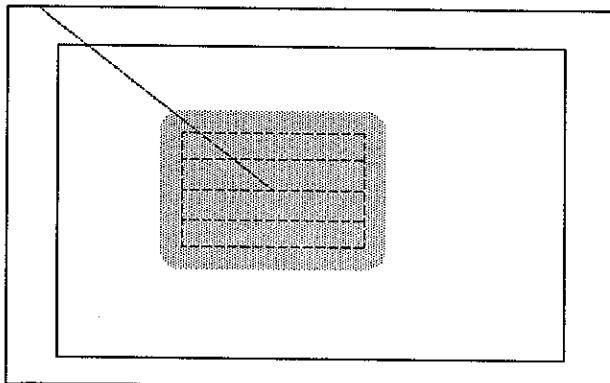
- Select RECT POCKT

- Input depth (F1), length (F2) and width (F3) of the pocket.

#### Note:

The values for depth, length and width are related to the tool centre point. With the sign of these values you can determine the orientation of the rectangular pocket in relation to the tool.

- Press F10. The cycle will be executed.



### Free Form Pocket Cycle

With this command you can mill a drawn pocket with any form or max. 7 islands.

This command creates a cycle which reads a file (L....) containing the geometry of a predefined contour.

G29 X... Y... Z... L.... P2=... P3=...  
P4=... P5=... P7=... P8=... D1=... D2=...

The parameters are as follows:

G29	Cycle call
X,Y,Z	Absolute start position
L	Number for the contour file (max. 4 digits). The file is stored as e.g. L1234.SD2
P2	Radius for tangential approaching.
P3	Offset
P4	Angle of the milling lines
P5	Distance of the milling lines
P7	Depth of the single infeeds
P8	Retraction height
D1	Direct/tangential approaching 1 direct 2 tangential
D2	Machining side 1 left 2 right 0 on the contour

### Creating and storing the contour(s)

Draw the contour(s) of the pocket and/or the island(s) with the normal CAD commands.

- Move the tool on a fitting start point.
- Calling the cycle with F6 FREE POCKT
- The following parameters appear in the menu:

#### Contour

Enter a program number for storing the contour. Define the first contour (the contour for the pocket) as described under "Contour Milling Cycle" and note the direction of defining.

The system asks for a machining start point (to dive in with the tool). Move the cursor on a fitting point and press ENTER.

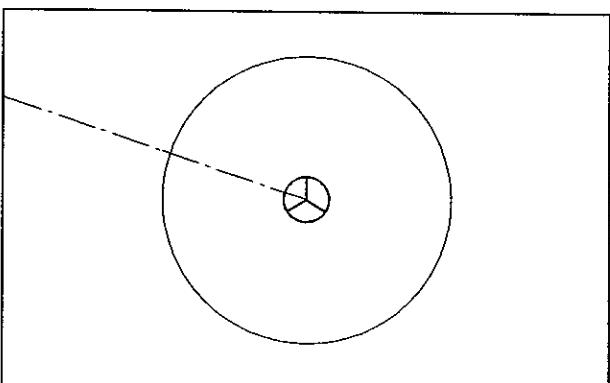
The system asks for defining the next contour (contour for island).

Go on with any key or define the next contour with pressing ENTER.

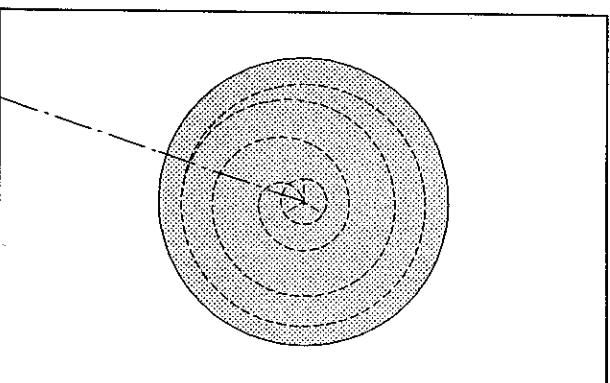
If you define islands and the islands should be machined outside the contour and the pocket should be machined inside the contour, you must define the islands in the opposite direction to the pocket.

### Circular Pocket Cycle

- Move the tool into the centre of the circular pocket

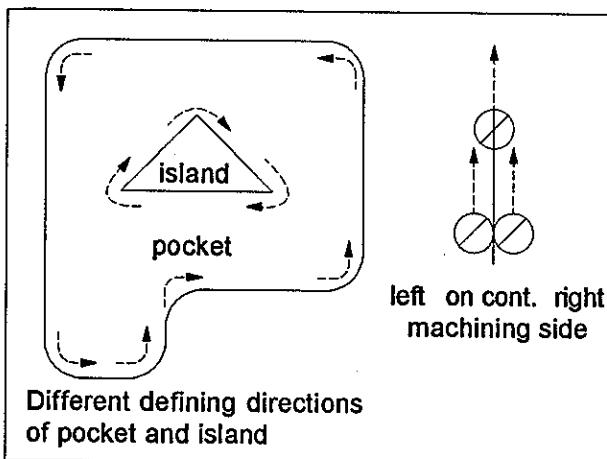


- Select CIRC POCKT
- Inputs
  - F1 height of approaching path
  - F2 maximum feed depth
  - F3 total depth of the pocket
  - F4 height of return traverse
  - F5 climb milling or upcut milling
  - F6 diameter of pocket
- Press F10. the cycle will be executed



## Machining (machining side)

Select whether the tool should traverse at the left or right side of the contour (seen in contour defining direction) or on the contour.



## Offset

If the pocket should be finished afterwards, a positive or negative (due to machining direction) finishing offset must be entered here.

## Cut. depth (depth of single cuts)

Enter the value of the single infeeds. If you want to machine the pocket in one cut, enter a value which is clearly larger than the difference of approach height and end depth.

## End depth

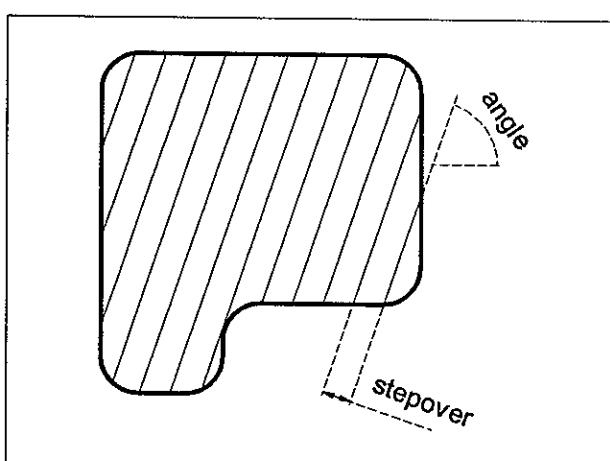
Enter the end (bottom) depth.

## Angle

Enter the angle of the cutting pathes to the horizontal.

## Stepover

Input the distance between the cutting pathes (smaller than tool diameter).



## Retract

Enter the retraction height (absolute).

## Approach

Select whether the contour should be approached direct or tangential. For tangential approach define the approaching radius.

## Execute

This menu point starts the free pocket cycle.

The tool first follows the contour of the pocket and/or the island(s) and then it mills the areas inbetween in lines under the given angle.

After machining the free form pocket the you can use the contour follow cycle to finish the pocket.

## Mill Text

With this cycle you can mill text automatically.

Position the cursor near the first letter of the text label and select F7 MILL TEXT.

Identify the text label and enter a number for the file to be separately stored (max. 4 digits).

The end Z depth and the retract/approach height of the milling path are defined in DRAW - TEXT - SETUP. The text automatically will be machined with the active feed rate. The tool always retracts between letters and moves to new position in rapid feed.

In the editor this command is represented by a special G code with the following parameters:

G28 X... Y... Z... P1=... P3=... D3=... D5=...

The parameters are as follows:

G28 Cycle call

Z End depth of cut

L File number for the text file (max. 4 digits).  
The file is stored as e.g. T1234.SD2

P1 Text height

P3 Approach height at the start and between the letters

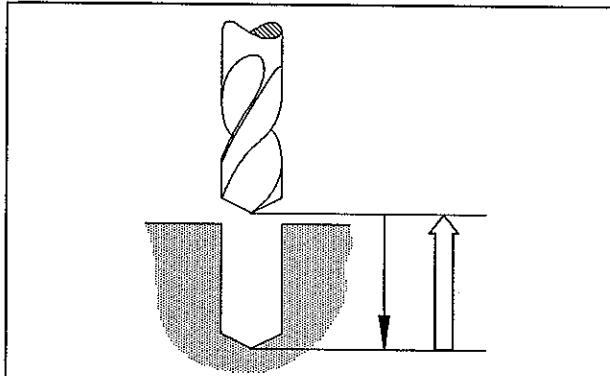
D3 Type of text font

D5 Slant of the text

## Drilling Cycles

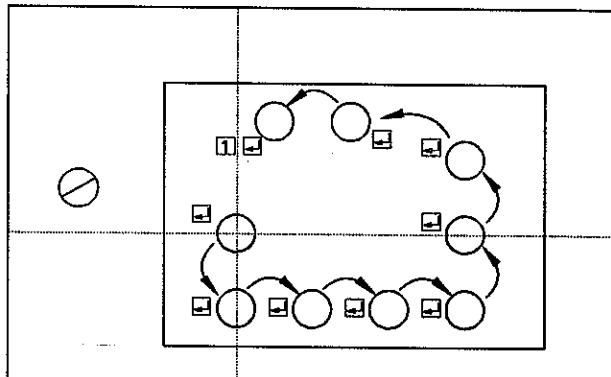
The software offers 2 drilling cycles.

- Drilling (DRILL) - G81

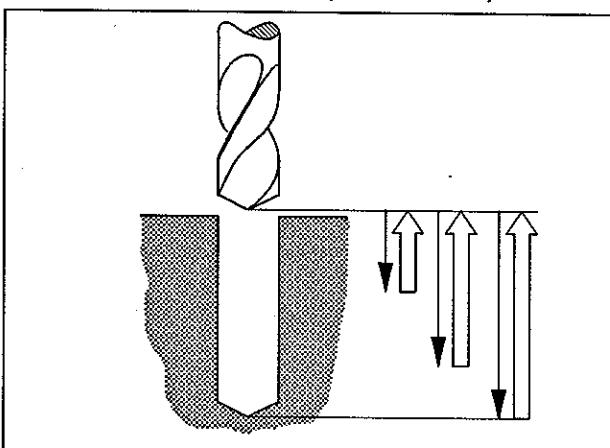


The tool moves down to the programmed drilling depth with feed speed and moves up immediately with rapid speed.

- Move the cursor on the first boring and press ENTER.
- Move the cursor on every boring in a useful succession (short distances) and confirm every boring with ENTER.



- Deep hole drilling cycle (DEEP HOLE) - G86



The tool moves back periodically in rapid speed to put the chips out of the hole. Use this cycle for drills in materials with bad cutting property.

- Confirm the last boring with ENTER and press 1 to cease the definition sequence.

- SEQUENCE  
1KEEP  
2REVERSE

Select, whether the boring should be machined in the order of input or in the opposite direction.

- The symbols for the cycle parameters appear in the menu box.  
Press the displayed F-keys (F1, F2, ...) to modify the parameters.  
Continue with F10.

**Input correct this way (← = yes)**

Confirm with ENTER or abort with any other key.

- The first boring will be executed. In the menu box appears the inquiry:

- 1 manual  
2 automatic

Select "manual" if you want to change drilling depth or feed for a following boring. Select "automatic" if all following borings of this definition should have the same feed and drilling depth.

- If more cycles are selected, the inquiry appears: TOOL CHANGE

- 1 YES  
2 NO

Selecting YES leads to the tool change sequence, NO continues without change.

The next cycle starts with

- 1KEEP  
2REVERSE

## Input of drilling cycles

- Select the menu point DRILLING. The two drilling cycles appears in the menu box.
- Select the desired drilling cycle.

**1 cycle was selected as .... (See menu - F10 = end):**

If you want to run more cycles on the borings (e.g. pre-drilling with smaller diameter and finish drilling), select the next cycle, else press F10.

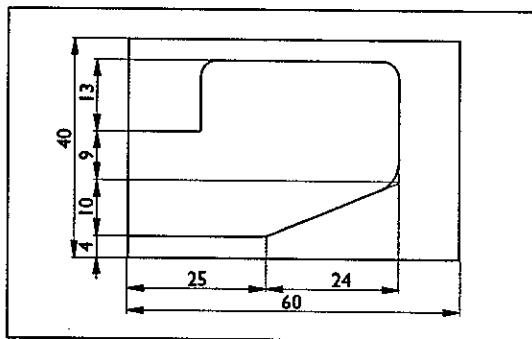
**Identify drilling holes (← = next hole, 1 = end)**

### 3.7.6 Editor

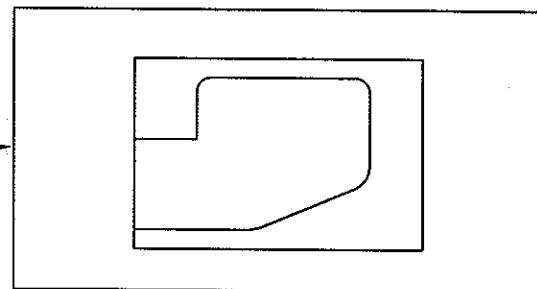
By pressing the key F4 you enter the "Edit" program. The editor is the programming station in the conventional sense. In the editor you can work as with the original CNC machine and set up NC programs according to standards.

#### Machining possibilities (Survey)

##### Workpiece data



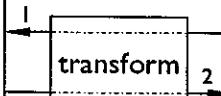
##### CAD (design on screen)



##### EDIT

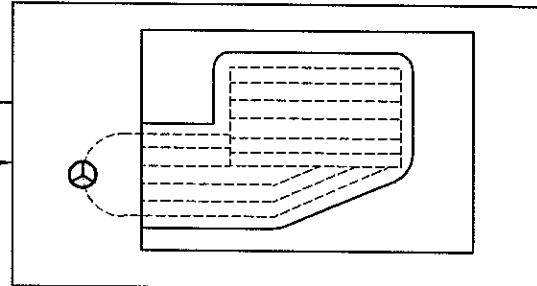
(determine machining with CNC program)

N0010	G40	G70	G90	G94	G97
N0020	G92	X0	Y0	Z0	
N0030	G54	T0202			
N0040	G92	X0	Y0	Z0	
N0050	G59				
N0060	G00	X-6	Y-1	Z1	
N0070	G00	Y10			
N0080	G00	Z2			
N0090	G01	Z-3			
N0100	G41				
N0110	G01	X0	Y7	Z-3	
N0120		X23.974			
N0130	G03	X25.943	Y7.404	I0	J5



##### CAM

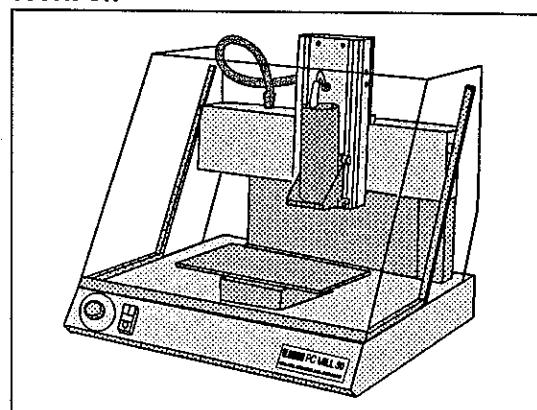
(Determine machining process graphically and simulate)



**Ref. 1:** The machining process (CAM) determined graphically can be transformed into NC-programs and changed there (in the editor).

**Ref. 2:** The NC-program entered in the screen is transformed by pressing a key and is simulated automatically on the screen. The machining process determined in the editor can also be changed graphically again and in the following be executed on the machine.

##### Work off



## Introduction

### Explanation of term EDIT

The procedure of entering data (numbers and letters) into a PC or in a control is also called edit.

#### Example:

An NC program is entered into the computer (edited). This is carried out in a certain part of the software, the EDIT.

EDIT = mode for program input

This information is:

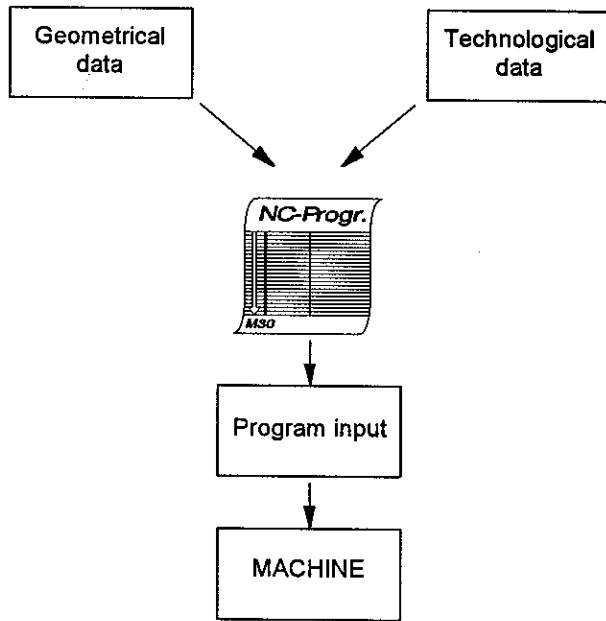
1. Geometrical data  
You find these geometrical data (dimensions) on the drawing of the workpiece.
2. Technological data  
Feed, spindle speeds, tools, etc.
3. Machine functions  
(see G, M-functions)
4. Program instructions  
When setting up an NC program certain instructions on sequences of commands (see G, M-functions) have to be adhered to.

### What is programming

Programming = communicating data in a settled sequence and language which the computer can understand and transform. The NC-programming language and the NC-program structure was determined by experts in DIN 66025 and ISO 1056.

### Setting up an NC-program

When you are setting up an NC-program you have to give exactly the same information and instructions to the computer as are needed by someone for machining a workpiece on a hand-operating machine who has no idea of turning.



**Edit functions****Alter a word**

Mark the word with the brown background bar () and overwrite it by input via keyboard.

**F1 - Store and exit**

Changes will be saved and displayed at the screen with a graphic simulation.

Syntax errors e.g. unknown G-codes will be displayed marked after pressing F1. Saving a program with that errors is not possible. Technological errors (e.g. wrong feed) will not be recognized.

**F2 - Insert a line**

A line will be inserted over the marked line.

**F3 - Erase word**

The marked word will be deleted.

**F4 - Erase line**

Screenmessage:

Erase line! ENTER = yes, any other key = no

Press ENTER to delete the marked line.

**F5 - Search**

Screenmessage:

"Enter search word."

Put in the desired word and press ENTER. The search will be proceeded in direction end of program. The area over the search start position will not be examined.

**F6 - Print**

Is printer ready?

Press ENTER (printer in "ready"-status). The program will be printed.

Program	print-out	page: 1
N0010	G40 G70 G90 G94 G97	
N0020	G92 X0 Y0 Z0	
N0030	G54 T0202	
N0040	G92 X0 Y0 Z0	
N0050	G59	
N0060	G00 X-6 Y-1 Z1	
N0070	G00 Y10	
N0080	G00 Z2	
N0090	G01 Z-3	
N0100	G41	
N0110	G01 X0 Y7 Z-3	
N0120	X23.974	
N0130	G03 X25.943 Y7.404 I0 J5	
N0140	G01 X42.97 Y14.701	
N0150	G03 X46 Y19.297 I-1.97 J4.596	
N0160	G01 Y30	
N0170	G03 X43 Y33 I-3 J0	
N0180	G01 X19	
N0190	G03 X16 Y30 I0 J-3	
N0200	G01 Y23	
N0210	G02 X13 Y20 I-3 J0	
N0220	G01 X0	

**ESC - End**

ESC leaves without saving. After leaving the editor the simulation of machining will be rebuilt, no changes will be saved.

**Survey of NC commands****Preparatory functions, G codes**

G00 Rapidtraverse  
G01 Linear interpolation  
G02/03 Circular interpolation  
G40 Cancellation of the cutter path compensation  
G41 Cutterpath compensation left  
G42 Cutterpath compensation right  
G59 Position shift offset  
G70 Measurements in inches  
G71 Measurements in mm  
G81 Drilling cycle  
G83 Withdrawal cycle  
G86 Chip breaking cycle  
G87 Rectangular pocket milling cycle  
G88 Circular pocket milling cycle  
G92 Set position shift offset 5  
G94 Specification of the feed speed in inch/min

**Miscellaneous or switching functions**

M03 Spindle ON clockwise  
M30 Program end with return to program start

### 3.7.7 Toolchange

#### Procedure

- Move the current tool to a tool change position (with F1 = rapid).
- Press F7, a tool range appears on the screen.

END MILL 0.06	END MILL 0.12	END MILL 0.25	ENGRAVER
1	2	3	4
5	6	7	8
9	10	11	12

- Select the tool (e.g., 3 
- Continue with CAM programming.

Tool change while machining run:

(see MACHINING)

- With the last position of the old tool the CAM program stops.
  - Open the machine door
  - Change the tool - mind all safety regulations! (see machine description)
  - Close the machine door
  - Select MACHINING - F9 MANUAL. Reduce the step width (with key -) for the following scratch-on sequence.
  - Move the spindle down to the workpiece and scratch slightly on the workpiece surface.
  - Select MACHINING - F2 POSITION. Enter the value 0 for Z.
- Now the system "knows" the length of the new tool and the program can be continued.
- Continue the program by selecting F3 AUTOMATIC.
  - Instead of scratching on the workpiece surface you can scratch on any surface from which the Z value is known and enter this value (instead of 0) as new Z value.

### 3.7.8 Erasing the machining program

The complete program is erased.

### 3.7.9 Entering the machining parameters

#### Feed F

Press F1. Input the feed value and press ENTER.

#### Speed S

Press F2. Input the speed value and press ENTER.

#### Offset

Press F3 to alter the adjusted fining overmeasures.

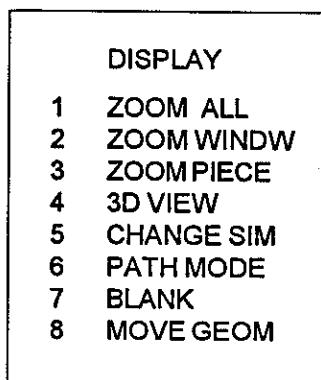
Screen message	Entry
	
Enter contour overmeasure 0.100 (  = no change)	0.02 

#### Single Block

F4 selects the single block mode.

### 3.8 DISPLAY (F4)

The screen display is determined or altered in this menu.



#### Changing the Simulation Display

With F5 CHANGE SIM you can change between display of the tool path or display of the true machining situation.

#### Tool Path Display

You can select the display of the tool centre path as dashed line or the display of the milled slot.

#### Blank

With the menu points

F1 VICE  
F2 WORKPIECE  
F3 TOOL  
F4 TOOL PATH

you can select / deselect the display of the vice, the workpiece, the tool and the tool path.

#### Zoom all

Everything shown on the screen (vice, workpiece, workpiece contour, ...) is enlarged, so that it can still be displayed within the screen.

**F1** ... The complete screen area is enlarged.

#### Zoom Window

A "screen window" is defined and enlarged across the whole CAD area of the screen.

Two diagonal edge points are determined with the cursor keys and ENTER. The defined rectangle is then enlarged across the whole of the screen surface.

- Select F2 ZOOM WINDW
- Position the cursor to the first edge point of the window to be zoomed and press ENTER.
- Position the cursor to the second edge point of the window to be zoomed and press ENTER.
- The defined window will be enlarged across the whole CAD area of the screen.

#### Zoom Workpiece

The workpiece shown on the screen is enlarged, so that it is still shown within the screen, when F3 ZOOM PIECE is selected.

#### 3D View

Select F4 3D VIEW to display the working area three-dimensional.

Select 1 for oblique view right or 2 for oblique view left.

Press ENTER to continue.

#### Move Geometry

With F9 MOVE GEOM you can shift a drawing at the screen.

**F9**

Move cursor to desired start point (ENTER = accept.)

Move the cursor on a point of the drawing.

Move cursor to desired end point (ENTER = accept.)

Move the cursor to this position, on which the previous marked point should be shifted and press ENTER. The drawing will be shifted.

### 3.9 Print

The respective screen display is printed.

#### Condition

The printer is connected, switched on and set in the IBM graphics mode (see printer manual).

Screen message	Entry
	[F1]
Is the printer connected and on "line"? (ENTER = yes)	[◀]

#### Possibilities

ENTER = printing

Any other key = interruption

### 3.10 Machining

With this menu the machining functions are controlled.

MACHINING	
1	REFERENCE
2	POSITION
3	AUTOMATIC
4	SINGLE BLK
5	FAST RUN
6	EMPTY CUT
7	REPEAT
8	--> CURSOR
9	MANUAL

#### Reference

Before machining the machine and the PC must be synchronized. This occurs by approaching the reference point.

#### ATTENTION

The slides will move completely up, to the front and to the right (reference point). Remove all obstacles in the working area.

Select F1 REFERENCE before working with the machine.

If the machine is not connected or not switched on or if the machine door is open, the machine can not be initialised.

The screen shows:

"Attempt to initialise the machine! (<ESC> = abort) :"

Press ESC to continue the program.

Connect the machine to mains and to the PC (see machine description), close the machine door, release the EMERGENCY OFF switch and switch on the machine.

Run REFERENCE again.

#### Position

Select F2 POSITION. At the bottom line the tool position is displayed (values X, Y and Z). With F1-F3 you can enter new values for X, Y and Z. (see tool change)

#### Automatic

The actual machining program will be executed automatically.

ESC program abort

#### Single Block

The machining program will be worked off block by block.

Every program block must be acknowledged by pressing ENTER before it will be executed. With ESC this menu point will be aborted.

#### Fast Run

NO MACHINING! FOR TEST RUN ONLY!

No workpiece must be clamped. All tool movements will be in rapid feed.

You can check whether the program runs in the correct working area.

#### Empty Cut

With this menu point you can start a program from any block.

Select F6 EMPTY CUT.

Position the cursor with the arrow keys to the desired block.

Home key: jump to first block

End key: jump to last block

From this block on the machining program can be started.

#### Repeat

The machining program can be shifted and repeated.

Application:

Producing several equal parts from one workpiece.

#### --> Cursor

At the screen the tool will be traversed from its actual position to the cursor position with feed speed. The machine proceeds the same movement at the same time. This movement will not be stored in the machining program.

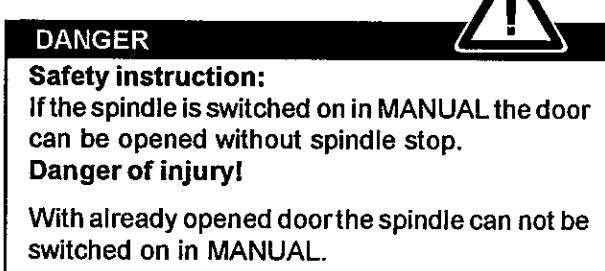
**Manual**

The axes can be moved step by step with key pressing.

**Keys for moving (numerical key block):**

- 6 +X direction
- 4 -X direction
- 9 +Y direction
- 1 -Y direction
- 8 +Z direction
- 2 -Z direction
- x Spindle on/off

The step width for axis movements can be altered with the + and - key.

**Example of a Machining Run**

- Store the program before running it or call up the program to be executed (see ARCHIVE).
  - Select MACHINING - REFERENCE. The slides approach to the reference point.
  - Clamp the first tool to be used - mind all safety regulations! (see machine description)
  - Select MACHINING - MANUAL. Reduce the step width (with key -) for the following scratch-on sequence.
  - Move the spindle down to the workpiece and scratch slightly on the workpiece surface.
  - Select MACHINING - POSITION and enter the value 0 for X, Y and Z.
  - Select PROGRAM - TOOL CHNGE. Enter the number of the first tool.
  - Select MACHINING - AUTOMATIC. The program starts, movements will be displayed at the screen.
  - With the last position of the first tool the CAM program stops.
  - Select MACHINING - MANUAL and traverse the milling head to a useful position for tool change.
  - Open the door and change the tool - mind all safety regulations! (see machine description), close the machine door
  - Enter the new tool at the PC with PROGRAM - TOOL CHNGE and selection of the respective tool number.
  - Select MACHINING - MANUAL. Traverse the tool to the workpiece surface and scratch on.
  - Select MACHINING - POSITION. Enter the value 0 for Z.
- Now the system "knows" the length of the new tool and the program can be continued by selecting MACHINING - AUTOMATIC.

etc.

**3.11 Archive****Storing the Program**

Screenmessage	Entry
	F6
input file name to be stored:	demo1 <input type="text"/>

The machining program is stored under the name "demo1" in the user path.

In the sub directory a program is stored in two files:

DEMO1.GEO

DEMO1.NCP

DEMO1 is the name you have chosen (max. 8 signs) and an automatic addition (.GEO resp. NCP).  
.GEO in this file there are the informations about workpiece, drawing, (CAD) and tool path (CAM).  
.NCP in this file the NC-program is stored.

Note:

With indicating a floppy disk drive you can store files on diskette, e.g.: a:demo1 .

**Loading the Program**

A stored machining program can be recalled.

**Example 1: Call-up of a program**

Screenmessage	Entry
	F7
Input file name to be retrieved:	demo1 <input type="text"/>

The machining program "demo 1" is loaded.

**Example 2: Listing all stored programs**

All stored programs are displayed in the area menu box, when the sign \*  is entered.

Screenmessage	Entry
	F7
Input file name to be retrieved:	* <input type="text"/>

The stored programs are displayed and can be selected by means of the   keys and recalled with .

Note:

With indicating a floppy disk drive you can load files from diskette, e.g.: a:demo1 .

### 3.12 End

#### Storing the Geometry

A workpiece drawing can be stored.

Screen message	Entry
	[F8]
Input file name to be stored:	part1 <input type="text"/>

The workpiece drawing is stored under the name "part 1".

The workpiece geometries (are stored under the name entered by you in your sub-directory (e.g.: EMCO\USER) and are automatically provided with the suffix .DXF.

The suffix .DXF means that the workpiece geometries are stored in the DFX format. I.e.: you can read AUTOCAD drawings in the DXF format into this software or workpiece geometries created with this software can be copied into the AUTOCAD software.

#### Note:

With indicating a floppy disk drive you can store files on diskette, e.g.: a:part1 .

#### Loading the Geometry

A stored workpiece drawing can be recalled.

Screen message	Entry
	[F9]
Input file name to be retrieved:	part1 <input type="text"/>

The workpiece drawing "part1" is loaded.

#### Note:

With indicating a floppy disk drive you can load files from diskette.

Listing all stored workpiece drawings works as with programs.

#### Erasing the stored programs and geometries

- Exit the software.
- Change into the path C:\EMCO\USER resp. into the path determined by you with installation.
- All files in the sub-directory are listed by means of the DOS command "DIR".
- Erasing the respective file (see DOS manual).

Exit from the program

#### Attention!

You must store the programs complied by you beforehand (archive menu).

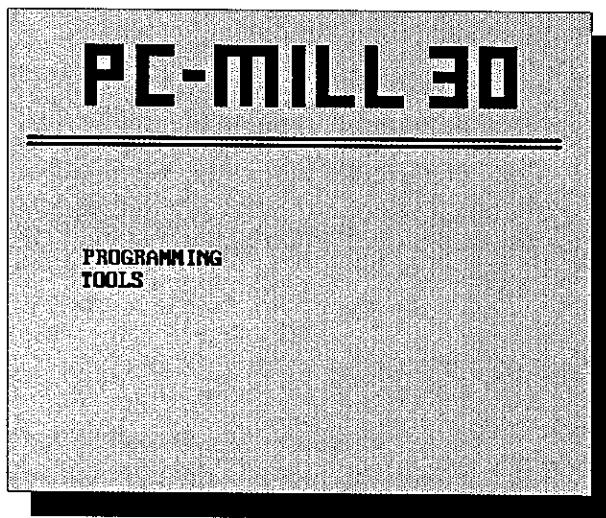
Screen message	Entry
	[F10]
Are you sure? (ENTER = yes):	<input type="text"/>

#### Possibilities

ENTER = exit from the program

Any other key = remain in the program

The title screen appears again:



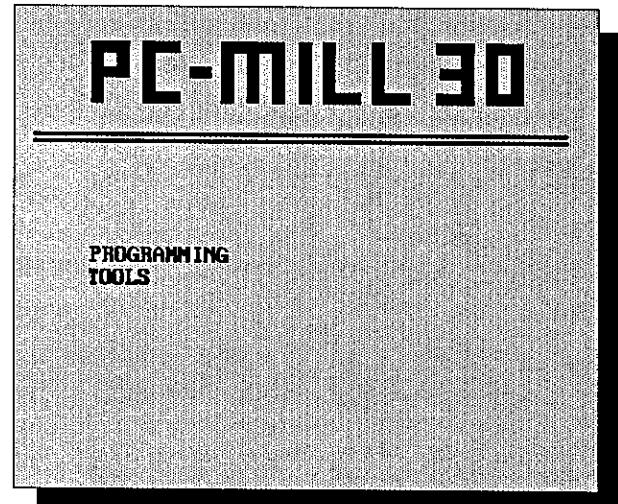
Copyright EMCO MAIER GMBH 1994

**↑↓ = Select      ←→ = accept      <ESC> = End**

**Esc ... Return to DOS**

## 4. Tools

Title screen:



Copyright EMCO MAIER GMBH 1994  
↑ = Select      ↓ = accept      <ESC> = End

Select TOOLS. The following screen appears:

File name : TOOLS.MIL	Number of tools: 33
EDITOOL - MAIN MENU	
TOOL LIST	/PRINT
TOOL LIST (OF THE SAME KEY )	/PRINT
TOOL LIST (OF THE SAME DIAMETER)	/PRINT
TOOL LIST (OF THE SAME KEY AND DIAMETER)	/PRINT
VIEW TOOL DATA	/PRINT
CHANGE TOOL DATA / GRAPHIC EDITOR	/PRINT
ADD A TOOL	
INSERT A TOOL	
COPY TOOL	
ERASE TOOL	
FEEDS AND SPEEDS	
CUTTER COMPENSATION	
TOOL HOLDER	/PRINT
END / STORE	/PRINT
↑ MOVE HIGHLIGHT - ↓ ACCEPT OPTION - <ESC> CANCEL	

## 4.1 Using the existing tools

The tools you can use for CAM programming are listed in the so called TOOL HOLDER.

This TOOL HOLDER represents a tool turret as it is used with industrial large-scale milling centres. On the EMCO PC MILL 30 the tools must be changed manually.

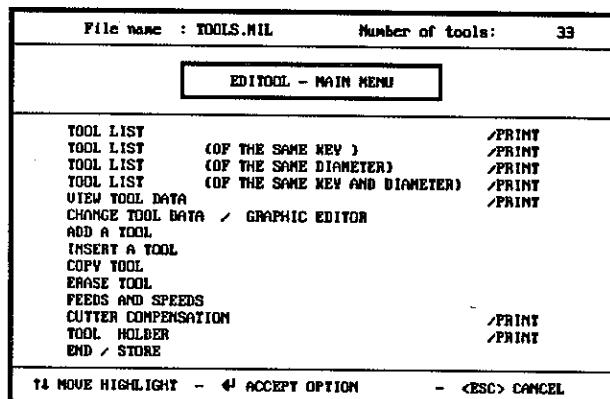
The tools you determine in "TOOL HOLDER" are shown in "TOOL CHANGE" (see PROGRAMMING).

### Example:

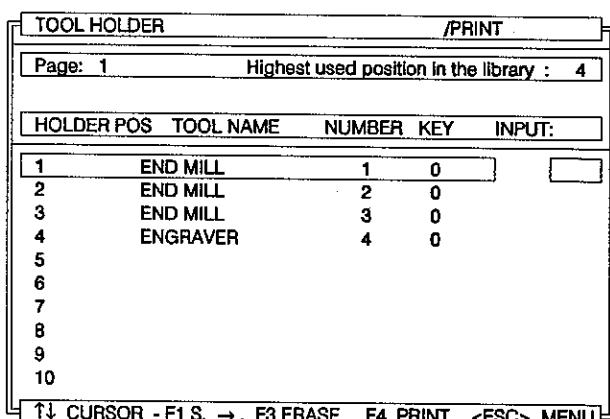
The engraver (no. 4 of the tool list), shall be set to tool holder position 3.

### Procedure:

You are in EDITOOL - MAIN MENU:

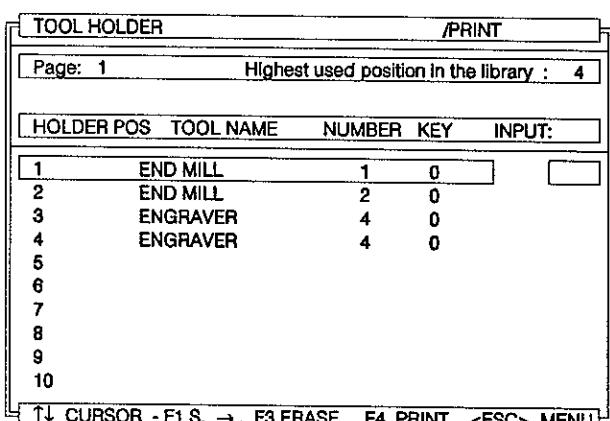


Move the luminous beam to the menu point TOOL HOLDER and confirm with ENTER. It appears:

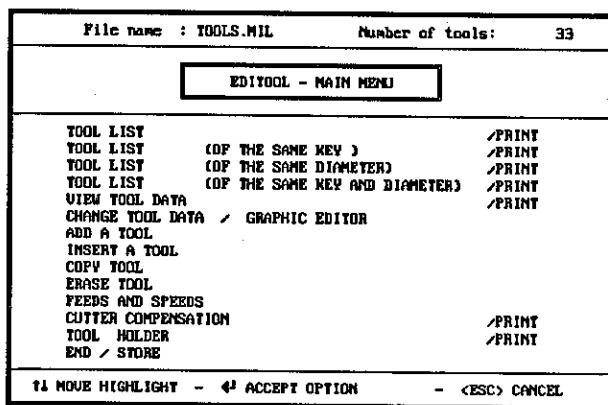


Move the luminous beam to turret position 3 and enter 4 and confirm with ENTER.

The engraver has holder position 3.



## 4.2 Expansion of tool library



Using these menu items, you change, expand, etc. the already existing and stored tools.

- Call-up of a menu item:  
Using the cursor key ↑ you move the luminous beam to the required menu item and confirm with ENTER.  
ESC key: Exit from TOOLS into the title screen of the software without storing any modifications carried out (storing is only effected during exit with menu item "END/STORE".)

### Description of the Menu Items

#### 5.2.1 Tool List

All tools are listed.

#### 5.2.2 Tool List (Similar Tool Key)

This item is not used with the EMCO PC MILL 30, it is only significant for working with EMCODRAFT CAD/CAM.

#### 5.2.3 Tool List (Similar Diameter)

When entering requested tool diameter (e.g. .125), all tools with ø .125" are listed.

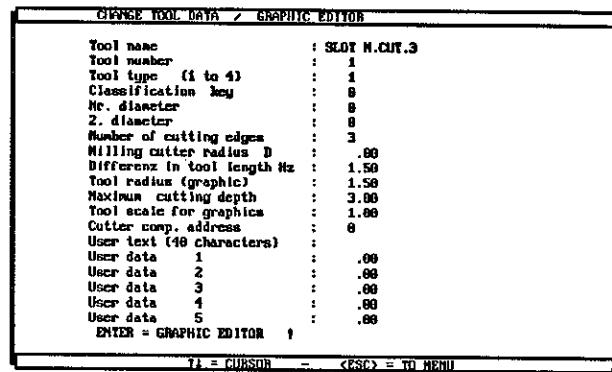
#### 5.2.4 Tool List (Similar Key and Diameter)

This item is not used with the EMCO PC MILL 30, it is only significant for working with EMCODRAFT CAD/CAM.

#### 5.2.5 Read Tool Data

All tool data of the indicated tool are listed. Further description of tool data see chapter 5.2.6.

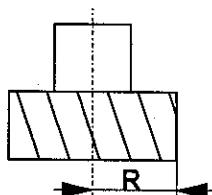
### 5.2.6 Change Tool Data / Graphic Editor



- Ad 1:** Name of tool: Enter max. of 20 characters.  
Note:  
In TOOL CHANGE (PROGRAMMING) only 13 characters are displayed.
- Ad 2:** Tool number: Enter number from 1 to 9999.
- Ad 3:** Enter tool type  
1...for boring or milling  
2-4...turning tools (not active)
- Ad 4:** Classification key  
This item is not used with the EMCO PC MILL 30, it is only significant for working with EMCODRAFT CAD/CAM.
- Ad 5:** Nr. diameter  
This item is not used with the EMCO PC MILL 30, it is only significant for working with EMCODRAFT CAD/CAM.
- Ad 6:** 2. diameter  
This item is not used with the EMCO PC MILL 30, it is only significant for working with EMCODRAFT CAD/CAM.
- Ad 7:** Cutting edges:  
E.g.
- 


- 2 cutting edges    3 cutting edges    6 cutting edges
- Ad 8:** Tool comp. in X(Z)  
This entry has no significance.
- Ad 9:** Tool comp. in Y  
ditto

**Ad 10:** Radius:  
Enter the radius of the milling cutter



**F2 SNAP:** Cursor jumps to nearest point of drawing. X(Z), Y(X) position of cursor is displayed. Move the point of the drawing into position wanted using arrow keys.

**F3 DEL:** Delete the line drawn last. If too much was deleted, it is always possible to leave with ESC and establish the entry state.

**Ad 11:** Max. cutting depth :  
For milling it has no significance - enter 0.

**F4 SCALE:** Change scale of drawing shown using

**Ad 12:** Tool scale:  
Here the scale is determined for the graphic representation (item 14).

Possible scales:

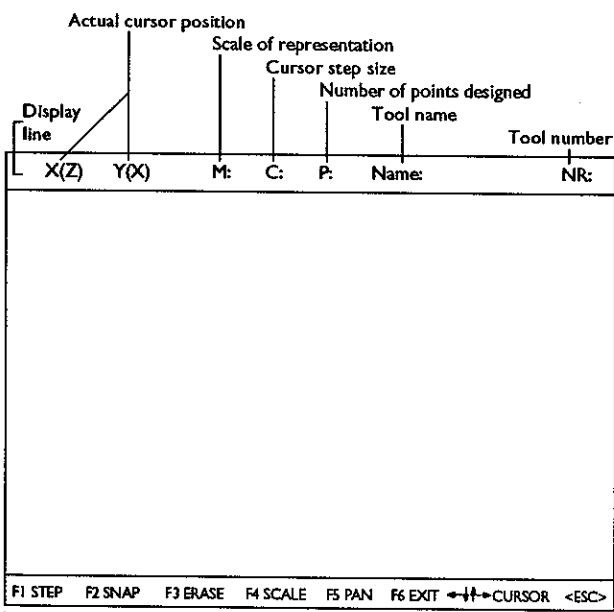
0,25	=	1:4
0,5	=	1:2
1	=	1:1
2	=	2:1
4	=	4:1
8	=	8:1

**Ad 13:** These data are only significant when working with "EMCODRAFT CAD/CAM".

**F5 PAN:** Move screen window with cursor keys.

**Ad 14:** Graphic representation:  
Each tool is designed with a continuous line.

**F6 EXIT:** Exit from graphics menu and store.



**CURSOR:** Move cursor with cursor keys according to step size set.

**ACCEPT:** By pressing the ENTER key a line from the end of the line drawn last to the cursor is drawn. The first line always starts in the center point.

**<ESC>:** Using the ESC key you can always leave the graphics menu without storing a change that was carried out. The entry state remains.

### 5.2.7 Add tool

The newly set up tool is added last in the list of existing tools.

Setting up is described in item 4.2.6.

**F1 STEP:** Change cursor step with   
Possible cursor steps: 0,1 inch  
0,5 inch  
1,0 inch  
5 inch  
ESC key: End step change with F1.

### 5.2.8 Insert tool

Inquiry of program:

Key in the library position to insert the tool (max. 20)?

The newly set up tool can be added to a similar tool. Set-up is described in item 4.2.6.

### 5.2.9 Copytool

If you want to integrate in your library a tool which differs only slightly from the one already existing, it is not necessary to enter all data again.

You only copy the data of the existing tool to a new file position and make the necessary changes.

Inquiry of program:

Enter the tool number of the tool to be copied: 13

Select the new tool number : 19

Select the new position (max.18) ? 15

I.e. the new tool number 19 has the same tool data as tool number 13 and was inserted in the tool list in position 15.

### 5.2.10 Delete tool

Enter the tool number of the tool to be deleted: 19

Tool name: TWIST DRILL 17 inch Tool number: 19

Do you want to delete this tool (ENTER = yes) ?

### 5.2.11 Feeds and speeds

Ten values for F and S you can relate to every tool. Select "Feeds and speeds" and press ENTER. Input the number of the desired tool. The adjusted values will be listed.

Below the headline the number and name of the desired tool are displayed. Below are three columns, number of machine / material, related feed and related speed. Pressing ESC aborts, pressing F4 prints these informations. Pressing the cursor keys shifts the input-field behind the old value and entry the new value. Press ENTER to take over the new value. Press ENTER to take over the new value as feed or speed for the active type (marked by an inversed bar).

### 5.2.12 Cutter compensation

This is only significant for working with EMCODRAFT CAD/CAM.

### 5.2.13 Tool holder

All tools actually in the holder are listed.

TOOL HOLDER		/PRINT	
		Page: 1 Highest used position in the library : 4	
HOLDER POS	TOOL NAME	NUMBER	KEY
1	END MILL	1	0
2	END MILL	2	0
3	END MILL	3	0
4	ENGRAVER	4	0
5			
6			
7			
8			
9			
10			

↑↓ CURSOR -F1 S. → , F3 ERASE , F4 PRINT , <ESC> MENU

#### Feeding holder differently:

Place luminous beam with cursor ( ) to the desired holder place, enter requested tool number and confirm with ENTER.

#### F1,F2:

Theoretically, the turret may be fed with 100 tools in the program.

These are listed on 10 pages. With F1 you turn a page back and with F2 one page forward.

#### F3:

With F3 the tool, on which the luminous beam is situated, is deleted.

#### F4:

Print-out of screen contents on on-line printer.

#### ESC:

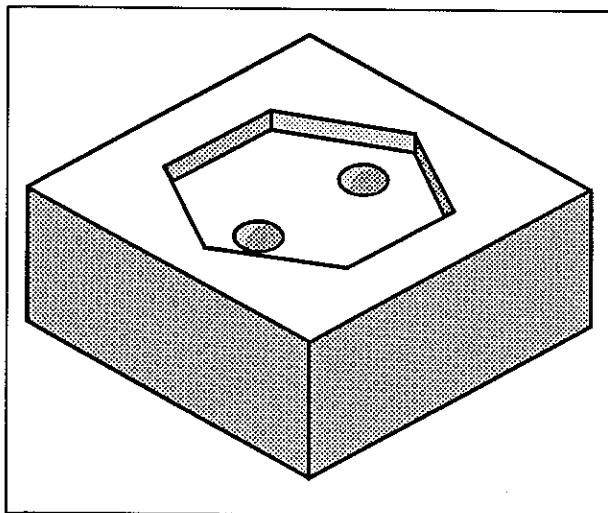
Back to main menu.

### 5.2.14 End/Store

This menu item ends work in the tool edit program. The tool library you have just worked with before is stored in its actual state.



## F Training Example Step By Step

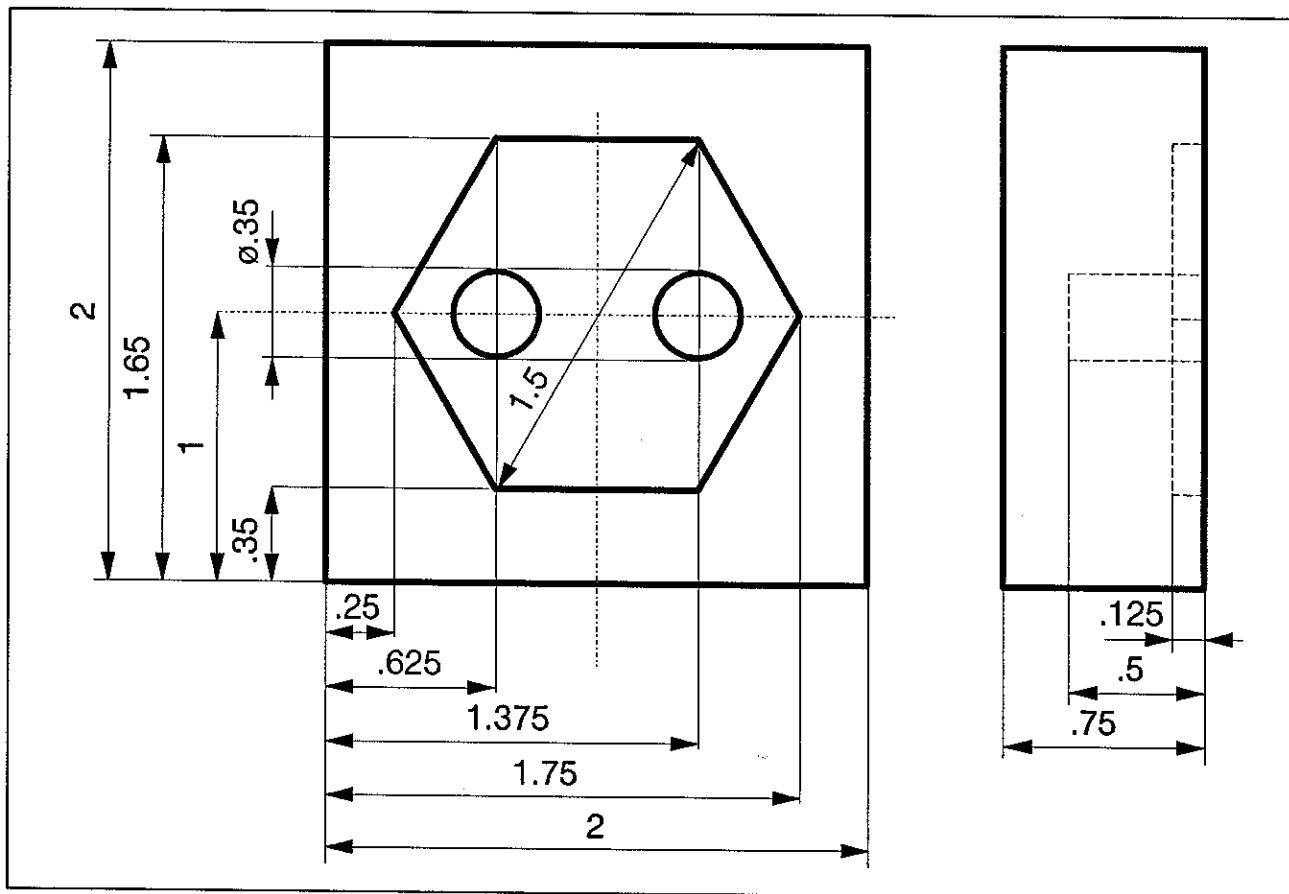


In this example you will draw, program and mill a hexagon and borings.

It will be an easy introduction in CAD/CAM programming and working with the EMCO PC MILL 30. The working sequences are described step by step.

After this example you will be able to draw straight lines and circles with the CAD system, determine the tool movements with the CAM system, start the machine, change tools etc.

### Technical Drawing



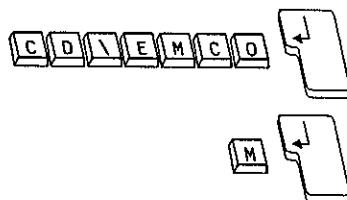
In the following this part should be produced.  
All necessary measures are given by this drawing.  
Your task is to transmit this drawing into the computer, to determine all machining sequences and to produce this part.

## Starting the Software

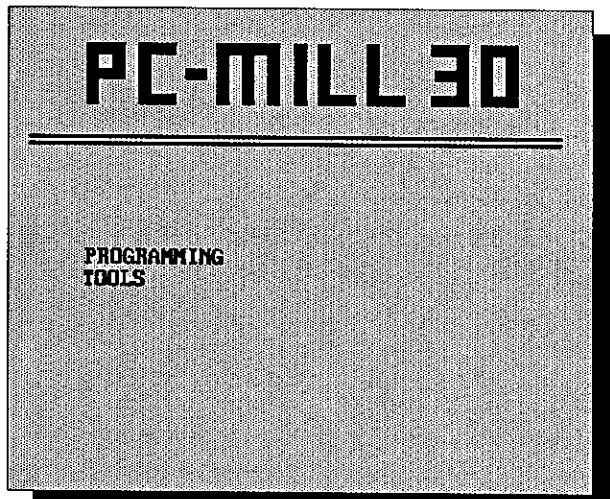
Precondition:

The software is installed correctly in the path C:\EMCO.

- Switch on the computer and the monitor.
- After the computer start-up sequence you should see the C prompt.  
It will look like this  $\Rightarrow$  C:\>



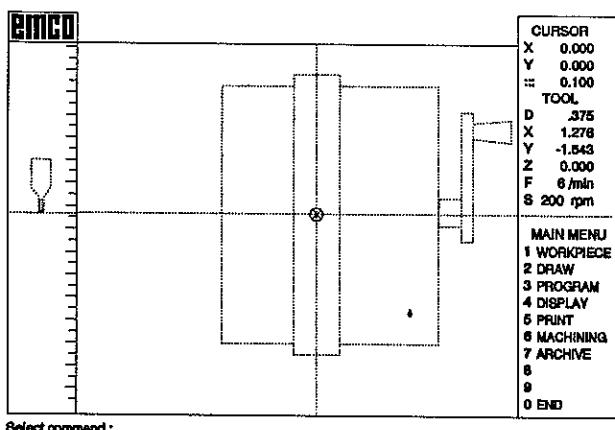
- Key in CD\EMCO and press ENTER  
Now the prompt will look like this  $\Rightarrow$  C:\EMCO>
- Key in M and press ENTER.



- At the screen you see the basic menu.



- PROGRAMMING is highlighted. Press ENTER to start the program.



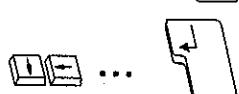
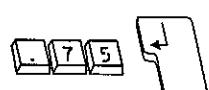
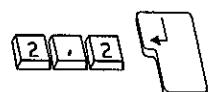
- Now the screen shows the CAD/CAM surface.

## Enter the Workpiece Dimensions

F1

- Press F1. This will select the prompt to describe a workpiece (menu point WORKPIECE in the MAIN MENU).

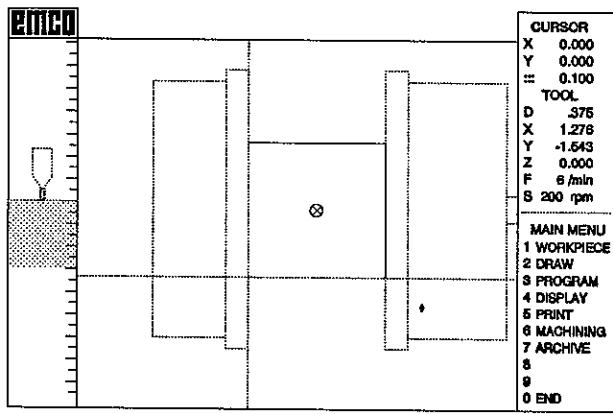
You are prompted to specify the length and width of the workpiece (bottom line).



- Key in 2,2 and press ENTER  
This is for the 2" x 2" workpiece.

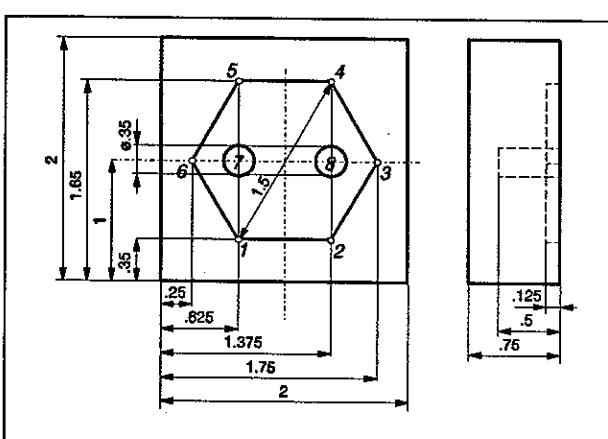
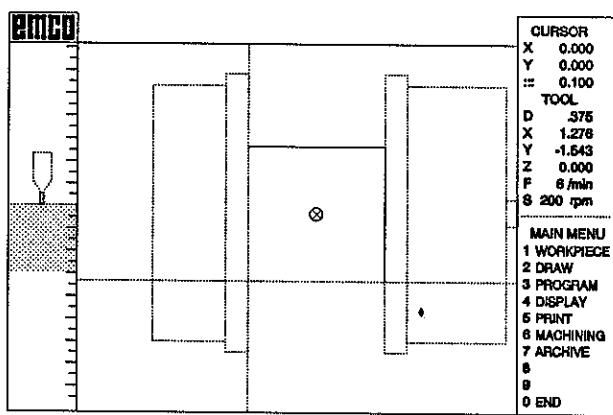
- You are prompted to specify the thickness of the workpiece.  
Key in .75 and press ENTER.

- Now the workpiece zero point is requested. Move the cursor to the left bottom edge of the workpiece (by multiple pressing the cursor keys) and press ENTER.



- The screen shows the workpiece clamped in the vice.

## CAD Drawing



- The screen shows the workpiece clamped in the vice.

- This geometry data should be transferred to the CAD system.

In the following we will show you to enter the points 1-6, the lines between the points and the circles 7 and 8.

There are several ways to enter this data, we will show you some different ways with this example.



- Press F2. The DRAW menu is displayed in the menu box.



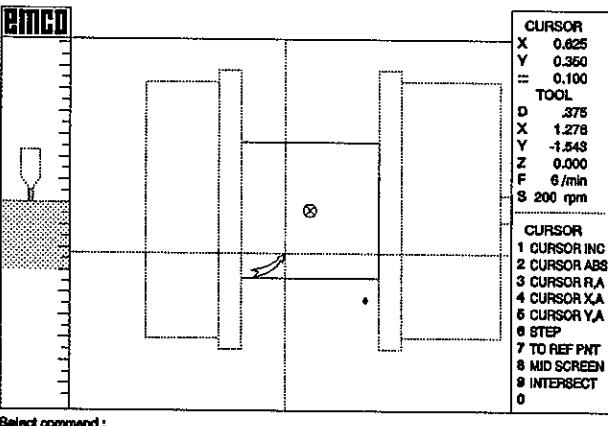
- Press F1 to select the CURSOR submenu.



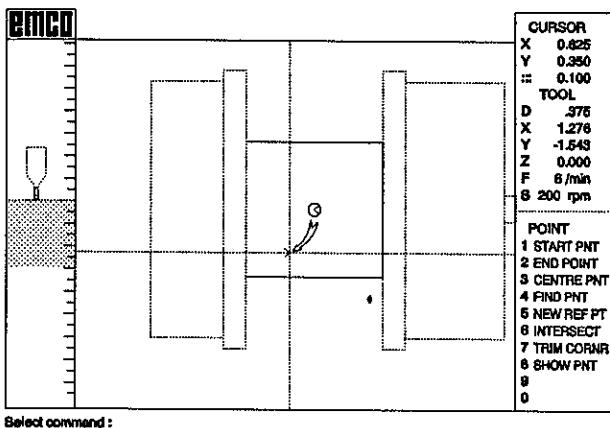
- Press F2 to select CURSOR ABS. Here you can enter the absolute coordinates of the first point.



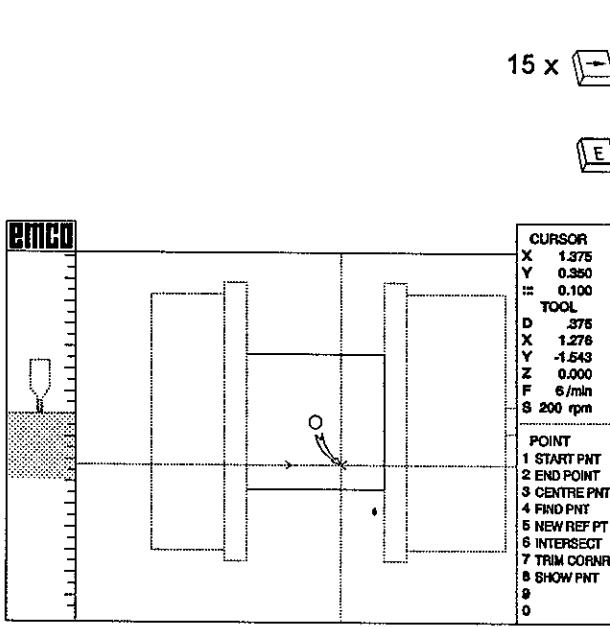
- Key in .625,.35 for the X and Y coordinates of the first point and press ENTER.



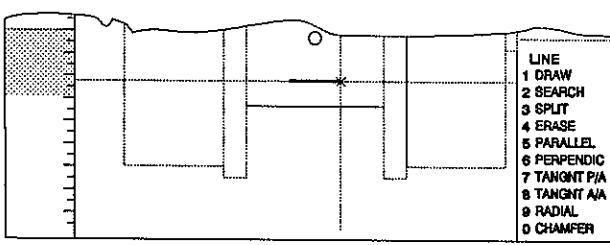
The cursor jumps to the position of point 1.



- Press ESC to leave the CURSOR menu.
- Press F2 to select the POINT menu.
- Press F1 to acknowledge the actual cursor position as start point.
- The start point sign (>) jumps to the cursor position.



- Press the PageDown key to halve the cursor step width to .05".  
The cursor step width is displayed in the third line at the top right corner of the screen.
- Press the ArrowRight key 15 times to move the cursor .75" to the right ( $15 \times .05 = .75$ ).
- Press the key E (hotkey). This acknowledges the actual cursor position as end point.
- The end point sign (<) jumps to the cursor position.



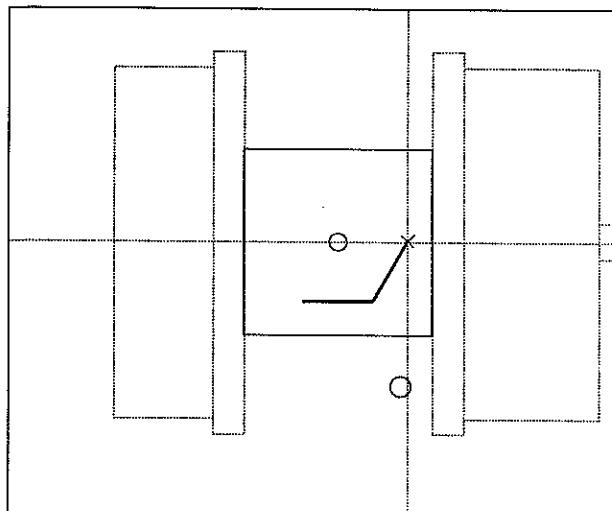
- Press ESC to get back into the DRAW menu.
- Press F3 to select the LINE menu.
- Press F1 to draw a line from start point to end point.  
At the same time the start point sign jumps to the end of the line.

- Press ESC to get back into the DRAW menu.
- Press F1 to select the CURSOR menu.
- Press F3 to place the cursor by entering radius and angle.
- Key in .75,60 (.75 is the side length of the hexagon, 60° is the angle to point 3). The cursor jumps to the position of point 3.

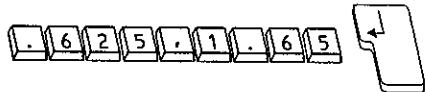


- Press the key "+" (hotkey). This draws a straight line from the start point to the actual cursor position.

At the same time the start point jumps to the end of the line.



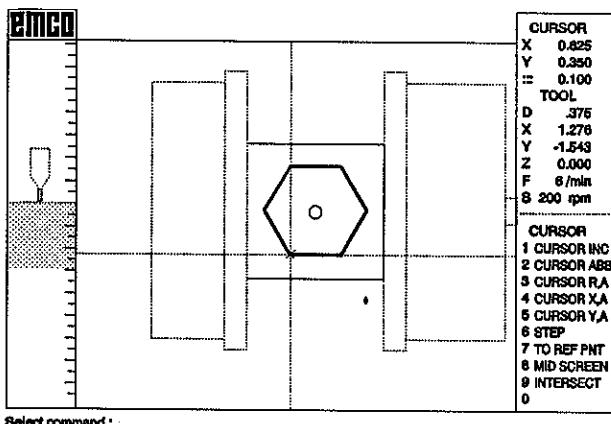
- Press F2 to select CURSOR ABS. Here you can enter the absolute coordinates of the next point.
- Key in 1.375,1.65 for the X and Y coordinates of point 4 and press ENTER.
- Press the key "+" (hotkey) to draw a line from the start point to the actual cursor position.



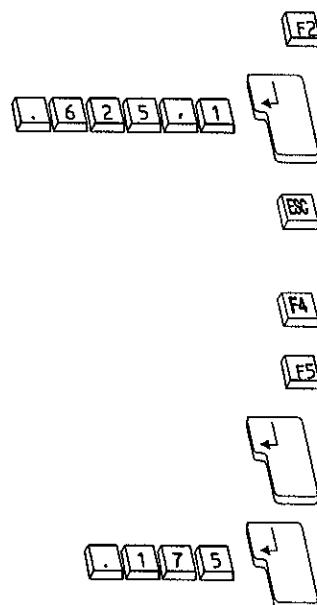
- Press F2 to select CURSOR ABS. Here you can enter the absolute coordinates of the next point.
- Key in .625,1.65 for the X and Y coordinates of point 5 and press ENTER.
- Press the key "+" (hotkey) to draw a line from the start point to the actual cursor position.



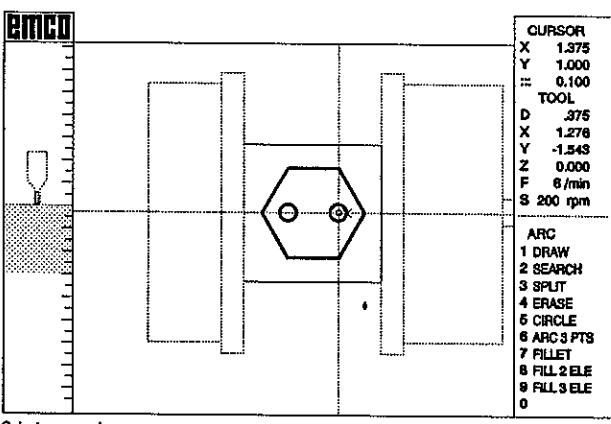
- Press F2 to select CURSOR ABS. Here you can enter the absolute coordinates of the next point.
- Key in .25,1 for the X and Y coordinates of point 6 and press ENTER.
- Press the key "+" (hotkey) to draw a line from the start point to the actual cursor position.



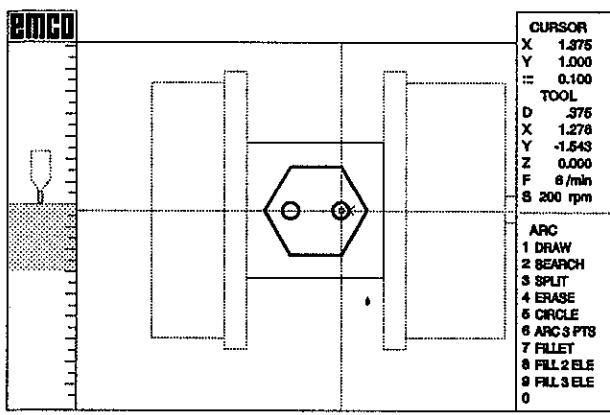
- Move the cursor near point 1.
- Press the hotkey P. This searches the next point. The cursor jumps on point 1.
- Press the key "+" (hotkey) to draw a line from the start point to the actual cursor position.
- Drawing the hexagon is finished.



- Press F2 to select CURSOR ABS. Here you can enter the absolute coordinates of the next point.
- Key in .625,1 for the X and Y centre coordinates of circle 7 and press ENTER.
- Press ESC to get back to the DRAW menu.
- Press F4 to select the ARC menu.
- Press F5 to select the menu point CIRCLE. You are prompted to define the centre point. The cursor is already at the centre point, so just press ENTER.
- Now you are prompted to enter the circle radius. Key in .175 (halve diameter .35) and press ENTER. The circle will be drawn.
- Move the cursor .75 " to the right and repeat drawing the circle.
- The drawing of the workpiece is finished.



## CAM Programming



- The screen shows the workpiece and the drawing.

Here you will determine the movements of the tools, feed rates, spindle speeds etc.



- Press ESC twice to get to the MAIN MENU.



- Press F3 to select the PROGRAM menu.



- Press F7 to select TOOL CHNGE.



- Press 2 to select the .125" diameter milling tool and press ENTER.



- Press F9 to select the menu PARAMETER. Here you can enter the cutting data.



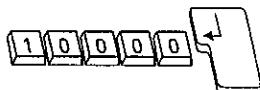
- Press F1 to enter the feed rate in inch/min.



- Key in 20 and press ENTER.



- Press F2 to enter the spindle speed in rpm.



- Key in 10000 and press ENTER.



### DANGER

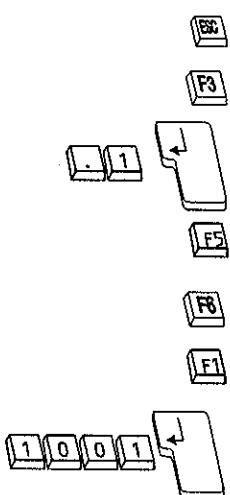
#### Safety instruction:

These values are for machining with premium high-speed tools in cured polyurethane resin (e.g. CIBA-GEIGY CIBATOOL BM 5500).

Please consider the maximum data of your tools otherwise the tools could break.

**Breaking tools are like gun bullets.**

For less quality tools or workpiece materials with worse cutting properties lower feeds and speeds(depending on tool stability) must be selected.



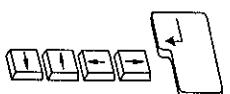
- Press ESC to get to the PROGRAM menu.
- Press F3 to select the Z height of the tool tip.
- Key in .1 ENTER to place the tool .1 inch over the workpiece surface.
- Press F5 to select the menu CYCLES.
- Press F6 to select the free form pocket cycle.
- Press F1 to enter the contour. The system requests a number to store the contour as subroutine.
- Key in 1001 and press ENTER.



- The cursor jumps on point 1 of the contour. The system asks whether this is the desired start point.  
Press ENTER to accept the start point.



- The cursor jumps on point 2 of the contour (definition direction: counterclockwise).  
Press ENTER to accept the point.
- Accept point 3 - 6 in the same way.
- The cursor is on point 1 again. Press ENTER to accept the point.



- The system asks for a start position of the tool.
- Move the cursor near the centre of the hexagon ( $X=1, Y=1$ ) and press ENTER.

any key, e.g.

- The system asks for further contours. In this example no islands are to be machined, so press any key (but not ESC and not ENTER) to cease the contour input.



- Press F2 to enter the machining side. The contour definition was in counterclockwise direction, so you must define the left side as machining side. The first contour following cut of the cycle will be inside the drawn hexagon.



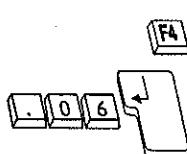
- Press F1 to select the left side.

- Press F3 to enter contour offset. In this example no contour offset is needed, you have to enter the value 0.



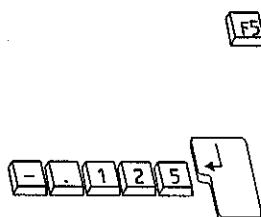
- Key in 0 ENTER.

- Press F4 to enter the maximum depth for infeed. For the .125 " cutter the maximum infeed is .06".



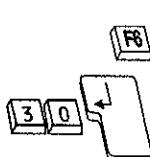
- Key in .06 ENTER.

- Press F5 to enter the end depth of the free form pocket. The value is -.125" (see workpiece drawing). The - is because the end depth is below the workpiece zero point.



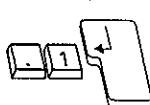
- Key in -.125 ENTER.

- Press F6 to enter the angle of the single milling lines. Select 30°.



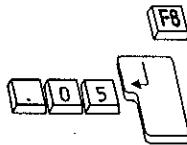
- Key in 30 ENTER.

- Press F7 to enter the distance between the single milling lines. This distance should be about 85% of the tool diameter. Select .1 inch.



- Key in .1 ENTER.

- Press F8 to enter the height of retraction movements. Select .05 inch.



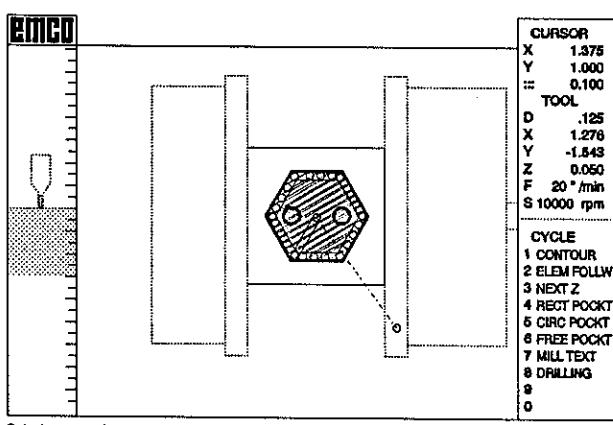
- Key in .05 ENTER.

- Press F9 to enter the way of approaching to the contour. Select "direct".



- Press F1

- Press F10 to process the cycle.  
The system simulates the cycle at the screen.



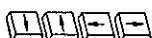
- For the following tool change operation move the tool in a suitable position.



- Press ESC to get to the PROGRAM menu.
- Press F3 to enter 1 inch as new Z position.



- Key in 1 ENTER.



- Move the cursor to the position X=1, Y=-1.
- Press F1 to move the tool on the cursor position.



- Press F7 to select the next tool.
- Key in 3 and press ENTER to select the .25 " milling tool.



- Press ESC to get to the MAIN MENU



- Press F2 to get to the DRAW menu.



- Press F2 to enter the absolute cursor position.



- Key in .625,1 ENTER (centre point of circle 7).



- Press ESC twice to get to the MAIN MENU.



- Press F3 to get to the PROGRAM menu.



- Press F1 to move the tool to the cursor position.



- Press F5 to get to the CYCLE menu.
- Press F5 to select the circular pocket.  
The menu box shows the parameter for the circular pocket.



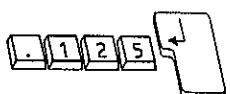
- Press F1 to enter the approaching height.



- Key in .05 ENTER.



- Press F2 to enter the maximum depth of the single infeeds.



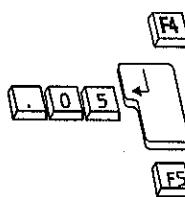
- Key in .125 ENTER.



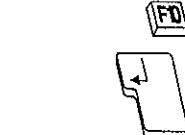
- Press F3 to enter the end depth of the circular pocket.



- Key in -.5 ENTER.



- Press F4 to enter the retraction height.
- Key in .05 ENTER.
- Press F5 to enter the milling direction.
- Key in 2 ENTER (synchronous milling).
- Press F6 to enter the diameter of the circular pocket.
- Key in .35 ENTER.
- Press F10 to cease the parameter input for the circular pocket.
- The system asks whether the input is correct. Press ENTER (yes).  
The system simulates the pocket milling at the screen.



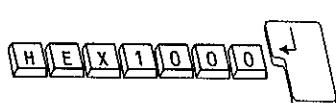
- Move the cursor to the position of the second circular pocket - X=1.375, Y=1 (with CURSOR ABS).
- Move the tool on the cursor position (pocket centre) - PROGRAM - RAPID --->
- Repeat the input of the circular pocket



- Move the tool up to a 1 inch height (PROGRAM - Z-ABS)
- Move the cursor to the position X=1, Y=-1.
- Move the tool on the cursor position (program end position) - PROGRAM - RAPID --->

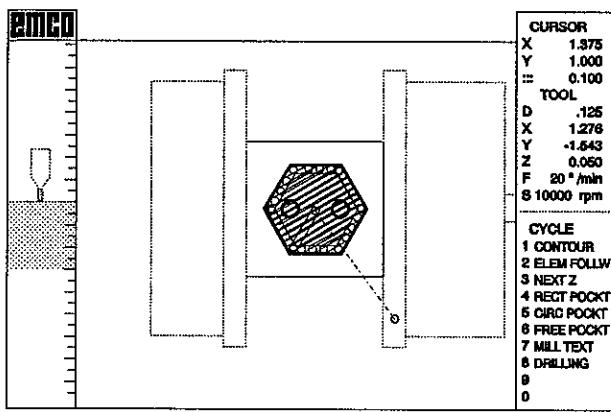


- Press ESC to get to the MAIN MENU.
- Press F7 to select the ARCHIVE menu.
- Press F1 to store the program.



- The system asks for a program name. Key in HEX1000 ENTER.
- The program is stored with the file name HEX1000.GEO.

## Test Run



Select command :

- The screen shows the workpiece, the drawing and the machining pathes.

In the test run the machine runs all movements with rapid feed and standing spindle, no workpiece and no tool is clamped.

### DANGER

#### Safety instruction:

The test run occurs with rapid feed.  
In the case of a collision the tool could break or  
the machine could be damaged.  
Neither a tool nor a workpiece must be clamped.



- Connect the machine to mains and to the PC.
- Remove (if mounted) the tool, the spindle screw and the collet.
- Close the machine door.
- Release the Emergency-off button and press the 1 button to switch on the machine.

- Get into the MAIN MENU.

- Press F3 to select the PROGRAM menu.



- Press F7 to select TOOL CHNGE.



- Press 2 to select the .125" diameter milling tool and press ENTER.

For machining always the respective tool must be selected.



- Press ESC to get to the MAIN MENU.
- Press F6 to get to the MACHINING menu.
- Press F1 to approach the reference point. The slides traverse to the reference position.



4 ... 1 ...



- In the following points you move the tool to the zero position for the test run.
- Press F9 to select MANUAL operation.
- Press the + key twice to enlarge the step width to 1 inch.

- Press the 4 (for moving in X) and the 1 (for moving in Y) key in the numeric keyboard (the most right block at the PC keyboard) until the milling spindle is approximately over the middle of the working area.

- Press the - key twice to reduce the step width to .1 inch.

- Press the 2 key (for moving in z) in the numeric keyboard until the milling spindle is approximately 1.5 " over the split vice.

- Press ESC to leave MANUAL.

- Press F2 to select the POSITION menu.

- Press F1 to alter the X value.

- Key in 0 ENTER.

- Press F2 to alter the Y value.

- Key in 0 ENTER.

- Press F3 to alter the Z value.

- Key in 0 ENTER.

- Press F10 to cease the position input. Now the zero point for the test run is determined.



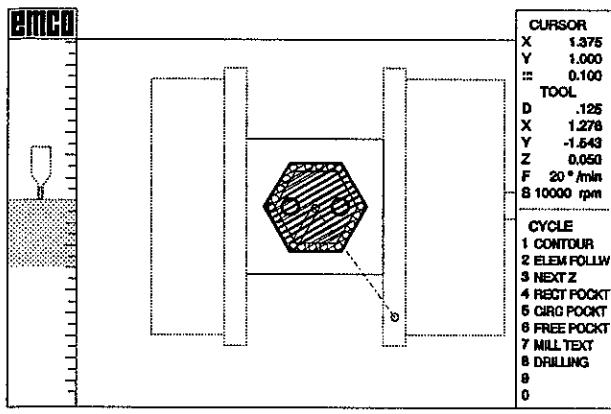
## DANGER

### Safety instruction:

In the case of collisions or other dangerous events press the EMERGENCY-OFF button.

- Press F5 to start the test run.
- All movements which are programmed for the first tool will be proceeded. With the last movement of the first tool the program stops.
- Select the tool no. 3 (PROGRAM - TOOL CHNGE). This is the second tool which is used for machining.
- Press F5 to start the test run. All movements which are programmed for the second tool will be proceeded

## Producing the Programmed Part



- The screen shows the workpiece, the drawing and the machining pathes.

In the automatic run the machine runs all movements with the programmed feed and spindle speed, the tool cuts the programmed path into the work piece.

- Connect the machine to mains and to the PC.
- Release the Emergency-off button and press the 1 button to switch on the machine.
- Clamp a workpiece (material: cured polyurethane resin, e.g.:CIBA-GEIGY CIBATOOL BM 5500) with the dimensions 2" x 2" x .75".
- The workpiece must be clamped tightly.



### DANGER

#### Safety instruction:

Take care for safe clamping, otherwise the workpiece could be pushed out of the vice, the tool could break, the machine could be damaged etc. Consider the chapter "The Split Vice" in the machine description.

- Mount the tool with .125 inch diameter. Use premium high-speed tools only.



### DANGER

#### Safety instruction:

Take care for safe tool clamping, otherwise the tool could be shot out of the spindle or break, the machine could be damaged etc. Consider the chapter "Tool Clamping" in the machine description.

- Close the machine door.
- Get into the MAIN MENU.
- Press F3 to select the PROGRAM menu.
- Press F7 to select TOOL CHNGE.
- Press 2 to select the .125" diameter milling tool and press ENTER.



For machining always the respective tool must be selected.



- Press ESC to get to the MAIN MENU.
- Press F6 to get to the MACHINING menu.
- Press F1 to approach the reference point. The slides traverse to the reference position.



- Move the tool to the reference position for the workpiece.



- Press F9 to select MANUAL operation.

- Press the + key twice to enlarge the step width to 1 inch.



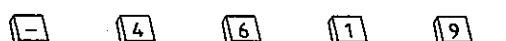
- Press the 4 (for moving in X) and the 1 (for moving in Y) key in the numeric keyboard (the most right block at the PC keyboard) until the tool is approximately over the left front edge point of the work piece.



- Press the - key twice to reduce the step width to .1 inch.



- Press the 2 key (for moving in z) in the numeric keyboard until the milling spindle is approximately .1 " over the workpiece edge.



- Reduce the step width with the - key as required and traverse the tool tip exactly over the workpiece edge.



- Press the \* key to switch on the spindle.



- Traverse the tool down to the workpiece until it scratches slightly on the surface.



### DANGER

#### Safety instruction:

Do not open the door while spindle run.

**Danger of injury by the tool or splintering or blown up chips etc.**



- Press ESC to leave MANUAL. The spindle stops.



- Press F2 to select the POSITION menu.



- Press F1 to alter the X value.



- Key in 0 ENTER.



- Press F2 to alter the Y value.



- Key in 0 ENTER.



- Press F3 to alter the Z value.



- Key in 0 ENTER.



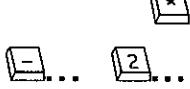
- Press F10 to cease the position input. Now the reference point for machining is determined.



- Press F9 to select MANUAL operation.
- Press the + key to enlarge the step width to .5".
- Press the 8 key to traverse the tool up.
- Press ESC to cease the manual operation.

**DANGER****Safety instruction:**

In the case of collisions or other dangerous events press the EMERGENCY-OFF button.



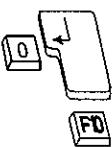
- Press F3 to start the automatic run.
- All movements which are programmed for the first tool will be proceeded. With the last movement of the first tool the program stops.
- Select the tool no. 3 (PROGRAM - TOOL CHNGE). This is the second tool which is used for machining.
- Mount the tool with .250 inch diameter. Use premium high-speed tools only. Consider all safety regulations. Close the machine door.
- Move the second tool in manual operation over the left front workpiece and scratch on the surface like done before with the first tool. The X and Y values need not to be remeasured, so you need not to place the tool exact over the edge.



- Press the \* key to switch on the spindle. Do not open the door while the spindle is running.
- Traverse the tool down to the workpiece until it scratches slightly on the surface.



- Press ESC to leave MANUAL. The spindle stops.
- Press F2 to select the POSITION menu.
- Press F3 to alter the Z value.



- Key in 0 ENTER.
- Press F10 to cease the position input. Now the new tool length is determined.



- Press F9 to select MANUAL operation.
- Press the + key to enlarge the step width to .5".
- Press the 8 key to traverse the tool up.
- Press ESC to cease the manual operation.
- Press F3 to start the automatic run for the second tool. When the machine stops, your workpiece is finished.
- Switch off and clean the machine.



## Annex: MS DOS Operating System

MS-DOS was introduced on the market in 1981 and has been continuously developed further. To distinguish the different steps of development (versions) they were numbered. The number before the point indicates the main version, the number after the point the further subdivision.

E.g. DOS 2.11 is considerably more recent than DOS 1.14, whereas DOS 3.2 only differs little from DOS 3.1.

Recommended versions: DOS 3.3, DOS 5.0

### Purpose of the operating system

The operating system controls the computer and supervises peripherals. It simplifies the operation by making commands available.

DOS is a software protected under copyright and normally it is purchased with the computer.

Buying EMCO software alone does not entitle the user to apply DOS.

### The most important DOS applications

The following part of the subject instructions forms a summary of the most frequent DOS applications in general use with MS-DOS computers.

Handling the MS-DOS can be learnt most easily directly with the computer by trying out.

#### Starting the PC

The PC cannot be operated without loading and starting the operating system.

##### Cold start

- The PC is switched on (main switch)
- The PC carries out a self test (keyboard, memory etc.)
- The PC tries to load from drive A. If there is no floppy in A: the PC tries to load from C:. If the floppy in A (C) is no system floppy an error message appears.
- The PC loads the system (consisting of two invisible files) as well as the COMMAND.COM and CONFIG.SYS files.

##### Warm start

- The PC is already switched on.
- By pressing at the same time the Ctrl + Alt + Del keys the PC starts again. Proceed as with cold start, the self test is eliminated.

After cold or warm start the PC looks for a file with the name AUTOEXEC.BAT. If it exists the PC carries out the commands contained in it, otherwise DOS with the message A> or C> is ready for input.

## The DOS commands

DOS commands are subdivided in internal and external commands.  
Internal commands are those commands which DOS can carry out any time.  
Only the fundamental and most important commands are internal commands.

External commands are not commands in the real sense of the word, but rather programs. To carry them out DOS has to return to a floppy or hard disk, thus the drive or the directory in which the external command is written has to be known.

## Command input

After starting the system a blinking cursor appears that marks the so-called command line.

If you enter the command text via the keyboard, it appears in the command line.

With the ENTER or ↵ key the computer takes over the text of the command line.

If the text is an internal command or program in the directory actually active, the computer carries it out. If the text is not an internal command or not an executable program the following message appears:

Command or file name not found

### **Example:**

**Enter the following command**

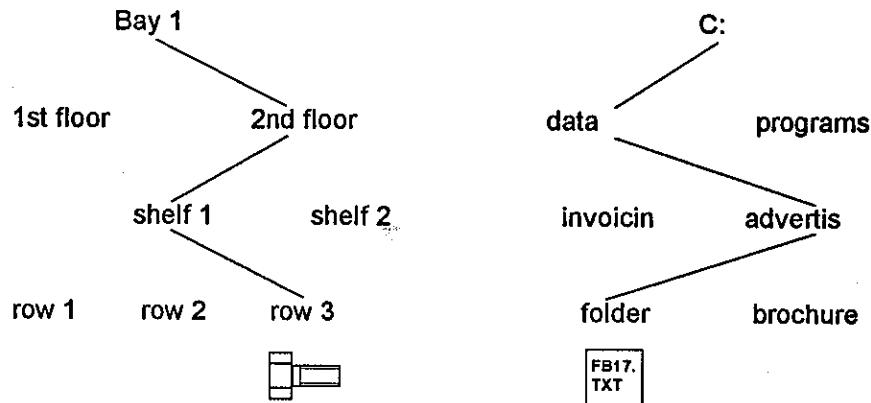
*DIR* **ENTER**

The computer now lists all files and subdirectories of the actually active directory.

#### **Indication of drive and directory**

To enable DOS to carry out an external command or a program it has to know where these are stored.

**Indication of directory:** Directories have names that can be freely selected (max. 8 characters)



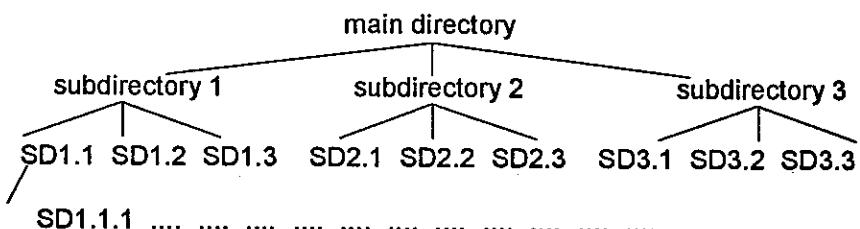
To find the screw you need the following information:  
bay 1, 2nd floor, shelf 1, row 3,  
screw

To find file FB17.TXT, DOS needs the following information: C:\data\advertis\folder\FB17.TXT

### Data organization in directories

If a floppy contains many files the directory list becomes very complex. With hard disks with their large storage capacities this is frequently the case. MS-DOS allows to subsume files to groups (directories), to divide groups into subgroups etc..

Thus, a strictly hierarchical structure is created:



The way you organize your data and how far you branch the structure should depend on two items:

1. A strict subdivision in directories, subdirectories, ... affords high clarity, short and easily detectable lists of directory etc..
2. When working with a file you have to indicate exactly where it is. This becomes complicated in case of profound branching.

Example: COPY C:\DATA\ADVERTIS\FOLDER\FB17.TXT B:  
possible remedy: PATH command (see "further DOS applications")

## Working with drives and directories

### Changing the active drive

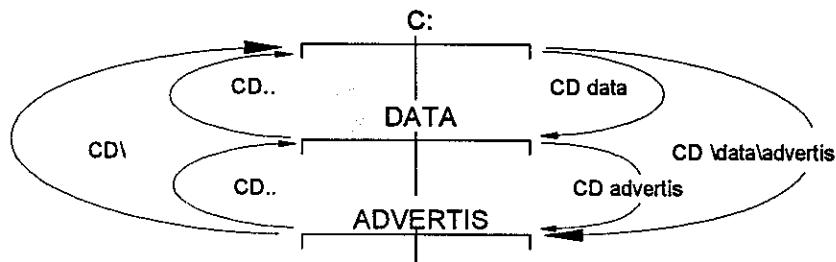
Enter the name of the drive to which you want to change (A:, B:, C:) and press ENTER.

**Example:**

A: ENTER

The input request A> appears. If there is no floppy in A: an error message appears when you try to read it for the first time.

### Changing directories



**CD "change directory"**

**Input:** CD (name of directory) ENTER

**Example:** CD DOS ENTER

You now are in the DOS directory.

If you want to change to the next directory, you only have to enter the directory after CD.

If you want to change to any directory, you have to enter the drive and the path to this directory.

Entries are separated respectively by a backslash (\)

If you want to change to the main directory, enter CD\.

If you enter CD alone, the actual directory is shown.

### Creating directories

**MD "make directory"**

**Input:** MD (directory name) ENTER

**Example:** MD DATA ENTER

You have created the DATA directory.

The name consists of a maximum of 8 characters.

### Removing directories

**RD "remove directory"**

You only can remove empty directories, i.e. those in which neither data nor other directories are to be found.

**Input:** RD (directory name) ENTER

**Example:** RD DATA ENTER

You have deleted the DATA directory.

## Working with files

The file name consists of two parts:

AUTOEXEC . BAT

name	extension
max. 8 characters (no spaces, only letters, digits and some special characters)	max. 3 characters, some combinations are not admitted

The extension indicates the file type. Particular importance is attached to the file types .COM, .EXE and .BAT. These are programs which can be called up in DOS like a command.

### The joker signs \* and ?

An asterisk in a file name shows that instead of the asterisk any sequence of characters can be taken instead of the asterisk.

A question mark in a file name indicates that any character may be used instead of the question mark.

These joker signs are used to apply a command to various files.

Example:

DEL \*.BAK ..all data with the extension .BAK are deleted.

## DIR

Each floppy/hard disk has a directory list. With the command DIR it is shown on the screen.

Dir [drive][directory]/p/w

Adding /p will show long lists of directories page by page, adding /w will show only file names (without indication of size and date) in five columns.

Example: DIR C:\DOS\\*.COM/W ENTER

All .COM files in the DOS directory are shown in five columns.

## COPY

COPY [drive1][directory1][name1][drive2][directory2][name2]

If you want to copy into the active directory (the directory you are inside at that moment) you need not determine [drive2][directory2]. If you do not want to change the name you need not determine [name2].

Note:

Use the command COPY to train selecting files from different directories and the usage of the joker signs \* and ?.

**DEL**

DEL (delete) deletes the files indicated.

DEL [drive][directory][name]

Example: *DEL \*.BAK ENTER*

All .BAK files in the actual directory are deleted.

If you enter DEL \*.\* this means that all data in the actual directory should be deleted.

MS-DOS will in such a case ask the safety inquiry:

Are you sure? Y/N

If you ENTER Y for "Yes" the data are deleted.

**REN**

REN (rename) renames the files indicated.

REN [drive][directory][old name][new name]

Example: *REN C:\DOS\\*.BAK\*.SIK ENTER*

All .BAK files in the DOS directory are renamed .SIK files.

**TYPE**

TYPE displays the content of files on the screen

TYPE [drive][directory][name]

Example: *TYPE C:\AUTOEXEC.BAT ENTER*

The content of the AUTOEXEC.BAT file is displayed.

The TYPE command makes only sense with text files, with other files special characters are displayed on the screen.

If the text file is longer than one screen page you can use a command such as the following one:

*TYPE READ.ME | MORE ENTER*

However, the MORE.COM file has to be in the actual directory.

## Working with floppies

**FORMAT**

Since floppies are also used for other operating systems the characteristic MS-DOS structures first have to be transferred to the floppy before you are able to read and store data (format).

Attention:

Formatting destroys any existing data on the floppy.

FORMAT [drive][/s]

If you enter the parameter /s, if formatting the system files IO.SYS and MSDOS.SYS (both invisible in DIR and not transferable with copy) as well as the command processor COMMAND.COM are copied to the floppy with this floppy you are then able to start the system ("system floppy")

Example: *FORMAT A: ENTER*

DOS requires you to insert a floppy in drive A: and press ENTER. According to the type of floppy and computer speed formatting may take up to a few minutes.

## DISK COPY

With DISKCOPY you can copy floppies.

**DISKCOPY [drive][drive]**

If you enter the same drive twice, you have to change the floppies several times during copying.

Both floppies must have the same size and the same format.

## Further DOS applications

### EDLIN

With the EDLIN command you can write or change a file. The EDLIN editor works line for line.

Example: You want to change the AUTOEXEC.BAT file.

The EDLIN.COM file has to be in the active directory.

Enter *EDLIN AUTOEXEC.BAT ENTER*. Since this file already exists, the message "end of input file" appears. If you want to write a file that does not yet exist enter a name that does not exist already in the active directory - the message "new file" appears.

The asterisk "\*" marks the cursor.

Commands:

L: file is listed

I: Insert one or more lines

Ctrl C: Exit from inserting

D: delete lines

Q: quit from the EDLIN editor without storing the file

E: quit from the EDLIN editor with storing the file

If you change a line enter only the line number, then you can rewrite the line.

## PATH

### Purpose:

Allocation of subdirectory names (path) for MS-DOS for using external commands.

### Example:

You work on the hard disk in the EMCO subdirectory.

Now you want e.g. to format a floppy and insert the FORMAT command. The system immediately reports the error message: "incorrect command or file name" since the FORMAT.COM file is not in the EMCO subdirectory but in the DOS subdirectory.

To format your floppy you first have to change into the directory (CD C:\DOS), enter there the FORMAT command and subsequently change to the EMCO subdirectory to continue work.

This, however, is an unnecessary effort.

### Solution:

Insert the command PATH C:DOS with EDLIN in the main directory in the AUTOEXEC.BAT file.

After storing (E) enter AUTOEXEC ENTER so that this modification is considered.

### The advantage is as follows:

If you enter the FORMAT command in the EMCO subdirectory , the system will now look for the FORMAT.COM file not only in this directory but also in the DOS directory. Since in this directory all DOS commands are to be found, with this solution you can enter commands also in subdirectories without having to change continuously from subdirectory into main directory and back.

### PROMPT

With the PROMPT command you can change operator guidance of the DOS command.

By leaving out the text input the system message is set to the standard value which consists of the active drive name and the ">" symbol.

E.g.: C>

Additionally, you can set up your own system message e.g. to indicate the actual subdirectory.

To do this, enter the command PROMPT \$p\$g in your AUTOEXE.BAT file in the main directory.

After storing (E) enter AUTOEXEC so that the modification is considered.  
If you change into the EMCO subdirectory you will have the following display:

C:EMCO>

For further and more detailed descriptions of DOS commands refer to your MS-DOS manual.

## The Most Frequent Failure Situations with the PC

### **The keyboard will not react:**

- Check the cable between keyboard and computer, the plug has to fit tightly in the socket.
- Frequently the computer does not react immediately during an actual operating procedure or floppy access. However, your keystrokes will be stored and displayed and/or carried out after execution of the current routine.
- If the computer does not indicate activity in the drives (control lamp) and will not react even after a short waiting period to keystrokes or to any stroke with a beep only, the computer has probably "crashed", see "system crash".

### **The computer interchanges keys**

Probably you have not installed the driver for the UK keyboard.

1. Ensure that on the hard disk there is the KEYBUK.COM file (up to DOS 3.2) or KEYB.COM (from DOS 3.3).
2. Write the KEYBUK command (up to DOS 3.2) or KEYBUK (from DOS 3.3) into your AUTOEXEC file (e.g. with EDLIN)
3. Via a restart call up the UK keyboard driver.

Of course, you may use the UK keyboard driver only if you really use the UK keyboard. If you do not call up a keyboard driver the computer uses the US keyboard driver.

For other than the mentioned DOS versions exist other commands (codepage etc.) Details see in the DOS manual.

### **The screen will not display**

- Check if your monitor is connected correctly to the mains supply and switched on (ready display)
- Check the connecting cable between computer and screen, the plugs have to sit tightly in the sockets.
- Check if the screen is connected via the correct socket to the computer (description of equipment)
- Check if the screen can be controlled at all by the graphics board of your computer.

### **Flickering/rolling display**

- By changing the controller for horizontal and vertical synchronization (holding control) the display can frequently be improved.
- Test whether in the area of the connecting cable a loose connection is to be found.
- Electromagnetic disturbances may also deteriorate the display.  
A frequent cause is to be found in a second monitor in the direct vicinity.

**The screen shows a jumble of special characters**

- Check if you really use the graphics board required for your software.
- In trying to print .COM, .EXE or similar files with the TYPE command, the screen will also display only special characters. TYPE can only show ASCII text files in a meaningful way.

**The floppy drive does not react**

- Check if the drive that should react is actually selected.

**The floppy cannot be read**

- Check if the format of the floppy is in accordance with the drive.
- If the drive was already able to read the floppy, probably the writing/reading head is disadjusted. Have the drive checked and, if necessary, adjusted by an expert.

**The floppy cannot be written**

- Check if the floppy is formatted.
- Check if the floppy is write disabled.
- Check if the file you want to rewrite is write disabled.
- If also other floppies cannot be written probably the drive is disadjusted, get in touch with an expert.

**The hard disk will not react**

- A newly connected hard disk has to be formatted and partitioned (FDISK command). In some systems it is to be integrated in the system configuration with an installation program.
- If a hard disk operating up to now does not react any more, the hard disk itself could be defective. Get in touch with an expert.

**The computer will not start**

- Check the mains connection of the computer and the monitor (ready display)
- Check the connection between computer and monitor.
- Insert a system floppy in drive A and press the RESET key. If the computer then runs up there is no operating system on the hard disk.

**The computer is unable to process DOS commands**

- Check if you have written the command correctly
- External DOS commands have to be stored on hard disk or floppy, drive and path have to be indicated.
- Check if your DOS version can process the command. The DOS versions of Messrs. Microsoft are not compatible with each other.

**System "crash"**

We are talking about a crash if an illogical state in the computer will cause that the computer does not react to commands any more.

With a crash the data in the main memory will get lost. Therefore, it is of particular importance that during the work with the PC you store intermediately from time to time.

**Remedy:**

Restart with key combination CTRL ALT DEL, sometimes RESET is necessary.

**Causes:**

- Professional software is highly sophisticated so that it is impossible to test it completely. Minor errors, under certain conditions, lead to the system "crash".
- Less frequently "crashes" are caused by disturbances in the power mains.

**The printer will not react**

- Check the mains connection of the printer (ready display)
- Check the connection cable between computer and printer, the plugs have to sit tightly in the sockets.
- Check if you use the correct interface on the computer. Printers are mostly connected to the parallel (CENTRONICS) interface.
- Check if the printer is switched ON LINE.
- If the printer cannot be switched ON LINE check if there is a printer error (e.g. paper end, paper jam, no ribbon ....).
- Many printers have a self test function with which you can check if your printer is defective.

**The printer will print incorrect characters**

- Check if the printer is able to process the entire 8-bit IBM-ASCII character set (printer manual).
- If the printer prints brackets or braces instead of the German "umlauts", you have to switch the printer over to the German character set (printer manual).
- The printer is controlled by the user program as graphics printer although it is not able to process graphics.
- Possibly you use a connection cable that is too long between the computer and printer, it should be shorter than 3 m.

## Hints for Screen Work

Regular work at unsuitable screen-workstations may endanger your health.  
Observe the following points to avoid unnecessary stress:

### Technical data of the screen

Picture frequency:	min. 70 Hz non-interlaced	
Heat emission:	max. 75 W	
Noise level:	max. 30 dB(A)	
Radiation:	X-rays	max. 5 µGy
	UV-A-rays	max. 10 W/m <sup>2</sup>
Statrical electricity:	max. ±500 V	
Low-frequency magnetic fields:	Induction (0,3 m in front of the screen 0,5 m around the screen)	max. 25 mT/s
	magnet. flux density (0,3 m in front of the screen 0,5 m around the screen)	max. 50 nT

Do not use screens with fans, they would contamine the air with considerable amounts of dust.

Size, sharpness and colour of the characters and line space must ensure easy reading.

The characters must be designed in a way that the characters C-G, X-K, I-1, D-O-0, B-8, S-5 can not be confounded with.

Ä, Ñ, Å, Ç, É,... should have full size.

### Design of the screen-workstation

The design of the screen-workstation affects the working quality substantially. Worse designed screen-workstations cause posture faults, eye diseases (too close sitting in front of the screen) and also a lack of concentration and fast fatigue.

#### Reflexions:

Reflexions on screen and keyboard handicap the work seriously.  
Avoid direct light on keyboard and screen.

#### Position of the screen:

The position of the screen influences your posture no less than the furniture.

The following approximate values allow a relaxed working posture:

Height of upper picture border: adjustable 37 cm to 52 cm over the desk surface

Inclination of the screen: adjustable -5° to 20°

Distance screen - eye: approx. 60 cm

The easiest way to reach this values is the usage of swivel arm systems.  
Ensure a secure and vibration-free fixing of the screen.

