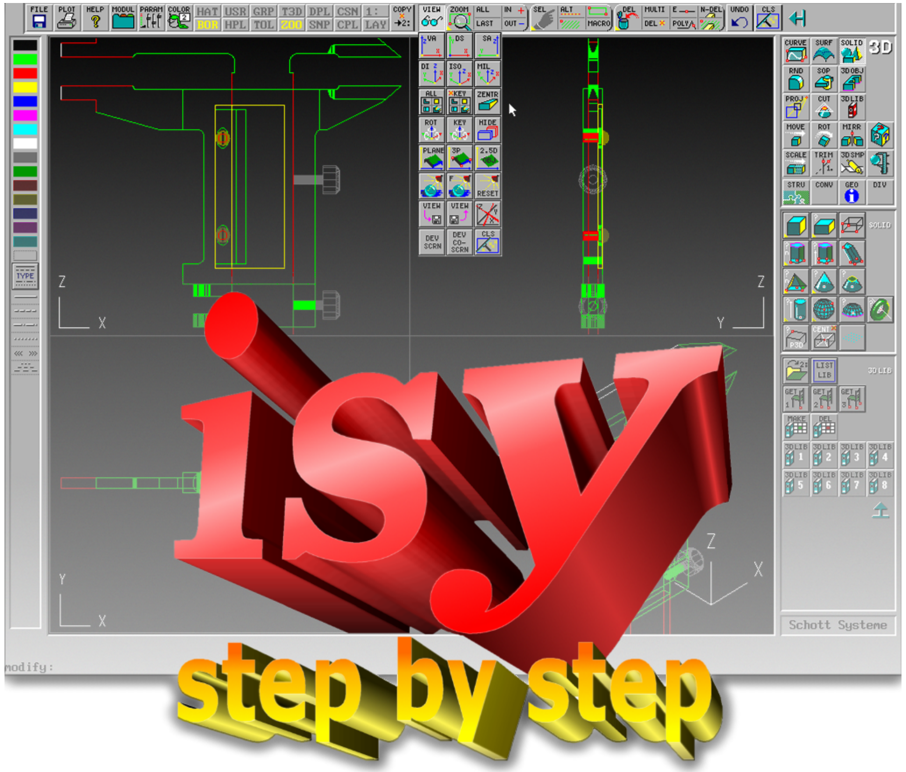

Didactic-Plugin for CAD/CAM-Programm **isy**

Didaktik-Plugin für das **isy**-CAD/CAM-software

Integrated Systems

aus CAD/CAM-Software und CNC-Maschineconsisting of CAD/CAM-software and CNC-machine

iselautomation

Copyright

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Printed in Germany

CONTENTS

Preface

Isy step by step is based on the user interface Picto which was developed for training purposes. Picto V.1.0 (1991) was the first graphic interface specially designed for the CAD program Pictures by PC (Schott Systeme - Munich) which was specifically developed for training purposes. Picto allows rapid familiarisation with computer assisted technical design which is why it is used very successfully in many high schools in Bavaria, Germany, at vocational schools and when training apprentices.

Isy is an open system and can be adjusted to fit to the needs of the user. This means additionally required functions can be activated in the system when the program is being used for training purposes. Other functions can be de-activated when they would be superfluous for the CAD student or would overload him at the time. The CAD beginner has, with **isy** step by step, the use of a range of functions which match his present needs and is thus able to learn the essential basic concepts of computer assisted design.

The following points were observed from the very beginning during the development of **isy** step by step:

- Consistent constructing of the menus
- The capacity to reproduce work steps
- The simplification of complex menus
- The simplification of time-intensive design procedures
- The implementation of helpful additional functions which support the training, above all in the area of visualisation
- Easily understandable documentation

isy step by step guides the user, step by step, to be able to undertake specific CAD design work with **isy**. The user can choose between three compatible user interfaces with varying degrees of difficulty which he can call up, either by using the appropriate icon when starting the program from Windows Desktop or at anytime while the program is running. The three levels of complexity are as follows:

- Stage 1 is suitable for CAD beginners and when the program is used in schools. The menu blocks contain very few commands. The menu depth was reduced by removing as many fly-out menus as possible. This allows the elementary basic concepts of CAD to be learnt quickly without unnecessary encumbrances. The range of commands available is appropriate for and matches the secondary level of the first year's study of Technical Drawing.

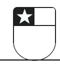
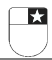
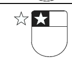
- Stage 2 is suitable for experienced students and advanced courses during training. The commands which are available are sufficient for the majority of standard design tasks.

- Stage 3 is designed for the professional use of **isy,** working in combination with modelling packages. The 2D/3D sub-menus from **isy** were not changed.

All three levels of development have the same menu hierarchy which is reached from a toolbar which has been designed specifically to match training requirements as well as two modified main menus, 2D and 3D.

Conventions

Working with this manual has been simplified by structuring it clearly. The following conventions and symbols are used consistently throughout:

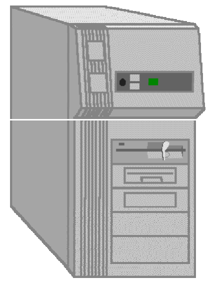
<table>
<tr><td>Italics</td><td colspan="2">For all inquiries and messages from the system</td></tr>
<tr><td>CLS</td><td colspan="2">where the user should make an input, this is indicated by using the typeface “Helvetica”</td></tr>
<tr><td><u>COMMAND</u></td><td colspan="2">Commands and the titles of text help menus are emphasised using underlining</td></tr>
<tr><td>Command</td><td colspan="2">Commands and the titles of text help menus are emphasised using underlining</td></tr>
<tr><td></td><td colspan="2">Commands and the titles of text help menus are emphasised using underlining</td></tr>
<tr><td>X</td><td colspan="2">represents a key on the keyboard</td></tr>
<tr><td>① ② ③ . . .</td><td colspan="2">numbering marks for paragraphs which represent work steps</td></tr>
<tr><td></td><td colspan="2">the monitor is the symbol for an output from the system</td></tr>
<tr><td></td><td colspan="2">the hand (halt!) is the symbol meaning stop a particular operation</td></tr>
<tr><td></td><td>mouse click (L)</td><td rowspan="3">A mouse click, in short form, indicates the selection of a command with the cursor which is active at the time or selection with the cross-hair and pressing the mouse button. L is the left mouse button (standard button) and R is the right mouse button</td></tr>
<tr><td></td><td>mouse click (R)</td></tr>
<tr><td></td><td>double click (L)</td></tr>
</table>

Chapter 1

Start

System requirements

COMPUTER



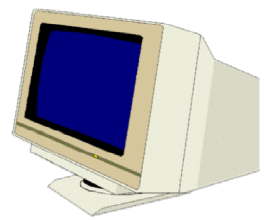
Isy does not make high demands on the hardware. The software will already run on an AT with 4MB of RAM, a co-processor and a hard disc. Acceptable operating speeds can already be obtained using a 486 processor. An extended main memory (XMS), which is recommended to be in the range of 8 MB and 32 MB, reduces the constant writing of data to disc.

THE MONITOR

Isy offers the possibility of selecting from a large range of monitor drivers and their corresponding screen resolutions. Higher screen resolutions allow one to show more details - and the size of the area which is available for drawing also increases proportionately. Step effects with diagonal lines are less visible for high screen resolutions.

It is not meaningful to use a small screen running on a high resolution, also when this is possible, since the text menus and the graphic button menus become more difficult to read. The following values have proven themselves in practice:

Resolution in pixels	Size of the monitor in inches	Horizontal frequencies for a required refresh rate	
		75 Hz	100 Hz
640 x 480	14 - 15 and LCD	38 kHz	51 kHz
800 x 600	15 - 17	47 kHz	64 kHz
1024 x 768	17 - 20	60 kHz	81 kHz
1280 x 1024	20 and larger	81 kHz	108 kHz



Black and white monitors are not recommended since complex drawings on black and white monitors are very difficult to see (the line thicknesses can only be differentiated between according to colour). It is preferable to use low radiation emission monitors according to the Swedish standard MPR II or even better according to TCO ’92. The maximum limits given in these standards refer to electrostatic, magnetic and electrical fields.

Other criteria which a monitor should fulfil include:

- good non-reflective qualities of the cathode ray tube
- the smallest possible distance between pixels (e.g. 0.28 mm)
- a flicker-free image due to high refresh rates (>70Hz)

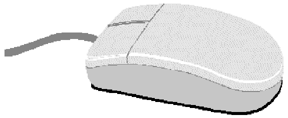
GRAPHICS CARDS

VESA compatible or VGA graphics cards.

Before buying a graphics card, please inform yourself about the drivers **isy** supports. A good quality image on the monitor in the individual work areas from **isy** and when showing shading is usually the result of the right combination of graphics card, monitor and drivers.

Isy step by step automatically supports and recognises the VGA mode, the 800 x 600, the 1024 x 768 and the 1280 x 1024 modes. The menus are automatically adjusted to the resolution which has been set. We recommend using a resolution of 1024 x 768.

THE POINTING DEVICE



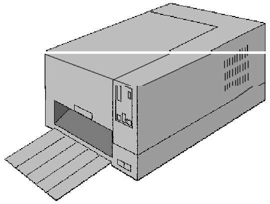
Die The two-key mouse

In a mouse, the movement of a rolling ball causes the cursor to move across the face of screen. Even rapid movements of the hand result in an exact movement of the cursor. Pressing a key (a mouse click) causes functions to be triggered. There are usually two or even three keys on a mouse. **isy** step by step only needs two mouse buttons, the left one and the right one (for three key mice the middle key is not supported).

The mouse fulfils two main functions:

- ❑ TO ENTER COMMANDS. Commands can be selected either using the highlighting bars or via the mouse pointer and initiated with a mouse click.
- ❑ SELECTION or ENTERING CO-ORDINATES. Here a crosshair is moved across the screen. The flawless grid function on **isy** allows very precise work to be performed.

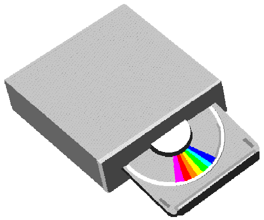
OUTPUT DEVICES



isy can control various types of plotter and printer. When the thickness of the lines is important on a normal print-out a plotter is necessary, or a printer which has the option “Colour = Line width” installed, that is the colour of the type of line which it used decides how thick the line is. This is usually possible with printers which are either HPGL compatible or with postscript printers. Laser printers are recommended in training areas since they give a very clean print-out and are fast. Make sure when you are buying a printer that it is capable of operating under the operating system DOS since some laser printers only operate under Windows.

We recommend the use of economically priced colour inkjet printers for the colour printing of shading views which have been saved. The print-out can be made using an image processing program such as Paint Shop Pro.

SOFTWARE



MS-DOS 6.2, 6.22 or WIN95/98, **isy** - in a version which has been correctly installed (at best on the C: drive of the hard disk).

Where **isy** is used with a WINDOWS NT system, the CAD program should be installed in its own DOS partition. A boot manager menu will then allow you to choose, after switching on the computer, which operating system you wish to work with.

Installation

Standard installation

① Insert the isy step by step CD into the CD ROM drive and notice the designation letter of the drive - in the following we use D:

② Starten the program **isy**

> The installation routine **sbsinst** from **isy** step by step only functions when **isy** is installed according to the manufacturer’s instructions. If **isy** step by step is already installed it should be removed with **delsbs** (see below) before being re-installed.
>
> **modify:d:\sbsinst -a (**„a“ means „ask“)
> The installation routine **sbsinst** from **isy** step by step only functions when **isy** is installed according to the manufacturer’s instructions. If **isy** step by step is already installed it should be removed with **delsbs** (see below) before being re-installed.
>
> **modify:d:\sbsinst -d** („d“ means DOS)
> In order to install Picto under an older version of DOS, it is necessary to insert option „d“.If you do not use this option you will obtain the error message:
>
> 0 files copied

③ At the prompt type in:

modify:d:\sbsinst ↵

It is not necessary to concern oneself with higher or lower case writing. The preliminary to the installation menu appears after a short period of time.

④ With ↵ start the **isy** step by step installation. A checking routine first checks the most important hardware and software data (see example):

```
isy-Versionsnummer: 2.60049

ssi: System-Informationen
      Rev. 1.01.014 - Copyright by Schott

Betriebssystem:                 MS-DOS Version 7.10
                                unter Microsoft WINDOWS

Prozessor:                      ??? im virtuellen 8086-Modus
Numerischer Koprozessor:        ???

Konventioneller Speicher:       639 k (0000-9FFF)
Frei für Programme:             598 k (0A46-9FFF)

DOS Upper Memory:               138 k
Freie DOS UMBs:                 0 k

Speicher-Manager:               Microsoft WINDOWS Ver. 4.03

XMS-Treiber:                    3.00 (3.5F)
High Memory:                    Verwendet durch DOS - 160 Bytes übrig
Upper Memory:                   0 k
Extended Memory:                65535 k
Freier XMS-Speicher:            65535 k (2048 k in einem Block)

dir: 1590362112 Bytes frei von 2147155968 Bytes insgesamt
Weiter ↵
```

If the value “Free for programs” is significantly below 600 KB, you have made too little memory capacity free in the lower memory area which can lead to problems when memory intensive processes are running. Check the start files CONFIG.SYS and AUTOEXEC.BAT and de-activate any unnecessary entries (insert REM in front).

⑤ After pressing the following system prompts will appear:

```
─────────────── Verzeichnissse ───────────────
Menüs:          C:\ISY\CDF&MNU\DEUTSCH
Buttons:        C:\ISY\CDF&MNU\BUTTONS
Prozeduren:     C:\ISY\PROCS
Pixel-Dateien:  C:\ISY\VECTOR
Zeichnungen:    C:\ISY\VECTOR
Hilfsdateien:   C:\ISY\TOOLS
──────────────────────────────────────────────
SBSINST kopiert jetzt alle Dateien von
D: in die oben angegebenen Verzeichnisse ...
<W>eiter oder <S>top?
```

⑥ There is the possibility to terminate the installation

after the request to make an input

`( C )ontinue or ( S )top?`

terminates the installation, the entry of

w or **W** initiates the copying progress.

⑦ The files will now be copied into the appropriate directories. . .

```
3D-Bibliotheks-Elemente ...
ESSGR4.VEC
ESSGR4R.VEC
ESSGR6.VEC
ESSGR6R.VEC
ESSGR8.VEC
ESSGR8R.VEC
TISCH4.VEC
TISCH4R.VEC
TISCH6.VEC
TISCH6R.VEC
TISCH8.VEC
TISCH8R.VEC
          12 Datei(en) kopiert
hix:        Indizierung von Hilfstexten
            Rev. 1.2 - Copyright by Scho

     1070 Einträge 1070 Schlüssel

Weiter ↵ _
```

...and after the massage „Installation (successfully) completed“, isy step by step starts itself automatically.

Windows 95/98

The batch files are located in the main directory of **isy**, namely isy1, isy2, isy3, for which you should place a link on the desktop.

- Make a mouse click (the right hand mouse button) on the Desktop surface
  ∅New ∅Connection ∅Browse
- Search in the directory **C:\ISY** for **isy1.bat** and select this file using a double click.
  ∅Continue - here you can input any name you wish (e.g. Step1).

∅END

The associated symbol now appears on the Desktop. Repeat this process for isy2 and isy3.

Making adjustments

- To create one’s own pop-up menus (3DLIB) it is necessary to install the corresponding plotter drivers. Input the following string at the DOS prompt :

  C:\isy>install

  and install the drivers “PICTURES 2.0 Graphical pop-up menu” as a plotter from 3 to 8 (see the picture to the right).

```
═══ P I C T U R E S  B Y  P C  2 . 6  I N S T A L L A T I O N ═══
        ┌──────────── H A U P T  M E N Ü ────────────┐
        <0> Rückkehr zu DOS

        <1> Installation mit Menüs

        <2> Drucker installieren
        <3> Plotter installieren
        <4> Bildschirm-Treiber installieren
        <5> Maus / Digitizer installieren
        <6> PATHES und FILES festlegen
        <7> Speicher-Konfiguration festlegen
        <8> Aktuelle Konfiguration anzeigen

        ── Geben Sie die Nummer des gewünschten Punkts ein ──
        -> 3
```

```
═══ P I C T U R E S  B Y  P C  2 . 6  I N S T A L L A T I O N ═══
──────────────── Installierte Plotter ────────────────
 1 Encapsulated PostScript Format (EPSF)
 2 PIC-SYNTAX 2.0
 3 WINDOWS METAFILE Format (WMF)
 4 HPGL (File)
 5 HP DraftMaster ISO A0 exp. (DTR Hardwire-Handshake)
 6 HP LaserJet 4/5 HPGL/2
 7 PostScript Laserprinter ISO A4
 8 None

──── Geben Sie die Nummer des Plotters an (1..8) ────
                      -> 8
```

- Change **scolor** to have the following configuration in order to improve the presentation on the screen for graphic pop-up menus (see Chapter 2-Operating **isy** step by step):

```
Gr. Popup-foreground:
   0   0   0
Gr. Popup-background:
   210 210 210
```

```
═══ P I C T U R E S  B Y  P C  2 . 6  I N S T A L L A T I O N ═══
──────────────── Installierter Plotter 8 ────────────────
 None
 Schnittstelle =

────────── Wählen Sie einen Plotter als Nr. 8 ──────────
 <190> PICOM-MP 5001 ISO A4 fast
 <191> PICOM-MP 5001 ISO A4 slow
 <192> PICTURES 2.0 Graphical Pop-Up-Menu
 <193> PostScript Laserprinter (Color = Line width)
 <194> PostScript Laserprinter (Multiple - Color = Line width)
 <195> PostScript Laserprinter (Multiple)
 <196> PostScript Laserprinter ISO A3

 <v>   Vorheriges Menü              <n>   Nächstes Menü
 <e>   Keine Änderung               <s>   Schnittstelle ändern

                     -> 192
```

Tests

isy step by step possesses three simple system tests which can only be initiated via the command line:

modify:test1 and
modify:test2
test the performance of your computer using the most common 3D functions. You can optimise the performance of your computer by comparing the running times after making individual adjustments.

modify:test3
creates a presentation of colours for various colour ranges and shading types to check their quality.
The important thing here is the showing of the screen frequency at the end of the test. It should not be less than 70 Hz for ergonomic reasons.

Entering **modify** will take you back into the graphics mode.

Examples of Start files

The following two Start files show a tried and tested system configuration for running isy under WIN95 - deviations from this, according to the system, are possible.Additionally, please note the installation guidelines in the isy manual.

CONFIG.SYS

```
DEVICE=C:\WINDOWS\HIMEM.SYS
DEVICE=C:\WINDOWS\EMM386.EXE NOEMS RAM
DOS=HIGH,UMB
BUFFERSHIGH=30
FILESHIGH=30
LASTDRIVE=Z
FCBS=4,0
COUNTRY=049,850,C:\WINDOWS\COMMAND\COUNTRY.SYS
DEVICEHIGH=C:\WINDOWS\COMMAND\DISPLAY.SYS CON=(EGA,,1)
```

AUTOEXEC.BAT

```
@ECHO OFF
SET TEMP=C:\TEMP
PATH %PATH%;C:\ISY;C:\ISY\TOOLS\WIN95;C:\ISY\TOOLS
LH C:\ISY\TOOLS\WIN95\PICUMB 60
MODE CON CODEPAGE PREPARE=((850) C:\WINDOWS\COMMAND\EGA.CPI)
MODE CON CODEPAGE SELECT=850
LH KEYB GR,,C:\WINDOWS\COMMAND\KEYBOARD.SYS
```

The following batch file is **exclusively** designed to start **isy** step by step when operating in a pure DOS mode: The hard disc cache program **SMARTDRV** and the mouse driver **MOUSE.EXE** or **MOUSE.COM** can also be inserted in the Start file **AUTOEXEC.BAT** but this has the disadvantage that these files also (and unnecessarily) remain in the main operating memory even when working under Windows 95/98.

ISY.BAT

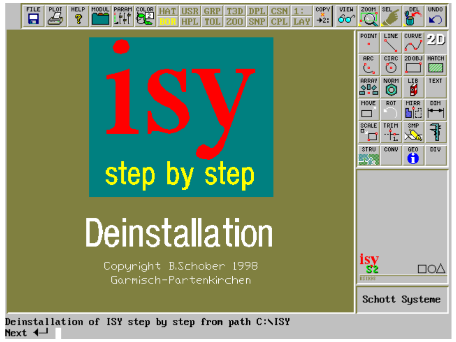
```
@ECHO OFF
C:\WINDOWS\SMARTDRV          – loads the hard disc cache
LH C:\MOUSE\MOUSE            – adjusts the directory where needed
C:\ISY\PICTURES p%1          – starts, isy 1,2 or 3 depending on what is written there
```

EXAMPLE:

The input ISY 1 ↵ starts the module which is suitable for CAD beginners.

Uninstalling

Isy step by step can be uninstalled in the same way as described above for installation and can be completely removed from your system



① Start isy

② At the prompt type in:
modify:delsbs ↵

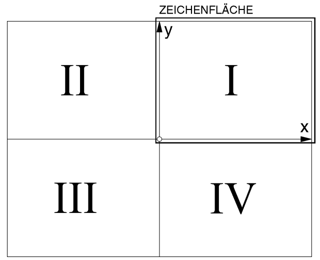
Chapter 2

Working with isy step by step

The basics of generating geometrical shapes

The 2D co-ordinates system

Every drawing point is stored internally in the CAD system in the form Drawing areaof **co-ordinates**. Co-ordinates are numbers which define the position of the point (x,y for 2D point co-ordinates).

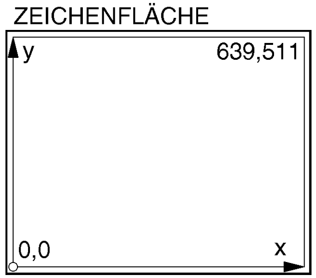


The **co-ordinate axes x,y** are at right angles to each other and divide the work surface into four work areas known as **quadrants**. The four quadrants of the co-ordinate system are numbered anti-clockwise. **Isy** works mainly in the 2D area in Quadrant I. of this right-angled (Cartesian) co-ordinates system.

Units of measurement: GDU (Graphics Display Unit). The drawing limits extend from - 999999, - 799686 (below left) to + 999999, +799686 (upper right).

Quadrant	x	y
I	1	1
II	-1	1
III	-1	-1
IV	1	-1

isy uses absolute co-ordinates internally. The x- and y-axes of the co-ordinate system fit exactly to the x- and y-axes of the monitor screen (x=x,z=y). The co-ordinate zero point 0 (0,0) corresponds to the upper left corner of the standard drawing area. All values on the standard drawing area (no zoom!) for the co-ordinates x and y are positive. The visible co-ordinate area extends from 0,0 to 639,511 GDU. A 14" monitor shows a section sized approx. 20 x 16 cm. of a surface measuring 625 x 500 metres!



EXERCISE 1

A small overview of how **isy** manages geometrical data can be obtained by trying the following exercise. Start **isy** and enter the following commands, at first using the keyboard.

① **line**

A crosshair appears on the screen and the system prompts: *Select the 1st point*

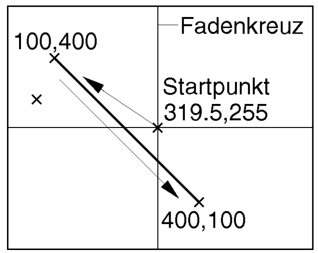
② Position the crosshair with the cursor key at the desired position on the drawing area and press the key "Escape" to initiate the procedure.

line: location of the current point is 319.50,255.00 a=0.00 (for example) *Next point:*
At first, the current point does not lie on a precisely defined point on the drawing surface.

④ In order to move the current point to the desired start point, enter the following, without any spaces:

ma100,400

line:location of the current points is 100.00,400.00a=146,64 (a=the angle of the last point)

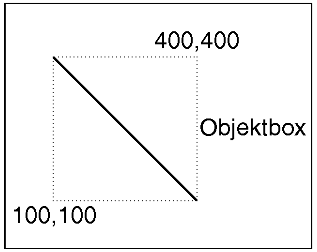


Next point:

⑤ **a400,100**

line: location of the current point is 400.00,100.00
a=315.00 Next point:

⑥ **e** for exit – ends the entry of co-ordinates



You have generated an **object** in the first quadrant (where all values are positive) which only consists of one **element,** with the help of numerical co-ordinate entries. Enter the following:

modify:edit

You will now find yourself in the **Editor** which shows the geometrical data for the stored lines. **isy** needs six internal commands in order to generate the object, which you will only seldom be confronted with when you are entering co-ordinates using the mouse. **isy** stores all drawings in the vector directory using this alphanumeric form. The short commands which are used here have the following meanings

```
os obj1
ob 100,100 400,400
co 8
ma 100,400
da 400,100
oe
```

os	Object start - obj1 is the name of the object which **isy** automatically assigns. You can change it as you wish.
ob	Object box - every object is surrounded by an (invisible) rectangle. The box is automatically generated when the object is being created. All existing object boxes can be re-calculated by using the command **box all**
co	Object colour - here 8 = white - changes the value of the colour (2 to 32) thus changing the colour of the object on the drawing area
ma	Move absolute - moves the virtual pencil, which is located here at position 100,400. If you change the co-ordinate data, the starting point of the line will shift
da	Draw absolute - uses the virtual pencil to draw a line from the current point to 400,100. If you change the co-ordinate data, the starting point of the line will shift
oe	Object end

EXERCISE 2

Mit Create a second object which is a yellow square located between the upper line end 100,400 and the point 200,500.
Now enter the values directly into the editor after obj1 - it works just like a word processor
Use to go to a new line.

Use to get back into the graphics mode and to see the result of this exercise

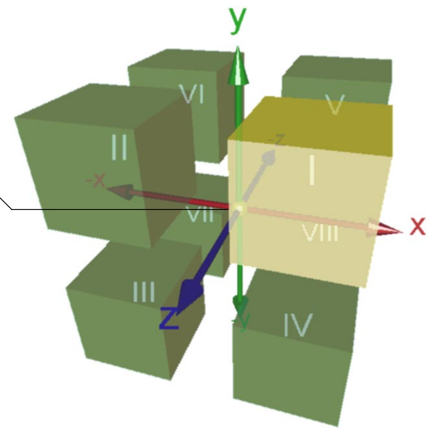
```
os obj2
ob 100,400 200,500
co 4
ma 100,400
da 200,400
da 200,500
da 100,500
da 100,400
oe
```


The 3D co-ordinates system

Space is sub-divided into three levels standing vertically one above the other and eight work areas, the **octants** (I to VIII). The numbering of the individual octants is according to the diagram on the right.

The three co-ordinate levels all meet at one point, the Co-ordinate origin (0,0,0), and the lines which

Pass through this point are called the co-ordinate axes **x, y, z** .



The co-ordinates x,y,z can be used to define the position of every point in the octants, but one must be careful to take note the sign at the front (see table). The values of the three co-ordinates in the I st octant of a three dimensional system are always positive and the diagonally opposite values in the VII th octant are always negative.

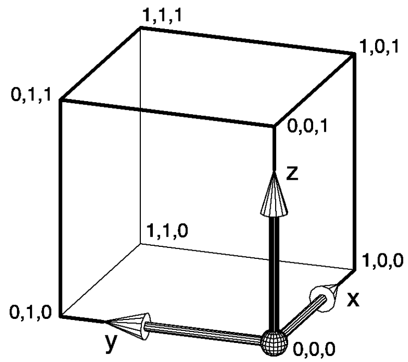
Internally, **isy** also uses absolute co-ordinates for 3D designs. In the standard condition (zoom not used, top view) the x- and y-axes of the co-ordinate system fit exactly to the x- and y-axes of the monitor screen (x=x,z=y). The third axis (the z-axis) is at 90º to the x/y surface where its positive half projects out of the screen and its negative half projects into the screen. The lower left hand corner of the drawing area represents the co-ordinate's origin.

Oktant	x	y	z
I	1	1	1
II	-1	1	1
III	-1	-1	1
IV	1	-1	1
V	1	1	-1
VI	-1	1	-1
VII	-1	-1	-1
VIII	1	-1	-1

When you move an object in the z direction while in standard condition the movement is not visible since the 3D top view (TV) represents a special form of the parallel perspective. 3D designs should, therefore, be undertaken from the start in the diametric or an isometric view.

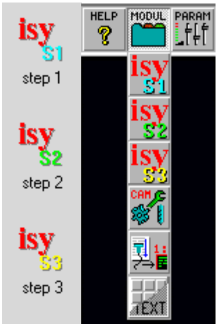
EXAMPLE

In the example below, a cube with an edge length of 1 will be positioned in the first octant of the co-ordinate system in such a way that a corner is lying on the co-ordinates origin. Every corner of the cube is defined by other co-ordinate values. The co-ordinates of the top surface only differ from the co-ordinates of the base surface by the value 1 on the third location, so the base surface was effectively shifted just upwards parallel to it original position.



Starting isy step by step

isy is started from MS-DOS by:
C:>isy 1 ↵ or C:>isy 2 ↵ or C:>isy 3 ↵



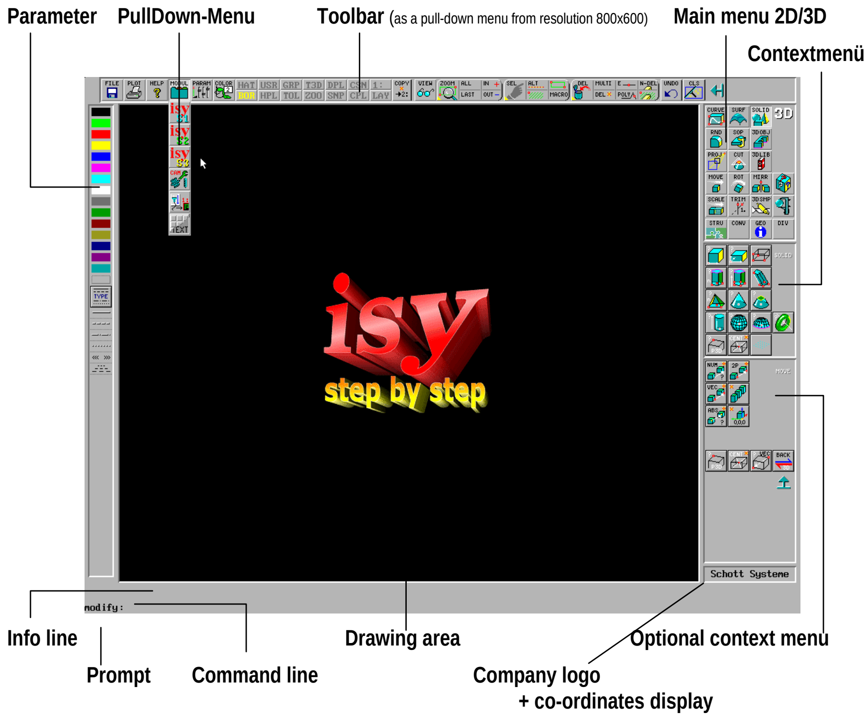
When working under Windows 95/98 starting **isy** step by step is simply a matter of a mouse click on one of the three icons available. **isy** step by step shows its logo and is then ready to start work. Changing between the individual program modules is possible at any time by using the toolbar (button "Module").

Stage 1 is suitable for CAD beginners and when the program is used in schools. The menu blocks contain very few commands. The menu depth was reduced by removing as many fly-out menus as possible.

Stage 2 is suitable for experienced students and advanced courses during training. The commands which are available are sufficient for the majority of standard design tasks.

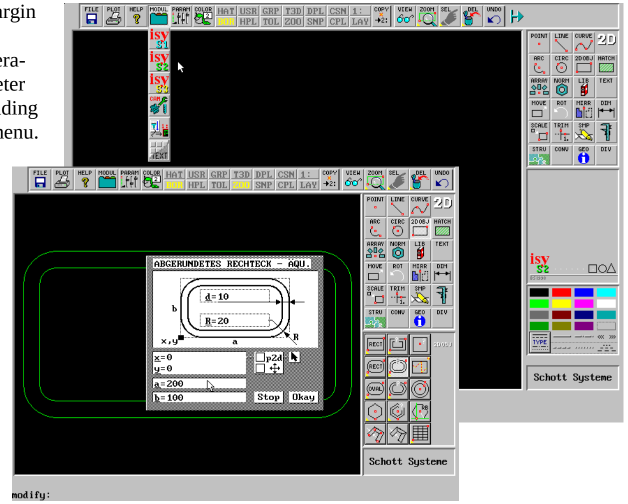
Stage 3 is designed for the professional use of **isy**, working in combination with modelling packages. The 2D/3D sub-menus from **isy** were not changed.

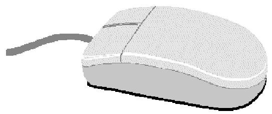
Structure of the screen display



The menu area on the left hand margin of the resolution 800 x 600 is not available because of space considerations. The context oriented parameter menu for colour, line, font and shading is thus located under the context menu.

When using a resolution of 640 x 480, the user must give up the pull-down toolbar and the comfort of having immediate access to the parameter menus at any time. Isy still remains fully functional, however, and can thus be used on older lower resolution VGA monitors or laptops.





Operating isy step by step

All menu and function buttons are exclusively actuated by clicking on them with the mouse. A mouse click (L) calls up the appropriate or the function chosen. Clicking and holding down on a desired button with the right hand mouse button calls up a short description of the function (Quick Info.)

The Toolbar

The control centre for all of your drawings is the toolbar, which is located at the upper margin of the screen or the head bar. This contains all of the basic functions which you often need. The **isy** toolbar is static.

5 menu buttons for File, Plot, Help, Module, Colour	Global menu with various indicators and switches	4 menu buttons for viewing, zooming, selecting, deleting and the undo-button

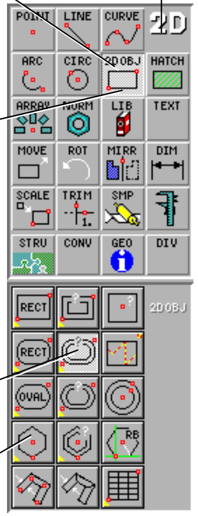
The **dynamic toolbar** from **isy** step by step adjusts its size according to each monitor resolution and can be extended with additional commands by a mouse click on the blue arrow on the right. This offers a significant increase in working speed since commands which are often used are directly available and the number of mouse clicks required drops. The maximum length of the pull-down menu increases automatically according to the resolution which has been set. A mouse click on the blue arrow collapses the dynamic toolbar back to its original size.The 2D/3D main menu / button-menus.

One can change between two menus which are located on the right hand margin of the screen by clicking with the mouse (L) on the white 2D or 3D symbol – active context menus are included.

① Choose one of the higher menu buttons in the main menu with the mouse pointer

② Activate the context menu with a mouse click (L)

The selected menu button remains depressed and the required context menu appears in the menu field under the main menu



NOTE !

> Menus can only be called up when there is no text in the command line.

STARTING AT 1024 x 768:

② Activate the context menu with Ctrl +

Two context menus - that is up to 40 commands are now available simultaneously (see diagram of the structure of the screen display)
2D and 3D menus can be combined this way in any way required.
A big advantage : The drawing area or other menus are not covered by windows due to this action.

③ The lower menu is closed again by clicking on the arrow button using the mouse.

Calling up a command using the buttons

① Select the desired command using the mouse pointer.

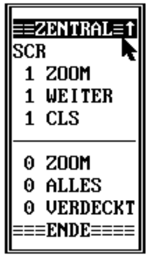
② Activate the command by pressing the left hand button of the mouse

NOTE !

> Activation buttons which are located on the left below and which are in the form of a yellow sloping triangle activate two commands.
> A **short mouse click (L)** initiates a command.
> **Clicking on the button and holding down** opens either a pull-down menu or fly-out menu.

Text pop-up menus

Using symbols to operate a software is not always desired in certain cases. **isy** and **isy** step by step thus have text menus and text pop-up menus in addition to the button menus and the graphic menu bars..



The selection of commands is achieved in all text menus using the highlighting bar which only work vertically, or, in the case of 2 column pop-up menus, which also move between columns.

① Select the desired command using the highlighting bar

② Click on the mouse (L)

You can return to the next higher menu level out of the text menus and the text pop-up menus by clicking on the header line (highlighting bar on the title). The arrow pointing upwards - next to the menu title - returns to a higher menu level.

The command line

It is not recommended that CAD beginners operate **isy** usingdirect commands placed in the command line (modify) but practised users can often gain a lot of speed in this way.

The direct entry ranges from simple commands such as **edit, sheet, Zall, dir, format**, etc. through to a complex string of commands (separated by semicolons).

> It is not possible to make entries into the command line when a pop-up menu is active.
> One does not have to take care concerning upper case and lower case when writing commands.
> Commands which have been issued already can be retrieved as a command list using the cursor keys ↑ ↓ This saves time and offers the possibility to check and commands.

Exiting isy step by step

Never simply switch your computer off when you are finished making your drawing. Click on the exit button in Files menu to end a work session correctly or type in:

modify: exit ↵

System response: *Are you sure (J/N)?*

modify: Y ↵ **Adjusting the screen colours**

The colour and contrast setting for the various modules can be adjusted by inserting

scolor ↵

and then changing the colour in the pop-up menu shown to the right to achieve the required presentation.
Note that the setting you have made is only effecting one of the four possible work areas.

OK accepts the setting for a work session

Save makes a permanent change in the settings

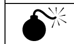
Cancel rejects the changes

Test shows the colour change-over for two test examples for checking purposes

Recommended settings for **isy** step by step

```
Gr.Pop-up-foreground    0   0   0
Gr.Pop-up-background  210 210 210
```

Emergency exiting

new ↵	**deletes** - after a security question, all of the drawings in the active memory buffer.
modify ↵	**Return to the main menu** If the prompt “modify” is no longer visible it means you have landed in another part of the **isy** program. This can happen particularly when you are outputting to a printer or plotter.
Ctrl + Pause	**Break** - stops the process which is running at the time. A “Break” deletes both the information and the command line.
Ctrl + Alt + Delete	**Warmstart**. A warmstart causes your computer to reboot. Your drawing will be lost. A warmstart is only necessary when the program cannot be exited properly.
RESET	**Warmstart**. If the situation arises where your computer will no longer react to inputs from the keyboard there is no other option left than to push the RESET button on your computer. A RESET can cause an error on the hard disc if it is pushed while a “write to disc” process is running.
 **Switch off the computer**	Switching on the computer (again) using the mains power switch is known as **cold start**. This should only be used as an “emergency brake” when even RESET doesn’t work. Do not restart until the hard disc has stopped spinning. Often repeated cold starts are bad for the life of your computer since the hard disc is sensitive to being switched on and off often.

Function keys and hot keys

F1 User Help

You obtain information about the last command or call-up one of the **isy** Help menus

F2 Branching off to the next higher menu level

Pressing the F2 key, when using text menus, corresponds to a mouse click on the menu title in the menus at the margin of the screen.

F3 Activating the text

Pressing the F3 key corresponds to a mouse click on the second line of the menus at the margin of the screen or a mouse click on the button symbol in the graphics menu bar.

Alt + Y Zoom everything

Zooms the drawing up to full-screen

Tab + A Display *

Emphasises the active object by giving it a special colour. A second mouse click returns the object to its original colour.

 *ACTOBJ=1:Name*

Alt + S Rebuild the screen

The hotkeys ALT + S rebuild the whole screen, which includes the menu boundaries, the menus at the margin of the screen, as well as the edge of the screen. Thus can become necessary after shading processes have been performed or an external program has been called up.

Ctrl +  Change a parameter immediately

The change of parameter is only effective for the active object.
This functions in the static margin menus line colour/type, hatching colour/type and text colour/type and well as the pop-up menus hatching and font selection.

Alt +  Changing a parameter – multiple objects

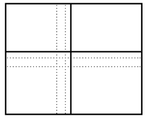
Multiple objects can be selected using the crosshair and the selected parameter can be changed for all of them at once.
This functions in the static margin menus line colour/type, hatching colour/type and text colour/type and well as the hatching and font selection pop-up menus.

The Various cursor forms

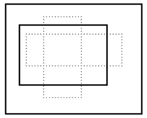
Mouse pointer The white mouse pointer (or arrow) appears when there is an active graphics menu bar. It can move around freely and serves to select commands

Block cursor The block cursor marks the writing position in the command line. It can be moved backwards when an insertion should be made or when a typing mistake has occurred.

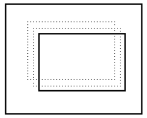
Highlighting bars The red highlighting bars can only be moved vertically. In text menus it serves to select commands and menus.



The **crosshair** is the standard graphics cursor. It is used to exactly position the points of a new element or to select existing elements.



The **variable window cursor,** which can be varied in size can, for example, be used to select a number of elements, **to** set the size of the zoom window, to enter size data for rectangles …



The rigid **window cursor** is used to move objects. It **characterises** the maximum dimensions of the object and must not be larger than the drawing area.

A command reference – 2D/3D main menu

Every menu button in the main menus for the 2D and 3D areas calls up a sub-menu (context menus), each of which has up to 20 commands. The following table gives a short overview of the meaning of the individual buttons and can be used as a presentation which can be copied.

2D-main menus

POINT 2D point	LINE 2D line	CURVE 2D curve	2D to 3D-menu area
ARC 2D arc	CIRC 2D circle	2DOBJ 2D object	HATCH 2D hatching
ARRAY 2D arrangement	NORM 2D standards	LIB 2D library	TEXT 2D lettering
MOVE 2D moving	ROT 2D rotating	MIRR 2D mirroring	DIM 2D dimensioning
SCALE 2D changing the scaling	TRIM 2D trimming	SMP 2D smoothing	2D measuring
STRU the structure of objects	CONV converting	GEO info about geometry	DIV divers functions

3D-main menus

CURVE 3D line and curves	SURF 3D surfaces	SOLID 3D bodies	3D to 2D-menu area
RND 3D rounding	SOP 3D volume operati.	3DOBJ 3D object	
3D projection	CUT 3D cut-out	3DLIB 3D library	
MOVE 3D moving	ROT 3D rotation	MIRR 3D mirroring	3D help functions
SCALE 3D scaling	TRIM 3D trimming	3DSMP 3D smoothing	3D measurement
STRU structure of objects	CONV converting	GEO info about geometry	DIV divers functions

Chapter 3

The Basic Functions

The toolbar

FILE	Menu: Import-Export, program modules, Exit
PLOT	Menu: Printing and plotting
HELP	Menu: Program help and system information
MODUL	Menu: Optional additional module
PARAM	Menu: Setting or checking parameters
COLOR	Menu: changing over colours - creating new objects in the colour of your choice
HAT / BOR	Button to insert hatching Curves on the border
USR / HPL	The USER co-ordinates display Button for the hatching filter
GRP / TOL	Button for element snapping Capture tolerance
T3D / ZOO	Button for the 2.5 D matrix Zoom indicator or zoom factor
DPL / SNP	Button for duplicating for the co-ordinates snapping
CSN / CPL	Button for the colour snapping for the colour filter
1: / LAY	Button for the buffer Layer
COPY →2:	Copy the current object into an alternative memory buffer
VIEW	Menu: View
ZOOM	Zoom everything (the magnifying glass function) / Menu: Zoom
SEL	Selecting the crosshair / Menu: Select
DEL	Delete the object to be selected / Menu: Delete
UNDO	Undo the last step = cancel

FILE

isy stores drawings in the form of vector files on the hard disc.
A file names is to be given for a files, which should not be longer than 8 characters:
e.g. **treppe.doc**
The file name must be known in order to load it. File names should be meaningful in order to avoid any confusion between them.

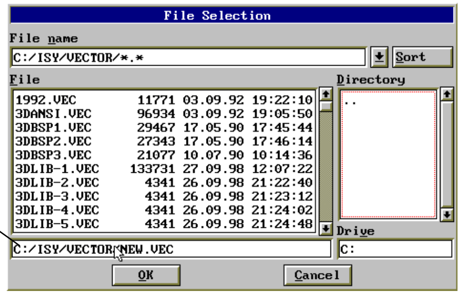
NEW

Deletes the current memory buffer - a new drawing (NEW).
The command NEW, which can also be entered using the keyboard, deletes the contents of the currently active memory buffer (usually Buffer 1:)

A pop-up menu asks the user to confirm. The deletion process is only initiated after there is a mouse click on “Yes” (or, as an alternative, the key “Y” is pressed). The drawing is no longer retrievable.
If a mouse click is made on “Save” (or, as an alternative, the key “S” is pressed) the procedure can be undo-ne using the Undo button.

SAVE

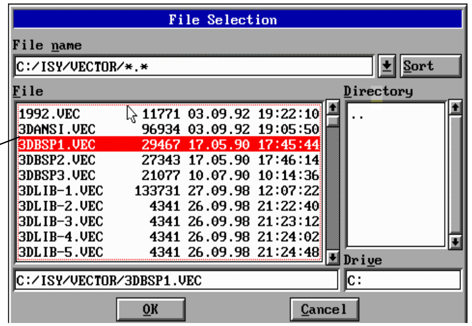
This is used to save drawings under the current or another selectable name.If you want to **overwrite** an existing **file** (update) select the file name using the highlighting bar (see below) in the directory win-dow. **New file names** are entered into the Entry Window.
An alternative method is to enter “save name” via the keyboard. In every case a message appears for safety purposes when the same file name is being used, as in the case of a file update



Save: the file “NEW.DOC” exists-do you want to overwrite it ? (Y/N)

LOAD

To allow files to be loaded into the current buffer (MODBUF) **isy** offers a list of files in a pop-up menu. The vector files in the established vector di-rectory are listed. One can choose the way in which they are sorted.
First click with the mouse on the file you require and then click on the “OK” button.
Alternatively you can type “**load name**” using the keyboard.



If drawing objects are already in the current drawing buffer, a system prompt appears instead of the menu:

Clicking on “No” adds the file to be selected to the buffer contents.

NOTE!

> In order to avoid identical file names when there are a number of files in one drawings buffer, you should absolutely change the consecutive numbering of the drawing objects.

LOAD INTO A WINDOW

Load a file into a window section (just for 2D drawings)

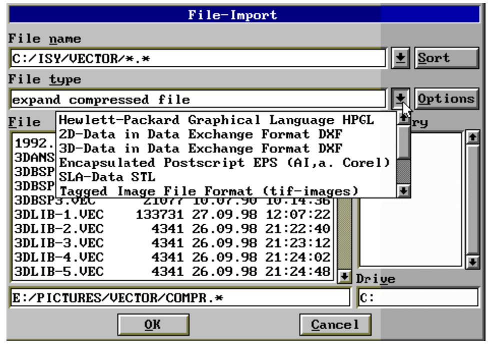
① *Select a rectangle using two diagonal points:*
Select the window section into which the 2D drawing should be fitted.

② Select the required file from the menu

IMPORT

Import files from other programs or read in converted data:
isy can work with the following formats:

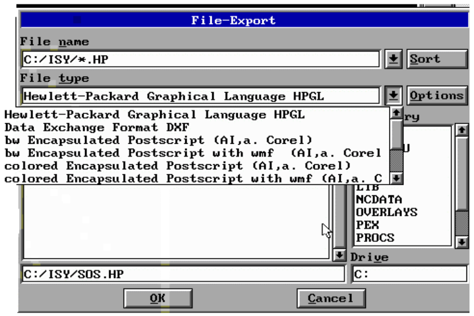
Hewlett-Packard Graphical Language HPGL
2D-data in the Data Exchange Format DXF
3D-data in the Data Exchange Format DXF
Encapsulated Postscript EPS (AI,and Corel)
IGES-files IGS
VDA-files VDA
SLA-files STL
Tagged Image File Format (tif-images)
NC Code (G-Syntax)
Expand compressed files



EXPORT

Export data to other programs or export converted data. Possible export formats include:

Hewlett-Packard Graphical Language HPGL
Data Exchange Format DXF
Encapsulated Postscript SW (AI,u. Corel)
Encapsulated Postscript SW using wmf (AI,u. Corel)
Encapsulated Postscript Colour (AI,u. Corel)
Encapsulated Postscript Colour using wmf (AI,u. Corel)
IGES-files IGS
VDA-files VDA



SLA-files STL
Tagged Image File Format (tif-images)
Windows Meta File WMF
Compress files

isy possesses its own efficient compressing program (COMPRESS.EXE) which allows very large files to be stored on disc or sent over the internet. The compressed file can only be read by isy after it has been decompressed

MAIN

Switch-over into the program section MAIN (logo prompt) - also possible via the keyboard.

SHEET

Switch-over into the program section SHEET (calculation worksheet) - also possible via the keyboard.
The calculation worksheet from **isy** consists of 2048 lines and 160 columns. Use the area which begins at cell address A1. Input data into a defined range which you can output later as a table, for example, or which can be further processed by various procedures.
Read in existing sheet tables which have been saved as data files with „read“.

An example:

Read c:\isy\data\bundes.dat a1..e20

This reads the fils “bundes.dat” into the SHEET area, from A1 to E20.

EDIT

Switch-over into the editing mode (cancel with <ESC>) - also possible using the keyboard.
In order to check the structure of a drawing or to understand it better it is possible to edit the active object or the macro-object. The editor allows the object to be manipulated using the keyboard as required.

PROC

Used to edit and save files and programs (procedures) which are in buffer 4 using a file select menu - also possible via the keyboard using “proc all”, for example.

EXIT

Exit **isy** - stop running the program - also possible via the keyboard.

SEARCH

Look for (a) specific file(s) in all of the directories

① *Insert the names of files which should be searched for: <front.vec>*
Enter the name of files you are searching for, <u>including the extension</u>

All corresponding files, with their directory, will be listed

Plotting and Printing

The following factors play a major role in the outputting of CAD designs

- DIN-format
- Line strength
- Dimensional stability
- Colour
- Speed

Pen plotters, that is output devices which **still** work with ink wells, are being replaced by inkjet plotters, which print out the drawing data line by line and thus operate significantly faster.

Output the **DRAWING AREA** (not to scale)

Create a hard copy of the drawing area on the default plotter or printer.
The drawing data can be either in a 2D or a 3D format.

① *Number of the plotter <1>:*
The default unit is Plotter 1, that is the plotter which you installed using the routine “Install” as Plotter 1.
isy is also capable of treating certain printers as a plotter an.

② *Is the unit ready?*
Confim „Okay“ on the board with the buttons

INSTALL

Change the printer/plotter installation file while the program is running
(cf. Isy manual 1: First installation procedures and configuration)

NOTE!

When you start “Install” from the DOS level, all selected settings for the printer and plotter remain intact. Plotter drives which have been selected while the program is running are only active during that work sessionnd.

FORMPLOT RAPID OUTPUT IN METRICAL FORM !

The metrical outputting of drawings or parts of drawings within a special FORMPLOT border is possible under **isy** where various FORMPLOT borders are offered in the menu “Miscellaneous functions”. The light blue rectangle on the border corresponds here to the page margin. The drawing is, for the same output format, (e.g. A4 Formplot border on a DIN A4 page), transferred exactly true to scale.

Plotting and printing **METRICALLY**

Metric output of the whole drawing or a freely selected plot window.
The procedure is not easy to understand for beginners but offers all manner of possibilities to set parameters for a desired plotter or printer output.

① *Logical unit ? (prtr,plot2(,plot3,plot4)) <plot1>:*
Plotter 1 is the default plotter
Should the prompt „modify“ be missing because of a wrong entry, please input:

modify

mplot: maximum size of plot1: 286mm x 197mm
The maximum size which is announced is, in this example, one for a laser printer.

② *Plot window ? (o=obj, o=?, w=x,y..x1,y1, w=?) <ENTER>=all:*
If you the plot window corresponds to a box which surrounds all available drawing objects.

③ *Should the drawing be rotated through 90° <N> ?*
The default setting is „No“. The drawing will then be printed out in a landscape format as it appears on the screen.

mplot: maximum window size: 256mm x 197mm

④ *Size ? p(,u,x,y)=#mm(,cm,i) oder s=#,#mm(,cm,i):*
Enter the desired width x or (height y) of your drawing, for example:

x=210mm

mplot: plot size of the window: 210mm x 167.9mm

⑤ *Enter the position (c,ll,lr,ul,ur) or (x,y mm(,cm,i)):*
The print-out position of your drawing on the paper can be established either by using a short code digit or by entering metric co-ordinates

c	the centre (centre of the page)
ll	lower left corner
lr	lower right corner
ul	upper left corner
ur	upper right corner

> Check the metric entry for the maximum size of the plot. It is not universally fixed.

x, y = x is the distance from the left hand margin of the drawing to the left hand margin of the plot area in millimetres. Y is the distance from the lower margin of the drawing to the lower margin of the plot area in millimeters.
The input is valid for the right hand side margin when x is a negative value. The input is valid for the upper margin when y is a negative value. It is usually sufficient to press .

⑥ *Do you want to limit the output of the drawing to (0,0..639,511) <Y>?*
“Yes” is the default response. Where your drawing is larger than the standard screen answer with **N** .

⑦ *Plot object ? <ENTER>=all:*

Enter for the whole drawing or, when you want to limit the output to just part of the drawing, type in the name of the macro-object to be plotted:

⑧ *Plot colour ? <ENTER>=normal:*

⑨ If you now enter , the plotting pencils or the line strength will be allocated to the colours of the drawing – assuming that your output device can do this and that you have the correct driver.

2

means that the whole drawing will be outputted in the corresponding line strength or colour.

CUTPLOT – two sheets of paper, in landscape format

CUTPLOT – two sheets of paper, in portrait format

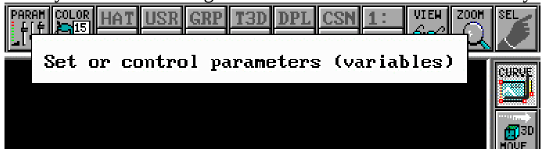
CUTPLOT – four sheets of paper, in landscape format

CUTPLOT – four sheets of paper, in portrait format

Output of the current buffer, scaled to two or four sheets of paper.
This routine allows you to still print out larger format drawings even when there is only a DIN A4 printer available.
With the option “two sheets of paper” you first of all cut the first sheet along the automatically printed line and then glue it to the second sheet.
With the option “four sheets of paper” you cut the margins, which are indicated by hatching, of the sheets and then glue the four sheets together.

Help

isy and **isy** step by step have a number of types of Help function.
Pressing F1 brings you the total overview of the **isy** Help where you can call up information about commands which are used, the **isy** language elements, variables and error messages (see below). You obtain a short text about the function of particular command or menu button when you click on the right hand mouse button and hold the key down.



INFO

The address of the software manufacturer.

ACTIVITY

Switch the progress display in or out.

SYSINFO

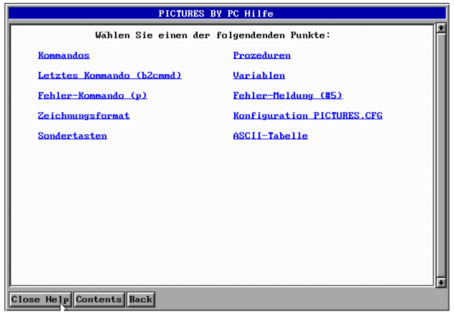
Retrieves system information: the serial number … installed hardware, etc.

MENUECHO

Suppress or show command messages.

HELP

Suppress or show command messages.



VAL

Pocket calculator-..alternatively you can also write:
VAL <formula>

COMMLOAD

COMMSAVE

Load a stack of commands out of a file or save them into a file.

Module

The modular construction of **isy** offers the advantage that the user is always working in the same part of the program which he chose to use. One can switch between modules at any time without losing drawings.

STEP 1

isy step by step – Stage 1 is suitable for CAD beginners and when the program is used in schools. The menu blocks contain very few commands. The menu depth was reduced by removing as many fly-out menus as possible.

STEP 2

isy step by step – Stage 2 is suitable for experienced students and advanced courses during training. The commands which are available are sufficient for the majority of standard design tasks.

STEP 3

isy step by step – Stage 3 is designed for the professional use of **isy,** working in combination with modelling packages. The 2D/3D sub-menus from **isy** were not changed.

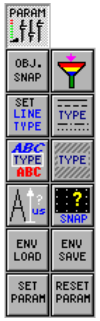
CAM

Switching the program over to CAM

SCAN

Switching the program over to scanning and vectoring

Parameter

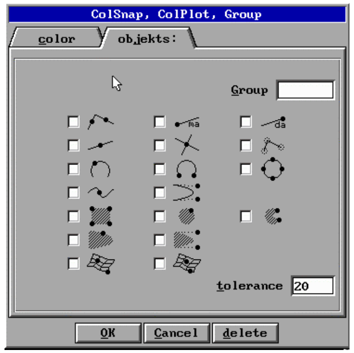


Parameter is used to establish the appearance of the lines, hatching, text, dimensioning or the optical lattice. Parameters are variable. The adjustment of the values does not present a problem since their effect can be seen by the user.

Further parameters which are not quite so easily grasped are the values for object snapping, colour snapping, colour filter, capture tolerance, zoom, duplication, perspective, drawing buffer, layer, etc. A change in these settings is shown by **isy** on the corresponding buttons and displays on the toolbar.

All parameters are set to standard values at the start of the program. System parameters can be changed permanently by using INSTALL before the program is started

GROUPS – object capture (snap)



Establishing the object group for the element-/object snapping
Adjustment of the snapping tolerance

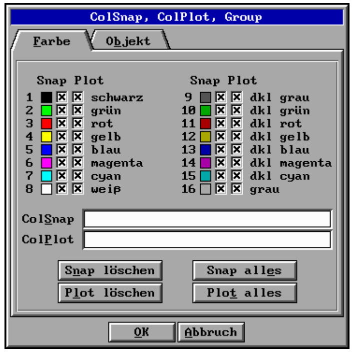
Here one establishes which elements or groups of elements are effected by the object snapping. If, for example, the symbol for corners (da) has a cross next to it, then during the generation of an object the crosshair will snap exclusively and with great precision on the corners of the polygon. This is particularly useful when a point has to be placed exactly between two existing elements and the crosshair would click into place onto one of them, which, in this case, would be an undesirable result.

① Click on the desired element group(s)

② Leave the pop-up menus with a mouse click (L) on „OK“

The group-settings can be combined in any way one desires. Existing settings can be reset with “DELETE”.

Turning the colour filter, colour snapping on and off



A graphic pop-up menu allows you to limit the object snapping **ColSnap** to elements with a particular colour or colours. This is particularly useful when other selection methods fail (e.g. when overlapping elements) or when you want to delete just the objects of a particular colour from a whole drawing. Activate (or deactivate) the individual colours by clicking on the corresponding check box. **ColSnap** can also be combined with the other parameters of the object snapping.

ColPLot allows you to define which colours should be visible on the screen.
The default condition for both cases is that all colours are activated.

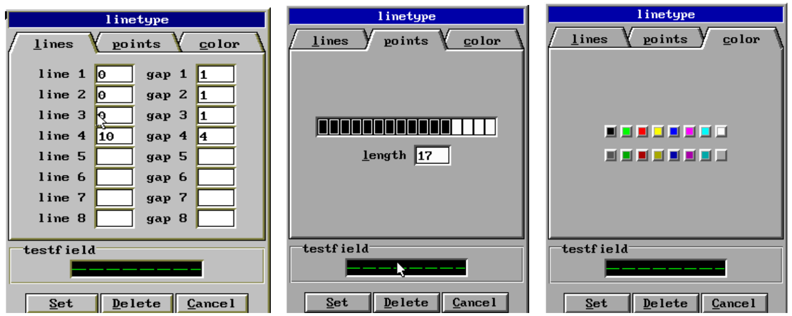
Setting new line types individually using menu

NUMERICAL

You have the possibility to define certain line types when the standard lines do no suffice for your design,

① Click on the input field

② Confirm the inputted value with 



EXAMPLE:

The line parameters **8,1,0.1,1,0.1,1** are entered for a dashed double dotted line, the input is achieved using GDU’s.

BE CAREFUL WHEN ENTERING DATA!

The **comma** just separates the individual part parameters.
The **decimal point** separates off the real numbers after the comma, whereby the leading zeros can be left out. **Spaces** are not allowed.

LINE TYPE

Set a new standard line type using menus.
The pop-up menu **LINETYPE** is reached using the pulldown menu “Parameter” and the border bars (for the 800 and 1024 resolutions).
Here you set the following line parameters:

LINIENART	AUTOCOL	EINTEILUNG
Broad full line	white	
Narrow full line	green	
Dashed line	red	5,2
Narrow dashed single dotted line	red	10,1.5,.1,1.5
Broad dashed single dotted line	white	5,1.5,.1,1.5
Dashed double dotted line	red	10,1,.1,1,.1,1
Dotted line	yellow	0.05,1.95

A MOUSE CLICK (L) on one of the seven possible standard lines sets the variable LINETYPE to the appropriate value, which means that all further objects will now be drawn with this line type. The commands can also work with multiple selection, as required, which makes it possible to make rapid changes even with large drawings.

A mouse click (L) - while the CTRL key is being held down - changes the line type for the **active**

object immediately to the line type which has been selected

Alt A mouse click (L) - while the ALT key is being held down - on a field calls up the crosshair and you can then selectably transfer the line type format onto **a number of objects** at once.

The size of the intermediate spaces between dash dot lines and dotted lines is fixed and can be shown in the INFO line. The intermediate spaces remain unchanged also when objects are being scaled up or down (increasing size, decreasing size).

ADJ – fit in line

This command creates dotted lines, dashed lines and dash dot lines which have a clear break-off point.

SCALE – scale the line division

Entering a scaling factor allows the same type of line in a (macro object) or the whole drawing be changed very rapidly. This is particularly useful when line types have to be adjusted to get a good print-out.

① *Select the object*

② *Faktor:*

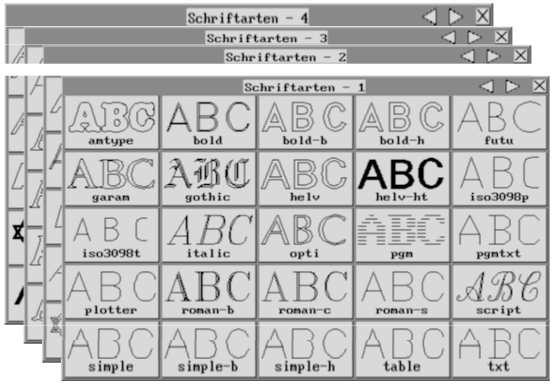
Enter the factor by which the part elements of the lines should be increased or decreased in size.The position and the dimensions of the selected objects remains unchanged!

Proportional change to the line division

AUTOCOL – automatically allocate line colours

The option AUTOCOL should be activated when only standard lines are being used. **isy** step by step organises the allocation of colour automatically when a change in the line type is made.

Selecting FONTS



A **MOUSE CLICK** (L) on one of the 4 x 25 possible typeface fonts sets the variable TXTSPEC to the corresponding standard value

SAVE TIME:

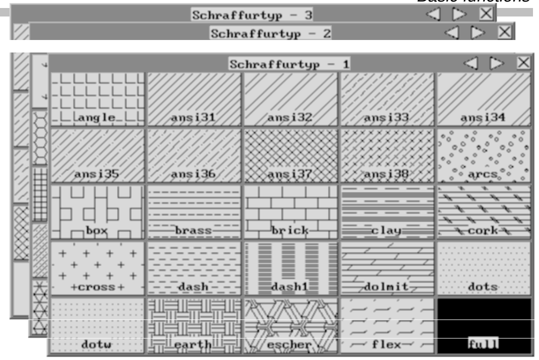
Ctrl A mouse click (L), as one is also holding down CTRL key, changes the typeface font for the active text object immediately to the font which has been selected.

Alt A mouse click (L), as one is also holding down the ALT key, on a field calls up the crosshair and you can then selectably transfer the line type format onto **a number of objects** all at once.

TEXTSIZE

Adjusting the font size in user units (e.g. in mm)

Set the HATCH TYPE



A **MOUSE CLICK** (L) on the required hatching type sets the variable HATCH1 to the corresponding standard value. All hatching types listed below can be executed in the pattern selected.

SAVE TIME:

Ctrl A mouse click (L), as one is also holding down the CTRL key, changes the hatching for the **active hatching object immediately** to the font which has been selected..

Alt A mouse click (L), as one is also holding down the ALT key, on a hatching field calls up the crosshair and you can then selectably change the hatching type on **a number of hatching objects** all at once.

SNAP

Set the continuous lattice grating (variables GRID, SNAP)

The **optical lattice** (GRID) marks the lattice points of the snap grid and is comparable to the squares on the pages of a school exercise book. It is simply a drawing aid. Do not choose the separation between lines too tightly since otherwise the optical lattice is no longer visible. Too many grid points also reduce the speed of the system since the grid points have to be redrawn every time the screen re-assembles again. The grid points are not visible on the print-out.

The snap grid (SNAP) ensures that the position points are placed on the screen exactly at a pre-set distance from each other. The spacing of the snap grid generally corresponds to that of the optical grid but intermediate values can also be entered for the snap grid (e.g. GRID=10, SNAP=5). This is meaningful when the number of grid points is hindering the work.

> The optical lattice (GRID) is visible - the snap grid (SNAP) is not visible!.
>
> Entering a grid spacing also sets snap grid to the same value.

Pressing the button SNAP in the main menu causes the following system message to appear in the command line:

① *Enter the horizontal grid spacing (z.B. 20):* 10 ↵

② *Enter the vertical grid spacing <10>:* ↵

A quadratic point grid appears on the screen.

A mouse click on the button “SNP” (see below in the section “buttons”) will cause the grid to be **hidden** and to be again **unhidden** with the default values shown above.

ESAVE

ELOAD

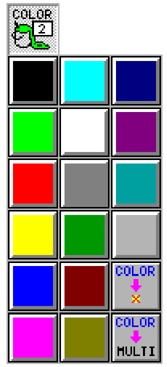
Save parameters (variables) in a file or load them from a file.

SET PARAM Set the value of parameters and variables using the dialogue menus

RESET PARAM Reset the value of parameters and variables to standard values

COLOUR

isy can operate with up to 32 screen colours. The colour numbers 17 to 32 correspond to the colour numbers 1 to 16. One usually works with colours 2 to 8.



The default colour (green) when printed out results in thin lines (2 pixels). Changing the colour changes the thickness of theprinted line, assuming that the printer is capable of interpreting information in this way (e.g. PostScript printer). The higher the colour number, the thicker the printed lineinie.

A mouse click (L) on the desired colour sets the variable COLOR to the corresponding value. All objects, with the exception of the active ones, will appear in this colour until another colour change isstellt.

Farbe:1=black

Farbe:2=green

Farbe:3=red

Farbe:4=yellow

Farbe:5=blue

Farbe:6=magenta

Farbe:7=cyan blue

Farbe:8=white

Farbe:9=dark grey

Farbe:10=dark green

Farbe:11=dark red

Farbe:12=dark yellow

Farbe:13=dark blue

Farbe:14=dark magenta

Farbe:15=dark cyan blue

Farbe:16=grey

CHANGE COLOUR

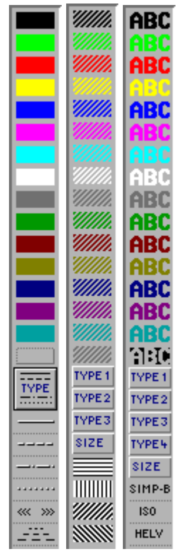
Change the colour of the active object to the current colour (COLOR)

CHANGE THE COLOUR OF MANY OBJECTS

Change the colour of a number of selected objects to the current colour (COLOR)

LINES, HATCHING, TEXT COLOUR0

The three colour menus to the right are found, for the 1024 resolution, on the left hand border of the screen and for the 800 resolution below on the right, in a slightly different arrangement. They open according to the context and are then always available. A mouse click (L) on the desired colour, as described above, sets the variable COLOR to the corresponding value.



SAVE TIME:

Ctrl

A mouse click (L) as one is also holding down the CTRL key, changes the colou of **the active object** immediately to the colour which has been selected

Alt

A mouse click (L), as one is also holding down the ALT key, on a colour field calls up the cross air and you can then selectably change the colour of a number of **objects**.

Switch

In this part menu of the toolbar it is possible to switch important global parameters (“Flags”) on or off, that is settings which, as far as possible, will effect all subsequent processes. A wrong setting can have fatal consequences:

EXAMPLE:

If a single line is drawn while the setting HATCHING (On) and BORDER (Off) is active, it is not visible even though it exists in the drawing memory buffer, since at least three surface points must be present for hatching to be visible.

HATCHING/BORDER CURVES

HATCHING

ON All surface elements are immediately shown hatched. The border flag is immediately switched off when hatching is switched to on, and a hatched surface appears instead of a surface with a border around it. It is possible to give the hatching a border if required by using the additional option “BORDER”.

OFF The default setting

BORDER

ON The default setting

OFF The hatching surfaces will be shown without border

THE USER CO-ORDINATES DISPLAY/HATCHING FILTER

HATCHING VISIBLE

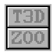
It can take some time to re-construct the image on the screen when drawings have complex hatching surfaces. This button hides all hatching for as long as you want to.

ELEMENT SNAPPING/Capture TOLERANCE

ELEMENT SNAPPING

ON The crosshair snaps onto the elements or elements which have been set up in “GLOBAL”

OFF The crosshair only snaps onto the capture grid. When there is no grid set, all grid functions are switched Off. The snapping functions of the majority of commands which have their own, pre-set, object groups for the object snapping (e.g. the elastic line), are also de-activated by this setting.



2.5D-MATRIX / ZOOM INDICATOR OR ZOOM FACTOR

2.5D-MATRIX

ON All newly created objects which have been generated with the 2D commands can be presented in three
dimensions. In this mode, lines, surfaces or text can, by clicking on the button, be seen in perspective 3D mode (3D main menus), rotated (VIEW ROTATE) and handled like a 3D object.

OFF The default condition.

DUPLICATING/CO-ORDINATE SNAPPING

DUPLICATING

ON The original object remains unchanged when form or length changes are made.

OFF The default condition.

CO-ORDINATE SNAPPING

ON The optical lattice / snap grid is active

The default value is usually the same as that for the snap grid but a somewhat larger grid spacing can contribute to a significant acceleration in the re-construction of the image.

OFF The optical lattice / snap grid are not active (default value)

Values which have onetime have been set are stored and do not need to be entered again each time the computer is switched on.

COLOUR SNAPPING/COLOUR FILTER

BUFFER / LAYER

BUFFER

1: Pre—set value
Only two buffers (drawing sides) are available for drawing

2: When Buffer 2: is activated the drawing remains in buffer 1: and vice versa.

LAYER

The arrow leads to the pop-up menu “LAYER” (Keyboard input: LY). The number in the brackets refers to the active layer. **isy** offers up to 1,000 layers! These are required with very complex drawings to allow working at various image levels. This also allows elements of the drawing such as dimensioning to be hidden.

COPY *→2:

The active object will be copied from the active drawings buffer to an alternative second drawings buffer.
The active object can be further processed there or inserted into an existing drawing.
The button title changes automatically to **COPY *->1:** when you are buffer 2.

VIEW

The menu point View allows 3D objects to be viewed in various projections:
Orthogonal (view from the front, top view, view from the side), diametric and isometric projections, military perspective, central perspective.
The point being viewed from and the viewing angle are variable.
All perspectives can be shown with or without concealed edges. The colouring of 3D objects is possible using the shading function, can be stored as TIFF files and can thus be further read and processed by other programs.

> Only the point being viewed from is changed for the various 3D viewing modes - the geometric data remain intact.

X-Z-VIEW – View from the front

X-Y-VIEW – Top view

Y-Z-VIEW – Side view from the left

The format sensitive presentation of 3D objects in a right-angled parallel projection according to DIN 6 / Projection method 1
An axial cross (at the bottom right of the drawing area) shows the position of the 3D axis in the three dimensional space. The symbol for the drawing area lies at the source when the point in the selected image section is visible. It is only shown as a line in the VA and SA modes.zeigt.

DIAMETRY – 7°/42°

ISOMETRY – 30°/30°

MILITARY PERSPECTIVE – 45°/45°

The presentation of 3D objects in an isometric or diametric projection according to DIN 5, as well as according to the military perspective.
The parallel lines of a model in the parallel perspective also remain parallel in the three dimensional presentation which makes this particularly suitable for technical presentations. Double indications can occur in the isometric projection mode (30/30) because of overlapping.

TIP:

> A 3D workpiece can be converted from the parallel perspective to 2D and can then be further processed using the 2D commands and be used as a dimensionally stable three dimensional image as an addition to a 2D projection drawing.

ALL FOUR VIEWS-ALL

A change button for the setting or hiding of three additional screen windows. The three windows correspond in their arrangement to the views obtained in the three board projection according to DIN 6. **All** drawing objects are format sensitive and proportionally presented for the time being.

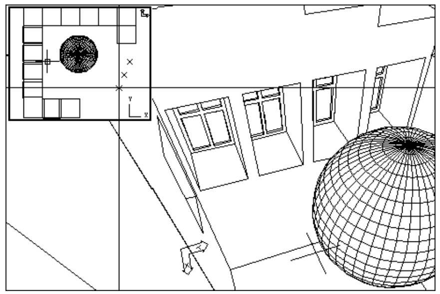
Two windows can also be chosen to present the same view or parallel perspective (for example, to compare line and volume models), or the concealed edges can be hidden. All screen editing functions (point selection, zoom, ..) can be used separately for each window. It is also possible to create line connections between points in the various windows.

ALL FOUR VIEWS-KEY

Generate or hide the additional three screen windows.
The three windows correspond in their arrangement to the views obtained in the three board projection according to DIN 6. The **active** drawing object is format sensitive and proportionally presented for the time being.
Select the following options using the keyboard.

↑ ↓	+ / – Zoom
V	hide the concealed edges in all windows
S	shading in the fourth window
E or Esc	exit the procedure
4	switch off the All Four Views mode

CENTRAL PERSPECTIVE



The central ,perspective is our most natural way of looking at a drawing. Here the lines which run into the depth of the drawing, parallel to our viewing direction join at the vanishing point. An illustration in this perspective is shown in the form of a photograph. The process of taking a photograph is also similar to the following necessary work steps:

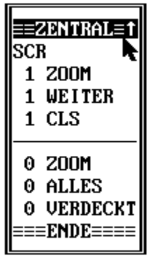
- A help window appears at first in the upper left screen corner after clicking the command (SCREEN 1) and the system requests:

① IN THE HELP WINDOW: Select the viewing point Click in the help window on the part of the drawing which you want to view

② Height of the viewing point above the drawing object <0>:
The height of the viewing point above the drawing object together with the height of the eye point governs the “camera inclination”. Making sure the two values are the same avoids abruptly falling

- The viewing point is marked virtually by a violet marking cross.The maximum is 179.99°

③ Eye angle <90>:Here you select the „objective“-the default value is 90° (which corresponds in small image format to a 24mm wide angle objective)



④ Eye height <500>:
The eye height depends on the size of the drawing object. An eye height of 600 allows you to look at the above example with a bird's eye view

⑤ IN THE HELP WINDOW: Select the eye point
Select your viewing location with the crosshair – it is marked in the help window in green.

Step 5 can be repeated as often as necessary

Exit: <ML> Border menu or Polyend <F6>

The selection menu to the right can be obtained with a mouse click (R) whereby the commands above relate to the help window (SCREEN 1) and the commands below relate to the drawing area (SCREEN 0).

VIEW ROTATE-DYNAMICALLY

Rotate the view around a co-ordinate axis.
Dynamic rotation of the 3D view around the x, y, z axes (keyboard)

Esc Exit the procedure

VIEW ROTATE-WITH THE CURSOR

Dynamic rotation of a 3D view increases the three dimensional presentation, like looking at a real object from all sides. The geometric data of the drawing are not changed. The procedure functions in every perspective.The menu VIEW ROTATE offers the choice between the active rotation of a 3D view using the cursor keys or the automatic rotation around one of the three co-ordinate axes (DYNAMIC). The rotation angle in each case can be changed as required.
Select the rotation axis and the direction of rotation using the keyboard

← →	+ / – rotation around the X-axis
↑ ↓	+ / – rotation around the Y-axis
Page Up Page Down	+ / – rotation around the Z-axis
V	hide the concealed edges
S	shading
E oder Esc	exit the procedure
Esc	exit the procedure

HIDE

Hide concealed edges. Edges on three dimensional objects and the facets of a line model can, with the increasing complexity of a design, lead to a confusing array of lines. Hiding concealed edges increases the three dimensional impression. The improved overview of the three dimensional structure obtained in this way is more in tune with our perception of reality than the line model.

Once the calculation finishes, the information line contains details of the number of surfaces (F) and lines (L) which have been included.

VIEWING-PLANE

The 2.5D level and the view of a level which is vertical to a co-ordinate axis.

VIEW-3P

The 2.5D level and the view by selecting three points

VIEW-2.5

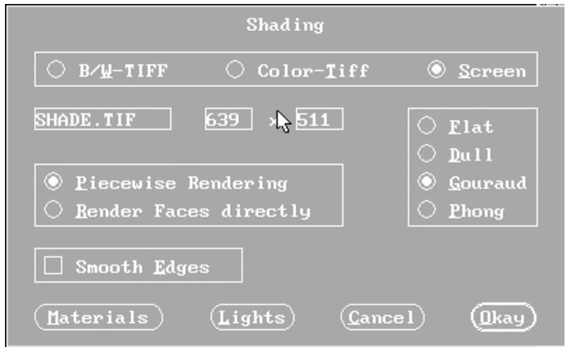
The 2.5D level and the view of a 2.5D object

SHADING

Modelling of the drawing using light and shade leads to an even greater three dimensional impression. **isy** makes it possible to create shadows on components and objects by simulating illumination in 3D views by a maximum of 8 fictional light sources. Depending on the resolution of the selected output device it is possible to obtain a range of presentations reaching from a quick visualisation on the screen through to a high quality presentation which is as realistic as a photograph, as a coloured TIFF file with more than 16 million colour shadings. The images generated in this way can be exported directly to a DTP or word processing software.

The following parameters can be set using the pop-up menus:

- Colour, intensity and position of the light source
- Colour, level of gloss and brightness of the object (materials)
- Size of the Tiff files and the screen section involved



Select the option **Screen** (default) in the main shading menu when you want to see the shaded object immediately. Clicking B/W - Tiff or Colour-Tiff stores your 3D design as a file called SHADE.TIF in the current directory, whereby the resolution can be adjusted (Default is 639 x 511).

Example files for the adjustment of the shading parameter:
load shtest1, shtest2 (see diagram above) or shtest3

The parameter adjustment is not required in an active ALL FOUR VIEWS**.** The pixel graphic which is generated fills the lower right quarter of the drawing area. The presentation of the three further views remains unchanged as a result.

SHADING – FULL SCREEN

Coloured shading of the 3D view which is set without parameter setting.
The pixel graphic which is generated fills the whole of the screen

SHADING – standard values

Resetting the shading parameter back to the default value
Your own values will be deleted when you confirm the system request !

VLOAD

VSAVE

Activating View Save or View Load

NOAXIS

Hide the axis markings

DV SCRN

DV COSCRN

Change the screen viewing mode
DV SCRN higher resolution / less colours
DV COSCRN lower resolution / fewer colours

CLS

Re-construct the screen - Clear Screen

Zooming

The difference between working with CAD programs and traditional technical drawing is that the draughtsman only works in a visually restricted part of the whole drawing. This limited general overview is one disadvantage of CAD. If the whole drawing were to be shown on the screen a DIN A0 drawing is often smaller than a DIN A4 sheet (14” monitor) and details can no longer be recognised. The drawing sheet can, however, be as big as one likes. This is achieved by using the function ZOOM which offers a blow-up of any section of the drawing one wishes. Correct operation of the ZOOM function is a pre-requisite for precise draughtmanship

> ZOOMING is simply a help function for drawing and does not change the geometric data of the drawing.

WINDOW ZOOM/MENU ZOOM

Increases the size of the window section
The required size of the new windows section is requested using the messages

① *Select the first corner of the ZOOM section*
and
② *Select the second corner of the ZOOM section*

The relative size of the sides of the object remains constant

③ Exit ZOOM: Border menu or Polyend F6

ZOOM EVERYTHING – ZALL

Blows up the drawing to the full screen format.
It is possible to calculate the object boxes anew with the command “BOX ALL” (menu 4 or 5) if not all objects are required to be visible after this command.

LAST ZOOM-SECTION

Zooms back to the last screen section or the one before last.
In this way it is possible to call up the last 10 screen sections set. When working on complex drawings it is possible to use “ZOOM BACK” to work in just a section of it. This also offers the advantage that the waiting time for the screen to re-assemble (e.g. as for CLS) is reduced.

2 POINT-PAN

Shift the zoomed section by moving 2 points.
The zoom factor does not change. The existing zoom window is moved across the drawing paper using two selection points like a magnifying glass. This can be very useful when working with very complex drawings.

ZOOM CLOSER – by a factor 0.5

A zoom factor of 0.5 corresponds to doubling the size of the image.

ZOOM FURTHER AWAY – by a factor of 2

A zoom factor of 2 corresponds to halving the size of the image.

MOVE UPWARDS

MOVE DOWNWARDS

MOVE TO THE LEFT

MOVE TO THE RIGHT

Shift the zoomed section in a specific direction

STANDARD – ZOOM=

The zoomed section will be reset to 0,0..639,511. This corresponds to a zoom factor of 1.
The same effect can be obtained when, on calling up the window zoom, you click on the text menu instead of opening a window.

MAXIMISE THE OBJECT

Zoom onto the active object - the active object will be shown in a format sensitive manner.

ZOOM FACTOR

The zoom factor shows how much the screen section has been blown up (or reduced in size) compared to a standard section .

BOX ALL

Calculate all of the object dimensions anew (BOX)
It is possible, if you forget to call up this command after scaling, that some scaled objects can no longer be selected because their object box still has its old co-ordinates.

SELECTING

Most commands concerning the manipulation of objects relate to the currently active object

> Active always refers to the last generated or processed object.

Another object must first be selected when it becomes necessary to activate it do do further work on it. **isy** offers a range of possibilities for selecting and activating drawing elements. The most important selection commands are immediately available in the **isy** step by step-Toolbar.

SELECT– Standard / **MENU SELECT**

Select and activate an object

① *Select and object*

Select one of the object points with the crosshair and click on the mouse (L). The activated object will be shown in special colour and the name of the object appears in the information line. The co-ordinates indicator can be set to (0,0) during this selection process by pressing Function Key F3 (measurement of sections of a line)

WITH THE CROSSHAIR – standard (see above)

MACRO – activate an enveloped object

If the active object is part of a higher macro-object, this command will activate the macro-object, mark it in colour on the screen and its name will appear. This command can be repeated to bring up multiply nested macro-objects.

The macro-name in<>can be confirmed by pressing the key.
The activated macro will then be highlighted for a while in the selected colour.

ALTERNATIVE

The selection of identical objects which lie on top of each other.
It sometimes occurs that identical objects lie on top of each other. Normal selection would only find the first object of its kind which was generated. The button “Alternative” allows the selection of the objects which lie over it.

IN THE WINDOW

The rectangular window cursor must envelope the middle point of the box around the object which is to be selected.

① *Select the first corner of the selection window*

② *Select the second corner of the selection window*

ACTOBJ=1:Name

HATCHING – select the hatching border point

This is used to activate hatching within polygons or polygon lines by clicking the crosshair on the corner point of the required hatching.

LIST

Selection from a name list (out of the menu)

NAME

Selection by entering the name of a known object using the keyboard
One is also allowed to use the names of macro objects.

① *Enter the name of the object:*

ACTOBJ=1:Name

EVERYTHING

Select all of the objects which exist in the active drawings memory buffer

SHOW*

Highlight the active object with a special colour.

ACTOBJ=1:Name

MARKING – of the active objects

Show **INFORMATION ABOUT ELEMENTS** for the active object

CMA

The selected object will be alternately coloured green or red (at every ma command)

DELETING

DELETION in a CAD system requires a number of steps which differ in the range of object effected and the effect. The scale ranges from deleting a singe element, similar to the effect of using an eraser, through to the irrevocable deletion of a complete drawing.

WITH SELECTION

Click to **On** to delete the selected object

ACTIVE OBJECT – DEL * (DELete))

DEL* deletes the active object (*) irrevocably both from the screen and from the memory.

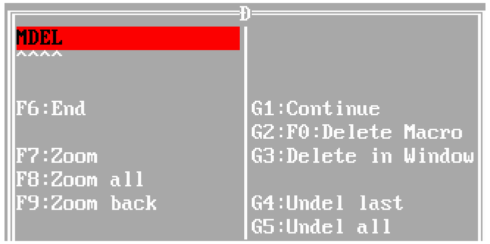
HATCHING

This is used exclusively to delete hatching. Please note that the hatching border must be clicked all of the time during the selection procedure

MULTIPLE DELETION – (MultiDEL)

Deletes one or a number of objects by selecting it/them with the crosshair when requested
Select the 1.object
Select the 2.object
Select the 3.object...
or delete while in the window.

The right hand mouse button activates a pop-up menu, in which various options can be selected.



`Zoom, Everything, Zoom back`
Change the section on the screen

`Not the last one / All not`
The deletion of the objects is not final.
When running procedure MDEL , the latest or all of the deletions can be undone.

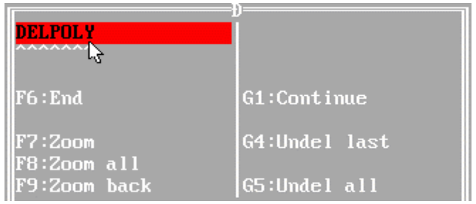
The Function Key <F10> deletes the macro envelope of the last deleted object with all of the other part objects contained therein.

`Exit`
Exiting MDEL and deleting the objects irrevocably.

PART POLYGON – DELPOLY

Deletes one or more part polygons out of a single object (up to the split-point)
This command does not delete the whole object, unlike MDEL. The procedure confines itself to polygon lines which are connected together or parts of polygons. The polygons which have been selected with the crosshair will only finally be deleted when the procedure is completed over the pop-up menu using POLY-END. All polygons have now been lost, irrevocably!

The right hand mouse button activates the pop-up menu in which various options can be selected.



Everything, Zoom back

Change the section on the screen

Not the last one / All not

The deletion of the objects is not final. When running procedure DELPOLY , the latest or all of the deletions can be undone.

Exit

Exiting MDEL and deleting the polygons irrevocably.

SCREEN4-WINDOW

Activation of the option “4-VIEW” in the 3D menu allows a three dimensional object to be shown according to the three boards system. **SCREEN4 - WINDOW** allows a reduction in the number of the additional three windows which have been introduced.

① *Enter the number of the window 1,2 oder <3>:*
3 (page view) is the default value

Window n will be hidden

1 ELEMENT

Deletes individual elements out of a polygon line or an arc (polylines, elements of circles or Beziers). Elements which have one time been deleted are lost forever.

① *Select the first element*
Select the first element
Select the first element...

Exit: Border menu or Polyend F6

NEW

Deletes the current memory buffer - a new drawing

N-DEL

Delete the objects in a group by entering the number area.

NEW IMAGE – CLS (CLear Screen)

CLS rebuilds the image on the screen and cleans it up. This can become a necessity when the overview is becoming unclear due to the presence of many marking symbols or incomplete objects.

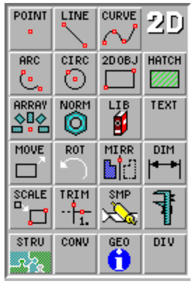
CLEAR

Delete a data area in a SHEET

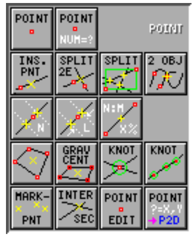
Data and standard values which are being stored on an intermediate basis in the sheet can be lost in this way. **isy** step by step stores data for 2D and 3 D objects in the sheet - the values must be entered again if the range they are stored in is deleted.

CHAPTER 4

The 2D Menu Area



The 2D POINT



A single point is registered internally in **isy** by the command ma (move absolute) e.g.

ma 100,100.

It is necessary to have two internal commands in order to make this point visible, namely ma 100,000 and da 100,100 (draw absolute)

PNT

Draw a point using the crosshair - select the point position

① *Select a point*

Positioning with the crosshair sets a visible point and the point co-ordinates which are so determined are stored in the variable **p2d** and then outputted.

p2d= x, y

PNT-NUM

A numerical 2D point entry (X,Y) - the point co-ordinates are absolute co-ordinates

① *Enter 2D co-ordinates (x,y): <x,y>*

The value with in <> is a default value which can be accepted with

> Inserted intersection points cannot be seen at first!
>
> Check with  „MARK POINT“

INTERSECTION POINT – manual

Insert an additional intermediate point (ma) in an element (at the second selection point)

① *Select an object*

② *Select the first element*

INSERT INTERSECTION POINTS – in 2 elements

Split (separate) two crossing elements = insert additional points (ma’s) at the standard points

① *Select the first element*

② *Select the second element . . .*

SPLIT IN THE WINDOW

Split (separate) crossing elements in the window

INSERT INTERSECTION Points – in 2 objects

The command splits (separates) two objects which cross over each other at the crossing point. The splitting is a preparation for a change of form. There are three steps which must be taken for each separating point (ma):

① *Select the first object*

② *Select the second object*

③ *Select the intersection points . . .*

The marking cross springs to the inserted intersection point.

If you want to convert the final object into a part object select the command HK-OBJ „GENERATE AN OBJECT“ in the menu STRU „OBJECT STRUCTURE“.

SPLITTING A SECTION OF LINE – according to number

① *Do you want to work on a single element (e) or a complete object <o>?*

② *Select an object*

Show the active object and the points contained in it

③ Enter the number of the part sections <2>

A section of the active object which is to be selected (or all sections) will be split into n identical part sections (the default value being 2)

Show the calculated part point(s)

PART-L

Sub-dividing a section of line into a (maximum) number of segment lengths

SECTION

The sub-division of a plotted section of line

PNT-CENT

The middle point - the arithmetic middle of a number of points

PNT-GRAV

The centre point of closed contours (more than 3 points)

MODAL POINT – at a point of intersection

NODAL POINT – along a line

The nodal point on the point of intersection of two straight lines or at some freely selectable point on a straight line. It marks the point of intersection of two straight lines or the corner points of a polygon with a circle, rhombus or a rectangle. This routine can be used, for example, for the manufacture of photographic templates for integrated circuit boards (the soldering points).

① *Enter the type of symbol: Circle, rhombus or rectangle (1,2 or 3): <1>*

② *Enter the radius: <5>*

③ *Select the point or the point of intersection*

Exit: Border menu or Polyend F6

MARK THE POINTS

The points (ma, da) on the object which is to be selected are marked with the crosshair. This is a means by which the intermediate points on the objects can also be localised.

PNT-INT

Generate a point of intersection - a point on a crossing point

PNT-EDIT

Edit a point position

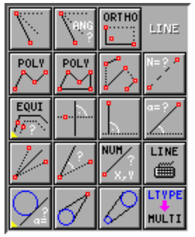
P2D

Determine the co-ordinates of a point:

① Select a point. The point co-ordinates will be saved

pcl: p2d=x, y
where by x,y are the drawing co-ordinates which have been determined for the selected point. These co-ordinates will be saved and inserted as standard default value for various procedures (e.g. shifting the absolute position).

The 2D Line



In **isy** two commands are required to produce **a single line** (1 element):
ma (move absolut) = the beginning point and
da (draw absolut) = the end point
A **polygon** line consists of a number of elements (one “ma”, many “da”’s)

RUBBER LINE

A line in the matrix with the effect of a rubber band
Using the rubber line, every drawn part element of a polygon line is immediately visible. The last element can be freely positioned and is stretchable. The rubber band effect makes it easier to build up complex outlines step by step. The individual part elements which are grouped together create a single object. The function key <F10> allows one to withdraw point data during the current procedure.

① *Select the first point*

Exit: Border menu Polyend F6

RUBBER LINE – making an angle within the snap grid

Draw a rubber line making an angle within the snap grid.

① *Enter the angle to be made within the snap grid*:

② *Select the first point*

The stretchable rubber line snaps at an angle which is a multiple of the angle entered. The last element can be positioned freely and is stretchable.

> To avoid snapping onto other objects, either switch off the object snapping in the GLOBAL menu or restrict the snapping possibilities in the GROUPS menu (*better!*).

A SNAP LINE – orthogonal

A line parallel to the axis (with multiple functions)
This snap line creates connections between lines which are parallel to the axis and thus, when used properly, generates lines which are only horizontal or vertical which snap automatically onto other elements.

① *Select the first point*
➔ automatic object snapping onto the existing element

② *Select the second point*
The second point which is needed to generate a horizontal or vertical line is just positioned roughly and snaps onto the next appropriate element.

③ The system response appears again.

Select the second point

You can now finish the procedure with a double-click (L) in the text menu or enter further points. The endpoint of the line so generated is then always the starting point of the next one.

④ The next snap line can be generated from a new starting point after making amouse click (L) on he border menu or Polyend <F6>. Every line is a separate object!

POLYGON – open, standard lines

Polygon line connections
The polygon or the polygon line of a chain of straight lines connected together, which together create an object. The endpoint of an element is the beginning point of the next element.

① *Select the nth. point*
n stands for the number of points. The selected points are shown by the highlighting.
The polygon itself is only drawn when the last point has been selected.

Exit: Border menu or Polyend F6

The selected points will now be joined together by straight lines.

POLYGON – closed

A closed polygon line connection (with a minimum of 3 points)
The description is the same as above for the open polygon.

① Select the nth. point

Exit: Border menu or Polyend F6

BROKEN UP POLYGON

A broken up polygon (straight lines, openings, straight lines, etc.) .

① *Select the nth. Point*
The number of the polygon points must be divisible by 2.

Exit: Border menu or Polyend F6

The points 1-2, 3-4, 5-6, . . . get connected through lines.

BROKEN LINES

Regularly broken 2 point lines.
The number of intervals will be requested by the system.

EQUIDISTANT – parallele to a polygon

Numerically equidistant (splitting on branches is necessary)

① *Spacing:*
Enter the spacing between the equidistant lines from the polygon

② *Select an element*
Any of the elements can be selected out of any of the polygons which are resident in the memory puffer.

③ *Select spacing/position*
Here you can now determine on which side of the original polygon the equidistant lines should be.

④ *Select element*
Select further elements or exit the procedure

Exit: Border menu or Polyend F6

MIDDLE VERTICAL LINE

A middle line vertical to a straight line

① *Select the straight line:*
The length of the middle vertical line is the same as that of the straight line

PERPENDICULAR LINE

A line perpendicular to a straight line

① *Select the straight line*:

② *Select a point* - from which the perpendicular will project downwards.

SLOPING STRAIGHT LINE

A sloping straight line from a point on a straight line.

A LINE WHICH HALVES AN ANGLE

Length through the plotted point

① *Select the vertex:*

② *Select the first arm*
The distance from the vertex to the selection point corresponds to the length of the line which is halving the angle.

③ *Select the second arm.*

ANGLE

Design an angle (arm length through the plotted point)

① *Select the vertex*:

② *Select a baseline*
You should also decide here how long the arm which you want to create should be. The spacing between the plotted point and the selected point is the length of the arm.

③ *Enter the angle (relative):*
A mathematical entry !
Positive values give an angle which is in the anti-clockwise direction and negative values give an angle which is in the clockwise direction.

NUMERICAL LINE

A numerical line entry (absolute, relative, polar)

LINE

Lines (circular arcs), with numerical co-ordinate input, create drawings of lines (circular arcs) with numerical co-ordinate input (absolute, relative, polar). A small instruction window appears as shown to the right as a design support.

```
LINIE NUMERISCH
  ·ABSOLUT:
   a(x,y)
  ·RELATIV:
   r(dx,dy)
  ·POLAR:
   p(dl,α)
BEWEGUNG
  ·ABSOLUT:
   ma(x,y)
  ·RELATIV:
   mr(dx,dy)
  ·POLAR:
   mp(dl,α)
KREIS-BOGEN:
  c(dr,tangα)
NULLPKT.: o
ZURÜCK: b
PKT.NEU:<Enter>
END:e
```

① *Select the first point:*
Establish the first point manually. The crosshair snaps onto the existing object.

line: current point is ax,ay a=0.00
Whereby ax, ay are the absolute co-ordinates of the selected starting point.

② *Next point.*
According to the design required you now enter a command letter followed by co-ordinates or measurements (e.g.r 100,0, a200,200,p100,45...)

The command line should not contain any spaces !

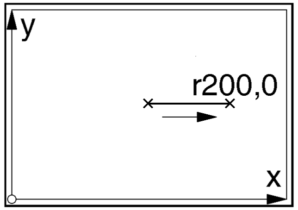
③ *Next point:* e exits the procedur.
The „e“ stands for „exit“.

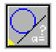
The meaning of the command letters:

ax,y	(absolute) Entering absolute co-ordinates
b	(back) delete the last line segment. The drawing begins at the old point
crx,tang	(circle) A circle (circular arc) with a radius rx and the tangential end angle tang
m	(move) Moving without drawing (only in connection with or r)
o	(origin) Select the current point to be the reference point
prx,ang	(polar) The distance rx and the angle relative the last point
rdx,dy	entering relative co-ordinates

AN EXAMPLE:

Entering relative co-ordinates.
The x- and y-axes which lie parallel to the x- and y-axes of the screen, the entry r200,0 refers to the last generated point.
Relative (and polar) co-ordinates are recalculated on entry into absolute co-ordinates.



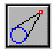


TANGENTS – with details of the angle

Tangents on a circular point with details of the angle of inclination.

① *Enter the angle of inclination:* 90º is the default value and represents a vertical tangent (to the right). Possible angles range from 0º and 360º

② *Select the ellipse (circular arc)* - polygon circles are not acceptable.

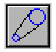


TWO TANGENTS – point / circle

Two tangents from one point on a circle.

① *Select the ellipse (circular arc):*
The selection point can be from any point on the ellipse

② *Select a point outside of the ellipse*



TWO TANGENTS – cirkle/cirkle

Two tangents on two circles.
The selection point for both objects can be at any point. The system does not differentiate between circles, circle arcs and ellipses when making tangents.

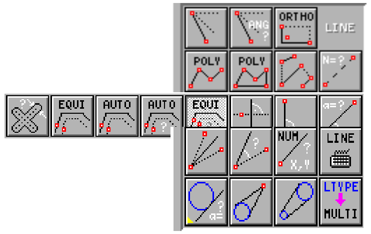
① *Select the first ellipse (circle (circular arc))*

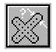
② *Select the second ellipse (circle (circular arc))*

CHGLT-M

Change lines to the current value of LINETYPE (a multiple selection is possible)

2D Lines – flyout 1





WLINES

Automatic widening of individual lines

ECONT-P

Equidistant lines, the spacing is interactive (splitting at the branches is necessary)

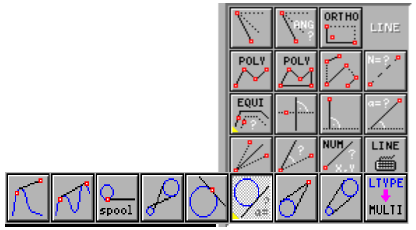
ACONT-P

Automatic equidistant lines, the spacing is interactive (no intersections are permitted)

ACONT

Automatic numerical equidistant lines (no intersections between straight lines are permitted)

2D Linie – FlyOut 2



TANGENT – point/polygon

Tangents to a smoothing polygon (approximation)

① *Select the first polypoint from all available*
The selection point lies on the polygon nearby to the tangential point. The distance from the first selection point to the second point must be greater than the length of the tangent

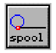
② *Select the second polypoint from all available*

TANGENT – element/element

Tangents to two elements (polygons or a circle/polygon)
One should choose the points very carefully. The tangential points must lie between the two selection points and thus the distance between the selection points should be chosen as greater than the planned length of the tangent.

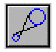
① *Select the first point from all available*

② *Select the second point from all available*



UNWINDING

The unwinding of ellipses and polygons

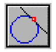


CROSSED OVER TANGENTS

Crossed over tangents to two circles.
The selection point for both objects can be at any point. When making tangents the system does not differentiate between circles, circular arcs and ellipses.

① Select the first ellipse (circle(arc))

② Select the second ellipse (circle(arc))



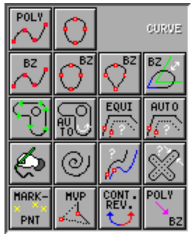
TANGENT – point on the circle

Tangents to a specific selected point on a circle

① *Select the ellipse (circle(arc))* - polygon circles or Beziers will not be accepted here

The inclination of the tangents is determined by the position of the point on the circle.

The 2D Curve



SPLINE – open

SPLINE – closed

Open/closed periodic spline arcs as a poly-line (a minimum of 3 points).
Poly-splines are approximation polygons which are generated from manually anchor selected points. The anchor points (a maximum of 50 allowed) are suitable as lattice points or points on an existing polygon. Where closed poly-splines are concerned, the beginning and endpoints come together. There is no bend at the connecting point.
Hatched surfaces can be generated with or without a border. (Switch the parameter on in GLOBAL

① *Select n. point*
Spline designs require a minimum of three points.

Exit: Border menu or Polyend F6

spl: n points

You can read in the information line how many part elements the spline is made up of.

BEZIER-SPLINE – open

BEZIER-SPLINE – closed

Open/closed period spline arcs consisting of Beziers (a minimum of 3 points).
Bezier-splines are smooth arcs and consist of a row of Bezier arcs which combine together on the marked anchor points. Hatched surfaces can also be generated.

① *Select n. points*
Spline designs require a minimum of three points.

Exit: Border menu or Polyend F6

spl: n points
You can read in the information line how anchor elements were required to construct the spline.
This also gives information about the number of part elements: (n-1):3

BEZIER-ARC – closed, 3 point

Closed spline arc consisting of Beziers (a minimum of 3 points).
The closed Bezier arc is stretched from a closed polygon with three sides, and three points must be selected for every arc section, whereby selection points 2 and 3 do not lie on the arc.

Select 3n points

① *Select the 1th. point .*
You must select at least three points. Where there are more than 3 points (..6,9,12 ..) a closed arc drawing is created with bend points at the connections to the part Bezier.

Exit: Border menu or Polyend F6

CONNECT SMOOTHLY

Rounding off freehand drawn arcs on Beziers and straight lines. Generate a smooth connection between two objects - either as a manipulated Bezier-arc or as a Bezier circle (similar to the command “Round off”, one of the trimming functions). We do not have to select the three points here.

① *Select the first object*

② *Select the second object*
If you have selected the option “Bezier-arc”, subsidiary lines appear in two colours

③ *Select a point*
Enter the position of the centre point of the connecting arc. Select a point which lies between the two subsidiary lines.

CONTOUR – manual

Manual contour tracing (or changing the direction in which it rotates) - a duplicate.
Generate closed arc drawings or hatched surfaces (also with a change of the direction in which it rotates)
The arc drawing becomes interactive, selected piece for piece. Successfully selected elements will be shown in the colour SHOWCOL and will be surrounded by a highlighting triangle.

Beginning point – with the point pointing downwards
End point – with the point pointing upwards

> A help menu (ZOOM) can be obtained by pressing the mouse button

Arc drawings which are recognised as such will be accompanied by an acoustic signal.

① *Select element*

② *Select element*

③ *Select element . . .*

Exit: Border menu or Polyend F6

CONTOUR – automatic

Automatic contour tracing - a duplicate.
The automatic generation of closed arc drawings or hatched surfaces (also with a change of the direction in which it rotates)

> A mouse click (R) calls up a selection menu

① *Select first object*
The whole object will be automatically processed.

② *Select the second object. . .*

Exit: Border menu or Polyend F6

EQUIDISTANT CONTOUR – manual

Numerical equidistant lines (splitting at the branches is necessary)
See also **CONTOUR** - manual

① *Spacing:*
Enter the desired spacing between the equidistant contours on the primary object.

② *Select element*

③ *Select Element . . .*

Exit: Border menu or Polyend F6

The beginning element is marked by two triangles

④ Select spacing/position

> Select a position of the equidistant lines near to <u>the triangle with the vertex pointing downwards</u>. The selection point should lie on the perpendicular planned through the triangle middle point on the primary object.

EQUIDISTANT CONTOUR – automatic

Automatic numerical equidistant lines (no intersections of straight lines are allowed)
See CONTOUR - automatic.

① *Spacing:*

② *Select first object*

③ *Select second object . . .*

Exit: Border menu or Polyend F6

④ *Select spacing/position*
See above !

SKETCH

Freehand drawing - hold the mouse button down
Freehand drawing with the mouse or the digitiser

A crosshair appears after a signal tone sounds

① Hold the mouse button down and draw. All you see at first is a track of points (anchor points of the polygon drawing).

100% . . .00%
You can establisch 1024 points in one pass. The system shows you the

Beenden: Randmenü oder Polyend F6

SPIRALS

Arithmetic or logarithmic spirals.
The type of spiral to be made can be set at the beginning of the procedure. The arithmetic spiral has the same distance between the windings while the distance between the windings for logarithmic spirals increases as one goes outwards, as with a snail's shell.

① *(a)rithmetic or (l)ogarithmic spiral:*

② *Select the source*

③ *Enter the starting radius* e.g. 10
This system response only appears when making a logarithmic spiral.

④ *Enter the starting angle (0..360)* e.g. B. 0

⑤ *Enter the final radius* *e.g.* 150

⑥ *Number of twirls around the centre* e.g. 4

EBAND

Numerical equidistant lines or broadening a polygon

WLINES

Automatic widening of a line on individual lines

PNT-MARK

Mark points on the object to be selected

POINT CORRECTION/BENDING BEZIER

Place the point in a new position
When you have entered false dimensions or have positioned wrongly, you do not, as a result, need to draw an object completely from new. The point shifting of individual! Polygon points also allows later correction.

① *Select an object*

② *Select a point*
To shift a point, click on it with the left mouse button, hold the key down and position the crosshair on the desired final destination. Now let the mouse button go. If the point snaps in a wrong way back into the old position it means that the target location lies too close to the original location. **A help**: Position the point at first somewhat further away from the original starting point and then bring it back to the target location.

③ The system gives the command again:
Select a point
Follow the same procedure a number of times and then finish with

Exit: Border menu or Polyend F6

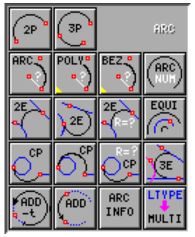
REVCO

Changing the direction of rotation of a contour

PBEZ

Change a polygon to a Bezier by entering limiting values (duplicate).

The 2D ARC



ARCS – based on 2 points

Draws arcs based on two points (the point selection is made anti-clockwise)
Generates an arc from two endpoints. The mid-point lies on the straight line which connects the selected points.

① *Select the first point*

② *Select the second point*

ARCS – based on 3 points

Draws arcs based on three points (the point selection is made anti-clockwise)
Generates an arc from three endpoints. Keep an eye on the mathematical rotation direction during design.

① *Select the first point*

② *Select the second point*

③ *Select the third point*

ARC – radius?

POLY-ARC – number of points?/radius? – Poly-menu

BEZIER ARC - radius? – Bezier-menu

① *Enter the radius:*

② *Select the central point*

③ *Select the start point*

④ *Select the end point*
The endpoint governs the angle of the arc

ARC – numerical

An arc from numerical data concerning: centre, radius and angle range

① *Enter the centre (x,y):*
Enter data in absolute co-ordinates

② *Enter the radius (rx(,ry)):*
An elliptical arc can be generated by entering different values (e.g. 100,50)

③ Enter the angle range (e.g., 0 ..270)

TANGENTAL ARCS– 2 elements

TANGENTIAL ARCS – the complementary arc

Tangential arcs / larger tangential arcs based upon two points from the first point.
A mouse click (L) generates a circular arc starting at the tangential point - anti-clockwise, and a mouse click (R) generates the complementary arc.

① Select a point on the circle

② Select a point on the second element

Keep an eye on the mathematical rotation direction when designing circular arcs (anticlockwise).

TANGENTIAL ARCS – on 2 elements/radius?

Tangential arcs on two elements with numerical input of the radius. This generates a tangential circle or circular arc on two elements (circle or straight lines). Not suitable for poly or bezier circles !

① *Radius:*

② *Select the first element from all available*

③ *Select the second element from all available*

Equidistant ARCS

Equidistant arcs and a numerical spacing (inside, outside or both)

① *Spacing:*

② *(I)nside, (o)utside or (b)oth ?*
Here one of the three possible, options must be selected to complete the process.

③ *Select a circle (arc)*

TANGENTIAL ARCS – circle/point (anti-clockwise)

TANGENTIAL ARCS – the complementary arc

Generates a tangential arc based on a circle (arc) and a freely selectable second point.

① *Select a point on the circle:*
This is the later tangential point.

② *Select an individual point*
Teh position of this point governs the proportions of the tangential arc.

TANGENTIAL ARCS – on a circle/radius?

Tangential arcs on a circle based on a point and a numerical radius

TANGENTIAL ARCS – on a 3 elements

Generates a tangential arc on three elements (circle or straight lines)

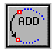
① *Select the first element from all available*

② *Select the second element from all available*

③ *Select the third element from all available*

ADDARC

Reproduction of the whole circle based on a circular arc.



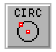
ADDARC1

Adding to a circular arc by selecting points in an anti-clockwise direction

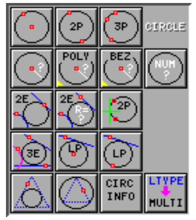
_ARCSPEC

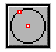
CHGLT-M

Change lines to the current value of LINETYPE (multiple selection possible)



The 2D Circle



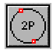


ARC-R

The quickest way of drawing a circle.
If the two points are already defined by existing polypoints, a snap grid should be set up to obtain exact shapes.

① *Select the centre of the circle*

② *Select a point on the edge (circumference)*
The distance from the point on the circumference to the centre is a means, by this method, of set ting the radius of the circle.

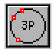


CIRCLE – defined by 2 points

Generates a circle (or arc) based upon 2 points on the circumference. The midpoint of the circle lies on the straight line connecting the two points

① *Select the first point*

② *Select the second point*



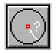
CIRCLE – defined by 3 points

Generates a circle based upon 3 points on the circumference. Keep an eye on the mathematical rotation direction when designing circular arcs (clockwise or anti-clockwise).

① *Select the first point*

② *Select the second point*

③ *Select the third point*



CIRCLE – radius?

POLY-CIRCLE – number of points/radius? - Poly-menu

BEZIER-CIRKLE – radius? – Bezier-menu

Create a circle with a numerically inputted radius at the point where the centre is placed

① *Enter the radius:*

② *Select the centre point:*

CIRCLE – numerical

Draw a circle by entering the middle point and the radius

① *Enter the centre co-ordinates (x,y):*
The entry should be in absolute co-ordinates

② *Enter the radius (rx(,ry)):*
Entering two different valuse (e.g. 100,50) generates an ellipse.

TANGENTIAL CIRCLE – circle/point

Generates a tangential circle on two elements from the first point

NOT FOR POLY- OR BEZIER CIRCLES !

① *Select the first element from all available*
This is the later tangential point

② *Select the second element from all available*

CT2E-R

A tangential circle to two points involving a numerical input for the radius

RBC

A 2 point circle with rubber band drawing

TANGENTIAL CIRCLE – on 3 elements

Generates a tangential circle or a circular arc on three elements (circle or straight line)

① *Select the first element of all available*

② *Select the second element of all available*

③ *Select the third element of all available*

TANGENTIAL CIRCLE – line/centre

TANGENTIAL CIRCLE – line/vertex point

A tangential circle to a straight line by choosing the centre-point of the circle and the vertex point of the circle. That which is decisive for the later position and size of the tangential circle is the second mouse click, which establishes either the centre-point or the vertex point. The tangential point lies at the nadir of the perpendicular through this point on the straight line.

① *Select the straight line*

② *Select the point*

AN INTERNAL CIRCLE

AN EXTERNAL CIRCLE

Internal and external circles for triangles, parallelograms and regular polygons

① *Select the object*

💻 *Object found: obj1*

Internal and external circles are only possible for the above-mentioned shapes. Other types of objects return the message:

💻 *iocirc: Wrong type of object selected*

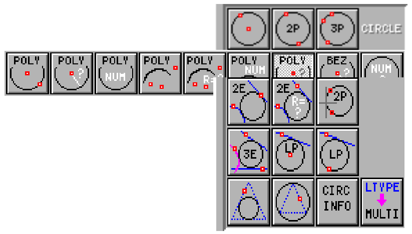
INFORMATION ABOUT CIRCLES

Shows data about a circle (circular arc)

CHGLT-M

Change lines to the current value of LINETYPE (multiple selection possible)

2D Circles – fly-out 1



Poly-circles or **poly-arcs** consist of a freely selectable number of straight lines and differ only in the way in which multi-cornered shapes are generated.

ARC-P

Polygon circle with a number of points which should be entered based on the centre point and the point on the circumference

ARC-PNR

Polygon circle with # points and a numerical radius to be placed on a middle point

ARC-PN

Polygon circle with # points and a numerical radius to be placed on a middle point

ARC1-P

Drawing a polygon arc with a middle, start and end point

POLY-ARC – ■1 Centre ■2 Sart point ■3 End point

A polygon arc with an entry for the radius and the selection of a middle, start and end angle

① *Select the centre*
Points 2 and 3 are selected one after the other anti-clockwise

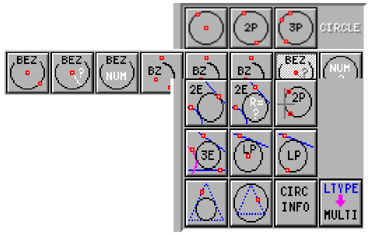
② *Select the starting point*
The starting point also establishes the arc radius at the same time

③ *Select the end point*
The end point determines the angle of the arc

ARC1-PN

Draw a polygon arc by making a radius entry and the selection of a middle, start and end radius

2D Circles – fly-out 2



Bezier curves and cubic splines, which are made up of Bezier curves, have the advantage that they are smooth no matter what the zoom factor is. They can be easily remodelled using MVP and can be adjusted as required. Bezier curves are suitable, amongst other things, for the rapid reworking of existing intersecting curves for design work as well as for producing lettering. They are the pre-requisite for designing freeform surfaces in the 3D section.

The routine * COLOUR in the menu CONVERT allows the curves which have been drawn to be analysed by alternate colouring of the part Beziers. The appearance of the Bezier curves on the screen can be improved further by setting the variable FASTBEZIER to OFF.

FASTBEZIER=OFF ↵

When you write this line in the Start file, the Bezier curves on the screen will be shown in the highest possible quality. The operating speed is reduced slightly but this is only noticeable for the most complex drawings. Operating with the Bezier commands is like working with the circle (arc) routines. The difference between it and the standard circular arcs lies in the structure of the object: Bezier circles consist of 4 Bezier arcs from a range of 1 to 4 Bezier curves.

BEZIER-CIRCLE – through two points

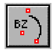
A Bezier circle through the middle point and a point on the circumference

BEZIER-CIRCLE – ■one centre/radius?

A Bezier circle with a numerical radius placed at the middle point

BEZIER-CIRCLE – numerical

A Bezier circle with a numerical radius placed at the middle point



ARC1-Z

Drawing a Bezier arc using a centre, start and end point

BEZIER-ARC – 1 Centre, 2 Start point, 3 End point

A Bezier arc with an entry for the radius and the selection of a centre, start and end angle

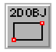
① *Select the centre*
Points 2 and 3 are selected one after the other, anti-clockwise

② *Select the starting point*
The starting point also establishes the arc radius at the same time

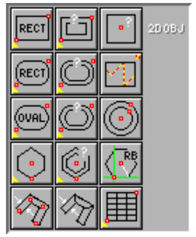
③ *Select the end point*
The end point determines the angle of the arc

ARC1-ZN

Draw a Bezier arc by making a radius entry and the selection of a middle, start and end angle

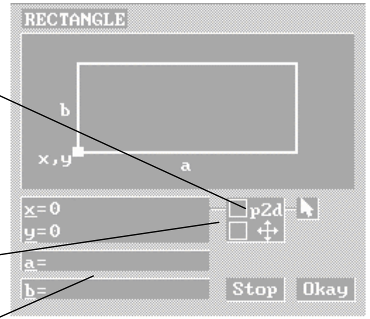


The 2D Object

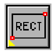


The co-ordinates of the starting point and the dimensions of 2D objects are established in easily understandable **pop-up menus**, in which the numerical entries remain stored and are thus reproducible or can be corrected. The numerical pop-up menus are reached over all buttons which are located at the bottom left in the form of a yellow circle, by **clicking on them and holding down** the left mouse button. A **short mouse click** (L) here generally initiates the standard mode (input into the command line).

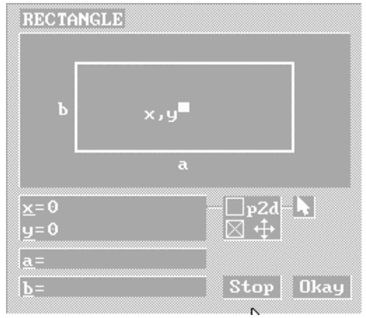
The numerical pop-up menu



- **Setting the starting point**
  When option P2D is activated a previously established or determined point will be adopted as the starting point. Clicking the arrow key can cause the starting point to be selected by the crosshair. When pressing „S“ key, multiple selection allows a number of 2D objects of the same size to be generated.
- **Position of the starting point in the object**
  The starting point, apart from the case of regular n-corners, can be selectively placed in the lower left corner of the object box (default standard) or concentrically.
- **Input field for numerical data**
  Activate the input field either by making a mouse click (L) or over the appropriate key (x,y,a,b..) on the keyboard! Confirm the entered data with <RET>



RECTANGLE



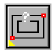
Draw a rectangle (using the window cursor)
The size of the rectangle is set by entering two diagonal points with the window cursor

① *Select the first corner*

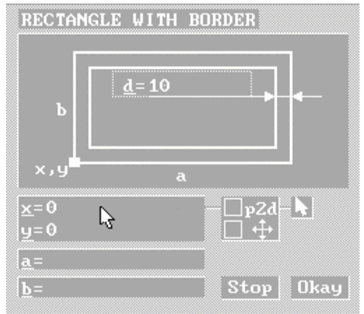
② *Select the second corner*

The numerical pop-up menu

x, y	Co-ordinates of the starting (absolute)
a, b	The width and height (relative)



EQUIDISTANT RECTANGLE



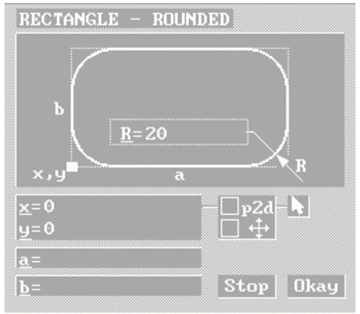
Draw a rectangle with a border (with the window cursor) or with the numerical pop-up menu

x, y	Co-ordinates of the starting point (absolute)
a, b	The width and height (relative)
d	Width of the border

A SQUARE

Draw a square - place it at the middle point

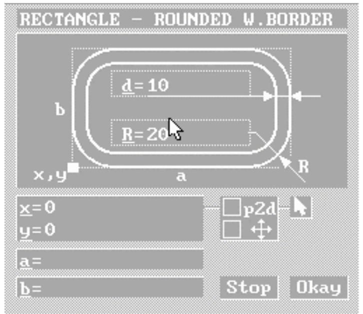
A ROUNDED OFF RECTANGLE



Draw a rounded off rectangle (with the window cursor) or with the numerical pop-up menu

x, y Co-ordinates of the starting point (absolute)
a, b The width and height (relative) of the object box
R A rounding radius - which can also be used as a standard for manual selection

A ROUNDED OFF RECTANGLE-EQUIDISTANT



Draw a rounded-off rectangle with a border (with the window cursor) or with the numerical pop-up menu

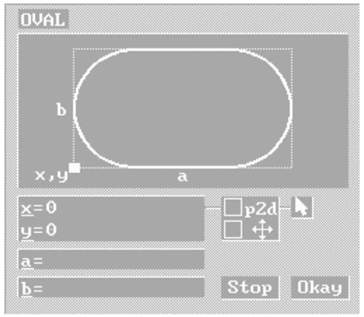
x, y Co-ordinates of the starting point (absolut)
a, b The width and height (relative) of the object box
d Width of the border
R A rounding radius - which can also be used as a standard for manual selection

> The rounding radius must not be greater than half of the length of the shorter side of the object box for the rectangle

RECTANGLE FROM THE BOX

A rectangle which is the same size as the BOX (maximum size) for thecurrent object (cf. variable BOX).
If the current object is a horizontal or vertical line, the corresponding object “BOX” is obviously not visibl

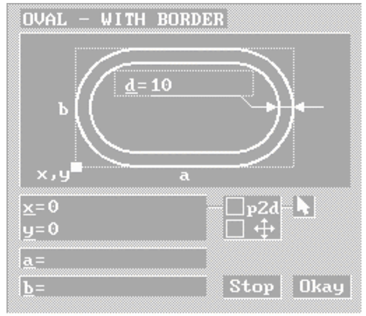
AN OBLONG SLOT SHAPE



Draw an oblong hole shape (with the window cursor) or with the numerical pop-up menu. The radius of the two half circles at the ends is calculated by the system automatically

x, y Co-ordinates of the starting point (absolute)
a, b The width and height (relative) of the object box

AN OBLONG SLOT SHAPE - EQUIDISTANT



Draw an oblong shape (with the window cursor) or with the numerical pop-up menu

x, y Co-ordinates of the starting point (absolute)
a, b The width and height (relative) of the object box
d The width of the border

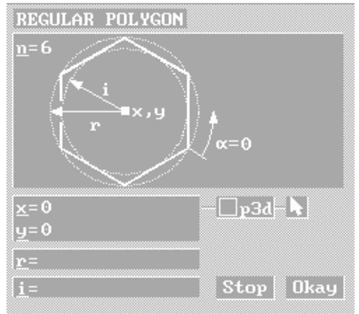
RING

Draw a circular ring with a centre point, inner radius a. outer radius

① *Select the centre point*
② *Select the first radius*
③ *Select the second radius*
④ *Select the centre point*
The ring so generated can be positioned as often as necessary either freely by hand or numerically:
Border menu or Polyend F6

The Enter key completes and exits the procedure

A REGULAR POLYGON



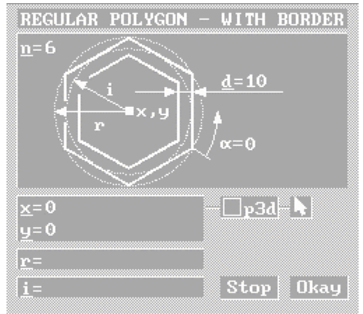
Draw a regular polygon or with the numerical pop-up menu.

① *Enter the number of corners*
② *Select the centre point*
③ *Select the point of intersection*
Selecting the corner points corresponds to entering a circumferential radius: it also defines the position of the polygon.

The numerical pop-up menu

x, y Co-ordinates of the starting point (absolut)
n The number of corners
r The outer radius
i The inner radius, which is half of the key width SW
α Rotation around the centre in degrees

A REGULAR POLYGON-EQUIDISTANT



Draw a regular polygon with a border or with the numerical pop-up menu.

x, y Co-ordinates of the starting point (absolute)
n The number of corners
r The outer radius
i The inner radius, which is half of the key width SW
α Rotation around the centre in degrees
d The border width

REG2

Draw a regular polygon around a centre point using rubber band lines

BAND

Draw a band with a width which must be entered (no object snapping)

① *Enter the width of the band*

② *Select the next point*

Exit: Border menu or Polyend F6

BAND – segmented

Draw a segmented band with a width which must be entered (no object snapping)

TABLE – without text

A rectangular table with columns and lines, where the number of each which must be entered

① *Select the position of the table (first point)*

② *Select the second point*

③ *Specify the number of horizontal divisions*

④ *Specify the number of vertical division*

2D-Object – flyout

SHEET TEXT IN THE MIDDLE

SHEET TEXT ALIGNED TO THE LEFT

SHEET TEXT ALIGNED TO THE RIGHT

Drawing a text table with data out of a SHEET area.
The cell contents written in the table fields in the middle/aligned to the right/ aligned to the left.
Data can be inputted by performing

SHEET

in the calculation worksheet from **isy**, which consists of 2048 lines and 160 columns. Use the area which begins with cell A1.
Write the data in the defined area which you subsequently want to have displayed in table form. Read exi-sting sheet tables which have been saved as data files with "read"

AN EXAMPLE:

read c:\isy\procs\bundes.dat a1..e20

reads in the data from "bundes.dat" which is contained in cells a1..e20 (cf. Pocket Guide, Chapter "Sheet")

IN ORDER TO CREATE THE TABLE YOU NEED:

❑ The designation (address) of the first cell (upper left) and the last cell (lower right)

① *Select the window (first point)*

② *Select the window (second point)*

③ *Enter the address of the first cell (e.g. a1):*

④ *Enter the address of the second cell (e.g. e20)*

SHTBL-E

Create number tables using the exponential form (from SHEET data)

RING-A

A circular ring with outer hatching (centre, start and end radius, multiple inputs)

RING-I

A circular ring with inner hatching (centre, start and end radius, multiple inputs)

OBJECT ON A CURVE

Place the current object along a curve in the form of a chain (multiple duplication-example a string of pearls).

YOU REQUIRE:

❑ the main curve (any poly or Bezier curve), the currently active object

① *Select the first object point*

② *Select the second point from the "object name"*

Points 1 and 2 are the external reference points for the starting object

③ *Select a curve*

This selection point selects the main curve and also determines the beginning of the structure

④ *Select a direction*

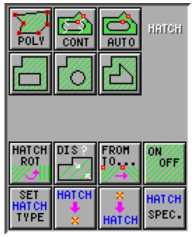
MAPOBJ

Fit the active polygon between two curves (object modulation)

RWAY

The segmented sample of a polygon (cartographic railway line)

2D Hatching



Delivered with **isy** are about 70 different types of hatching and the selection of the hatching is achieved, as described under “Parameter”, using the three selection menus. The border menu for the hatching parameter is obtained according to context for resolutions of 800x600 and greater, when the hatching menu is open.

FILL POINT BY POINT

Add hatching: plot hatching points (at least 3)
If you want to just hatch certain areas there is the possibility, for less complex contours, to use the point by point plotting of border points.

① *Select:*
Select one of the following commands from the called up border menu
F2 *New polygon* or F3 New circle (part circles are also possible)

② Now plot the required point

③ F4 *Exit* finishes the point entry. It is from this point onwards that the hatching area is filled

F5 *Cancel* stops the procedure

FILL OUT STEP BY STEP

Produce hatching by following the contour, element by element (in the sense of performing a revolution around the object) - half automatic contour following.
Recesses in the hatching surface are taken into account, if they were selected

① *Select an element*
The outer border of the hatching must be selected step by step. Successfully selected elements will be shown in the colour SHOWCOL and will be surrounded by a highlighting triangle:

The beginning point	–	the vertex is pointing downwards
The end point	–	the vertex is pointing upwards

> A mouse click (R) calls up a Help menu (ZOOM).

Chains of elements which are connected together will be recognised by the system.

Closed
A signal tone shows that the processing of the border around the object is finished.

② *Select element*
The next hatching surface can be selected according to the same principle.

Exit: Border menu or Polyend F6

FILL OUT AUTOMATICALLY

Automatic generation of hatching (no crossing over contours is allowed)
Generates a hatching surface by fully automatically following the contour line

> A mouse click (R) calls up a selection menu.

① *Select the first object*
The whole object will be processed automatically

② *Select the second object...*

Exit: Border menu or Polyend F6

CUTTING OUT A RECTANGULAR BLANK

Cut out a rectangle in the existing hatching (leaving a blank)

① *Select the corner point of the hatching*

② *Select the window area*

③ *Select the second corner point of the cut-out*
The selected area should not lie outside the hatching surface

HWINDW-C

Cut out a circle in the existing hatching (leaving a blank)

① *Select the corner point of the hatching*

② *Select the centre point*

③ *Select the starting point*
The selected area should not lie outside the hatching surface.

❑ The border around the cut-out circle can be removed with “delete first element”.

CUTTING OUT A POLYGON SHAPED BLANK

Cut out any shape of polygon in the existing hatching (leaving a blank)

① *Select the corner point of the hatching*

② *Select the first point*

③ *Select the second point. . .*
The selected area should not lie outside the hatching surface.

Exit: Border menu or Polyend F6

The border around the cut-out polygon can be removed as required with “delete part polygon”

HTCHROT

The relative direction of rotation for sloping and network type hatching

HTCHDIS

Setting the numerical distance between lines for line based hatching

> The most commonly required hatching in technical drawing DIRCT and NET can be adjusted later for slope angle and metric scaling. The spacing of the hatching will be given here in GDU. A quadratic hatching pattern can, for example, be so defined that it fits to the points on the snap grid.

HT2HAT

Change the type of hatching by pointing to a pattern and the target object

HTCHPLOT

Unhiding and hiding existing hatchings (Variable **HTCHPLOT)**

HTCHTYPE

Selection of the type of hatching, the colour and the spacing between lines

CHGHT-H

The current hatching object obtains the present hatching type (HATCH1)

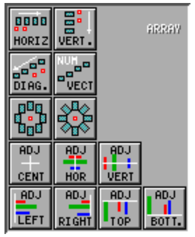
CHGHT-S

The hatching of the current object is saved in HATCH1

HT-SPEC

Specification of the hatching by menu

2D Arrangement



HORIZONTAL PROGRESSION

VERTICAL PROGRESSION

DIAGONAL PROGRESSION

2 points define the displacement vector

① *Select the start object*

② *Enter a repeat number (including 1):*

③ *Select the source point*

④ *Select the target point*

> Watch out for object snapping. If the target point should lie exactly on a line, for example, it advisable to activate the object snapping in that line in the GROUP menu.

PROGRESSION with a numerical input

A freely selectable pattern: Numerical displacement vectors (cf. LINE.PRC), e.g. r10,10 (relative displacement x,y). The parameters are entered as numbers. The starting object will be placed a number of times horizontally, vertically or at an angle.

① *Select the start object*

② *Enter a repeat number (including 1)*

③ *Translation vector (r(dx,dy) or p(r,a)*

RADIAL ROTATIONAL PLACEMENT – the angle of the object remains intact

RADIAL ROTATIONAL PLACEMENT – the angle of the object changes

Rotationally symmetric placement radially or axially about a given point

① *Select the object*

Object found: name

② *Total number (including 1)*

③ Select the rotational centre

ADJ-CENT

Orientate a number of objects around the centre of the reference object

ADJ-HOR

Orientate a number of objects towards the reference object

ADJ-VER

Orientate a number of objects vertically towards the reference object

ADJ-LE

Orientate a number of objects to the left towards the reference object

ADJ-RI

Orientate a number of objects to the right towards the reference object

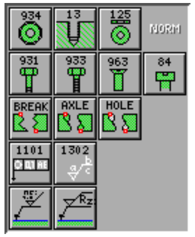
ADJ-TOP

Orientate a number of objects towards the upper edge of the reference object

ADJ-BOT

Orientate a number of objects towards the lower edge of the reference object

2D Standards



nut

Generate a screw nut (similar to DIN 934)

DIN13

A tapped hole (similar to DIN 13)

DIN125

A washer (similar to DIN 125)

DIN931

An hexagonal head bolt (similar to DIN 931)

DIN933

An hexagonal head bolt (similar to DIN 933)

DIN963

A countersunk screw (similar to DIN 963)

DIN84

A cylindrical screw (similar to DIN 84)

BREAK

A jagged break in an enclosed polygon

BREAK-A

A wavy break in an enclosed polygon

BREAK-H

A hollow shaft on an enclosed polygon

DIN1101

The symbol for FORM AND LOCATION tolerances (similar to DIN 1101)

DIN1302

The symbol for the qualities of the surface (similar to DIN 1302)

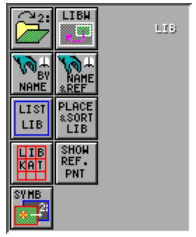
ROUGHNS1

Draw the symbol for average roughness values (similar to DIN 1302) and add values

ROUGHNS2

Draw the symbol for average depth of the roughness in the surface (similar to DIN 1302) and add values

The 2D Library



LIBLOAD

Load the library (drawings file) in memory buffer no. 2

LIBW

Manage the library by using the window which is faded in

GET

Save the font type, size and colour of a selected text into the variable TXTSPEC

GET-REF

Get a library symbol by name and possibly also (a) reference point(s)

LIB-LIST

List all of the objects in the buffer symbol, usually in memory buffer 2

POSLIB

Arrange objects (symbols) simultaneously

LIBCAT

Create a library catalogue of the symbols in memory buffer 2

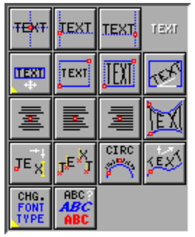
REFPNT-S

Show the reference point

COPYSYMB

Copy objects into an alternative memory buffer and retain their original name

2D Lettering



isy offers a wide range of lettering types (fonts) and possibilities for modifying lettering. You can recognise lettering files by their file extension "*.CDF". They can be found in the directory ISY/CDF&MNU. You have the possibility to convert the lettering into the vector form ("BZ OBTAIN") and to treat it as a drawing ob-
ject
in order to be able to change it with MVP or to change its form. The screen presentation of lettering can be improved even further when the variable FASTBEZIER is set to OFF (see also for "BEZIER").

FASTBEZIER=OFF

The selection of the lettering is achieved, as described under "Parameter", using the four selection menus. Border menu for the lettering parameter is obtained according to context for resolutions of 800x600 and greater, when the hatching menu is open.

CENTRED

ALIGN TO THE LEFT

ALIGN TO THE RIGHT

> **IMPORTANT!**
> The reference point for selection in the case of lettering is at the lower left point !

Place the crosshair in the middle of the text or on the left or to the right of the base line (without object snapping). The font size is the default size.

① *label-text:*

② *Select the text position*

SIZE FIXED (standard)

Enter the text and place the writing window _ menu: Specify the lettering
The lettering is an established font size.The font size is the default size

① *label-text:*

② *Select the text position*

SIZE VARIABLE – horizontal

Enter the text and fit in proportionally into the rectangular area. A rectangle is selected with the variable window cursor. The lettering is fit proportionately, either in the x <u>or</u> the y direction into this window.

① *label-text:*

② *Select the first corner of the text window*

③ *Select the second corner of the text window*
The proportions of the selected fonts remain intact

WITH SOME DISTORTION – horizontal

The size of the object box is set using the variable window cursor. The lettering is fit into this window and is scaled disproportionately in the x-direction and the y-direction in the process.

① *label-text:*

② *Select the first corner of the text window*

③ *Select the second corner of the text window*

AT AN ANGLE – numerical

Sloping lettering - enter the angle and the text and place in the text window. Generate the lettering text using a numerically inputted angle to the horizontal. The letter is not distorted. The font size is the default size.

JUSTIFIED TEXT CENTRED

JUSTIFIED TEXT ALIGNED TO THE LEFT

JUSTIFIED TEXT ALIGNED TO THE RIGHT

A block of lines (from a text file or by entering many lines of type) around a central point.
An empty line can be obtained by entering an empty symbol at the beginning of a line.

① *Select the centre* - select using the crosshair

② *Enter text:* Change line with

③ Exit text input with:

TEXT BETWEEN TWO CURVES

Placing text on a surface between two polygon lines (Font modulation)

YOU REQUIRE:

❑ two polygon lines (splines) which are lying one over the other

① *label-text:*
The text is placed using the variable window cursor; the size of the text is not important.
Do not, however, use any filled fonts since ugly polylines can be generated during the automatic text conversion process.

② *Select a lower line*

③ *Select an upper line*

The object will be distorted to fit between the two polygon lines

TYPING WITH KERNING

Typing in of text and positioning of the individual letters using the arrow keys (during input).
The command sets the inputted text into individual letters which are placed either with the same spacing or with variable spacing between them. Each letter has its own starting point (ma).

> The font type and the colour have the set default values.

① *Select the beginning point* – The first beginning point (the lower left point of the first letter) is selected using the crosshair.

① From now on you are working with a word processor and a coloured cursor marks the position of the next digit.

You can use the following keys during this procedure:

↑ ↓ ← → To position the individual digits

Page Up / Page Down	Decrease and increasie the displacement interval
←	Delete the inputted digit
↵	Line change or confirmation of the digit position
Esc	Finish the entry

POSITION CORRECTION

Split existing text (move individual letters with the arrow keys, <ESC> takes one to the next)

YOU REQUIRE:

- ❑ active lettering or an other active object which contains text
- ① *Select the text from 1: Object name*
  Click the desired text at the reference point. Further processing corresponds to the command TYPE (see above)

LBLCIRC

Circular lettering (normal: clockwise - reverse: anti-clockwise)
Set the lettering above or below the circle

YOU REQUIRE:

- ❑ A starting circle (arc) with the internal format “el” or “es”
- ① *Select normal or reverse lettering (r):<n>*
- ② *Select an object*
- ③ *Input the text*
  A maximum of 56 digits are allowed
- ④ *Select the centre of the base line*

LBLCRV

Enter text and place it letter by letter on a curve (POLY)
The associated procedure LBLCRV possesses further interesting options which you can call up with Esc

YOU REQUIRE:

- ❑ A horizontally oriented polygon curve - Bezier curves are not allowed
- ① *Select a curve*
- *Object found: (e.g.)spl*
- ② *Lettering*
- ③ *Establish the beginning of the text: -*
- ④ Place the individual letters

CHGFNT

Change the font (value from TXTSPEC)_menu: Changing the font

LB-TYP

Select a font

2D Lettering – flyout

ITALIC-S

ITALICS

An existing font will be afforded an italic shadow at the angle which is specified (italic-s) or the font will be tipped over at the angle which is specified (italics)

- ① *Select an object*
  The reference point for the shadow is at the bottom left!
- ② *New (or shadow) angle (relative):*

NEWTEXT – fitted in

NEWTEXT – aligned to the right

NEWTEXT – aligned to the left

NEWTEXT – centred

Change the text content of an existing text
Here you have the possibility to correct and align the text as either centred, aligned to the left or aligned to the right. The text piece can be longer or shorter depending on the correction. Select the option “FITTED IN” if the corrected text should have the same length as the original starting text.

KERNED-O

Split the text and change the FONT (out of TXTSPEC), place with the arrow key and <ESC>

PUTM-TSP

The font and the size of the selected text is changed from TXTSPEC

CHGFNT1

The selected text will be changed to the font type which is inputted

GET-TXSP

Save the font, size and colour of the selected text in the variable TXTSPEC

LSPACE

Set the line spacing to be a % of the font height (for justified text)

LB-COLOR

Set the colour of the font: 2 green, 3 red, 4 yellow, 5 blue …32

LB-SIZE

Set the size of the font [, width] as a % of the standard screen section

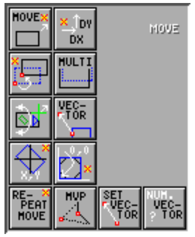
LBSIZE-U

Set the size of the font in user units (e.g. mm)

① *Height of the font in user units (e.g. mm): <5>*

When you enter for example 50, the font size (size “A”) corresponds to approximately 1/10 of the maximum height of the drawing area (ZOOM out).

2D Moving



IN THE WINDOW

Moving an object with the help of the window

① *Select the object position*
If the object was created snapped exactly into the snap grid, it can also be moved exactly within the snap grid.

RELATIVE – Δx, Δy

Moving objects using relative co-ordinates (dx, dy)
The currently active object or macro-object will be moved by a difference value from its original position. The co-ordinate input is numerical.

① *Difference value (dx, dy):*

MOVE WITHIN THE SNAP GRID

Move by snapping the currently active (macro) object in the grid - from point to point

① *(Starting) point from 1: Select a name*

② *Select a target point*

MULTIPLE – with a vector

Move a number of objects at once.
First of all select a translation vector

① *Select the first point*

② *Select the second point*

③ *Select the first object*
All selected objects will be marked in colour

Exit: Border menu or Polyend F6

The objects will be moved together

DYNAMIC MOVING 2D

Dynamic moving with rotation (PgUp, PGDw,+,-) - also works on macro objects.The selected object is moved, keeping a visible check at all times, the contour remains visible. Possible options:

Page Up, Page Down	Continuous rotation of the object
+, -	Changing the angle of turn

WITH VECTOR – many times

Moving objects with a vector which has been pre-set (also many times)

① *Enter the translation vector* (dx, dy)
This request to enter data only appears once, the entered vector is saved (new data should be entered using the “NUMERICAL” button).

② *Select the first object. . .*
Click on all objects which you want to move by the entered vector - multiple selection of the same object is possible - and finish with

Exit: Border menu or Polyend F6

ABSOLUTE

Move the object centre (BOX) to a numerical position (x,y)

① *Enter the new position for the object centre <0,0>*
Only enter absolute co-ordinates here.
A previously selected 2d point will be offered as set position.

TO THE ORIGIN

Move the object box to the origin - the bottom left corner of the object box will have the co-ordinates 0,0

MOVE-REP

Repeat the last move

MVP

Set the point onto a new position (a description can be found in the section “Point”)

VECTOR – 2points

Set the moving vector between two points
Instead of making a numerical input of the translation vector it is also possible to use selection by the cross-hair.

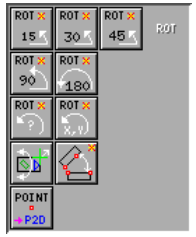
VECTOR – numerical

Set the numerical moving vector (absolute, relative, polar)
Enter the translation vector in a similar way to when using the LINE procedure, e.g.

> The entry will always be interpreted as relative here.

a100,100 or r100,100

2D Rotation



The following commands can be used to rotate the currently active object either around its own centre or some other selected centre. Switching on the flags “DUPLICATE” gives a rotation scheme

TURN THROUGH 15° **TURN THROUGH 30°** **TURN THROUGH 45°**
TURN THROUGH 90° **TURN THROUGH 180°**

Turn according to the set angle.
The range of rotation available corresponds to the object centre of the active object. Where the object is asymmetric, this is the centre of the object box.

ROTATION – Centre? / angle of rotation?

Rotating the object through a specified angle around a freely selectable point

① *Angle of rotation <90>:*
90º is the defaut value

② *Select the rotation point*
A quadratic highlighting marks effective snapping of the object

ROTATING – angle of rotation?

Rotating an object around a numerically inputted point through a specified angle

① *Angle of rotation <45>:*
45º is the default value

> Errors can only be removed here by entering the same angle with the opposite sign in front. This is also valid for all objects which were rotated unintentionally.

MOVE-ROT

Dynamic rotation (PgUp, PGDw,+,-) - also works on macro objects

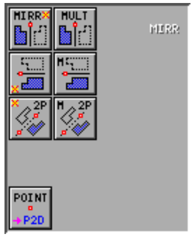
ROT-2P

Rotating objects by selecting pairs of reference points

PNT-STOR

Save the position of the point in the variable P2D - taking on the value

2D Mirroring



HORIZONTAL – on a point

HORIZONTAL – on a point, a number of times

VERTICAL – on a point

VERTICAL – on a point, a number of times

(Multiple) mirroring in a horizontal/vertical direction at the selection point

① *Select the mirroring point*
The mirroring point will be saved. Newly selected objects can be mirrored on the same point by clicking on them with the mouse (R).

ON AN AXIS

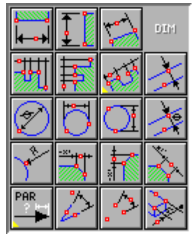
ON AN AXIS – a number of times

Mirror (a number of) objects on a straight line

MIRRORING POINT

Save the position of the point in the variable P2D - taking on the value

2D Dimensioning



The dimensioning parameter such as dimensioning number, arrow length, length of the auxiliary lines jutting out projections, etc. are automatically set at the beginning of the program to the normal range of 0.7. The rounding is set to one place after the decimal point. The procedure DIMPAR gives access to the setting of dimensioning parameters and other highlighting types.

HORIZONTAL

VERTICAL

SLOPING

① *Select the first point*
The first selection point sets the position of the dimensioning number for small dimensions (dimensioning arrow outside)

② *Select the second point*

③ *Position of the dimensioning line*

CHAIN DIMENSIONING – horizontal

CHAIN DIMENSIONING – vertical

CHAIN DIMENSIONING – sloping - menu: special dimensioning

① *Select the first point*

② *Select the second point*

> The **first two selection points** always set the measure (watch out for object snapping).With **small spacing** between measures it is possible to get some overlapping of the dimensioning numbers

③ *Position of the dimensioning line*

④ *Select the next point. . .*

SPACING

SPACING – with a diameter sign

Spacingdimensioning at parallel lines

① *Select the first point*
The first selection point sets the position of the dimensioning line.

② *Select the second point*

DIAMETER

Dimensioning a diameter - the first point decides the length of the dimensioning line

① *Select the first point*
The first selection point also sets the angle of the dimensioning line.

DIAMETER – horizontal

DIAMETER – vertical

Horizontal and vertical dimensioning of diameters

RADIUS

Radius dimensioning: the arrow can come from inside or outside (according to the circle seleted)

① *Select the first point*
The first selection point also sets the location and direction of the dimensioning arrow at the same time. Dimensioning arrow is generated on the side of the selection point (whether on the inside or the outside)

CHAMFER – horizontal

CHAMFER – vertical

CHAMFER – on a slope

① *Select the first point*

② *Select the second point*

③ *Position the dimensioning line*
The third selection point governs the distance between the dimensioning line and the workpiece.

PARAMETER

Select the type of symbol (arrow, circle or dash) _ Parameter setting (see below)

ANGLE – 2 points

Angle dimensioning between 2 straight lines: first + second point: straight line - third point: dimensioning line. Keep an eye on the mathematical rotation direction when selecting points!

① *Select the first line* - the first leg

② *Select the second line* - the second leg

③ *Position the dimensioning line*
This point governs the radius of the dimensioning line.

ANGLE – 3 points

Angle dimensioning between 3 points.

① *Select the first point* - then click on the vertex

② *Select the second point* - the first leg

③ *Select the first point* - the second leg

④ *Select the position of the dimensioning line*
This point governs the radius of the dimensioning line

DIMENSIONING AN OBLIQUE IMAGE

Parallel projective dimensioning. Auxiliary dimension lines and measurement values are placed in space to assist the dimensioning of oblique images or spacial images.

> To undertake oblique image dimensioning on 3D designs they must first of all be converted to 2D

① *Select the first point*

② *Select the second point*

> The first two selection points always govern the dimension.

③ *Position the dimensioning line*

④ *Select the parallel axes*
Click here on an edge of the workpiece which should govern the orientation of the writing.

Letters and auxiliary dimensioning lines will be generated parallel to the last selected edge.

2D Dimensioning – flyout

AUXILIARY DIMENSIONING LINES – spacing

Adjust the distance between the auxiliary dimensioning lines and the edge of the body

AUXILIARY DIMENSIONING LINES – jutting out

Adjust the jutting out using the dimensioning line

NUMBER OF PLACES AFTER THE DECIMAL POINT

Round of the dimensioning text to the set number of places after the decimal point

ONLY ONE AUXILIARY DIMENSIONING LINE

The second auxiliary dimensioning line in each case is hidden

TOLERANCE

During dimensioning the tolerance will be requested and will be set higher or lower

AN ARROW

The dimensioning will only be set against an arrow and an auxiliary dimensioning line

MULTI

All selected dimensioning methods will be executed a number of times

RESET

All dimensioning options will be deleted (standard)

SIZE OF THE LETTERING

Adjust the size of the lettering in user units (e.g. mm)

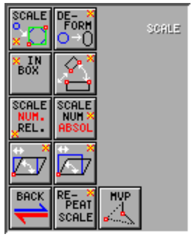
TYPE OF LETTERING

Select the type of font required

ASSOCIATIVE

Switch: between associative dimensioning and non-associative dimensioning

2D Changing the scaling



PROPORTIONAL SCALING – changing the size of an object without distorting it

Increasing or decreasing the size of the object proportionately using the window
An object must be activated before this command is activated. Use the window cursor to select a rectangle:

① *Select the first corner of the new box*

② *Select the second corner of the new box*

Then the active object will be fitted either in the x direction <u>or</u> the y direction into this window.

DIS-PROPORTIONAL SCALING – changing the size of an object while distorting it

Distortion of an object using window selection
An object must be activated before this command is activated. The size of the new object box is determined with the window cursor:

① *Select the first corner of the new box*

② *Select the second corner of the new box*

Then the active object will be fitted into the new box and be deformed in the either in the x direction <u>and</u> the y direction.

EINPASSEN IN BOX

Fit the object proportionately into a BOX
Fitting the active object into the object box belonging to a target object

① *Select the target object*

ROTATING/SCALING

Rotating the object and scaling it by selecting four points

① *Select the first starting point*
of the active object

② *Select the first target point*

③ *Select the second starting point*

④ *Select the second target point*

The starting object will scaled (up or down) without being deformed and will be shown at the default angle

NUMERICAL SCALING – using a factor

Numerical scaling (using a relative factor)
The numerical increase or decrease in the size of an active object using a factor

① *Scaling factor(s):*
Entering one value scales the starting object proportionately

Entering two values scales the starting object dis-propotionately, that it produces deforming

AN EXAMPLE:

1,2 ↵ means that the dimensions of the starting object in the horizontal direction (x=1) will not be altered but the dimensions in the vertical direction (y=2) will be doubled.

NUMERICAL SCALING – absolute

Numerical scaling (with an absolute change in size)
The numerical increase or decrease in the size of an active object by a given value

① *Enter the absolute change value x[,y]:*
e.g.. (-10),10:
Enter the value by which the dimensions of the x and / or y direction should change by.

SHEAR TO ONE SIDE – parallel

Horizontal shearing to one side, in parallel, of the active object
Shearing the active object (a polygon) by shifting a point parallel to the shearing line
The starting object remains intact.

① *Select the first point*

② *Angle:*

SHEAR TO ONE SIDE – radially

Shearing the active object (a polygon) by shifting a radial point
The shearing line can be set to any angle desired. The starting object remains intact.

① *Select the first point*

② *Select the second point*

③ *Angle:*

SCALE BACK

Undo the scaling operation - reset to the starting size

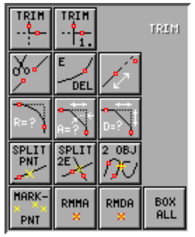
REPEAT SCALE

Repeat the last scaling operation

MVP

Place the point in a new position (described in the section “Point”)

2D Trimming



TRIMMING – trim both elements

Trimming a pair of elements (lengthen or shorten)
Lengthening or shortening of 2 elements around their common point of intersection
Suitable for straight line, circles (circular arcs) and ellipses

① *Select the first element*

② *Select the second element*
From now on you can repeat the procedure as often as you need or exit.

Exit: Border menu or Polyend F6

TRIM-A

Trimming the first element (lengthening or shortening)
Exact lengthening or shortening of an object to the nearest point
Suitable for straight line, circles (circular arcs) and ellipses. To trim a spline it must first be split (= insert a point of intersection). The part polygon can be removed with “POLY” delete.

① *Select the first element*
The first element will be corrected, that is lengthened or shortened

② *Select the second element*
The second element determines the length of the first element
From now on you can repeat the procedure as often as you need or exit

Exit: Border menu or Polyend F6

CUT OUT A GAP

Cut out part elements (note the direction of rotation in certain cases)
Takes a piece out of a straight line, circle (circular arc) or an ellipse leaving a gap.

① *Select the first element*
The selection point is also the limiting point of the gap.

② *Select the second element*
From now on you can repeat the procedure as often as you need or exit

Exit: Border menu or Polyend F6

Select in an anti-clockwise direction when working with circles (circular arcs) or ellises!

DELETE ELEMENTS

Delete elements (a part object)
Just deletes individual elements (from point to point)
Onetime deleted elements from circles or part Beziers are lost forever, straight lines (“da’s”) are changed into invisible points (“ma’s”).

① *Select the first element*
Select the first element
Select the first element. . .

Exit: Border menu or Polyend F6

LENGTHEN / SHORTEN

an element from the first selection point to the second selection point

① *Select the first element*

② *Select the second element*

From now on you can repeat the procedure as often as you need or exit

Exit: Border menu or Polyend F6

ROUND OFF an edge using a circular arc

Rounding off straight lines using a requested radius (Variable FILLET)

① *Rounding radius <10>:* 10 is the default value

② *Select the first element*

③ *Select the second element*

The radius which was set at ① is also valid for the next change or until the end of the work session

Exit: Border menu or Polyend F6

SLANTING OFF

A chamfer - slant off according to a requested angle (variable CHAMFER)

SLANTING OFF an edge (chamfer)

A chamfer - slant off according to a requested distance from the edge (variable CHAMFER)

① *Distance from the edge 1(,2) <10>:*
A chamfering angle of 45º is obtained by entering just one value, while any required chamfering angle can be obtained by entering two values which are separated by a comma.
The distances from the end and the chamfer angle remain active until the next save operation.

AN EXAMPLE:

10,30 ↵ means that the first selected point should be cut at a distance of 10 from the corner point and the second selected point should be cut at a distance of 30 units from the edge.

② *Select the first element*

③ *Select the second element*

INSERT POINTS OF INTERSECTION – manually

Split an element at the selected point
Insert further intermediate points (ma) in the drawing element (at the selection point)

① *Select the first element*

INSERT POINTS OF INTERSECTION – in 2 elements

Separate two intersecting elements (split them apart)
The description for this can be found in the section “Point”

INSERT POINTS OF INTERSECTION – in 2 elements

Separate two overlapping objects (split them apart)
The description for this can be found in the section “Point”

MARK POINTS

Mark points on the object to be selected

RMMA

Remove splitting points from the object data (ma commands)

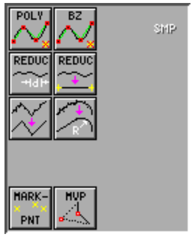
RMDA

Remove double points from the object data (da commands)

BOX

Re-calculate all object dimensions (BOX)

2D Smoothing



Here is where you find the commands for reworking existing polygons or curves which should be smoothed or where the number the points they contain should be reduced. The original curves are usually deleted

> **Smoothing** is meaningful, for example, when the print out of curves on a printer or plotter produces polgon corners which clutter the image.
>
> A **point reduction** can be undertaken when polygon lines are made up of an unnecessarily large number of part straight lines which fill up the operating memory and thus slow down the build up on the screen and long calculations.

Save your drawimg before working on it!

SMOOTHEN – with Polyspline

Smoothen the active polygon using spline

① *Set the point deviation for the smoothing <5>:*
The smaller the value which is entered, the better the quality of the curve - but this increases the amount of memory which is needed.

SMOOTHEN – with Beziers

Smoothen the active polygon using Beziers
The selected polygon line is replaced by a smooth curve (cubic splines), which pass exactly through the corner points of the starting polygon and which are of a high quality.

REDUCE THE NUMBER OF POINTS – the distance between the points

Reducing the number of points by setting the maximum distance between points (pre-set default value: 20=units) Entering the maximum allowable length of a single polygon element.

REDUCE THE NUMBER OF POINTS – angle

Reducing the number of points by setting limiting angle values
Entering the maximum allowable difference in angle between two polygon elements.

REDUCE THE NUMBER OF POINTS – maximum deviation

Reducing the number of points in a polygon by setting a maximum spacing area (duplicate)
Entering the maximum allowable deviation of a calculated polygon line. The result will be inserted as a new object.

REDUCE THE NUMBER OF POINTS – by approaching a circular shape

Reducing the number of points in a polygon by approaching a circular shape (duplicate)
Replaces suitable sections of a polygon line with circular arcs (internal “es”). The result will be inserted as a new object.

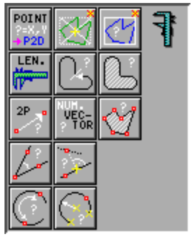
PNT-MARK

Mark the points on the object to be selected

MVP

Place the point in a new position (described in the section “Point”)

2D Measuring



P2D

Calculating the point co-ordinates

① Select a point. The point co-ordinates will be saved

pcl: p2d=x, y

whereby x,y are the determined drawing co-ordinates of the selected point. These co-ordinates will be saved and will be blended in during certain procedures as a default value (e.g. when moving in absolute terms)

CENTRE

Calculate the centre of a object box and show it - the co-ordinates of the centre will be saved (see above)

center:

Objekt=1:Name	the current memory buffer, the name of the selected object
2D=x,y	the determined centre of the box

SIZE

Determine the width, height and the ratio between them for the active object

Calculate and show the maximum dimensions of the active object, that is the size of its object box.

size:

Objekt=1:Name	the current memory buffer, the name of the selected object
2D=x,y	the largest width and height
R=	The relationship (ratio) of the two (size relationship between x and y)

LENGTH

Determine the length between the two selected points

Measure the length of a stretch of drawn line or, if more part stretches are inputted, produces the sum of the measured part lengths.

① Select a point #n of all available

Exit: Border menu or Polyend F6

length: l Output of the length determined

PERIPHERAL LENGTH

The peripheral length of a closed curved line by selecting parts of it step by step

AREA CONTENTS

Determine the area contents of a closed curved line by selecting parts of it step by step

VECTOR – 2 points

Measure vector between two points and

① *Select the first point*

② *Select the second point*

vector:

x1,y1..x2,y2	the point co-ordinates (from .. to)
l=	the length of the vector
a=	the absolute angle
dx=	the difference value in the x direction
dy=	the difference value in the y direction

VECTOR

Set a numerical moving vector (absolute, relative, polar) - cf. LINE.PRC

SURFACE

Determine the area between two manually selected points

ANGLE

Measure an angle (2 points: the inclination of a straight line, 3 points: the angle between 2 straight lines)

SPACING

Measure the shortest distance distance between two straight lines (show the nadir)

LENGTH OF A CONTOUR

Determine the length of a contour (e.g. arc length) between two points

CIRCLE DATA

Show data for circles (circular arcs) or ellipses on selection

The structure of objects

ACTOBJ

Show the active object_menu: Special object structure

NAME

Rename the curently active object
The new file name should not contain empty spaces, and an error message shows when an already existing name is used.

NEW NUMBERING – OBRENAME

New numbering of the object obj*
If you have loaded a file (inserted) with “load-a” or using the file manager into the existing drawing, you should absolutely renumber it in order to avoid having objects of the same name.

EDIT *

Check / edit the geometrical data for the currently active object

RMDA

Remove the redundant points from the object data (da commands)
All identical points in a polygon object which occur a number of times, one after the other, will be removed. Such points can lead to errors in calculations in procedures such as equi.prc.

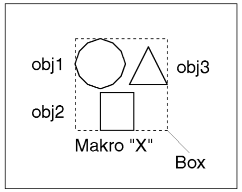
AN E XAMPLE:

```
os obj1
ob 100,100 400,400
co 8
ma 100,400
da 400,100
da 400,100
oe
```
– this line will be removed

RMMA

Remove the splitting points from object data (ma commands)
Polygons which are nearer together than double the value of the variable “digits” will be grouped together.

CREATE A MACRO



The grouping together of objects by selecting them individually with the crosshair or by window selection
The macroname in <pointed brackets> which is offered by the system can be confirmed with ↵ .The objects which are embraced in this way will be shown in a special colour.

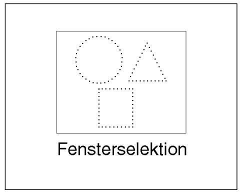
> A MACRO (or macro object) is the grouping together of a number of objects to make a new entity. The part objects remain intact but can, under a higher name, be further processed as a whole.
>
> The macro object has its own object **box** which surrounds the group of objects.

A mouse click (R) brings you to an additional pop-up menu, where you can select one of the various options

`Zoom, Zoom everything, Zoom back`
which changes the section of the drawing shown on the screen

`Macro sel.`
If the last selected object happens to have been an existing macro, this will be adopted in total and one saves oneself the effort of selecting each object individually

`Window sel.`
This command initiates selection exclusively with the window. All of the individual objects which are fully surrounded by the cursor will be combined together into a macro.



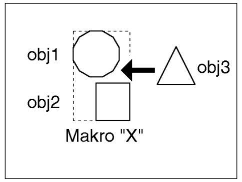
`Not the last one`
The selection of the last individual object wll be undone (also just <u>one</u> object even when there is multiple selection)

`Exit`
Finishes the macro and initiates the final acceptance of all of the selected objects

> Be systematic[1] in building up a macro, since they are not visible in your drawing. Macros which are nested too deeply are difficult to handle

INSERT AN OBJECT

Connect up the active object with a macro ($MACRO)



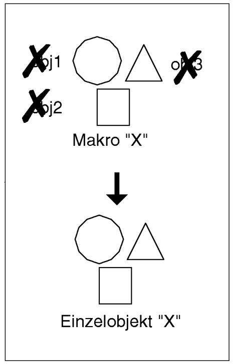
Insert an object

[1] It has been found useful in practice to assemble every view as a macro (e.g. the view from the front =VA, the view from the top=DS, the view from the side=SA, the spacial view=RB), and to use this system of designation in every drawing

PACKING A MACRO TOGETHER – objects

Fusing the sub-objects in a macro object together to make a single object with the same name as the macro object.

- PACKING reduces the saved quantity of data for a macro or macro object and the space it takes up in the operating memory and the hard disc
- The effect of packing cannot be seen on the screen
- The names of the individual sub objects are lost during the packing process

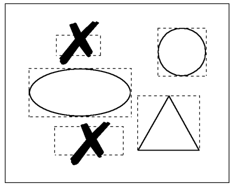


Makro packen

PACKING A MACRO TOGETHER – the rest

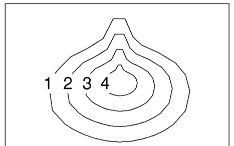
Removing the empty object[2], multiple colours and superfluous commands

The macro name in <sharp brackets> can be confirmed by pressing ↵


Leerobjekte entfernen

LEVEL

A structural analysis of the macro - status of the inter-linking of the current object. Check whether the active object is part of a macro.
A higher macro object will be highlighted with a special colour and then activated. Its object box will be visible for a short time (see above).
The number in brackets behind the given macro name shows the number of the macro envelopes around the active object.

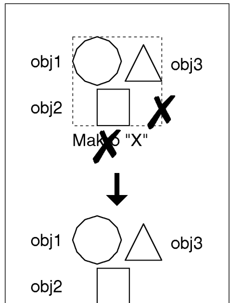


Makro-Hüllen

REMOVE A MACRO

The existing envelopes are removed, the macro name is removed and the structure of the macro is dissolved.

The name of the macro in <sharp brackets> can be confirmed by pressing ↵

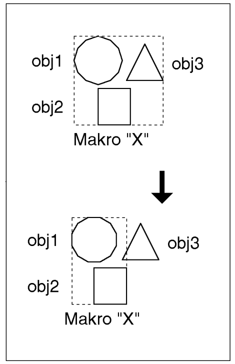


3 Einzelobjekte

[2] Multiple macro building gives rise sometimes to empty objects which cannot be seen on the screen, which do not contain any drawing commands and which can generate errors. The packing procedure deletes all empty objects from the complete drawing (keyboard command pack -e)

OBJECT FROM A MACRO

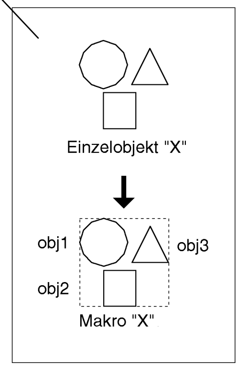
Extracting an object, which is selected with the crosshair, out of a macro object. The macro object remains intact.
The command can be repeated a number of times as required. A mouse click (L) on the text menu exits the procedure.



Einzelobjekt isolieren

GENERATE OBJECTS

Attention here! Reconfigure the memory buffer
Images of individual objects out of existing activated objects. Even a packed object can be reconverted back into the individual objects it contains.



Objekte erzeugen

BOXFRAME

Recalculate the BOX for the active object and make it visible
The enveloping object box for the active 2D or 3D objects will be shown in the colour cyan. The command can also be used on macro objects. The virtual image disappears after clicking with the mouse (R) on the drawing surface.

BOX *

Re-calculate the dimensions (BOX) of the active object
For very large drawings, time can be saved if you activate this command immediately after scaling the objects.

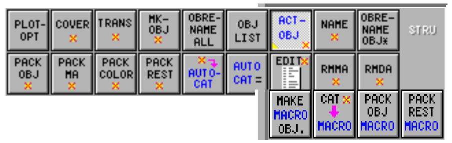
BOX ALL

Re-calculate the dimensions (BOX) of all objects

CO2COALL

Re-calculate the dimensions (BOX) of all objects

Object structure – flyout



PLOT FOLLOW

Arrange the objects in the selected sequence in the memory bufferWhen printing out onto pen or rapid plotter, the sequence in the memory buffer can be relevant (concerning plotting accurancy, connections with circles, etc.). It is like a row of letters on the screen: the first shown object will be the first to be printed out.

COVER

Create a macro envelope (cover) with a new name around the currently active object

POSITION

Move the currently active object in the memory buffer behind a target object

GENERATE INDIVIDUAL OBJECTS

Attention here! Reconfigure the memory buffer - images from individual objects in the current buffer
Even a packed object will be reconverted here back into the individual objects it contains. If the drawing contains a large number of individual elements, the size of the file will increase considerably.

OBRENAME

Renumber all objects (add a running number on the end)

OBREPORT

Save the object name in a selectable memory buffer in the first cells of SHEET

PACK – object(s)

Pack the active objects while losing the sub-object names

PACK – ma- commands

Remove superfluous ma commands in the active object

PACK – colour

Remove all multiple colours (co-commands) from the active object

PACK – the rest

Delete blank objects, several colors and unnecessary command

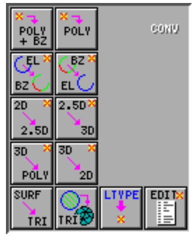
ACAT-A

For the automatic allocation of the interlinking name of the active object to AUTOCAT

NOACAT

Delete the interlinking variable AUTOCAT

Converting



This menu contains the 2D and 3D conversion commands. Before converting, a process which radically changes the structure of the object, the system request is made:

Are you sure ?

Consider the fact that most commands are also applicable to macros and even the whole drawing! Always save your drawing before converting.

*** ➔ POLY + BEZIERS**

Convert the active object into a polygon - Beziers remain intact.
This is like *➔ **POLY** (see below) but in this case Beziers in the object remain intact after conversion.
This command is suitable, for example, for converting texts into manipulatable objects.

> Beziers can be adjusted using MVP!

*** ➔ POLY**

Convert the active object into a polygon
Convert the active object which contains circles, arcs, Beziers, hatching and or text for further processing into one or more polygon lines. This produces a packed single object. The memory requirements of the converted objects is significantly higher than before converting.

CIRCLES(ARCS) ➔ BEZIERS

Circles and ellipses will be converted into Beziers

BEZIERS ➔ CIRCLES(ARCS)

Bezier curves in the current object will be converted into circular arcs

2D ➔ 2½D

Transfer an active 2D object into the 2.5D level
This transforms the active 2D object with the help of a t2 matrix into the current spacial drawing level. In this way all of the objects which have been generated with 2D commands can also be shown in three dimensions.

2½D ➔ 3D

Convert the active 2.5D object into a 3D object
As above, but, apart from the transformation matrix, z co-ordinates will also be added to the 2D co-ordinates

3D ➔ POLY3

An active 2.5D object or 3D object will be converted into a 3D polygon

Conversion of 3D solid objects or from solid objects which have limited area into line models.
Selecting the option "HIDDEN" trims invisible drawing lines. The remaining part of the body stays as a 3D polygon.

3D → 2D

Active 3D objects will be converted into a 2D object
Convert complete 3D solid objects, solid objects which have limited area or line models into 2D polygons - all edges are visible

> The perspective which is set at the time is decisive for the 2D projection. The projection level corresponds to the drawing area.

TOTRI

Convert the surface which is to be selected into triangular meshes

HA-TRI

Convert a 3D hatching into triangular meshing with the set side length

CHGLT-L

Changing the line type of the currently active object to the current type (LINETYPE)

EDIT *

Check / edit the geometric data of the currently active object

Information about the geometry

GEOED

Object information _ menu: Information about geometry

EINFO-S

Show a short information about elements in the selected object

PNT-MARK

Mark points on the object to be selected

EDIT *

Edit the geometrical data of the currently selected object for the purposes of checking it
In order to check and to obtain a better understanding of the structure of the drawing it is possible to edit the currently active object or macro object. The editor also allows the manipulation of objects using the key-board, as required.

EDIT POINTS

SHOWING point co-ordinates in the editor
Select the a point on a polygon using the crosshair. The system shows the point co-ordinates in the editor. Return with <Esc>

EDIT 3D POINTS

Select a 3D point (for POLYEND: Enter) and show it in the editor

2D-POINT **3D-POINT**

Select a point (for POLYEND: Enter) and store it in variable P2D or P3D

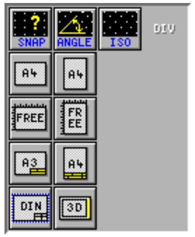
VECTOR

Measure a vector between two points and show all of the values

VEC3

Measure a 3d vector by selecting 2 points and store it in the variable VEC3

Miscellaneous functions



SNAP

Adjust the continuous snap grid (variable GRID, SNAP)
An exact description is contained in the section “Parameter”

SNAP – inclined

An inclined continuous snap grid (variable GRID, SNAP)

SNAP – isometric

Isometrics, continuous snap grid (Variable GRID, SNAP)

A4- SHEET – landscape format

A4- SHEET – portrait format

Generate the DIN A4 formplot frame
Generate a simple DIN format without lettering. 1 GDU ⇔ 1 mm

> FORMPLOT frames allow true to scale printing onto a printer or plotter. They are shown on the screen in cyan but do not appear on the printout.
>
> Each drawing can contain only one FORMPLOT

FREE FORMAT – landscape format

FREE FORMAT – portrait format

Generate a frame with millimetre gradations

① *Format <A4>*:
DIN A4 is the default setting. When the format input is correct, the size of the surrounded drawing area corresponds exactly to the paper size of the output medium.

> The entered measurements should never be greater than the maximum size of the paper format but smaller sizes are are allowed.

SIMPLE STANDARDISED SHEET – DIN A3

SIMPLE STANDARDISED SHEET – DIN A4

Simple drawing frames in which an existing drawing can be taken over true to scale, with an automatic lettering entry - the date and scale will be automatically entered into the lettering box while further lettering is entered in dialogue:

① *Enter your name:*

② *Enter the classification:*

③ *Enter the name of the drawing:*

The further inputted marking text will also be positioned automatically

The DIN A3 standard frame (landscape) can be printed out either onto DIN A3 or onto DIN A4 paper. This will be fitted in a true to scale manner in the frame (1:1 to 1:100) and centred when calling up of standard frames after finishing a drawing.

DIN DRAWING FRAME – with a field for lettering

Generation of a DIN drawing frame with a field for lettering.
The sizes range from DIN A4 as a minimum to DIN A10 as a maximum

① *Enter a format <A3>:*
DIN A3 is the default setting

3D- FRAMES

Fit a 3D drawing into the frame - also a section of it, with automatic lettering
The rapid generation of a plottable 2D drawing out of any 3D view (also out of ZOOM).
The section of the drawing which is visible on the drawing area will be adjusted into the frame and labelled vertically in dialogue.

Be careful! Convertion from 3D ➔ 2D
Are you sure ?

① Click on “Yes” when you have saved the drawing

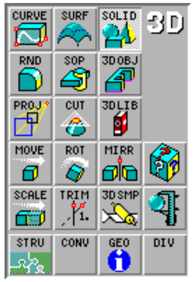
② *Enter your name:*

A short period of calculation ensues and then the converted and trimmed section of the drawing appears in the FORMPLOT frame

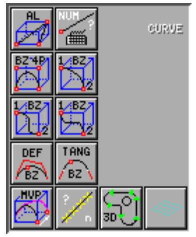
The procedure can also be used for screenshots (preferred sections) in 2D projections. Vertical lettering will also be generated in this case.

CHAPTER 5

The 3D menu area



3D Lines/Curves



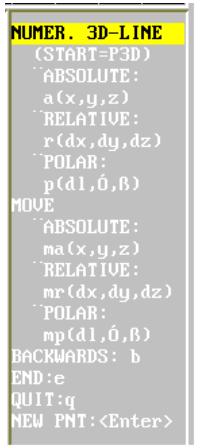
3D grid lines

3D polylines with a snapping grid. A quadratic marking will be shown in the case of object snapping

YOU NEED:

- ❑ an existing 2½D or 3D objects which can be selected with the crosshair and create the corner point of a 3D polyline.The set group parameters for object snapping will thus be taken into account.

3DLINE



Draw a 3D line numerically (3DLINE.PRC)
Drawing lines or achieving movements through the input of numerical co-ordinates (absolute, relative, polar). A small instruction window appears as shown to the right as a design support.

① *3dline(0,0,0)*: r100,100,0 ↵ (Example)

The starting point is contained in the brackets. You then enter a command letter according to the type of design (here r is for relative), followed by entries for co-ordinates or dimensions.

Pressing ↵ (without a value) allows you to establish the starting point manually. The crosshair snaps onto the existing object.

pt=100,100,0

> The command line must not contain any spaces!

② *3dline(100,100,0)*: r0,0,100 ↵
whereby rx,y,z are the relative co-ordinates of he next 3D point.

③ *3dline(100,100,100)*: e ↵ exits the procedure. The “e” stands for “exit”

3D-BEZIER-KURVE

Draw 3D Bezier curves on the basis of 4 points
The 3D Bezier curve will be created from an open polygon with three sides and the selected 3D points are the support points for the Bezier curves. Four points must be selected for each section of curve, whereby selection points 2 and 3 do not lie on the curve.

Select 3n+1 points ①

① *Select the first point. . .*

You must select at least 4 points. If more than 4 are selected (..7,10,13..) then an open curve line is created with bending points where there is a connection to the part Bezier.

Exit: Border menu or Polyend F6

3D-BEZIER – horizontal/vertical

3D-BEZIER – horizontal

3D-BEZIER – vertical

Insert a 3D Bezier - in the direction of the tangent: Vertical on the first and second point

SUPPORT POLYGON – to the Bezier curve

Generate the definition poly line (three edges) to an existing Bezier curve (deployable both in the 2D and 3D areas). Definition polylines connect the support points from the Bezier curve. Points 1 and 4 are in exactly the same location as the beginning and end of the Bezier curve. The procedure recognises whether the starting object is a 2D or 3D object and generates the same type of objects.

TANGENTS – on a Bezier curve

Generate tangential straight lines at the end of a Bezier curve
The generation of a seamless transition from Bezier curves into straight lines (the length is variable)

① *Length of the straight line <100>*

② *Select a Bezier curve*

POINT CORRECTION

Move points from 3D polys or Beziers while keeping the tangents
If there is no object which is active, the system produces the message:

① *Select an object*

② *Corner point of object 1:select obj1*
Select the point which should be moved

③ *Select the target point*

④ *Corner point of object 1:select obj1. . .*
Repeat the process on the same object or exit the procedure with:

Exit: Border menu or Polyend F6

POLYPOINTS

Select a polygon and change the number of points

3DCONTUR – manual

Manual following of the 3 D contour (change of rotation direction) - duplicate

3D- GRID

A freely definable 3D grid for simple spacial orientation of the drawing object!

The 3D point grid is used in the same way as the 2D snap grid bit with the difference that this is not a virtual grid but is actually an object. It serves to provide exact spacial positioning of 3D objects to the nearest point.

① *Direction of the axis (x,y<z>):*

② *Height in the direction of the z axis <0>:*

ON OBJECT SNAP ON!

③ *Size of the grid surface <100,100>:*

④ *Spacing in the grid <10>:*

3D Surfaces

3D- HATCHING SURFACES

Generate a 3D hatching (not “full”) between point on a plane surface
Select, in the first instance, menu 2D6a or 2D6b in a suitable hatching pattern - the default value is ZERO.

① *Select the first point*

② *Select the second point. . .*

Exit: Border menu or polyend F6

The selection points must lie on a plane surface

Previously selected parts of straight lines will be highlighted in colour, closed surfaces will be highlighted in vilet.

CHANGING THE ORIENTATION OF THE SURFACES

Rotating the hatching surface vector - <Enter>: Turn, <ESC>: do no turn
Making later changes to the orientation of 2 ½ D hatching surfaces. Multi-activation of the command using selection of the hatching surface

① *Select the hatching surface*

Rotation the surface orientation
You can see this for most hatchings due to the 180º turn which has been made

Exit the procedure

3D- SURFACES

Generate 3D surfaces which are parallel to the z-axis: Enter the length of the edge, select the centre
Use the quadratic 3D surface to design intersecting curves, for example.

① *Length of the edge <100>:*

② *Centre point <0,0,0>:* Enter numerical co-ordinates - or -

③ *Select the centre point:* Select with the crosshair

BEZIER- SURFACES

The generation of Bezier surfaces from two, three or four border curves (3D Bezier curves)

The free-form surfaces which are generated are only facetted in the normal screen view. The shading screen view gives a smooth surface, in contrast to Coon surfaces.
Bezier surfaces can be modified later by changing the Bezier border curves forms and can also be smoothened using the menu “CONVERT”

YOU NEED:

❑ two to four 3D Bezier curves
These can be real 3D Beziers or 2D Beziers witn a transformation matrix (2 ½ D), that is curves which have been converted from the 2D projection

① *Select the first Bezier curv . . .*
The procedure finishes when the fourth Bezier has been selected. Early break-off with

Exit: Border menu or Polyend F6

MSREV

Rotate Bezier surfaces using surface vectors

COON- SURFACE

The generation of Coon surfaces (polygon meshes) from two, three or four border curves (3D polygons)
The Coon surfaces which are generated are facetted, which means that they consist of many plane surfaces. The later smoothing of 3D meshes is not possible.

YOU NEED:

❑ two to four 3D polygons

① *Number of the border curves 2-4 <4>:*
4 is the default value

② *Number of segments <20>:*
The memory capacity needed for the 3D meshing increases is in direct proportion to the number of segments required

3D-FUNCTION

Generate numerical meshes by entering a mathematical function

SUPPORT POLYGON – to the Bezier meshing

Generate a definition polygon to the Bezier meshing

BORDER CURVE – to the Bezier meshing

Generate the border curves of Bezier meshing

A PERPENDICULAR

Generate surface perpendiculars on volume operable surfaces (SOP.EXE)

SNORM

Generate surface perpendiculars on a surface by drawing 3 points and entering a length dimension
The length corresponds to the longest side of the selected triangle

① *Select the first point*
The first selection point is generally the vertex between points 2 and 3

② *Select the second point*

③ *Select the third point*

The nadir of the perpendicular lies on the straight line between points 2 and 3. The direction of rotation of the point selection determines the positive or negative position of the perpendiculars

MSPART

Changing the density of the meshing on selectable Bezier surfaces
If the quality of the surface on the Bezier surfaces or rotating bodies is not adequate, increase the number of meshing lines. This will give a better result for volume operations or when designing penetrating curves but requires more resources from the system.

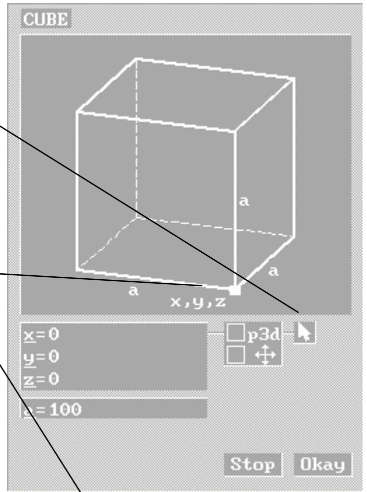
3D Bodies

The co-ordinates of the starting point and the dimensions of 3D objects are determined in the easy to use **pop-up menus** in which the inputted numerical values remain saved and are thus reproducible or correctable.

The numerical pop-up menus can be reached from all buttons which are on the bottom left in the form of a yellow triangle by **clicking on** them with the left mouse button and **holding it down**. The short mouse click (L) generally pulls up standard menus (input into the command line).

The numerical pop-up menu

- **Determining the starting point**
  When option P2D is activated, a previously established or calculated point will be adopted. Clicking the arrow key allows selection of the starting point with the crosshair. Keeping the "S" key pressed and multiple selection allows a number of objects of the same size to be generated.
- **Location of the starting point in the object**
  The starting point can, with the exception of spheres, be located either at the lower corner of the object box (x_{min}, y_{min}, z_{min} = default value) or concentrically
- **Entry field for the numerical data**
  Activate the entry field by either clicking on it with the mouse (L) or, even faster, by pressing the appropriate key (x,y,a,b..) on the keyboard!
  Confirm the entered data with <Return>



A flat surfaced body

THE CUBE

Create a cube by selection and the numerical pop-up menu

Point selection - with object snapping

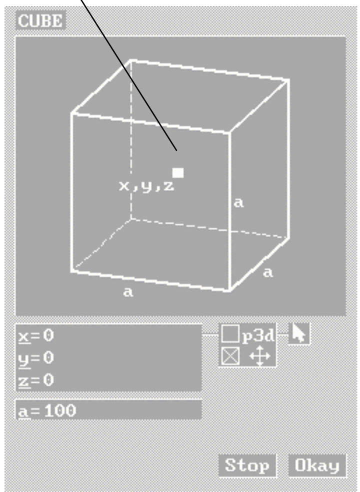
① The first selected point determines the origin

② the second determines the length of the side of the cube and the direction of the first side

③ the third establishes, according to the direction of rotation, the direction to the cube side which is perpendicular to the selection plane

The numerical pop-up menu

x, y, z	Co-ordinates of the starting point (absolute)
a	The length of a side



FLAT BLOCK

A dialogue and a pop-up menu

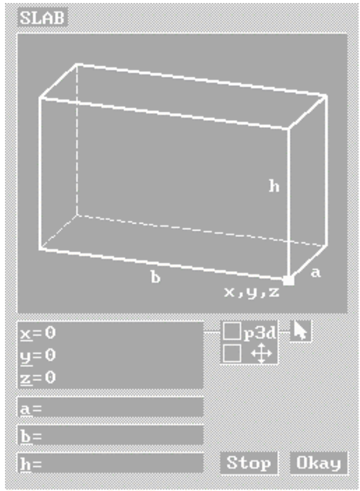
Point selection - with object snapping

① *Select the origin*

② Enter the dimensions in dialogue with the system

The numerical pop-up menu

x, y, z	Co-ordinates of the starting point (absolute)
a, b, h	Depth, width, height (relative)



FLAT BLOCK - manually

Generate a flat block by selecting all points; inclined four facetted prisms are also possible

① The first selected point determines the origin

② the following selection points determine the position of the three corner points and thus the position of the three body edges to the origin

A REGULAR PRISM

Generate a regular, straight prism with a maximum of 18 edges by selecting points (object snapping!) and a numerical pop-up menu.

Point selection – with object snapping:

Use the 3D grid while drawing:

① *Enter the number of corners (smaller than 18): <6>*

② *Enter the height of the prism <100>:*
Negative values are also allowed!

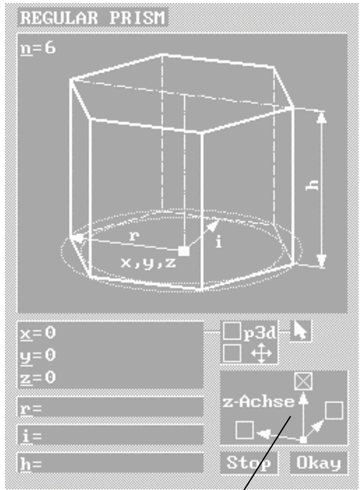
③ *Select the centre point*

④ *Select the starting point*
The starting point lies on the surrounding radius of the base surface

⑤ *Select further points from the base plane*
The location of the third point determines, according to the direction of rotation, the direction of the prism edges.

The numerical pop-up menu

x, y, z	Co-ordinates of the starting point (absolute)
n	The number of edges
r	The surrounding radius of the base surface
i	The inner radius of the surface
h	The height of the prism



Orientation of the central axis
Alignment of the object in the x,y,z directions(z is pre-set)

AN IRREGULAR PRISM

Generate an irregular straight prism by entering a height and by selecting points (object snapping)

Use the 3D grid while drawing

① *Enter the height of the prism <100>:*
Negative values are also allowed!

② Click on the corner points of the base surface (a maximum of 18). Do not close the polygon!
The direction of rotation of the selection points establishes the direction of the prism sides which are perpendicular to the selection plane

Exit: Border menu or Polyend F6

AN INCLINED PRISM

Generate an inclined prism by selecting points - the base and top surfaces lie parallel to each other.

Two parallel 3D grids are available here for selecting points

① Click on the corner points of the base surface (a maximum of 18). Do not close the polygon!
The direction of rotation of the selection points establishes the position of the prism
Finish point selection with

Exit: Border menu or Polyend F6

② *Select the height (to the first point*
You are also establishing the height and the angle of inclination at the same time.

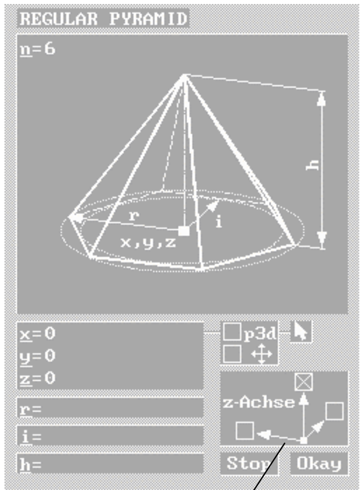
A REGULAR PYRAMID

Generate an equal-sided pyramid by selecting points and using a numerical pop-up menu.
The base surface is a n-cornered polygon with a maximum of 18
corners. The upper tip of the pyramid lies vertically over the centre point of the base surface.

Point selection - with object snapping:
To aid in the design use the 3D grid dialogue such as that for "**A REGULAR PRISM"**!

The numerical pop-up menu

x, y, z	Co-ordinates of the starting point (absolute)
n	The number of edges
r	The surrounding radius of the base surface
i	The inner radius of the surface
h	The height of the pyramid



Orientation of the central axis
Alignment of the object in the x,y,z directions (z is pre-set)

Rotary bodies

The bent surfaces of the rotary bodies are Bezier surfaces but the facetting is only visible on the screen as a line model - it appears with smooth surfaces in the shading projection.

The main factor which must be established for rotary bodies is the **orientation of the rotary axis**. Thus the first request from the system is:

① *Axis in the direction (x,y,<z>, a=free):* The rotation axis of rotary bodies usually lies in the direction
x,y or z (z is the default value) - this is also valid for all of the graphic pop-up menus (see the diagram)

a=free If you enter a, you establish the alignment of the rotary body as you are entering point selections in dialogue. In this case, the numerical input for the centre of the base surface is not required.

A STRAIGHT CONE

Generate a cone through selection and by using the numerical pop-
The tip of the cone lies vertically above the centre point.

Point selection - with object snapping:

① *Pole axis in the direction (x,y,<z>, a=free):*

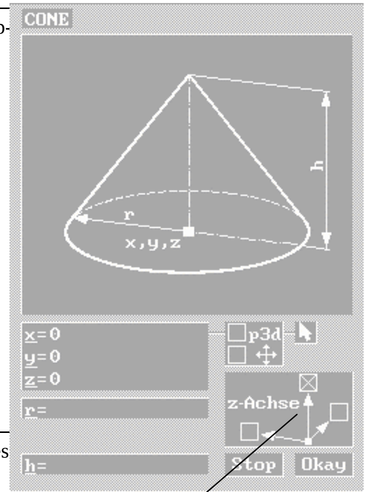
② *Enter a height <100>:* [1]

③ *Select a centre point*

④ *Select a radius* - select a radius with the crosshair

The numerical pop-up menu

x, y, z	Co-ordinates of the starting point (absolute)
r	Radius of the base surface
h	Height of the cone



Orientation of the rotary axis

A TRUNCATED CONE

Generate a truncated cone - the base and upper surfaces are circles

Point selection - with object snapping:

① *Axis in the direction (x,y,<z>, a=free):*

② *Enter a centre point <0,0,0>:*

③ *Height of the truncated cone (a section)*

④ *Radius* - of the base surface:

⑤ Height: - of the starting body. A negative value changes the alignment

[1] The values in <sharp brackets> are default value which can confirmed with <RETURN>

A STRAIGHT CYLINDER

Generate a cylinder through selection and by using the numerical pop-up menu. The base and upper surfaces are circles. The cylinder wall lines and the axis of rotation are perpendicular to the base surface>

Point selection - with object snapping:

① *Polar axis in the direction (x,y,<z>, a=free):*

② *Enter a height <100>:*

② *Select a centre point*

③ *Radius:*

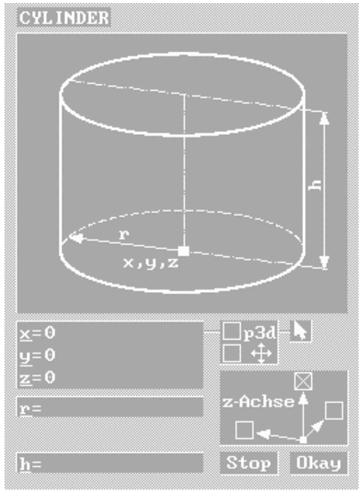
④ *Height:* - A negative value changes the alignment

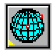
The numerical pop-up menu

x, y, z Co-ordinates of the starting point (absolute)

r Radius of the base surface

h Height of the cylinder
A negative value changes the alignment





A SPHERE

Generate a sphere by selecting points and by using the numerical popop menu

Point selection - with object snapping:

① *Polar axis in the direction (x,y,<z>, a=free):*

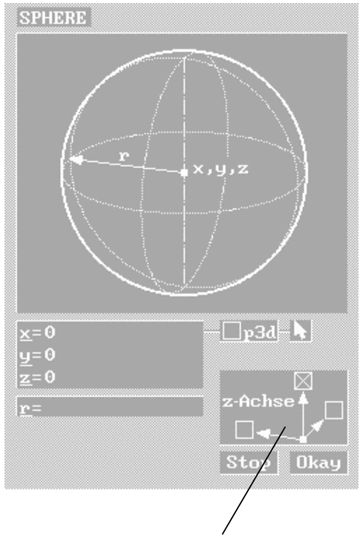
② *Select the centre point*

③ *Select the sphere point*
The selected point establishes the radius of the sphere

The numerical pop-up menu

x, y, z Co-ordinates of the starting point (absolute)

r Radius of the sphere



Orientation of the rotary axis

A HALF SPHERE

A full sphere which has been cut in half through the equator - numerical: enter the centre [=P3D], the polar axis and the radius. The half sphere is open on the cut surface and thus has limited use in volume operations (see below):

① *Polar axis in the direction (x,y,<z>, a=free):*

② *Enter the centre point <0,0,0>:*

③ *Radius:* Entering a negative value changes the alignment of the half sphere

THE TORUS

The torus is created when a circle with a radius S is rotated about a line in its plane at a definite distance G from the rotation centre.

① *Axis in the direction (x,y,<z>, a=free):*

② *Enter the centre point <0,0,0>:*

③ *Radius <[G,]S>:* **60,10** ↵ AS AN EXAMPLE !

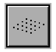
In this case you obtain a torus with an internal diameter of 100 and an external diameter

A 3D POINT

Select a 3D point (when in POLYEND: Enter) and store in the variable P3D
Measuring and defining 3D points as a basis for 3D drawing

A CENTRE

Determine the centre of the 3D box of the current 3D object and define the centre as a 3D point



3D- GRID

A freely definable 3D grid - a drawing object!

3D Rouding

ROUNDNG CORNERS

The production of tools to round off corners

① *Radius:*

② *Select the corner:* - which should be rounded

Click on the edges of the two surfaces either side:

③ *Select the first surface*

④ *Select the second surface*

Exit: Border menu or Polyend F6

⑤ Subtract the rounding tool(s) from the basic object you are working on

ROUND OFF EDGES - “Suitcase corners”

The production of tools to round off corners

① *Radius:*

② *Select the first edge*

③ *Select the second edge*
The first and second edges establish the pole of the eighth of a sphere

④ *Select the third edge:*

Exit: Border menu or Polyend F6

⑤ Subtract the rounding tool(s) from the basic object you are working on

AN ALTERNATIVE:

The procedure “3dc1” allows you to generate the “Suitcase corners” automatically by clicking on three rounding tools (of the same radius!).

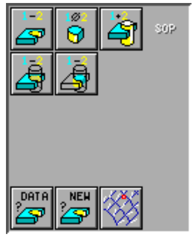
SUBTRACTION

A volume operation: the difference between two solid objects

MSREV

Rotating Bezier surfaces using surface vectors

3D Volume operations



Quantatively theoretical connections always require two starting solid objects which are then a connected to a third complex volume.
The surface quality of the new volume object is made worse through this volume operation since all of the Bezier surfaces are converted into facetted surfaces (not those on the starting object). It is necessary to increase the number of meshing lines when there are high demands on the generated surface.

DIFFERENCE CUT-OFF AMOUNT SUM

Volume operations with two solid objects
Both starting objects will be deleted
Before calculating the connected volume, **isy** automatically makes a back-up copy of the currently active memory buffer.

① *Select the first object*

② *Select the second object*

When using “Difference”, the starting body which you select first is the **workpiece** and the second starting body is the virtual **tool** which is to do the “machining”. The order in which selection is made is not important for “Cut-off amount” and “Sum”,.

DIFFERECE CUT-OFF AMOUNT

A volume operation on two solid objects
The starting body remains intact and will not (Bezier surfaces!) be converted into polygons

SOP-DATA

Calculate and show the volume of the currently active object in cubic units (GDU^3), and the surface will also be shown in GDU^3 at the same time
The unit (GDU) can be a millimetre, a centimetre or a metre depending on the application.

SOP-NEW

New orientation of volume objects which have previously been generated with SOP and conversion of the surface limited body into a volume.
The surface limited body must be surrounded on all sides without a gap by 3D hatching or 3D surfaces. Use a line model as a scaffold. You only obtain a volume when the individual cover surfaces are orientated in the correct way:
The perpendiculars to the surfaces must be pointing outwards. Therefore, select the corner points of the hatching surfaces from the outside when seen in terms of the mathematical direction of rotation (anti-clockwise).

① Create a macro in the individual surfaces
The polygons from an existing line model in the macros will be deleted on conversion!

② The active macro will be processed when one clicks on the command.

SOP-N

Generate surface perpendiculars on volume operable surfaces (SOP.EXE)

The 3D Object

3D-EXTRUSION – elevation of the z-axis

Extrusion of a even closed contour by entering values for height and the slope of the form

YOU NEED:

❑ a closed curve, consisting of 2D, 2 ½ D or 3 D polygons and/or 2D, 2 ½ D or 3 D Beziers

① *Select an object*

② *Height:* - Negative values are also allowed.

③ *Angle:* 0 Other values give a slanting off all of the way round.

3DSOL

Generate a numerical flat block _ menu: 3D regular solid object

3DBAND

Draw a 3D band between two contours (3D or 2.5 D polygons or Beziers)
The contours must consist of the same number of part straight lines

① *Select the first 3D polyline*

② *Select the second 3D polyline*

3DBAND – triangles

Draw a 3D band (triangles) between two contours (3D or 2.5 D polygons or Beziers)

ROTATION

Generate 3D rotation bodies with Bezier meshings

YOU NEED:

❑ a 3D straight line as a rotation axis and a Bezier curve (2D or 2 ½ D)

① *Select the starting object*
Select the Bezier curve

② *Select the rotational axis* (3D)
A rotational object will now be generated when the starting object is a 2 ½ D curve

③ *Select the 2D rotational axis*
This system response arises only when the starting object is a 2D curve.

PART ROTATION

Generate a segment of a 3D rotational solid object with Bezier meshing - an open one.

① *Select the angle range <0..180>:*
The default value is a 180º part rotation

② *Select the starting object*
Select the Bezier curve

③ *Select the rotational axis* (3D)
A rotational object will now be generated when the starting object is a 2 ½ D curve

④ *Select the 2D rotational axis*
This system response arises only when starting object is a 2D curve.

OBJECT OVER A CURVE

2D-Objekt am selektierten Punkt über eine 3D-Polygon ziehen

YOU NEED:

❑ a 2D object which has been generated (polygon or Bezier curve) and a 3D primary line (polygon curve)

① *Select the starting object*

② *Select the 3D curve*

③ *Select the centre point*
The centre point is, for example, the centre point of a Bezier circle or the point on a polygon which will be pulled over the primary line.

CROSS OVER

Pull a 2D object over a 3D Poly with cross over to a second 2D object of the same structure

YOU NEED:

❑ two concentric 2D objects (polygons or Bezier curves) and a 3D primary line (polygon curve)

① *Select the starting object*

② *Select the second starting object*

> The second generated object must have the same structure as the first object (the same number of points, or the same number of Bezier part line stretches).

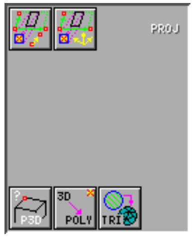
③ *Select the 3D curve*

④ *Select the centre point*
The centre point is generally the common centre point of the two starting objects

3DPLANE

Generate a Z parallel 3D surface: Select cente point, enter the length of the edge

3D Projection



PROJ3-V

3D projection of the active object onto a plane (3 points) in the direction of a 3D vector (2 points).
First of all switch on “DUPLICATE” in the global menus if you will still need the starting object.

① *Select the first (..second,.. third) point on the projection plane*

② *Select the first (..second) point in the directional vector*
The directional vector establishes whether the object is projected vertically or at a particular angle onto the selected plane.

PROJ3-P

3D projection onto a plane (3 points) in the direction of the axes (X,Y, or Z)

P3D

Select a 3D point (for POLYEND: Enter) and store it in variable P3D

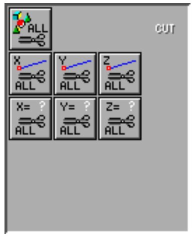
TO3DPOL

Convert an active 2.5D object or 3D object into a 3D polygon

HA-TRI

Convert a 3D hatching into triangular meshing with a numerically defined side length

The 3D Cut-out



isy uses the EXE file “IFACES” which is to be found in the path IST/TOOLS to calculate auxiliary cuts and penetration curves. Make sure, when installing the software, that this path is noted in the AUTOEXEC.BAT of your computer.

AN EXAMPLE:

```
PATH C:\;C:\WINDOWS;C:\WINDOWS\COMMAND;C:\ISY;
C:\ISY\TOOLS
```

AUXILIARY CUT

Generation of penetration curves (3D polygon lines) for a 3D body of your choice
The calculated curves are separate objects and can be seen in isolation. The quality of the curve depends on the facetting of the 3D solid object. A finer subdivision gives better curves but a price is paid in greater calculation times and higher memory requirements.

Generate cuts from all objects, one after the other, as 3D polygons (time!)
Generate the auxiliary cuts parallel in the three projection planes. The calculated contours of the cut surfaces are 3D polgon lines.

① *Cut* in the direction <z>:

② *Height of the cut in the direction z or the interval <150..0, -10>:*
Here you establish what height the cutting plane should be at.

INT-PX

An x-parallel cut through “everything” at the selected position (3D poly)

INT-PY

An y-parallel cut through “everything” at the selected position (3D poly)

INT-PZ

An z-parallel cut through “everything” at the selected position (3D poly)

INT-PNX

An x-parallel cut through “everything” using a numerical input (3D poly)

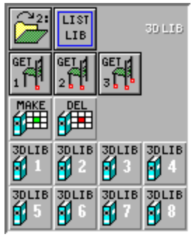
INT-PNY

An y-parallel cut through “everything” using a numerical input (3D poly)

INT-PNZ

An z-parallel cut through “everything” using a numerical input (3D poly)

The 3D Library



LIBLOAD

Load the library (drawings file) into memory buffer no. 2

LIB-LIST

List all of the objects in the buffer symbol, usually in memory buffer 2

GET3

Position 3D library elements out of buffer 2 using a reference point

GET3-2

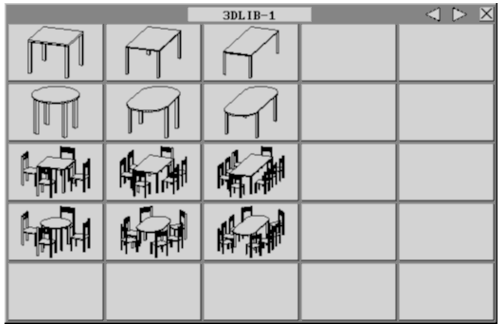
Position 3D library elements out of buffer 2 using 3 reference points

GET3-3

Position 3D library elements out of buffer 2 using 3 reference points

3DLIB-MAKE

Insert the current drawing as a 3D library element. The current drawing will be prepared as a library element (packed) and inserted into a path which was made when **isy** step by step was installed. The element so generated can be copied later into Buffer 1 with a mouse click. The “thumbnail” view shows the actual perspective of your drawing.



① First of all name the library element: *Enter name (maximum 8 digits!):* - a request for newly created objects or, (for already loaded objects) *Accept the library element as “Name” or give a new name?*

② *Which 3D library should be modified <1> ..8?*
Enter *here* the number of the desired pop-up menu.

③ *Click on the desired button ...*
Click in the button on which the library symbol should appear. Some calculations take place and then the modified pop-up menu appears.

3DLIB-DEL

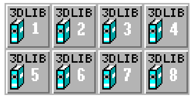
Entry into the 3D library

① *Which 3D library should be modified <1> ..8?*
Enter here the number of the desired pop-up menu.

② *Click on the desired button ..*
Click on the library symbol which should be removed

③ *Button n was deleted*

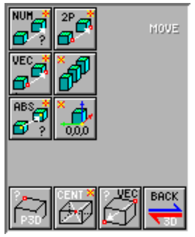
④ *Delete library file “name.vec”? Yes/No*
The file which should be deleted here is located on the special path C:**ISY**\LIB. Such a file in the standard vector path will not be deleted.



3DLIB-1 to 3DLIB-8

Call up a 3D library

3D Moving



RELATIVE – dx, dy, dz

Numerical 3D moving of the active object
The active object or macro object is moved from its original position by the difference value. The co-ordinate entries are made numerically.

① *Difference value (dx, dy, dz):*

NEW BOX: 0,0,0..100,100,100 (an example)

SNAP END - point on point

Snapping 3D moving of the active object: selection of two points
(can also be used with macro objects)

① *Select the starting point*

② *Select the target object*
Click on the desired target point on the target object.

NEW BOX: 0,0,0..100,100,100 (an example)

WITH A VECTOR

Onetime or multiple moving of the active object by the value of the previously selected vector.

① Select the required translation vector before calling up this command using the command 3D-VECTOR

② Every mouse click on the command key moves the active object by the value of the vector

MOVE dx, dy, dz: 0,0,50
NEW BOX: 0,0,0..100,100,100 (an example)

DYNAMIC MOVING

Dynamic moving - keep an eye on the information line!
Move the active object by the same interval each time using the keyboard (keep a visible check at all times!)
The running co-ordinate indicator also offers numerical control of the moving vector at the same time.
Area of use: Explosion views, moving fixtures , translational duplication

① *Distance <10>:* The moving interval

② Position using the cursor and the screen keys

← →	+ / – in the X direction
↑ ↓	+ / – in the Y-direction
Page Up, Page Down	+ / – in the Z-direction
↵	45° rotation around the Z-axis. The starting body remains as a virtual image for better orientation and disappears at
Esc	Ending the procedure

ABSOLUTE

Move the box centre of the active object onto a 3D point

① *Enter the new position for the object centre <0,0,0>:*

Enter the co-ordinates of the 3D point numerically or select them before executing the command using "POINT" (see above).
Please note that the centre of the object box does necessarily have to be the centre of the enveloped body!

NEW BOX: 0,0,0..100,100,100 (an example)

TO THE ORIGIN

Move the active solid object to the origin (the corner of the space in the first octant).
The first three co-ordinates of the object box will be set to 0,0,0 which means that it covers the co-ordinates origin.

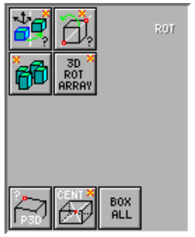
3D-POINT CENT CENTRE 3DVECTOR

Description as for "3D Measurement"

3DSCBACK

Undo 3D scaling - reverse it

3D Rotation



For a description see “3D measurement”

ROTATION - around the centre

Rotate the active object around the x,y,or z axis with requests concerning the values of the angle and the point of rotation

① *Angle:*

② *Axis of rotation (x,y,<z>:*

③ *Co-ordinates of the point of rotation <0,0,0>:*

ROTATE AROUND THE 3D AXIS

Rotation around a freely selectable 3D axis with requests concerning the value of the angle as well as the axis for the second point. Rotation of the active object around a 3D axis to be selected
The position of the 3D axis in space is a matter of choice.

① *Rotation angle:*

② *Select the first point of the axis:*

③ *Select the second point of the axis:*

DY3DROT

Dynamic rotation of the active object by the interval each time - keep an eye on the information line! Using the cursor key, a drawing object can be visibly rotated around its own or any other selectable centre. The starting object remains visible for control purposes. The current angle of rotation will be shown. The procedure functions in every perspective.
Area of use: Simulating rotating movements, collisions, generation of an axial 3D rotation arrangement when DUPLICATE is switched on

AN EXAMPLE:

① Angle of rotation <10>:

② Rotation axis (x,y,<z>:

③ Roation point <0,0,0>(*=centre):*

④ Rotate using the cursor keys:

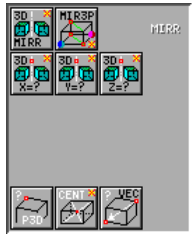
← → Reduce or increase the ange of rotation

Esc Exit the procedure

3DROTARR

A rotation arrangement of a 3D object around a freely selectable 3D axis

3D Mirroring



MIRRORING - numerical

3D mirroring of the active object around <P3D> in the 3D axis direction

① *Mirroring in the direction (x,y,or <z>)?*

② *Coordinates of the mirroring point <0,0,0>:*

3DMIRR-P

3D mirroring on a plane to be selected which is defined by 3 points

① *Select the first point of the plane:*

② *Select the second point of the plane:*

③ *Select the third point of the plane:*

This command makes it possible to mirror 3D objects in any desired direction

MIRROR – in the x direction

MIRROR – in the y direction

MIRROR – in the z direction

3D mirroring in the Z direction on the co-ordinate which is to entered

3D-POINT **CENTRE** **3D-VECTOR**

See “3D Measurement” for a description

3D Help functions

HIDDEN

Hide covered edges

_3ANS

Convertion of 3D objects to the three board system

_3ANS-H

Convertion of 3D objects to the three board system (hidden)

LINE MODEL 3D

Convert a 3D object into a 3D polygon (covered edges will be hidden)
Convert a complete 3D volume body or a surface limited solid object into a line model - all edges become visible

> The perspective which has been set is decisive for the 2D view. The projection plane corresponds to the drawing.

COVERED

Convert 3D objects into 2D polygon (hide covered edges)
Convert a complete 3D volume body, surface limited solid object into a 2D polygon - only visible edges will be shown

LINE MODEL 2D

Convert 3D objects into 2D polygon (all edges). Convert a complete 3D volume body, surface limited solid object or all line models into a 2D polygon - all edges are visible

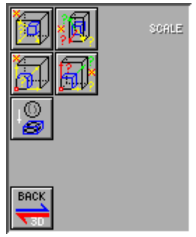
MARK POINTS

Mark points on the object to be selected

2.5D STANDARDISATION

All t2 matrices of the current 2.5 D objects will be standardised
Standardisation is, for example, recommended when processing hatching in a drawing level with 2D commands. Hatching patterns which appear distorted after transformation will be restored.

3D Scaling



NUMERICAL SCALING – using a factor

Scaling (with a factor) of the active 3D object around its own centre - numerical increasing or decreasing of the size

① *Enter the scaling factor:*
Scale the starting object proportionately by entering a value

DISTORTION

Distortion (using 3 factors) of the active 3D object around its own centre

① *Enter the scaling factor (dx, dy, dz):*
Entering three different values scales the object disproportionately and thus deforms it.

AN EXAMPLE:

1,1,2 means that the dimensions of the starting object will not be changed in the x and y direction but will be doubled in the vertical direction (y=2).

3DSCALE2

Scaling (using a factor) of the active 3D object around a point
As above, but the object centre can also be selected with the crosshair.

3DSCALE4

Scaling (using 3 factors) of the active 3D object around a point

FITTING INTO A BOX

Fitting a 3D object's object into the box belonging to the active object - with distortion

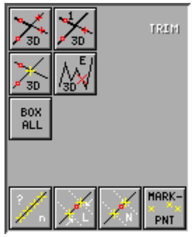
① *Select an object*

Object found: obj...

3DSCBACK

UNDO/REDO 3D-scaling

3D Trimming



TRIM3-M

Trim pairs of 3D polygons (lengthen or shorten up to the cut-off point)

TRIMMEN – only trim the first element

Trimming the first selected 3D polygon (lengthen or shorten up to the cut-off point)
The 3D straight lines must lie on one plane!

① *Select the first straight line*

② *Select the second straight line*

INSERT A POINT OF INTERSECTION - in 2 elements

Splitting of two 3D polygons (insert a point at the point of intersection)
Insert additional 3D points (ma’s) at the points of intersection on the 3D lines)
The 3D straight lines must lie on one plane!

① *Select the first straight line*

② *Select the second straight line. . .*

Exit: Border menu or Polyend F6

> The inserted points of intersection are not visible at first !
>
> Check with MARK-PNT “MARK POINT”

DELETE ELEMENT

Delete individual elements out of 3D polygon lines and 3D curves (from point to point)
Deleted Beziers are lost completely.

① *Select the straight line or Bezier curve which should be deleted. . .*

Exit: Border menu or Polyend F6

BOX

Re-calculate all of the object dimensions (BOX)

PPTS

Select a polygon and change the number of points in it

PART-L

Splitting a given stretch into segments according to a (maximum segment length)

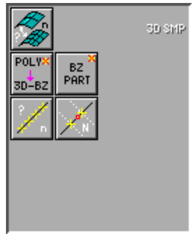
PART-N

Splitting a given stretch into segments according to their number

PNT-MARK

Mark points on the object to be selected

3D Smoothing



MSPART

Change the meshing densiity on selectable Bezier surfaces

SMP3-Z

Smoothing a 3D polygon - conversion into a 3D Bezier curve

BZPART

Change the number of segments in a Bezier curve

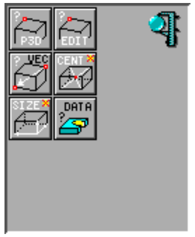
PPTS

Select a polygon and change the number of points in it

PART-N

Splitting a given stretch into segments according to their number

3D Measurement



3D-POINT

Select/scan a 3D point (for POLYEND: Enter) and store it in variable P3D
The measurement and definition of 3D points as a standard for 3D designs

① *3D point select/scan*
Select the desired point with the crosshair

3D point co-ordinates (P3D): 100,100,100 AN EXAMPLE!

If you click on the menu instead of selecting/scanning a point, a pop-up menu appears with further point options.

EDIT A 3D POINT

Select/scan a 3D point (for POLYEND: Enter) and display it in the EDITOR

① *3D point select/scan*

Show the selected point in the Editor

Esc Switch back to the graphics screen

3D-VECTOR

Measure a 3D vector by selecting/scanning 2 points and store in the variable VEC3

① *Select the first point*

② *Select the second point*

vec3=

x1,y1,z1..x2,y2,z2	Point co-ordinates (from..to)
l	Length of the vector
dx	Difference value in the x direction
dx	Difference value in the y direction
dz	Difference value in the z direction
ah	Absolute angle in the horizontal plane
av	Absolute angle in the vertical plane

CENTER3

Determine the centre of the 3D box for the currently active object

SIZE

Measure and display the size of the currently active 3D object (3D box)

Calculate and display the maximum dimensions of the active object, that is the size of the object box.
The object box will be shown initially in cyan.

size:

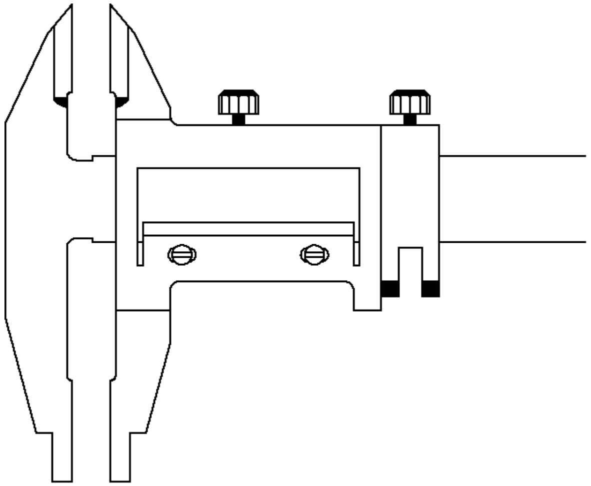
Object=1:Name	current buffer, name of the selectable object
3D=x,y,z	largest width, depth and height

SOP-DATA

Select the solid object display the volume and area

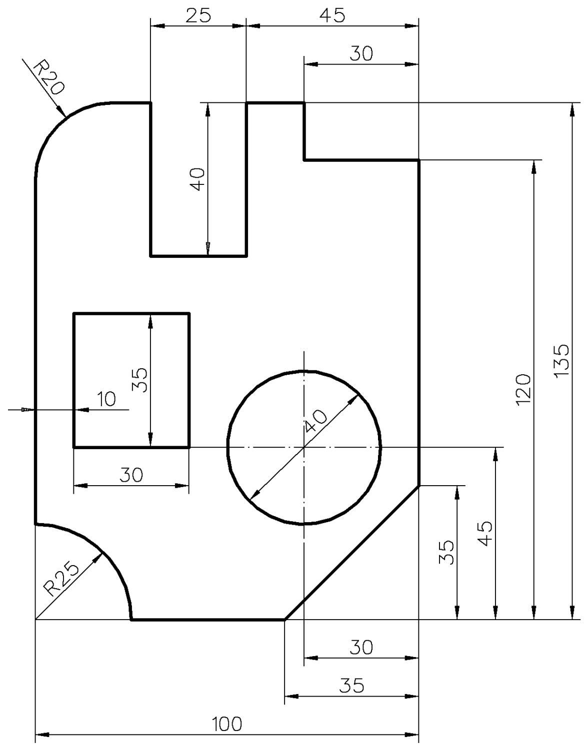
CHAPTER 6

2D-Design techniques



2D-Design

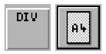
A flat workpiece



Task:

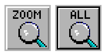
A flat workpiece (see the drawing on the right) should be generated on the monitor screen using specific 2D design techniques.

Preparing the drawing area



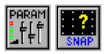
DIN A4-SHEET – portrait

The blue border is a FORMPLOT border for the true to scale output onto a printer or plotter



ZOOM EVERYTHING

Zoom the border to take up the whole screen in the middle of the drawing area.



GITTER

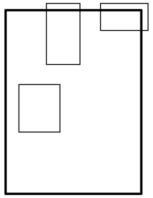
① Enter the spacing for the snap grid: 5 ↵ This value also sets the snap.

The set value will be displayed for checking purposes until the next change is made.

Drawing the basic shape

The starting form for this workpiece is a rectangle with the dimensions 100 x 135 mm. The drawing size was chosen in such a way that the workpiece can be drawn in the middle of the A4 sheet at a scale of 1:1.

RECTANGLE



① *Draw the first diagonal point*
Move the crosshair to the lower left corner of the border. This, in this case, is the co-ordinates' origin. Moving the crosshair upwards and to the right increases the x and y values on the co-ordinates indicator. Position the crosshair on the point 55,80 and click on this point to fix it..

② *Draw the first diagonal point*
Set the co-ordinates display to 0,0 with the Esc key.
Now measure the relative size of the rectangle from this point:
Move the crosshair to point 100,135 and click on this point to fix it.

The rectangle will be generated on the point which you have established.

Generate tools for changing the characteristics of rectangles

RECTANGLE

A step, a groove and a breakthrough will be generated according to the measurements which are entered. The three rectangular corners of the baisc shape serve as reference points during positioning. The following elementary steps are always the same:

① *Enter the first diagonal point*
Position the crosshair on a reference point set the co-ordinates display to 0,0 with the F3 key. Move the crosshair to desired position while watching the co-ordinates as they change in the display and click on this point to fix it.

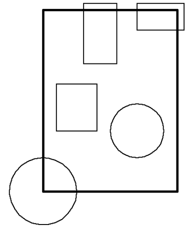
② *Enter the first diagonal point*
Set the co-ordinates display to 0,0 with the F3 key. Now set the size of the rectangle relative to this point and click on this point to fix it.

> Completed dimensioning saves you long-winded conversion calculations for all of these steps.

Drawing in a circle

isy step by step basically offers various ways of generatimg a circle for various applications. Since this workpiece only possesses dimensions which lie in the snap grid, manual point selection using the crosshair can be used here.

A CIRCLE - centre and point on the circumference



① *Select the centre*
Click the lower left corner of the basic shape.

② *Select the point on the circumference*

You can outwit the object snap is the following way:
Set the co-ordinates display to 0,0 with the F3 key. Now set the radius of the circle by moving the left: move the crosshair to the point -25,0 and click on this point to fix it.

A CIRCLE - centre and point on the circumference

① *Select the centre*
Move the crosshair tom the lower right hand corner of the basic shape.
Set the co-ordinates display to 0,0 with the F3 key.
Move the crosshair to the point -30,45 and click on this point to fix it.

② *Select the point on the circumference*

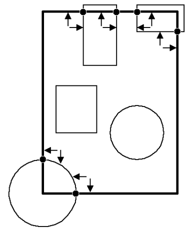
You can outwit the object snap is the following way:
Set the co-ordinates display to 0,0 with the F3 key. Now set the radius of the circle by moving the right: move the crosshair to the point 0,-20 and click on this point to fix it.

Deleting superfluous elements

MARK POINTS

In a different way to which our eyes work, the CAD system only recognises a point of intersection when it is defined as such. You can then perform a check by marking the drawing point.

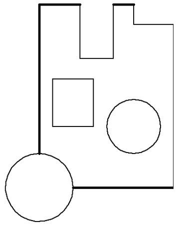
INSERT A POINT OF INTERSECTION



① *Select the first element*

② *Select the second element. .*
Always click two elements together alternately which should contain the point of intersection. The additional points always occur in both of the elements which intersect each other and can be made visible with"MARK POINTS".

Exit: Border menu or Polyend F6

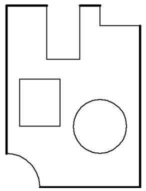


DELETE A PART POLYGON

Select the command PART POLYGON in the pop-up menu “DELETE”.

① Click all of the superfluous polygons or poygon lines. All deletion commands can be undone in the associated pop-up menu “MDEL” which can be obtained with a mouse click (R).

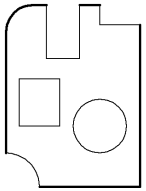
Exit: Border menu or Polyend F6



DELETE A PART CIRCLE

Since the three quarter circle at the bottom left is not a part polygon but an element, you need the command “DELETE ELEMENT”
The command cannot be undone.

Trimming



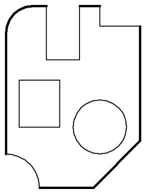
ROUND OFF

① *Rounding radius <10>:*20
Thus radius remains as the default set radius unlike the next change.

② *Select the first element*

③ *Select the second element*
Click on the two straight lines which lead to the edge which should be rounded.

Exit: Border menu or Polyend F6



SLANT OFF

① *Distance from the edge <10>:* 35
The distance from the edge remains the default set dimension unlike the next change.

② *Select the first element*

③ *Select the second element*
Click on the two straight lines which lead to the edge which should be slanted off.

Exit: Border menu or Polyend F6

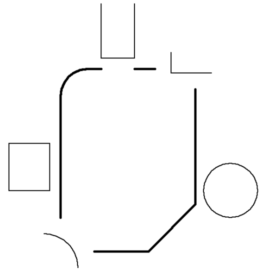
BOX ALL

The object boxes of the trimmed drawing components couild be a source of difficulty. The object box of the quarter circle still has the original size of a full circle, for example. It is possible that the quarter circle will not be embraced within the macrto which will be made afterwards. BOX ALL actualises all object boxes.

The steps for the 2D DESIGN WORK have now been completed.

Save the work with save ü-01

Making corrections to a drawing



The drawing now consists of a number of individual objects. (see the diagram). This has certain disadvantages when working on the drawing later, as, for example when positioning the whole drawing.
A macro bundles the individual objects togther to make a whole. The part objects remain intact but can be further processed altogether.

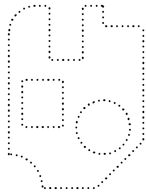
CREATE A MACRO

① *Enter a macro name <>:* Sheet metal

② *Select the first object for 1: Sheet metal*
Draw a selection window around the whole worksheet which is large enough to have large spacing around it

③ *1: Sheet metal lies in drawing plane 0*

All of the drawing components which are contained in the macro will be coloured.



THE MACRO OBJECT

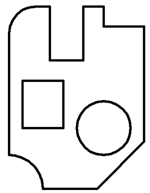
When you are completely sure that the position or form of the individual objects in the macro object no longer need to be changed, it useful to fuse the sub-objects in the macro object “Sheet metal” into a single object with the name “Sheet metal”.

① *Enter the macro name <>:*

② *All of the objects in Macro 1:Sheet metal will be lost - Are you sure?*
Click on “Yes”

The packed object does not differ externally from the starting object. If you select a particular object point, however, the whole object will be activated. You can recognise this from the special selection colour.

CHANGE COLOUR



In order to obtain a standard print-out onto, for example, a PostScript Laser Printer, the colour of macro object “Sheet metal” must be changed:

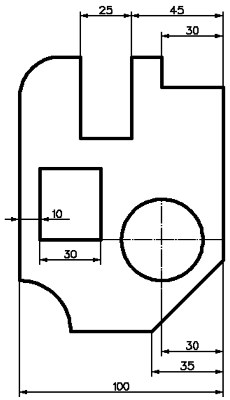
While the macro object or the packed object is still active, hold down the Control key and click with the mouse button on the colour white (8) in the border menu “COLOUR”. The whole object will be coloured white. On a PostScript Laser Printer this corresponds to the line strength 0.7.

The steps for the RETROSPECIVE WORK have now been completed:

Save the work with SAVE Ü-02

Dimensioning

SETTING PARAMETERS

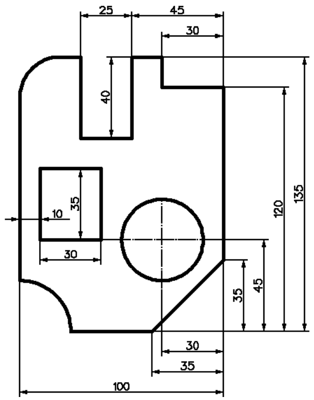


Click in the command block PARAMETER on the 0.7. Thus is how you set the font, the font size, the arrow length, the distance between the workpiece and the dimensioning lines, the jutting out of the dimensioning lines and the number of places of the standard range 0.7. The colour of the dimensioning from now on is the active line colour (varaible COLOUR). A mouse click on MULTI activates the multiple actuation of the dimensioning commands.

HORIZONTAL

Click on the stretch of line which should be dimensioned and establish the distance from the the measuring line to the body of the drawing with a right mouse click. This third selection point snaps on to the snap grid which was set up. If you are not happy with the measuring line spacing of 10 mm in the present example then set the snap grid, quite independently from the visible design grid, to 1 mm. This allows you to have 7 mm spacings with staggered measurements.

Exit: Border menu or Polyend F6



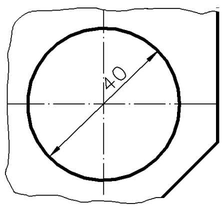
VERTICAL

In an analogue fashion to horizontal dimensioning, now the vertical measurements will be inserted. Do not forget to use the ZOOM function when positioning.

SPACING

When dimensioning the breakthrough it is possible in some cases to disregard the auxiliary measurement lines.The command DIMENSION
THE SPACING recognises the dimensioning direction to the selected points. When there are small spacings, first select the side on which the meaurements number should appear.

DIAMETER



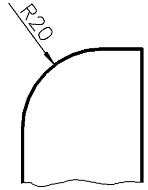
The measurement number first of all collides with the middle axis in this case. You have two possibilities to get around this:

1. Methode: Click on the option M.TEXT in the command block PARAMETER and enter a space with the keyboard followed by a measurement number. If you do not know what the meawsurement is then enter to % instead. This will then be replaced by the correct measurement. Do not forget to set the options back to their original condition.

> The string is a place marker for the measurement number.

2nd. Methode: Trim a gap in the middle axis (axes) which is (are) getting in the way.

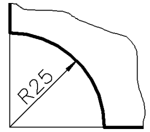
EXTERNAL RADIUS



To install a radius dimension from the outside, click on the circular arc outside the workpiece. The selection point determines the position of the dimensioning arrow.

RADIUS INNEN

To install a radius dimension from the inside, click on the circular arc inside the workpiece.
If necessary it is also posibble to extend the measurement line up to the middle of the radian point using Trimming . Click fiorst on the measurement line and then onto a drawing body edge or an auxiliary measurement line which sets the length of the measurement line.

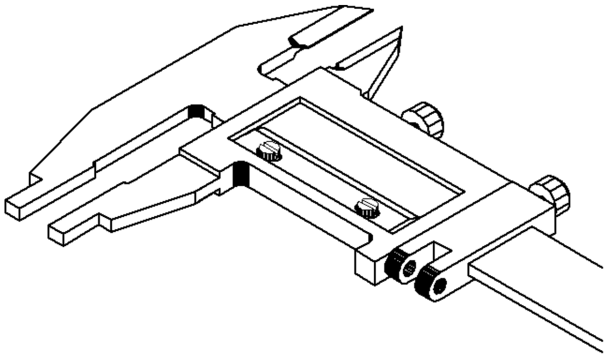


The steps for the DIMENSIONING have now been completed.

Save the work with save ü-03

CHAPTER 7

3D-Design techniques



3D-Design

Oh, what a sweet and wonderful thing this is, this perspective view!
Paolo Ucello (1397-1475)

A flat workpiece

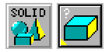
The task: The flat workpiece from the section “2D design” should now be generated using various 3D design techniques

The form of the starting shape is achieved in the **first design version** by developing differences. The procedure is similar the machining processes which occur in the metal cutting industry using machine tools (sawing, drilling/bording and milling). Thus is why we also refer to the processing bodies (units) as **tools**.

The required processing tools remain in the starting position at first and are not deleted (inserting them in a holder). In a process of subtractive connection with the starting solid object, which is the actual processing operation, they are to be moved in the z direction in order to obtain an exploded view.

Drawing the basic shape

The starting form for this workpiece is a flat block with the dimensions 100 x 135 mm. Use the numerical input menu to generate the flat block. (Place the menu cursor on the button press on it with the left mouse button until the menu appears).



FLAT BLOCK

① *Starting point:* **0,0,0**

These values are already present as default values in the upper input window and do not need to be changed.Enter the dimensions of the basic solid body:

② *Length (a):* **100**

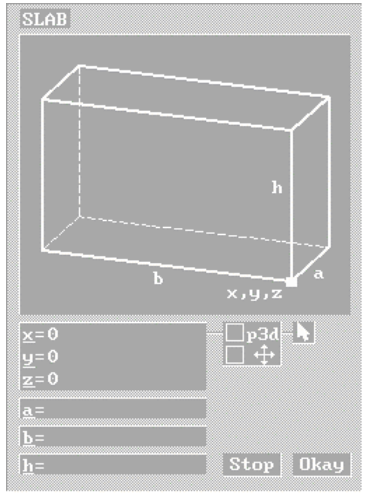
③ *Width (b):* **135**

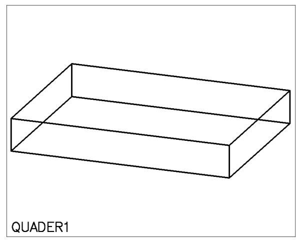
④ *Height (h):* **20**

⑤ Confirm the entries with a mouse click on “Okay” Or with .

The flat block will be generated at the position which was set. If you only see a rectangke in the lower left corner of the screen, select the desired perspective in the VIEW menu (here the diametry).

The **co-ordinates origin** can be recognised on the x/y marking arrows. With our flat block it is located below on the front edge.
The 3D screen markings, on the drawing area below on the right, serve to offer better spacial orientation.

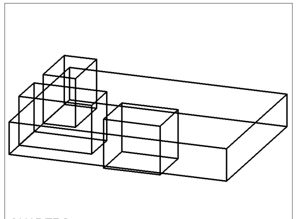




Quader as a tool for steps, grooves and breakthroughs

Take the position and the sizes of the 3 tolls from the following table. Compare the dimensions of the wi-thnthe dimensioned data from the 2D section. You can see that it is also possible here to use the manufactu-ring related domensioning to generate the workpiece quickly. The orientation of the location measurments at the co-ordinates origin (at the bottom left) will simplify the work even further.

SOLID	Step	Groove	Breakthrough
Starting point x,y,z	**70, 120, -5**	**30, 95, -5**	**10, 45, -5**
Length (a)	**35**	**25**	**30**
Width (b)	**20**	**45**	**35**
Height (h)	**30**	**30**	**30**

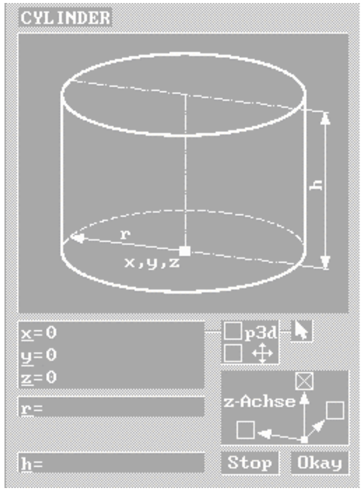

QUADER2

Not the oversize of the tools. It would be easier to generate the tools tight against the surface of the starting body but it is better to make all of the a little bigger in order to rule our errors from the very beginning which can occur when volume generating spacial bodies.

The cylinder as a tool for drilling and rounding off

Use the input menu “Straight circular cylinder” to generate the two cylinders which are required.
(Place the menu cursor on the button press on it with the left mouse button until the menu appears).

SOLID	Drill hole	Rounding off
Axis in the direction x,y,z	**z**	**z**
Centre of the base surface, x,y,z	**70, 45, -5**	**0, 0, -5**
Radius (r)	**20**	**25**
Height (h)	**30**	**30**



Rounding off

RND **ROUND OFF AN EDGE**

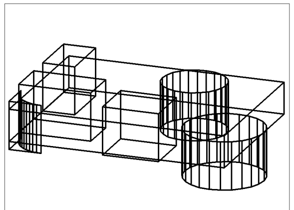
① Radius: **20**

② *Select the edge* - which should be rounde.
This is in vertical edge on the left the dimetric view, next to the edge of the drawing area.
Click on the edges of the two neigbouring surfaces:

③ *Select the first surface*

④ *Select the second surface*

Exit: Border menu or Polyend F6


QUADER4

Bevelling (chamfering)

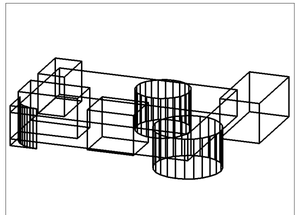
SOLID **QUADER**

① *Starting point*: **65,0,-5**
Enter here the dimensions of the basic body:

② *Length (a):* **60**

③ *Width (b):* -30 Note the negative sign in front

④ *Height (h):* 30


QUADER5

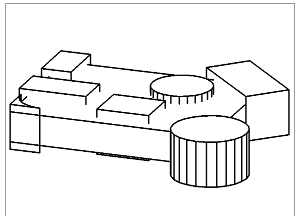
ROT **ROTATION** - about the centre

Rotate the Quader around an absolute 3D point

① *Angle*: **45**

② *Rotational axis (x,y,<z>:*

③ *Co-ordinates of the point of rotation <0,0,0>:* **65,0,-5**


QUADER6

Processing with volume operations

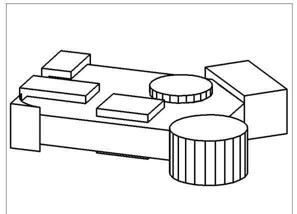
The command which is used here for the “Volume difference” works in such a way that just the first selec-ted body (1st object), in each case, is deleted. It is replaced by the processed body (3., newly calculated ob-ject). In this way the tools remain intact for the exploded view. A mouse click on “ERROR” returns the con-dition of the drawing back into the condition it was in before the volume operation.

SOP **DIFFERENCE**

① *Select the 1st. object* - click on the basic body

② *Select the 2ndt. object* - click on a tool

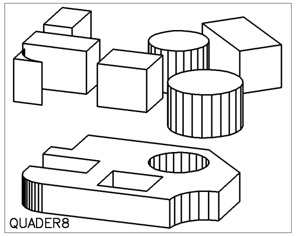
> When doing difference operations always click on the **workpiece first** and then on a tool.


QUADER7

Repeat the procedure for all changes.
Alternatively you could have made a packed macro out of all of the tools and perfomed all the volume operations in one pass.

The exploded view

DYNAMIC MOVING



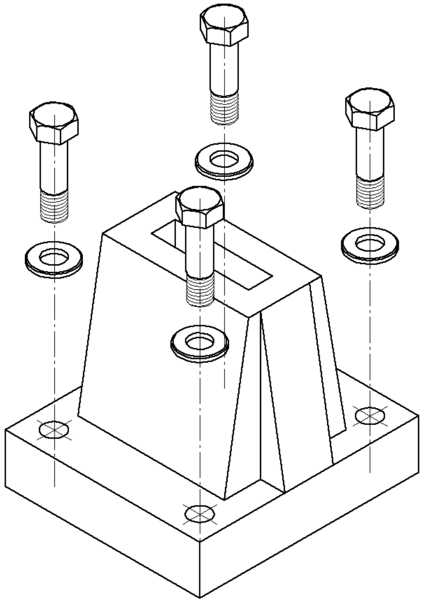
Activate the desired tool and move the activated object up to the correct height. The running co-ordinate indicator gives you continuous numerical control of the moving vector.

① *Stretch <10>:* ↵ Moving interval

② Position using the PgUp/PgDn keys:

Move in the z direction

Exit the procedure.



When designing in the exploded view the explsion axes can be inserted as 3D lines to improve the claroty of the 3D views, in particular the parallel perspectives.

3D-Extrusion

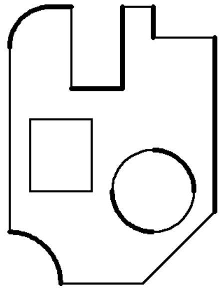
When producing the second design version further processing causes the body to take on the 2D contour. **isy** is able to convert all 2D data for the purposes of designing 3D bodies. Conversion from 2D to 3D will, according to the application, require preparation of the 2D data.

Load your drawing without dimensioning with **load ü-03** ↵

CONTOUR - follow

The individual drawing components in the workpiece "Sheet metal", whether in a packed or an unpacked form, are stored in the order in which they were created.

The extrusion, that is the changing of a 2D part into a 3D volume, requires a closed curve line **in the same direction of turning**. The new object obj1 is created. Delete the starting object which has an identical shape using the keyboard.



del Sheet metal ↵

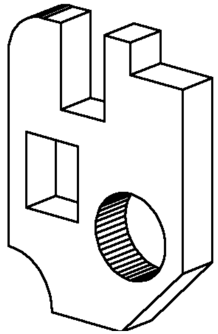
Pressing F4 will cause the screen to rebuild itself

EL → BZ

In order to extrude a 2D object which has circles or part circles in it into a 3D object, the circles (EL) must be converted into polygon lines or plolyons with Bezier curves (BZ). This changes the structure of the object. Thus the question from the system:

Are you sure?

EXTRUSION



Extend the prepared 2D object 20 mm in the z direction. This creates a 3D body which can be further processed using volume operations.

> The spacial image is only visible when you have selected a perspective in the 3D main menu.

2D starting shaopes and the drawing border can be deleted

The steps for the 3D EXTRUSION have now been completed.

Save the work with save ü-04 ↵

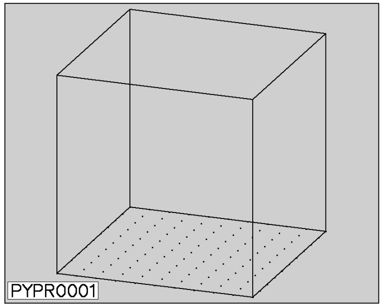
Penetration of a pyramid by a four sided prism

Task: A quadratic, equally sided pyramid should be penetrated by a regularly shaped four sided prism by being stuck into it. Four different positions of the **prism** are needed to make the design:

- horizontal, in the middle
- horizontal, in the middle with a - 45º rotation in the length axis
- tilted, in the middle
- tilted, in the middle with a - 45º rotation in the length axis

1. Drawing the basic body

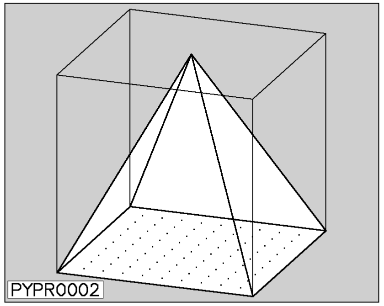
3D OBJ A **cube** (with a side length of 100) and a **3D grid** (size 100 x 100) will be shown first to perform volume comparisons and as an aid to orientation. The starting point for both objects is the co-ordinates origin 0,0,0.


PYPR0001

AS AN ILLUSTRATION:

The cube lies in the 1st. octant which means that all co-ordinates are positive (or 0). The 3D grid creates the border to the 5th octant which lies under the 1st octant

If the cube is to remain, it must first of all converted into a 3D polygon otherwise it will be covered when the pyramind is hatched

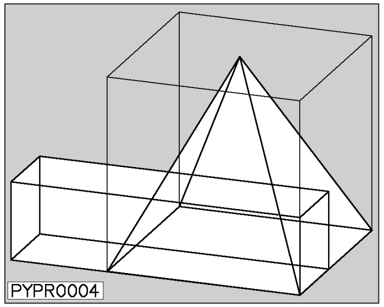

PYPR0002

The data for the **pyramid**:

Starting point 0,0,0
Base surface 100 mm x 100 mm
Height 100 mm

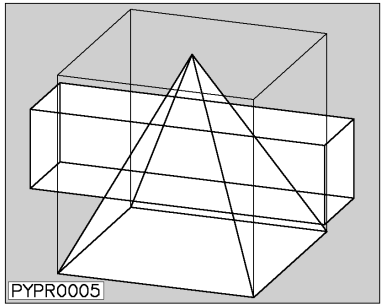
The data for the **flat block**:

Starting point 0,0,0 (just at first)
Length 40 mm, width 140 mm
Height 40 mm


PYPR0004

2. Positioning the initial body

activates the pyramid and The calculated point will be “frozen” by the system.


PYPR0005

Now activate the flat block.

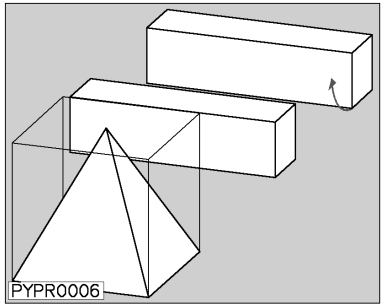
Now use the button “Move Absolute” to move the flat block in the desired central position. The pyramid and the prism are starting bodies for the Further design work, so subtraction is not yet undertaken.

Move now the prism 200 mm in the x direction by entering: 200,0,0

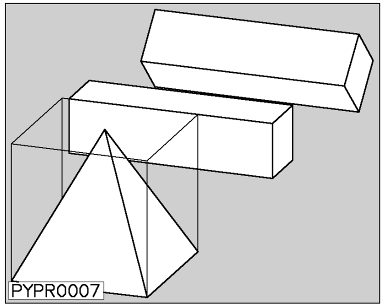
Click on the button “DPL” (duplicate) In the toolbar and

to repeat the “relative movement”.

Click again on the button “DPL” to switch off the duplication.


PYPR0006

Since the last generated object is active, it can, without selection, be rotated immediately though 45º (rotational axis y).


PYPR0007

3. Multiplying the initial body

Click on the button “DPL” (multiply)

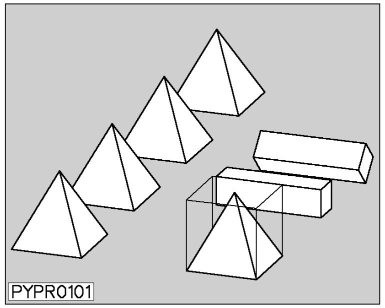
and activate the pyramid.

Using “Dynamic moving” multiply the pyramid into the position shown to the right (shifting interval 250):

↑ 1x in the y direction

→ 3x in the x direction

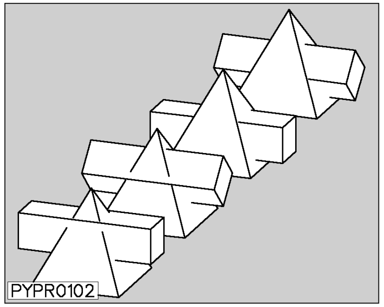
Esc Exit the procedure


PYPR0101

Now calculate, as before in Point 2, one after the other the centres of the newly generated pyramids and multiply, according to Diagram PYPR0102, both prisms into the corresponding pyramid centres.

Switch the duplication off again.

Now move the two rear prisms downwards by25 mm - entry: 0,0,-25

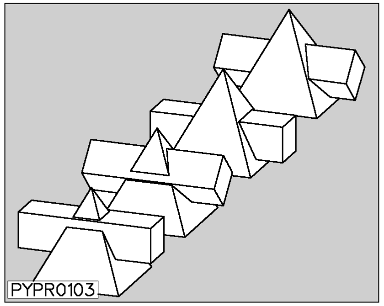

PYPR0102

4. Checking the penetration point

Hiding the covered edges allows you now to decide which of the starting bodies should be penetrated. No body should be cut into two part bodies by the subtraction process.

5. Subtraction

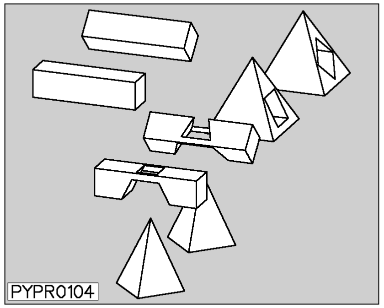

When selecting this command for the volume operation “Difference”, just the first selected body in each case will be deleted. It is replaced by the body which is to be processed. Thus the **“tools”** remain intact for the exploded view.
Click, first of all, on the body which should be processed (workpiece), and then the “tool”.

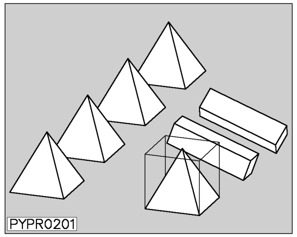
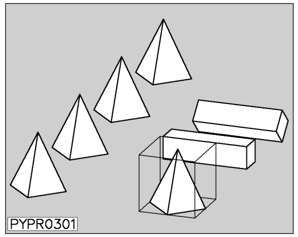
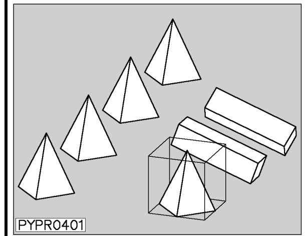
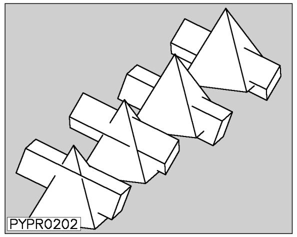
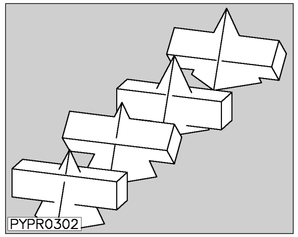
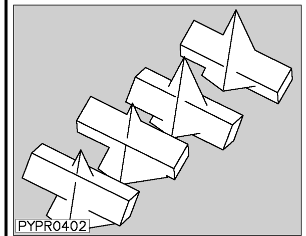
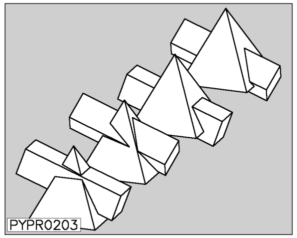
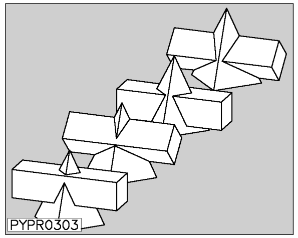
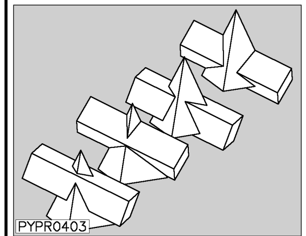
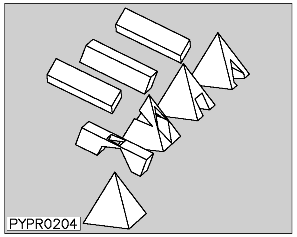
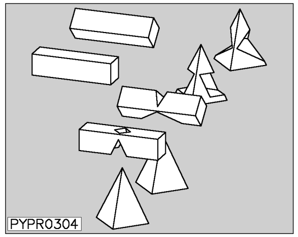
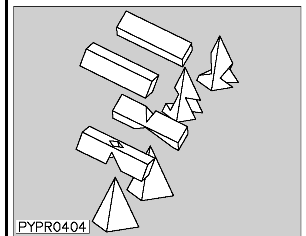

PYPR0103

A mouse click (R) on the “UNDO” will bring the drawing back into the condition it was before the volume operation.

6. The exploded view


Move the uncut bodies, that is the tools, out of the penetration holes into a position where thay can be easily seen.


PYPR0104

Tilted penetration	Turned pyramid	Turned pyramid, tilted penetration
 PYPR0201	 PYPR0301	 PYPR0401
 PYPR0202	 PYPR0302	 PYPR0402
 PYPR0203	 PYPR0303	 PYPR0403
 PYPR0204	 PYPR0304	 PYPR0404

All 3D designs can be found as a vector file under the names of the files which were shown here in their vector directory, or on the isy step by step CD.

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