Content

1 Introduction

1.1 Information On Help

Words shown underlined in the manual are featured in a section of the on-line help file.
Words in *italics* are those seen on-screen in the various dialogues
The following signs are used to highlight important passages:

Particularly important information

TwinCAM 32 user tip

Example

It should be noted that TwinCAM 32 follows normal Windows conventions for the use of the mouse, graphic tablet, buttons, scroll bars and so on.

This document is available as an RTF-File on this CD in directory MANUAL\MANUAL\twincam_en.rtf, and can be exported to the majority of word processing software. Additionally, it can be read as an HTML-File in directory MANUAL\HTML\MANUAL\ENGLISH\INDEX.HTML and can be searched using links in the same way as a web page.

1.2 Contact Information

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English Language Translation by Kris Gruber.
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2 Installation

2.1 System Requirements

For TwinCAM 32 to run successfully on your PC, it must meet the following minimum requirements:

IBM compatible PC with Pentium CPU or higher (Pentium II recommended)
32mb RAM (64mb RAM recommended)
10mb free hard drive space
SVGA display or an 8514 graphics card
Windows 95/98 or NT/NT2000 versions
Mouse or a graphic tablet

The Machine Control Version has different requirements.

2.2 Installation

Only valid for IBM compatible PC versions

Installation

Before you can use TwinCAM 32, it needs to be installed on your PC's hard drive. To do this start the computer and open windows
1. The programme is supplied on CD only. Place the CD in the appropriate drive.
2. Select *START* then *RUN* from the bar at the bottom of the screen.
3. Enter *X:**setup*, where X is the designator letter for the drive being used (usually **d** for CD drives) then press enter. If autorun is enabled, setup will start automatically.
4. Follow the on screen instructions.

Updates

Changes to the configuration files are normally transferred automatically. However, if you are attempting to update a version of TwinCAM 32 older than version 5.1.0.xx, it may be that not all changes can be successfully transferred. In this case, a warning will be displayed at the end of the installation cycle and you should contact your TwinCAM 32 dealer for advice. The programme version can be found by selecting *help* from the menu bar and then *info.*
When you install an updated version of TwinCAM 32, the original configuration file is saved as a back up. This back up can be found under the file name X:\twincam32\oldcfg\mmddHHMM, where X is the drive the programme is installed on, m is the month, d is the day, H the hour and M the minute the back up was carried out. Back up files are not deleted automatically, they must be deleted by the user if required.
If the programme is being run in conjunction with a machine control version of TwinCAM 32, different update procedures apply. Please see Features of the Machine Control Version.

2.3 Copyright Protection

TwinCAM32 is copyright protected by means of a 'dongle' or hardlock device which is unique to each licensed copy of the software.
The device must be installed in a parallel port on the computer, for example the printer port. The device will not affect the port's performance in any way, however for optimum performance of the device, any printer or other hardware connected to the port should be switched on.
If the computer is linked to a network, the device must be installed on the workstation where the programme is to be used. It is not sufficient for it to be installed on a central server port.

For perfect function of TwinCAM32 the dongle driver of sentinal must be installed. It is found in your TWINCAM-directory in subdirectory DRV. This driver is already installed for AutoCAD user (not the LT-version).

Further recent information you will find in file readme

2.4 Features of the Machine Control Version

There are versions of TwinCAM 32 which are run directly using the machine's own control programme. Information on these is included only with the relevant version of the programme.

Updating machine control versions.

Where both PC and machine control versions of TwinCAM 32 are in use together, they must both be from the same version series. This can be found by selecting help then info. The version series is shown in square brackets[] after the version number. To update your programme you will need to contact your machine's manufacturer.

3 Using TwinCAM 32

3.1 An Overview of TwinCAM 32

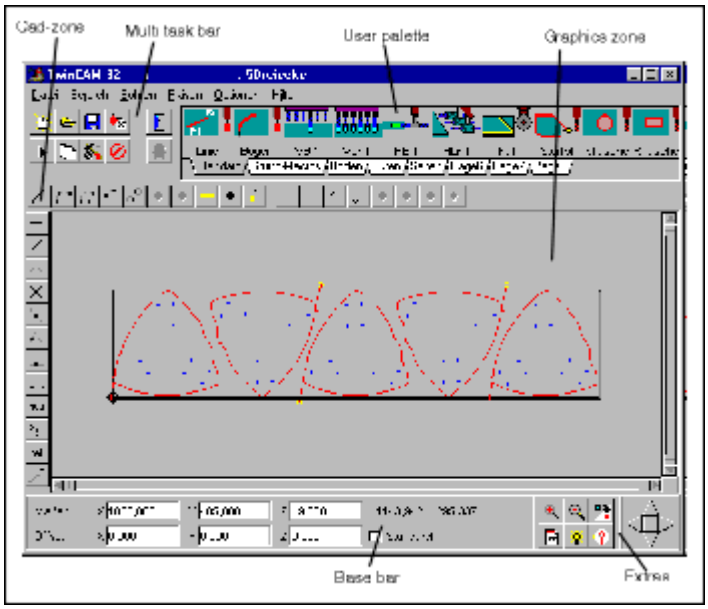
TwinCAM 32 was specially developed for the woodworking industry and is based on a parametric description of both the workpiece and the work to be carried out.. TwinCAM 32 can, of course also process CAD based designs using its own integrated import filters. The formats that can be accommodated are

- AutoCAD .dxf format
- Licom AlphaCAM
- PC-Draft
- Pro-Lignum 3D

TwinCAM 32's NC generator consists of several components:

- The machine configuration file which contains the machine's technical details
- The post processor
- The import filters
- Parametric workpiece description and macro modules
- The user interface

Of these, the user interface is the major component of the NC generator and will be described in some detail. The other components will only be described to the extent necessary to understand how the system works.



The Machine Configuration File.
The machine configuration file contains specific data about each machine, relating to range of travel, machining units and tool storage locations. The generator uses this information to locate the tools and check whether a process is within the capabilities of a machining unit with regard to its direction of rotation and range of movement. A machining unit is taken as being a part f the machine which is capable of accepting one or more tools and carrying out work with them. As well as a mathematical description of the units' range of movement, there is also a link to the bitmap files which hold graphical representations of all the various types of tools. This enables the system to create a picture of the machining units in the user interface.

The Post Processor
The post processor is the machine dependant part of the generator. It prepares the relevant NC code for the machine to carry out the operator's instructions for cutting patterns, feed rates and so on.

Import Filters
TwinCAM 32 makes it possible to process a wide variety of design formats. These are described below:-

LDF format (*.LDF) which is TwinCAM 32's own internal format. All drawings and macros created using TwinCAM 32 are saved using this file extension.

AutoCAD (*.DXF) This filter enables drawings prepared using AutoCAD to be processed. Almost all CAD programmes on the market are able to export files in the *.DXF format. TwinCAM 32 is therefore able to generate CNC programmes from a wide range of CAD software. It should be noted that certain DXF conventions have to be maintained. See Creating CAD drawings for TwinCAM 32.

Pro-Lignum 3D (*.HKN)
Designs created in ProLignum 3D can be imported directly into TwinCAM 32 and processed further if required.

DXF Export
TwinCAM 32 offers the possibility of being able to *export* parametric drawings created in TwinCAM 32 to a CAD programme which supports the *.DXF format.

3.2 Programming

3.2.1 The Base Bar

An Overview of the Base Bar

Enter the finished dimensions of the panel in the base bar under *dimension*.

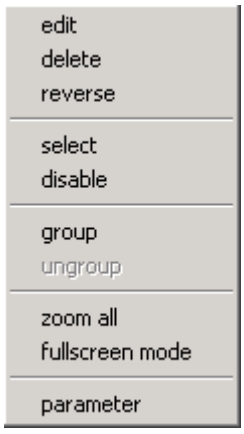
Offset allows you to enter the X and Y values by which the machine actually varies from the machine's nominal zero to ensure that the edges of the panel can be machined cleanly.
A Z offset value can be entered to allow for the use of stencils or suction pad extensions. The default value of Z takes standard suction pads into account.
If *Standard* is selected, any value entered under Z is ignored.
The field to the right of the *dimension* boxes shows the co-ordinates of the current cursor position.

To format a panel, enter the finished dimensions and then shift the panels position by 3-5mm using the X and Y offset. This will ensure that all the edges are cleanly machined. The *Format* macro is used for this purpose.

3.2.2 General Parameters

3.2.2.1 Context Menu

If you click on the RIGHT mouse button anywhere in the graphics area of the screen a drop down context menu will appear.

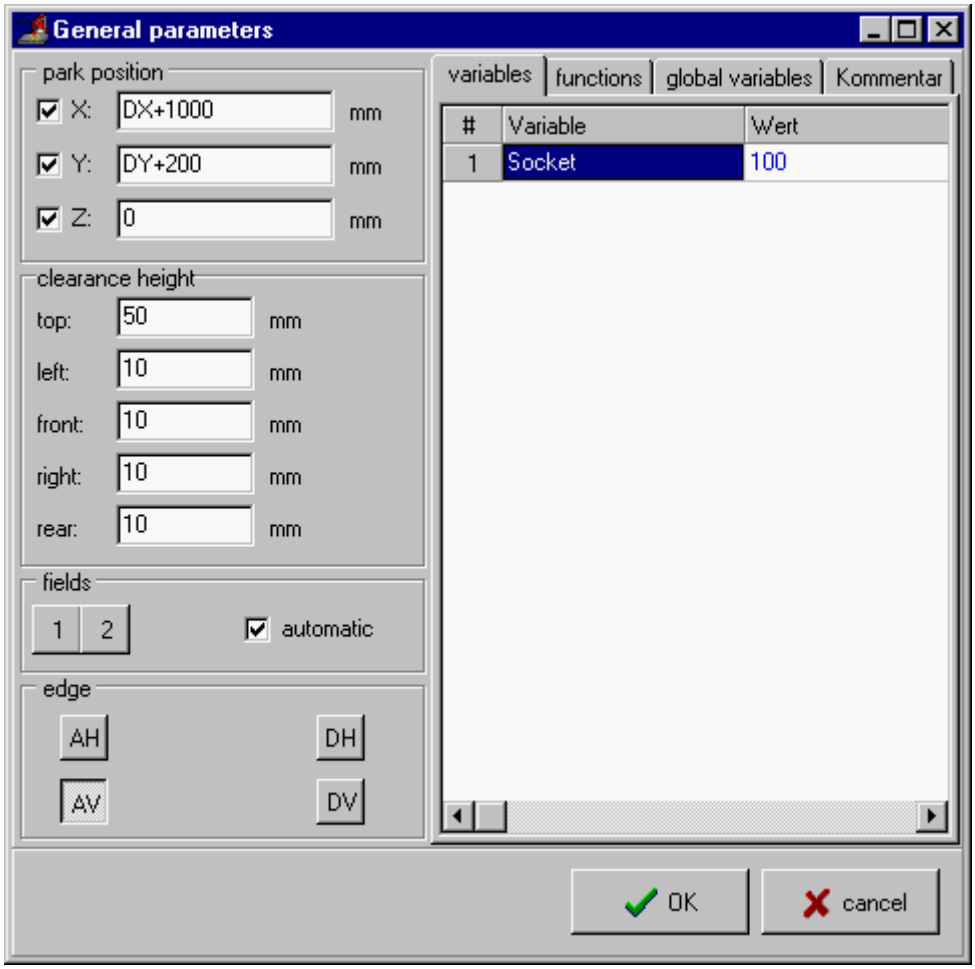


Edit - edits a marked drawing element (equivalent to double clicking on the element)
Delete - deletes a marked element
Reverse - reverses a routed element (start point becomes end point and vice versa) - further described in Grouping
select - activates a closed element/gorup
disable - deactivates an element/a group, the included treatments will not be generated
Group - Links two or more elements, see Grouping
Ungroup - see Grouping

Zoom - resets zoom to normal view
Fullscreen mode - expands the drawing to full screen size. See zoom
Parameters - point of rest, clearance height. See Parameters and overview of variables programming.

3.2.2.2 Parameters

The parameter dialogue allows you to set various parameters for programme generation.



Park Position
X, Y and Z co-ordinates for the machine head at the end of the programme. The park position axes are selected using the appropriate check boxes
Clearance height
Top = standard clearance height in Z for empty travel. The clearance height for individual tools is added to this value.
Left, Right, Front, Back = clearance around the named side for horizontal machining.
Fields
This setting is machine dependant. It sets the relevant work fields in relation to the size of the panel. If Auto is selected, TwinCAM 32 sets this value. Depending on the machine type, suction pad control, or panel changing may be affected.
Stops
This machine dependant setting defines which stop the panel is positioned against on the machine.
The variables and functions field to the right will be described in programming with variables - see overview of programming with variables

use the default values, plus an additional margin of safety.

3.2.3 Multi Task Bar

3.2.3.1 Overview of the Multi Task Bar

The multi task bar contains TC's principal functions.

The individual buttons have the following functions:-

New - creates a new drawing

Open - opens an existing TwinCAM 32 (*.LDF), DXF or ProLignum 3D file

Save - saves a drawing either in *.LDF or *.DXF format

Insert Group - inserts an existing TwinCAM 32 (*.LDF) file into the current drawing

Generate CNC programme - see Generate programme

Edit NC programme, display programme - see CNC editor/display, using explorer view

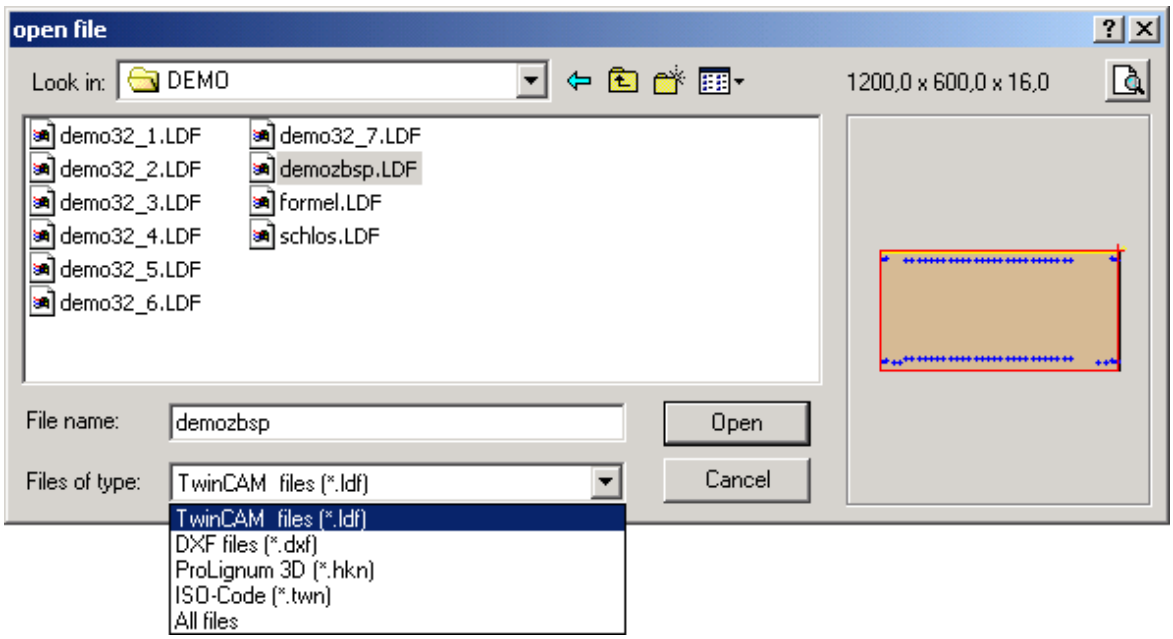
Tool Admin - see tool admin overview. Edit tool list and configuration file

Undo - reverses the last action. See undo function

Delete - deletes marked element(s). See deleting drawing elements

Exit, End program

3.2.3.2 Open Command



Clicking on the open command will open the dialogue box shown above. You will have the choice of opening an existing file in one of a number of formats. The format is selected using the *File type* drop down menu.
Select from:

TwinCAM32: *.LDF,
AutoCAD: *.DXF (or other programme with the same file extension)
ProLignum 3D: *.HKN.
ISO-CODE-File: *.TWN Load ISO-Code file (manual programmed code concerning TWINCAM-edition)

A list of available files in the chosen format will appear in the central part of the dialogue box, with a preview of the selected file visible in the right hand area.
The DXF files form a link between drawings in the CAD system and the NC generator. The geometric information for the NC generator is taken from these files, whilst supplementary information such as cutting rates or rotation speeds are calculated by the NC programming system. Imported drawings can be converted to parametric drawings by TwinCAM 32 provided DXF conventions have been complied with.
In the same way, drawings created in ProLignum 3D can be imported and converted to parametric drawings.

3.2.3.3 Save Command

Clicking on the *save* button saves a drawing in the TwinCAM 32\LDF file or another folder of your choice. You may select between TwinCAM 32 (*.LDF) or DXF format

3.2.3.4 Insert Group Command

clicking on this button inserts an existing TwinCAM 32 drawing into the current drawing. This process is described more fully in working with macros.

3.2.3.5 Generate Programme Command

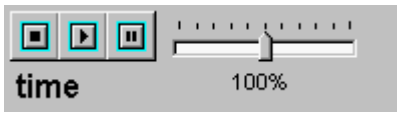
Clicking on this button activates NC code generation .
The programme generation is carried out in the background, with an immediate indication of whether the process is valid or not. If the process is for some reason invalid, this is indicated by the display being shown in magenta. Moving the cursor across the various elements will display the appropriate error message in relation to the element.
The error messages are as follows:

Min-X	range of movement in X- insufficient (applies also to Min-Y &-Z)
Max-X	range of movement in X+ insufficient (applies also to Max-Y& -Z)
Type	No tool of the required type in the current configuration
Diameter	No tool of the required diameter in the current configuration
Direction	No tool of the required type/diameter available to work in this direction
Rotation	Rotate/counter-rotate selected but no appropriate router available

The generation is not possible, if the Item-Editor is switched on.

3.2.3.6 Edit/display NC Programme

Running the display.



To the left of the dialogue box there are buttons to start and stop the display as well as a pause button. The slider bar affects the speed of the display, which is shown in real time. If you adjust the speed of the display using the slider bar, the real time elapsed is shown. Currently the system does not take tool changes into account.

3.2.3.7 Undo Command

Clicking on this button undoes previous actions in reverse order. Actions in drawing elements and manipulations are supported.

3.2.3.8 Delete Command

To delete a drawing element, select the element by clicking on it with the left mouse button, then click on the delete button. To delete several elements together, hold down the control key whilst selecting each element in turn, then click the delete button.

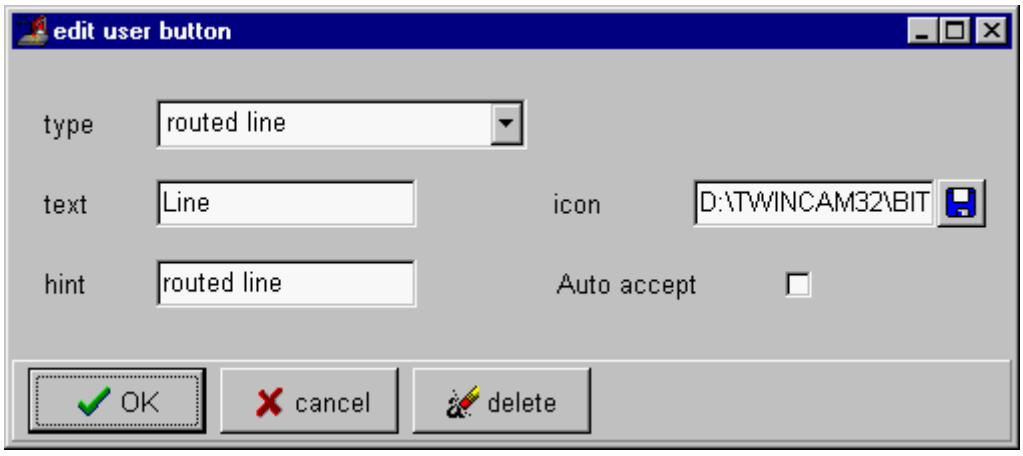
3.2.4 User Palettes

3.2.4.1 Using the User Palettes

TwinCAM32 enables you to create an unlimited number of drawing menus. The TwinCAM32 palette TWINCAM is supplied with the programme as an introduction. Supplementary palettes (USER1-3) are also supplied as the basis for creating your own menus.The number of palettes can be extended as the user wishes; there is no limit to the number. All the palettes contain a section named *standard* with the basic drawing functions and another called *basic macros* which gives access to the basic macro functions such as formatting for example. This section is intended to be expanded by the user. Equally, when you create your own palettes from scratch, you should ensure that both these sections are included.

Loading a palette
TC will load the TWINCAM palette as a default. If you wish to create your own palette, you will need to load a new palette, for example USER1. Click on *File* on the menu bar and then on *load palette.* Select the file you want from the dialogue box and click on *OK* . The TWINCAM palette contains not only the sections described above, but also examples for making a simple cupboard. The sections named *bases, sides* and *doors* contain pre-prepared macros for camlock bolts, locks and hinge mounts.

Editing a Palette
In order to insert your own functions (macros) into a palette, they must first be saved as macros. They should then be placed in a sub directory of TwinCAM 32. It is best if you assign a sub-directory to each register in each palette, to make saving and retrieving files easier. Click on an empty tab on the register button bar with the RIGHT mouse button and the following dialogue box will appear.



The box marked *type* , when selected reveals a drop down menu of the names available for register buttons. Of these the one you are most likely to use is *insert group* as the others are, in

any case, related to TwinCAM 32 's basic functions and included in the standard palettes. In the *Text* field, insert the text you wish to appear on the button. The *Info* boxcontains the text which will appear as an explanation in a yellow field when the cursor is passed over the relevant button. Insert the file path for the desired icon in the *icon* box, or alternatively, select a bitmap file by clicking on the blue diskette symbol. A library of examples are included in TwinCAM 32 's bitmap file. *Name* refers to the file name, which you should either enter as the complete path or select by clicking on the blue diskette icon. The *autoOK*
check box is only valid for TwinCAM 32's basic functions, not *insert group* or *macro*. If the check box is selected, the appropriate basic function is inserted into the drawing without further dialogue. If the *Group* check box is selected, all the elements which are to be inserted into the drawing are grouped together. Click on *OK* and the entries will be saved as part of the user palette.

If, for example, you want to save several different drillings as part of a drawing, create a register button for Vertical drillings. Open the register and enter the required values for the drillings you wish to include in the drawing and then click on the *save* button. Then edit the button and select *auto OK*. Now when this button is selected, the complete drilling pattern will be saved to the drawing without further dialogue.

Editing and deleting register buttons.
To amend or delete the information on a register button, open the dialogue box shown above. Amend the values which need changing and select OK or select delete to delete the whole button.

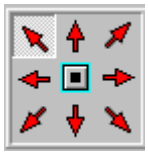
Saving a user palette.
To save a palette that you have created or amended yourself, select *File* on the menu bar and then from the drop down menu select *save palette as* . You may enter any suitable name for the palette.

3.2.5 Drawing Elements

3.2.5.1 General Information

Creating Parametric Drawings

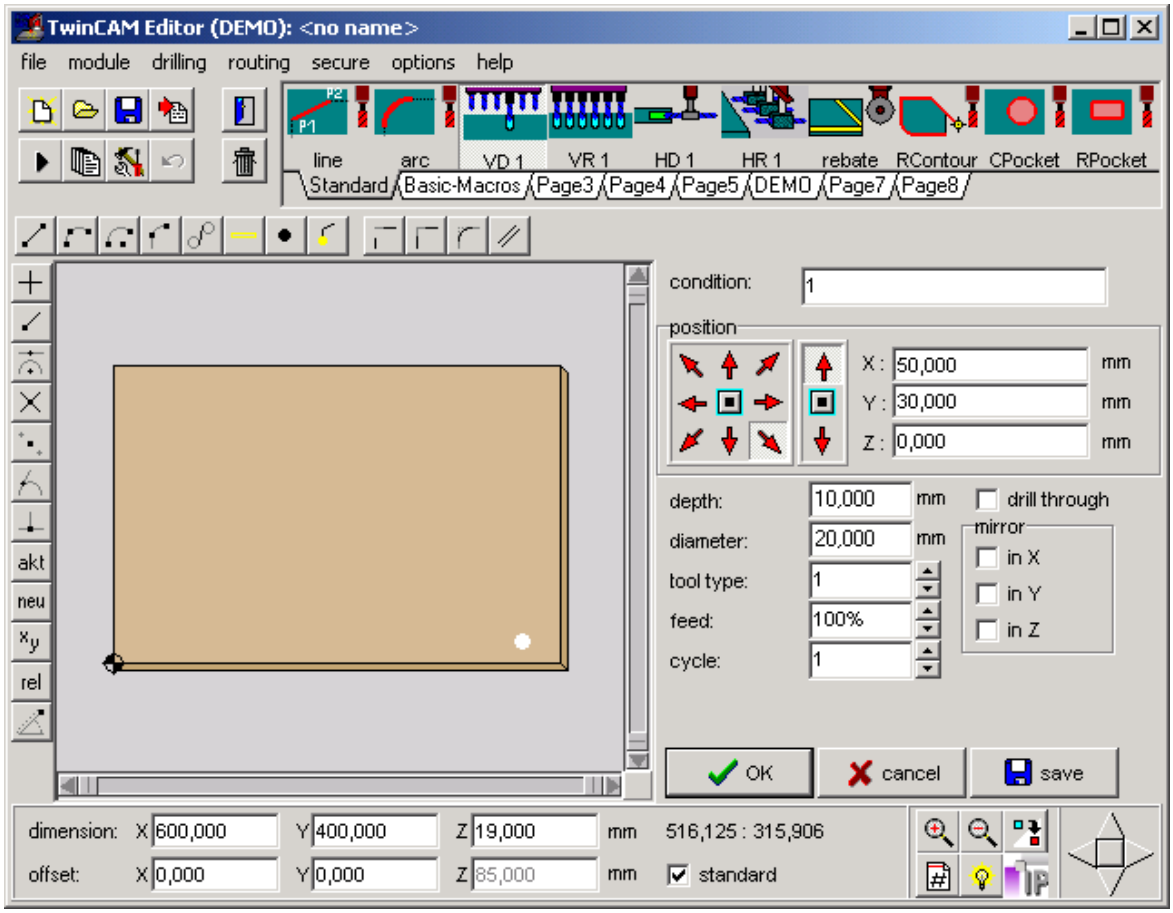
This method of creating drawings makes it possible to design the format for a particular part, a base panel for example, once only and then save it. If there is a subsequent need to vary the size of the panel dimensions, then each defined element will change automatically to suit. This is done by relating each element to a particular, different, reference point on the panel, rather than as is the case with CAD drawings relating all elements to ONE reference point. In TwinCAM 32 these reference points are known as *Magic Points* . Each of these nine *magic points* can be selected as can be seen in the illustration below.



Magic Points

All the dialogue boxes for the different drawing elements contain the same or very similar buttons and data entry fields. These are all described in *overview of general information* and will not be discussed further in relation to the individual dialogue boxes.

For example, a drilling is to be located 50mm from the right edge and 30mm from the front edge of a 600x400 panel. The bottom right corner is selected as the *magic point* . The centre of the drilling will be 550mm from the left edge of the panel, 50mm from the right, 370mm from the top edge and 30mm from the bottom. If the panel dimensions are now changed to 1200x700, the position of the drilling in relation to its reference point does not change, although it does change in relation to all the other corners of the panel. It is now 1150mm from the left and 670mm from the top. It has, as it were, travelled with its *magic point* . In this way as many different elements as are required may be linked to different *magic points* . In each case, when the panel dimensions are varied, the element remains constant in relation to its own *magic point*.



Overview of General Information

All the dialogue boxes for the different drawing elements contain the same or very similar buttons and data entry fields. These are described here and will not be discussed further under the individual dialogue box headings.

Standard data entries:-

Magic points

Dialogue buttons

Condition

Feed rate

Tool selection

Magic Points

Magic Points or reference points are the basis of parametric drawings. They are the reference points for all elements of a drawing, although it should be noted that start and endpoints of elements each have their own *magic points* . Depending on how they are to be constructed, arcs may have up to three *magic points*. Either figures, alphanumeric variables or formulae may be entered in the data entry fields. See overview of programming variables. The field with the nine buttons determines the reference point(s) in the working plane, that is each corner of the panel plus the mid points of each side and the centre point of the panel. The vertical field with three buttons determines the reference point of the Z value. The three references are:-
up arrow-- top surface of the panel
down arrow- bottom surface of the panel
centre box- centre point of the thickness of the panel.
Either next to or below these fields you will see data entry fields for co-ordinates. Working from the *magic point* positive values are towards the centre of the panel, negative are away from the centre of the panel. If the centre point of a panel edge is selected, positive values are taken as up and negative values down.

Whichever plane you are working in, X always describes horizontal values, Y vertical values and Z values in the depth of the material.

To link an element to a different *magic point* without changing its position, click on the desired *magic point* with the right mouse button.

Condition

In dialog field terms it is possible to activate or deactivate the corresponding elements under use of formulas.

If the term is fulfilled (=1, TRUE) the element will be activated, at term =0 (FALSE) deactivated.

If you want to place f.e. a twin bore from a plate length of over 1500mm, the function WDS will be used. (look at Funktions)

The initialisation would be (length of X-axis):

WDS(DX>1500;1;0)

if DX>1500, then 1(TRUE), otherwise 0(FALSE).

Buttons

Accepts changes to the drawing

Closes the dialogue

Saves the current entries as default values for the dialogue box. When the box is next opened the values saved will be shown in the data entry fields.

inserts an edited element as new element of a drawing. See Editing elements.

Feed Rate

A nominal feed rate forms part of the definition of each tool. See tool administration. The feed rate for any given element is shown as a percentage of the nominal feed rate for the selected tool.

Nominal feed rate for a tool = 8m/min
Feed rate for element = 60%
Programmed feed rate = 4.8m/min (i.e. 60% of 8m/min)

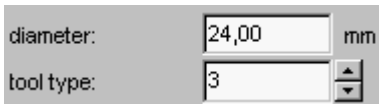
If a feed rate of 0% is entered the programmed value will be the nominal feed rate for the tool.

Feed rates are valid only for a particular element, not for a complete contour.

Entering 10m/min as the nominal feed rate for a tool in its definition (see cutting data) will lead to round figures for the actual feed rate 40% = 4m/min

Tool Selection

In several of the dialogue boxes, you will be invited to select a tool. In TwinCAM 32 the selection of a tool is carried out using the following criteria:-
Each tool is allocated a type number as part of its definition (see overview tool list). TwinCAM 32 selects a tool for the task according to the type number entered in the element definition.



Drilling
The tool is selected by type number and diameter.
Routing
If the tool type has been entered as '0', the selection is carried out by diameter, in any other case by the tool type number. If no appropriate tool is found when the programme generator is runing, an error message will appear. See programme generator.
Any worklist to be used in conjunction with the tool should be entered in the tool's definition.

Sawing
Selection is according to the tool type number entered.

rebates can be either sawn or routed. TwinCAM 32 will search first for a suitable saw and then for a router to carry out the work. You should allocate tool type numbers with this in mind.

Give each router a separate type number to prevent confusion.
For drills the following type numbers may be used:-

Clearance drill	type 1
Standard drill	type 2
Hole cutter	type 3
Pilot drill	type 4

Error Messages

Min-X	range of movement in X- insufficient (applies also to Min-Y &-Z)
Max-X	range of movement in X+ insufficient (applies also to Max-Y& -Z)
Type	No tool of the required type in the current configuration
Diameter	No tool of the required diameter in the current configuration
Direction	No tool of the required type/diameter available to work in this direction
Rotation	Rotate/counter-rotate selected but no appropriate router available

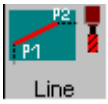
By defining the work to be carried out using tool types rather than tool numbers or tool locations, the process is made independent of individual machine types.

There are two identical tools installed in two different machines, both are however given the same type number in the tool list. Provided that both are included in the current configuration, the programme can be run on both machines without altering the drawing.

3.2.5.2 Overview of Drawing Elements

TwinCAM 32 enables you to define elements in two different ways:-
- creating a parametric drawing using standard elements
- CAD supported element definition. See overview of CAD functions

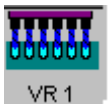
This section deals with the standard elements in the user palettes. See also using user palettes.
CAD functions are described in overview of CAD functions.
TwinCAM 32 uses the following standard elements in its programming:



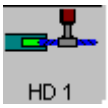
Routed lines

Routed arc

Vertical drilling



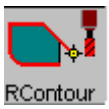
Vertical row



Horizontal drilling

Horizontal row

Rebate



Routing start point

Circular pocket

Rectangular pocket

Cornice Arc

Text routing

Insert ISO - code

Ellipses (segment)

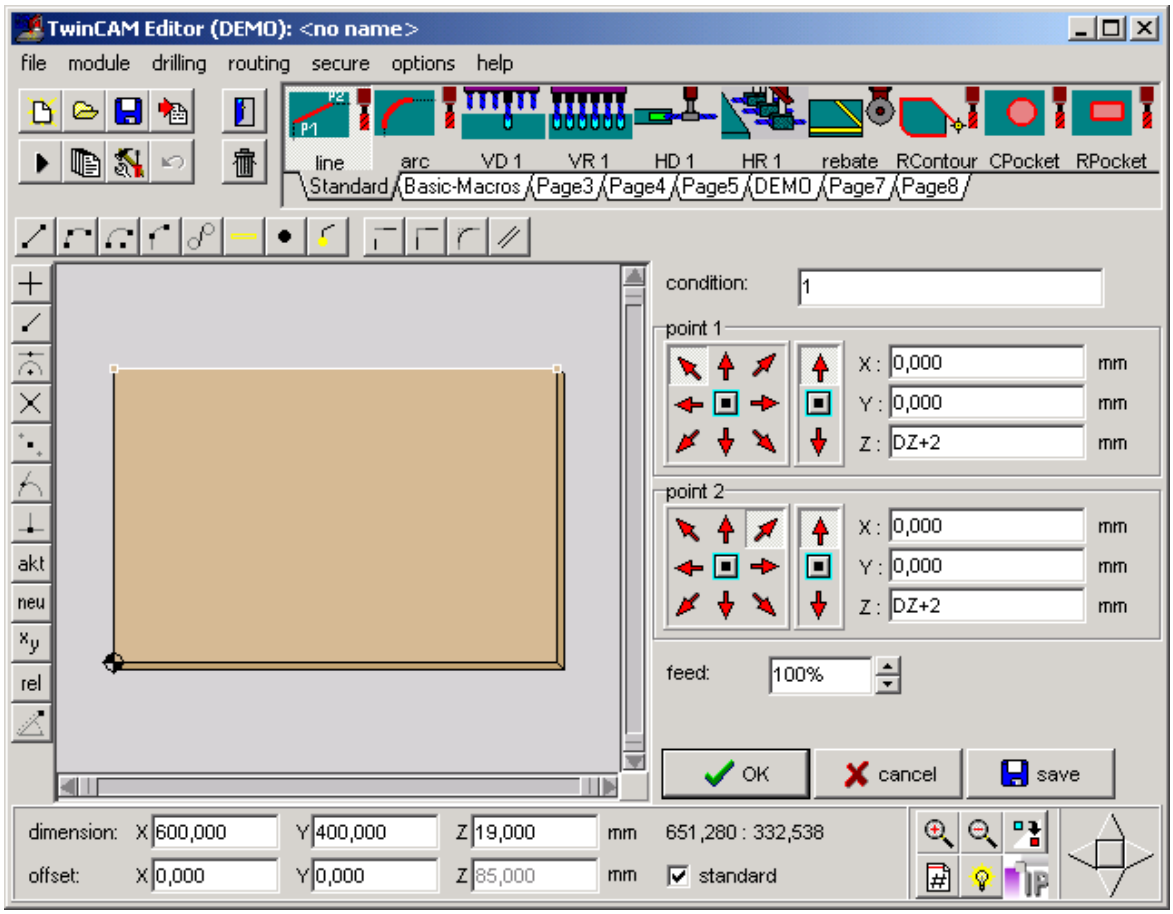
In addition to the elements mentionned above there a also tensioning elements as:

exhauster circular
exhauster angular
traverse exhauster
traverses

For the tensioning elements no standard button are integrated, as these are different in form and version according to type of machine.

3.2.5.3 Lines

Defining a routed line



The illustration shows a routed line with its start point (point 1) top left on the panel edge. The *magic point* is the top left hand corner. The end point (point 2) top right hand on the panel edge, and the *magic point* for this is the top right hand corner. The entry DZ+2 indicates a routing depth in a 19mm thick board of:-
panel depth (DZ) + 2mm = 21mm
See also programming variables.

Double clicking on *Point 1* links the new line to the end point of the last created line or arc element.

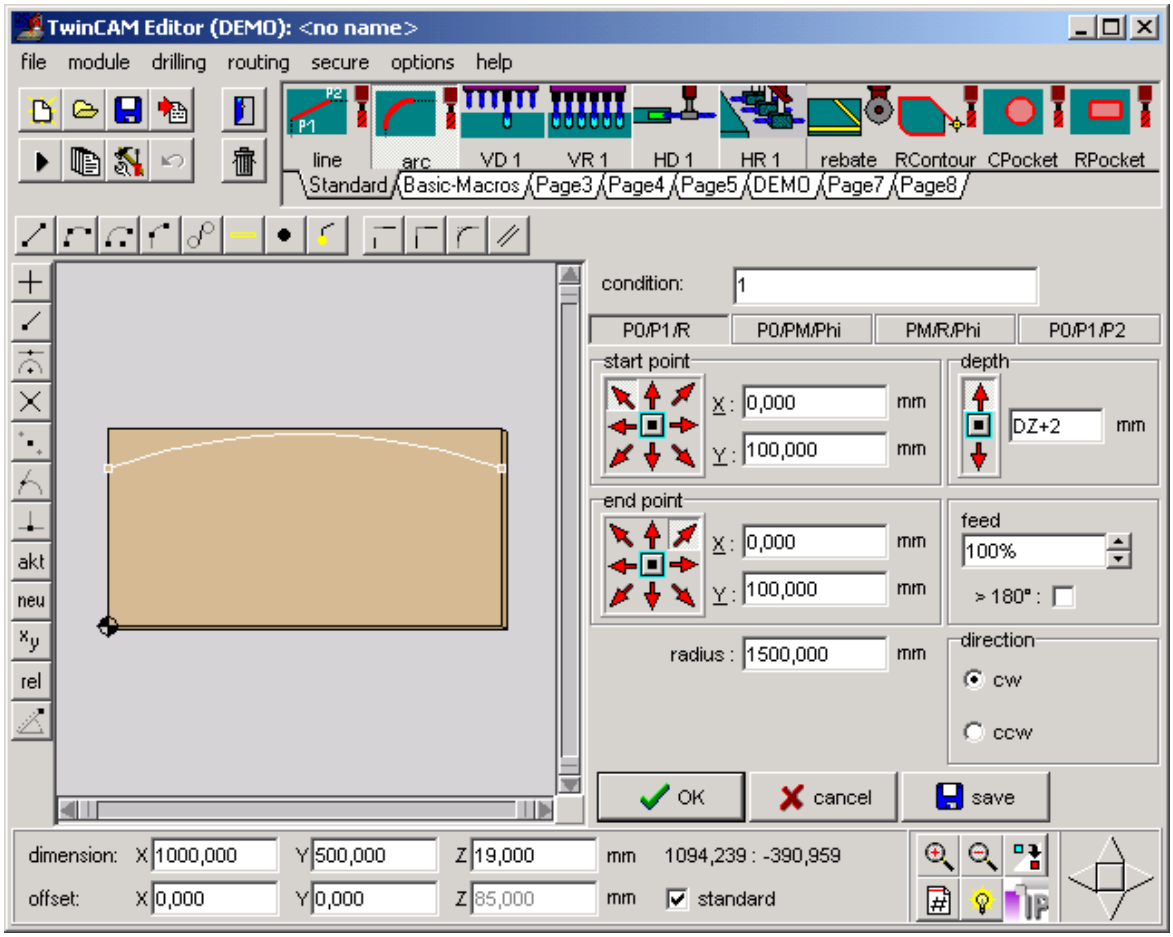
All other entries are explained in General information.

3.2.5.4 Arcs

There are four different methods of defining an arc:-

P0/P1/R Start point - end point - radius of arc
P0/Pm/Phi Start point - centre point - angle = start- centre -end
Pm/Phi centre point - opening angle - closing - angle radius
P0/P1/P2 Start point, Point 1 , end point

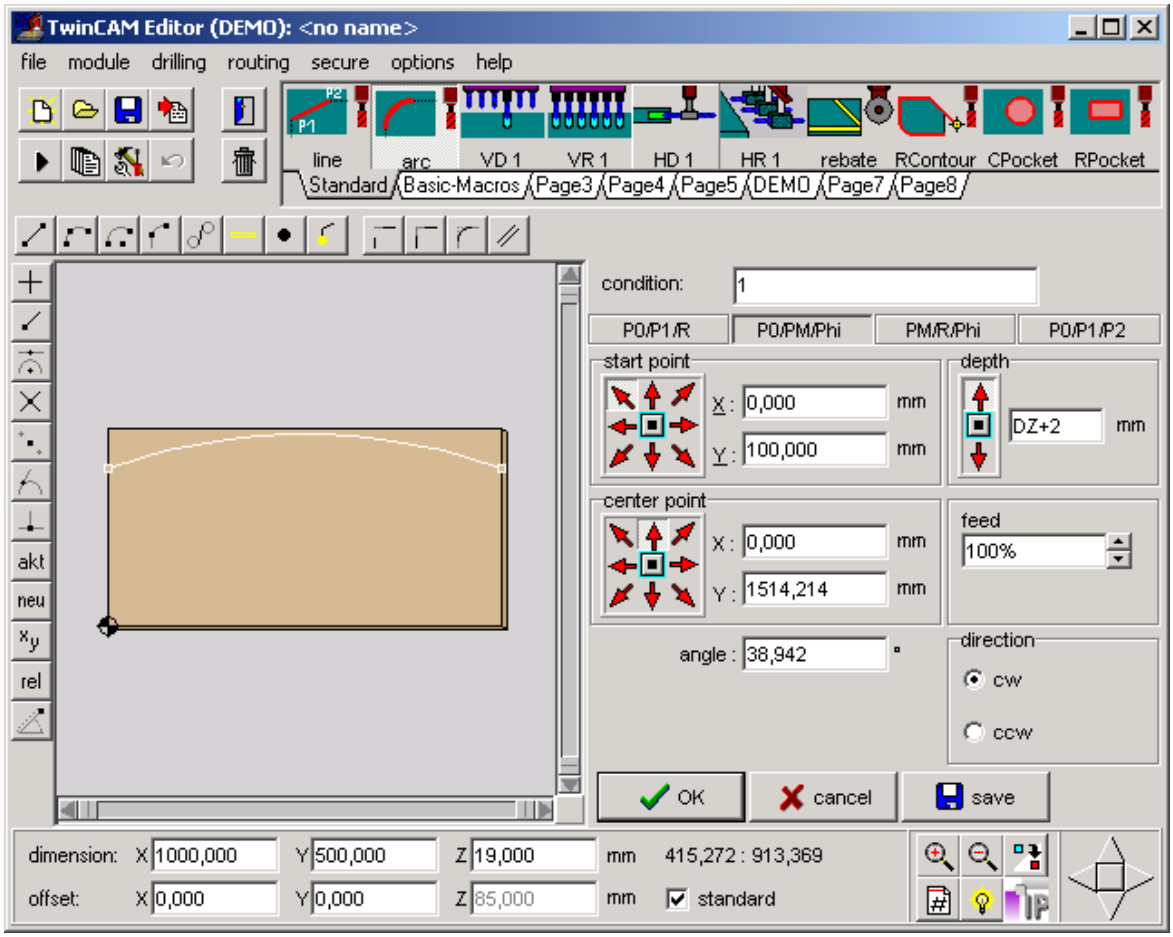
P0/P1/R



This is the simplest way of defining an arc. The data entry fields are one above the other in the dialogue box. Below this is a filed to enter the radius of the arc and below that, in turn, a check box for the orientation of the arc. Selecting CW means the arc will run clockwise from start point to end point. Deselecting CW will mean that the arc will run counter (anti-) clockwise. As this definition is still ambiguous - there are two possible arcs for this definition - there is an additional check box to indicate whether the opening angle is greater or less than 180°.

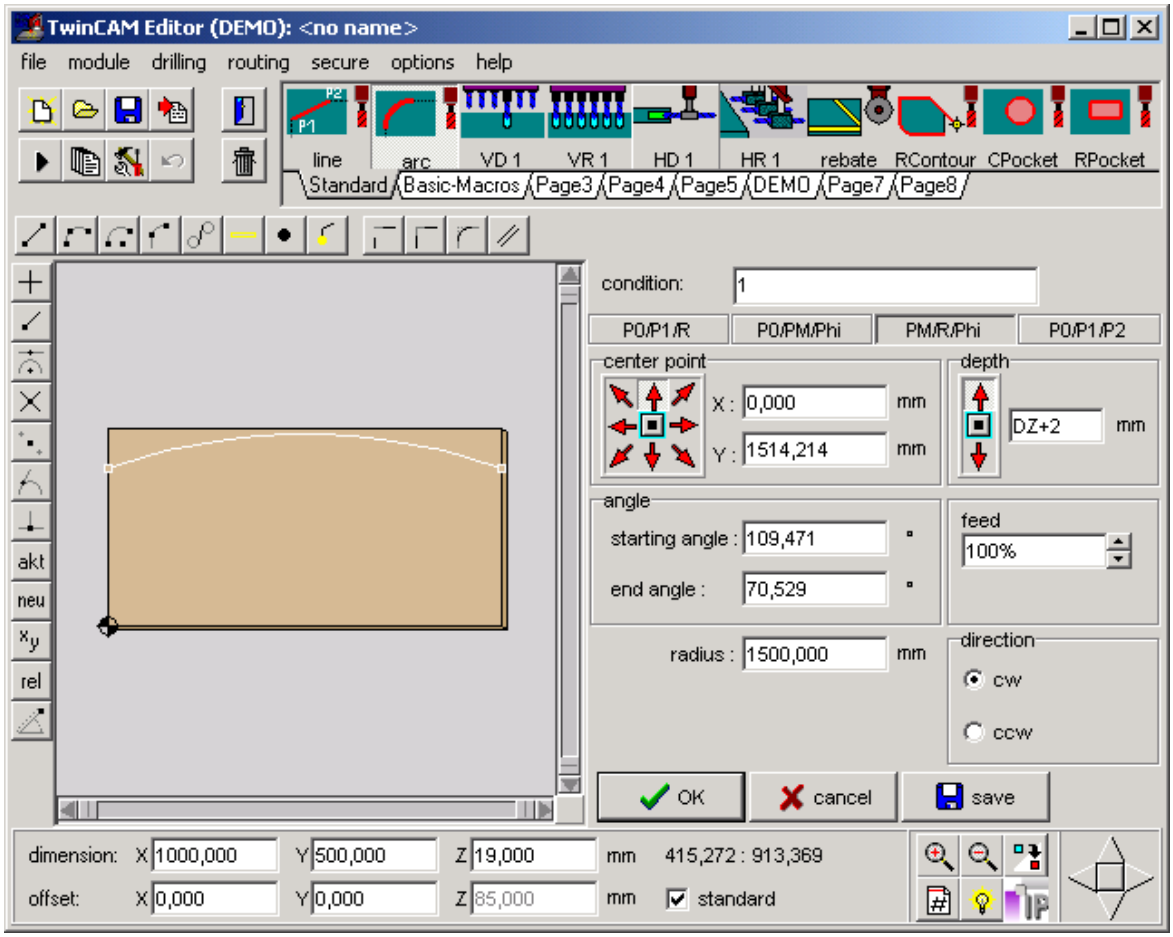
Double clicking on *Start point* links the new line to the end point of the last created line or arc element.

P0/Pm/Phi



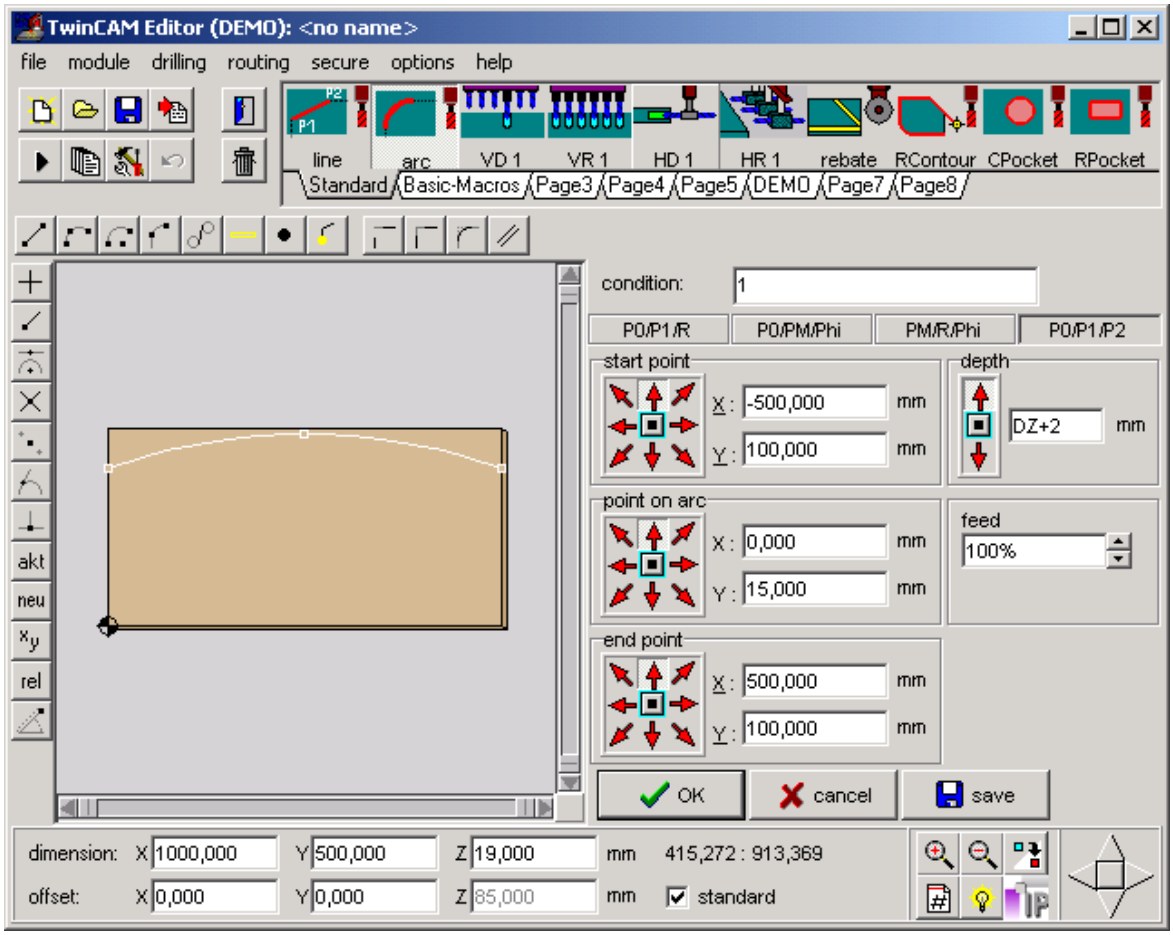
In this instance the angle between the start and end points is given in place of the end point and the centre point in place of the radius.

Pm/Phi

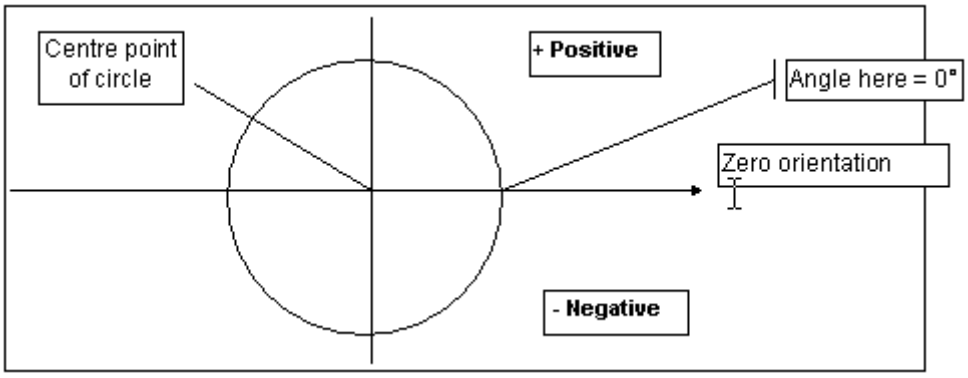


A further variation of describing an arc using its centre point, the start angle, the end angle and the radius.

P0/P1/P2

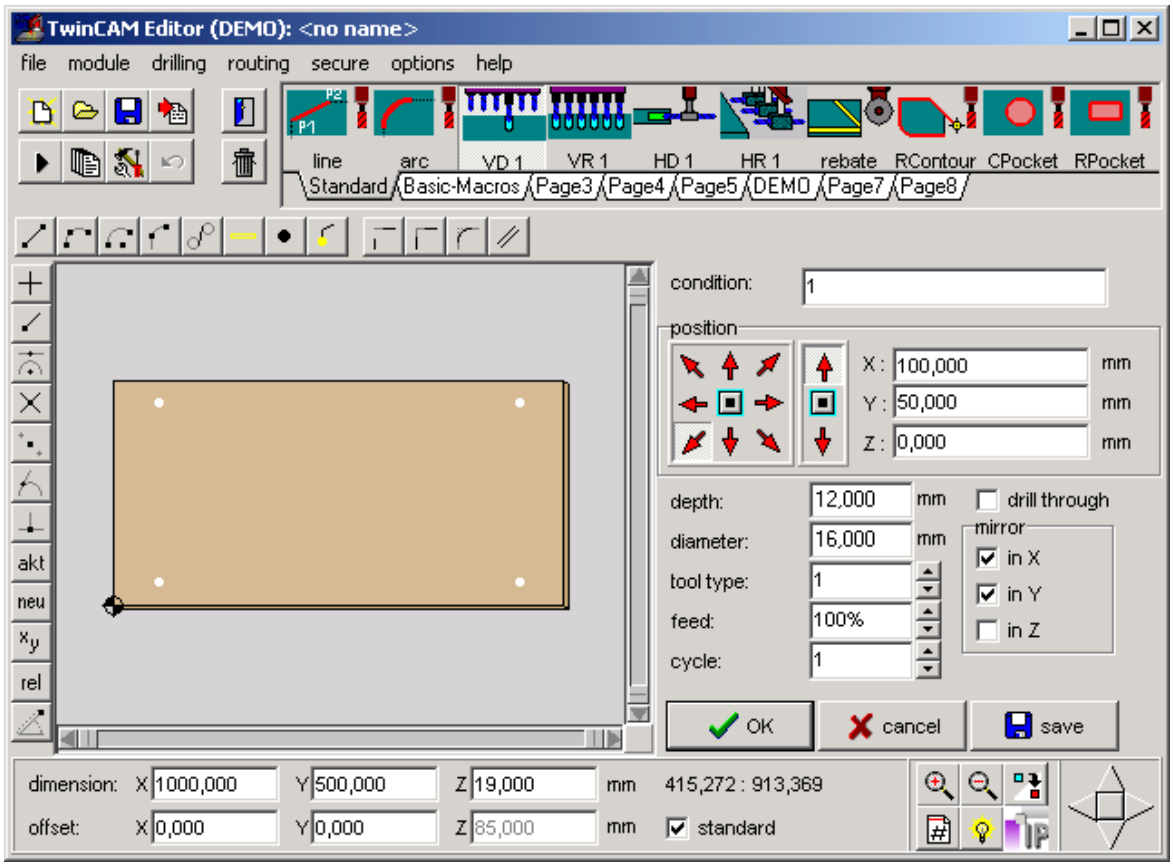


The last method of defining an arc is to enter the start point, the end point and any other point along the arc.



The zero point for all angles is oriented from the centre point of the arc horizontally to the right. In line with maths conventions, angles measured clockwise from zero are shown as a NEGATIVE value, those in an anticlockwise direction POSITIVE .

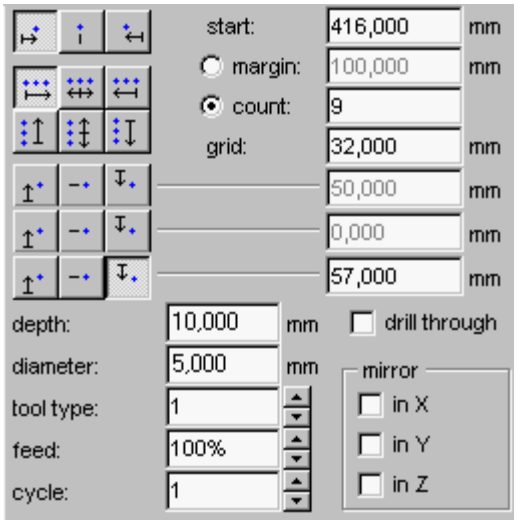
3.2.5.5 Vertical Drilling



In the upper part of the dialogue, enter the *magic point* and co-ordinates of the drilling. The Z value describes the start point for the drilling. A value of zero indicates the top surface of the panel. The depth of drilling is entered under *Depth*. Defining drillings in this way means that, for example, a drilling can be placed in a pocket, speeding up the processing. It is also possible to mirror drillings in both X and Y planes so that up to four drillings can be defined in one dialogue. This is of particular advantage when working with symmetrical pieces. In each case the mirroring is carried out about the centre axis of the working surface.
Cycle refers to certain set drilling speed patterns for specific tasks. The codes for these are machine dependant and are included in the post processor and are also available from the machine manufacturer. In some instances the user may be able to write his own code. The *Drill through* check box determines whether the drilling should travel right through the material or not. If the box is checked, *depth* is greyed out, and TwinCAM 32 calculates the depth required from the thickness of the material and any overlap value - see Tool definition.

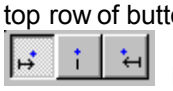
3.2.5.6 Vertical Row

A row of drillings can be defined either as a fixed count or by defining a margin to be left clear. TwinCAM 32 will position an appropriate number of drillings without impinging on the defined margin at the end of the row.
The reference point for vertical rows is always taken as the top surface of the panel; in other words, a row cannot be drilled into a pocket as a single drilling can.
The user is able to mirror the row in all planes about the centre axis of the panel and also specify whether the panel should be drilled through or not.



The dialogue box features eighteen buttons in six rows of three to define the reference points for rows in X and Y.

Start indicates the distance from the reference edge of the panel which is selected using the top row of buttons for the



left edge, centre of the panel or right edge.

The next row of buttons will activate a row in the X plane.

The reference can be selected as the left hand drilling, centre or right hand.

To the right are check boxes to select *margin* or *interval* and a data entry field for each to enter the appropriate value.

The next row activates a row in the Y plane

in the same way as those for the X plane.

The next three rows are to select the second co-ordinate for each of up to three rows. For a row in X the options are to select the

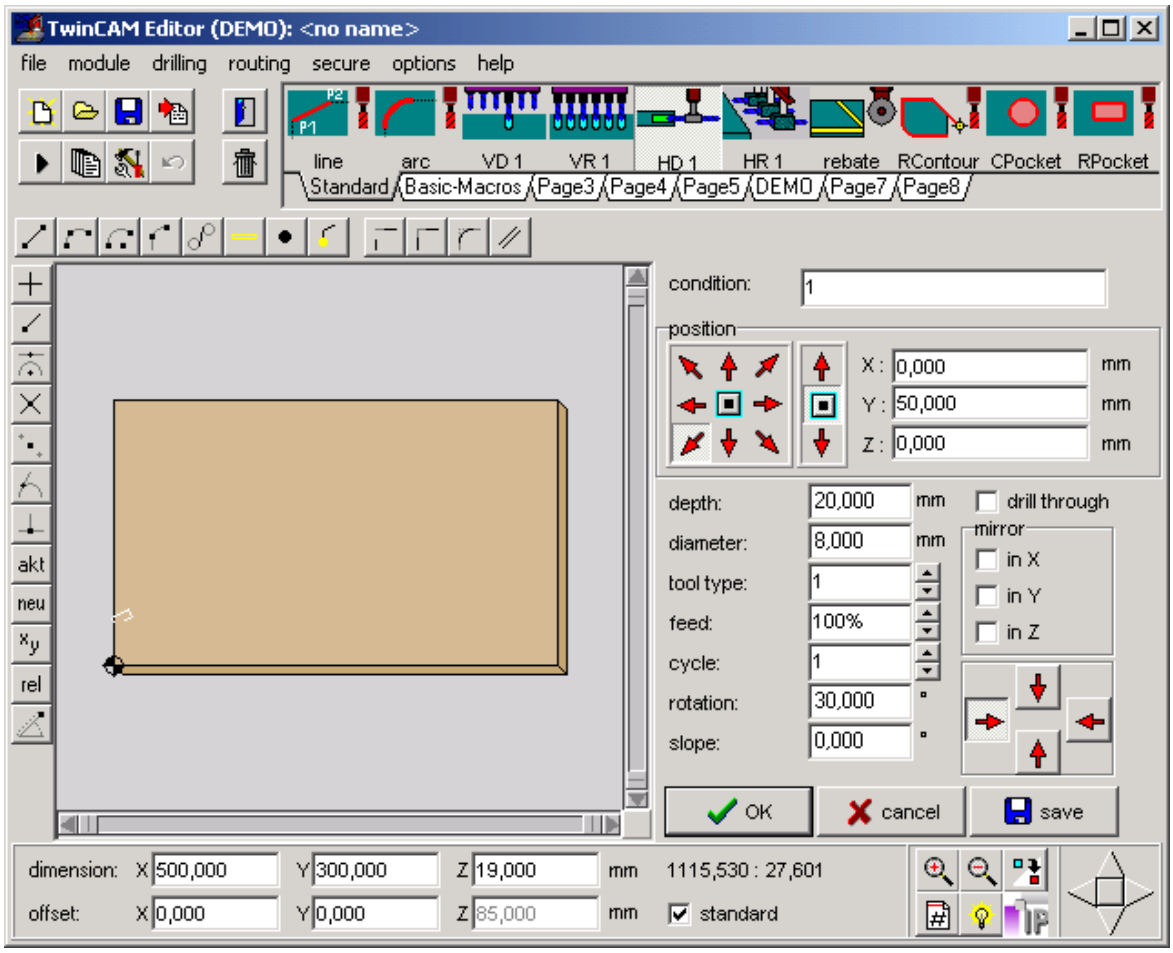
top, centre or bottom of the panel.

For a row in Y the options are
left centre or right of the panel. The data entry fields to the right of each set of buttons is to determine the distance from the reference point in each case.
If a button is not selected, then no row will be created.

Some combinations of buttons will not produce a worthwhile result.

All the other entry fields are described in overview of general information.

3.2.5.7 Horizontal Drilling

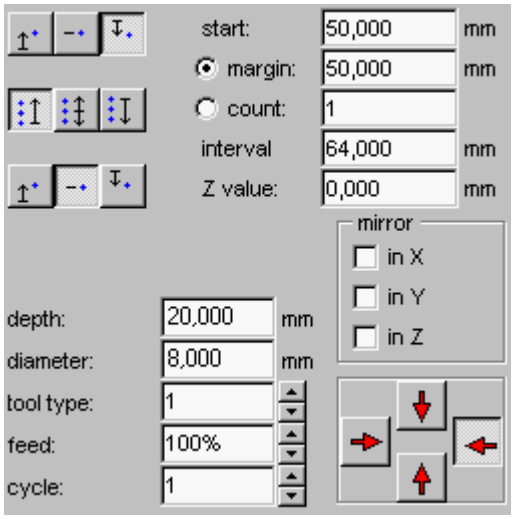


The X and Y co-ordinates fix the start point for the horizontal drilling. *Depth* indicates the depth in X or Y from the edge of the panel and Z indicates the location on the edge of the panel in relation to the top centre line or bottom of the panel as indicated by the up and down arrows and centre box next to the *magic points* selector. If top is selected, for example, then the Z value indicates how far down the edge from the top the drilling should be. Selecting centre and a Z value of 0 will place the drilling on the centre line of the selected edge. A positive Z value will be towards the bottom surface of the panel, and a negative value towards the top. If the bottom arrow is selected then Z values will move the drilling towards the top surface of the panel. Having positioned one drilling, it can, of course be mirrored in all planes.
All drillings are carried out at right angles to the selected surface, unless an entry is made under *rotation* to vary the angle of a drilling in the horizontal plane or *nutation* to vary tthe angle of the drilling in the vertical plane.

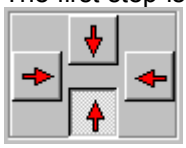
All other entries are as described in overview of general information.

3.2.5.8 Horizontal Row

A row of drillings can be defined either as a fixed count or by defining a margin to be left clear. TwinCAM 32 will position an appropriate number of drillings without impinging on the defined margin at the end of the row.
The reference point for rows is always taken as the upper edge of the panel.
The user is able to mirror the row in all planes about the centre axis of the panel.

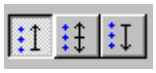


The dialogue for this type of row is less complex than that for vertical rows.
The first step is to select via the four arrows, which of the panel edges is to be drilled.



For a row in the Y axis a start value must be selected and referenced via the top row of buttons

to the top edge, centre or bottom edge of the panel.
Then select whether the reference drilling should be



at the bottom of the row, the top or the centre of the row.

For a row in X the procedure is similar, i.e. the start value is selected and referenced

to the left edge, centre or right edge of the panel
and then whether the reference drilling should be

at the left of the row, the centre or the right of the row.
The Z value describes the location of the drilling on the vertical edge of the panel, firstly by selecting one of the buttons to indicate

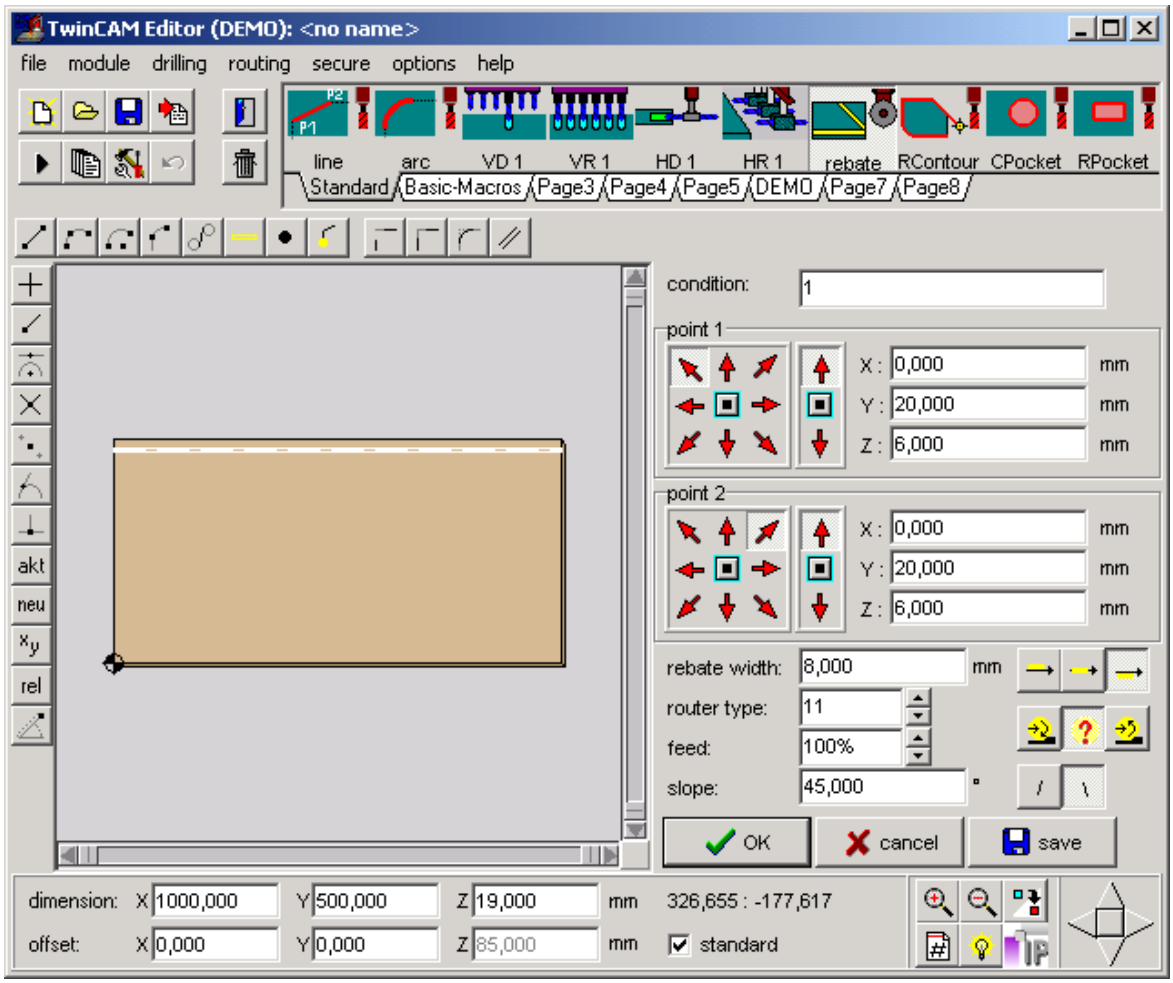
bottom edge, top edge or centre of the vertical surface.

If the top surface is selected a Z value indicates the distance towards the bottom from this edge. Centre and O indicates the exact centre of the edge regardless of the thickness of the panel. A positive Z value is a position towards the bottom edge, whilst a negative value is towards the top edge. If the bottom edge is selected, a Z value indicates a position towards the top of the edge from this point.

Some combinations of buttons do not give a worthwhile result.

All other entries are as described in overview of general information.

3.2.5.9 Rebates



Magic points, start and end points, and the side of the panel to which the rebate is to be referenced are all defined as for a routed line. The lower part of the data entry zone differs however. The width of the rebate needs to be entered in the left hand area. Even if the width of the rebate is wider than the available saw blades, TwinCAM 32 will calculate the number of passes required to complete the work on the basis of the width of the blade. To the right of this field, the top row of buttons set the required correction factor, which is always as seen from the start point in the direction of cutting.

 The values to be selected are left right and zero correction.

Below these buttons are a further three to select the direction in which the machining is to be carried out.

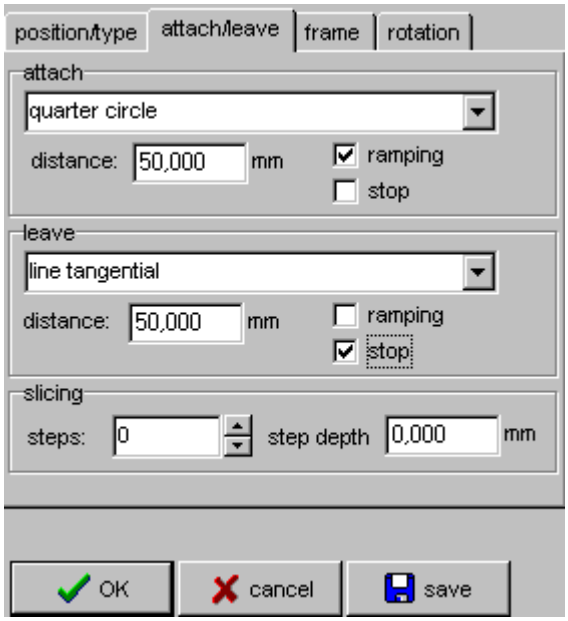
 This may be with the direction of rotation, against the direction of rotation or either direction. If the latter is selected, TwinCAM 32 will use the tool most appropriate to the task.

Slope

The falling gradient buttons define the gradient direction of saw, looked at from starting point of groove (point1) in line with the groove in sawing direction.

If the start point of the rebate is at the edge of the panel, the machining will in effect begin outside the borders of the panel. In any case the machining will be carried out in such a way as to ensure no damage is caused to the panel.
Rebates can be either sawn or routed. If there is no suitable saw available, TwinCAM 32 will attempt to find a suitable router.
All other entries are as described in overview of general information.

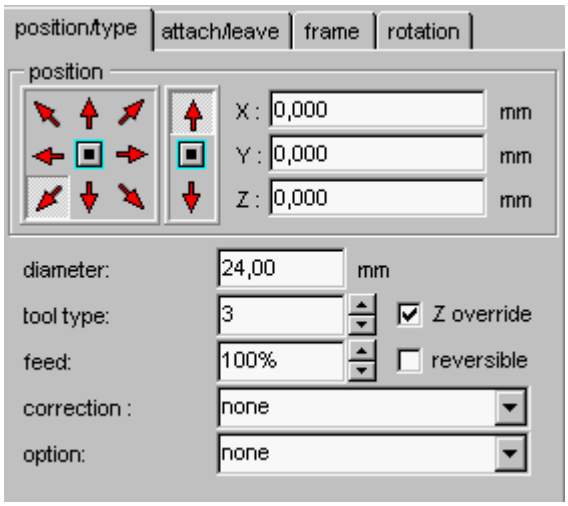
3.2.5.10 Start Point Attach/Leave



The next tab in the start point dialogue is '*attach/leave*' which enables the user to define the manner in which the tool attaches to and leaves the workpiece. There is also a field to set the *approach* distance. There four different attach/leave modes:-
1. Perpendicular - the tool attaches at right angles to the line or arc
2. Tangential - the tool attaches at a tangent to an arc, or as a continuation of a straight line.
3. Quadrant - the tool describes a quarter circle before attaching to the work
4. Semi circle - the tool describes a half circle before attaching to the work.

If the *ramp* check box is selected the tool will attach using the defined approach pattern at the programmed feed rate starting at Z value 0, with the reverse applying for leaving the workpiece i.e. the tool will be at Z value 0 as it leaves the workpiece in the defined pattern.
If *step depth* is selected TwinCAM 32 will calculated the required number of passes to machine the total depth. Alternatively, the user can specify the number of *steps* the machining should be carried out in, in which case TwinCAM 32 will calculate the depth of each step.

3.2.5.11 Start Point



In order for TwinCAM 32 to unambiguously define a routing, it needs a start point for the contour. To enter the required detail, click on the start point tab to reveal the dialogue box shown above. The position/type tab allows you to set the *magic point* and reference level, using the *magic point* selector and the up and down arrows and centre box adjacent to it. In order to link the start point to a contour, its co-ordinates must match those of the contour it is to be linked to. The other fields are for entering the diameter of the router, the feed rate and type code for the router (see tool selection). A routing list can also be entered under *type* for the selected start point (see routing list) , *Correction* seeks an entry for the relevant correction factor. The drop down menu offers a choice of left, right or none, in each case seen from the direction of cutting.
If the Z-Over ride check box is selected, the Z value for the start point is maintained throughout the entire contour. If not selected the Z value of each individual element is retained.

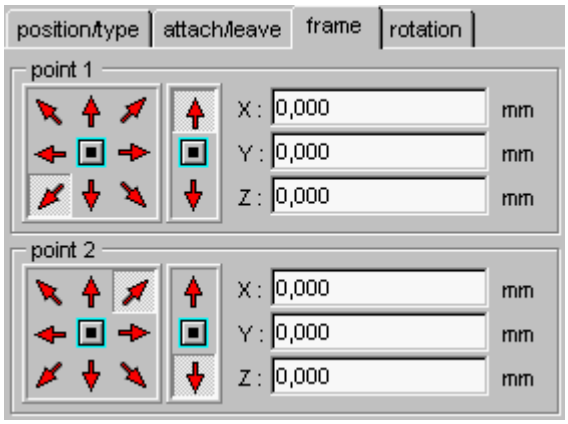
A particular case of working is the use of Z-Over ride of a milling machine. For this the starting point has to be referred to the bottom edge of panel and has to be booked as Z-value (Zero). A booked Z-over ride in tool data will only be used in this constellation, otherwise it will be ignored.

Options enables the user to select whether the machining should be with or against the direction of rotation. TwinCAM 32 will then select a router of the appropriate type to carry out the work in the required way. If no suitable tool is available, a '*rotation'* error message will be displayed. In this context if the '*reversible'* check box is selected, TwinCAM 32 will reverse the contour. If a router of the opposite rotation is available, the contour will be machined from the end point to the start point. If the z laser check box is selected, a laser projector programme is created which will project the overall outline of the workpiece together with the active contour on to thje work area of the machine. This enables accurate positioning of awkwardly shaped work pieces.

A start point is also created when routed contours are grouped. Default values will be entered automatically unless *edit* is selected to manually enter the required values. the start point for the group will be the start point of the first element selected as part of the group. if a particular start point is required, then the element with that start point should be selected first when grouping the elements together.

See also start point attach/leave framing and grouping

3.2.5.12 Start Point Framing

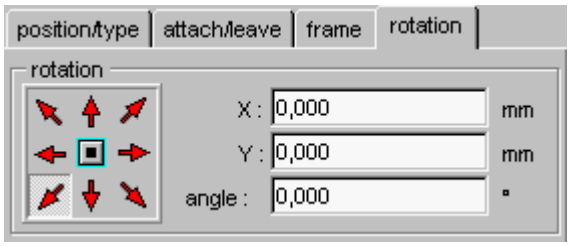


The frame is normally set to the same dimensions as the panel to be worked on. However it is possible to set the co-ordinates so that the frame is a 'virtual panel' with different dimensions to the actual panel and its own grouped elements

With function frame starting points grouped elements can be moved in relation to point 1 and point 2 to the reference points of elements.
This means only those elements can be moved, which relate with their referenz to one of the definition points of movement. If you move the point at the bottom left, only elements will move which relate to this point. Elements which refer to the right side will not be noted.

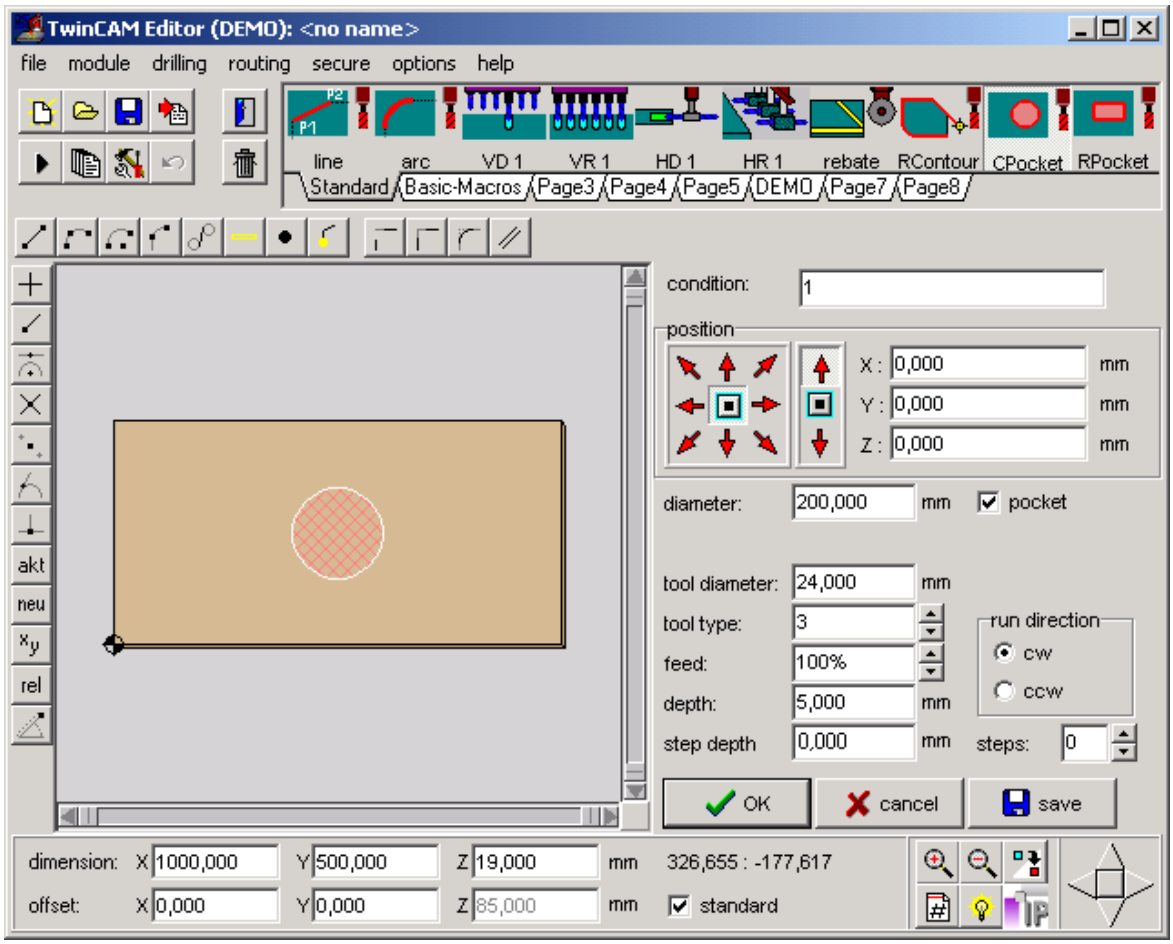
This function is also very suitable for Copying Elements in groups.

3.2.5.13 Start Point Rotation



Grouped elements (see Grouping) can be rotated about a defined point using this command. The elements to which this applies are drillings, routings,rebates and pockets. All grouped elements are rotated.
Enter the co-ordinates of the point about which the elements are to be rotated in the fields for X and Y. The *angle* is the number of degrees of rotation required.

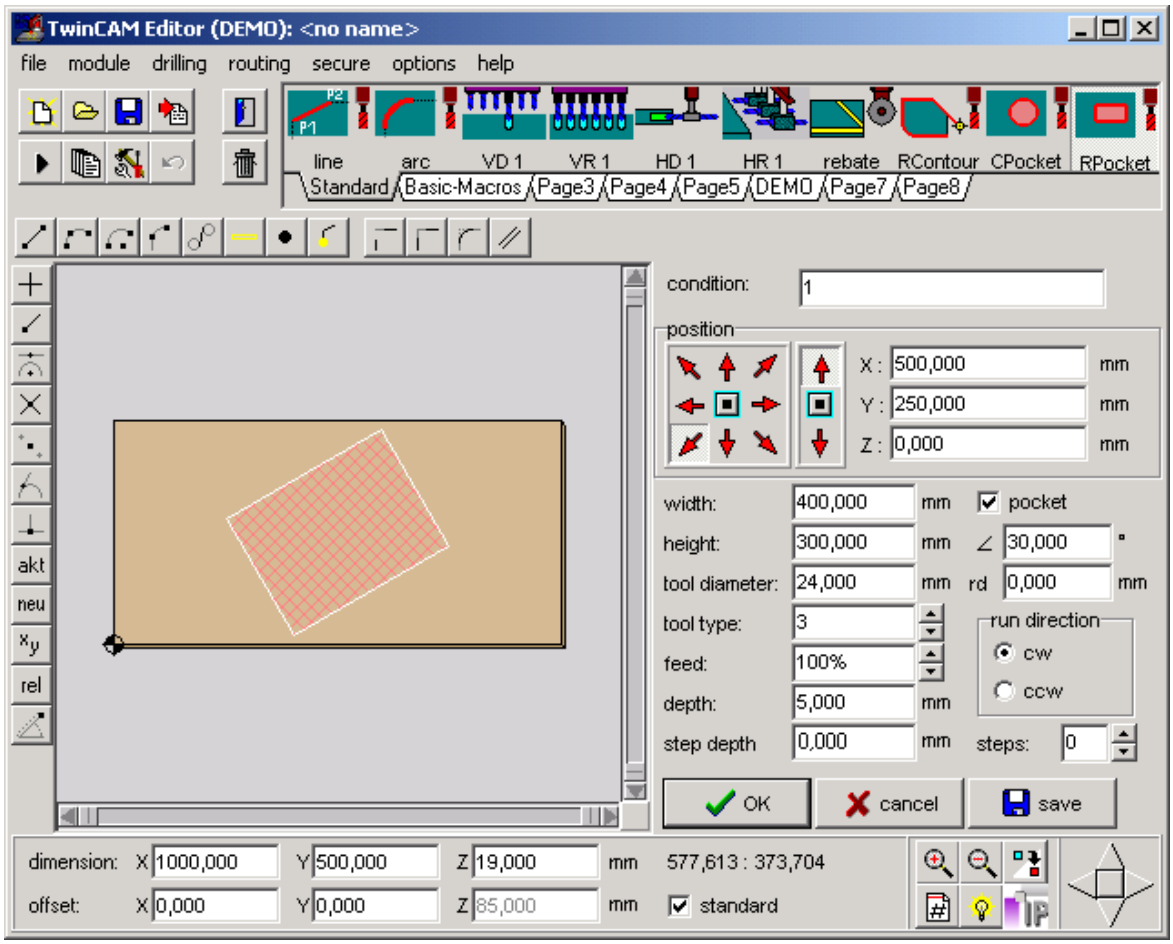
3.2.5.14 Circular Pockets



This function can be used to cut circular apertures as well as pockets. Which of the two you choose is dictated by the *pocket* check box to the right of the dialogue. If an aperture is required, set a *depth* value greater than DZ Select the *magic point* using the *magic point* selector and the reference level using the two arrows and centre box to the right of the selector. The data entry fields for X and Y co-ordinates are to set the centre point of the circle. The Z value refers to the starting level for the pocket, which will normally be 0 . The depth of cut is set by completeing the *depth* field and you will also need to specify the *diameter* of the pocket. The two remaining fields are for *step depth* and *steps*. If a maximum depth in one pass (step depth) is specified then TwinCAM 32 will calculate the number of passes required to cut the overall depth desired. Conversely, if a number of *steps* are specified, TwinCAM 32 will calculate the depth of each to achieve the required total depth. Pockets which have been designed using TwinCAM 32 do not need to have a start point specified. The entries for diameter of the router and type of router are the same as those required in the start point dialogue. TwinCAM 32 searches independently for a suitable tool with which to carry out the work.
Using the *rotation* check boxes specify whether the machining is to be carried out clockwise or counter (anti-)clockwise.

All other fields are as described in overview of general information.

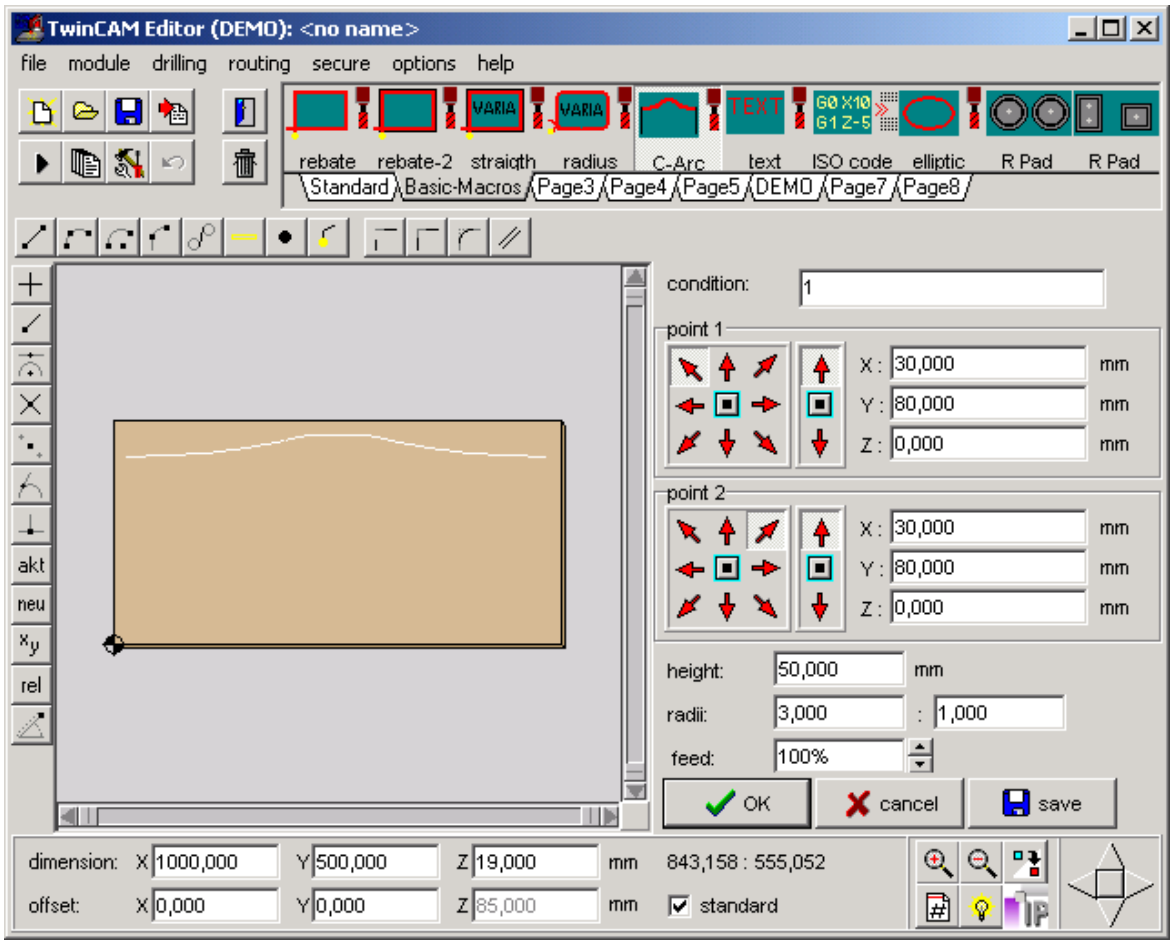
3.2.5.15 Rectangular Pockets



As with the previous section, this command can be used to cut rectangular apertures as well as pockets, and again the choice is specified by selecting the *pocket* check box. If an aperture is required, set a *depth* value greater than DZThe entries for the *magic point* and *reference level* are as before. The X and Y entries are to set the centre point of the rectangle and the Z value is the starting level for the machining, i.e. usually 0.. The depth of the pocket or cut is set using the *depth* field. The fields for *width* and *height* require the desired dimensions of the rectangle to be entered. *Step depth* and *steps* are identical to the same functions in circular pockets, that is to say if a value is entered under *step depth*, TwinCAM 32 calculates the number of passes to achieve the total depth, whilst if a value for the number of *steps* is entered TwinCAM 32 calculates the depth of each to reach the overall total depth. The *angle* field, marked with a ∠ symbol enables the user to rotate the rectangle about its centre axis through the number of degrees entered. The field below, marked *RD* , is for a radius value in mm to be entered if you wish the rectangle to have rounded corners.
Pockets which have been designed using TwinCAM 32 do not need to have a start point specified. The entries for diameter of the router and type of router are the same as those required in the start point dialogue. TwinCAM 32 searches independently for a suitable tool with which to carry out the work.
Using the *rotation* check boxes specify whether the machining is to be carried out clockwise or counter (anti-)clockwise.

All other fields are as described in overview of general information

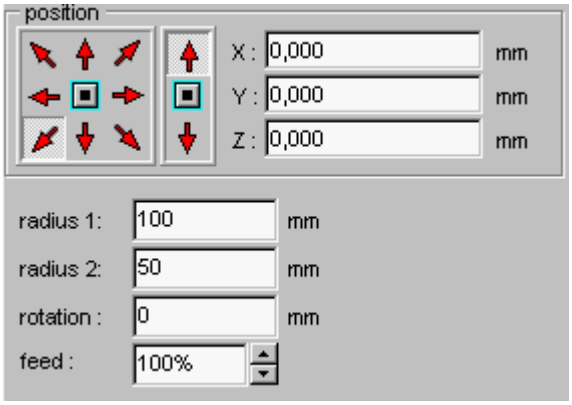
3.2.5.16 Cornice Arc

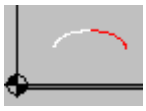


The entry in the *height* field is the peak height of the arc, i.e.from the lowest point to the highest point of the arc. There are two *radius* fields, which are entered as a ratio. The higher the ratio entered the steeper the arc will be. For example 5:1 would result in a flat arc., 1:1 a smooth arc and 1:5 in a steep arc.
All other fields are as described in overview of general information.

3.2.5.17 Ellipses

In TwinCAM 32, an ellipse is created in quarter segments.





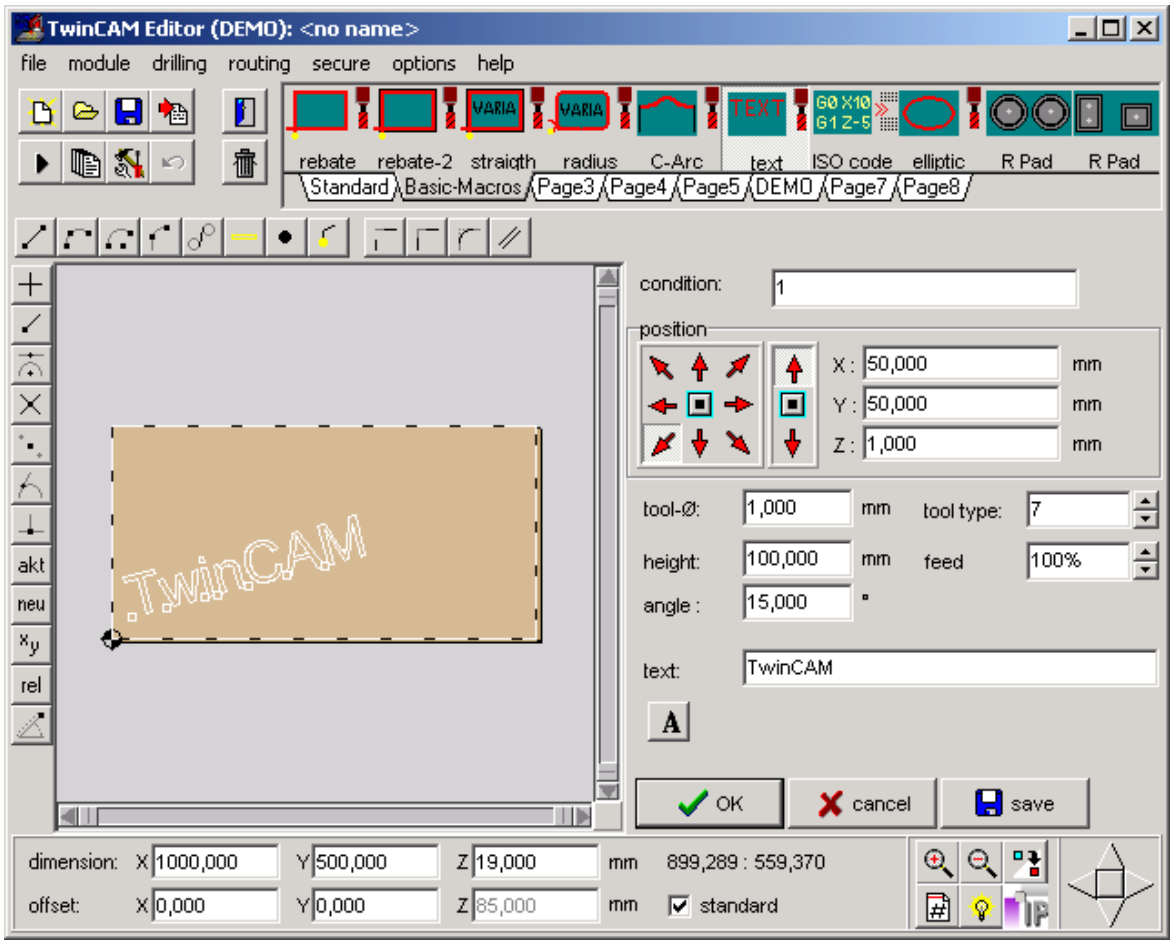
The co-ordinates locate the centre point of the ellipse. *Radius 1* defines the radius of the ellipse in X, whilst *radius 2* defines the radius of the ellipse in Y. Enter a *rotation* value of 0. To create a further segment of the same ellipse, retain the cordinates, enter a rotation value of 90°, and REVERSE the radii.
EXAMPLE
To create a complete ellipse, you need to define four segments in the following manner:-
Enter the co-ordinates as X=200, Y=100

	Radius 1	Radius 2	Rotation
Segment 1	100	50	0
Segment 2	50	100	90
Segment 3	100	50	180
Segment 4	50	100	270

If the ellipse is to be offset, the angle of rotation should be added to the rotation value entered.So if the ellipse is to be offset by 45°, the rotation values would be entered as 45, 135, 225 and 315 degrees.

The output accuracy of an ellipses is adjustable in global variables with _SystemEllipsePrecision.

3.2.5.18 Routing Text

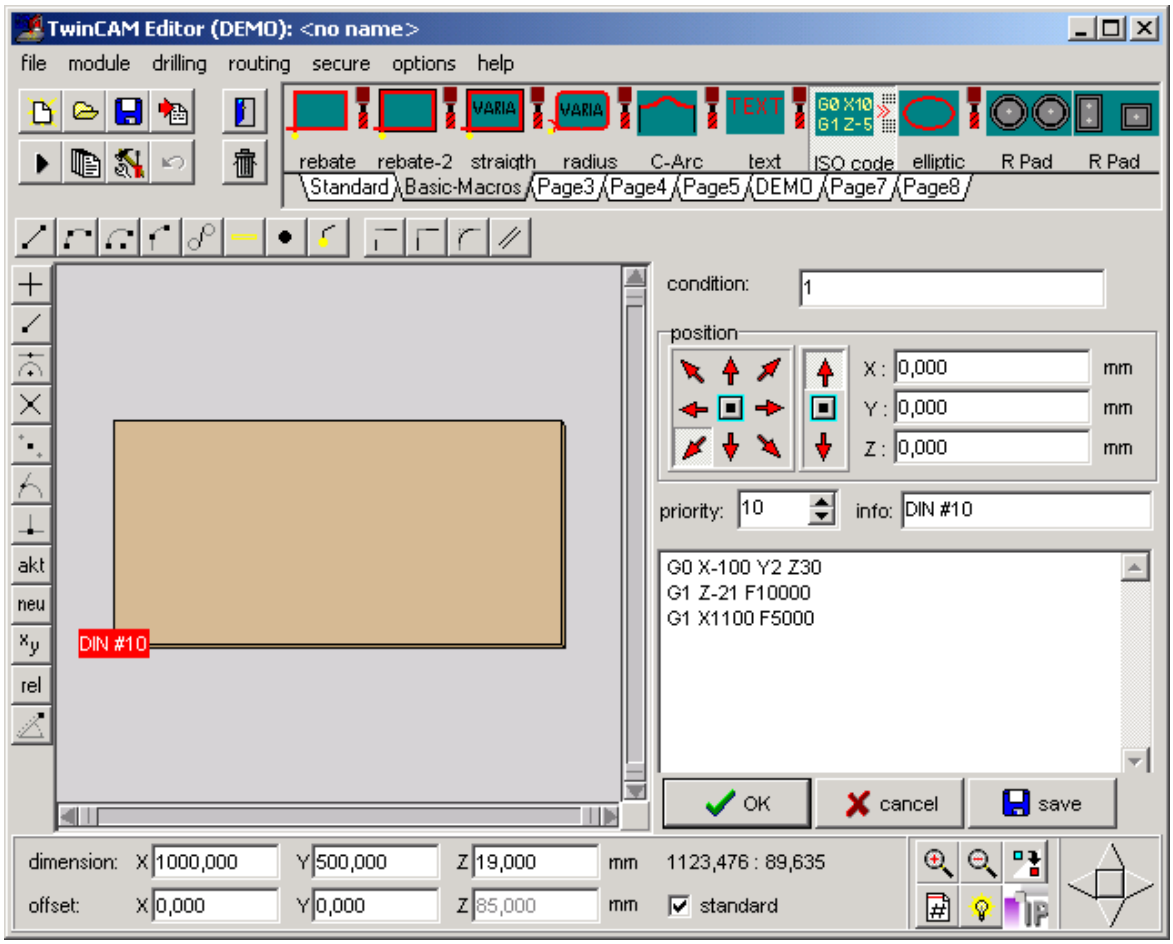


Using this function, text can be simply defined. Using the *magic points* selector and X and Y co-ordinates, set the bottom left corner of the text field. In the *height* field enter the required text size in mm, then select the text button.

A You can then selected the desired font from the dialogue box

Whilst it is possible to select any windows font that is installed on your computer, you should bear in mind that some, whilst attractive in print, are not suitable for machining.
All other fields are as described in overview of general information.

3.2.5.19 Inserting ISO Codes



This function provides the user with the opportunity to integrate an ISO code, comment or a sub programme in the TwinCAM 32 code.
The text will be considered when a simulated programme is run, so care must be taken that the code entered is comaptible with the machine dependent post processor code. You should take particular care to ensure that there is no conflict over control of margins of safety and clearance heights.

Under Open Command you can load complete ISO-Code files from data file. This can be overworked and adjusted with it.

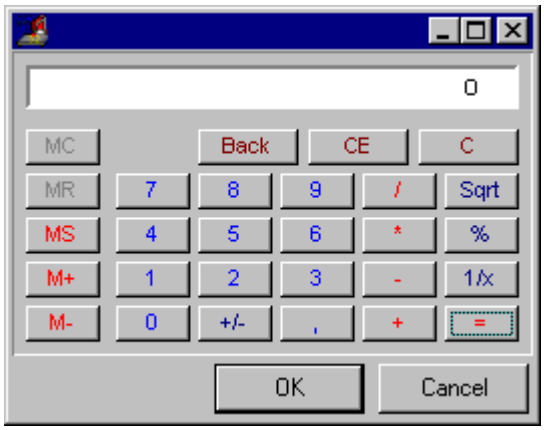
All other fields are as described in overview of general information

3.2.6 Control Functions

3.2.6.1 Calculator

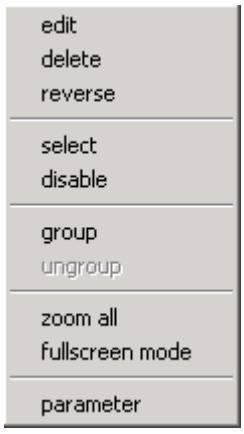
The *calculator* function is used to calculate values and enter them directly into the appropriate field. Move to the required field either by clicking on it with the mouse or using the tab key. Press *control* and *enter* simulatneously to activate the calculator. The calcluations are carried out as normal; by selecting *OK*, the result is entered into the field.

Don't forget to to click on the equals (=) sign to complete the calculation ***before*** you transfer the value to the entry field.



3.2.6.2 Grouping

The grouping function is used to link a number of drawing elements.
To create a group, hold down the *control* key and select the elements you wish to group together by clicking on them with the left mouse button. Once all the elements have been selected, open the context menu by clicking the RIGHT mouse button, then select *Group* using the LEFT mouse button. Once elements have been grouped together, TwinCAM 32 treats them as a single unit. If one element of a grouped series is selected, all are. If a group is selected and you then click on *delete*, all the grouped elements will be deleted.



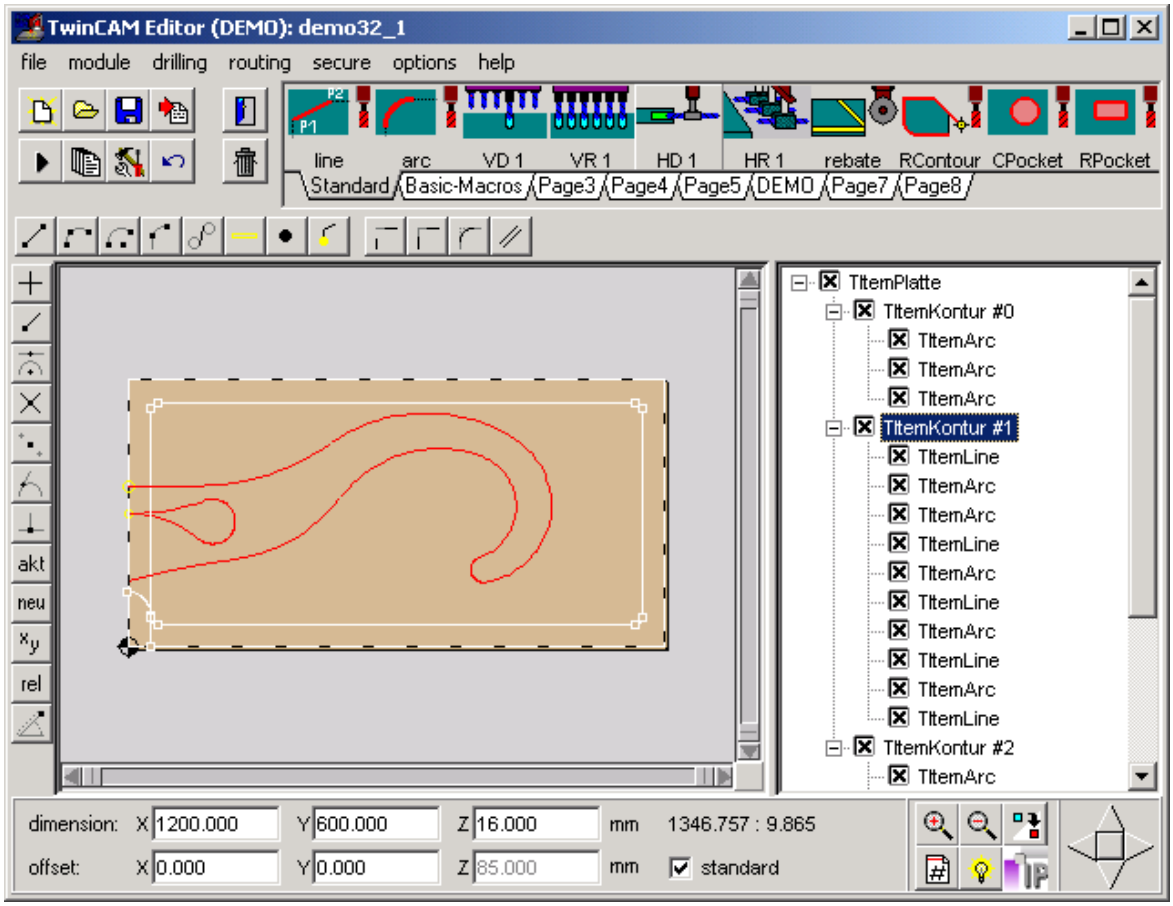
If you subsequently want to ungroup a series of grouped elements, select the group, open the context menu, and select *ungroup*. To select an element within a group, press *ALT* whilst clicking on the required element.

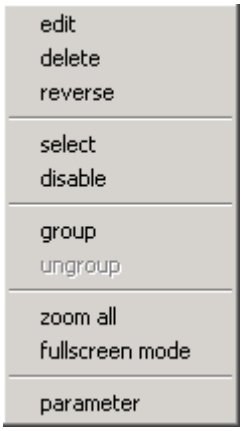
Grouped elements retain their grouping when saved as part of a drawing and also when inserted, as a group, into a new drawing. See *insert group.*

3.2.6.3 Using Explorer View

Using the explorer view, it is quite simple to edit the various elements of your drawing. To open the explorer view, select the CNC editor button with the RIGHT mouse button. This cannot be done when the CNC editor is running.

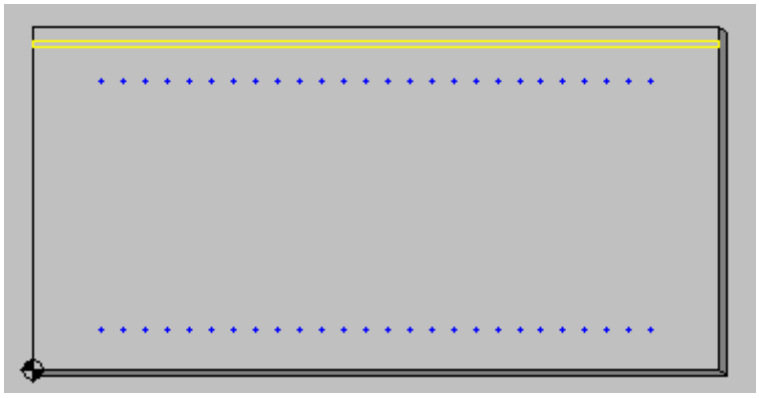
CNC Editor



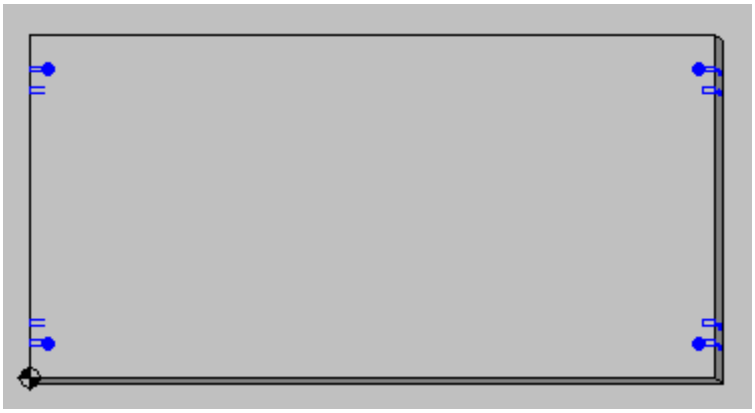


3.2.6.4 Working with Macros

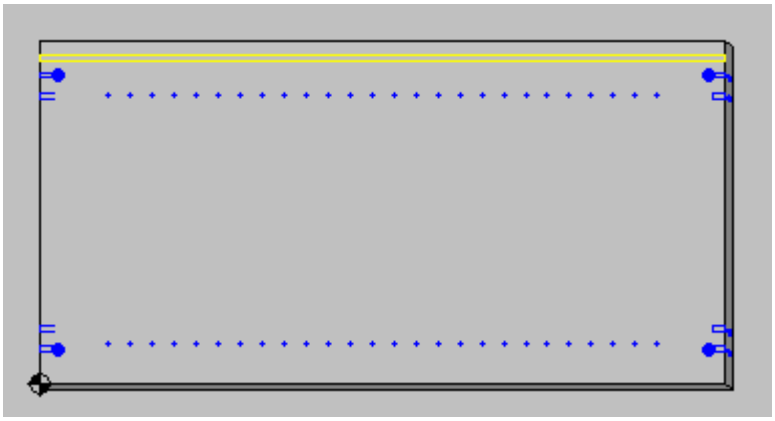
Working with macros or groups makes creating programmes with TwinCAM 32 much faster. A macro is a drawing with one or more drawing elements which has been saved together with all its associated references and technical data. The macro function enables the user to insert previously saved complete or part drawings into a new drawing. All the reference points are retained, and the inserted elements adjust to the new panel size automatically. As an example the machinings required for each type of fitting over an entire range of furniture can be saved as individual drawings and then inserted into a process drawing as needed for a production run. Say, for example, you have created a drawing which you will want to use as part of subsequent designs. To save this drawing as a macro, select *save as (*see saving files.) and then select under *folder* the path TWINCAM\GROUP. Save the drawing using a memorable name. When you want to insert this drawing into another drawing select *insert group* , select the desired file from the list and click on *OK*. The selected drawing file will be inserted into the existing drawing and the various elements will retain their original references or *magic points.*
Macros can also be accessed via register tabs in the user palettes see using user palettes.
The first illustration below shows the side of a cupboard as a new drawing. The second shows the complete drillings required for camlock bolts which have been previously saved as a *group*. The third picture shows the end result, where the two drawings have been put together to form a finished drawing. In this way, the desired result has been achieved using three mouse clicks rather than having to define all the drillings individually.



Picture 1: New created Drawing



Picture 2:



Picture 3:

3.2.6.5 Editing Elements

To edit an element in a drawing, simply double click on the element with the LEFT mouse button. This will open a dialogue box for data entry, and yu can makes entries as for defining a new element. Once you are satisfied with the entries, click on *OK,* see buttons, to accept the changes. If you want to amend an already created element in a drawing you can use the *insert* button see buttons.

to link an element to a different *magic point*, without changing the elements position, click on the *magic point* you want to link the element to with the RIGHT mouse button.

3.2.6.6 Copying Elements

To copy several elements, they can be grouped, then moved at an other position with the function Frame in starting point and added with the Add Button in the new position.

Selected groups can also be mirrored or turned. You can select a group and copy this with turn panel and then Mirror as side-inverted processing at the bottom side of plate.

3.2.6.7 Load ISO-Code file

In dialog *open file* you have the possibility, to open a manual written programme.

Such file includes TwinCAM conformal code (which means the code generated of TwinCAM , depends on postprocessor).
In this file an initialisation as well as an offset is not allowed. Also no commands for end of program. Which command line must be left out depends on postprocessor.

In contrast to the function Inserting ISO Codes the code of an existing file will be loaded to the drawing, it is not necessary to edit it manual.

Example (Siemens-Code):

```
;#PANEL X400 Y400 Z20.0
N20 TC_CHANGETOOL(6,1,3,14000,,,,,40.000,0,1)
N30 TC_SETFACE(0)
N40 G0 X0.000 Y0.000 M_Absaugung1
N50 G0 Z40.000
N60 F4000
N70 G0 X156.665 Y58.476
N80 TC_STARTKONTUR
N90 G0 Z30.000
N100 G1 Z-10.000
          :
          :
          :
N420 TC_BORING(-1.058,186.877,-15.000,0.0,12.000,12500,,,,,,,1)
N430 TC_SETFACE(3)
N440 TC_CHANGETOOL(152,1,3,3500,400.065,202.441,30.000,,20,,,2)
```

3.2.6.8 Change over millimeter / inches

To change over between millimeter and inches please make a doble-click with left mouse botton at any place of the current value. The usual possibility is to define mm/inch behind the dimensions of ground panel.

3.2.7 Extras

3.2.7.1 Overview of Extras

The *extras* zone on the base bar contains a number of supplementary functions.

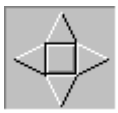
These are:-

  *Zoom in / Zoom out*

 *Mirror*

 *Priority (order of work)*

 *Transparent mode*

 *Turn panel*

3.2.7.2 Zoom In and Zoom Out

 Zoom

 Unzoom (Zoom back, Zoom all)

TwinCAM 32's zoom in function can be used to enlarge the view of a section of drawing. Click on the *zoom in* button in the extras zone. The cursor will change to a small cross. Move the cursor to the area you want to enlarge, then, holding the left mouse button down, drag the cursor across the area to be enlarged. Once the area has been covered, release the mouse button. Zoom mode can be switched off either by clicking on the *zoom in* button or by clicking the RIGHT mouse button. The standard view is regained by clicking on the *zoom out* button.

Scrolling
When the screen is in zoom mode, you can change the field of view by using the scroll bars at the side and base of the screen.

Dynamic Zoom
With the screen in zoom mode, as above, move the cursor over the end of the scroll bar and a double headed arrow will appear, hold down the LEFT mouse button, and drag the screen margins to increase the viewing area.

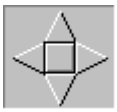
Zoom out
Zooming out, or returning to the standard view can be achieved in two ways. Either click on the *zoom out* button in the extras zone, or click on the bottom right corner of the scroll bars.

3.2.7.3 Mirror

Using this function will cause ALL elements of the current drawing to be mirrored about the centre of the X axis if you click on the LEFT mouse button, or the Y axis if you click on the RIGHT mouse button.

Using the function mirroring all SELECTED treatments of working pieces will be mirrored about the centro of X-axis (left mouse button) or Y-axis (right mouse button).
If there is no element selected, the complete drawing will be mirrored.

3.2.7.4 Turn Panel



Some machines have a feature whereby the underside of a panel can be machined, or alternatively, the panel can be turned to allow the other side to be machined. In order to be able to define work on the underside, this function has to be used. The panel can be turned through 90° about its X (vertical) or Y (horizontal) axis. Click on one of the arrows on the button to turn the panel in that direction. Pressing the centre square button turns the panel about its Z axis. You can now work on the underside of the panel.

If single elements or groups are selected, only this elements will be turned over/on the panel. This function suits very well for Copying.workings at the underside of panel.

3.2.7.5 Priority

This function is used to alter the order in which various machining tasks are to be carried out. If this function is active, each element's priority will be displayed in a yellow box adjacent to it. To alter the priority, select the element by clicking on it with the LEFT mouse button and then use the + or - keys to adjust the priority. Elements with the same priority rating will be ordered according to programme internal criteria such as the type of machining to be carried out and range of travel of the machining heads.
The order of priority can be amended in the machine dependant *.ini file.

TwinCAM 32's default priorities are:-

- Routing
- Vertical drilling
- Horizontal drilling
- Rebating
- Routing text

When using working lists the priorities of the drawing add with those of the list. Please give priorities every 10 steps, so that there is enough free space when defining the list.
The priority of starting point has for example priority 20, in the correspondidng list the 3. workin hat priority 3. So the 3. working has the priority 23. If there is an other drawing element with priority 22, the list would not be worked one after the other point, but the working of this element would be intervened.

In combination with functions and conditions this handling of priorities allows a very flexible control of working expiry.

3.2.7.6 Transparent Mode

This function is an aid of drawing, in which the drawing is displayed as transparent.
This is particularly useful when both sides of a panel are to be machined or to see marchined parts edge-hidden.

3.2.8 The Menu Bar

3.2.8.1 Overview of the Menu Bar

The menu bar contains all of TwinCAM 32's principal functions and is divided into seven separate menu headings.
File
Module
Drilling
Routing
Secure
Options
Help

An explanation of each heading and its sub-menus follows.

3.2.8.2 File

New	Create new drawing
Open	open file. Open existing drawing
Save	Saves a drawing as the same name
Save as	Save file Saves a drawing under a new name
Insert File	insert file inserts a file (group)
Load Palette	using user palettes loads a user palette
Save Palette as	using user palettes. Saves a palette under a new name
Print	Printing. Prints the current drawing and NC code
Back up	Back up Saves the machine configuration and user data
History	A list of the last four edited drawings is displayed
Exit	Closes TwinCAM 32

3.2.8.3 Module

This menu heading is divided into two:
Tools which opens the tool adminstration, see Tool admin, and
Job list which opens the job list, see overview of Job lists

3.2.8.4 Drilling

Drilling is divided into:-

Vertical drilling	creating single vertical drillings
Vertical row	Creates a row of vertical drillings
Horizontal drilling	Creates a single horizontal drilling
Horizontal row	Creates a row of horizontal drillings

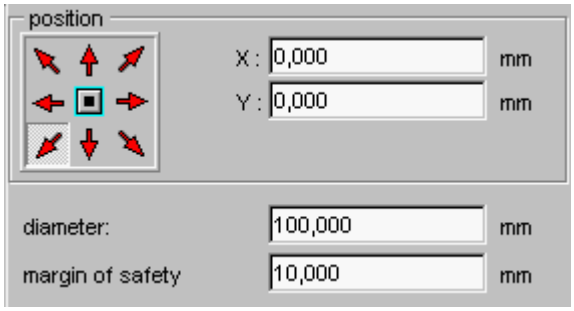
3.2.8.5 Routing

This heading contains the following sub menus

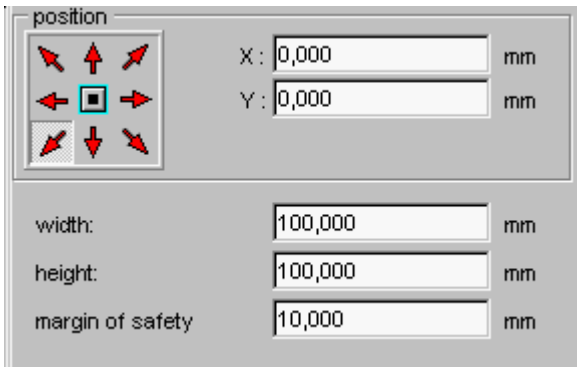
Start point	Links a start point to a routed contour.
Line	Creates a routed line
Arc	Creates a routed arc
Rebate	Creates a routed or sawn rebate
Circular Pocket	Creates a circular pocket or aperture
Rectangular pocket	Creates a rectangular pocket or aperture
Cornice Arc	Creates a cornice arc
Ellipse	Creates segments of an ellipse
Text	Creates routed text
Insert ISO code	Inserts ISO code or other text into a programme.

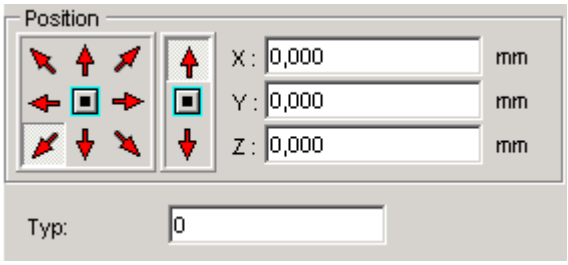
3.2.8.6 Secure

This heading if selected will give the option of either round or square suction pads for securing the workpiece.
For round suction pads, position the pad by selecting a *magic point* and setting the X and Y co-ordinates. *Diameter* refers to the diameter of the pad and *safety* to the minimum distance the pads should be apart.

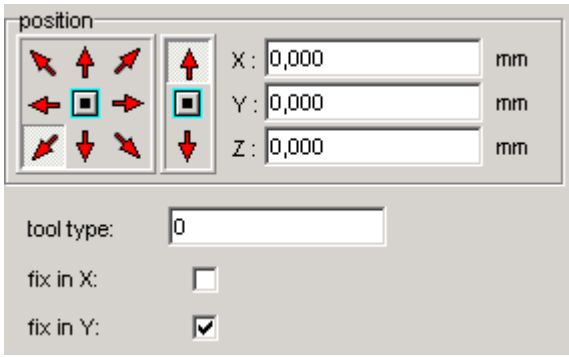


The entries for Square suction pads are similar except that *height* and *width* of the pad are required instead of diameter.
To position the suction pad using the mouse, click on it with the left mouse button and drag it to the desired location.





cross-arms exhauster are machine-depending exhauster. They are especialliy defined in the machine configuration. The choice of the different versions will be made by type.



Cross-arms are defined in the machine configuration. Different versions can be chosen with type.

Cross-arms exhauster and cross-arms are machine- and manufacturer-dependent. Information about this elements can be obtained at corresponding machine maufacturer.

3.2.8.7 Options

Enables the user to select the type of machine (See Machine selection), display colour (see Colour settings), and the work list editor.

3.2.8.8 Help

Contents	Gives access to the help files
Index	Opens the help file index
Tutorial	Opens the TwinCAM 32 tutorial. See Defaults
Info	Information on TwinCAM 32's version and serial number.

3.2.8.9 Printing

Using the print command in the File menu, you can print the currently displayed drawing and its NC code. The programme code will only be printed if the programme generator is active and the CNC editor is open. The printing function uses the windows default printer.

3.2.8.10 Back up

TwinCAM 32's back up function in the *file* menu saves the machine configuration as well as the user defined data. User defined data includes the *palettes, work lists, function files* and so on. Either the machine configuration or the user data can be backed up and/or restored.The programme will back up all data automatically onto a floppy disk in Drive A, into a file named backup.cfg.It is recommended that the defaults set by the machine manufacturer or distributor are not changed.. If it should become neccessary to change these settings, please contactTwinCAM 32 support. Back up output is is compressed in ZIP format. An appropriate utility such as WinZip or PKUnZip is required for decompression.

The functions BACKUP and RESTORE of TwinCAM act only as data protection and backup of machine or of corresponding PC.
It is unsuitable for transfer of machine data between machine and PC.

At some versions the the machine import is integrated in setup, depends on machine manufacturer.
The file IMPORT.TXT on CD or at file directory of TWINCAM\BIN contains detailed information.

3.2.9 CAD Functions

3.2.9.1 Overview of CAD Functions

TwinCAM 32 contains a range of CAD functions which make using the programme very much easier.
These include CAD drawing elements, object capture functions and manipulation.

3.2.9.2 CAD Drawing Elements

 Routed line between two points. If the control button is held down whilst marking the line, it will only be drawn as horizontal or vertical.

 Routed arc over three points

 Routed arc over start point end point and angle

 Tangent arc as a tangential continuation of a line or an arc.

 Routed line as a tangent to two arcs

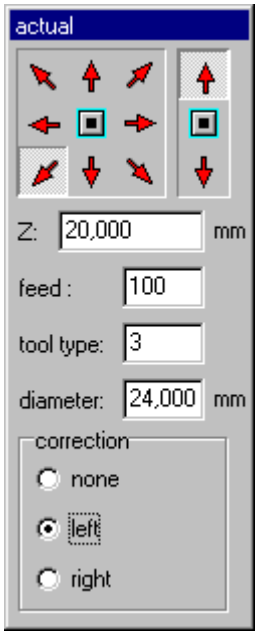
 Rebate, sawn or routed, between two points

 Single drilling

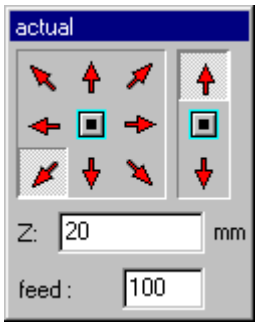
 Contour start

When contour start is selected, entries have to be made in the following dialogue box.

The entries must be made BEFORE the start point is set.



For all other elements, the routing depth and feed rate must be entered BEFORE the first part of the element is set.



3.2.9.3 Object Capture Functions

The shortcut keys for each of these functions are shown in brackets.

Clicking in the CAD zone deactivates any active object capture functions.

Captures the end point of an element, including the panel edge. (E)

Captures the mid point of a line or curve. (C)

Intersection or assumed intersection of two elements (X). In the case of an assumed intersection the two elements may not intersect directly.

Mid point between two known points (M), captures the mid point in space between two known points, which may be end points, intersections mid points etc. on elements.

Tangent on a curve/Circle (T) captures the end point of a tangent.

Perpendicular (L) constructs a perpendicular line on the end point of a curve or line.

Current point (Y). The last marked or captured point.

New (N). Creates a new current point using a mouse click, co-ordinate entry or object capture.

Co-ordinate entry- absolute (A), taken from the left lower corner of the panel, opens the dialogue

for co-ordinate entry, for the co-ordinates to be accepted you must hit *enter*.

Co-ordinate entry - relative (R) to the current point, opens the dialogue for co-ordinate entry, for the co-ordinates to be accepted you must hit *enter*.

Co-ordinate entry- polar (P) relative to the current point, enrties required for the length of the line and its angle to the horizontal axis, opens the dialogue for dialogue entry. For the co-ordinates to accepted you must hit *enter*.

3.2.9.4 CAD Manipulation

Trimming - 1 element. Reduces the length of an element from another element, or extends an element to another element. The end of the element to be reduced or extended should be selected first, then the element to which it is to be extended or from which it is to be reduced.

Trimming - 2 elements. Reduces the elength of two elements at their point of intersection, or extends to elements to a common intersection. Select the ends of the elements to be reduced/extended.

Rounding. Rounds the intersection between to elements. Before selecting the elements, enter the desired curve radius in the dialogue box.

Parallel. Displaces lines and arcs by a selectable distance to be parallel to another element. The reference point of the displaced element remains fixed, but the co-ordinates will change. In the case of arcs, the radius will also change. Before selecting the element, you must enter the distance it is to be displaced.

In order to select the correct end of the element you wish to manipulate, move the cursor from the centre of the elememnt towards the end before selecting.

Note that because CAD functions can be used in the construction of drawings intersections between elements to be trimmed or rounded may lie outside the margins of the panel.

3.2.10 Work Lists

3.2.10.1 Work Lists

The use of work lists is particularly important in window and door production. Although machining with a number of different routers may be required, only one contour is actually drawn, which is then processed using a defined list of different tools.
Work lists are numericaly coded in the WORKLIST.DAT file. They may be edited either by selecting *options* from the menu bar or by using any standard text editing programme.
Priority ratings in the work list are added to those created in the drawing. To activate a work list, enter the worklist name (the figure in square brackets) in the router type field of the start point dialogue. Enter the number of processes to be carried out in the COUNT field.
Depending on the entry in the zoverride field, different effects are produced as follows: -
Zoverride = -1 The start point values are used and if the Zoverride box in the *start point* menu is checked, it is taken into account. Any Zoffset values entered are also taken into account.
Zoverride = 0-2 The Zoverride checkbox in the start point dialogue is superceded by any entry in the *work list*.
Zoverride = 0 The offset Z value is added to the element's Z value. A range of Z values along a contour are possible.
Zoverride = 1 The offset Z value is added to the start point Z value, giving a fixed Z value for the whole length of the contour. Any values included in the drawing are ignored.
Zoverride = 2 A fixed Z value is defined from the upper surface of the panel resulting in a fixed cutting depth for the contour disregarding any Z values in the drawing or *start point dialogue*.

WOKLIST.DAT

;Zoverride=-1	Entries in the start pouint dialogue accepted-
;ZOverride=0	Offset Z values added to the drawing's Z value
;Zoverride=1	Offset Z value added to start point Z values
;Zoverride=2	Fixed Z value taken from top surface of workpiece.
;Priority=	process sequence 0.....
;Tooltype=	tool type code
;Diameter=	tool diameter - only relevant for *tool type* 0
;OffsetXY=	XY offset value added to drawing value
;OffsetZ=	value added to the Z value on the drawing
;FixedZ=	value entered is used for machining, drawing value ignored.
;Feed=	feed rate, if 0 is entered the drawing value is taken.
;Stop0=	programmed stop before the contour (0=inactive, 1= active)
;Stop1=	programmed stop after the contour (0=inactive, 1= active)

;!!!The process names entered under 1=, 2= 3= etc can only be used ONCE each in the worklists. See the example below

```
;Three phase routing process
[100]
Count=3
1=PREPRO
2=CUT2
3=FINISH

[PREPRO]
ZOverride=2
Priority=0
Tooltype=1
Diameter=100
OffsetXY=10
OffsetZ=5
FixedZ=5
```

Feed=3

[CUT2]
Zoverride=2
Priority=1
Tooltype=12
Diameter=110
OffsetXY=10
OffsetZ=5
FixedZ=1
FEED=3
STOP1=1

[FINISH]
Zoverride=2
Priority=1
Tooltype=12
Diameter=110
OffsetXY=10
OffsetZ=5
FixedZ=1
FEED=3

The process names entered under 1=, 2= 3= etc can only be used ONCE each in the worklists.

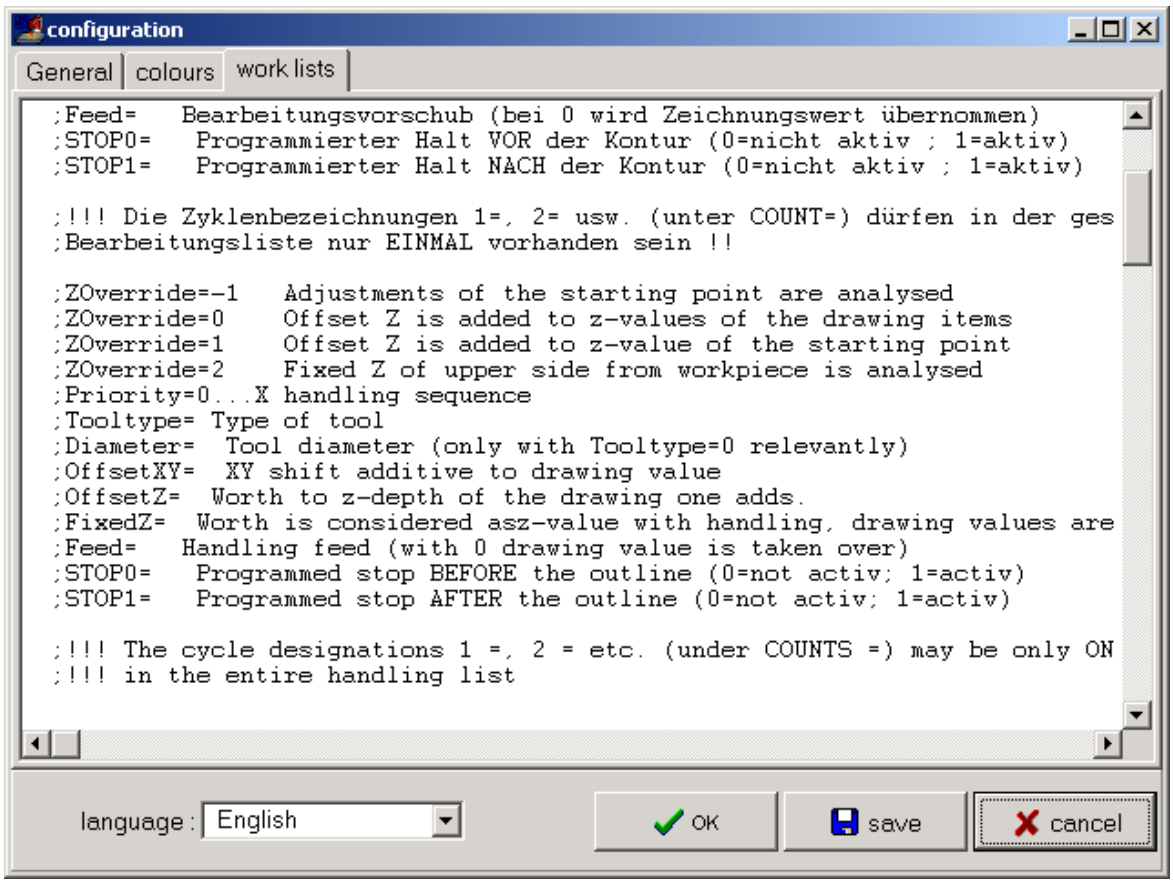
When using working lists the priorities of the drawing add with those of the list. Please give priorities every 10 steps, so that there is enough free space when defining the list.
The priority of starting point has for example priority 20, in the correspondidng list the 3. workin hat priority 3. So the 3. working has the priority 23. If there is an other drawing element with priority 22, the list would not be worked one after the other point, but the working of this element would be intervened.

In combination with functions and conditions this handling of priorities allows a very flexible control of working expiry.

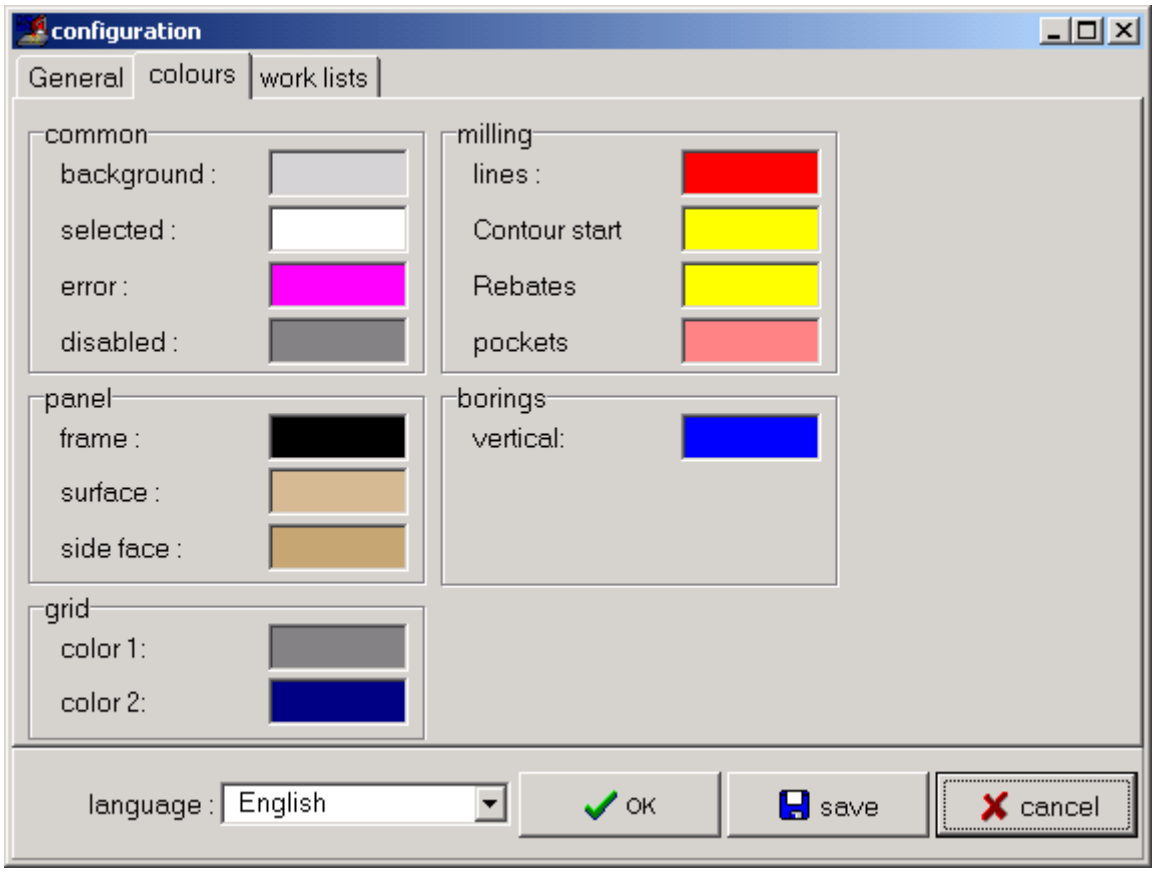
3.2.11 Options

3.2.11.1 Overview of Options

This dialogue enables you to adjust various settings.
The *General* register allows you to select the machine for which the programme is to be generated. See Machine choice. The work list editor can be found to the right of this screen.
The *Colours* register allows you to alter the colour setting for the display.
The *Directories* tab is not used.
In the lower part of the screen , there is a drop down menu to select the language you wish to run the programme in. See languages



3.2.11.2 Colour Settings



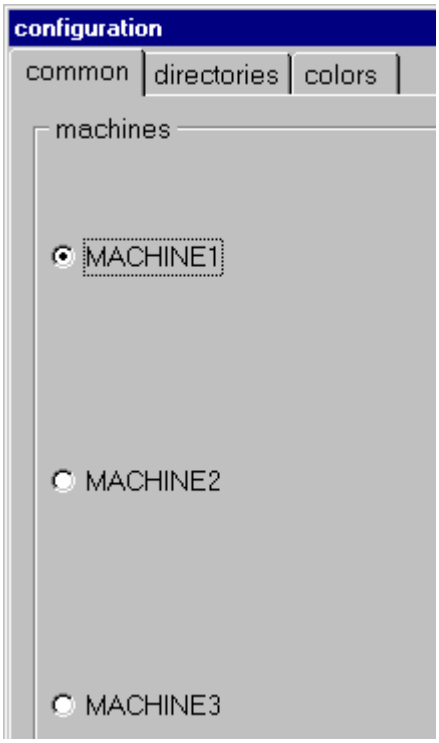
To change the colour of a programme feature, click on the colour field and select a new colour from the dialogue box, then confirm the selection by clicking on *OK*.

The screen shot above shows the TwinCAM 32 standard colours which are:-

Background	Light Grey
Selected	White
Error	Magenta
Edges	Black
Top surface	Light Grey
Sides	Dark Grey
Line/arc	Red
Contour start	Yellow (circle)
Rebate	Yelow (line)
Pockets	Light Red, dotted
Vertical drill	Blue
Horizontal drill	Green

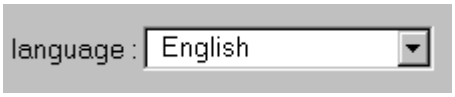
Please be aware that in some cases, only 16 colours are available for selection.

3.2.11.3 Machine Selection



The machine type is selected by clicking on the appropriate radio button. Which machines are available will depend on whether your programme was bundled with a machining centre or purchased separately. A machine change can be carried out at any time, and open drawings will be regenerated for the new machine type.

3.2.11.4 Language

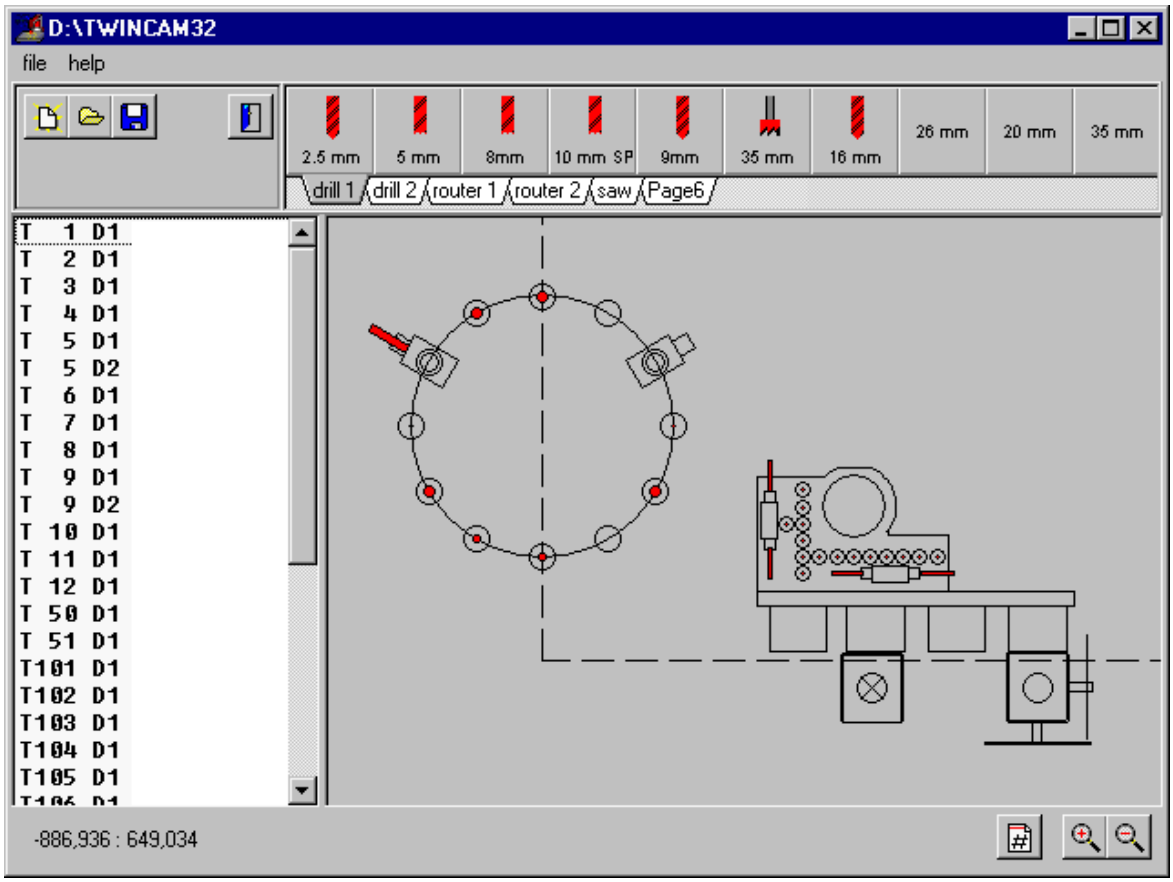


To change the selected working language, click on the arrow to the right of the language displayed to reveal a drop down menu, click on the required language and then on *OK*. You can choose between English, Spanish, German and French.

3.3 Tools

3.3.1 Overview of Tool Administration

TwinCAM 32 administrates one tool list for each machine configuration, in which all tools which can be used on the machine are listed. It can be compared with a tool cupboard, in which all the tools are stored. Although it is possible to administer several machines from one tool list, this is not advised as it may cause unexpected side effects.



Tool and Configuration Dialogue
Clicking on the configuration editor button opens the tool and configuration dialogue. There are three buttons at the top left of the screen:

 New configuration

 Open configuration

 Save configuration

Once a new configuration has been created, it is recommended that you save it using a memorable name, using the *save as* option on the drop down menu.
To the right of the file save buttons, you will see the Tool list. The graphic area of the screen is the configuration, see overview of the configuration file. This file is edited by dragging and dropping the various tools into their locations. The lower part of the screen displays the co-ordinates of the tools at park position. Editing the configuration is made easier by the *zoom* function.. The text window to

the left displays the current configuration in text form.

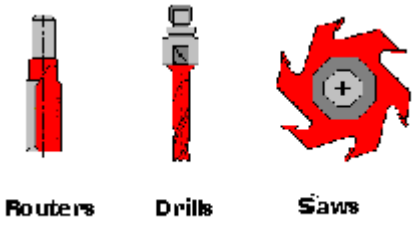
3.3.2 Tool List

3.3.2.1 Overview of the Tool List

- Editing the tool list
- Adding a tool
- Editing a tool
- Deleting a tool
- Copying a tool
- Tool data
- Display
- Geometry
- Cutting data

3.3.2.2 Editing the Tool List

The following types of tools can be stored and defined in the tool list:-



There is only one tool list. Creating a new configuration does not create a new tool list.

The tool list is found at the top of the screen. It is divided into a number of registers, each representing a different tool type. Clicking on a tab switches from one register to another and displays a different range of tools. Tools can be added to the list, amended or deleted from it in this section. The tools are displayed by means of an icon of the general tool type and a short text description. Large machining centers require a huge number of tools to be administered and it is for this reason that the tools are divided by type into separate registers, to reduce the number of tools on display at any time and to make finding an individual tool much easier.

Tool definition consists of four registers:
Tool data
Display
Geometry and
Cutting data.
Use of the tool list is made much easier by the context menu which appears when the RIGHT mouse button is clicked.

3.3.2.3 Adding a Tool

To add a new tool to the list, first select the general type of tool by clicking on the appropriate tab. Double clicking on the first vacant field to the right of the displayed icons will open the tool dialogue.

3.3.2.4 Editing a Tool

If the tool data change, for example because the radius has changed due to sharpening, or because a copied tool has different data, then these changes need to be entered in the tool list. To edit a tool, click on the tool with the RIGHT mouse button and then select *edit* from the context menu. The dialogue is identical to that used for defining a new tool, although there will already be data entered in the various fields. Simply enter the new details. Any tool can be edited, including tools which are included in a configuration. Click on *OK* to save the changes. Clicking on cancel will reject the changes and leave the tool data unamended. A tool can also be edited by double clicking on it in the configuration file or double clicking in the text window.

3.3.2.5 Deleting a Tool

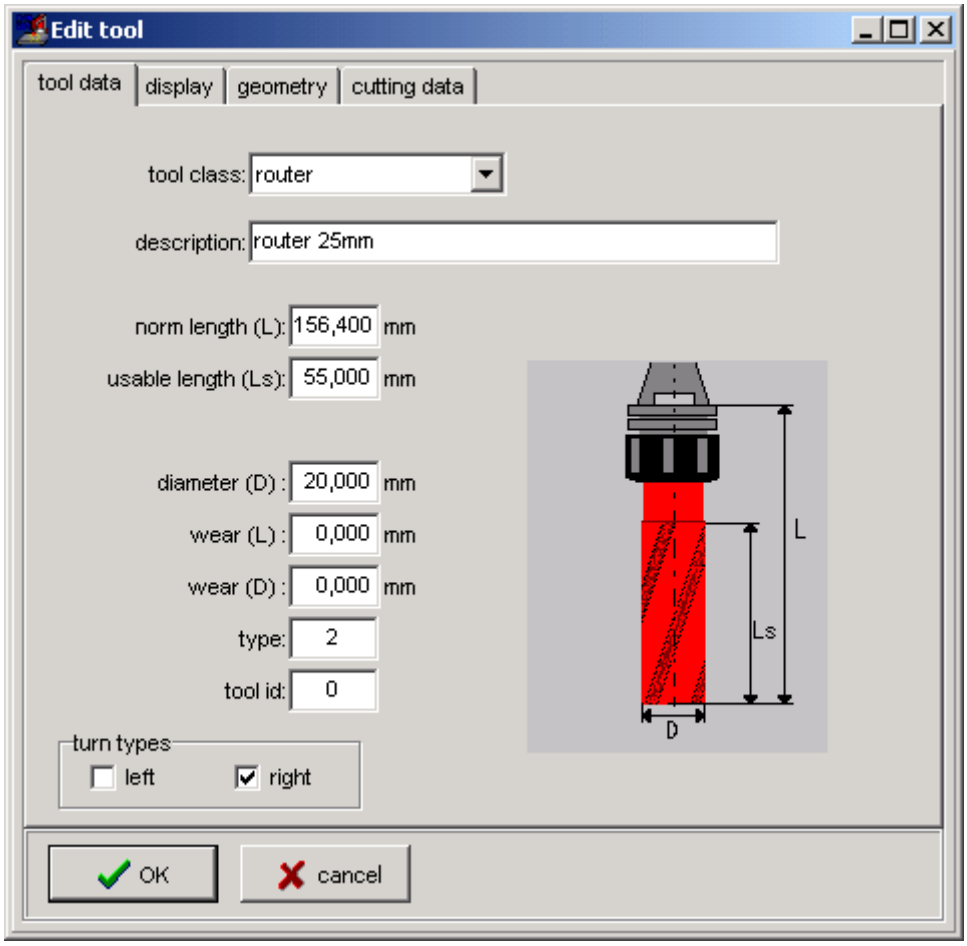
To delete a tool, click on its icon with the RIGHT mouse button and select delete from the context menu.

3.3.2.6 Copying a Tool

It is often useful to be able to copy a tool. For example, where tools are identical save for their direction of rotation or, drills, where the length is usually the same and only the diameter differs. With TwinCAM 32 this can be done quite simply. Click on the tool with the RIGHT mouse button and select copy from the context menu. Then move the cursor to a vacant filed on the tool list and again click on the RIGHT mouse button. This time *paste* is the only option available on the context menu, click on *paste* and the tool will be copied to the vacant space in the tool list. The tool will now need to be edited as described above.

3.3.2.7 Tool Data

This dialogue is the basic description of a tool. An icon display will help to identify the dimensions required.



Tool Type
The type of tool is selected from a drop down menu at the top of the screen. Take care not to enter drills in the saws register, for example, as this will make tracing tools unneccessarily difficult.

Description
Each tool has a field for a free text description, which should include data such asdiameter or use of the tool for ease of identification.

Nominal Length (L)
The length from the mouth of the chuck to the tip, as marked on the icon.

Useable length (Ls)
As the name implies the useable length of the tool

Diameter (D)
The diameter of the tool as indicated on the icon

Wear - length and diameter
The amount of wear on the tool as a result of sharpening. . Wear is taken into account when calculating the machining of pockets, for example.

Type code
TwinCAM 32 can mark contour start points and drillings with a tool type code. If the tools are identified with the same type code, then they will be selected for tasks which are coded. The choice of code for each tool is user selectable, and can be repeated for each classification of tool, i.e. a drill, a saw and a router can all have the same type code.

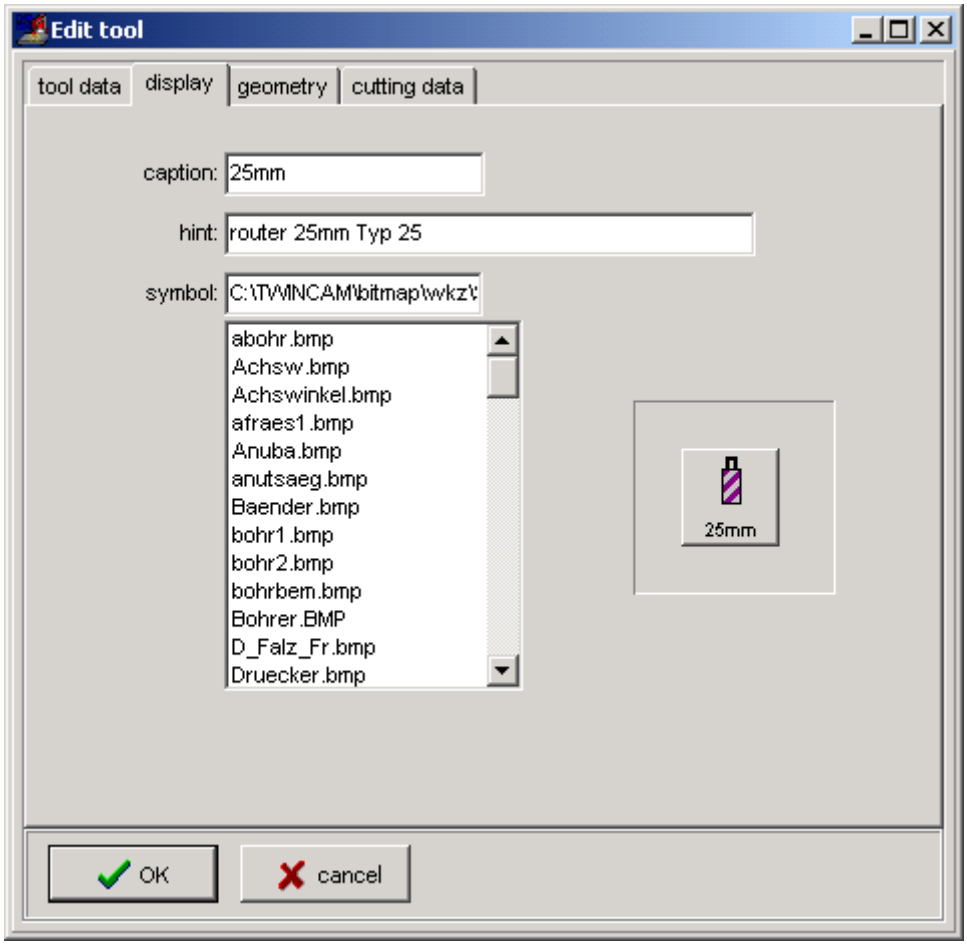
Tool ID
A fixed identification number set by the user for each tool, which may be used by the post processor for some machine types.

Rotation
Sets the direction of rotation for the tool by clicking on the appropriate check box.

For drills which can be used in bi-directional machine heads, it is recommended that you select both directions. This makes administration easier and less time consuming.

3.3.2.8 Display

This dialogue sets the icon and description for the tool's entry in the tool list.



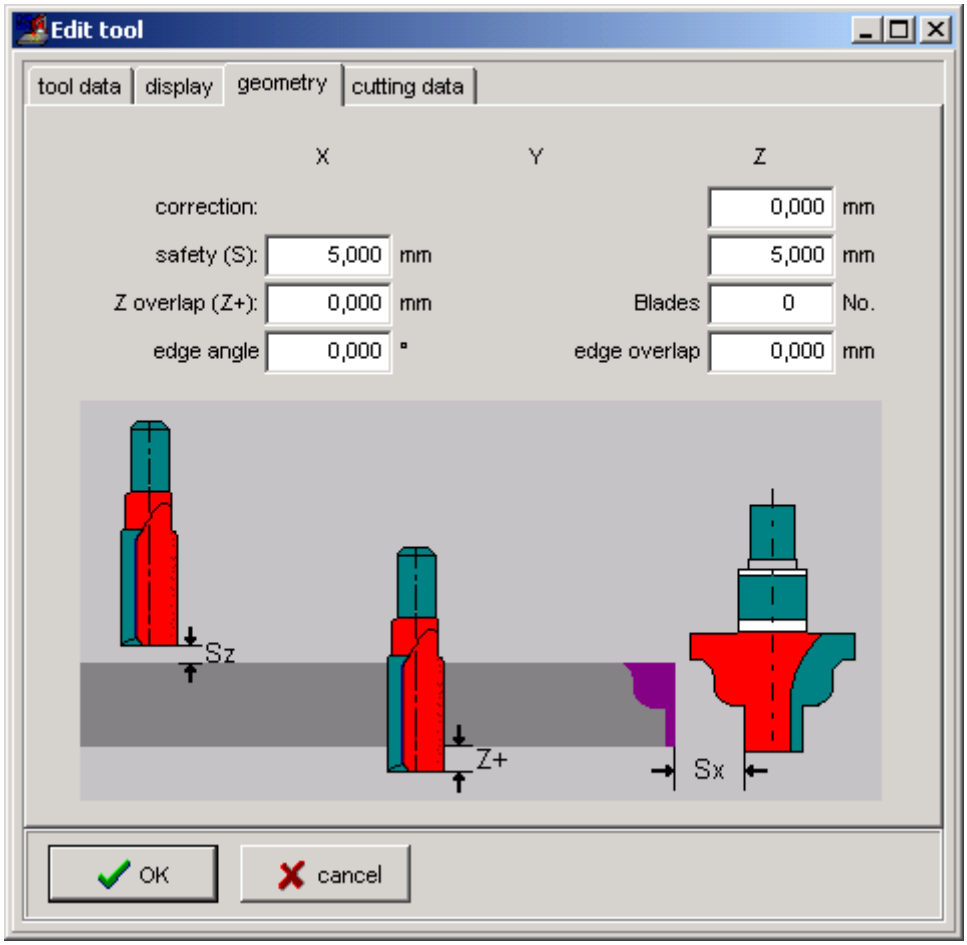
Caption
This is the text that appears with the icon in the tool list, the maximum length is 6 characters.

Hint
If the mouse cursor is moved across the tool icon, the contents of this field will be displayed. Ideally this should be the same or similar to the description under *tool data*.

Icon
TwinCAM 32 contains an extensive library of bitmap files to depict the various tools. You may either select a suitable icon from the dropdown menu or create your own. There is a preview field to the right of the screen so you can see what the icon looks like.

3.3.2.9 Geometry

This heading is for the user to enter factors such as clearance heights and margins of safety.



Correction
Some tools have to be mounted in special mounts such as angle drives. The appropriate correction compared with the normal (usually principal) drive needs to be entered here

Safety
The margin of safety required in the X and Z axes. Z defines the height at which the tip of the tool travels over the top surface of the panel.

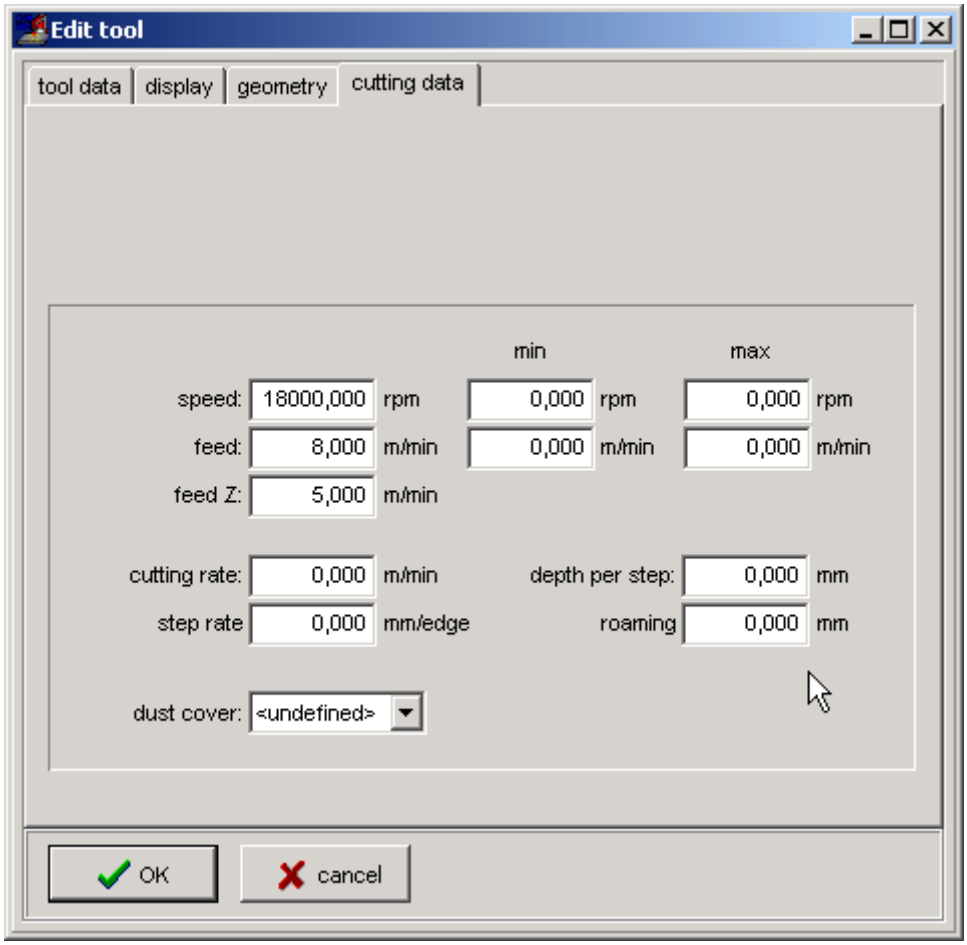
Z Overlap
TwinCAM 32 's default value for drilling through material is the bottom surface of the panel. The value entered here is added to the default. This is to account for the fact that tools frequently have a pointed tip, so to ensure that a clean cut is made through the material, the length of the tip needs to be added.
Z overlap of the milling machine will only be acivated, if the bottom surface of the panel is given as reference for starting point and the Z-value was set on 0 (zero).

This value will be added at drilling machines. Blind holes can be drilled to deep.

Blades
For the purposes of automatic cutting data calculation, the number of blades on a multi-bladed tool needs to be known.

3.3.2.10 Cutting Data

This register contains nominal and marginal data for the tool together with other technical data.



Speed
The nominal rotation speed for the tool (min and max values are for cutting data calculation.

Feed rate
Nominal tool feed rate (min and max values for cutting data calculation).

Feed Z
The approach rate in Z; If a 0 value is entered, the approach will be at the machines minimum speed.

Cutting rate
The speed of the cutting edge through the material. TwinCAM 32 calculates the appropriate speed of rotation from this and the tool diameter.

Step Rate
Feed per cutting edge in mm.

Depth per step
The maximum depth that can be cut in one pass. . If a greater depth is required by the process, TwinCAM 32 will calculate the number of passes required.

Roaming
The width of cut cleared by a routing tool when cutting pockets. Bei Eingabe von Null gilt ein Wert von ~72 % der Schneidenbreite.

3.3.2.11 Tool List Context Menu

This menu appears if you click on a tool icon in the list with the RIGHT mouse button.The commands which appear are:

Edit
Cut
Copy
Paste
Delete
And all have their standard meanings.

3.3.2.12 Cutting Data Calculations

Speed
The speed value is calculated from the tool diameter and the cutting rate. The optimum cutting rate for the tool can be obtained from the manufacturer.

$$\text{Speed} = \frac{\text{Cutting rate}}{\text{diameter}}$$

Feed
The feed rate is calculated from the step rate x blade count x speed.

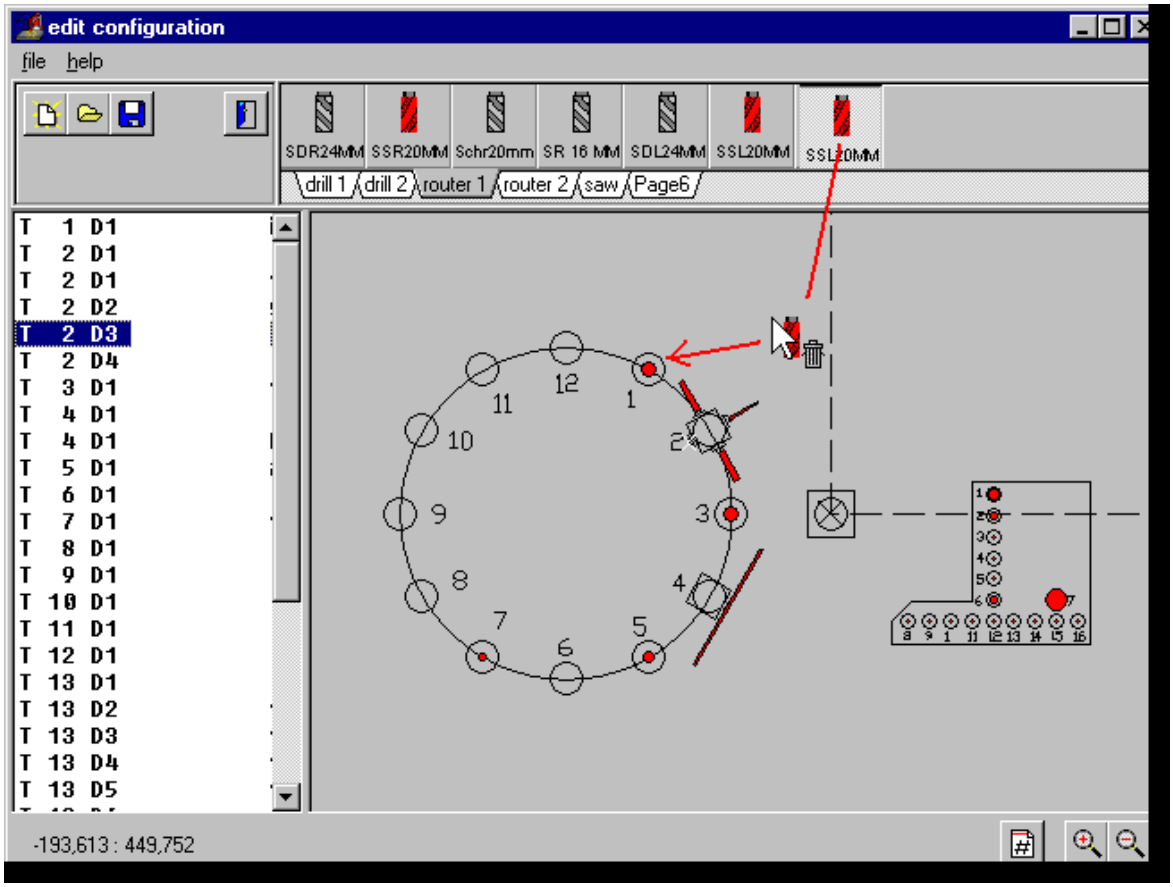
3.3.3 Configuration File

3.3.3.1 Overview of the Configuration File

The configuration file is used to equip the machine with tools.
A machine operator takes the tools required for a particular process out of the tool cupboard and fits them into the machine. They are then available for the control system to select using a tool code.
TwinCAM 32 works in the same way. The configuration file places the tools from the tool list in th machine's individual tool locations. The tols are only available for use once this has been done and a tool location number allocated.
There is no configuration file menu item in TwinCAM 32. The whole dialogue screen is the configuration file. As the file is designed to work graphically, the loading process is carried out by dragging and dropping the tools from the list into their locations. The machine layout is stored as a *.DXF file, which is either available from the manufacturer or may be produced using a CAD programme.

3.3.3.2 Loading a Tool

Mark the tool in the tool list by clicking on its icon with the left mouse button, then drag it to the desired location. Whilst the tool is being dragged, its icon will appear together with a waste basket symbol. Once a location is reached that will accept the tool, the waste basket will cange to a white box containing the tool location number. Click on the location with the left mouse button, and the tool is assigned to the location. A vertical tool will be displayed as a red circle whilst a horizontal tool will be shown in side view. If the cursor is moved over the location a descriptive text will appear. The tool can be removed from the location by double clicking on its entry in the text field and pressing *delete*.



3.3.3.3 The 'No Entry' Sign

The 'No Entry' sign has an important function in configuring the machine. Every tool location is defined by the type of tool that it can accept. If a tool is moved to a location which cannot accept it, a 'No Entry' sign will appear. This would occur for example, if you attempt to place a saw in a drilling drive, although the main drive may well be able to accept tools of all types. The direction of rotation is also taken into account and a left rotating tool cannot be placed in a right rotating drive.

3.3.3.4 Zoom Controls

If the tool locations are very close together, it may be difficult to place tools in the correct locations. However, by using the zoom control, the view is enlarged and the locations can be seen more clearly. To do this click on the *zoom in* button at the bottom right of the screen. The cursor will change to a cross shape, which should be dragged across the area to be enlarged, by holding the left mouse button down. When the mouse button is released, the view will appear enlarged. To leave zoom mode, either click on the *zoom in* button again, or click on the graphic area with the right mouse button. To return the view to normal, click on the *zoom out* button. This will return the view to normal in as many steps as it was enlarged.

 Zoom

 Unzoom (Zoom back)

3.3.3.5 Changing/deleting the Configuration

If you move the cursor accross the tool locations, you will notice that a tool location number appears. Locations which are occupied will also show the desciptive text entered in the *display* register. To remove a tool from its location, click on it with the RIGHT mouse button. This will cause a context menu to appear with *edit* and *release* as the two options. Clicking on *edit* will cause the tool edit dialogue to appear, whilst *release* will release the tool from its location. You can also releasethe tool by dragging it off and releasing it in any area where the waste basket symbol is displayed.

context menu

This very simple method of configuration has other advantages. As far as the generator is concerned, an entry in the configuration file is just an addition to to the information about the tool in the tool list. If you change the tool's characteristics, by sharpening it and amending its dimensions for example, these changes automatically take effect in the configuration file in so far as that tool is present in it. As the generator will support the creation and administration of an unlimited number of configurations, not only the current configuration, but also all others, will be amended. If a tool is deleted from the tool list, because it is no longer in use at all, it will automatically be removed from all configurations.

3.3.3.6 Administering the Configuration Files

TwinCAM 32 supports the creation and administration of an unlimited number of machine specific configurations. The commands to *save* and *open* configurations can be carried out using the buttons at the top left of the screen, whilst the *save as* command as well as the other two is availableas a menu command. If *save* is selected, then the configuration will be saved under the current name, as displayed on the title bar. Using *save as* allows the file to be saved under a new name. The *open* command opens an already existing file. To start a new configuration, either use the *new configuration* button or the *new* command from the menu list.

3.3.3.7 Printing the Configuration

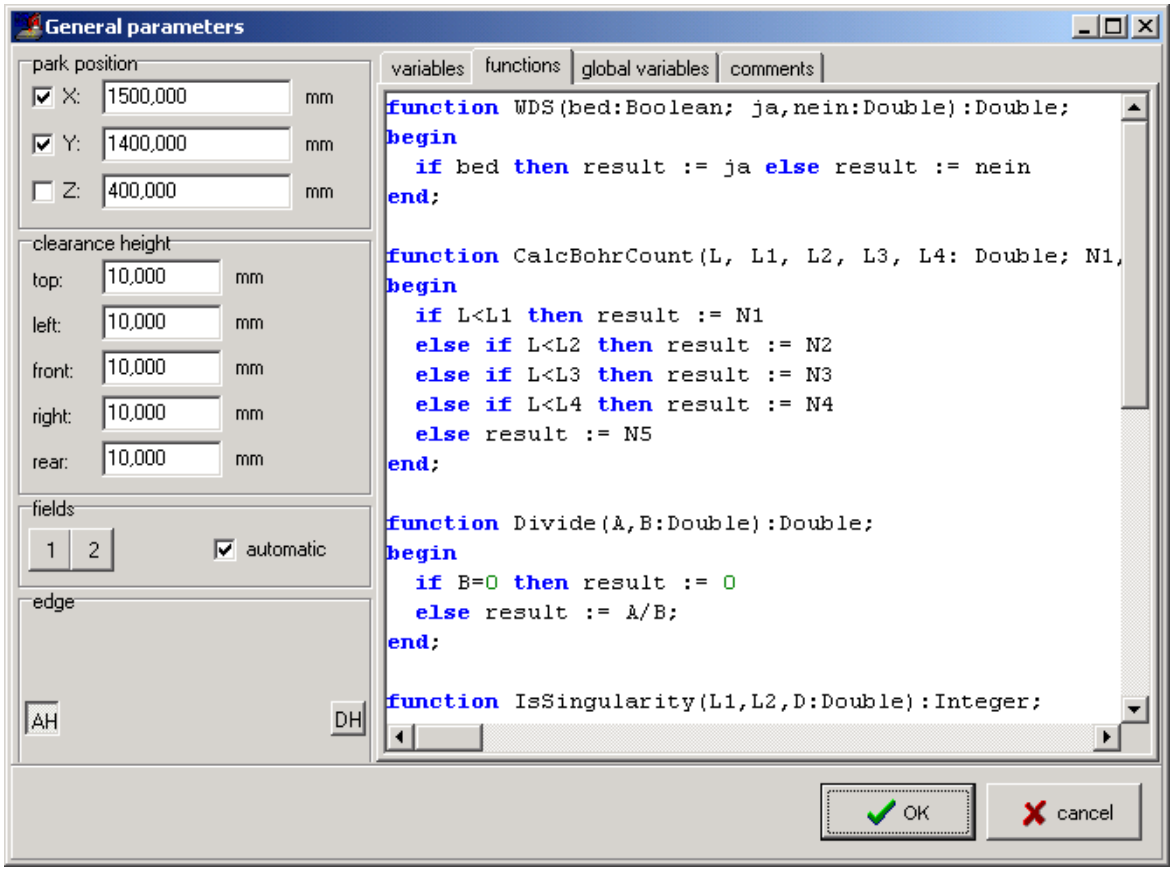
To print a copy of the configuration, sect *file- print* from the menu bar. This will produce a graphic print out of the layout and a text listing of the toollocations and their tools.

3.4 Programming with Variables

3.4.1 Overview of Programming with Variables

Variable programming in TwinCAM 32 allows the definition of processes without the use of fixed numerical values. Alphanumeric values are used instead. It is possible to use formulae and conditions to set the position of processes.
Variables programming is split into three areas;
Local variables which are relevant only to the current drawing
Global variables which apply to all drawings, and
Functions, which may be applied throughout the programme.
The comment tab can be used tio record cooments about a particular variable or indeed any other comment about the drawing.

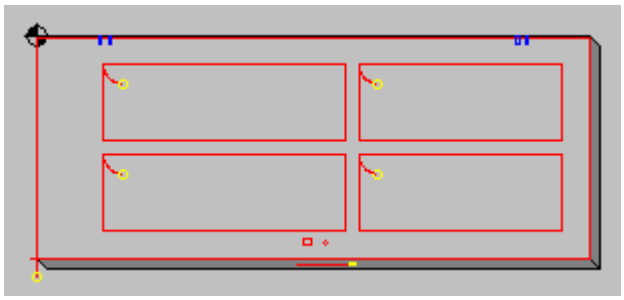
There are three basic variables:
DX panel dimension in X
DY panel dimension in Y
DZ panel dimension in Z.
More about the use of functions, mathematical operators and constants can be found under using programming with variables
To open the parameter dialogue, click in the graphics area using the right mouse button and select parameter from the context menu.

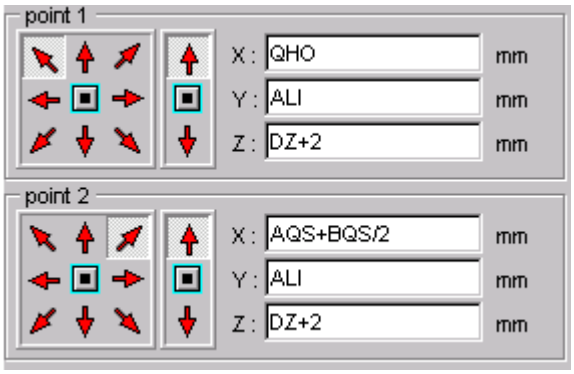


3.4.2 Local Variables

Local variables are only useable in the current drawing and are saved together with it. Calculations and equations can be used to define the variable. It possible to either set the variables in the parameter dialogue and later use them to define an element, or define the element first set the variables as part of this process. As soon as you confirm the element's definition by pressing *OK*, any variables used are saved as local variables automatically.
In defining an element, calculations can be carried out using the defined variables.

Example:- door with four apertures





First create the variables in the *variables l*ist and then add comments to the *comment* tab.
If you are using complex variable programmes, it is very easy to lose track if there are no explanatory comments attached and or/ the variables will be incomprehensible to others.
To delete variables which you no longer require, mark the variable then press *control* and *delete* simultaneously.

3.4.3 Global Variables

Global variables can be used in all programmes and drawings.
Calculations and equations can be used to define the variable. Global variables must first be prepared in the parameter list before they can be used in dialogues.
When defining elements, calculations can be made in the entry fields using the defined variables.

If you use variables in an element which have not been defined in the parameter list as global variables, they revert to being local variables.

3.4.4 Using programming with variables

This is an overview of basic variables, constants functions and mathematical operators which are available for use.

Basic variables - global:

DX	panel dimension in X
DY	panel dimension in Y
DZ	panel dimension in Z

Constants

π(pi)	3.1416. For convenience this is expressed as PI.

Operators

Standard Maths operators	+ - * /
comparative operators	< > >= <=
Supplementary operators	DIV, MOD

Functions

SIN	Sine
COS	Cosine
SQR	Square
SQRT	Square root
Round	Rounding
LN	Logarithm
EXP	Exponent
INT	Integer
FRAC	Fraction
ABS	Absolute value

3.4.5 Sine and Cosine

Sine and Cosine

Use of the sine and cosine functions can be carried out in two ways.
1. By entering the angle in degrees - SIN(30°)
2. By using the radian - COS(30*PI/180)

3.4.6 Squares and Square roots

Squares and Square roots

Square
To calculate the square of 5 - SQR(5)=25

Square root
To calculate the square root of 121 - SQRT(121)=11

3.4.7 Logarithm and exponent

Logarithm and exponent

Logarithm calculates the log of a given number - LN(52)
Exponent calculates e to the power of X, where is the basis of the natural logarithm

3.4.8 INT, FRAC & ABS

INT, FRAC & ABS

INT
The integer function displays the whole number component of a calculation, disregarding anything after the decimal point.

The result of INT(2.71) = 2
The result of INT(327.423) = 327
In a chain calculation INT(SQR(11)/8) the result is 15 (the full result is 15.125)

FRAC
Fraction is the opposite of integer. It displays only that component of the result AFTER the decimal point.
The result of FRAC(2.71) = .71
The result of FRAC(327.423) = .423
In a chain calculation FRAC(SQR(11)/8) the result is 0.125

3.4.9 ROUND, ABS

ROUND, ABS

ROUND
The round fuction rounds numbers according to normal mathematical rules, e.g.
ROUND(12.3) = 12
ROUND(12.8) = 13
ROUND(12.5) = 12

3.4.10 DIV & MOD

DIV & MOD

DIV & MOD
DIV and MOD are specialised division functions. DIV dispays only the whole number result of a division, disregarding anything AFTER the decimal point.MOD displays the remainder of a division calculation.
e.g 14/5=2.4
(14)DIV(5) = 2
BUT
(14)MOD(5)= 4

If decimal figures are used, they are rounded up/down according to normal rules, so :-
14.4/4.6 = 3.130
but if we calculate (14.4)DIV(4.6) = 2
In effect we are writing ((ROUND(14.4))DIV((ROUND(4.6)) = (14)DIV(5)=2

3.4.11 Functions

Functions can be used to define complex calculations with numbers, variables or conditions. In order to use functions some previous knowledge of programming is required.

```
Simple calculation
function Test              //define function
private c                  //define internal variables
parametera,b               //define maths operators
c:=a +b          //calculation (a+b=c)
An entry for element definition would be as follows:
Format           Function name (operator1;operator 2)
                 Test(10;30)      equivalent to 10+30
                 Test(margin1;margin2)  //variables must be pre-defined Conditions


Function WDS               //condition if...then....otherwise
private res                          //define internal variable
parameter cond, yes,no //define maths operators
if cond                              //if
        res:=yes                     //result1
else                                 //otherwise
        res:=no            //result2
endif                                //end of loop
return erg                           //return value
```

An entry for element definition would be as follows:
Format: Condition name(condition;result1;result2)

A drilling is to be placed at 500mm when a panel is larger than 1000mm, in any other case at 300mm.

WDS(DX>1000;500;300)

Example: Different number of drillings in one row of holes, denpendent on length of plate

The following shall be achieved:
until 500 mm 5 drillings
until 1000 mm 10 drillings
until 1500 mm 15 drillings
until 2000 mm 20 drillings
over 2000mm 25 drillings

As function there must be defined:

```
function CalcBohrCount(L, L1, L2, L3, L4: Double; N1, N2, N3, N4, N5: Integer):Integer;
begin
   if L<L1 then result := N1
   else if L<L2 then result := N2
   else if L<L3 then result := N3
   else if L<L4 then result := N4
   else result := N5
end;
```

L = length of plate
L1-L4 = limit
N1-N5 = number of drillings

This function is extensible until 25 conditions.

As function call results the following input:

```
CalcBohrcount(DX; 500; 1000; 1500; 2000; 5; 10; 15; 20; 25)
```

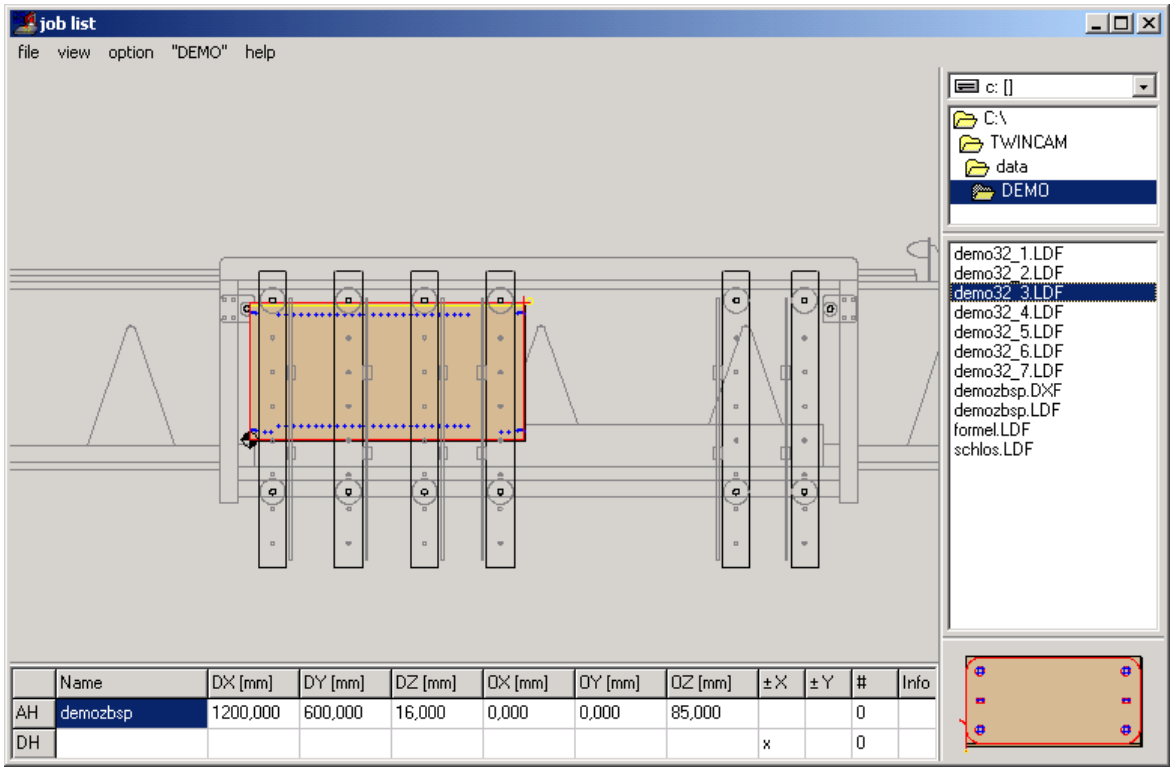
This call can be registered directly in field number of row of holes. But it would be better to allocate it to a variable (local or global) and to register the name of variable in field number.
This function can also be use to position the drillings. Then N will be the position of drilling.

3.5 Job Lists

3.5.1 Overview of Job Lists

Job lists are highly machine specific ansd only relevant to machine control versions. For this reason, only global functiomns are described here. A more detailed explanation can be obtained from the machine manufacturer.

The right hand side of the screen showsa list of files to select from. To select a file, click on it and drag it across to the main field which represents the machine's work area. A graphic of the workpiece will then appear. The panel dimensions are now displayed in the lower part of the screen. Any offset values required can be entered under OX, OY and OZ as appropriate. The ±X and ±Y columns, if selected will mirror the workpiece in the relevant direction. The # columnallows an entry for the number of pieces to be machined. This will count down as each piece is machied and shut off when the total is reached. To delete a workpiece, drag it away into the blank space around the work area.



3.6 DXF import / Creating NC Programmes with CAD

3.6.1 DXF-conventions / Drawing true to TwinCAM32 in CAD

DXF-Importation

This section turns to those user of TwinCAM32 who create their drawing parthwise with a CAD programme (e.g. AutoCAD). The transfer of information effects by a DXF file, an interface given by AutoCAD. Other CAD systems generally also have the option of output in DXF-format at their disposal. However the exact correspondance of formats is not completely given in every case.

The base of version for importation and exportation is AutoCAD 14 and higher.
TwinCAM32 imports the following elements (corresponding to the conventions mentionned below):

- milling lines
- milling arcs
- starting point
- vertical drillings
- horizontal drillings, turned and inclined
- grooves, turned and inclined
- circle and rectangular pockets

Necessary informations and are given, which have to be met for a correct interpretation of elements by TwinCAM.

A handling at any level efforts the transfer of different values of the handling to TwinCAM. This refers not event to geometric but also to tecnological data, as e.g. feed rate or tool correction.
The followeing conventions have to be met by working with TwinCAM32:

The colour of an *element* describes the handling that has to be carried out (as below).

The *Layername* gives information about the type of tool, the correction of tool and its feed rate during the handling. It consists of a number between 0 and 29 as well as the indication TTx for the tye of tool. Both indications are separated by an underline. The entries mean in detail:

Bsp: Layer 25_TT2

The tens digit describes the correction value of tool (left, right, without). If there is no correction for this element, so the tens digit is no entry, for example "7". In this case "2", that means correction at the left. This interpretation is selectable (look at the following).
The ones digit of the number describes the working speed in 10-percent-steps of the nominal drive of tool. In this case 50 % of nominal drive of tool.
The declaration TTx transfers the type of tool to TwinCAM. In the example the value 2.
The value of tool type is girded in $-sign (AutoCAD 14 compatibility).

False layer names will be ignored.
The interpretaton of tens digit of starting points is selectable in file TWINCAM.INI umschaltbar (look at settings , switch correction):
SwitchCorrection = 0, means the tens digit of layer 1 = left, 2 = right
SwitchCorrection = 1, means the tens digit of layer 1= right, 2 = left

The declaration of tool type with TTx can be left out. In this case the type of tool will be taken over from initial settings of the corresponding handling. This applies also to every

further entries at TwinCAM-elements. All entries which ar not described in DXF conventions will be overtaken from the defaults of single elements at DXF importation. The defaults of elements in menu bar will be used.
An exeption of this global definition will be pockets/ Eine Ausnahme dieser globalen Definition bilden Taschen /sectors. The drogations are described in this elements.
We recommend to use the order of indications in name of layer as proposed. The DXF-export form TwinCAM correspond exactly to the conventions described here. If there are derogations differnt layer names will result different at importation and exportation.

The *height of object* informs about the working profoundness at handling and the thickness of material at ground panel. Generally it has to be negativ, if the handling shall be done at the panell, that means the local coordinate system has to show **against t**he thickness of handling. As Z = 0 the top edge of panel is set.

A positive or negativ Z position is given to an element, this position will be the basic value for the handling. Otherwise the top edge of panel will be the reference in Z.This position will be driven in in rapid motion plusa the adjusted clearance distance.

On principle ther are the following specification for drawing elements:

ground panel:
White lines (rectangle, colour number 7) on layer 0 will be interpreted on ground panel on layer 0. The smallest and the highest X and Y amount of all white lines of drawing will give the measurements of furniture element. All dimensions refer to the edge at the bottom left of panel. The coordinate origin 0,0,0 will be ignored, however the ground panel should be positioned with the edge at the bottom left in origin. The negative object height transmittes the thickness of ground panel.

vertical drillings
This is displayed with a blue circle (colour number 5). The diameter of circle correspont to the diameter of the drilling beeing made.
The diameter of circle correspond to the diameter of drilling that is going to be made. The object height is the same as the drilling depth, this has to show negatively in direction of machining. The ones digit of layer name informs about the drilling speed, the indication TTx informs about the type of tool. Drillings will be treated as horizontal drillings, when the are not flat to the upper and under surface of panel.

horizontal drillings, turned and inclined
is also displayed with blue circles (colour number 5). The object height tells also about the depth of drilling. The handling direction of drilling correspond to the direction of object height of element. The circle has to be positioned at starting point with his coordinates, the object height has to be directed negatively in handlingdirection. The ones digit of layer name informs about the drilling speed, the indication TTx informs about the type of tool.

old definition (should no longer be used): green lines of the outer edge of panel with negativ object height of upper edge of panel. The length of line defines the depth of drilling, the object height defines the position of drilling seen from upper edge of panel. The layer defines the drilling speed. No transfer of type of tool, drilling machine diameter, turning or inclination.

grooves, turned and inclined
are displayed with yellow polylines rectangulars (colour number 2) described with negativ object height and layer name. The breadth of rectangular defines the breadth of groove, the negativ object height the groove depth, seen from upper edge of panel. The layer gives the driving speed (ones digit) and the type of tool. The position of groove will be

defined by the center points of end side-lines. To incline the groove in X(Y)/Z - chart, the groove has also to be turned over the center points of end sinde-lines. The turning in X/Y - chart. level can be reached by a simple turn around a free dinfinable point. A correction will not be given at this definition as centreline and groove width are defined.

oldl definition: yellow lines (colour number 2) describes handling with groove saw. The negative object height of line informs about the depth of groove, the ones digit of layer name tells about the grooving speed and the tens digit about the correction (1=right / 2=left).

Circle- and rectangular pockets/cuts
are defined by a magenta circle or a poliline-rectangular (colour number 6). The Z-position as well as the center point describe the position of pocket or cut; the negative object-height the depth. the pockets resp. the cuts have to be only on the six sides of panel, horizontal bevelled or inclined is not possible at this time.
The ones digit of layer name gives the driving speed, the tens digit the direction of milling: without declaration or 1 clockwise, 2 counterclockwise. Then the underlined type of tool TTx. A C for Cut, signed by underlining defines the element as a cut. Without C the element will be interpreted as pocket. The edge rounding radius (e.g. R20.5, Radius=20,5mm) is given by an underlined Rxx in layer name of rectangular pockets/cuts. At radii without decimal place the point and the 0 (zero) can be left out.
Bsp: 20_TT7_C_R20.5

Startingpoints of milling contour
will be realized by yellow circles (colour number 2). The ones digit of layer name informs about the diving speed, the tens digit gives information about the correction value of the complete milling contour, followed by indication of type of tool. The negative object height complies to the diving depth.

Red lines and red arcs
(colour number 1) describes handlings to be made with milling machine. The object height gives information about the ending depth of milling contour. The ones digit of layer name describes the milling speed.

In DXF file the single colours will be displayed by values. It is meant

1 red
2 yellow
3 greem
4 cyan (unbenutzt)
5 blue
6 magenta
7 black/white

Definitivly the pure colour code should be allocated to the elements, although the allocation of "ByLayer" will also be evaluated.
As type of line "Continuous" should be used.

Importation of blocs

Elements collected in blocs will be imported as group in TwinCAM. Each block builds an own arrangement. If there is a contour starting point in one block, all elements of this bloc will be

arranged to this starting point.
The characteristics of groups at exportation to DXF is described in exportation DXF

Circles can not be imported as milling in TwinCAM32. Circles are a closed contour, in which no starting resp. ending point can be interpreted. Please divide the circle in two semi circles.

Would you please always start with the drawing of ground panel (white rectangle). If you create the ground panel after definition of handling, the handlings will possibly not be displayed at the same time at of DXF-files to TwinCAM. However, it is possible to enforce the display in this case by changing to transparent-mode  and back.

To deposit comments or measurements in the DXF-file please use the colour CYAN (colour code 4). All elements of this colour will be ignored in importation.

3.6.2 DXF examples

Short examples

white rectangleweisses ground panel
Layer 0
object heigth= -19 Plattenstärke = 19mm

blue circle in in
horizontal projection vertical drilling
diameter 8 diameter of drilling = 8mm
Layer 4_TT1 drilling speed = 40 % of nominal drive
type of tool = 1
object height = -12 drilling depth = 12mm

blue circle in
elevation view horizontal drilling
Zposition = 8 position of drilling 8 mm of panel top edge
diameter 8 diameter of drilling = 8mm
Layer 7_TT5 drilling speed = 70 % of nominal drive
type of tool = 5
object height = -12 drilling depth = 12mm

red line / arc milling
Layer 0 driving speed = 100 % of nominal drive
object height = -20 milling depth (at the end of element) = 20mm

yellow circle startingpoint of a milling contour (at the ending point of a red line or arc)
diameter 16 diameter of milling machine = 16 mm
Layer 24_TT12 10s digit: correction at the left of milling contour; 2=left / 1=right (adjustable in Twincam.ini)
1s digit: diving speed = 40 % of Z-drive of milling machine
type of tool = 12
object height= -20 starting depth = 20 mm

yellow circle starting point of a milling contour (at the ending point of a red line or an arc)
diameter 24 diameter of milling machine = 24 mm
Layer 6 ones digit: diving speed = 60 % of Z drive of milling machine
object height= -24 starting depth = 14 mm
no tens digit in layer means that the handling will be made without correction.
without indication of type of tool in layer, the type 0 (zero) will be imported.

yellow rectangle groove (neu definition)
1200 x 7,2 length 1200mm, width 7,2mm
Layer 7_TT90 driving speed = 70 % of nominal speed
type of tool = 90
object height = -6 groove depth = 6 mm

yellow line groove (= groove, new definition)
1200 length 1200mm
Layer 17_TT90 10s digit: correction at the right
1s digit: driving speed = 70 % of nominal speed
type of tool = 90

magenta circle circular pocket or cut

diameter = 120	diameter = 120 mm
Layer 9_TT2_C	tens digit does not exist, default: handling will be made clockwise ones digit = 90% of nominal drive type of tool = 2 C = Cut for the aperture
Z-position = 0	Z-position of circle = 0, Upper edge of panel
object height = -19	depth of cut = 19 mm
magenta rectangle	rectangular pocket of cut
300 x 200	dimensions of pocket / cut, x=300mm Y=200mm
Layer: 25_TT3_R20	tens digit: handlings will be made counter-clockwise ones digit = 50% of nominal drive type fo tool = 3 appendix R20 = edge rounding 20 mm
Z-position = - 5	Z-position bei -5 mm
object height = -10	depth of pocket = 10 mm

3.6.3 DXF- exportation

Features at exportation of DXF-files

At download of AutoCAD a drawing may possibly not appear. In this case ZOOM / ALLES has to be executed first.
Please consider the specialites at layer definition in circular pockets /cuts also.

The conventions stated in DXF-Importation correspond exactly to the DXF-Export of Twin CAM32. As basic for importation and exportation the version AutoCAD 14 and higher applies.

Grouped elements can be exported as blocks. For this in file TWINCAM INI, Section [DXF] the value "UseBlocks" has to be set on 1 (look at DXF-Settings). This setting applies to the exportation of DXF-files only.
Rows of holes and mirrored drillings will also be exported as blocks. Thus at further importation of a DXF file exported by TwinCAM lead to grouping the rows of holes as single drillings, but they will not be put together to a row of holes again.

At exportation the follwing information and conventions not defined in technology data will get lost:

- conditions, formulas and references (all elements will be referred to the left edge at the bottom)
- exhauster and traverse information
- rows of holes and mirrored drillings will get single drillings grouped in blocks
- drilling cycles
- information about drilling type piercing
- start up and departure ways, depth of cut and width of step at milling
- groove informationen about correction (only new format) and cut direction
- cornice arcs will be exportet in three single arcs.
- ellipses will be separated in several arc segments (the precision is adjustable in the global variants with _SystemEllipsePrecision)

To export grooves of old format as a line, you will have to define the groove with a groove width of 0 (zero). The correction will be given then in layer.

3.6.4 DXF-Settings

In file TWINCAM.INI, section [DXF], the following settings are possible for DXF-importation:

[DXF]
Type = selection of an other DXF-importer. 0 = standard in accordance with description, 1 = Holz-Her U.S.
Type=0
Factor = conversion factor for indication of leng information; e.g.: 1 = drawing in mm, 25.4 = drawing in inch
Factor=1
MinHeight = Auto identification mm/inch; if the thickness of panel less than the indicated value, TwinCAM switches automatically to inch, otherwise it will be calculated with mm. A value of 0 will switch off this automation.
MinHeight=5
SwitchCorrection = interpretation of correction side by tens digit of layer name in milling starting points
0=> Layer 1x = left, 2x = right
1=> Layer 2x = left, 1x = right
SwitchCorrection=1
UseBlocks = generation of blocks at DXF-Export. However the files generated that way may not be upread in every case in different AutoCAD-versions.
UseBlocks=0 1= enabled, 0=disabled
DXF-colour interpretation for every single handling element. The description refers to the nominal values.
ColorPanel=7 ground panel, default white
ColorGroove=2 grooves, default yellow
ColorVertical=5 general drillings, default blue
ColorHorizontal=3 special colour at importation of a horizontal drilling as a line (old definition), default green
ColorStart=2 starting points for milling contour, default yellow
ColorMilling=1 milling contours, default red
ColorPocket=6 pockets and cuts, default magenta

The colour coding limits to the seven AutoCAD fundamental colours:

colour number	colour name
1	red
2	yellow
3	green
4	cyan
5	blue
6	magenta
7	black/white (black or white, depends on the colour of background)

Settings in TWINCAM.INI should only be made by experienced users. False settings may detract the funcion of DXF-importation. In extreme cases it may lead to inoperativeness of TwinCAM.

3.7 Machine- and userdata import

3.7.1 Suppositions for machine data importation

For importation fundatmentally applies, the machine is the master. Configuration an user data will be considered separately.
The import bases on the protection mask, listed at the end of this text (BACKUP.CFG). The import is not possibe when this mask will be changed.

Functions of import of machine data

At first installation of pc-version and selected import you need a complete data protection of machine (configuration and user data). A selection of components is not offered.

When making the setup once again, (of CD or SYSTEMSTEUERUNG / SOFTWARE) a new import of machine data can be made. You can select the configuration or the user data separately.

Configuration:
The files of machine (*.MAS, *.WKZ, *.INI, *.BSL, *.TRV) will always be importet and overdriven! At the DXF-files belonging to this, only files with the same name and older dates will be overwritten. A sub-selection for importation of the working lists follows.(WORKLIST.DAT).
Dialog for input of name of machine. Specificartion ist the name of MAS-file (assembled of type of machine and machine number, f.e. 7015_113.MAS). When changing this name, you have to use this name by new importation. It is possible to import several machines.

User data:
When importation of user data the following components can be selected separately:
- Userpallets
- global Variables(TWINNCAM.GLB)
- definition of function (TWINFUNC.PAS)
- drawing files

All files concerning the selected components will then be imported, files with the same name will be overwritten without any question. The TWINCAM\DATA directory inclusive sub-directories will be importet at the drawing files.

Specifications and restrictions

The secure files have to be in the same directory, specification is drive A:
The files have to be designated CONFIG.ZIP and USERDATA.ZIP. The machine INI-file has to be desingnated TC32_SPC.INI. This name can be different, reads the IMPORT.TXT file in the root-directory of CD. If a backup file not readable, the intallation will be aborted.

Base path is C:\TWINCAM. The installation of pc-version in an other directory or drive and the importation is possible. While importing absolute path specifications will be corrected in the *.MAS, *.WKZ files.
At the userpallets only the base path will be replaced. A verification of path entries and appropriate files will not follow. The configuration files have to be in C:\TWINCAM\CONF bzw. C:\TWINCAM\CONF\DXF. When the setup detects network paths at the configuration file, no importation will follow.
When changing the general given basic installation by hand (path specifications), arbitrarily renaming files in the machine configuration and storing of files outside of standard paths, no correct importation will be possible.

Before importation usually a secure of old configuration in directory TWINCAM\OLDCFG\Datum_uhrzeit will be made. In urgent cases this can be remade manually.
A secure of drawing files as well as the bitmaps will not follow.

3.7.2 Execution of machine data import

For the machine fundamentally applies, the machine is the master.
The import files will overwrite all files on the office-PC without security question.

Before importation normally a secure of the existing configurations is made in directory TWINCAM\OLDCFG\Datum_Uhrzeit. It is possible to reestablish it manually.
A secure of drawing files as well as bitmaps will not be made.

Detailed information you will find in suppositions for machine data importation.

For importation you need a data security of configuration and (or) user data.
The machine configuration and user data can be imported separately. At new installation of TwinCAM a complete backup (configuration and user data) is required. Both components seprarate as follows:

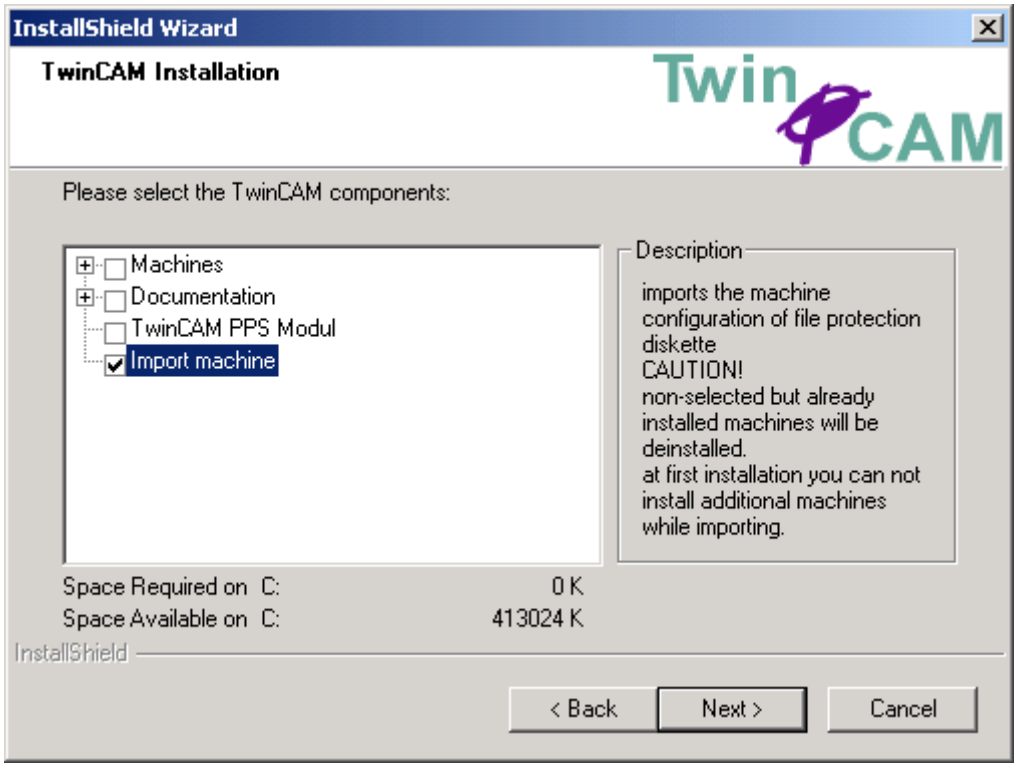
Machine configuration
- configuration files (configuration, tool list, assembly lists)
- work list (Worklist.dat)

User data
- user panel
- global variables (TWINNCAM.GLB)
- definition of functions (TWINFUNC.PAS)
- drawing files

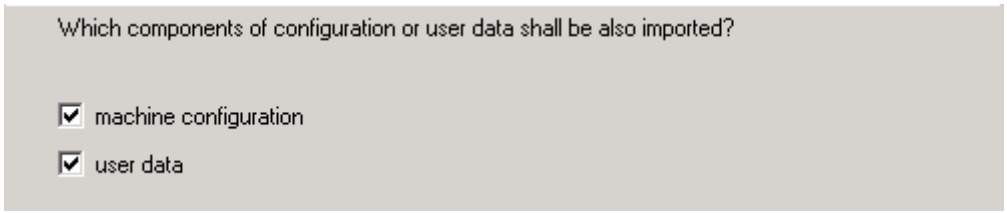
For importation please start the set up of TwinCAM office CD or form start/settings/system control/software with double-click on TwinCAM. After choice of language and greeting display you will see update-dialogue.

Please choose modify.

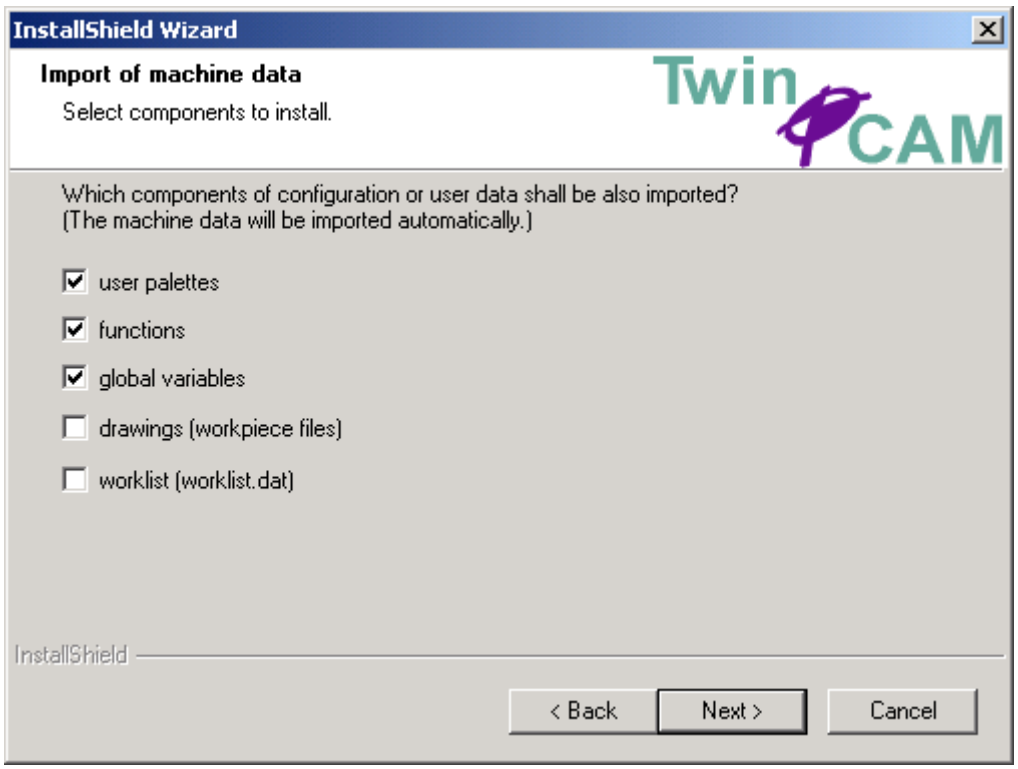
In following dialogue you can select machine inportation. Please do not change the other selected elements. Components will be deinstalled when the choice is eliminated. However you can add further components, e.g. the documentation at the same time.



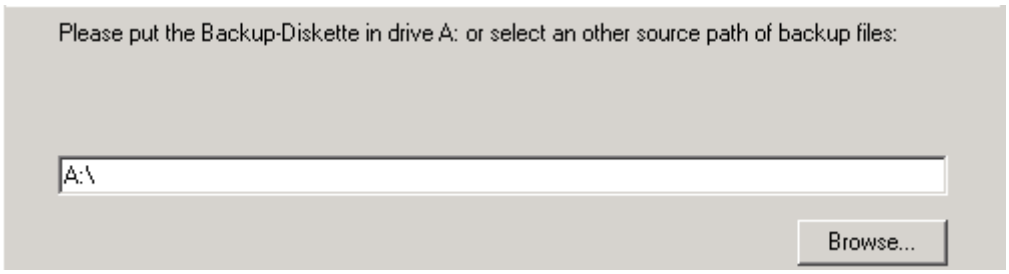
In next dialogue you can choose the main components you want to import.



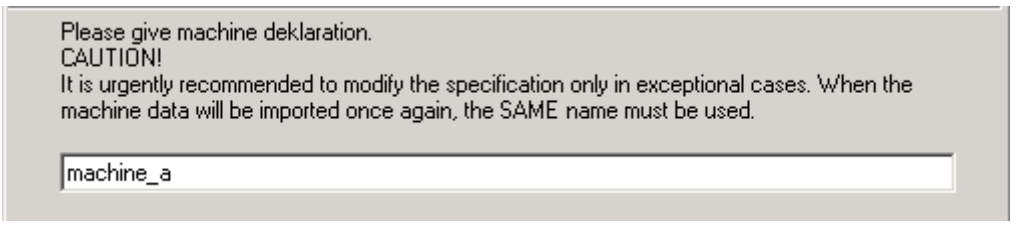
Then the dialogue for the choice of single components will follow. The content depends on the main components choosen before.



Next step will be to insert the backup disk of machine or to select the source path with browse to find the backup files (config.zip und userdata.zip)



At last please acknowledge the declaration for machine importation.



Now the data importation is completed.

4 Example

4.1 Drawing Example

4.1.1 Tutorial

The accompanying tutorial will help you with your first steps in TwinCAM 32. The tutorial is also available on-line.

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