RT480/PC

USER MANUAL

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Introduction

This program package provides the basic environment for file management for numerical control of the **NC RT480** series. The package is currently composed of:

- a manager for machines installed in the package;
- an editor for programs, sub-routines, fixed cycles and families of programs, offering also the possibility of creating graphics in programs and optimizing boring;
- an editor for machine data;
- an editor for work lists;
- a calculator to determine the length of time a program has been running;
- a NC RT480 disk format manager;
- a serial line manager for communicating with the NC system.

The following chapters illustrate the function and use of each listed program, with corresponding video screens that allow for faster comprehension of the operations to be carried out.
The computer tools available to the user allow for the creation of series of programs, graphic checks of programs, modification of machine data, the creation of lists of programs in work lists and transfer of all files (programs, list and machine data) onto a disk or directly to the NC system.
Conventional key commands are used in the programs. These include the keys for entering and exiting menus and windows. The following list of operations (not always indicated) are the most common:

- the keys <ESC> and <F10> are always used to end an operation or for exiting from optional windows, tables, menus etc;
- the <RETURN> key is used to confirm a choice or for going on to a subsequent step;
- by simultaneously pressing the keys <ALT> and <RETURN> in a file selection window, an instantaneous update is triggered. Note that a file selection window is used when the user has to select a file from those present in a certain directory. The file selection window is filled with a list of files, which is memorized separately and automatically managed by the various programs in the package. It may occur that this list does not correspond with the list actually available in the directory e.g. some files may be inserted or deleted manually or with other packages. Should this occur, use of the <ALT><RETURN> keys is recommended in order to update the list and have a list of files that are really present.
- The following functions are obtained in the edit tables:
  <ALT> <C> copy all data on previous line,
  <ALT> <D> delete previous line,
  <ALT> <I> insert an empty line,
  <ALT> <S> copy of the same field from the previous line.

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CHAPTER 1

Machine manager and NC selector.

At the end of the package installation procedure a machine has to be installed before you can proceed with machine operation (i.e. installation of data of an NC centre). Every file edit, copy or transmission operation must refer to an active machine i.e. the machine which is currently in use. This program installs new machines, activates one of the machines present and eliminates those which are not required.
The different data required for operation include the machine data, special cycles for the Assisted Editor and Examples and the configuration file of the NC system. The latter file, which allows for proper configuration of a machine, must be taken from the original disk supplied with the NC system materials. Users are reminded that copies of the original disks should be made so that back-up copies of the software are always available. This file is called the EESER file and must generally be available on a disk together with the machine data, any languages that may be required, the fixed cycles and all the important files needed to re-start the NC system in the case of malfunctioning or damage to drives C: or D:. If you do not have the disk with the EESER file, ask your dealer or agent to inform you as to how you should go about obtaining this file from your own NC system.
The paragraphs that follow will illustrate the various phases, starting with a new set-up without any machines installed.

1.1 Installation of a new NC system.

When you start running the system, the window which lists any installed machines will appear. Of course, this window will be empty for the moment. You will also see a window that shows the active NC system.

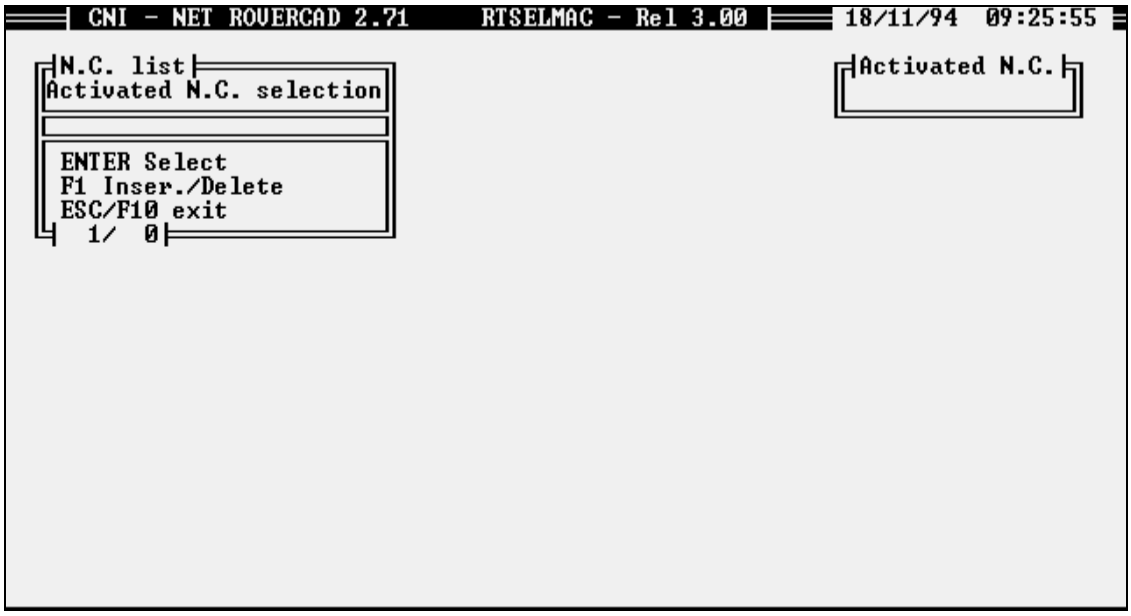


Figure 1.1 Initial situation with no NCinstalled.

Key **F1** leads to the phase where you have to decide whether to install or remove the data of a machine.

Figure 1.2 Selection of operation.

In this case we select "**Insert NC**". A window will appear where we have to insert a name consisting of a 5-figure code that identifies the NC system. After inserting the name, we are asked to confirm the operation.

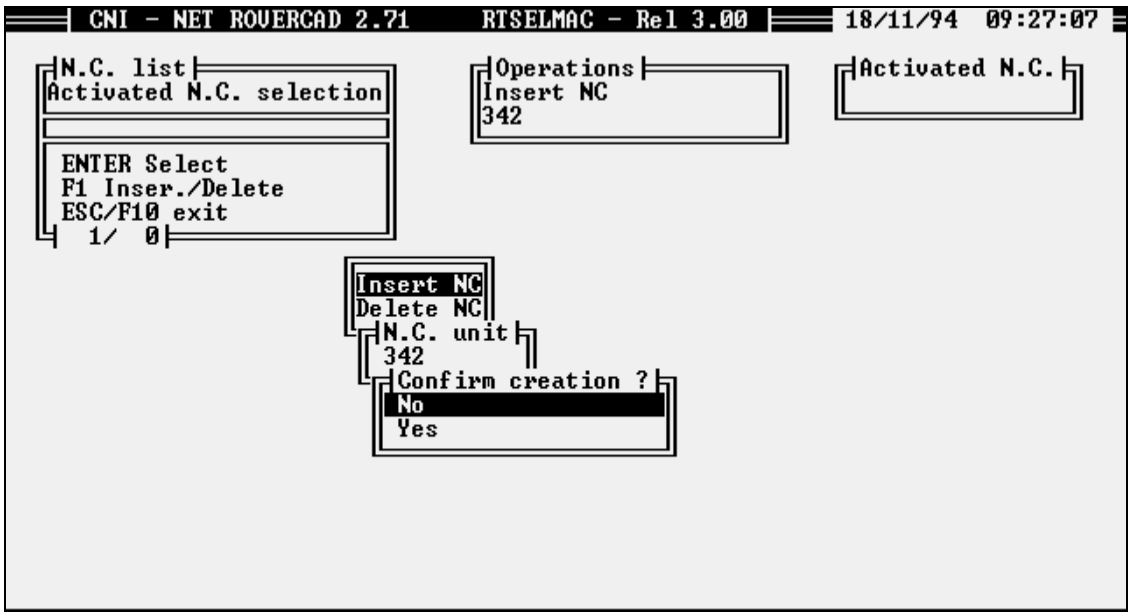


Figure 1.3 Operations for insertion of a new NC system.

This is not what we have to do at the moment but you should note that there is a control device which avoids insertion of a name of a previously existing NC system. This avoids inadvertent overwriting of data. The operation has to be repeated from the beginning (from the **F1** key) if an erroneous name is inserted.

Figure 1.4 Error message.

If insertion is not confirmed, the system takes you back to the starting point - otherwise it will continue to ask a new question:

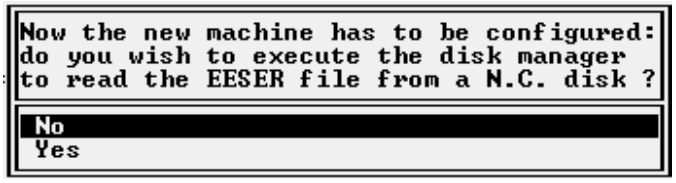


Figure 1.5 Load NC system configuration files.

This question will ask you to consider copying the EESER file from the disk, an operation to be carried out with the Disk Manager. The system offers to run the program directly to make a copy - rather than exit, return to the main menu and then run the Disk Manager. The operations to be carried out are described in the manual section on disk management but we shall briefly go over the procedure. At the beginning you have to select the "**COPY**" option and then the "**READING**" option from the window that represents a PC with a disk and direction arrows and press <**RETURN**>.

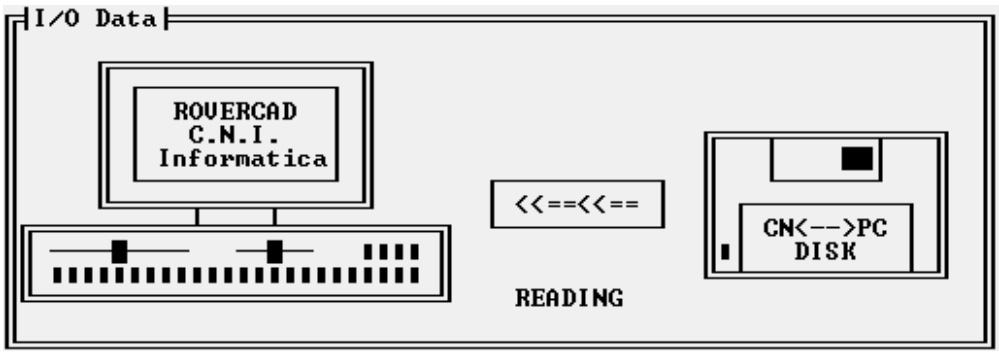


Figure 1.6 Disk management window for selection of a direction.

If you have two disk drives, you will also see a window allowing you to select the drive the files are to be taken from. Finally, a window for the choice of the file type will also appear. Select "**EESER**" and insert the EESER file name in the window that appears next. The file is then copied and, as the the machine is not yet configured, you will be asked if you want to carry out the actual configuration of the NC system. This last window will no longer be visible when the machine is running normally, nor will it appear when further copies of other EESER files are made. This means that after having configured a machine it is no longer possible to re-configure it.
After these operations the machine will be configured and all options in the main menu of the package will become available to the user.

1.2 Selection of an NC system.

After subsequent installations of machines, using the operations specified in the previous paragraph, the user will have access to a series of machines, each with its own rows of machine data, special cycles, programs, fixed cycles and all the files related to an NC centre of the RT480 series.

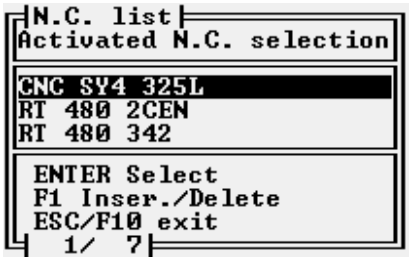


Figure 1.7 List of installed machines.

To activate a machine, select one with the cursor keys and then press <RETURN>. The name of the activated NC system will appear in the window in the upper right-hand corner. In all programs contained in this package a window similar to this one will always appear in this corner to indicate which machine is active.

Figure 1.8 Window with the name of the activated NC system.

1.3 Elimination of a NC system.

When an NC system contains data which is now useless or no longer required, this option allows you to permanently eliminate the entire NC system. You must be absolutely certain in this case that the machine is no longer to be used.

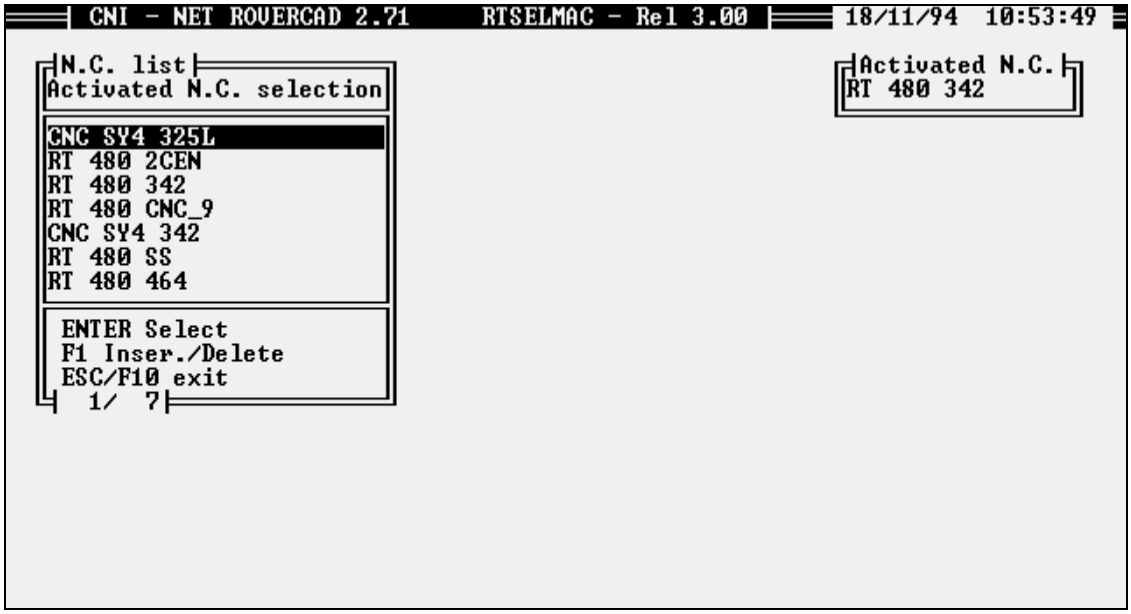


Figure 1.9 Initial situation of installed NC systems.

The **F1** key starts the phase where you can decide whether to install or remove data concerning a machine 1.2).
In this case we select "**Delete NC**". A window will appear, allowing you to insert a name, a 5-figure code identifying the NC system. After inserting this data you are invited to confirm the elimination.

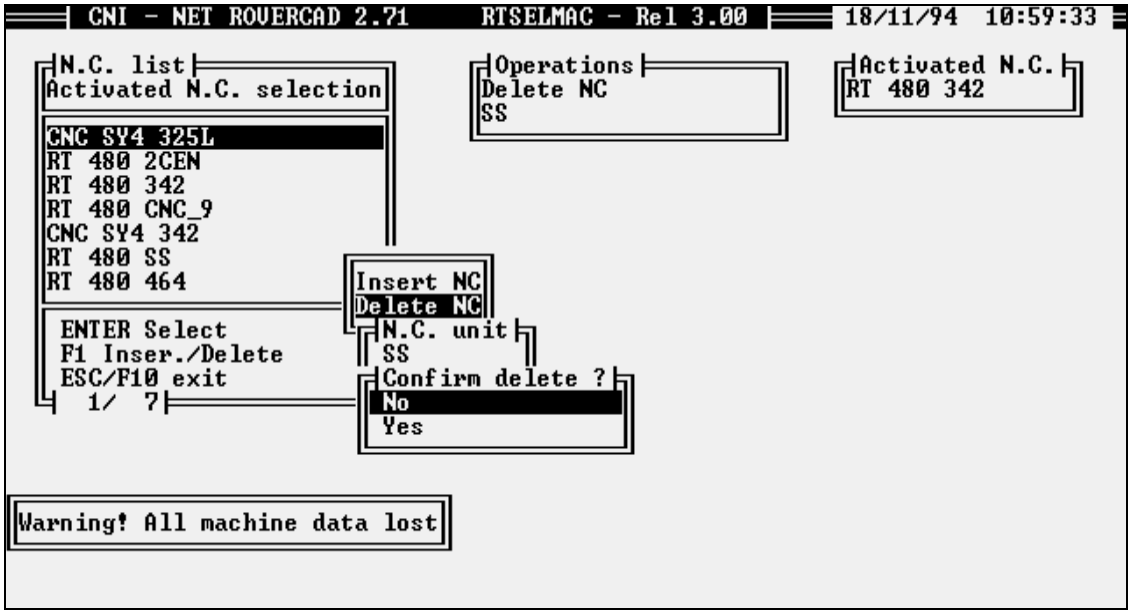


Figure 1.10 Operations for the elimination of an NC system.

To avoid an indeterminate situation there is a controller which impedes the elimination of an active NC system. The operation has to be re-started by pressing <F1> if an attempt has been made to eliminate an active NC system.

Figura 1.11 Error message.

If elimination is not confirmed you are taken back to the point where you started.

CHAPTER 2

Diskette management using the NC system.

Together with serial transmission, this part allows for the transfer of data from the PC terminal to the NC and vice versa. Unlike transmission via the serial line, the data transferred with a diskette can also be saved or kept as a reserve copy - to allow for 'snapshots' of machine states, copying machine data, work lists, special cycles, fixed cycles, programs and PLC data. It should be noted that the normal DOS commands cannot be used for NC disk management. You must always use disks formatted by this program or formatted directly by the NC. This program allows you to carry out the most common operations on the CNI format disk such as copying files, deleting, re-naming and formatting diskettes. The required option can be selected from the main menu.

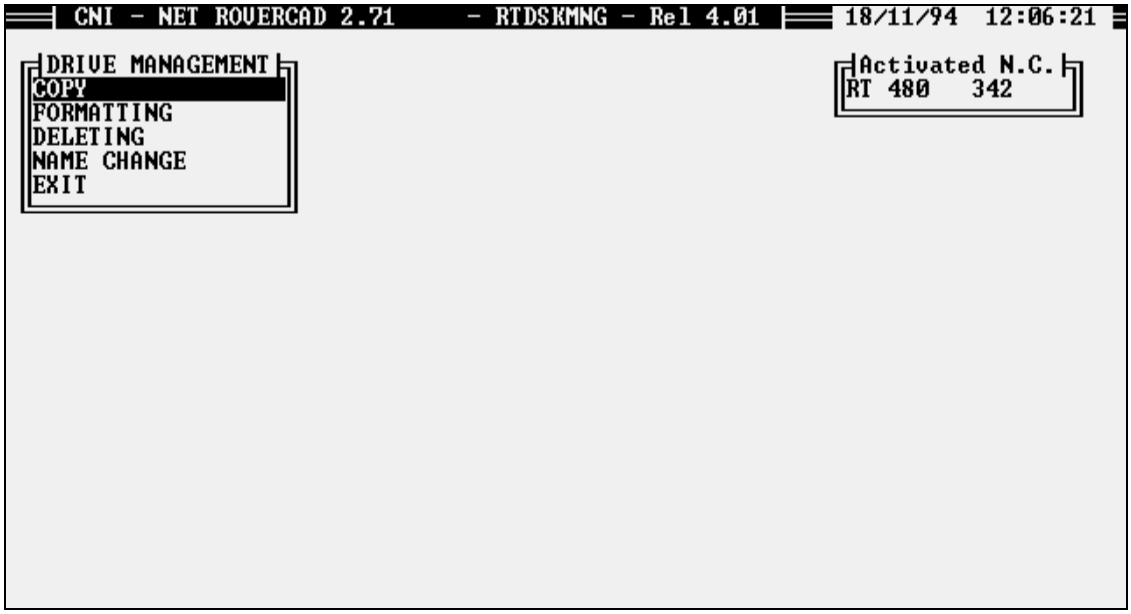


Figure 2.1 Functions controlled by the disk manager

If the PC has more than one drive, a window will appear to allow you to select the drive to be used:

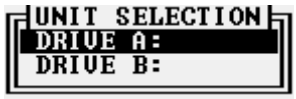


Figure 2.2 Selection of a drive

Each operation is indicated in the status window, which appears in the centre of the screen after selection of an option from the main menu:

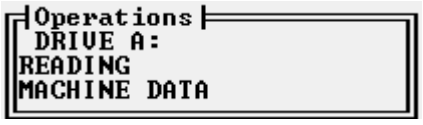


Figure 2.3 Operation in progress

2.1 Copying data.

Fram the main window shown in figure 2.1 select 'COPY'. We shall not distinguish between 'Copy from the NC disk' and 'Copy to the NC disk' as the windows that appear and operations to be performed are practically the same. It is only necessary to specify the direction of copying in the window that appears, with a stylized symbol of a personal computer, diskette and an arrow indicating the direction of the copying operation (==>>==>> **Write to disk,** <<==<<== **Read from disk)**. The cursor keys '⇦' and '⇨' can be used to change the direction of the arrows (confirm with <**ENTER**>.

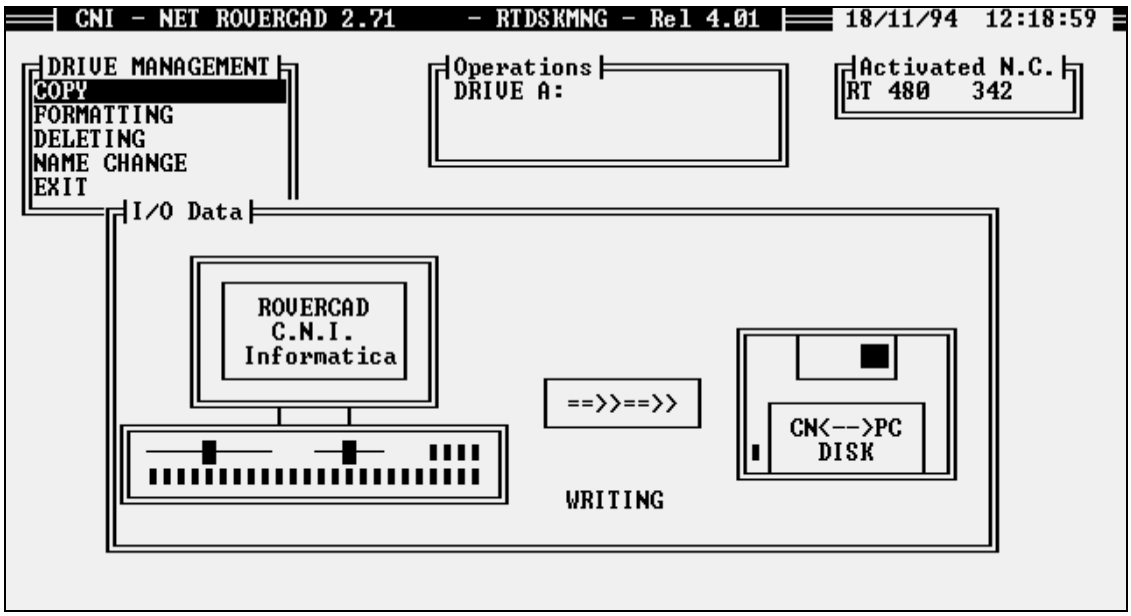


Figure2.4 Choosing the direction of copying

A window will now appear for selection of the type of file to be copied:

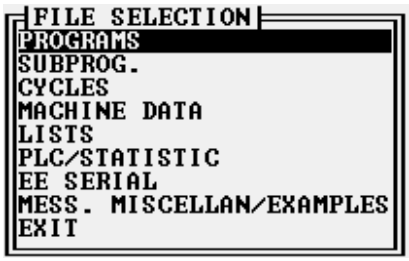


Figure 2.5 File types.

For all languages, except for the default language (Italian), there are 8 options + exit. In Italian the last option (messages for Assisted Editor and Programming Examples '**MESS. MISCELLAN / EXAMPLES**') is missing as it is not required for this language.

For the options referring to "**PROGRAMS**", "**SUB-PROG.**", "**CYCLES**" and "**LISTS**" a window (see below) appears to ask the user to select a file:

Figure 2.6 Choosing the name of the file.

After selecting the file or group of files, using the asterisk character '*', press <**RETURN**> to start copying the files. If the '*' character is used, a window in the centre of the screen will indicate the file currently being manipulated. The example shows files beginning with the letter '**T**' (**T***).

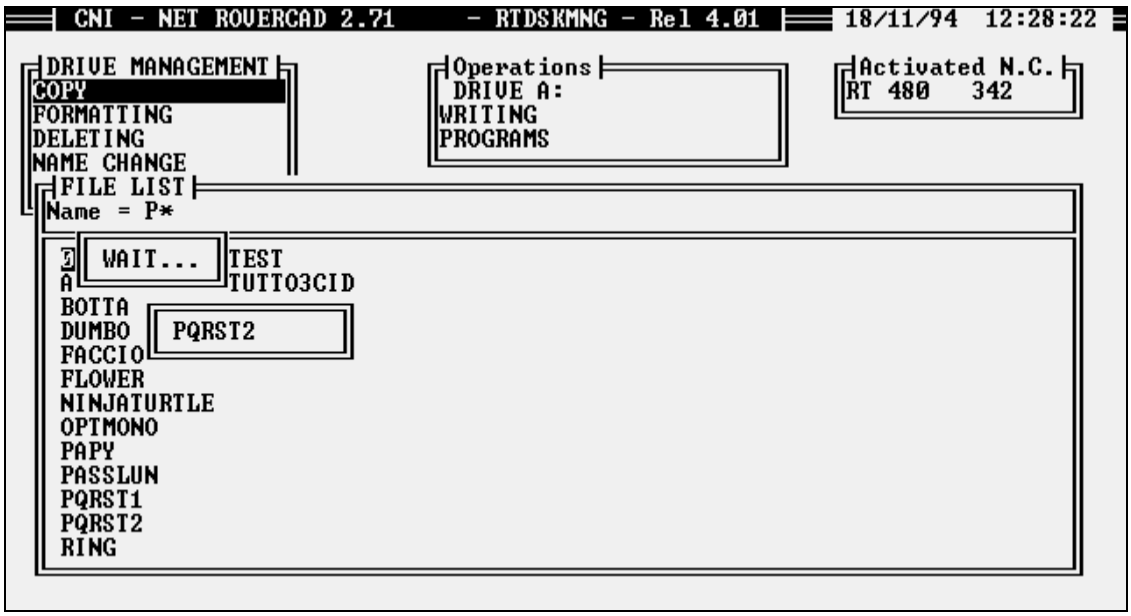


Figure 2.7 Copying a group of files.

Once the operation has ended, a window pops up to inform the user the operation has been completed successfully.

Figure2.8 End of copying.

In the case of "**LISTS**" an automatic routine is included to copy the files included in the work list itself. The file in the second field will be considered for each line of the work list unless it has as one of the following label (1st field) codes: '**READ', 'WRIT**', '**STOP**', '**KILL**', '**JMP**' or '**READ**'. As a consequence of this distinction, a window appears to ask the user if these particular programs have to be copied too. If no confirmation is given, we continue and return to the file-name selection menu, otherwise the copying operation will then be started.

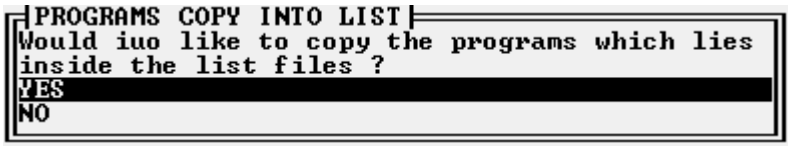


Figura 2.9 Confirmation for copying files in a work list.

A window will appear containing the work list on the first line. The second line contains the work list step and the third line will show the name of the actual program file to be copied.

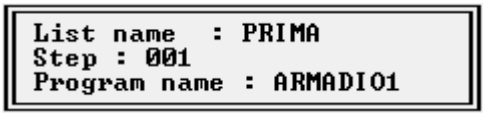


Figura 2.10 Window with a work list and program files to be copied.

It may happen that the work list programs are not all present because of deletions or because they have not yet been elaborated. When the copying procedure finds that a file does not exist, a window appears to allow the operator to decide which action to take.

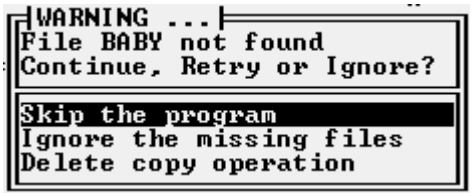


Figura 2.11 Message that appears when a work list file has not been found.

The first item allows us to ignore only a missing file. This window re-appears if another file is missing. The second item however can stop this window from appearing as it tells the program to ignore all missing files. The third item simply ends the operation immediately.
The menu item for selection of a file type (fig. 1.5) for "**PLC/STATISTICS**" allows for selection of the files to be copied as the statistics already memorized do not have a fixed name, which can be specified by the user. A name-change is also possible for PLC data during copying, which allows for the creation of various copies of the data.
The item "**MACHINE DATA**" is for copying all machine control data and a window will appear for selection of the file groups required. This window reflects the characteristics of the NC system and therefore the items may vary.

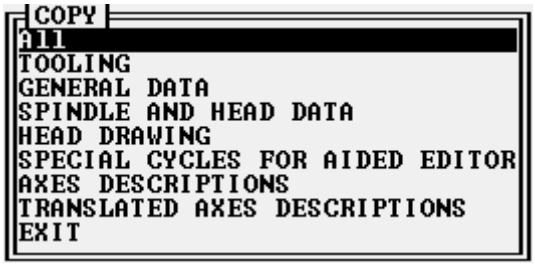


Figure 2.12 Window for management of machine data.

It is possible to copy the groups of files one at a time or all together (by choosing **"ALL").**
The items contained in this window correspond with the Machine Data Editor (**MDE**) tables:

"**TOOLING**" (TOOL-UP) Manages all "**TOOL-UP**" tables in the **MDE**.

"**GENERAL DATA**" Manages the "**GENERIC DATA**", "**ORIGIN DATA**" and "**AXIS DATA**" tables of "**MACHINE DATA** " in the **MDE**.

"**SPINDLE AND HEAD DATA**" Manages the "**DEFINITION OF HEADS**" tables and the four "**CORRECTOR**" tables of "**MACHINE DATA** " in the **MDE**.

"**HEAD DRAWING**" Manages a file which can be given graphic form in the NC system.

"**SPECIAL CYCLES FOR AIDED EDITOR**" Manages configuration files in the Assisted Editor.

"**AXIS DESCRIPTIONS**" Manages files containing texts with the descriptions of the axes that appear in the "**AXIS DATA**" table in **"MACHINE DATA** " in the **MDE**.

"**TRANSLATED AXIS DESCRIPTIONS**" Similar to the previous option but manages files with extensions depending on the language activated.

The conversion of machine data is run (first 'copy to disk' and then 'copy from disk') to translate the data into the appropriate form. An error that can occur is the lack of compatibility between the two environments as they are preset for different data. For example, having a NC with two work centres (two physical heads) and an active machine on a PC configured for only one centre or a number of axes in the NC different from the number in the machine active on the PC. Thus the user must always transfer the machine data from a NC to its corresponding machine (See the chapter "Machine manager and NC selector" at the paragraph with heading "Selecting an NC centre" on page 5).
The item "**EESER**" in the window box in figure 2.5 allows the user to copy the configuration file of the NC as a backup copy. This file is also essential for the program package as it allows for configuration of a machine on a PC. The procedure for creation of a machine is explained in the chapter "**Machine manager and NC selector"** at the paragraph **"Installing a new NC"**, on page 3.
If the machine is not yet defined, this is the only option to use as it allows for configuration of the machine. If the machine is already configured however, it will not be configured again. After selecting the option, the EESER file name has to be inserted in the window which appears next. The file is copied and, if the machine is not yet configured, the operator will be asked if the NC system has to be configured.

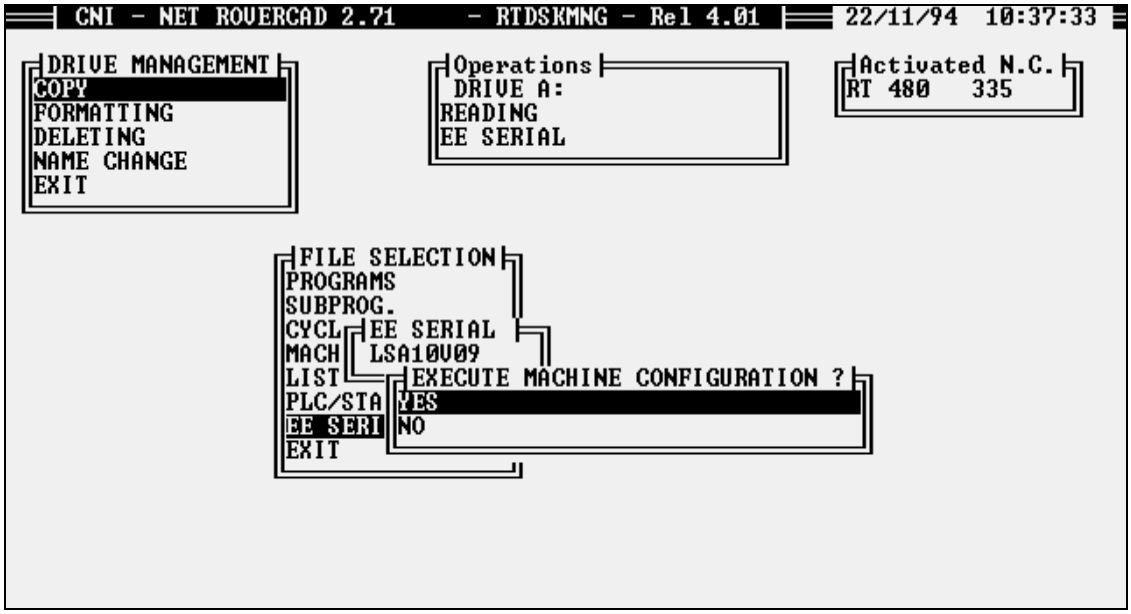


Figure 2.13 Window for configuration of the machine..

This final window no longer appears when the machine is operating under normal working conditions, nor will it appear after further copies of other EESER files are made. This means that after configuring a machine it is no longer possible to configure it again.
After these operations the machine will therefore be configured and all options in the main menu of the package and this program become available to the user.

2.2 Formatting disks.

From the main window shown in figure 2.1 select '**FORMATTING**'. Two types of formatting procedure are available: **720Kb** and **1.44Mb**. A window will appear to allow the user to select which formatting procedure is appropriate.

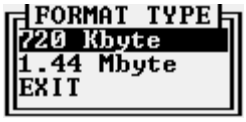


Figure 2.14 Window for format density

The procedures for disk management are internal and if formatting does not start on account of some undefined problem or incompatibility with the hardware, a DOS formatting procedure is available with post-formatting for the CNI format. Confirm the selected format by pressing <**ENTER**>. A new window will appear to confirm the copying procedure. After this, formatting will start, changing the screen setup and showing a pie-type counter of formatted traces and a percentage indicator of the operation being run.

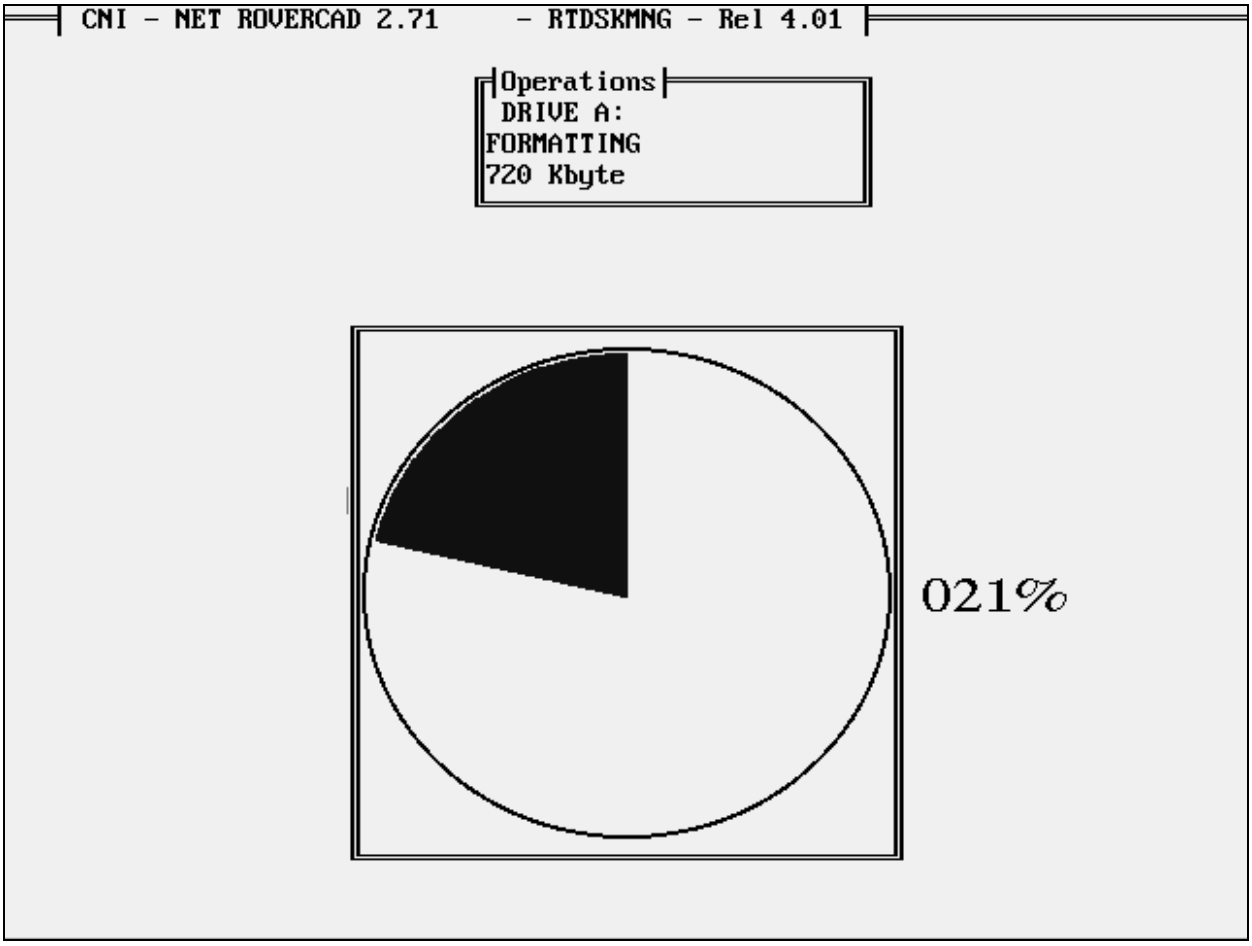


Figure 2.15 Graphics of formatted traces.

Of course, the user must not try to format a disk with a density level greater than the appropriate level of the disk. For some types of drive there is no management facility for density levels below the memory support level. We would therefore advise users to format disks at their specific density.
If problems occur with formatting, the second method can be tried, as previously mentioned. When the format selection window appears ((figure 2.14), confirm the density level with keys <**ALT**> <**F10**>.

```
Insert new diskette for drive A:
and press ENTER when ready...

Checking existing disk format.
Formatting 720K
Format complete.

Volume label (11 characters. ENTER for none)?

    730112 bytes total disk space
    730112 bytes available on disk

      1024 bytes in each allocation unit.
       713 allocation units available on disk.

Volume Serial Number is 2E6D-14CC

Format another (Y/N)?N

                  ....  WAIT...  ....
```

Figure 2.16 Screen for alternative formatting procedure.

The sequence of messages is the same as that used in the DOS formatting procedure (FORMAT) so the operator will follow the instructions for formatting a single disk and then post-formatting will be performed. There is no reason why this method should fail so any remaining problem will depend on disk damage, drive problems etc and will be referred to on the screen as an anomaly found by DOS.
Newly-formatted disks will have the following characteristics:

	Maximum number of files managed	***Available space (Kbyte)***	***Minimum space for a file (Kbyte)***
Disk 2DD (720Kb)	320	692	2
Disk 2HD (1.44Mb)	640	1384	1

2.3 Deleting files.

As in the case of file copying, a window is presented for selection of the type of file to be deleted (figure 2.5). The EESER option is not available in the deletion procedure so the window will be shorter by one item. After selecting the file type a window will appear for selection of the actual file to be deleted (figure 2.6), except for the case of machine data, for which a window will appear showing a list of groups of machine data files that can be deleted (figure 2.12). Whatever file has to be deleted, a window will appear asking you to confirm the operation:

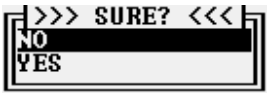
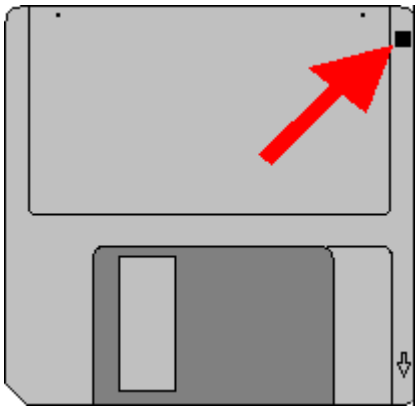


Figure 2.17 Confirmation of the file deletion operation.

As for the copy-to-disk operation, remember to unprotect the disk by moving the write-protect notch.



2.4 Changing file names on a diskette.

As for the file-copy operations, a window appears for selection of the type of file to operate on. For re-naming a file, neither the EESER nor the machine data options are available so the window will be shorter by two options:

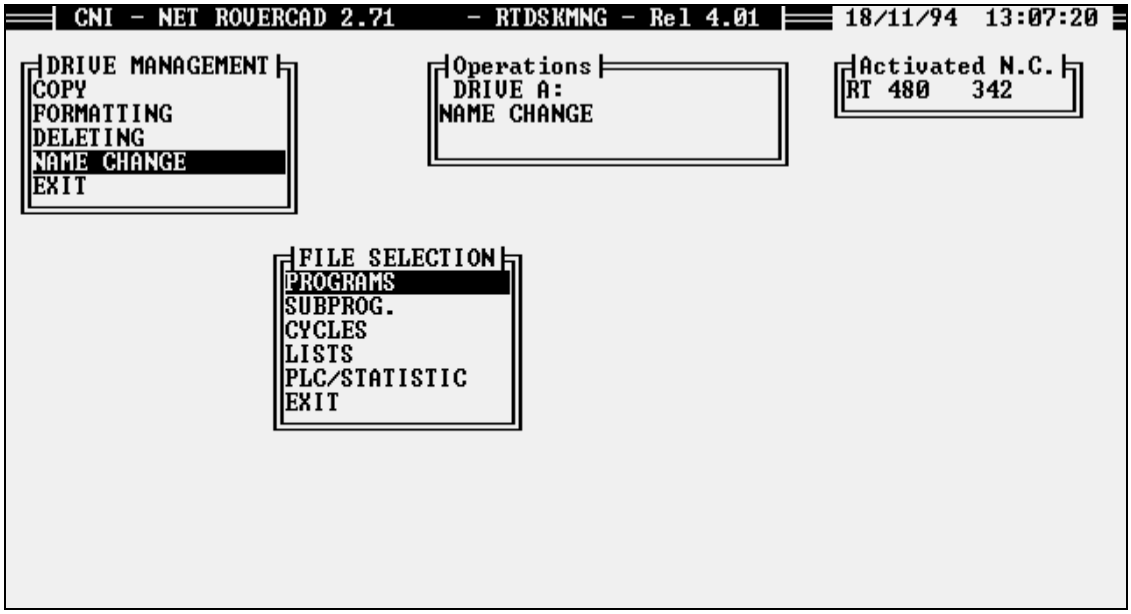


Figure 2.18 Types of files that can be re-named.

After selecting the file type, a window will appear for selection of the name of the actual file to be re-named (figure 2.6). After confirming the name, a window will appear allowing you to insert the name to be given to the file:

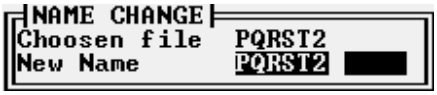


Figure 2.19 Window for changing a file name.

Do not use the name of a file that already exists. If this happens, a window will pop up to inform you of the fact.

CHAPTER 3

Tool-up and machine data editor.

Every NC system has its own features e.g. the number of physical and logical heads, the number of spindles, the number of interpolation axes and positioning axes (moveable panel supports) and so on. This program allows for the management of this kind of data in a manner which is analogous to that of an NC system. The presence of machine configuration data allows for the creation of specific programs for a particular machine, which can be optimized on the basis of its characteristics and equipment.
Data management is thus divided into three functional areas:

MACHINE DATA	the physical definition of a machine set-up, from the number of axes to the positions of spindles inside the heads *(note that once this data has been copied or edited by the NC, it should not subjected to any further modification*).
TOOL-UP	settings for the tools mounted in the machine, definition of tools and any tool magazines.
MACHINE SET-UP	completion of data required by the package and not available in the NC system.

When you exit from any of the tables, you will be asked whether you wish to save the data or not - also when no changes have been made. It should be noted that in the change-over from the very early versions to the more recent designs it became necessary to insert new data in some of the tables so files must be updated or saved by the editor that also manages the new data. This operation of re-saving the the data tables becomes necessary when programs that use the machine data give an error message to indicate that they have detected data in the older format. Generally, the tables to be re-saved are the four tables in the first configuration (TOOL-UP), the four tables of power takeoff offsets and spindles (MACHINE DATA) and the tables for bits and tools.
This module also follows the NC configuration file so some options explained in the various chapters may not be available in certain machines as they are able to be configured as a NC.
Each table can be printed individually by pressing the keys <**ALT**> <**P**> as indicated at the bottom of each window.
For more detailed information about the fields in each table see the User's Manual for the numerical control system.
The main menu offers a series of options, which are illustrated below.

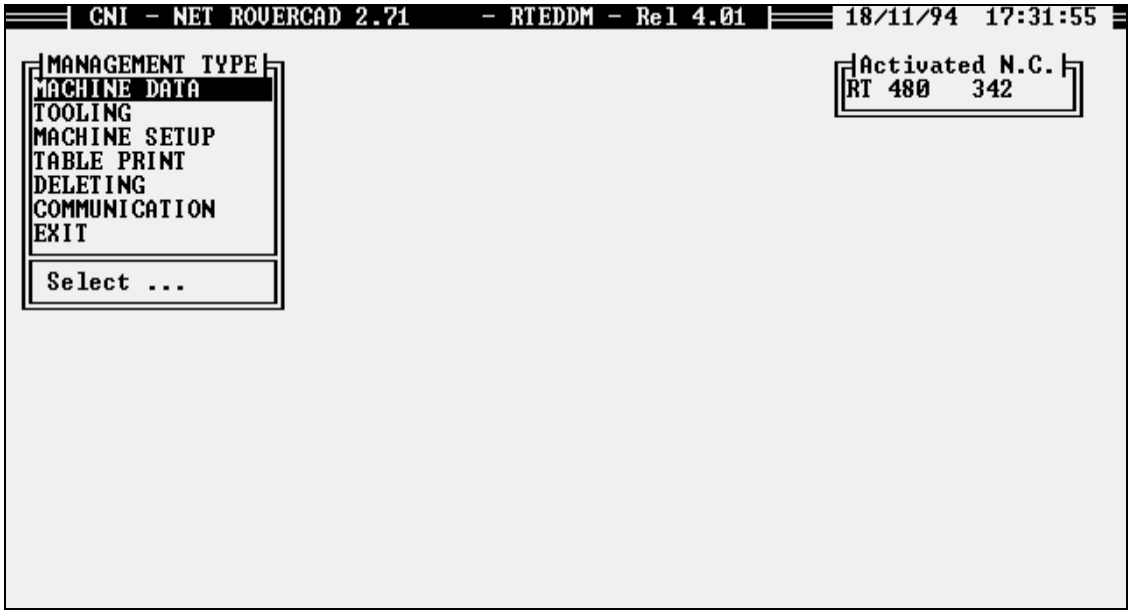


Figure 3.1 Main menu at the starting point.

 This symbol, which appears after the title of a chapter or paragraph, indicates that the topic explained relates only to the NC 0.9.0.0.0 and later versions so if you have an earlier version you may immediately skip to the next chapter or paragraph as the case may be.

3.1 Machine data.

Select '**MACHINE DATA**' from the main window shown in figure 3.1. A window will appear with the various tables used for definition of a machine.

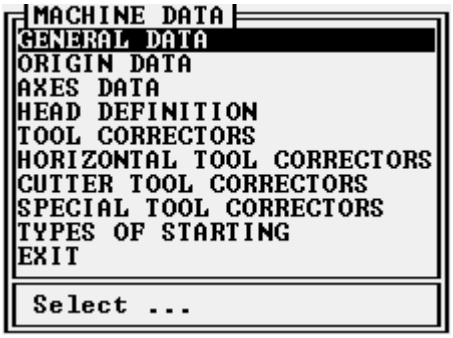


Figure 3.2 Machine Data tables.

Normally this data is taken from the controller and does not require further modification unless modifications are made to the machine itself.
All the data is grouped into two files at the moment of being transfered to the NC system. In the **NC Disk Manager** (on page 9) and in the **Serial Communications Manager** (on page 99) they are referred to as "General Data" (general data, origin data, axis data) and "Spindle and Head Data" (definition of heads and tables of the spindle and power take-off offset values.

3.1.1 General data

```
GENERAL DATA
Flag millimeter/inches ..........................................
Max. drilling depth on the basic length ..................... X     50.00
Max. drilling depth on the basic length ..................... Y     50.00
Max. drilling depth on the basic length ..................... Z     50.00
Working table length ..........................................   3000.00
Threading max. speed ..........................................   1000.00
Max. tool rotating speed ......................................  24000.00
Left area working limit .......................................   1000.00
Right area working limit ......................................   2000.00
Transmission ratio positionig machine center 1 ..................  .......
Transmission ratio positionig machine center 2 ..................  .......

ALT-P: Print
```

Figure 3.3 General data table.

Other lines contained in the window may be viewed by using the cursor keys.

3.1.2 Origin data.

```
ORIGIN DATA
     X          Y     T
   405.60     905.60 1
  1836.10     905.60 4
  2085.10     905.60 1
  3516.00     905.60 4
   405.60     755.60 1
  1836.10     755.60 4
  2085.10     755.60 1
  3516.00     755.60 4
   405.60     255.70 1

ALT-P: Print
Displacement in X
  1/ 16
```

Figure 3.4 Origin data table.

The third column, which is not present in the NC system, indicates the panel reference corner resting at the origin.

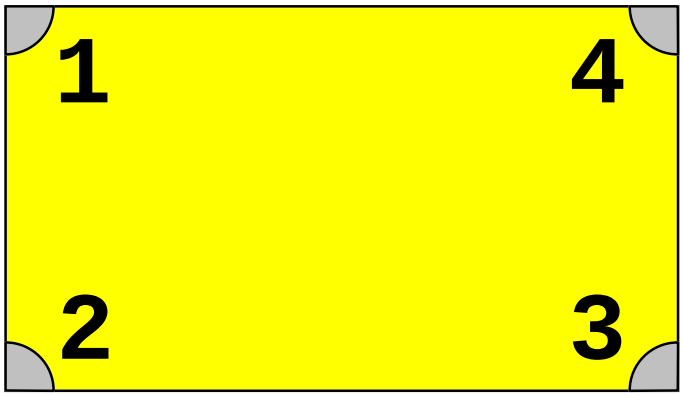


Figure 3.5 Numbering of the reference corners.

3.1.3 Axis data.

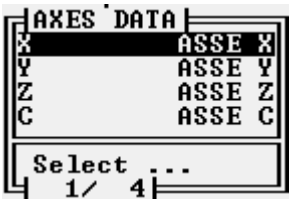


Figure 3.6 Choosing an axis.

When choosing the first axis (**X**), a window will appear for the insertion of all necessary data:

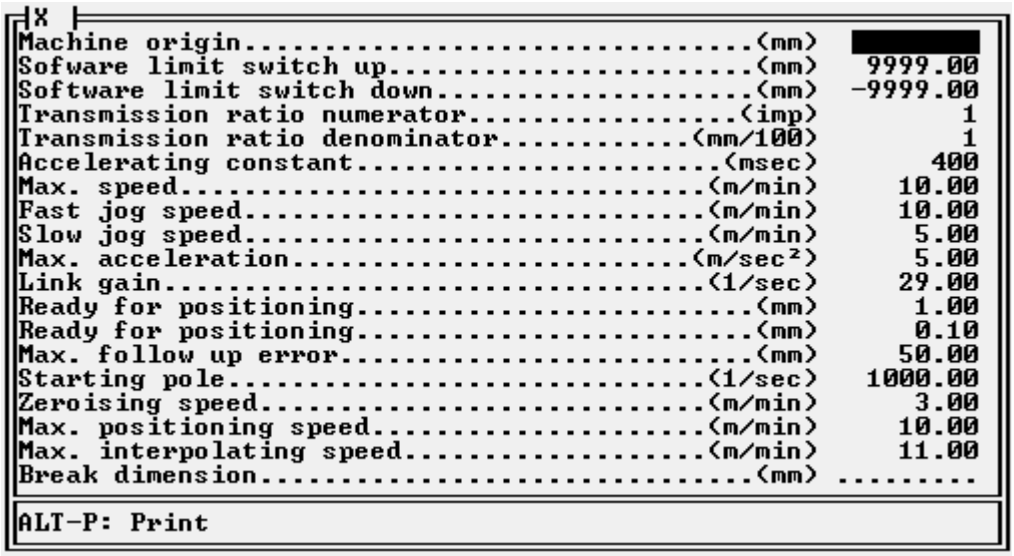


Figure 3.7 Axis data table

The axes are associated internally with a code that represents the axis type. This code is a 3-figure number and represents one of the few axis categories (about four available). In special machines it may occur that you have an axis type different from the default type such that the axis data listing will change, depending on the value. To avoid confusion we shall not include other masks and can use the most common as an example.
The window in fact contains other lines, which can be seen by using the cursor keys if the machine is configured for more than 19 data items per axis.

3.1.4 Head data.

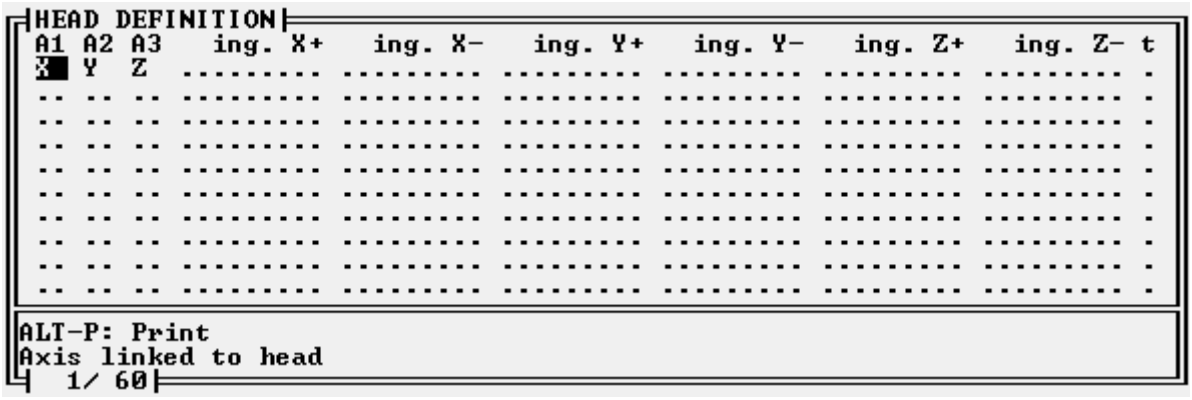


Figure 3.8 Head data table.

Each line of this table represents a logical head (i.e. a group of spindles and power take-offs, which will move as an integral part of the physical head) and can be associated to axes different from the conventional X, Y, Z axes. This data is of fundamental importance for the avoidance of collisons between the various logical heads that may be present. In the eprom version of the NC 7.xx the first three fields are grouped in a single field where, in the place of the axis code, the axis order number must be indicated e.g. 0=X, 1=Y, 2=Z etc.

3.1.5 Vertical spindles.

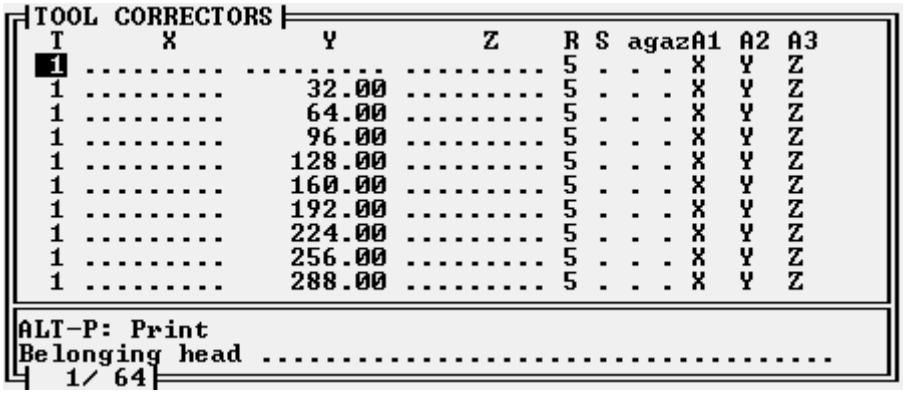


Figure 3.9 Vertical spindle table.

In this table, as in those of the other three types of spindle, the 'R' field indicates how the spindle is orientated.

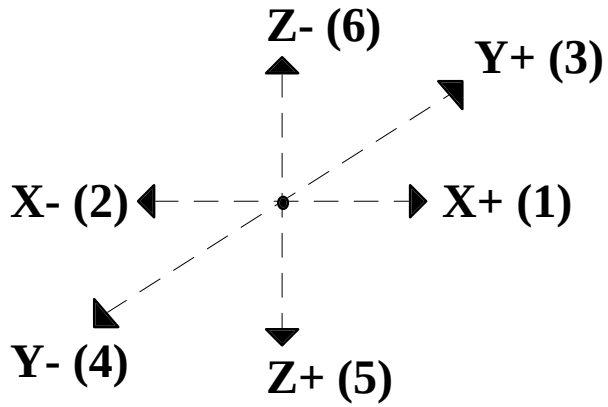
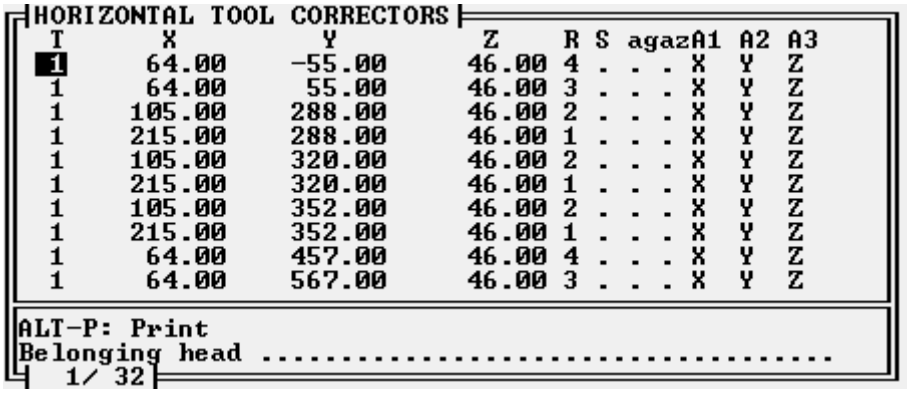


Figure 3.10 Spatial orientation.

The directions '**Z+**' (downwards) and '**Z-**' (upwards) can be exchanged internally on the basis of the NC configuration file, becoming '**Z+**' (upwards) and '**Z-**' (downwards).
The last three fields of each line indicate the three axes associated with the spindle.

3.1.6 Horizontal spindles.


HORIZONTAL TOOL CORRECTORS

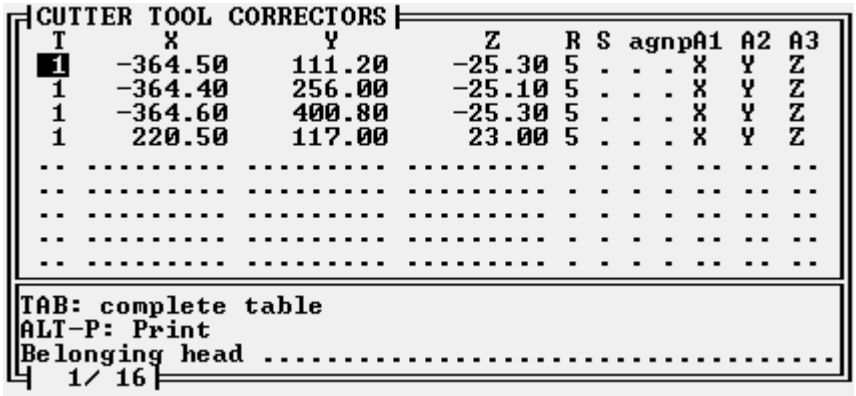
T	X	Y	Z	R	S	agaz	A1	A2	A3
1	64.00	-55.00	46.00	4	.	.	X	Y	Z
1	64.00	55.00	46.00	3	.	.	X	Y	Z
1	105.00	288.00	46.00	2	.	.	X	Y	Z
1	215.00	288.00	46.00	1	.	.	X	Y	Z
1	105.00	320.00	46.00	2	.	.	X	Y	Z
1	215.00	320.00	46.00	1	.	.	X	Y	Z
1	105.00	352.00	46.00	2	.	.	X	Y	Z
1	215.00	352.00	46.00	1	.	.	X	Y	Z
1	64.00	457.00	46.00	4	.	.	X	Y	Z
1	64.00	567.00	46.00	3	.	.	X	Y	Z

ALT-P: Print
Belonging head .....
1/ 32

Figure 3.11 Horizontal spindle table.

The last three fields of each line indicate the three axes associated with the spindle.

3.1.7 Router spindles.


CUTTER TOOL CORRECTORS

T	X	Y	Z	R	S	agnp	A1	A2	A3
1	-364.50	111.20	-25.30	5	.	.	X	Y	Z
1	-364.40	256.00	-25.10	5	.	.	X	Y	Z
1	-364.60	400.80	-25.30	5	.	.	X	Y	Z
1	220.50	117.00	23.00	5	.	.	X	Y	Z
..	.....	.....	.....	.	.	.	.	..	..	..
..	.....	.....	.....	.	.	.	.	..	..	..
..	.....	.....	.....	.	.	.	.	..	..	..
..	.....	.....	.....	.	.	.	.	..	..	..
..	.....	.....	.....	.	.	.	.	..	..	..

TAB: complete table
ALT-P: Print
Belonging head .....
1/ 16

Figure 3.12 Table of router spindles.

The last three fields of each line indicate the three axes associated with the spindle. The necessary data cannot all be displayed on a line so to see all data referring to a spindle, position the cursor on the appropriate line and press <**TAB**>. A window will appear with the necessary information and description.

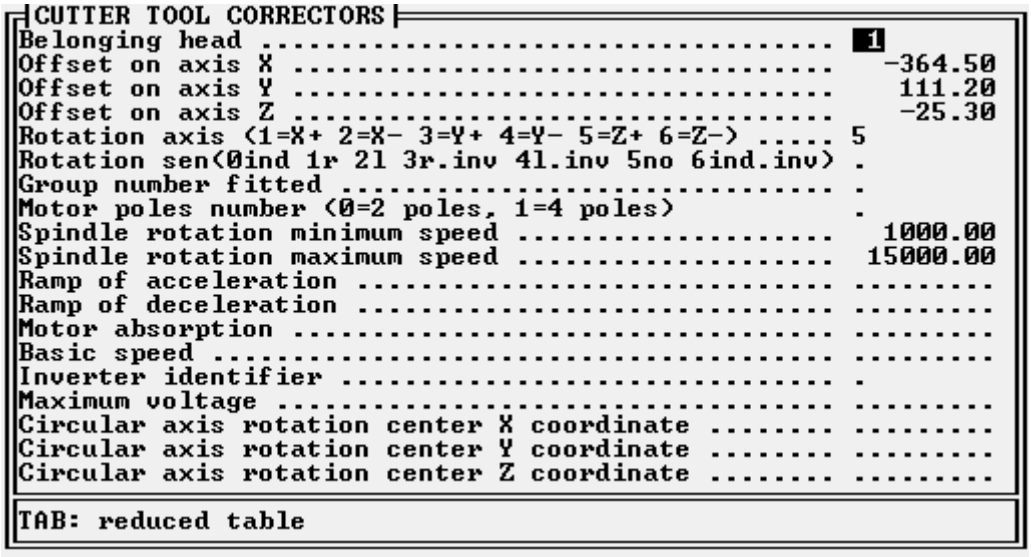


Figure 3.13 Extended table of router spindles.

Other lines contained in the window can be viewed by pressing the cursor keys.

3.1.8 Special spindles.

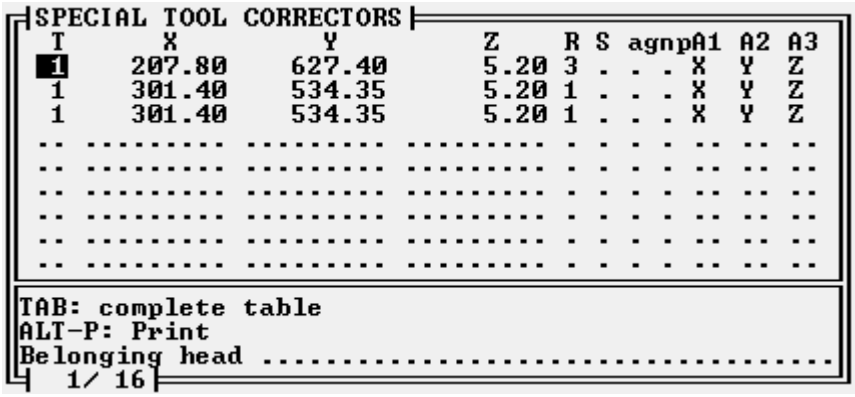


Figure 3.14 Table for special spindles.

The last three fields of each line indicate the three axes associated with the spindle. Again, in this table the extended format is available for viewing and editing all the data necessary for a spindle. Access the extended format by pressing <**TAB**> as in the case of the horizontal spindles.

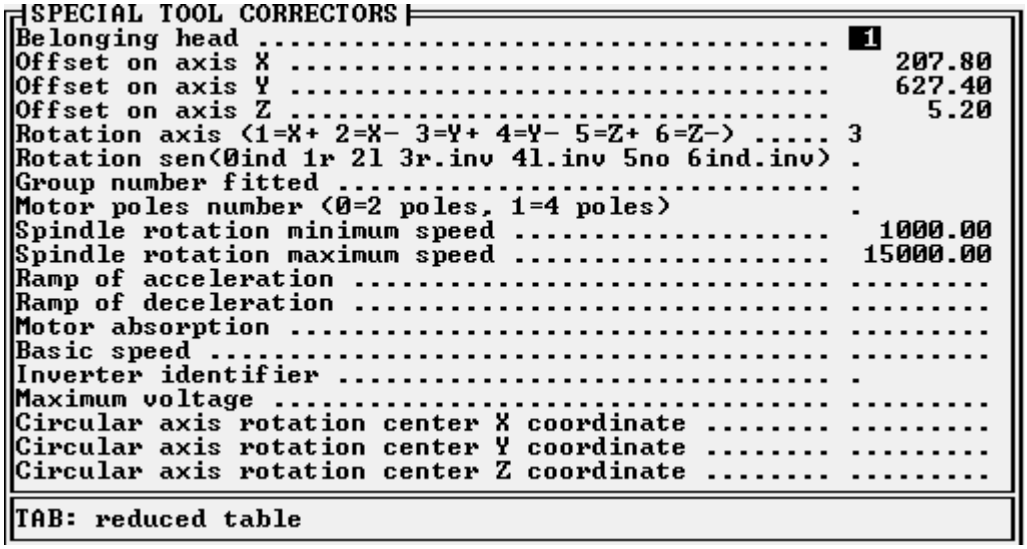


Figure 3.15 Extended table for special spindles.

3.1.9 Types of drive.

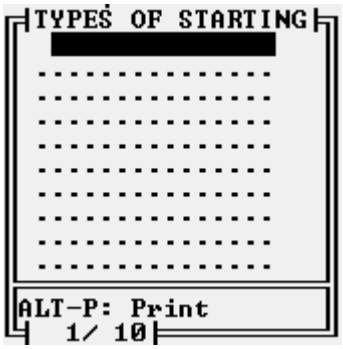


Figure 3.16 Table of drive types.

3.2 Tool-up.

Select '**TOOLING**' (Tool-up) from the main window in figure 3.1. A window with various items will appear, each of which allows for the definition of a tool or its association with a spindle or power take-off.

Figure 3.17 Tables for tool-up.

All of this data is grouped into two files at the moment of being transferred to the NC system. In the ***NC Disk Manager*** (page 9) and in the ***Serial Communications Manager*** (page 99) the data is referred to as "Tool-up" as they are copied in a block.

Contrary to the instruction not to edit data in the Machine Data section, Tool-Up is subject to change as the tools mounted on the machine can be changed as required by the operator.

3.2.1 Configuration of tools.

Once the machine has been equipped with all the tools necessary for operation with a certain type of workpiece, the machine configuration data has to be inserted in the computer package to allow for optimization of the programs (on the basis of tools actually present in the heads) and graphic reproduction of results. However, when the tools are changed, it is necessary to create a new configuration. To avoid having to rewrite the configuration each time, a 15-position archive is available where the most common or most frequently used configurations can be memorized.
A window appears on the screen asking the operator to specify which configuration has to be examined.

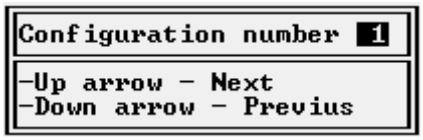


Figure 3.18 Selection of the configuration number.

After this a window appears for selection of the type of spindles to be configured:

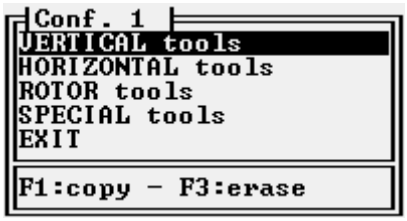


Figure 3.19 Selection of the configuration type.

Two functions are available at this level. These act on the configuration which has just been selected. By pressing <**F1**> a window will appear for insertion of the number of the configuration to be copied:

Figure 3.20 Copying a configuration.

The <**F3**> key is used to delete a configuration. Again, a window appears for confirmation.

We can now continue and enter the first option (window in figure 3.19):

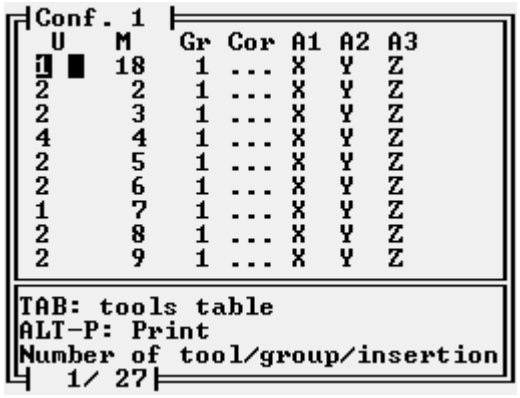


Figure3.21 Configuration of the vertical spindles.

The number of lines in the window is determined by the number of lines edited in the corresponding table of spindles. This is because we have to configure only defined spindles. The same applies to the other windows of the remaining configuration types.
The fields '**M**' and '**Gr**' contain data utilized during optimization and influence the outcome of this process. The first field is the number of the symmetrical spindle associated with the current tool, while the second field indicates the group a spindle belongs to. The association of a symmetrical spindle is fundamentally important if we wish to generate a program that can be made symmetrical (i.e. that can be executed at the symmetrical origin). The group it belongs to establishes which spindles can be used together in a single drop (i.e. the spindles of the same group.
The '**Cor**' field is used directly by the NC and indicates the number of the corrector associated with the bit.
The last three fields of each line indicate the three axes asssociated with a particular spindle. The <**TAB**> key allows the operator to access the tools table (presented below under the "***TOOLS TABLE***' paragraph on page 33) to check or modify the tool that has to be assigned. From the tools table the operator can exit with the usual keys <**ESC**> or <**F10**> or with the <**SHIFT**>+<**TAB**> keys. (✪) In this case, besides exiting and returning to the previous table, the tools table line number, where the cursor was positioned at the time of exiting, is placed in the previous table (configuration of vertical spindles) in the first field (with 'U' tool number) of the line the cursor is positioned on (spindle in edit mode). For example, we can imagine we are inserting the tool in the second spindle - so we position the cursor on the second line (configuration table) and then we press <TAB>. In the table of tools which appears next we then position the cursor on the line of the tool we are interested in - for example, the seventh. We then confirm with <SHIFT><TAB> (when asked to save, we respond 'no') and we automatically find the value 7 in the 'U' field of the second line of the configuration table. Although with different keys, this mechanism is also used with other types of tables, which we will see shortly.
The wwindow that appears if we select the second option (figure 3.19) is identical and the notes given for the first option also apply here.
For the third option there is a window that is identical to the two previous windows as regards data - but with more functions, due to the fact the power take-offs for the routers and grooving groups have special features.

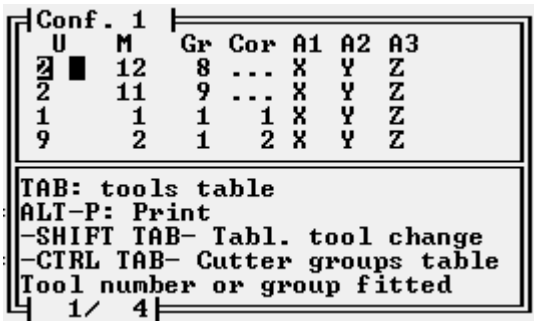


Figure 3.22 Configuration of the router spindles.

The first of these is the automatic tool change mechanism, which can be run by the program. In this way the operator can control tool-change magazines in which series of tools located in specific positions are available on board the machine. This association between positions and tools is managed by the program to allow for authentic optimization.
Another characteristic of the power take-offs is the possibility of supporting router aggregates or groups of routers (see paragraph '**ROUTER AGGREGATES**' on page 38). This applies only to the 0.9.0.0.0 and subsequent versions of the NC system. The functions are enabled by the controller configuration file.
If the tool-change is present in the machine, in the lower part of the window a message will appear indicating which keys to press to access the table that represents the tool magazine. The power take-off that governs the tool-change is no longer fitted with a fixed tool but, to distinguish it from other spindles, the " **@** " character is placed in the ' U ' field.

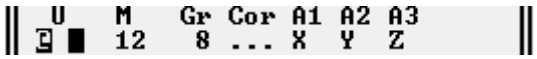


Figure 3.23 Setting up a tool change.

We now press <**SHIFT**><**TAB**> to access the tool-change magazine table:

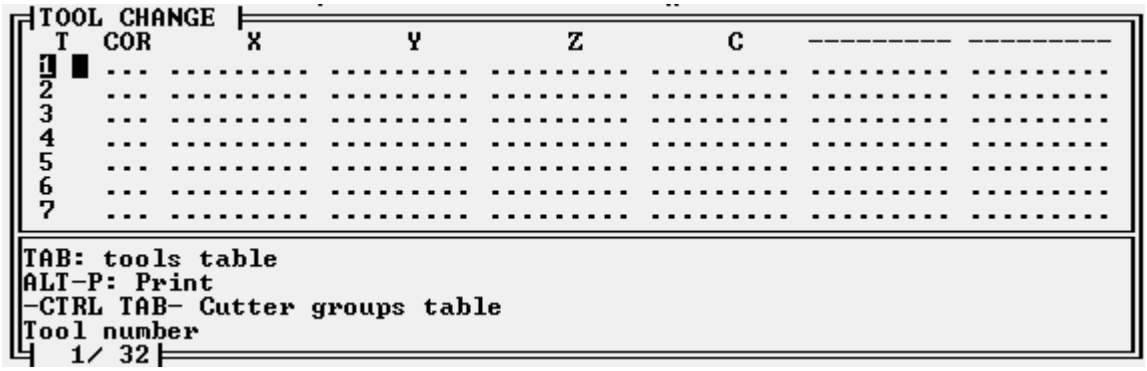


Figure 3.24 Table for the tool-change magazine.

Basically, this table is used to specify a list of ready tools that will be available in our tool magazine when we need them. The mechanism described previously and marked with the symbol ✪ (page 28) also applies here except for the fact that the "***ROUTER TOOLS TABLE***" will appear (explained below on page 33). In the eprom version of the NC 7.xx the last three fields are not present and the three **X, Y, Z** fields are shorter.

It is possible, if predetermined by the NC configuration file, to have a router aggregate either mounted directly on the power take-off (fixed) or available in the tool-change magazine. This table, as in the case of the previous table, allows for insertion of a code that identifies the router aggregate: an '**A**' followed by the number of the router aggregate. Even if the same same keys are not used, the mechanism referred to with the symbol ✪ (page 28) will be operative for automatic insertion of the router aggregate code. The only difference lies in the fact that before presenting the table where the aggregate data is listed the operator must select the aggregate number in a separate window.

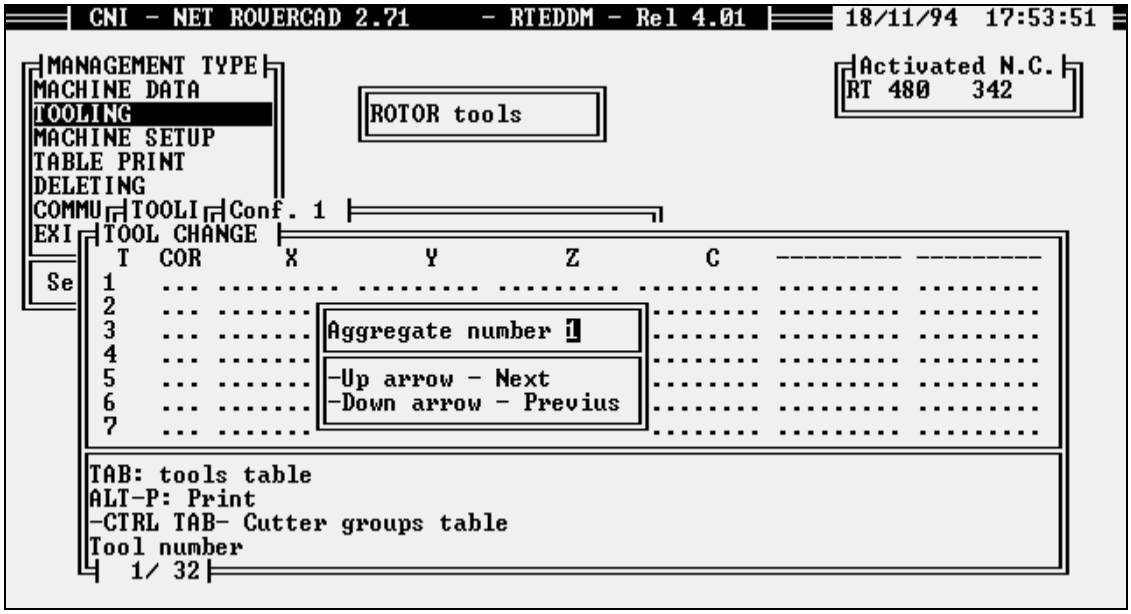


Figure 3.25 Selection of the router aggregate number.

After confirmation of the number, the main window for selection of data will appear with the indication of which keys to press to exit and assign the aggregate in the configuration table.
However, the window that appears if we select the fourth and final option (figure 3.19) is identical to the window of the first two options and the same rules will apply, except for the fact that when a tool is chosen with the <**TAB**> key, the "***ROUTER TOOLS TABLE***" will appear.

Examples for use of symmetry and groups

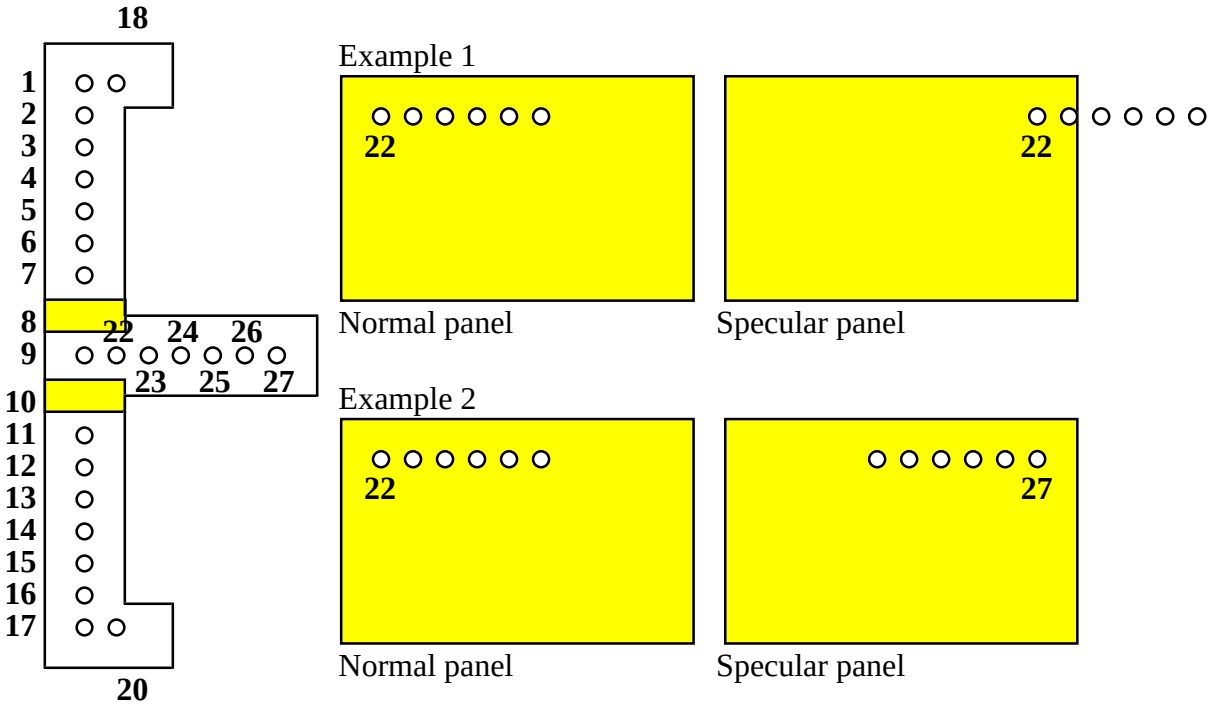


Figure 3.26 Example of the use of symmetry.

Let us suppose we want to create a program with symmetric layout for the drilling of 6 holes. The spindles to be used are numbers 22 to 27. If we specify that each spindle is symmetrically positioned with respect to itself, inserting in field '**M**' of the configuration table the spindle number itself (22/22, 23/23, 24/24, 25/25, 26/26, 27/27), we obtain the result shown in example 1 in figure 3.26.

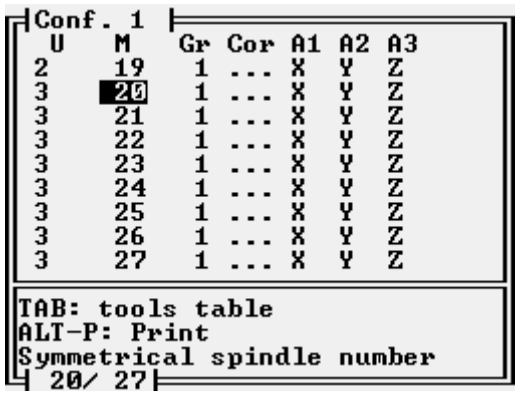


Figure 3.27 Table with unsuitable configuration.

If however we specify that each spindle is symmetrically positioned with respect to the opposite spindle, inserting in field '**M**' of the configuration table the spindle numbers (22/27, 23/26, 24/25, 25/24, 26/23, 27/22), we obtain the the result shown in example 2 in figure 3.26.

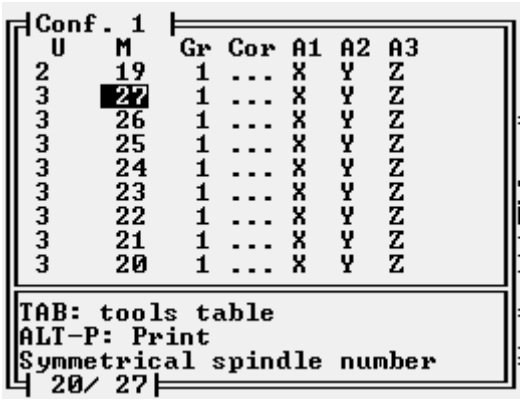


Figure 3.28 Table with ideal configuration.

The optimizer considers that all the tools in a drop must be of the same type, of the same side and of the same group. From release 2.72 and later versions the tools must also have the same drilling speed.

For the management of groups we can create a similar example. Let us suppose we want to create a program with symmetric layout for execution of 6 drills. The spindles to be used are 7, 9, 11, 22, 23, 24.

In figure 3.29 the crossed spindles are in group 2 and the circled spindles are in group 1.

If we specify that the spindles belong to the same group, inserting in the '**Gr**' field of the configuration table the number "1" (all circled), we obtain the result shown in example 1 because the optimizer creates a single drop with all spindles.

If however we state that spindles 22 to 24 belong to group 2 (crossed) then the optimizer sets two drops and the result will be as shown in example 2.

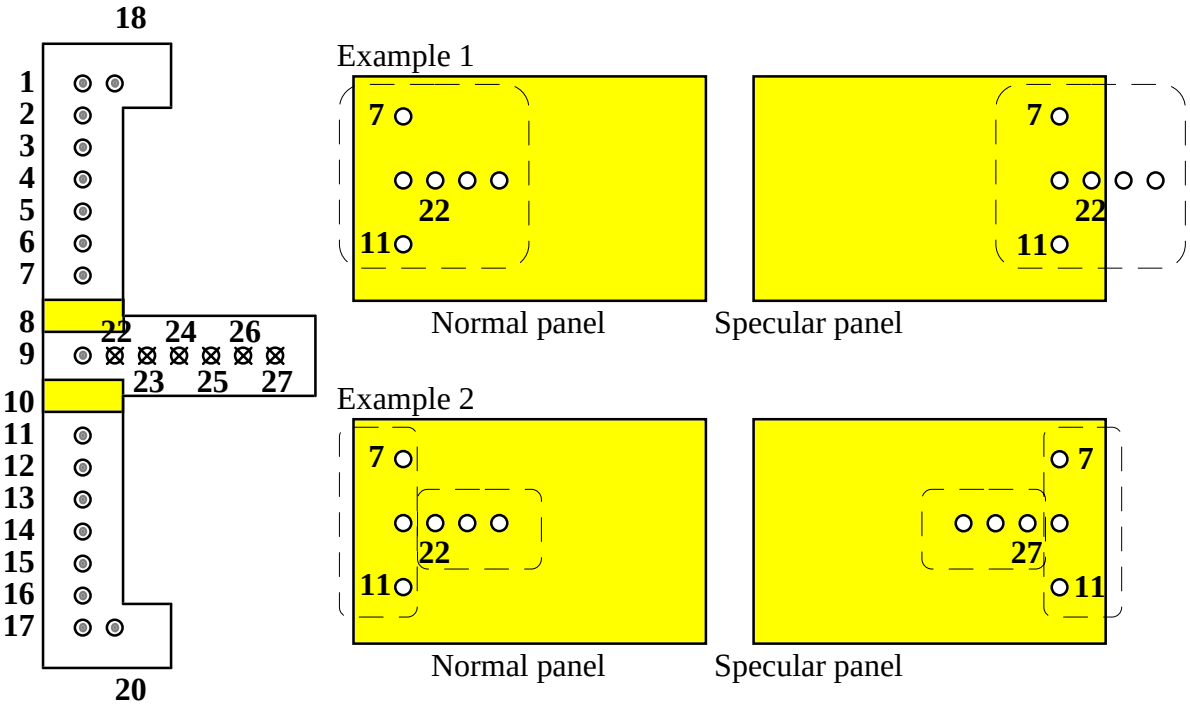


Figure 3.29 Example of the use of symmetry.

3.2.2 Tools table.

From the tool-up menu (figure 3.17) select the second item "**TOOLS TABLE**". The following window will appear:

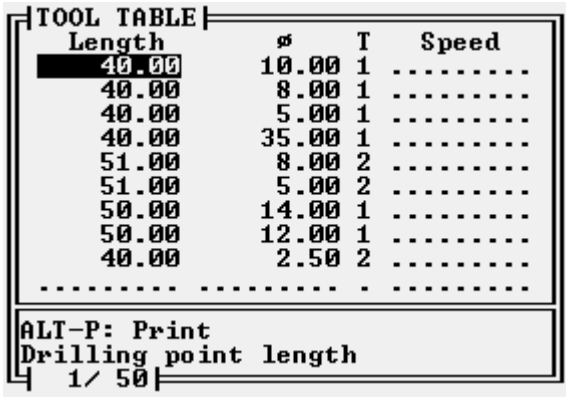


Figure 3.30 Table of drilling tools.

This data relates to the drilling tools and are thus associated with the configuration tables for vertical and horizontal tools or tool aggregates. The '**T**' field, which indicates the tool type, must be associated with a value corresponding to the number of a line of an element in the table of "***TOOL TYPES***" (see page 34). Each line describes a tool and therefore the line number is the tool number In the eprom version of the NC 7.xx a speed field is not included.

3.2.3 Table of router tools.

From the tool-up window (figure 3.17) select the third item "**CUTTER TOOLS TABLE**". The following window will appear:

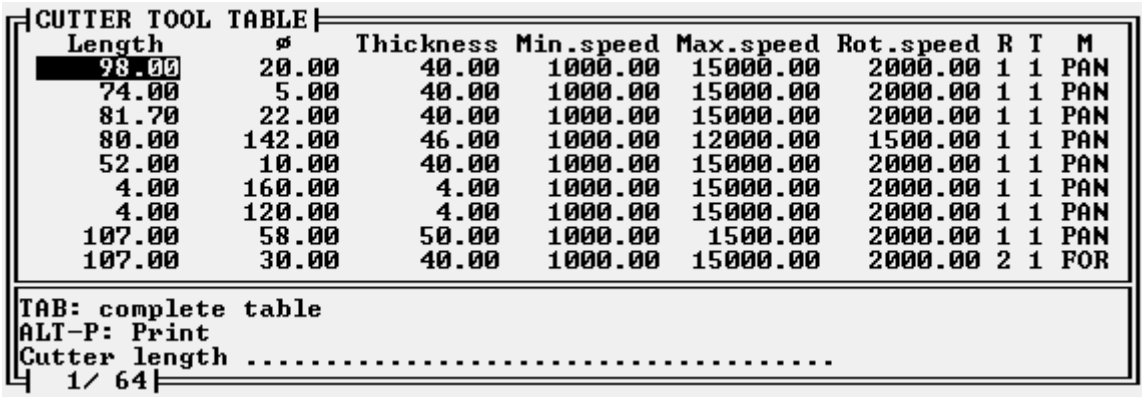


Figure 3.31 Table of router tools.

The column '**M**' , which appears on the far right, has been included for specification of the tool category i.e. the type of use (for routing, drilling, smoothing etc).
The necessary data cannot all be displayed on a line so in order to see all data relating to a tool you must position the cursor on the appropriate line and press <**TAB**>. A window will appear with all the information required preceded by a description.

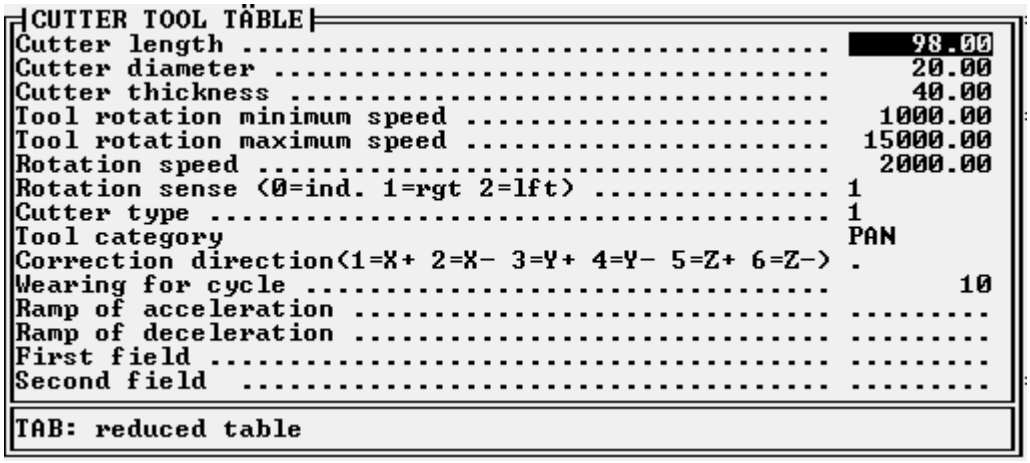


Figure 3.32 Extended table of router tools.

3.2.4 Tool types.

This table, which can be accessed by selecting the fourth item in the tool-up menu shown in figure 3.17, is used for specifying for the optimizer which fixed cycle it must use for execution of an operation on a given side with a given type of tool for drilling.

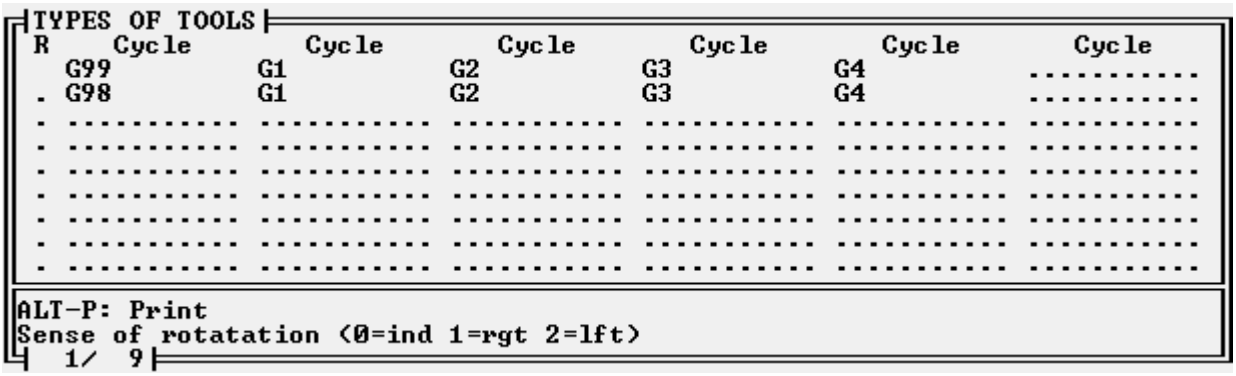
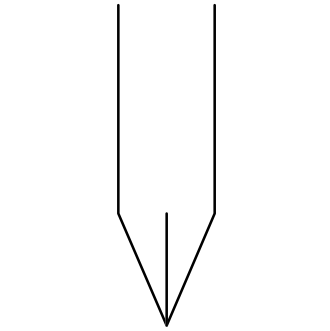


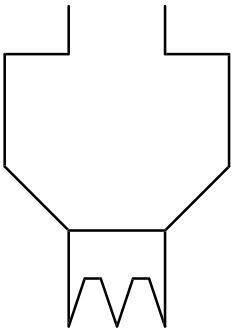
Figure 3.33 Table of tool types.

When we have at our disposal a series of different tools (i.e. different in terms of form or use), we associate a number to each of them thus providing a tool-type reference. In this table we specify for each type of tool (i.e. each line) 6 names of fixed cycles, one for each side of a panel.

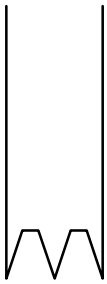
Example of numbering of types:



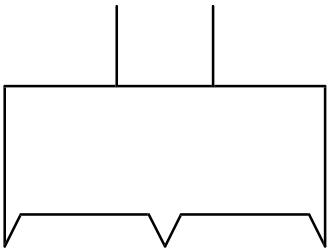
Bit used for a through-hole Type nr. 1



Bit for through-hole with countersinking Type nr. 2



Bit for recessing (pocket) Type nr. 3



Bit for larger recessing Type nr. 4

Figure 3.34 Examples of bit types and numbering.

The use of bit types also avoids an inappropriate use of bits e.g. using bits for through holes and bits for countersinking indifferently.
The bit type is the data to be inserted in fields "**T**" and "**Ti**' in the tables "***Vertical drilling***" (page 56) and "***Horizontal Drilling***" (page 59) in the chapter on "**Program/Sub-routine and Fixed Cycle Editor**".

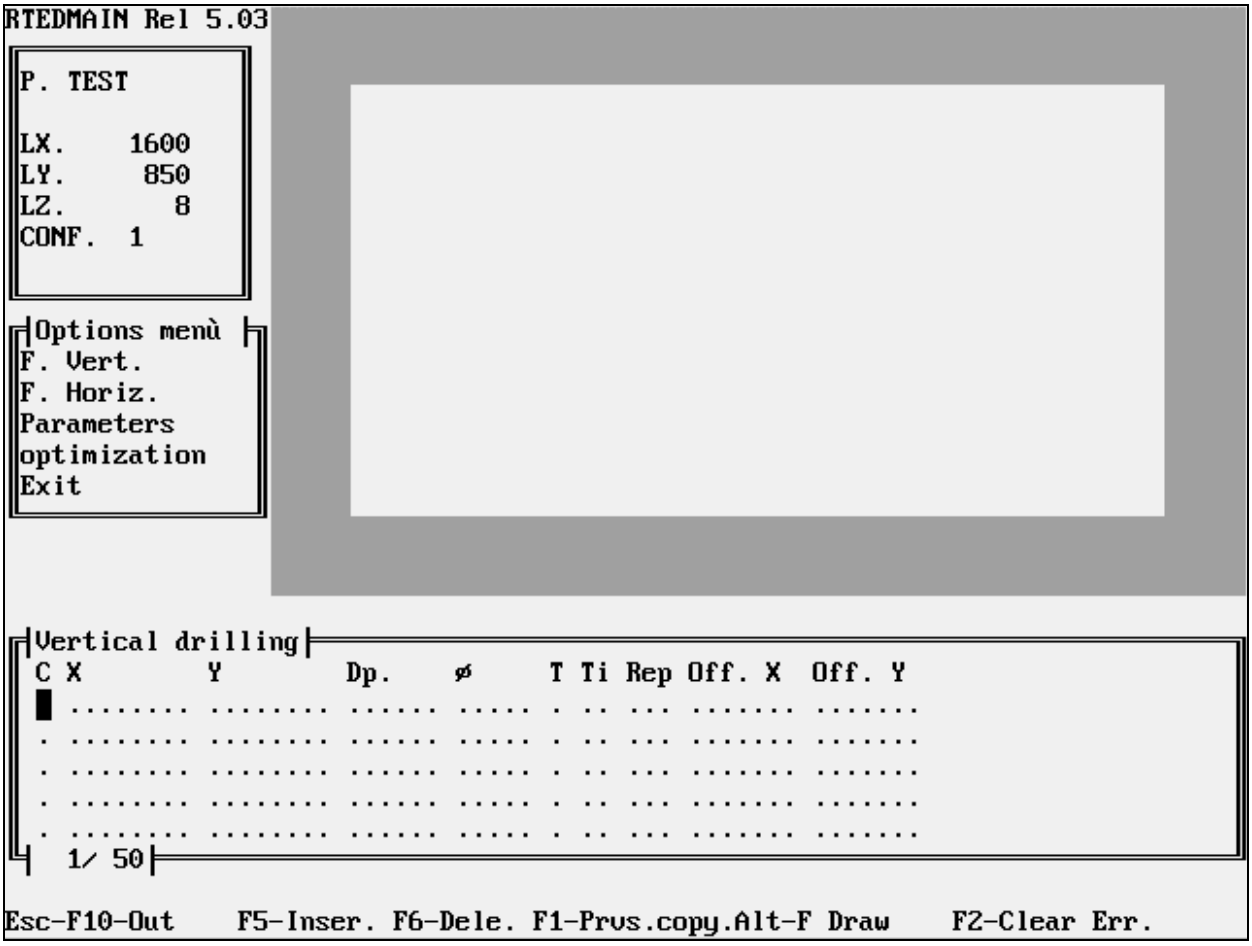


Figure 3.35 Editing the Vertical Drilling table.

3.2.5 Tool aggregates

From the tool-up menu (figure 3.17) select the fifth item "**TOOL GROUPS**". The following window will appear:

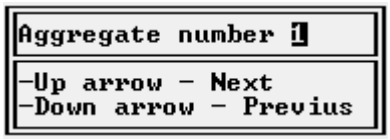


Figure 3.36 Selecting the aggregate number.

As in the case of the configuration of spindles, a 9-position archive is managed for memorization of 9 common or most frequently used aggregates. This avoids always having to rewrite the conformation of bits each time a new aggregate is used. The window in the previous figure is for insertion of the number of the aggregate that has to be edited. When this number is confirmed, the data-editing window appears:

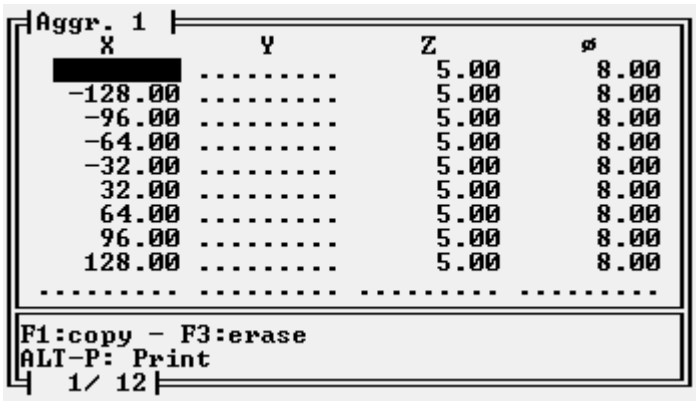


Figure 3.37 Editing an aggregate.

At this level we have at our disposal two functions, which act on the aggregate being edited: copying another aggregate and deletion. With the **<F1>** key we can now accessthe window needed for insertion of the number of an aggregate to be copied:

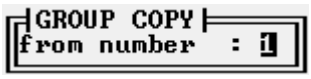
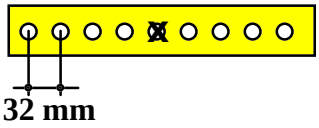


Figure 3.38 Copying an aggregate.

With the <**F3**> key however we can delete an aggregate after confirming the operation in the confirmation window.
The fields in the table in figure 3.37 have the following meanings:

X : distance through **X** from reference point
Y : distance through **Y** from reference point
Z : distance through **Z** from reference point
∅ : diameter of bit

The reference point - and therefore the reference spindle - must always be the first to have zero offsets (the controller positions the aggregate, while referring to the first spindle). In this way all other positions specified for the other bits will be related to the first. In the example in figure 3.37 the aggregate is:



in which the '**x**' indicates the reference spindle. The pitch is 32 mm. The operator should bear in mind that this is the tool-up phase so we need not specify which spindles are present in the aggregate but the mounted bits which may actually be used.
For correct operation the spindle on which the the aggregate has to be mounted must be symmetrical with itself. The configuration relating to the use of the aggregate in question will have to be edited and we must insert the number of the spindle itself in the '**M**' field.

3.2.6 Router aggregates.

Finally, the sixth item in the tool-up menu (figure 3.17) is for the "**CUTTER GROUPS**" (Router aggregates) and, as occurs in the management of the tool aggregates, 9 different configurations of router tools or milling cutters can be managed. The first window is for insertion of the number of the aggregate to be edited:

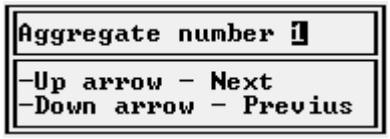


Figure 3.39 Selecting the aggregate number.

After confirmation of the number of the aggregate to be edited, the following window appears:

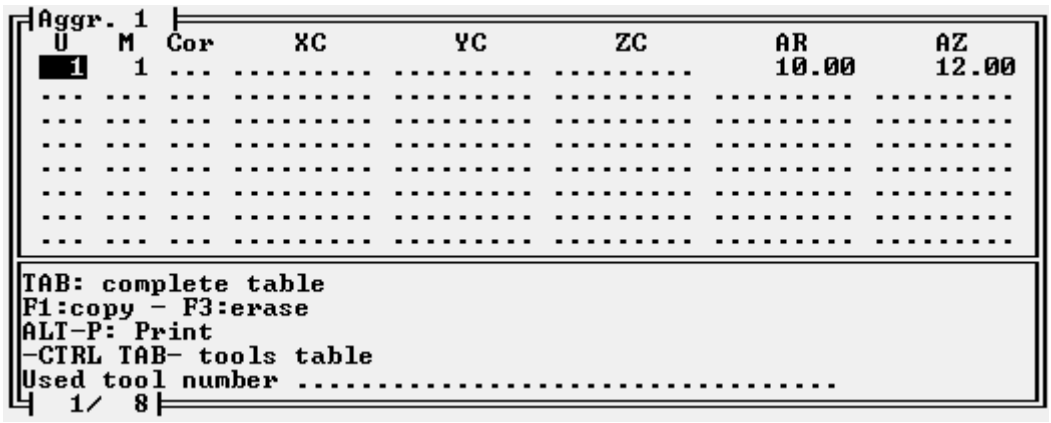


Figure 3.40 Editing an aggregate.

At this level we have at our disposal two functions that act on the aggregate being edited: copying another aggregate and deletion. When pressed, the <**F1**> key will bring up a window for insertion of the number of the aggregate to be copied (see figure 3.38). The <**F3**> key allows for deletion of an aggregate after confirmation of this operation.
Although the same keys are not used, the mechanism referred to with the symbol is used (page 28) for automatic insertion of the tool number.
The necessary data cannot all be displayed on the same line so to be able to see all the data for a power take-off of the aggregate, position the cursor on the line in question and press <**TAB**>. A window will appear with all the necessary information preceded by a description.

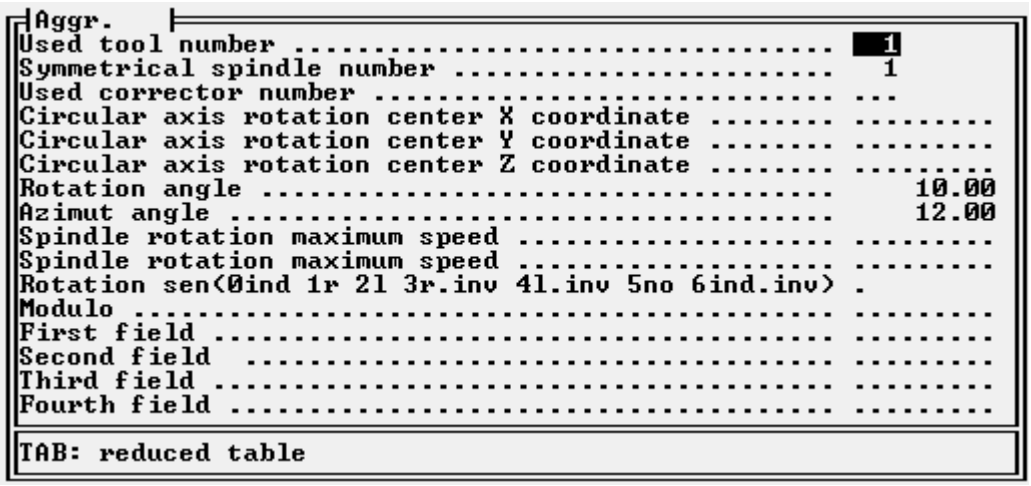


Figure 3.41 Extended editing of an aggregate.

It should be noted that the power take-offs (i.e. chuck) that support the router aggregates are different from the others so it becomes necessary to provide a specification for the optimizer. To do this you will have to enter the "**Machine Data**" environment, first option of the main menu in figure 3.1, select the item relating to the router spindles and in the table that appears next (figure 3.12) insert the value "**1**" in the '**ag**' field of the line (or spindle) in question. A positive value will indicate that the power take-off is the 'new' type i.e. that supports router aggregates. The same also applies to power take-offs for the tool-change as there can be an aggregate in the tool magazine.

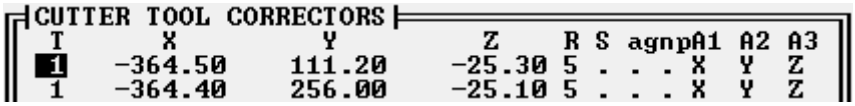


Figure 3.42 Power take-off that supports router aggregates..

3.3 Machine setup

The window that appears after selecting the third item in the main menu (figure 3.1) allows for insertion of the data that completes machine configuration.

Figure 3.43 Window for completion of machine settings.

For a description of the fields in these tables see the manual "***CAM Functions and errors list".***

3.3.1 Working data

Starting from the first item (figure 3.43), the following window will appear:

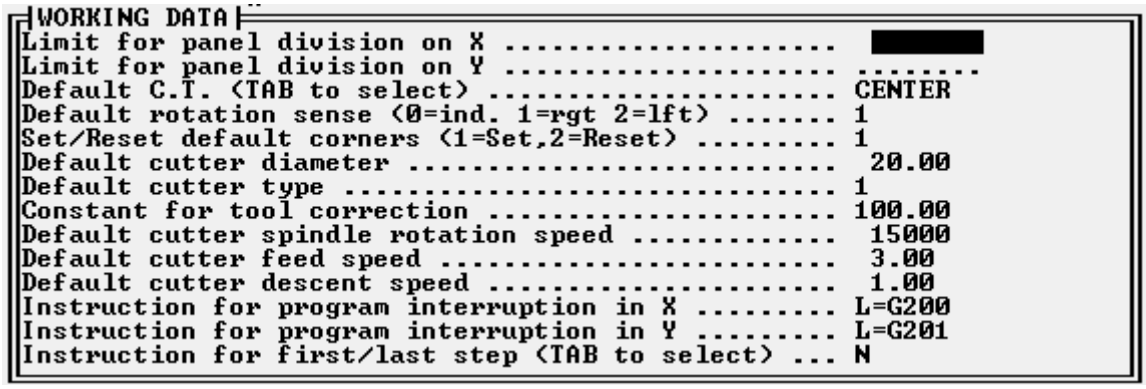


Figure 3.44 Default data for the optimizer (1 centre).

If the machine has more than one centre, the window that appears will be slightly different as a multi-centre machine requires a number of extra items.

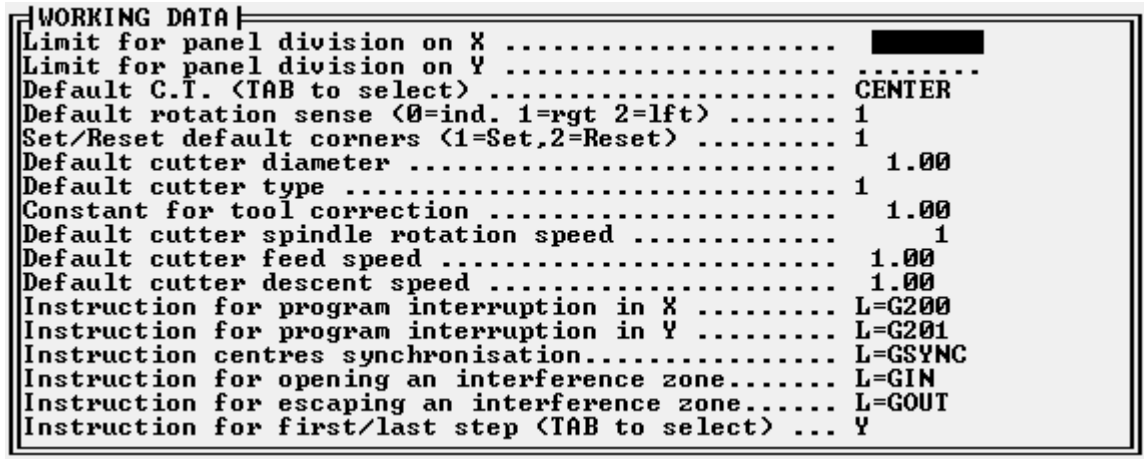


Figure 3.45 Default data for the optimizer (more than 1 centre).

The window for insertion of instructions for the first and last steps (press <**TAB**> when the cursor is on the last line) has the following format:

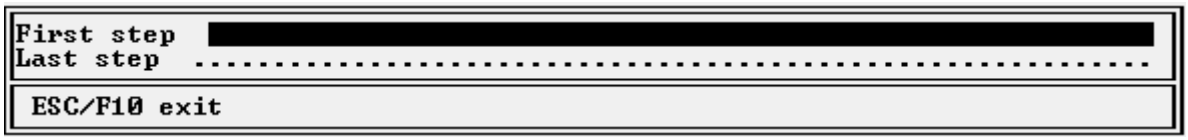


Figure 3.46 Editing instructions for first/last steps

3.3.2 Translation data

The second item (figure 3.43) will make the following window appear:

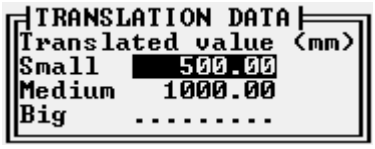


Figure3.47 Table of translation data.

3.3.3 Association of symmetric origins.

The third item (figure 3.43) will make the following window appear:

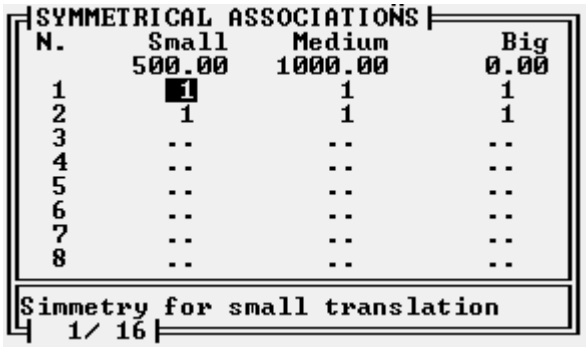


Figure 3.48 Table of associations of symmetric origins.

It should be noted that the second line of the window gives the "Translation Data" values (previous paragraph).

3.3.4 Translation data through Y axis.

The fourth item (figure 3.43) will make the following window appear:

Figure 3.49 Table of translation data through the Y axis.

3.3.5 Association of symmetric origins in Y.

The fifth item (figure 3.43) will make the following window appear:

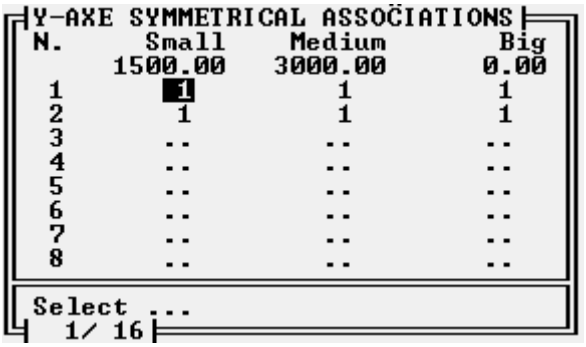


Figure 3.50 Table of associations of symmetric origins in Y.

Note that the second line of the window gives the values of the "Translation Data" (previous paragraph).

3.3.6 Spindles connected to rotation axes.

The sixth item (figure 3.43) will make the following window appear:

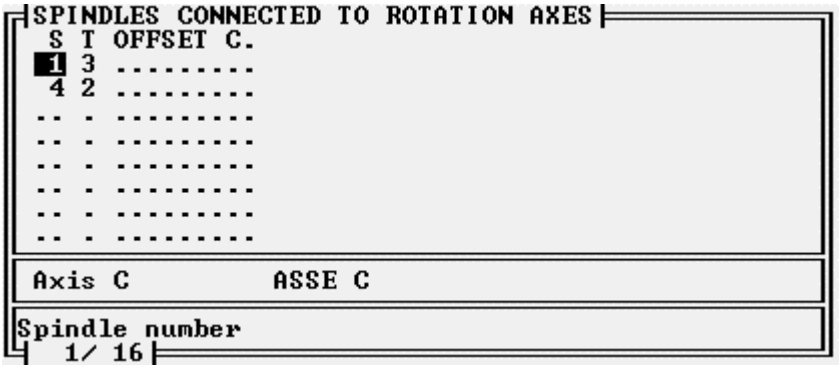


Figure 3.51 Spindles with rotation axes.

This table appears if there is a rotation axis (generally axis '**C**') in the NC system. The data to be inserted relates to spindles or power take-offs associated with this axis. The first field ("**M**')is the number of the spindle i.e. the number of the line in the spindles table (see "**MACHINE DATA**") indicated by the second field ('**T**'). The latter field in fact indicates the spindle type (**0**=vertical, **1**=horizontal, **2**=router, **3**=special). The third field indicates the distance between the centre of rotation and the spindle 'nose' i.e. at the point of clamping between the spindle and the sub-spindle.
If we insert **M**=**5** and **T**=**2** as shown in figure 3.51, we shall be specifying that the fifth router spindle is connected to the '**C**' rotation axis. The rotation axis we are dealing with is indicated in the penultimate line of the window.
The machine can install more than one rotation axis e.g. in an NC system with two centres there can be an axis per centre. In this case before the actual editing window appears there will be a window for selecting which axis is to be associated with the various spindles.

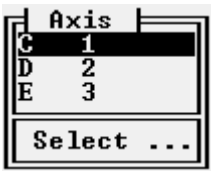


Figure 3.52 List of rotation axes.

In the previous figure, three rotation axes ('**C**', '**D**', '**E**') are created as an example for a machine with three centres, in which axis 'C' is active in the first centre, axis 'D' in the second and axis "E' in the third axis. The rotation axis code, the related centre and a description will appear in the window ("Description of Axes" in the machine data).
A typical example of the use of a rotation axis is an angular drill executed with a router. If we have a **NC with eprom, series 7.xx**, we have to bear in mind that there are certain limitations when using router tools for drilling. To execute an inclined drill it is necessary to set a fixed spindle (not with tool-change) with a router tool mounted in it (special tool for drilling). Note also that with this type of NC, elaboration is possible only for drills with AZ=0 (azimuth angle). The spindle must also be connected to the axis with angular movement in the relative machine data table.
The same limitation applies for inclined cuts, where it is necessary to specify a tool which is specially designed for cutting.
If we have a **NC with eprom, series 9.xx**, execution of drills or cuts with the AZ (azimuth angle) and AR (rotation angle) inclinations is obtained by using router aggregates. In this case the AZ=0 limitation is no longer present and it is also possible to use spindles with the tool-change facility.
Note: It is not possible to use tools mounted on router aggregates to execute normal profiles (profile specialization also excluded). It is possible to run only drilling or cutting operations. The only difference between drills and cuts lies in the AZ angle, which must be at 0 degrees for cuts.

3.4 Printing all tables.

From the main menu (figure 3.1) selection of the fourth item allows for printing of all the tables managed for machine data and tool-up procedure. A window appears requesting the operator to set up the printer before printing the data:

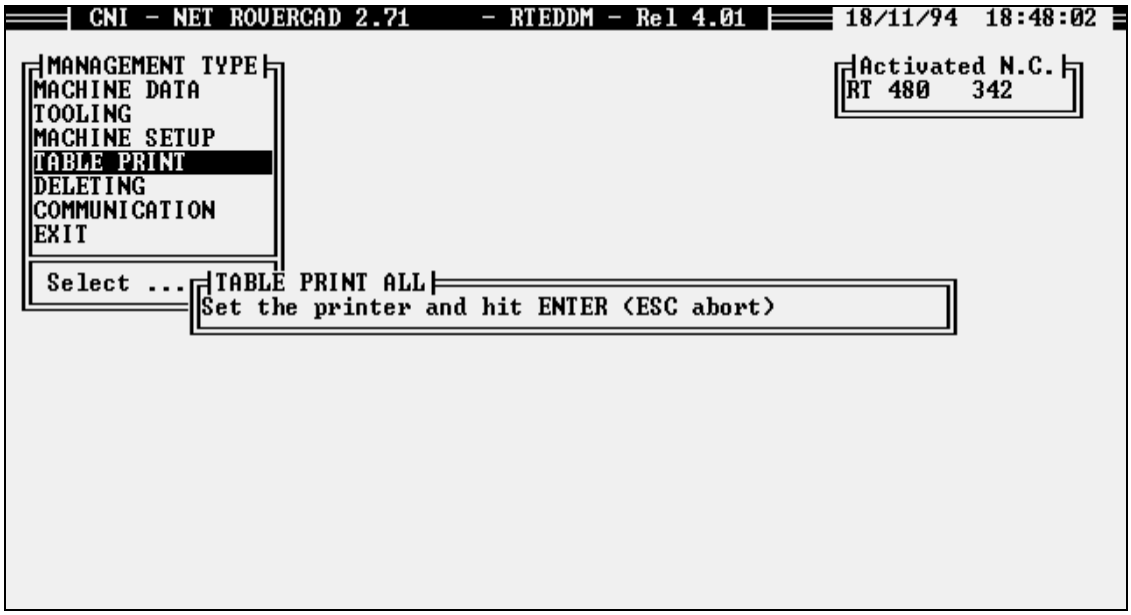


Figure 3.53 Printing the tables.

When confirmed, printing will start.
There is a lot of information to be printed, especially if one considers all the configuration data. We would advise operators to use this facility only for a general hard-copy back-up of data once the machine has been configured in the ideal way for operation. To obtain a reduced print-out of data it is probably more convenient to print the the single tables by pressing the keys <**ALT**> <**P**> when the various tables are displayed on the monitor screen.

3.5 Deleting archives.

From the main menu (figure 3.1), selection of the fifth item starts the procedure for deletion of all data memorized in the machine data directory. A window appears to inform the operator that this particular operation is about to start. Another window then appears to request confirmation and following this a third window appears as a final reminder on account of the importance of the operation.

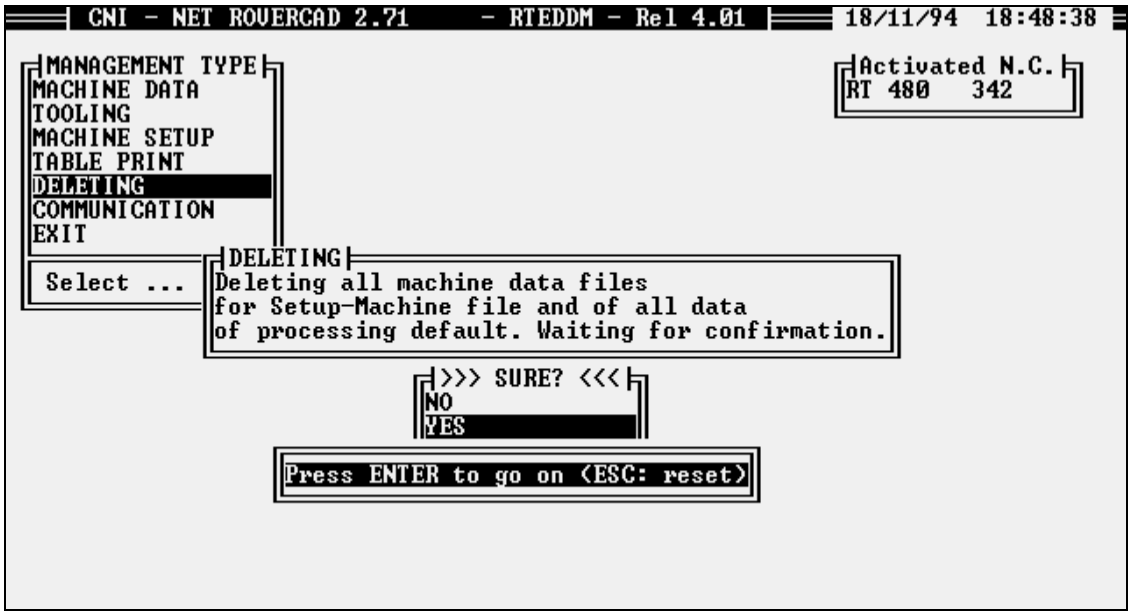


Figure 3.54 Elimination of all machine data.

When the operation is irrevocably confirmed, all machine data is deleted and it then becomes necessary to recopy the control configuration file from the disk. Refer to **"NC diskette Manager"** (page 9) (end of first paragraph).

3.6 Serial communication.

From the main menu (figure 3.1) selection of the sixth item allows for the setting of communication parameters. This data is local for the active machine and is necessary for the "***Serial communication manager***", page 99 for selection of the serial port and and communication protocol for connection with the NC system.

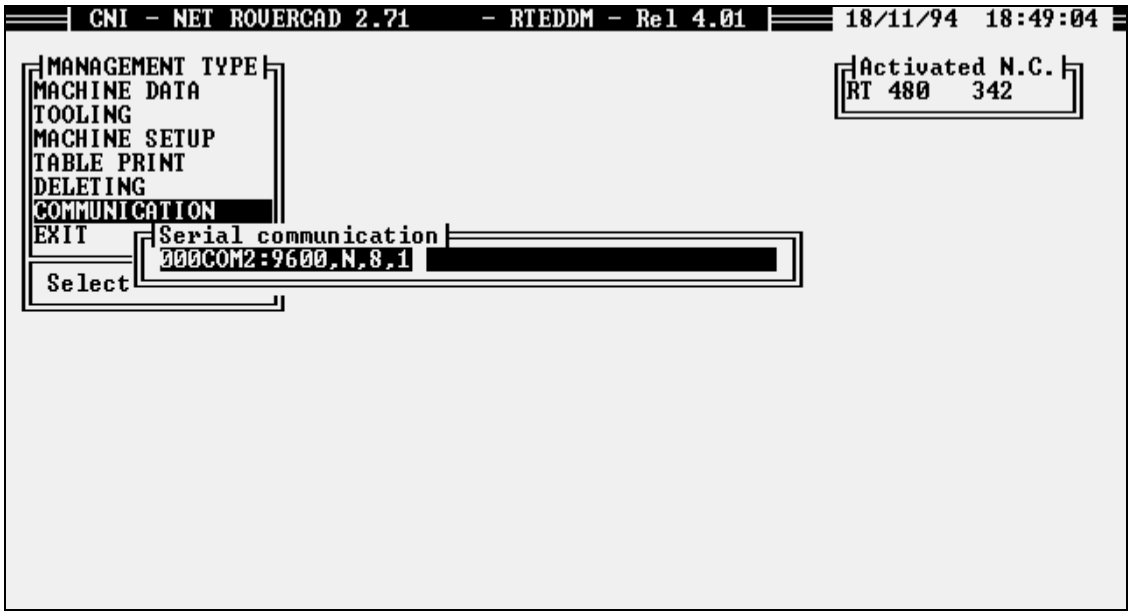


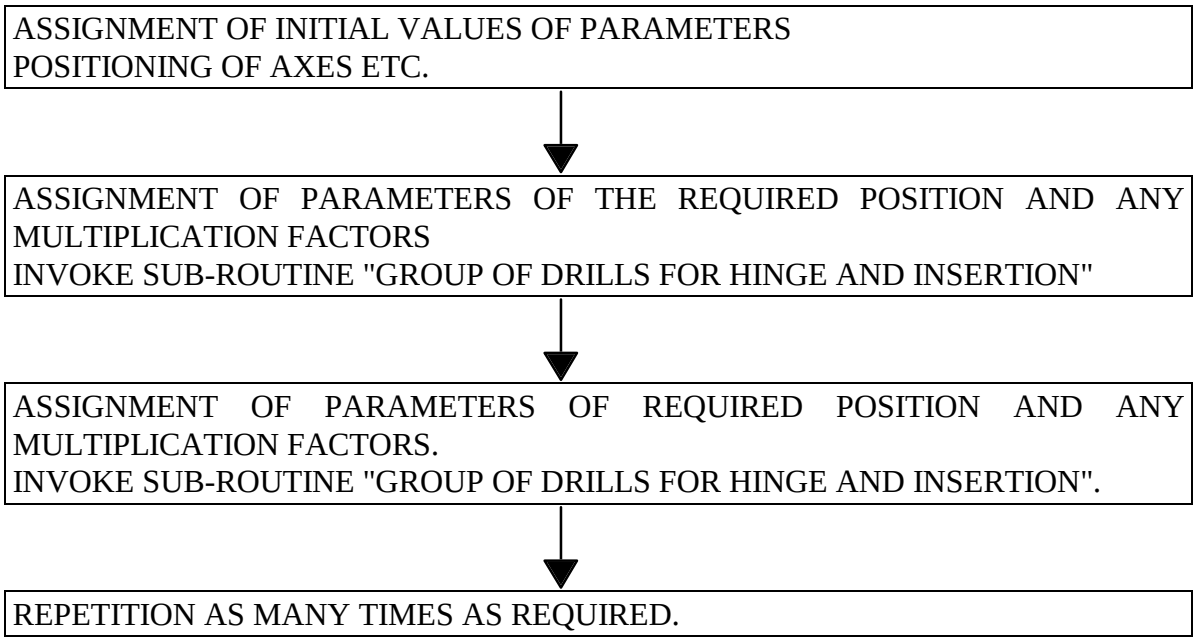
Figure 3.55 Setting communication parameters.

As can be seen in the figure, the first three characters are three zeroes. These must always be inserted regardless of the characters that follow. To confirm the data press <**F10**> or <**ESC**> and decide whether the data has to be saved or not.

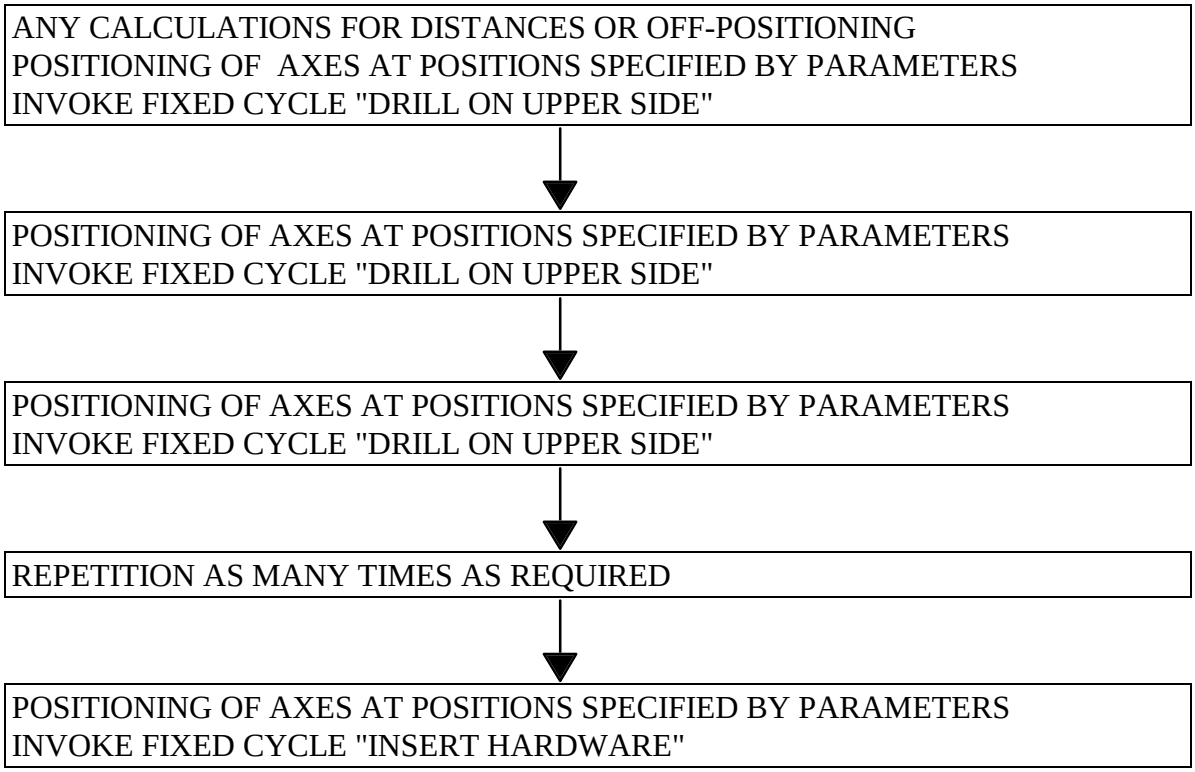
CHAPTER 4

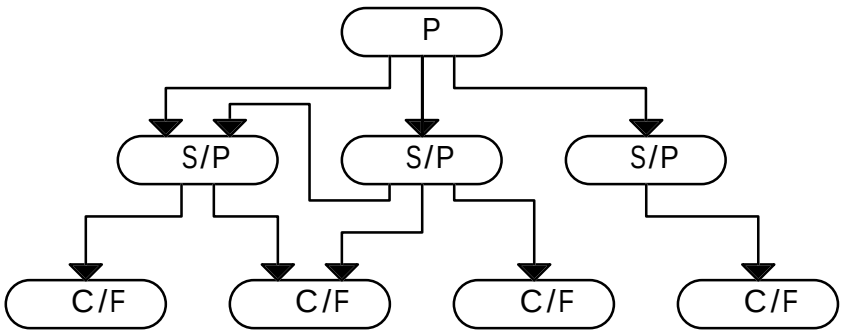
Program/sub-routine/fixed-cycle editor.

To ensure efficient and simple management of programs three different categories of files have been introduced: PROGRAMS, SUB-ROUTINES AND FIXED CYCLES. This division into three distinct categories allows for the grouping of instructions into independent functional blocks that perform specific work and are influenced only by the value of certain parameters set by previous blocks. The FIXED CYCLES are files which contain instructions for basic operations such as activating a router, running an initial drilling operation, drilling vertical or horizontal drills, cutting with blades or running a tool-change and so on. A SUB-ROUTINE is a set of basic operations, which, when ordered in the appropriate sequence, allow the operator to obtain a finished piece or part. A group of drilling operations or inlaying controlled by setting special parameters are typical examples of a sub-routine. Finally, a PROGRAM is a set of sub-routines and fixed cycles required to obtain a finished component. A well-organized program will be easy to read and might have the following structure:



A sub-routine would have a similar structure:





P: Program, S/P: Sub-routine, F/C: Fixed cycle
Figure 4.1 Structure of the files

The editor has three different access channels, one for programs, one for sub-routines and one for fixed cycles. Similarly there are three different directories for memorization of the content of files.
A special feature of the editor is the possibility of configuring through the EE-serial file of the NC RT 480. As a consequence of this characteristic, users may find configuration windows with fewer items and options with respect to those described in this manual. The most important configurations however are the multi-step or single-step configurations, with or without editing of dimensions and with or without the management of families. Operation of the single-step configuration without editing of dimensions is explained below. With regard to the families of programs it should be noted that a 'family' refers to a group of files or, more precisely, a group of sub-routines which form a particular category. The name of the family is the identifier of the category and corresponds with a file containing the list of sub-routines. Associated with the family there are special cycles for graphically displayed examples and definition of the Assisted Editor (used for editing steps). These will be explained later. If the operator inserts a file name that coincides with a family that exists on the disk, the special cycles are automatically loaded and the Assisted Editor programming advice is made available. Depending on the family selected and the menu item chosen, the editor will allow the appropriate parameters to be set in a sub-routine (taken from among those available in a family) created to carry out particular operations.
The sequence of operations required for accessing a program, sub-routine or fixed cycle is illustrated below. Note that the same operations are used for accessing various items in the main list and to allow for a rationale use of space in the manual the illustrations of the windows will appear only on this page.

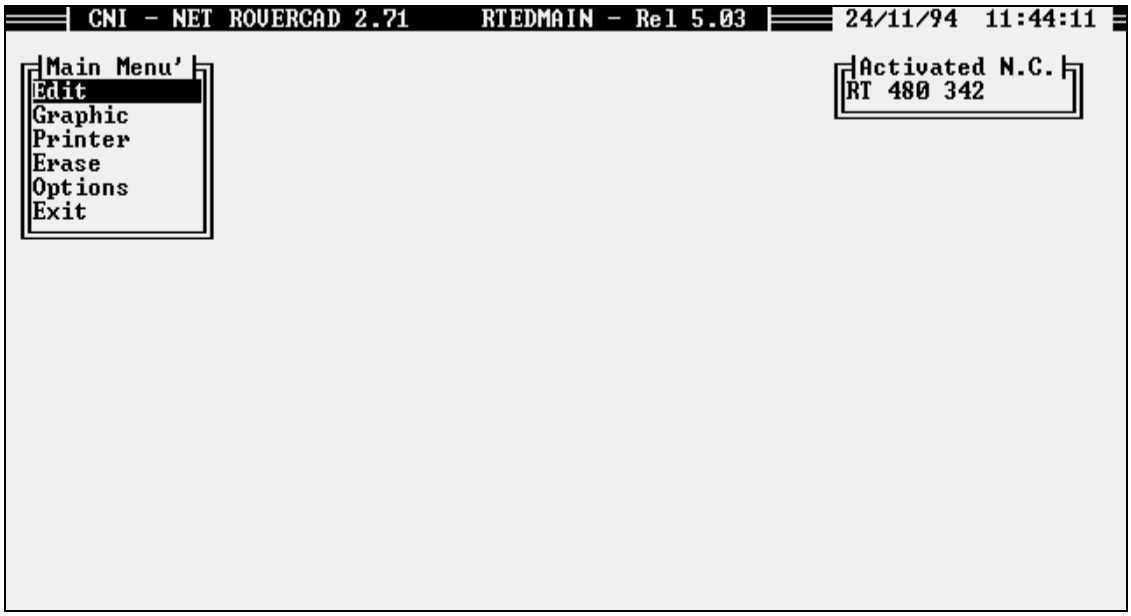


Figure 4.2 Main menu at the start of the program.

Figure 4.3 Menu for selection of file type.

After selecting an option e.g. **"Edit"** , a window will appear for specification of the file type. The following are the three file selection windows that can appear:

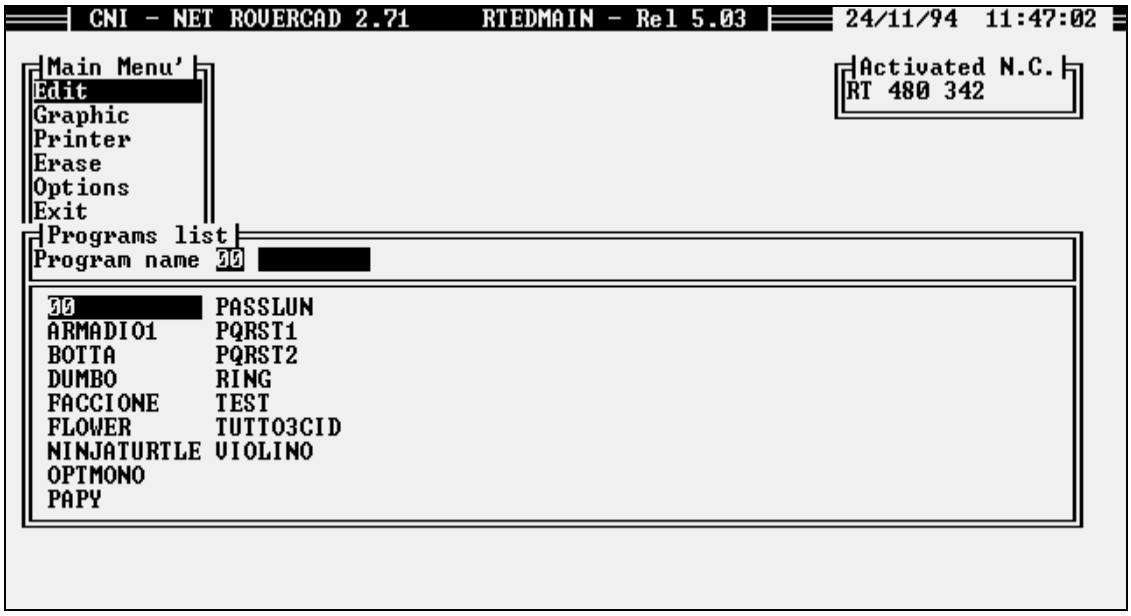


Figure 4.4 Window for selection of a program.

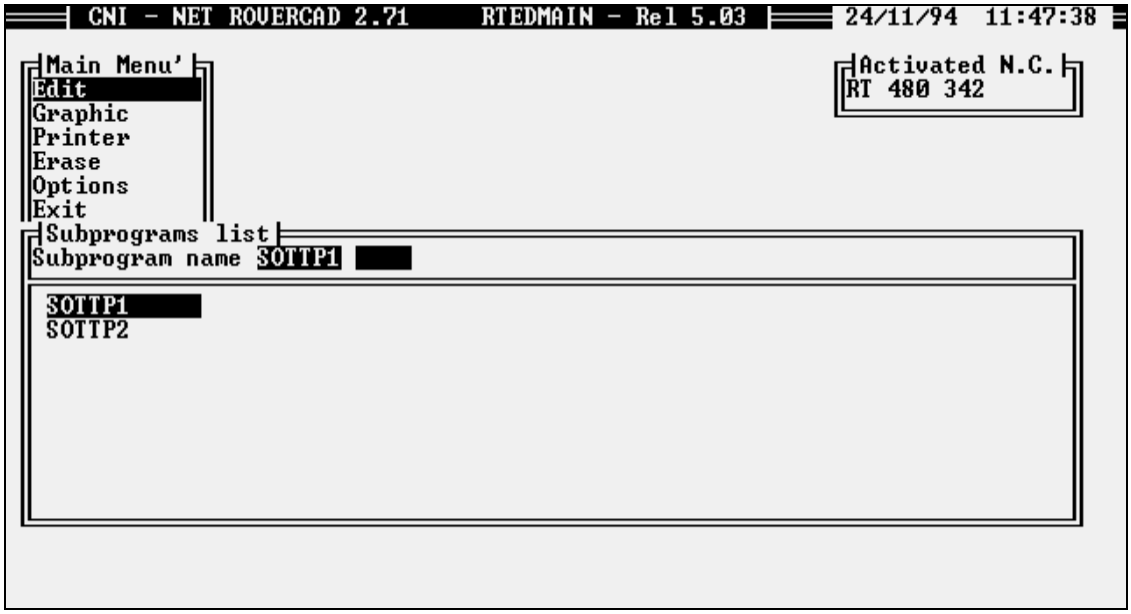


Figure 4.5 Window for selection of a sub-routine.

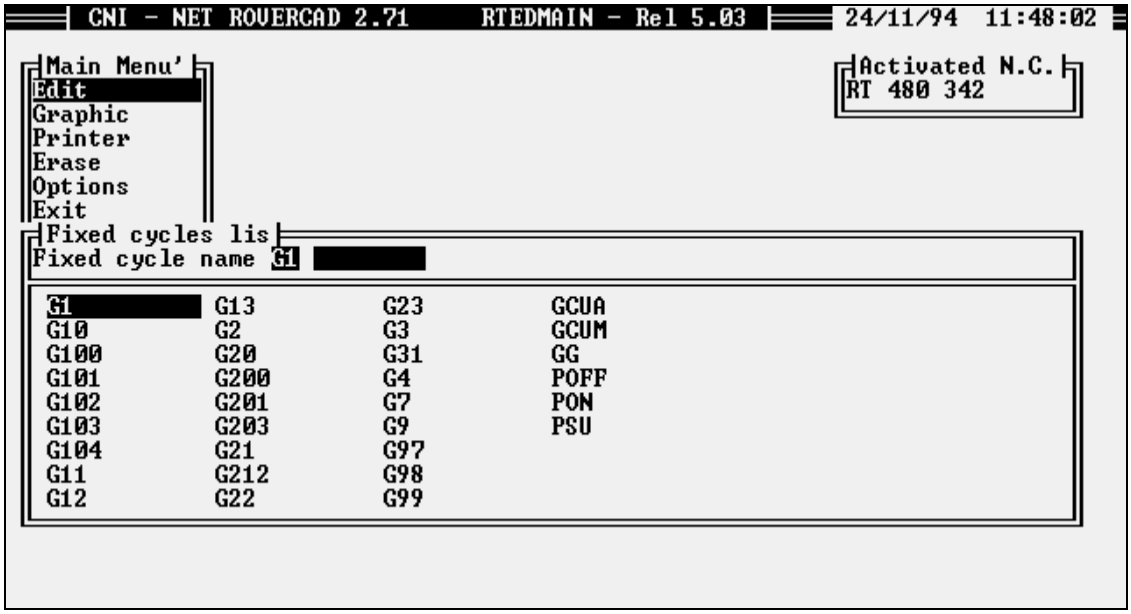


Figure 4.6 Window for selection of a fixed cycle.

The windows indicated below refer to the file selected and only the heading 'Program', 'Sub-routine' or 'Fixed Cycle' will change, depending on the format.
Independently of its type, a file is composed of a number of sections. One of these sections contains data and instructions required for operation of the NC. Those that will be of greater interest to the operator are for : **"Profiling"**, the **"Drilling table"** and the **"Optimized Drilling"**. The "Profiling" section is present in all three file types, while the sections with the "Drilling tables" and "Optimized Drilling" are present only in the programs. In the sub-routines the first step is preceded by the ";" character, which indicates a comment, because in the sub-routines dimensions are not required. Only the graphic display interprets the lines of the dimensions to obtain a coherent display of the data that follows. The fixed cycles however do not have a first step for the dimensions as they have no dimensions and cannot be graphically displayed on an individual basis. Another characteristic or, rather, limitation of the cycles is the fact that they cannot internally invoke any other file, cycle, sub-routine or program.

It must be stressed that the fixed cycles are the basis for proper operation of the controller as they execute commands for the activation of spindles, they control the entry of tools in a workpiece or panel and can pilot tool-changing, depending on which cycle is being run. It should be remembered that the cycles are invoked from all programs that have to execute the particular operations for which the fixed cycles are created. Thus an inappropriate or inaccurate modification can even cause damage to the machine if the operator runs these cycles modified by a program that cannot foresee the modifications made at the cycle level. Operators are advised not to modify cycles unless it is strictly necessary. If it is necessary, make a copy of the cycle, change its name and use the new cycle in the program that needs a modified cycle. This also applies to the sub-routines invoked by different programs (or sub-routines).

 This symbol, which may appear at the end of a title of a chapter or paragraph heading indicates that the topic discussed refers only to the 0.9.0.0.0 or later versions of the NC system. Those users who have a previous version may proceed to the next chapter or paragraph.

4.1 Editing dimensions.

After selecting "**Edit**" in the main menu, select the type of file and then the name of the file required. If the file does not exist, confirmation is requested otherwise the operator is asked to specify the name of the file to be saved on exiting.

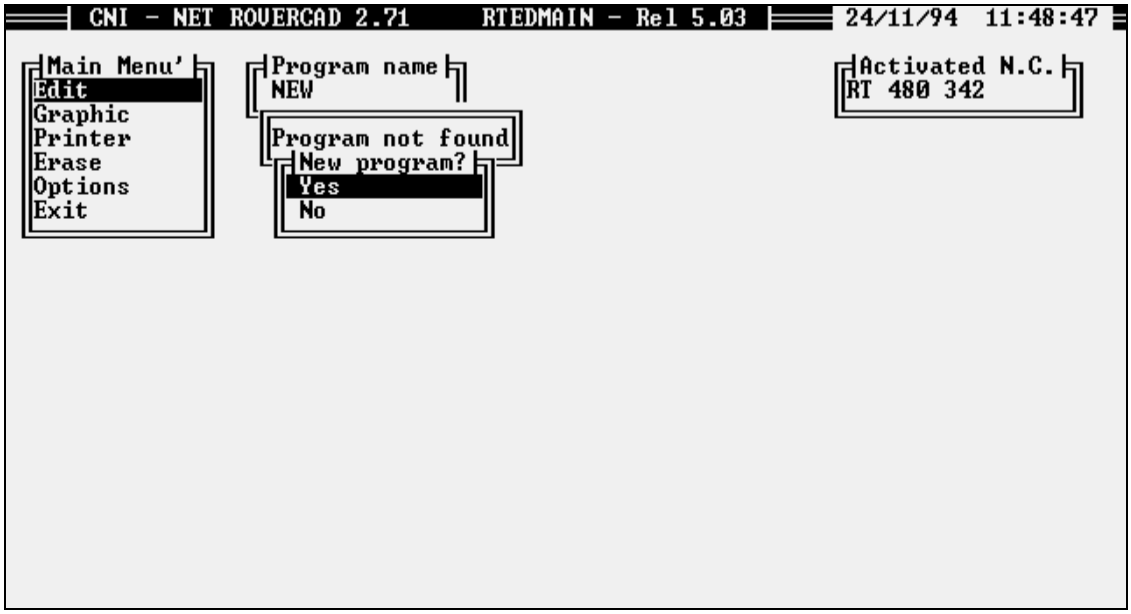


Figure 4.7 Confirmation in the case of a new file.

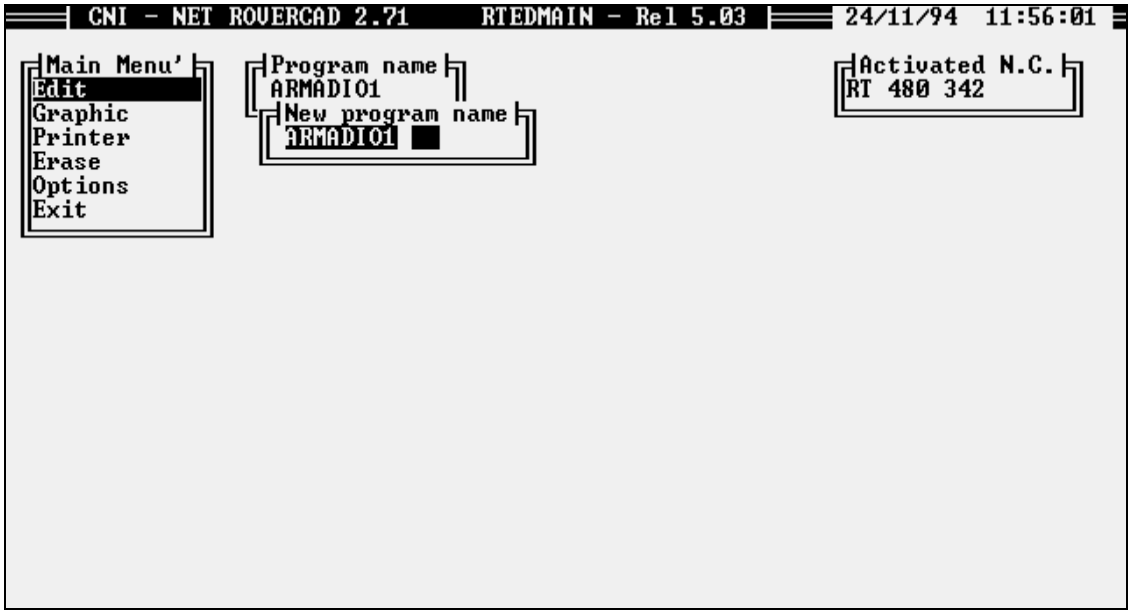


Figure 4.8 Specifying a name when saving.

If the name of a file coincides with a file that already exists, which is different from the file currently being manipulated, the operator is asked to confirm overwriting.

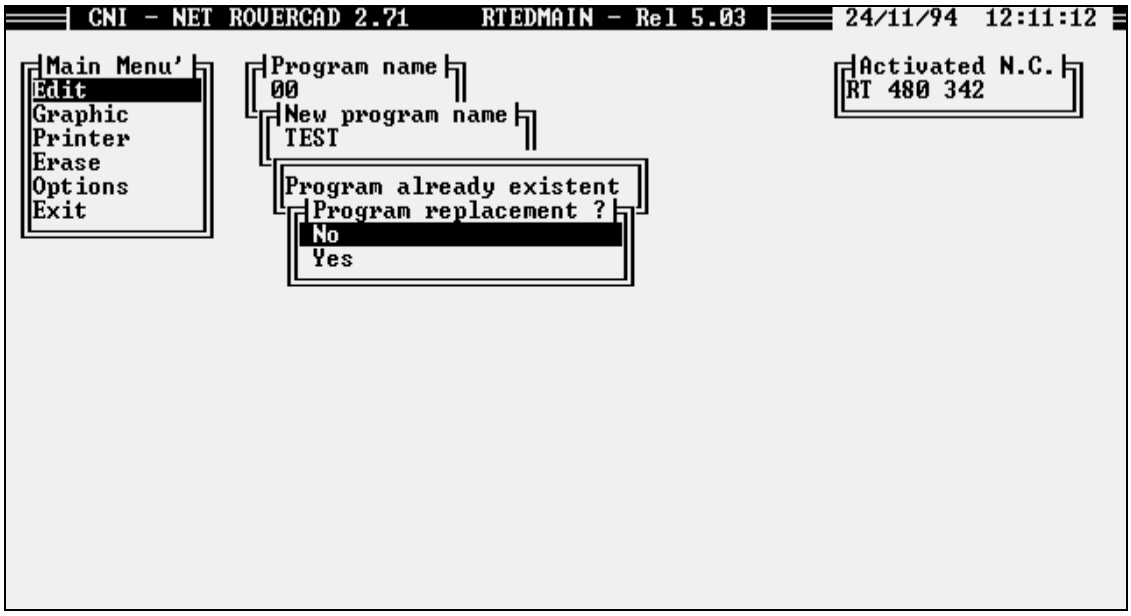


Figure 4.9 Confirmation when a file already exists.

At this point a window appears to allow for selection of a section to be edited and, especially for new files, for insertion of generic data relating to a workpiece. Remember that programs have two extra sections and the window will show the items "**Drilling reference tables**" and **"Drilling edit"** (Optimized Drilling) only when a program is being edited.

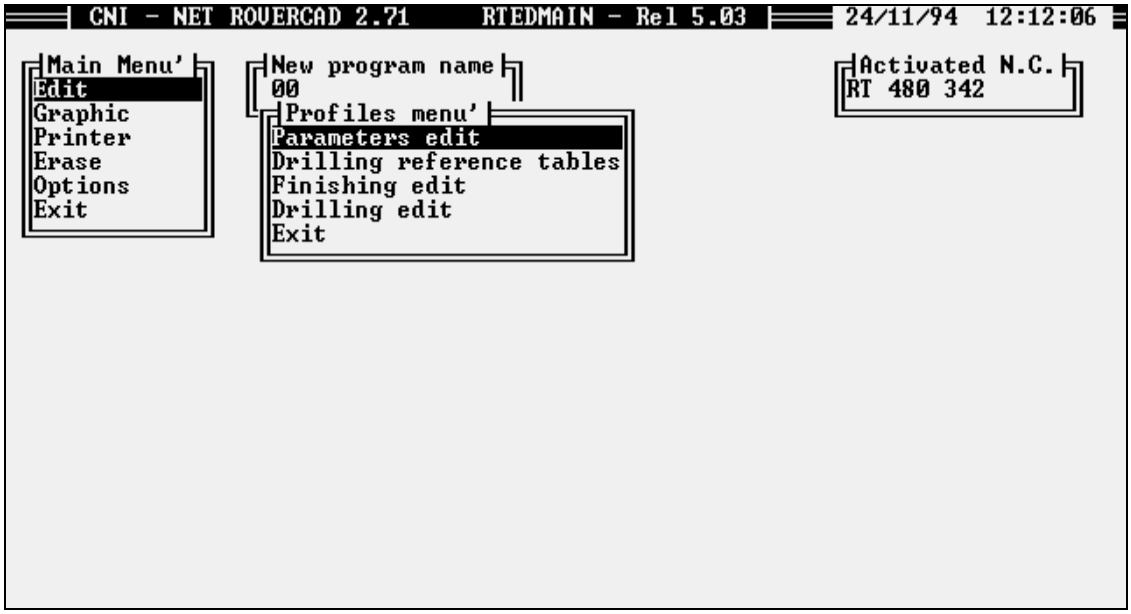


Figure 4.10 Window for selecting the type of editing procedure.

The first item, **"Parameters edit"**, allows for insertion of data relating to the workpiece (dimensions), the head configuration number (see chapter "***Edit Machine Data and Tool-up***" on page 19, the optimization corner for drilling and the enabling of the generation of a program with symmetrical configuration. These last two data are present only in the programs as they refer to the "Drilling tables" and "Optimized Drilling" sections.

Figure 4.11 Editing dimensions.

4.2 Editing drilling tables and optimization of drills.

The observations and sequence of operations indicated in the previous paragraph also apply here for accessing this particular editing phase, with the sole exception of having to select the item "**Drilling reference tables**" in the "**Operation Menu**".

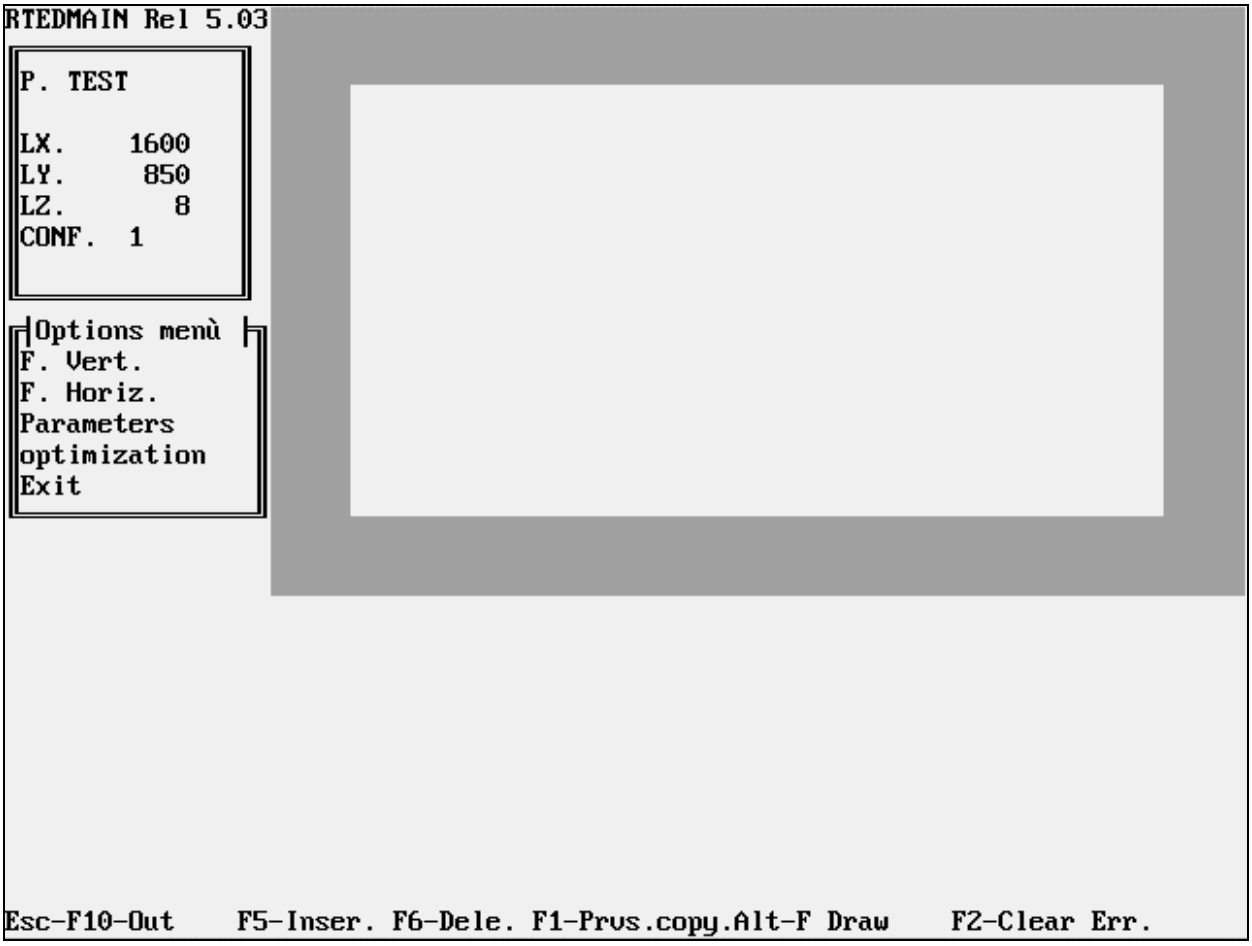


Figure 4.12 Drilling table editor environment.

4.2.1 Vertical drills.

If you select the first item **"F. Vert"** (Vertical Drilling), a window appears with 10 columns and 50 lines in which each line corresponds with a drill or group of drills with repetition.

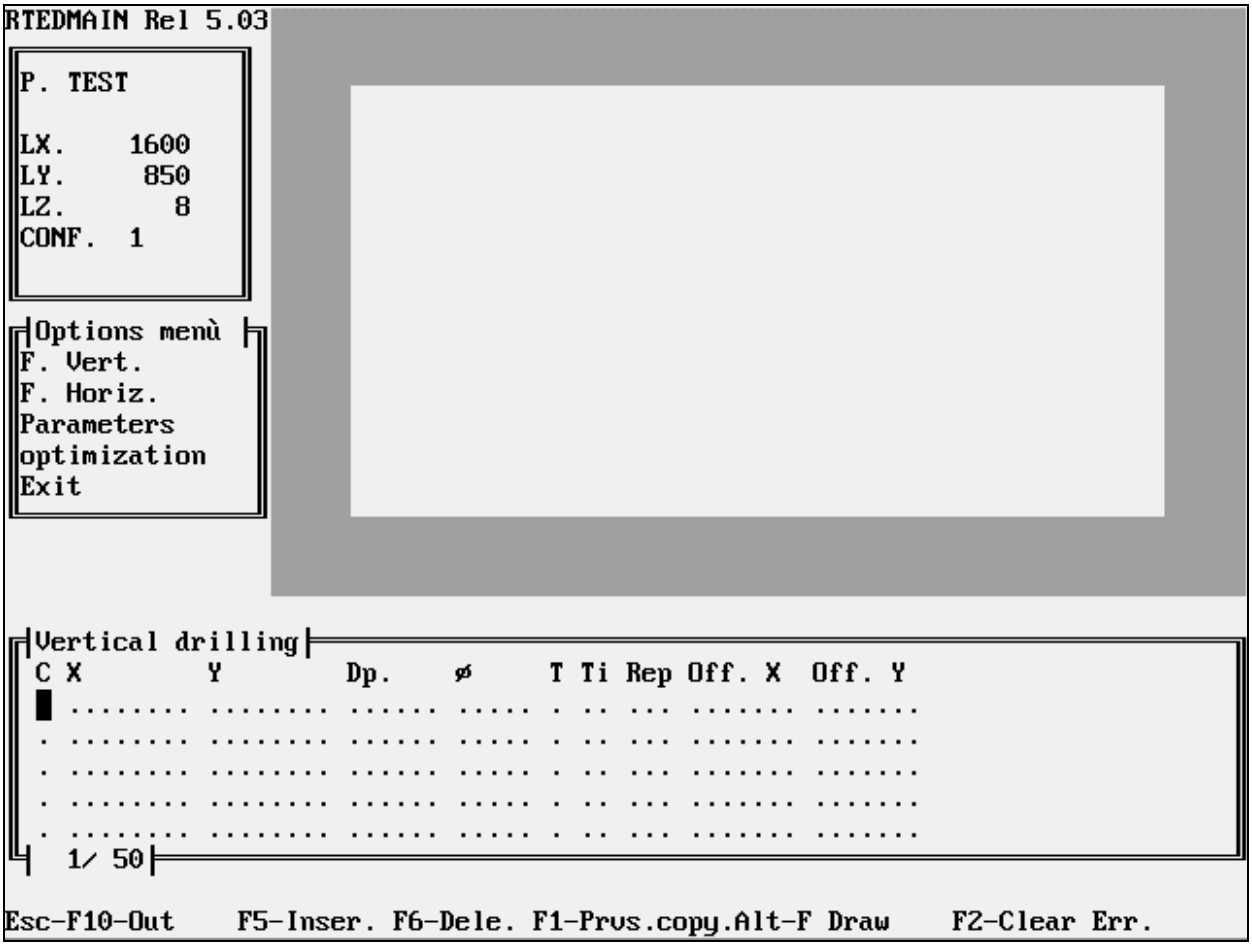


Figure 4.13 Editing the table for vertical drilling.

The data inserted here describes the vertical drills we want to make in a panel. The following list indicates the columns and their meaning:

- **C**: The origin to which the positions of the X, Y and Z fields relate (see figure 4.14).
- **X**: Position of the drill through the X direction.
- **Y**: Position of the drill through the Y direction.
- **Dp.**: Depth of the drill.
- ∅: Diameter of the drill.
- **T**: Drill type: indicates the tool that will make the drill (see **Machine Data Editor**).
- **Ti**: Insertion type: indicates the inserter that will perform insertion (as above).
- **Rep**: Number of drills to be made with Off. X and Off.Y distance between them.
- **Off. X**: Distance of the drill from the previous drill in X direction (case **Rep** > 1).
- **Off. Y**: Distance of the drill from the previous drill in Y direction (case **Rep** > 1).

Figure 4.14 Numbering of reference corners.

If you press **<ALT> <F>** after inserting the data for a drill, a graphic representation is displayed in the upper part of the screen**.**

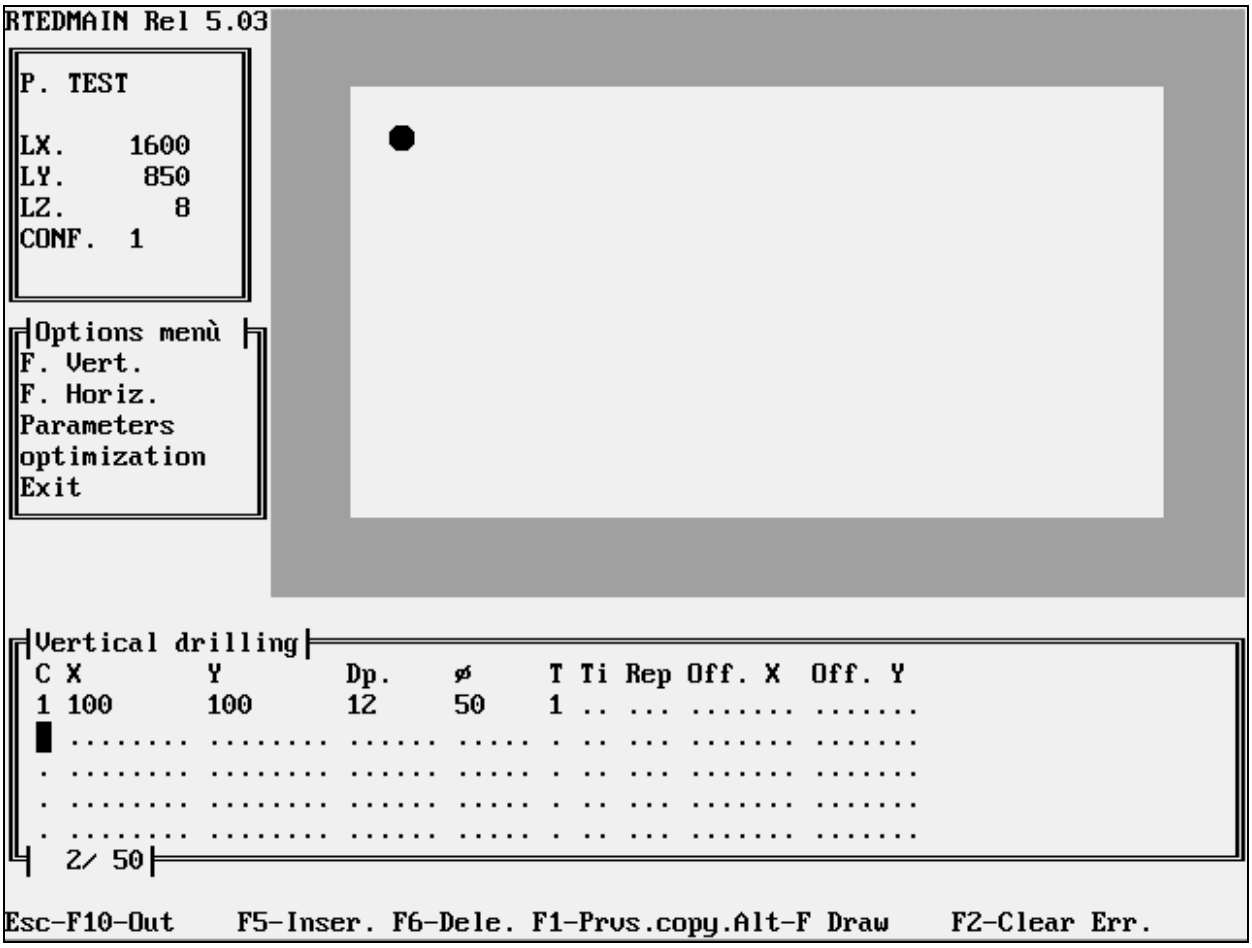


Figure 4.15 Editing a single drill.

The setting of the "**Off. X**" and "**Off. Y**" fields must be preceded by the number "**Rep**" of repetitions of drills to be executed with the same pitch. If **"Rep"** does not exceed 1, only one drill is required so the two offset fields need not be set.

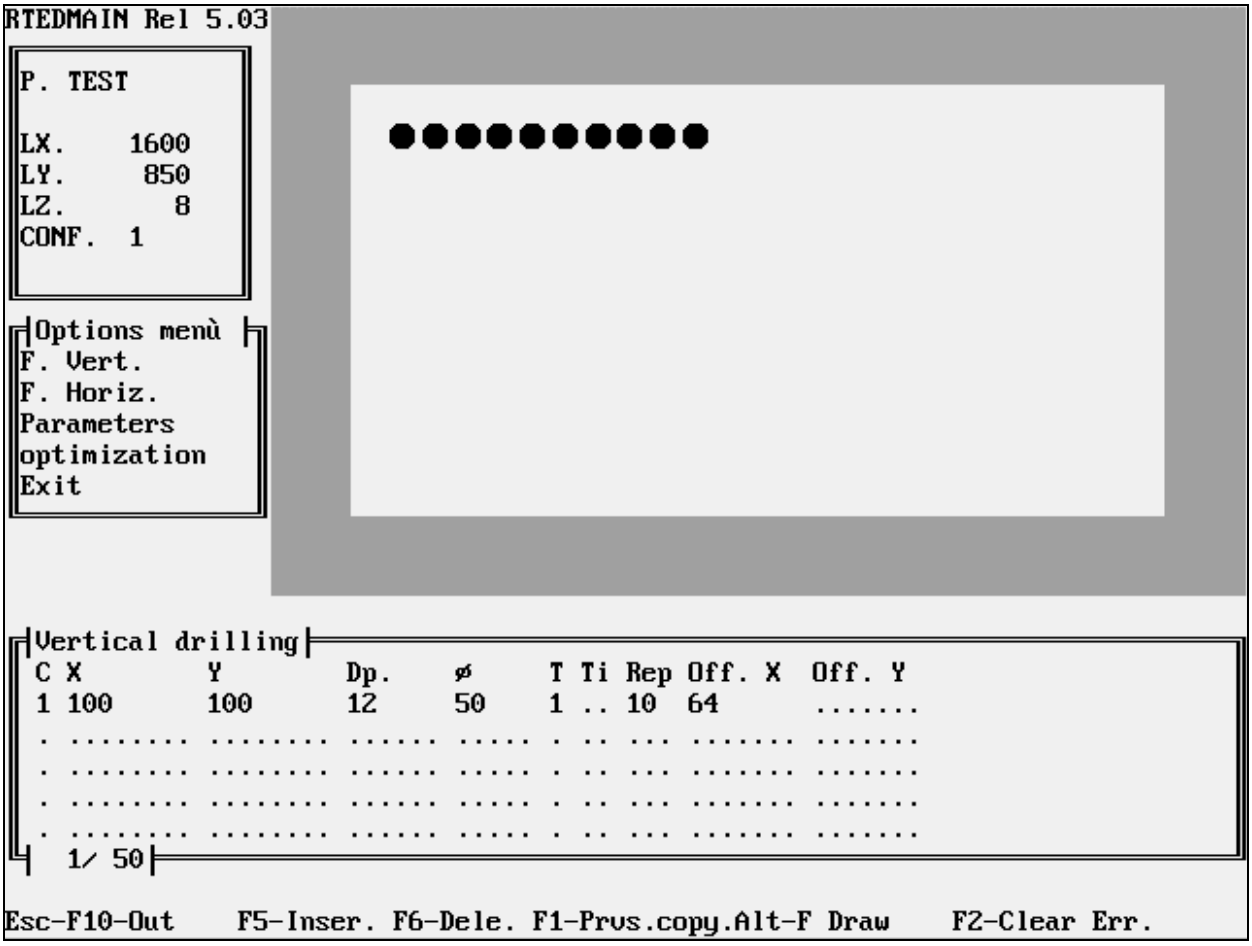


Figure 4.16 Editing a series of drills.

Some functions are activated with particular keys. See the list below:

Alt C:	Copy the previous line.
F1 o Alt S:	Copy the field in the previous line.
F2:	Clear any error messages on the screen.
F5 o Alt I:	Insert an empty line in the table.
F6 o Alt D:	Delete a line in the table.
Alt F:	Create graphics of drills specified in the table.
Esc o F10:	Exit and return to previous "**Operation Menu**".

Now, for example, let us imagine we have to execute the group of drills illustrated in figure 4.16 also at the end of the panel and in the front side. All we have to do is copy the line three times with the keys **<ALT>** and **<C>** and change the **C** field (reference corner). Insert 2 in the first line copied (group of drills in lower left corner), 3 in the second line (group of drills in lower right corner) and, finally, 4 in the third line ((group of drills in the upper right corner). To make the graphics appear press **<ALT> <F>** as usual.

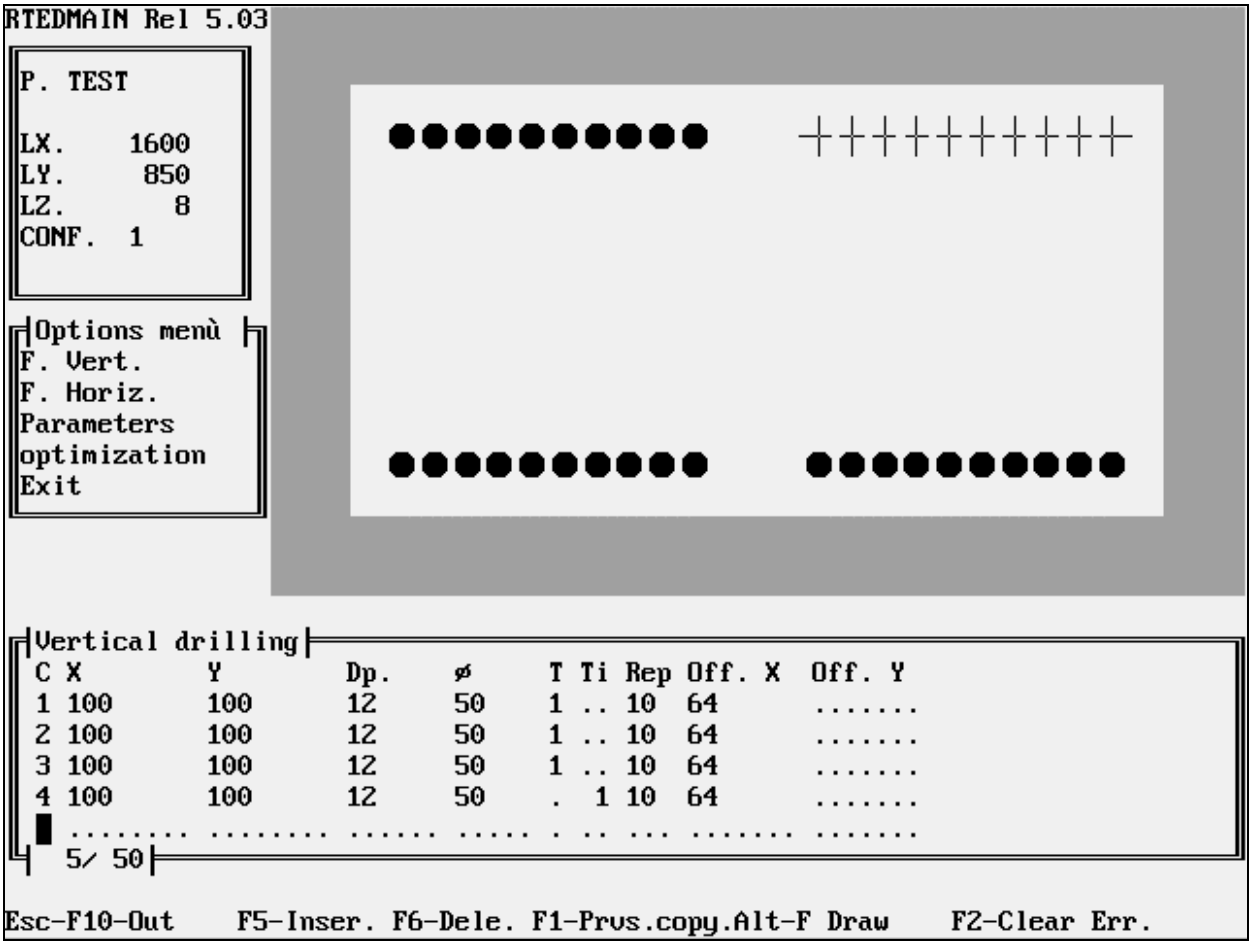


Figure 4.17 Repetitions of a series of drills.

Note that each of the drills in the upper right area (reference corner 4) are crossed. This is because the value 1 was specified in the **Ti** field instead of the **T** field. Insertion operations are identified by a cross marker to avoid confusion with the circles used for drills - as in fact there can be drills and insertions at the same point. We thus have the possibility of editing and checking in just one table all the vertical drills we want to obtain with corresponding insertions.

4.2.2 Horizontal drills.

In the second table, "**Horizontal Drilling**", accessed with the second item in the menu in figure 4.12, the fields of the previous table are all present and keep their meaning and there are also three extra fields:

Z: Position of the drill in the Z direction.
L: Side on which the drill is to be made (see figure 4.18).
Off. Z: Distance of the drill from the previous drill in the Z direction (case **Rep** > 1).

Care must be taken with the use of the "**L**" field as it indicates the side on which the drill has to be made. When the "**C**" reference corner has been decided e.g. the first corner, 'L' indicates the direction of drilling. That is, it indicates whether the drill will be orientated towards the right (on side 1) or left (on side 3).

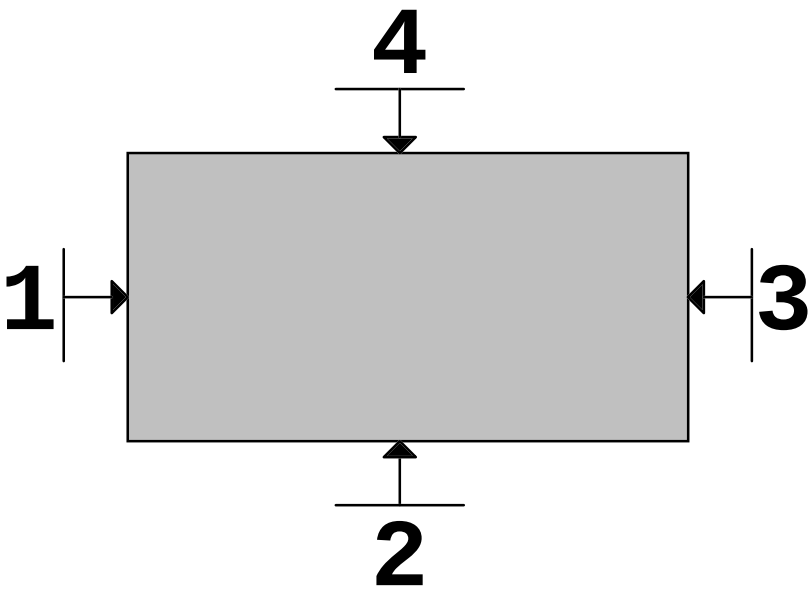


Figure 4.18 Numbering the panel sides.

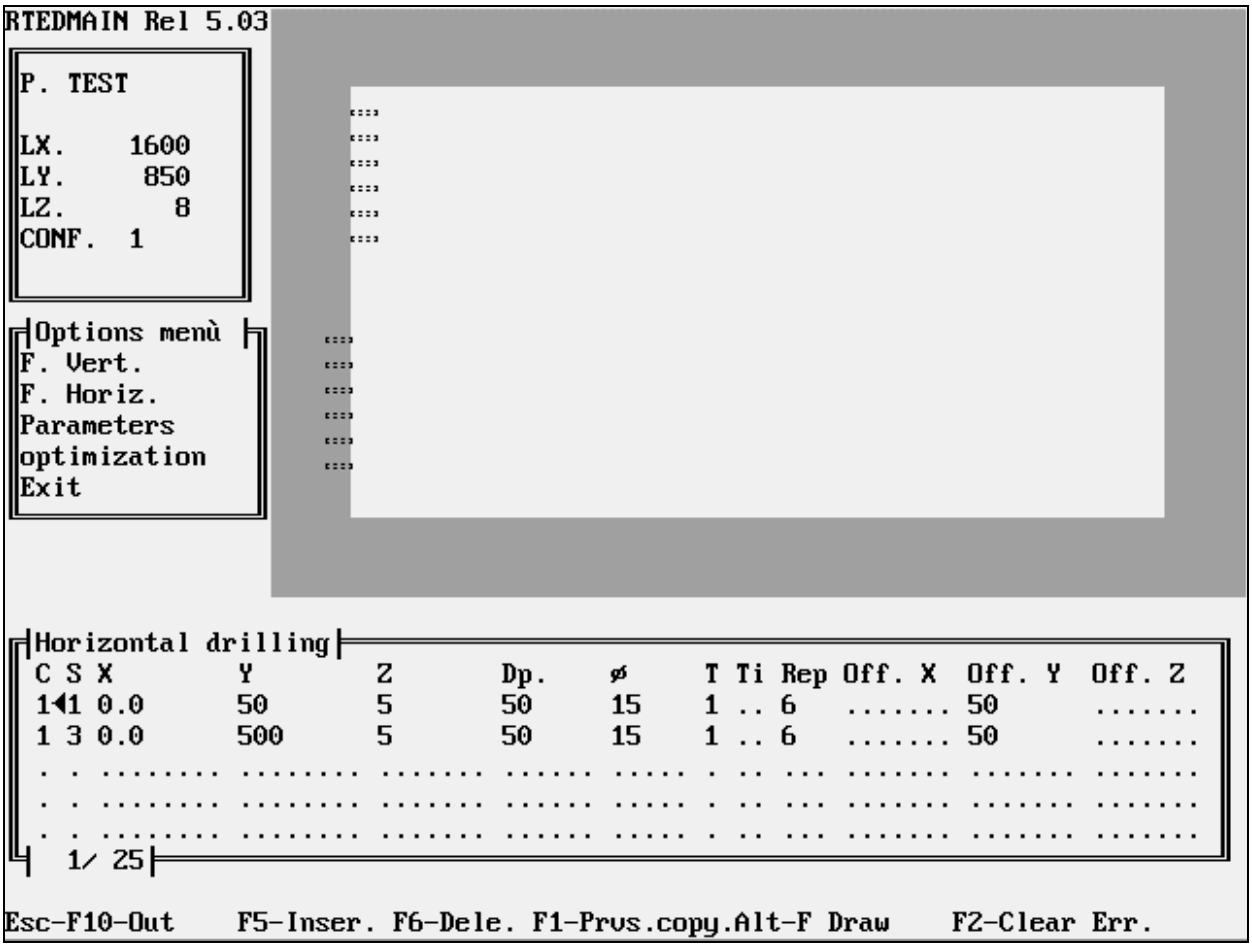


Figure 4.19 First example of a series of horizontal drills.

We can create another example and apply our reasoning to edge 2. To decide the direction of the drill, we specify the side that has to be drilled. If we want to make drills on side 1 towards the inside of the panel, we specify a value of 1 in '**L**', while direct drills towards the outside of the panel have **L** 2. As far as edge 3 is concerned, drills towards the inside of the panel have side 2, while those towards the outside have side 4.

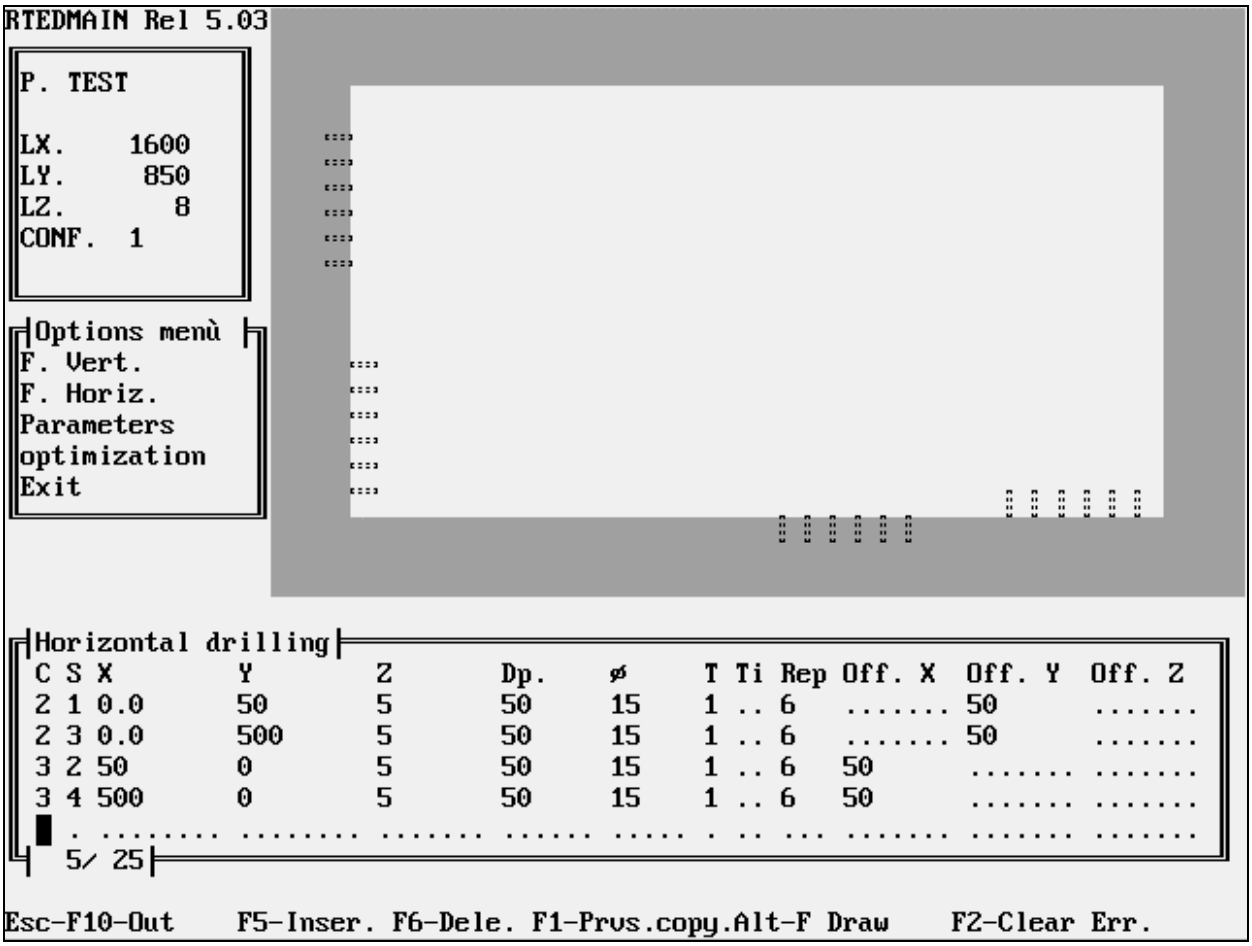


Figure 4.20 Second example of a series of horizontal drills.

4.2.3 Drilling with special parameter settings.

The third option in the menu illustrated in figure 4.12 allows you to obtain a series of drills that depend on certain parameters. We thus have the possibility of programming drills without specifying constant positions but with codes or variables that depend on the dimensions of the panel.
Certain numeric or parametric calculation functions are predefined to facilitate the operations:

_R()	=	Square root
_S()	=	Sine
_C()	=	Cosine
_A()	=	Arc tangent
_I()	=	Whole part of a real number.

Syntax: : **_F(value)** - in which, **"_F** " is the function and (**value**) is a number, parameter or expression.
The four basic operations of addition, subtraction multiplication and division are also available. Relatively complex algebrical expressions can also be carried out by using parentheses '('exp')'.
3 variables, LPX, LPY and LPZ, are defined. These are, respectively, the dimensions X, Y and Z of the piece to be worked.
For simplicity we shall use the table of vertical drills but use of the other table is perfectly identical.

Example 1

Let us suppose we have to make drills at a distance of 100 mm from the vertical edges of the panel indicated below and 100 mm from the centre line.

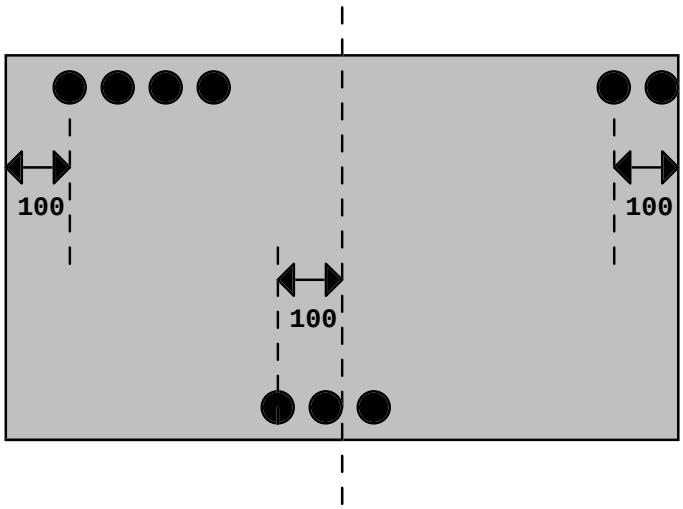


Figure 4.21 First example of a drilling operation.

Let us define a variable **OF** and assign it a value of 100 (the distance from the panel edge). We can now define another two variables: **QUC** and **QOB**. These are, respectively, the position 100 mm from the centre line and the position 100 mm from the right edge.

We thus obtain,

OF = 100
BBB = LPX / 2
QUB = LPX - OF
QUC = BBB - OF

or,

OF = 100
QUB = LPX - OF
QUC = (LPX / 2) - OF

as the editor is able to manage a number of levels of operations with parentheses.

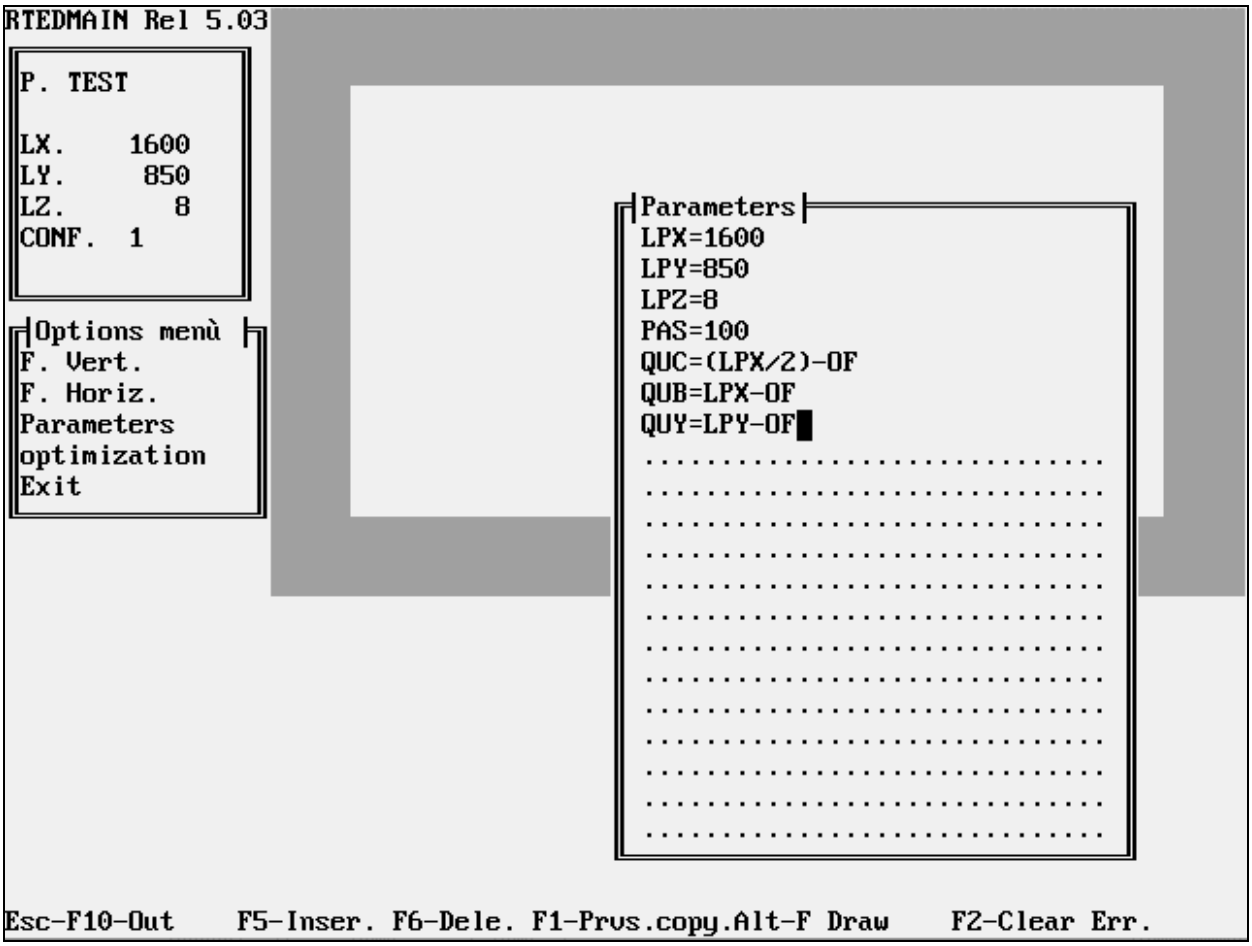


Figure 4.22 Table of parameters.

The result would be the same if we were to use constant positions but we would then lose the doubtless advantage of being able to create groups of drills at constant distances from the edges or from positions that can be calculated by means of additional parameters - without having to change anything when panel dimensions change.

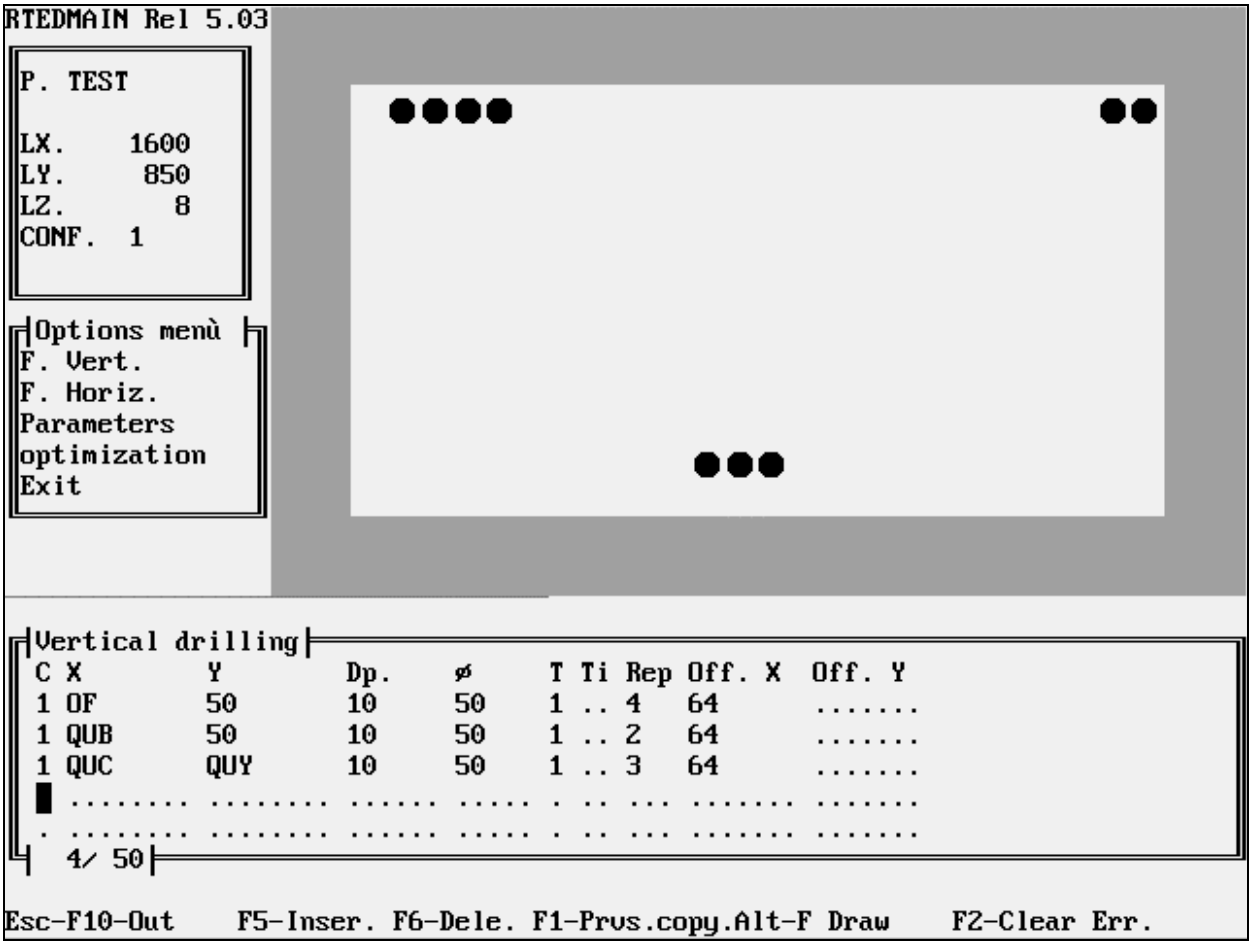


Figure 4.23 Vertical drills with definition of parameters.

Example 2

Let us suppose we have to create a series of drills that begin at the upper left corner of the panel and end at the lower right corner, with a diagonal row of drills across the panel surface.

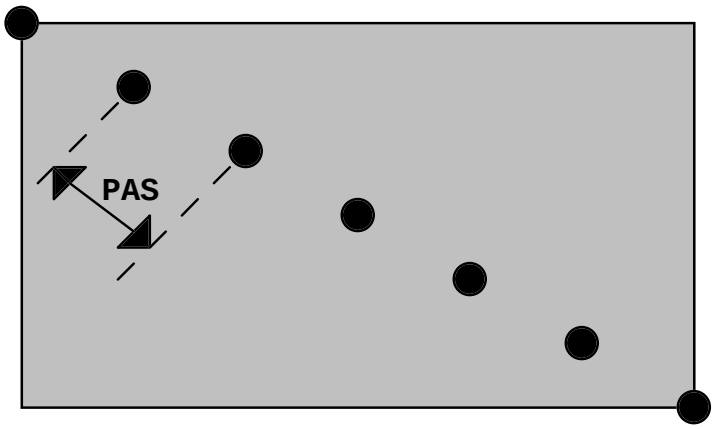


Figure 4.24 Second example of drilling operation.

The Pythagorean theorem states that the hypotenuse of a triangle (the diagonal line across the panel) is obtained from the square root of the sum of the squares of the catheti (the two sides of the panel). We can thus define:

```
PAS   =   32                        Distance between the drills
LR    =   _R( ( LPY * LPY ) + ( LPX * LPX ) ) Length of  the diagonal
AB    =     LR / PAS                Number of drills
```

A division between whole numbers can result in a whole number and a fraction (remainder). We use the whole number only (with the function _I()).

```
ABO   =   _I( AB )                  Number of drills

If AB   =   33.2    ,               ABO  =   33
If AB   =   33.5    ,               ABO  =   33
If AB   =   33.9    ,               ABO  =   33
```

A definition of ABO might be:

```
ABO   =     _I( (_R( ( LPY * LPY ) + ( LPX * LPX ) )) / PAS )
```

but for clarity it is preferable to define the variable as the result of two successive calculations of parameters.
The increment of a position between one drill and another is given by the size of the panel divided by the number of drills to be made.
To make the last drill, at the edge in the lower right corner, a unit has to be added to the total number of drills to be executed. We can now define a variable ABI that will contain the total number of drills to be carried out.

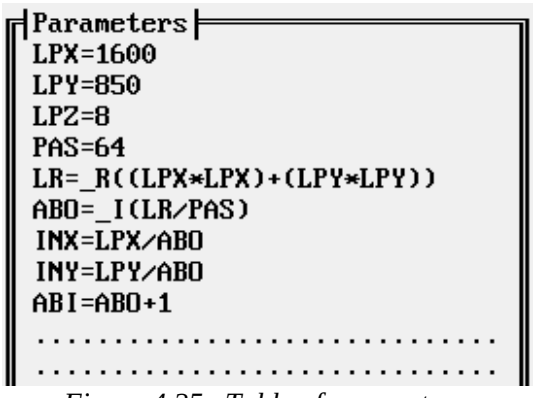


Figure 4.25 Table of parameters.

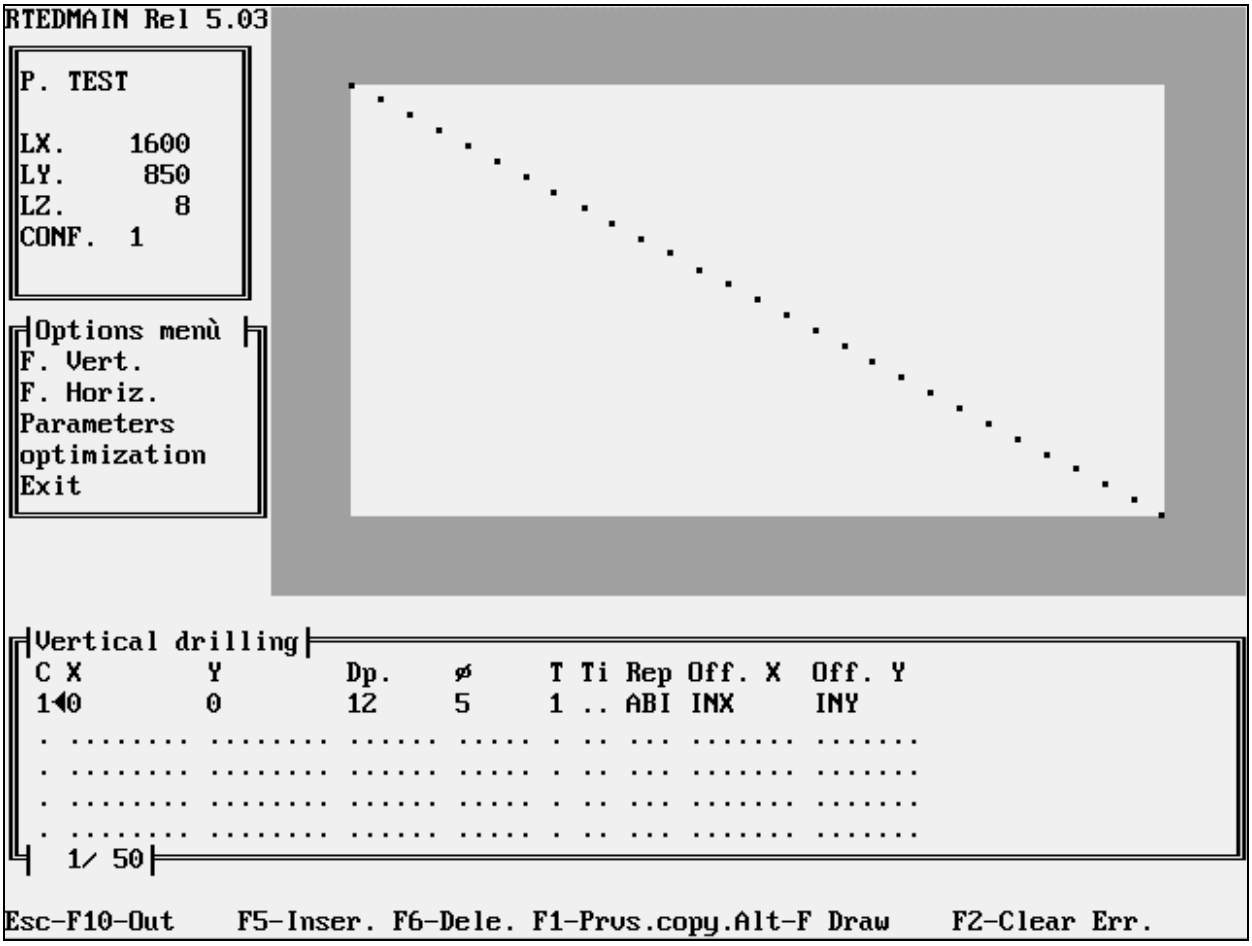


Figure 4.26 Vertical drills with definition of parameters.

4.2.4 Optimization of drills.

All the drills described in the two tables can be optimized. Select the fourth item "**Optimization**", from the menu in figure 4.12. If the active machine has more than one centre, a window will appear for insertion of a position. This 'cut-off' position is for dividing up the work-load between the two heads.
In the line under the window the operator must indicate whether global optimization has to be obtained or not i.e. sharing of the work-load between the two centres. If the operator responds affirmatively, the work to be performed to the left of the position (carried out with the first head) is located in the "**Optimized Drilling**" section of the first centre, while the remaining work is located in the section of the second centre. The optimizer elaborates the two groups of drills separately, taking into consideration the machine data of both centres. If the operator does not respond affirmatively with regard to global optimization, the result of the optimization operation is located in the section "Optimized Drilling" of the active centre as all work will be carried out by the active head.

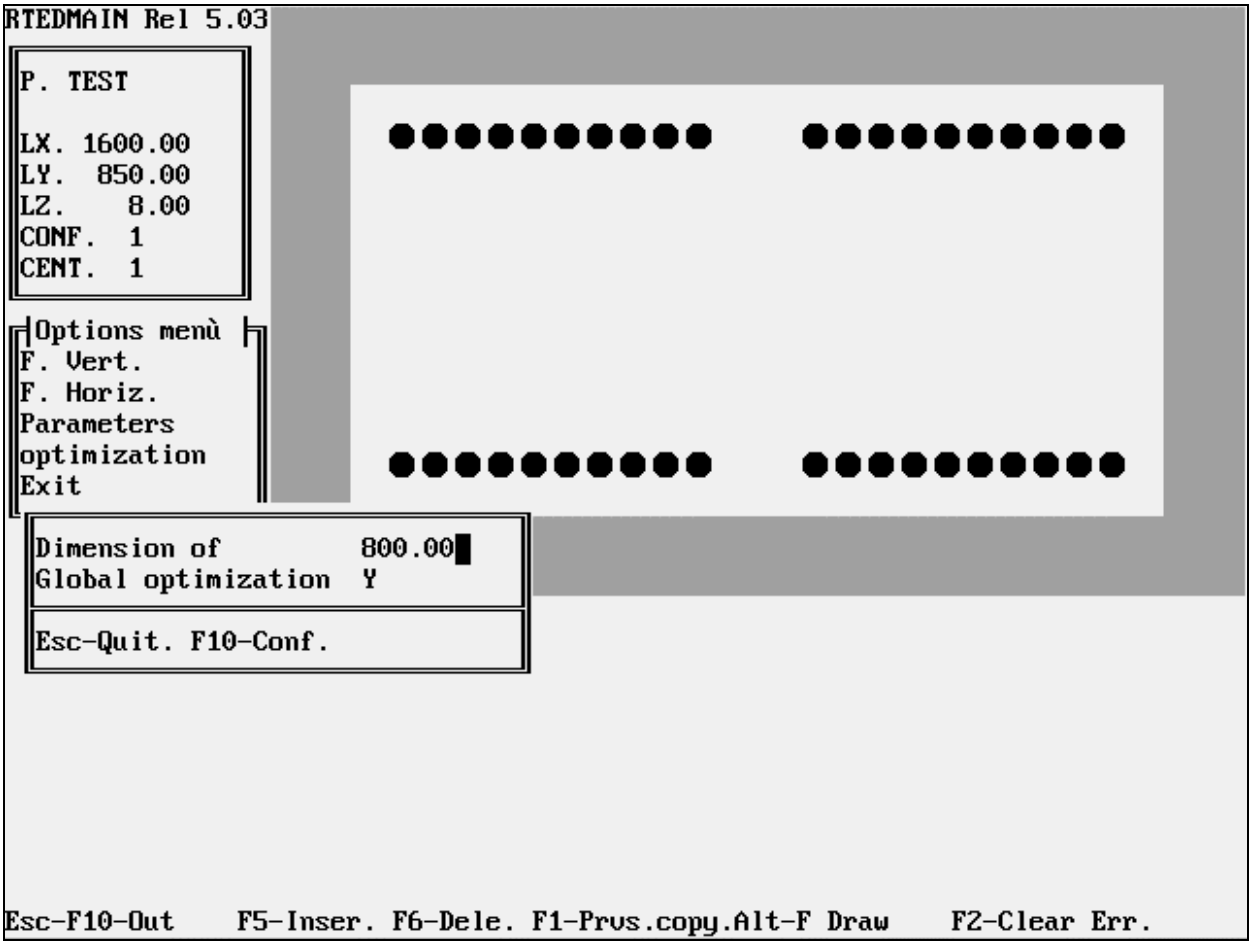


Figure 4.27 Setting the cut-off position for the optimizer.

The program created can be displayed graphically and executed on the NC. Any errors generated during optimization must be solved by consulting the errors appendix and then checking the machine data.

4.3 Edit Profiling.

To access the second editing environment select the item **"Finishing edit"** (Edit Profiling) from the operation menu.

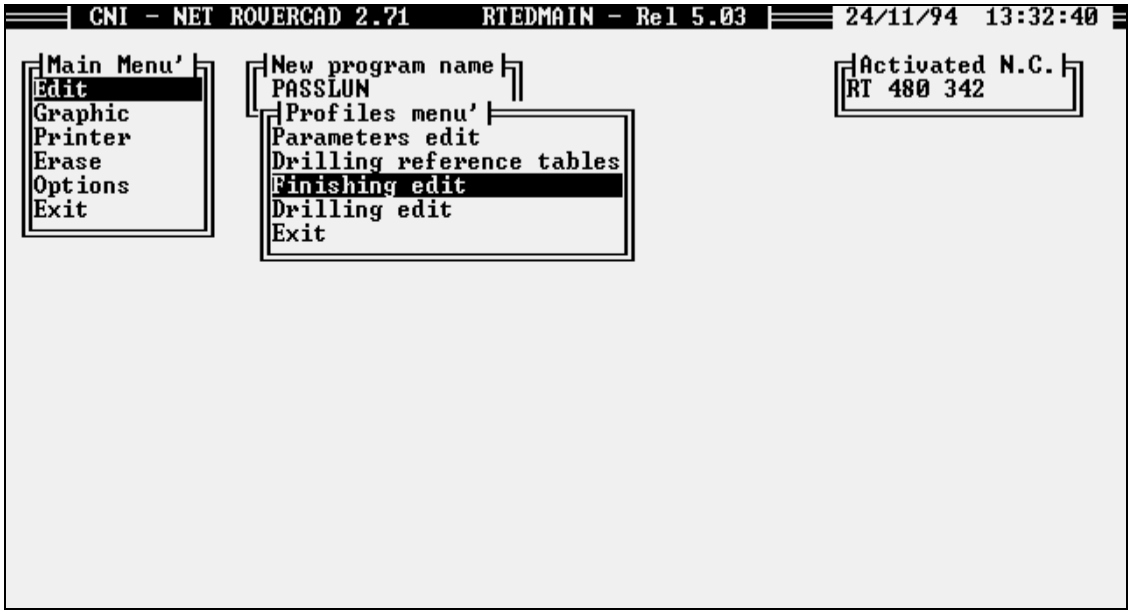


Figure 4.28 Accessing the Edit Profiling environment.

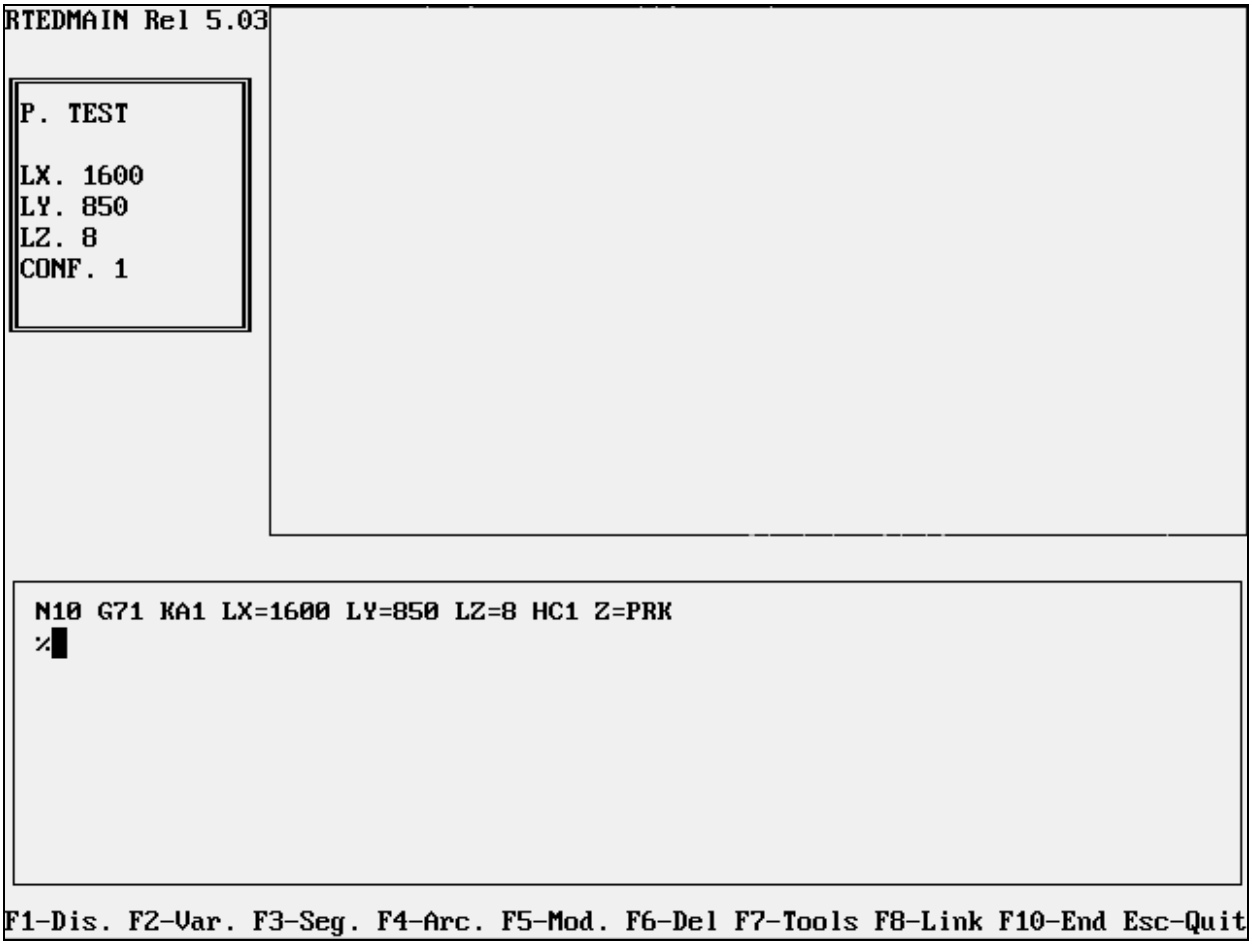


Figure 4.29 The Edit Profiling environment.

The video screen and operation of this part of the editor are controlled in such a way as to provide a working environment which is rather similar to that available with the **NC RT 480**. We can now describe the available functions indicated in the last line of the screen page.

<**ESC**>	Exit without saving the section that has just been edited.
<**F10**>	Exit and save the section.
<**F1**>	Execute graphics of the program present in the section.
<**F2**>	Activate the Assisted Editor (generic or with configuration options).
<**F3**>	Activate the Assisted Editor (specific for the segments).
<**F4**>	Activate the Assisted Editor (specific for arcs).
<**F5**>	Modify a step through the Assisted Editor.
<**F6**>	Delete current line (under cursor).
<**F7**>	Access further functions.
<**F8**>	Unite current and next lines to create a single line.
<**F9**>	Internal display mode of lines (full screen).
<**RETURN**>	If the cursor is at the end of a step, it inserts a new line. If it is before this point however, it will split the step into two lines at the point under the cursor.

The key **F7** accesses a second series of functions which are again listed on the last line:

```
F1-Mark1 F2-Mark2 F3-Copy bl. F4-Merge F5-Find F6-Renum F10-Esc-Quit
```

Figure 4.30 Second group of editing functions.

<**ESC**> and <**F10**>	Return to the previous group of functions.
<**F1**>	Insert a bookmarker to indicate the start of a block.
<**F2**>	Insert a bookmarker to indicate the end of a block.
<**F3**>	Insert the lines contained between one bookmarker and another at the start f the current line.
<**F4**>	Inclusion of sections of other files in the current section.
<**F5**>	Search for a sequence of characters in the section.
<**F6**>	Re-number steps starting from 10 with intervals of 10.

We shall start with the insertion of a few program lines to illustrate the use of the function keys. In the following figure we find a series of steps that make up a rectangle.

```
N10 G71 KA1 LX=1600 LY=850 LZ=8 HC1 Z=PRK
N20 X100 Y100 Z=PRK TP1 PRF=10 G40 L=PON
N30 G1 X800
N40 G1 Y400
N50 G1 X100
N60 G1 Y100
N70 L=POFF
%
```

Figure 4.31 Lines for the programming of a triangle.

The key **F1** runs the program graphically to allow us to see if any errors have been made or, more simply, to see whether what has been written corresponds to what we want to achieve. One of the errors that can occur in this phase is caused by the impossibility of obtaining valid machine data - due to incongruent data or missing data. If this type of error occurs (indicated by a pop-up window), the machine data should be checked for correctness of spindle configuration, tool archives and tool magazine data and so on. If however the syntax of a command is wrong or characters with no significance have been inserted, a window will appear describing such errors. The user should refer to the errors section for the description of the errors that can occur. The following is the result we obtain:

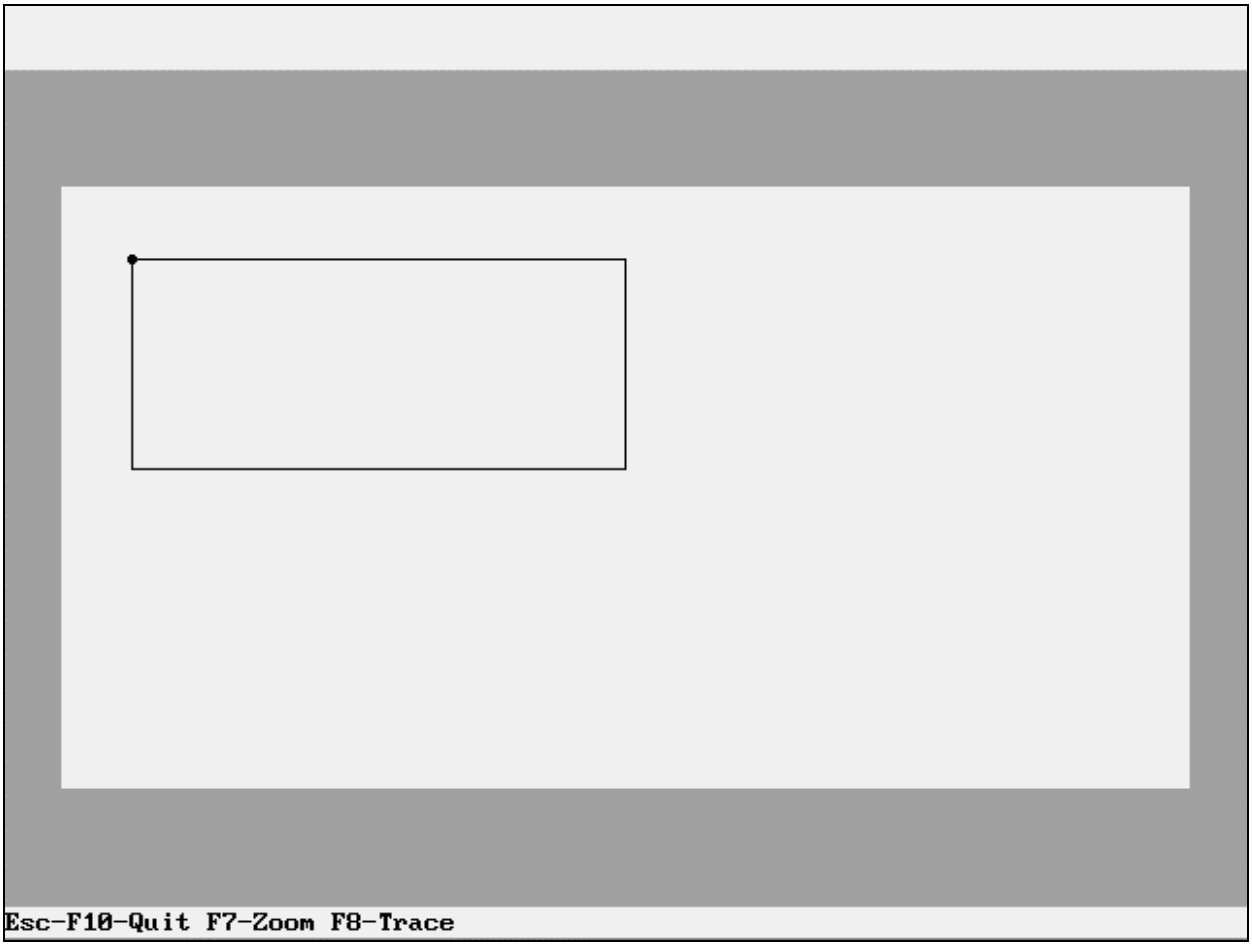


Figure 4.32 Graphics of steps.

From the figure we see that at this level i.e. after the graphic display of a program is given, two functions are available. These are the ZOOM (**F7**) and TRACE (**F8**) functions. The trace function provides a display of the data of each entity i.e. the initial point, final point and the radius and centre for arcs. Pressing the appropriate key, we enter the TRACE function and, by using the cursor (or ARROW-UP / ARROW-DOWN), we can view each entity in its order of execution (or reverse order). The data is displayed above the drawing and the entity being examined is 'marked' by two arrows (only one for the drills). Press ESC or F10 to exit the TRACE mode.

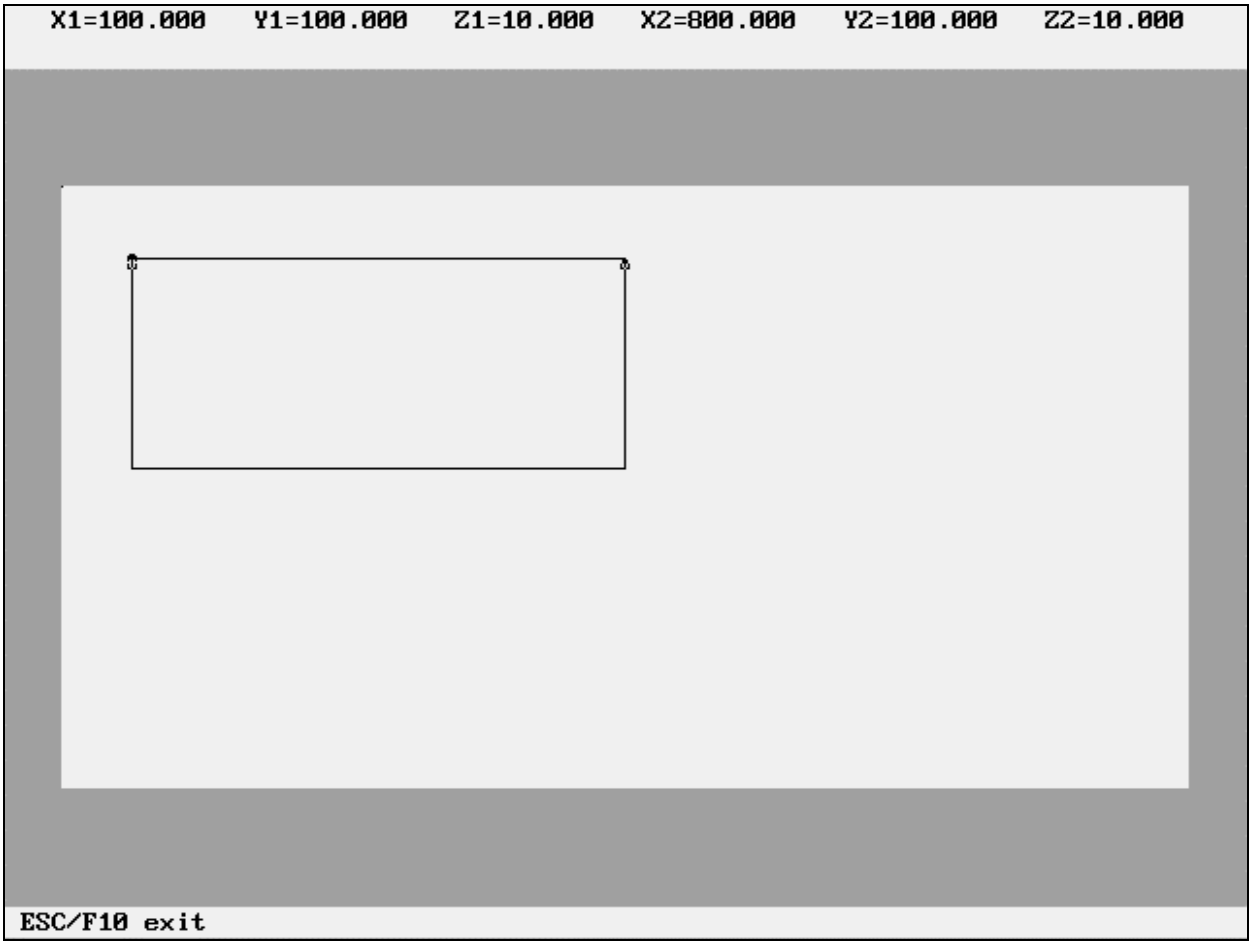


Figure 4.33 Trace function for graphics.

The key **F7** allows us to enter the zoom mode. By using the arrow keys and selecting an area, the graphics function will produce an enlarged full-screen drawing a selected area. Again, at the bottom of the screen we find a series of available functions. These functions are for selection of areas to be enlarged and the display of such areas.

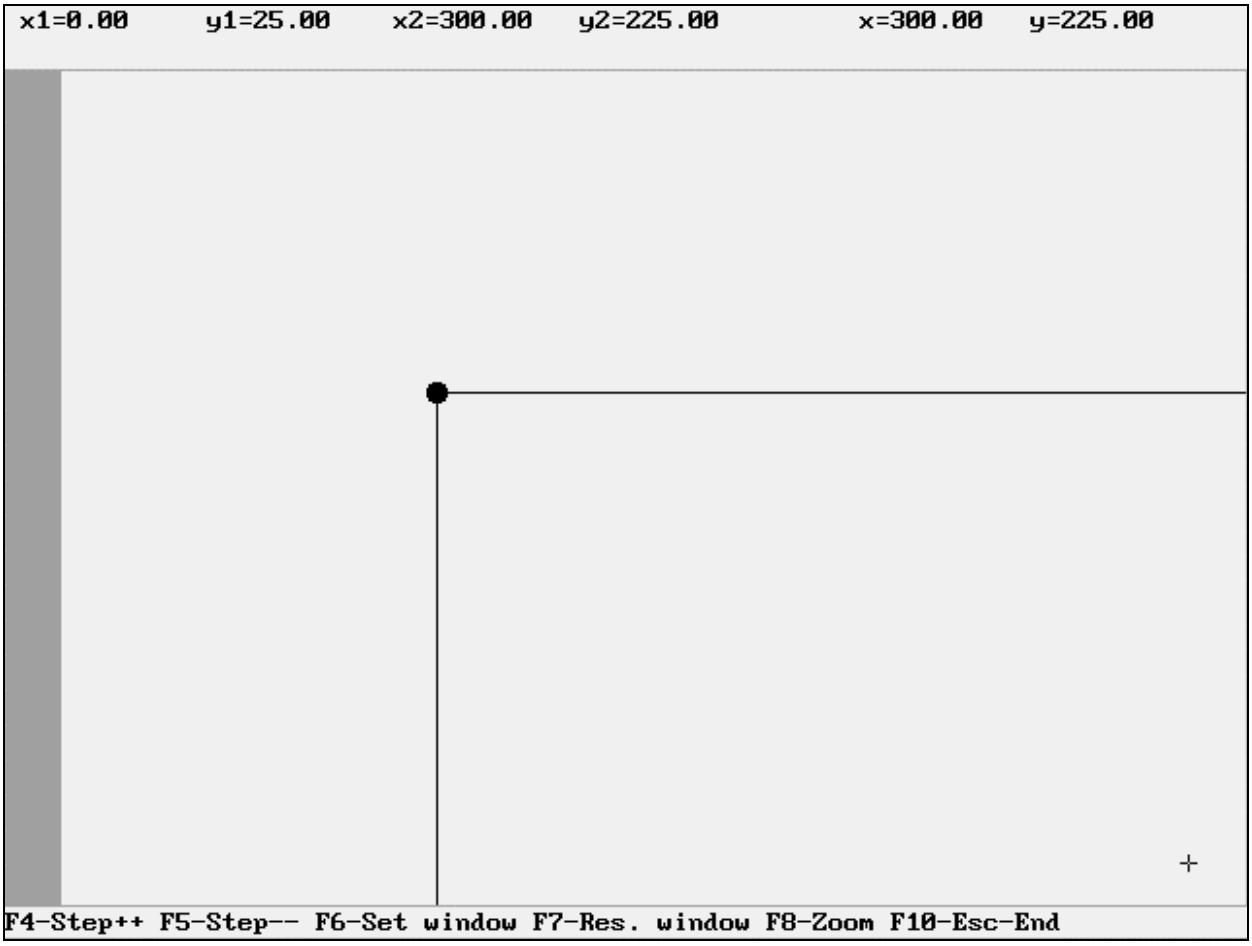


Figure 4.34 Zoom function with graphics.

- <**F4**> Increase cursor speed.
- <**F5**> Decrease cursor speed.
- <**F6**> Stablish the starting point (first press) and end point (second press) of the area to be enlarged.
- <**F7**> Return to previous zoom level (first press) or to drawing in normal scale (second press).
- <**F8**> Update the selected area (in scale) with cursor movement. Press F6 twice.

The first two keys, **F4** and **F5**, influence the cursor movement in the graphic space. These keys increase or decrease the spaces the cursor jumps when an arrow key is pressed. When the cursor has been positioned at the point where we want the zoom function to start, we press **F6**. From this point onwards a selected area will remain active and, starting from the previously indicated point, will adapt to the movements of the cursor. When we reach the point where we want the area to end, we press **F6** again to confirm this point and **F8** to update the screen. We thus obtain an enlarged image as shown in the next figure. **F7** will take us back to the drawing as it was before enlargement. If we make a further enlargement, F7 will take us back to the previous zoom level. By pressing F7 a second time, without creating other areas, we return to the initial drawing with no enlargement. The keys **ESC** or **F10** take us back to the initial condition before accessing the zoom function.

We can now return to the explanation of the functions of the basic editing environment (figure 4.29).
The keys **F2, F3** and **F4** activate the Assisted Editor and, depending on which key is pressed, the following windows will appear:

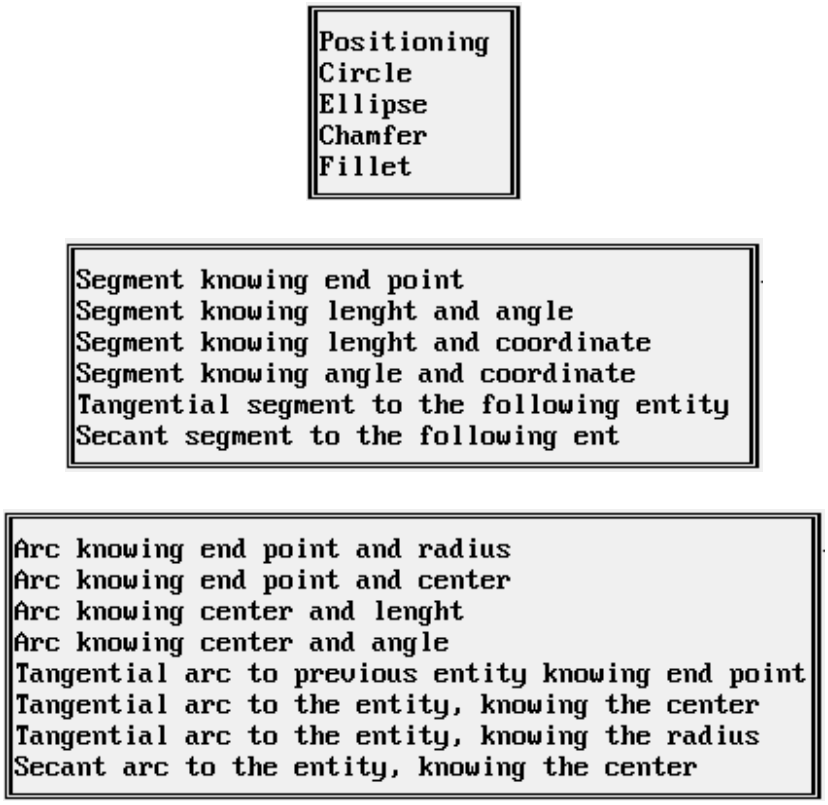


Figure 4.35 Window for the Assisted Editor.

Associated with every menu option there is a drawing that provides a graphic indication of the operation the option can perform. By selecting the first item in the segment window and pressing <**RETURN**>, we enter a window for insertion of the data required for the construction of a segment. From the figure that follows we note that the graphically displayed example in the window in the upper right corner indicates a segment with the final point highlighted. In fact the first item corresponds with the construction of a segment with the final point given.
Each item of the windows corresponds with a type of different construction. After selecting the most convenient type and having inserted the necessary data, the operation is confirmed with **F10**. The editor disactivates and inserts in the section a step with all programmed data and related instructions. The four segments of the rectangle in the previous example were obtained using this item in the Assisted Editor.
The user is advised to spend a little time gaining experience with these items to become familiar with this highly functional and rapid form of programming.
The **F5** key is also used in assisted editing. This function key runs an analysis of the step the cursor is positioned at and determines whether it contains a type of entity or programming included among those managed by the Assisted Editor. If this is the case, it fills the window corresponding with the type of entity found so as to be able to modify the data directly in the assisted environment in the window.

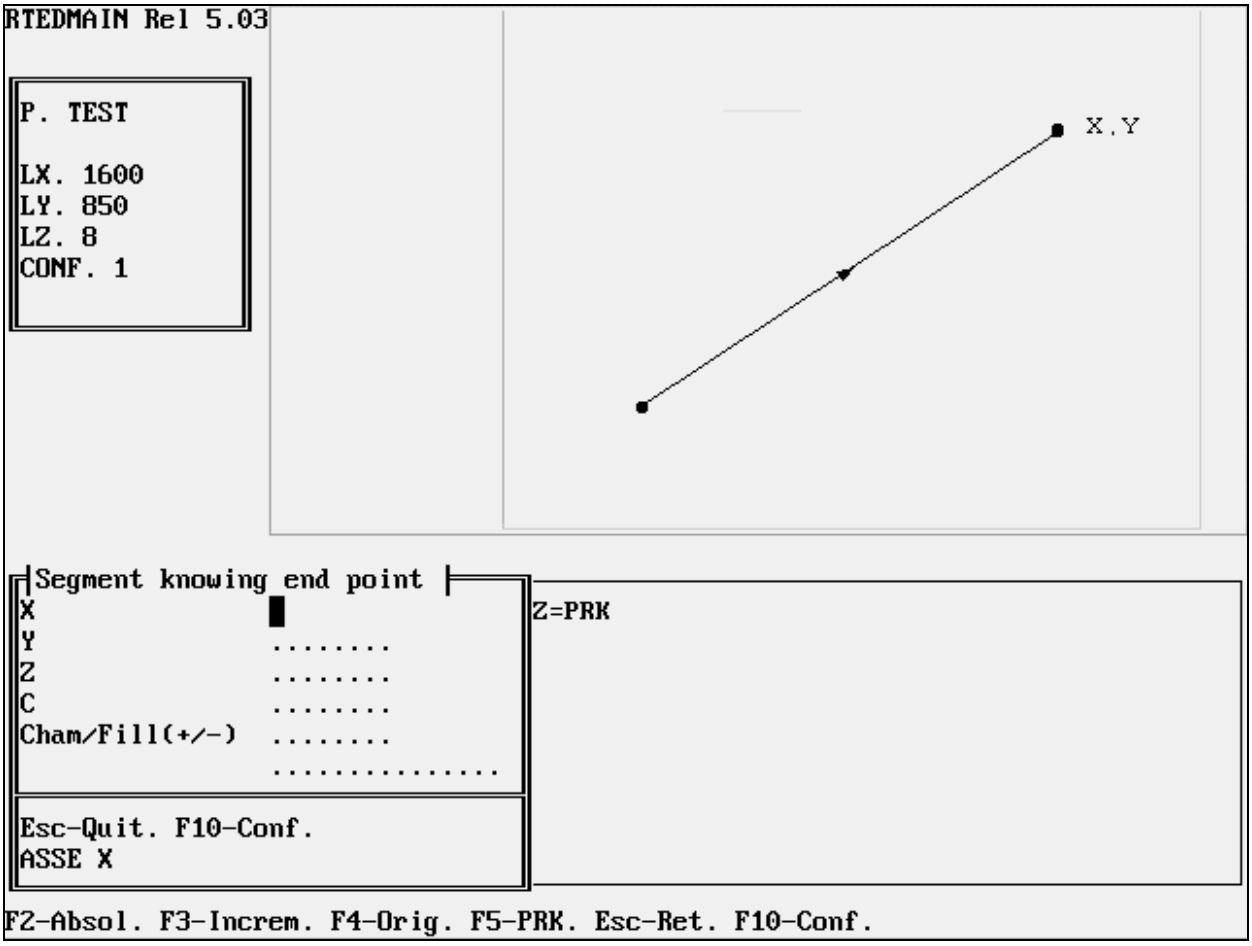


Figure 4.36 Window with an example of the Assisted Editor.

Keys F2 to **F5** invoke functions that in fact greatly facilitate the insertion of data because they take into account most of the common types of operation that may be used. However, the fundamental feature of the Assisted Editor is the presence of a phase for accessing a window which is configurable externally by means of two special cycles memorized as files together with the machine data. With this feature we can define a series of items (with relative windows and examples) for programming special operations, programming repetitive operations, setting data for evolving fixed cycles and so on. Generally, speaking, it is possible to have different cycles for different machines i.e. with different requirements.

Generally, these special configuration cycles are supplied together with the NC, they are already prepared for immediate use and the user will not need to access them. The functions of the cycles are displayed by pressing **F2**, which switches from the fixed window to the configurable window and vice versa every time it is pressed.

In figure 4.36, information about axis positions is present in the last line. It is possible to set absolute positions (**F2**), positions referring to previous positions (**F3**) or as a reference for subsequent positions (**F4**). With **F5** we can place the **PRK** parameter (parking position) in the fields of the axis positions.

We can now resume the descriptions of functions of the basic editing environment, continuing with the second group of functions accessed with the **F7** key (see figure 4.30). The first three keys refer to the function of copying of a group of steps. With the first key, **F1**, we mark the first line of a block, while with the second, **F2**, we mark the last line of the block. We must position the cursor on the line from which we want the lines to be copied, then with the third key, **F3** the copying is executed.

```
 N10 G71 LX=1600 LY=850 LZ=8 HC1 Z=PRK
^N20 X100 Y100 Z=PRK TP1 PRF=10 G40 L=PON <
 N30 G1 X800
 N40 G1 Y400
 N50 G1 X100
 N60 G1 Y100
 N70 L=POFF
 N20 X100 Y100 Z=PRK TP1 PRF=10 G40 L=PON
 %
```

Figure 4.37 The function of copying a block of lines.

In the previous figure the cursor was on step '**N20**' when **F1** and **F2** were pressed. In this way only one line is marked. As we can see from the '^' e '<' characters located at the beginning of the the first step and at the end of the last step marked, in this case it is a single step. The cursor had then been placed after step **'N70'** i.e. above the '%' end-of-section character. The block-copy key has ensured that the line was recopied between step N70 and the step with the '%' character.
As can be seen, the step copied still has **'N20'** even if the progressive numbering of the program really requires **'N80'**. It is at this point that one can appreciate the usefulness of the **F6** key which triggers the re-numbering of all steps.

```
 N10 G71 LX=1600 LY=850 LZ=8 HC1 Z=PRK
^N20 X100 Y100 Z=PRK TP1 PRF=10 G40 L=PON <
 N30 G1 X800
 N40 G1 Y400
 N50 G1 X100
 N60 G1 Y100
 N70 L=POFF
 N80 X100 Y100 Z=PRK TP1 PRF=10 G40 L=PON
 %
```

Figure 4.38 Steps re-numbered with F6.

F5 activates a search for characters. A window appears as follows:

Figure 4.39 Selection of a string for the search function.

Each time the string is found the cursor positions on the line that has been found and a window appears as follows:

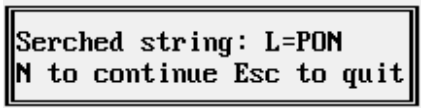


Figura 4.40 Window for subsequent searching.

We can now examine the last function with **F4**. This is the 'MERGE' function i.e. the inclusion of a section of a different file or even a part of the current file. A series of windows appears for selection of the type and the name of the file as explained at the beginning of the chapter. After this, if we have selected a program, a window will appear to allow us to choose between the sections: **"Finishing"** (Profiling) or **"Drilling reference"** (Optimized Drilling) (note that only programs have specific sections for drilling).

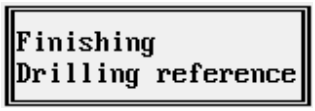


Figure 4.41 Selecting the section to be included.

If the NC has more than one centre, the operator is also asked to insert the number of the centre from which the section is to be taken. The section will be added starting from the position of the cursor.

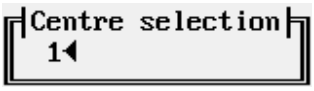


Figure 4.42 Selection of a centre.

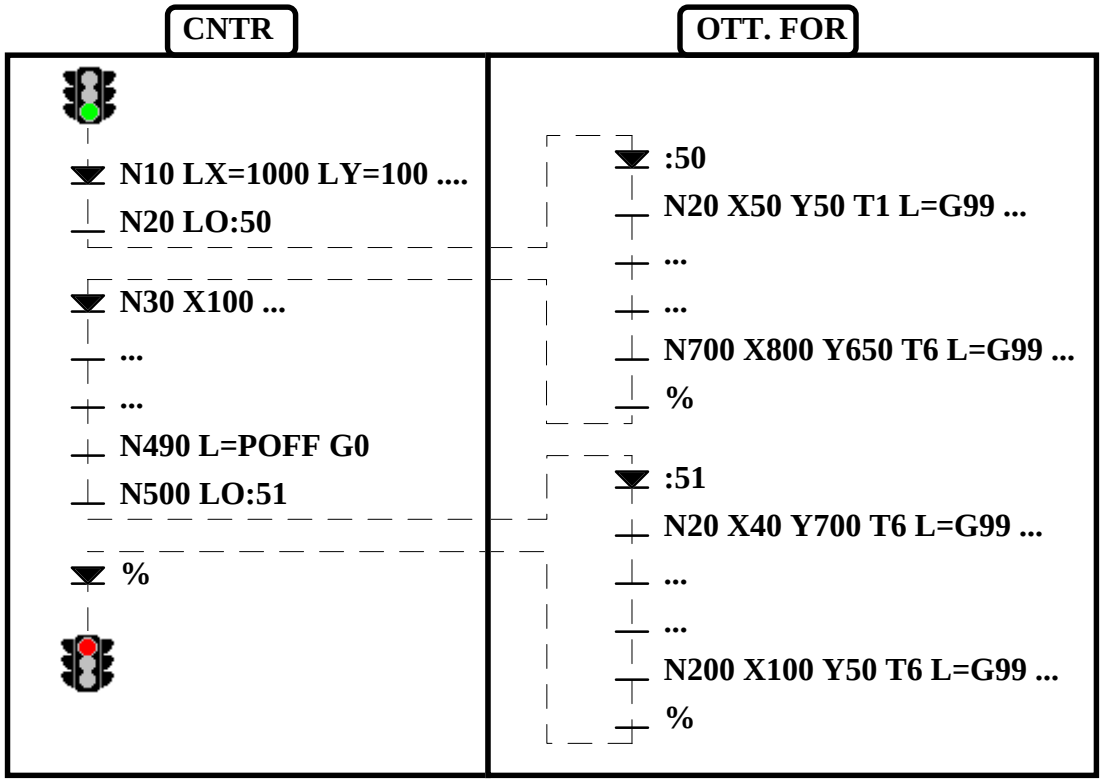
As far as the ISO programming techniques, the list of commands and corresponding explanations are concerned, see "**PROGRAMMING MANUAL RT480**".

4.4 Editing of optimized drilling.

This editing section uses the environment and characteristics of the "**Edit Profiling**" item (paragraph 4.3). The difference lies in the different section in which the edited steps will be unloaded. Furthermore, there is no first step for the editing of dimensions as this is a feature only of the **"Profiling"** section. Generally, the structure of this section has a block-type organization to allow for invocation of particular blocks from a program (a block is a group of drilling steps). Without this kind of organization the section would be in any case executed after the "Profiling" section. These blocks run between the label **':nn'** and the '**%**' character. The '%' character is the identifier of the end of a block. The ':' character is the identifier of a label and 'nn' represents the number that forms the label. These blocks are invoked from the "Profiling" section by means of 'JUMPS' which have the following format:

N<step number> LO:nn

in which, ':nn' is the label of the block that has to be executed.
During execution, when the interpreter finds the instruction **'LO:nn'**, it jumps directly to the "**Optimized Drilling**" section, to the position indicated by the label ':nn', and carries out the instructions it finds. As soon as the block has ended, it starts again in the 'Profiling' section where it left off previously.



CNTR: Profiling, OTT.FOR: Optimized drilling

Figure 4.43 Structure of the sections.

4.5 Total graphics.

We start from the main menu that is presented as soon as the editor starts. Selecting the second item, "**Graphics**", we find windows for the selection of a file, as explained and described at the beginning of the chapter, with the only exception that the windows are specific for the programs. This is because only the programs can be graphically displayed with this option. A window then appears for selection of a device to which the graphics have to be sent: to the video, printer or plotter.

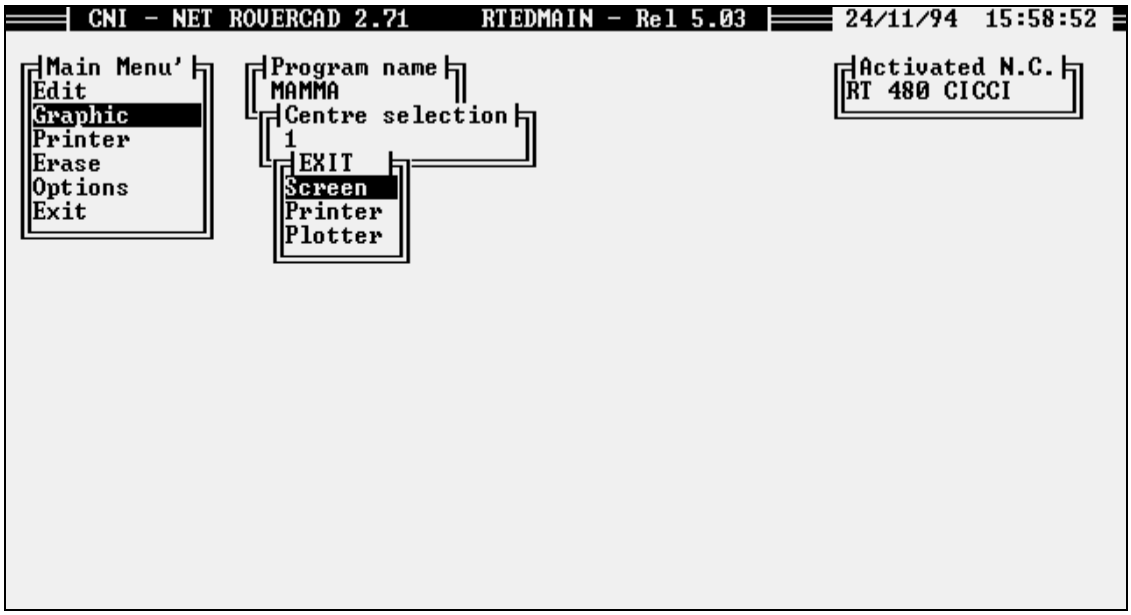


Figure 4.44 Selecting the device graphics are to be sent to.

As can be seen in the figure, there is a window for the selection of a centre number, which is displayed when we are working with more than one centre. To graphically display all the centres together it is sufficient to insert in the place of a number the asterisk character '*'. In this way they are graphically displayed one after the other unless errors occur. The considerations made in the "**Edit Profiling**" (4.3) paragraph are also valid here (key **F1** for the more frequent errors).
The two most important sections "Profiling" and "Optimized Drilling" are graphically displayed and if we select **"Screen"** (Video) the graphics are sent to the video only. To obtain a hard-copy reproduction of the program however select the item "**Printer**". A delay window will appear telling the operator to prepare the printer before starting the printing operation.

Figure 4.45 Preparing for the printing operation.

If a compatible **HPGL** plotter is available (HPGL indicates the type of protocol for data transmission), we can select the item "**Plotter**" to reeeproduce the program in detail. Three windows then appear for specification of the sheet format (A3 or A4), for inclusion of the mask surrounding the drawing with various pieces of information, the list of diameters of the drills present and, finally, inclusion of the positions of all the entities and drills.

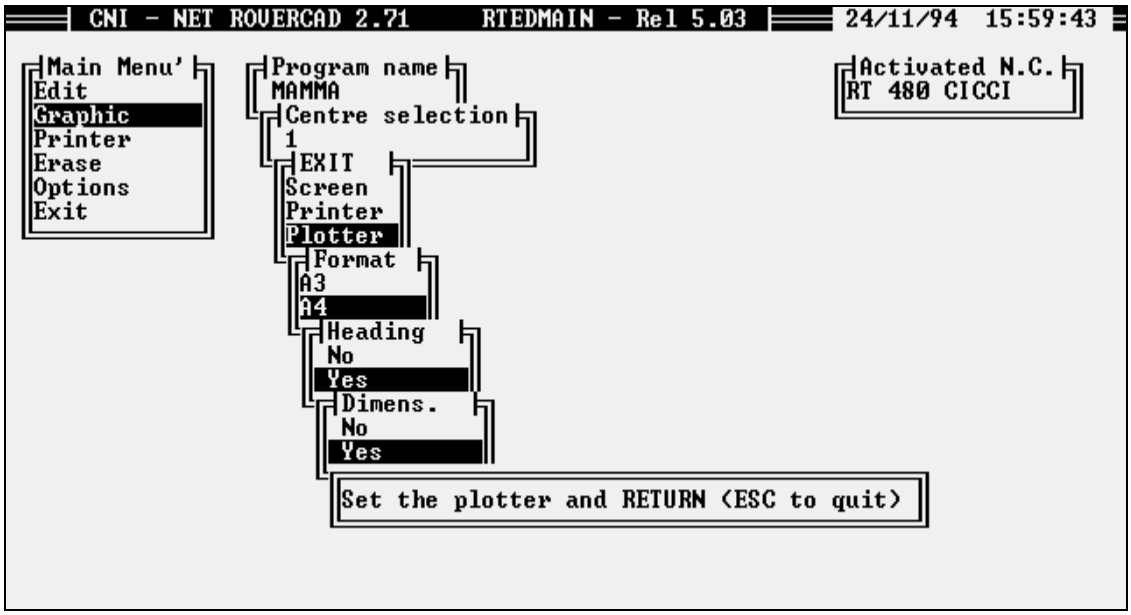


Figure 4.46 Setting data for the plotter.

For graphics on the printer and plotter a first graphic procedure is executed on the screen to make sure there are no errors. If no errors appear, the second graphic procedure will act on the selected device. In this way we avoid interruption of printing or plotting because of errors.

4.6 Printer

This option, the third in the main menu, allows us to make a hard-copy reproduction of the file and all program data. After running file selection (as explained at the beginning of the chapter) and printer set-up, a print-out is generated with:
- Generic data e.g. panel dimensions, commnents, configuration etc.
- **The "Drilling tables"**
- The list of parameters
- **"Profiling"**
- **"Optimized Drilling"**

Apart from generic data, all sections are repeated for the centres if we select overall printing by inserting an asterisk '*' when requested to insert the number of the centre to be printed.

4.7 Deletion.

This option, the fourth on the main menu, allows for elimination from the disk of the files that are no longer required. After selecting these files as explained at the beginning of the chapter we are asked if we are sure we want to delete the files. Deletion is final so we cannot go back and undelete.

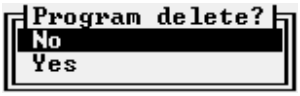


Figure 4.47 Confirming deletion.

4.8 Options.

The last option in the main menu deals with how the graphic display will respond when it encounters a particular instruction: the conditioned jump to **PLC**, **JP(<test of value>):<label>**.

N100 JP(0.1):10 If the result of the test of variable **0.1** is positive, it will jump to label :10 otherwise it will continue with the next step.

When the command interpreter finds this instruction, it must execute a test on the value of a variable of the PLC. In the NC environment there are no problems, while in a separate environment it is practically impossible as there is no PLC and, above all, as the graphics are purely a simulation. It is thus necessary when the interpreter finds a step with that particular type of jump that there be a result for the test. A message appears on the screen with the request for a number (0 if the test is to fail and 1 if it has to be successful).

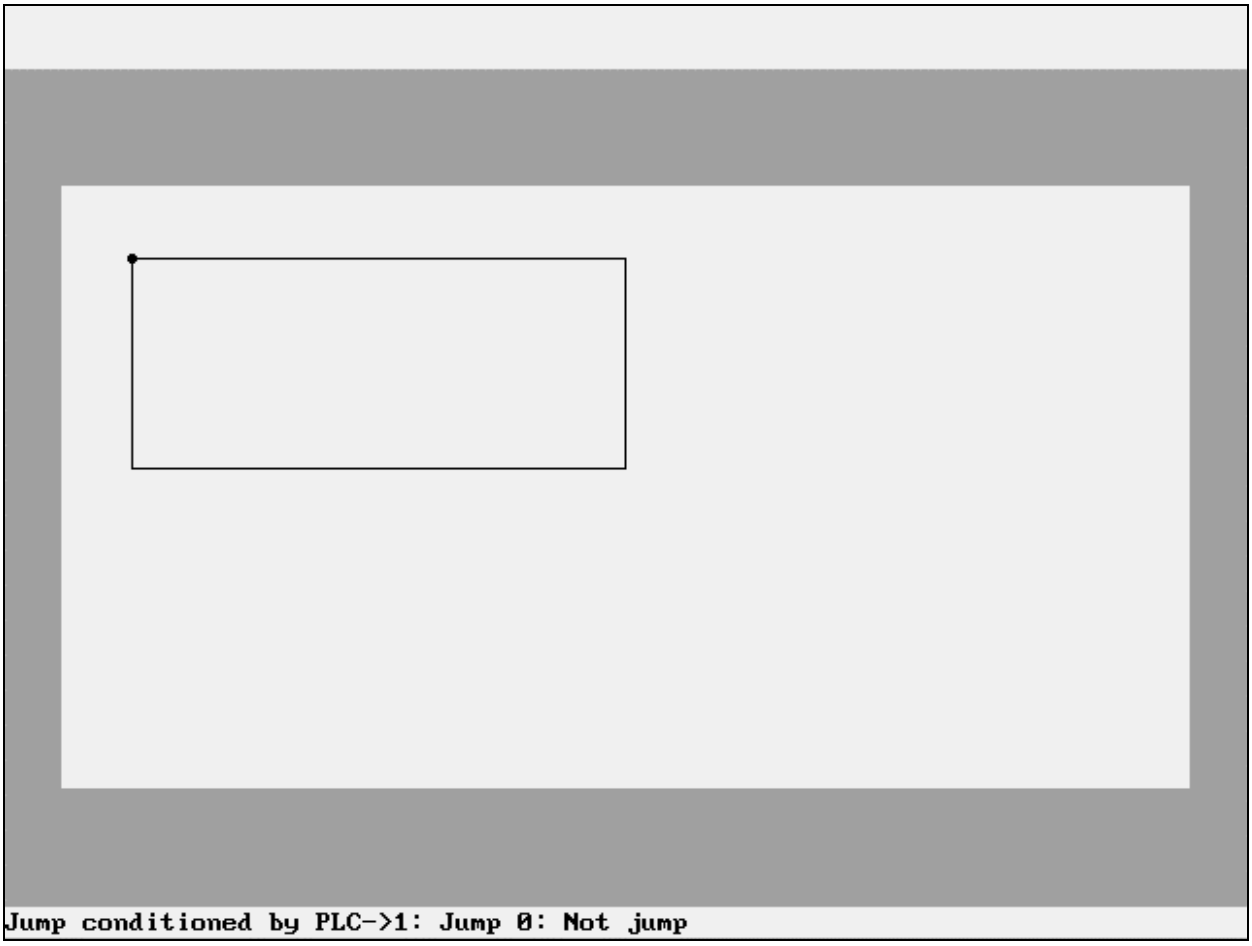


Figure 4.48 Conditioned jump to PLC

The selection window is used to specify whether to run these jumps automatically without having to always ask the user for the number for a test. In the case of an automatic jump we must specify whether to always use 0 or 1.

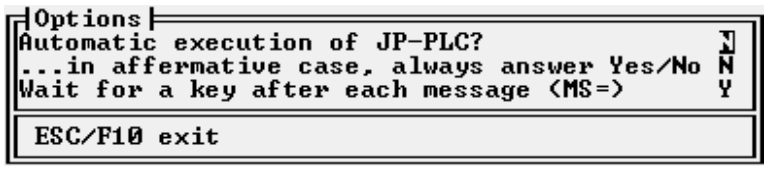


Figure 4.49 The options window.

The last item of this window allows the user to browse through the messages displayed on the screen during graphic representation. Following each display a key has to be pressed. The command which generates the messages is "**MS=**".
The program waits for the user to press a key after each message

4.9 Editor configured with 'multi-centre'.

The machines with various working centres are controlled in a manner almost identical to that used with the single-centre machines, with the only difference that in certain windows there are a number of extra options for management of the centre number. In particular we see that in the window used for deciding which section has to be edited (figure 4.10) the first option is "**Centre selection**". On confirming this option, a window appears for insertion of the number of the centre from which the program is to take the sub-sections to be managed with the next options.

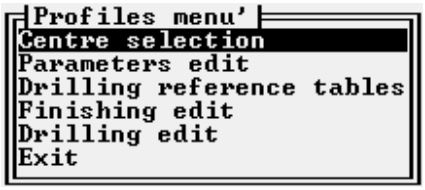


Figure 4.50 Window for selection of the section.

In the summary windows with the panel dimensions and configuration number the number of the active centre or file will also be given.

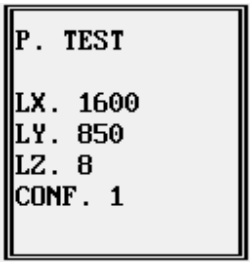


Figure 4.51 Window with a summary of file information.

The paragraph "**Optimization of drills**" (page 66) refers to a multi-centre configuration as the optimization of a single-centre machine does not require insertion of extra parameters.
Also in the paragraph "**Total Graphics**" (page 77) there are references to a multi-centre configuration allowing for a better understanding of where to intervene to change the centres to be displayed graphically.

4.10 Editor configured without dimensions.

For particular applications the program has no editing of dimensions. At this point the editor requires extra information to make up for the lack of this editing procedure. This information is copied together with the machine data when all data is transferred between environments.
The whole part that deals with the selection of a section to be edited is not included. Therefore the window in figure 4.10 does not appear and the operator can directly enter the profiling editing section. At the end of the editing session the operator is asked whether the program should save any modifications as the program will not return to the section selection window and it must be decided immediately whether the program is going to be saved or not.

4.11 Editor with single-step configuration.

Again, for particular applications it is determined that the program will not have the typical structure but will be formed only by the profiling section, which contains only one step (and dimensions). In the window for selection of the type of section to be edited (figure 4.10) the options relating to the drilling sections disappear so the window appears as follows:

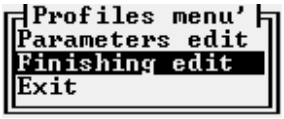


Figure 4.52 Window for selection of a section.

As far as the actual editing is concerned (selecting the second item of the menu), the area in the lower right corner no longer appears with the program lines (see figure 4.29) but the step is interpreted, if previously edited, recognized and associated with the window of the assisted Editor that generated it. The recognized window is then presented with the step data inside it. If however no step had been edited up to this point, the list of options (the windows) which are available in the Assisted Editor is presented and then the user can decide which wndow to generate the step with. Thus the Assisted Editor works as a complete editor.
This mechanism is dictated by the need for a series of predefined 'masks' i.e. windows with an ad hoc conformation that prepare the progam step and, as stated previously, the program is very simple because formed by a single step.

4.12 Editor configured with families of programs.

As explained at the beginning of the chapter, management of the program families involves recognition of the name of the program in that of a family to start loading of the new windows of the Assisted Editor associated with that family. Nothing changes from the aesthetical point of view except for the windows of the Assisted Editor, with only one extra item in the selection window of the type of file to be edited i.e. the families.

Figure 4.53 Window for selection of file type.

Selection of this option brings up the usual window for selection of a file name. The window is filled with the names of the families present in the active machine. By selecting one of these names, the corresponding file from the directory of programs will be opened.

4.13 Editor configured with positioning centres.

If the machine has more than one centre (see paragraph "**Editor configured with multi-centre**" on page 81), it can be configured so as to have centres for both profiling (default) and positioning (for information see the NC user's manual). The centres can be linked i.e. all containing the same data and all modifiable through only one centre and can be all linked or only those of positioning. To inform the user of the state of the centres (when one chooses to change centre with the option "**Centre selection**"), a window no longer appears for insertion of the centre number but a list of centres will appear with beside it the centre category (positioning or rotor working) and type (normal or twin):

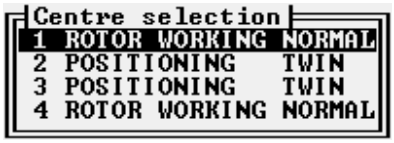


Figure 4.54 Window for selection of a centre.

CHAPTER 5

Calculator of operation time with the NC system.

When a complete program is available (either obtained by the optimizer or written manually) it is possible to know how long it will take to be run by the NC system. This program lets us to know how many pieces can be produced in a given period of time. This is not graphic simulation in real time but rather an interpreter, which, as in the case of the Program Editor, decodes the instructions in the steps. For each command it calculates the execution time on the basis of parameters set by the user and then provides a graphic display. As in the case of the graphics part of the Program Editor, there is a syntax check of the steps and any error causes the program to abandon elaboration.
The program is basically made up of a part where data is inserted for the calculation of times and a calculation environment with graphics. The data insertion part memorizes the data in a file so that once inserted, it need not be specified again in subsequent elaborations.
The results of an elaboration are displayed in both numerical and the pie-chart form.
We shall begin by describing the two parts of the program.

5.1 Setting the configuration.

In the main menu that appears when the program is started select the second option for "**Configuration**".

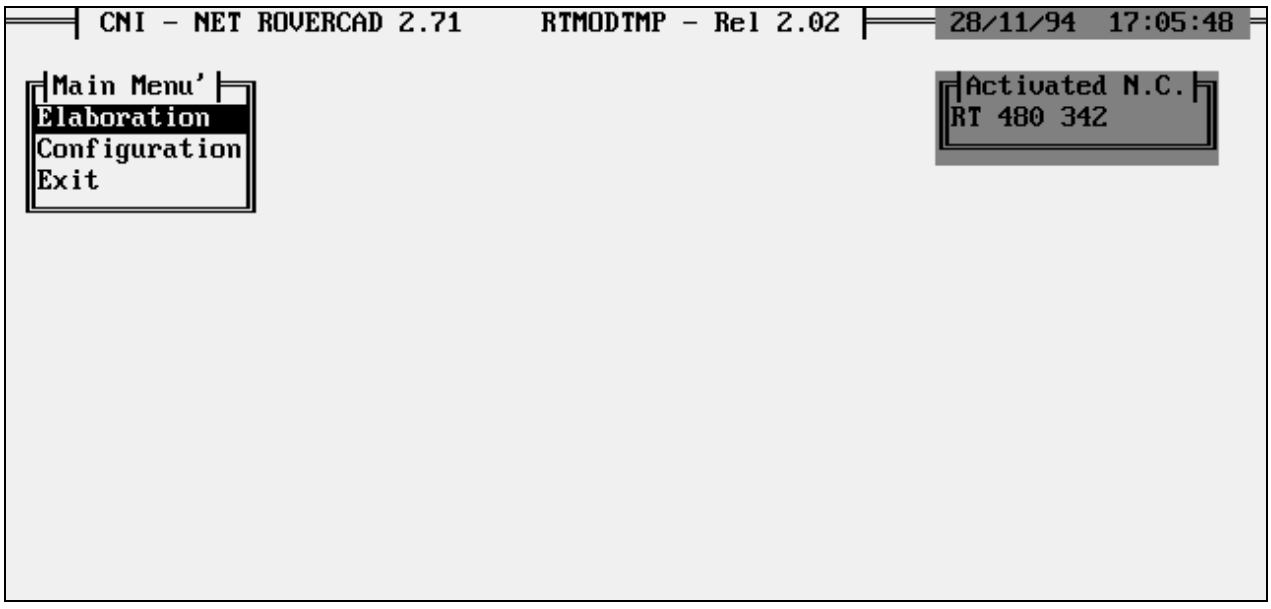


Figure 5.1 Main menu.

The next window allows you to decide which data to set:

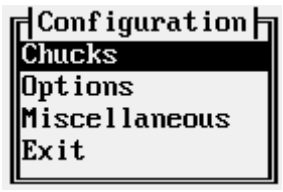


Figure 5.2 Configuration menu.

From this window you can specify the times required for certain events or action. There are three items. The first allows you to set the NC power take-off activation times. The second is not for activation timing but for program elaboration and, for example, allows you to enable a display of step management . The third item allows the user to keep an account of time 'lost' on various occasions.
We can start with the setting of the NC activation time. The following window will appear on the screen:

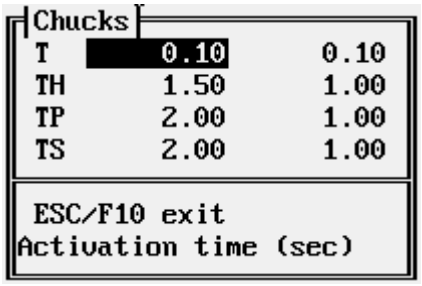


Figure 5.3 Setting activation time for power take-offs.

There are four lines, one for each type of corrector (vertical, horizontal, special router) and two columns (the first for activation and the second for disactivation times). With this table we can specify the activation and disactivation times of the spindles used for drilling, the blades and the routers, with the possibility of differentiation between one NC centre and the next.
Computation of these times takes place when the program contains a command for a power take off (e.g. **TP1** o **TS0**). The value 0 and the tool change involves adding the relative disactivation time to the overall time while any other value causes the addition of the activation time.
We can now consider the second item in the menu shown in fig. 1.2

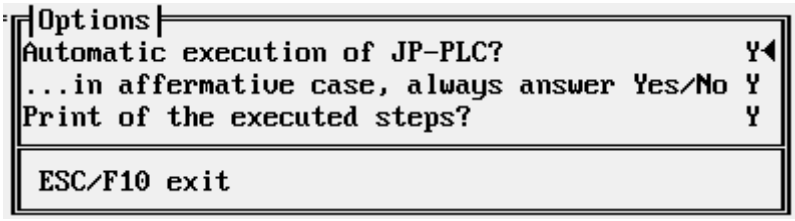


Figure 5.4 Configuring the program.

We also find a similar window in the Program Editor as in in both programs there is an interpreter which must be able to carry out jumps to labels conditioned by a PLC, while no PLC is actually available. Thus the first question we find in the window allows us to decide whether we insert data every time for every jump conditioned by the PLC. If we opt for the automatic procedure, then in the second line we have to insert the criterion for management of these jumps i.e. whether to consider the the jumps with an always positive or negative outcome. The third line however allows us to enable or disable screen printing of the steps that are 'calculated'. If the display is active then the entire elaboration is slowed down as it must repeatedly print all the steps on the screen - also those for the fixed cycles.
The third item in the "**Configuration**" menu (figure 5.2) allows for the setting of extra times, which may depend on each step performed, on each program run or on the invocations to the PLC. The following window appears as follows:

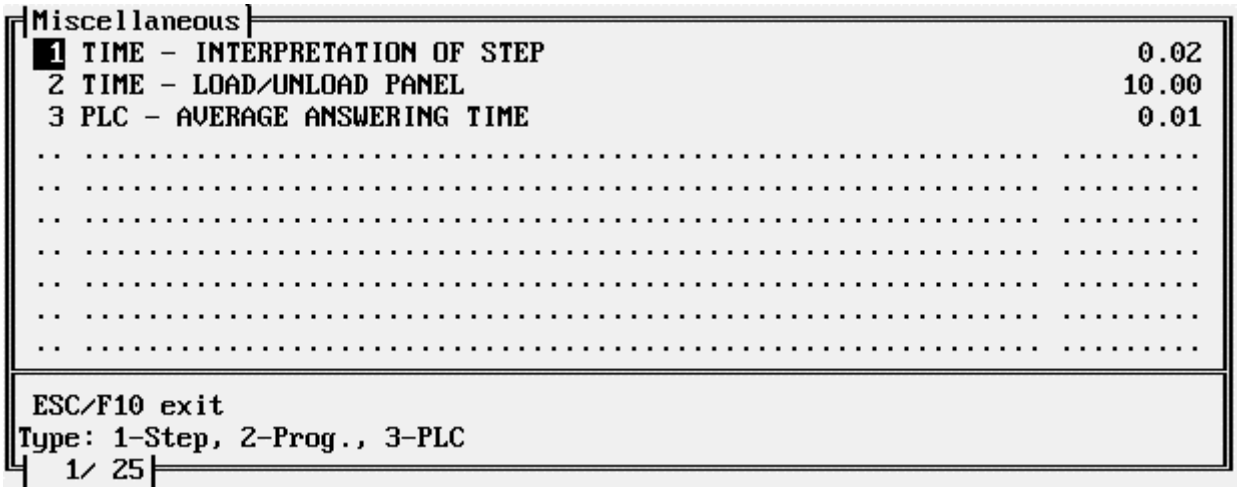


Figure 5.5 Setting various times.

In the first field of the table it is necessary to specify when to sum up the time involved (i.e. at each step, only once at the end of running, at each PLC invocation such as **M=** or **JP()**). The second field is a string for explaining the time type and the third field contains the actual time in seconds. These times are then indicated in the results under the item **'Various times'**.

5.2 Calculation of times.

From the main menu (figure 5.1) we choose the first item **"Elaboration"**. The window which then appears is for selecting a program or sub-routine.

Figure 5.6 Choosing programs / sub-routines.

In this case the supplementary time with code 2 (to be added at the end of a program) is added at the end of a sub-routine as it refers to the file being elaborated.

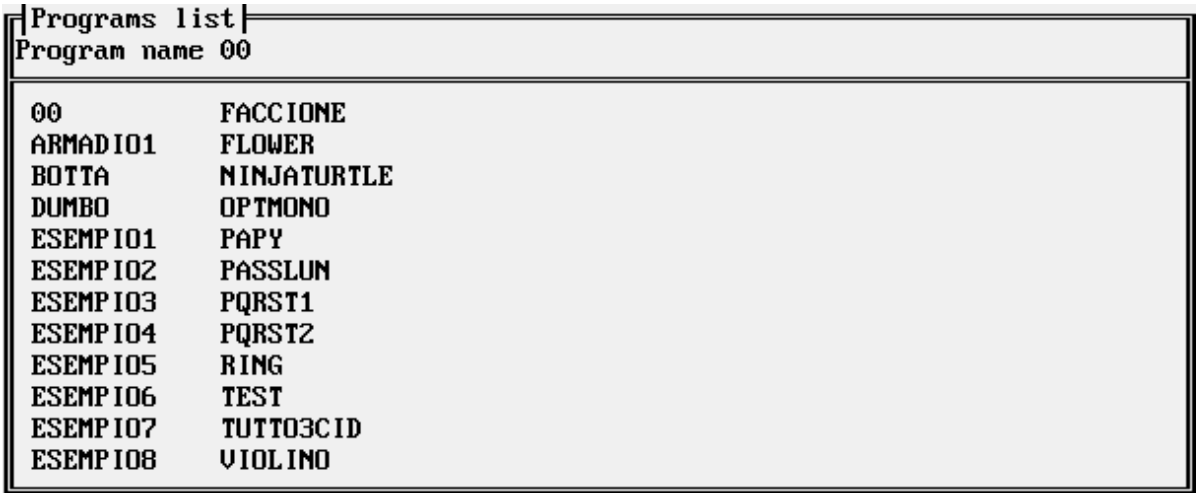


Figure 5.7 Window for choosing a file.

If the machine has more than one centre, a window will appear for selection of the centre to be elaborated while with the '*' character all centres of the drawing are specified.

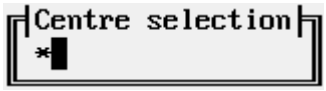


Figure 5.8 Window for choosing a centre number.

The elaboration starts and, as it runs, shows the entities converted and the steps that contain them (if configured in this manner). At the end the complete drawing will appear along with a message telling the operator to press a key to move on to the next screen.

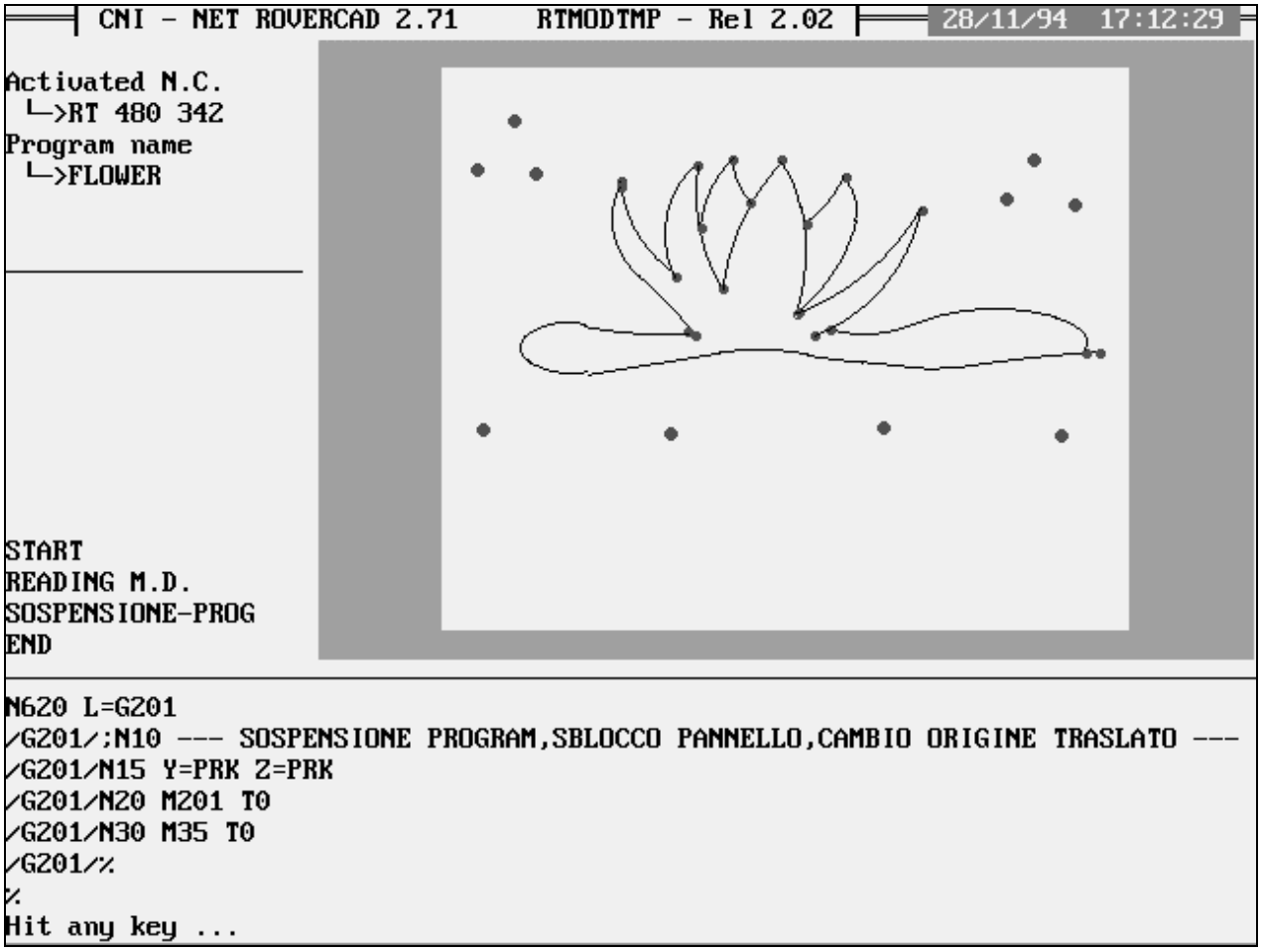


Figure 5.9 The end of elaboration of a file.

The screen page that now appears is a display of the times in figures and in graphic form. In the following figure the four categories of times are given a graphic format to convey an idea of the relation between the operations of the NC system: spindle activation, fast axis movements, axis interpolation and various other operations.

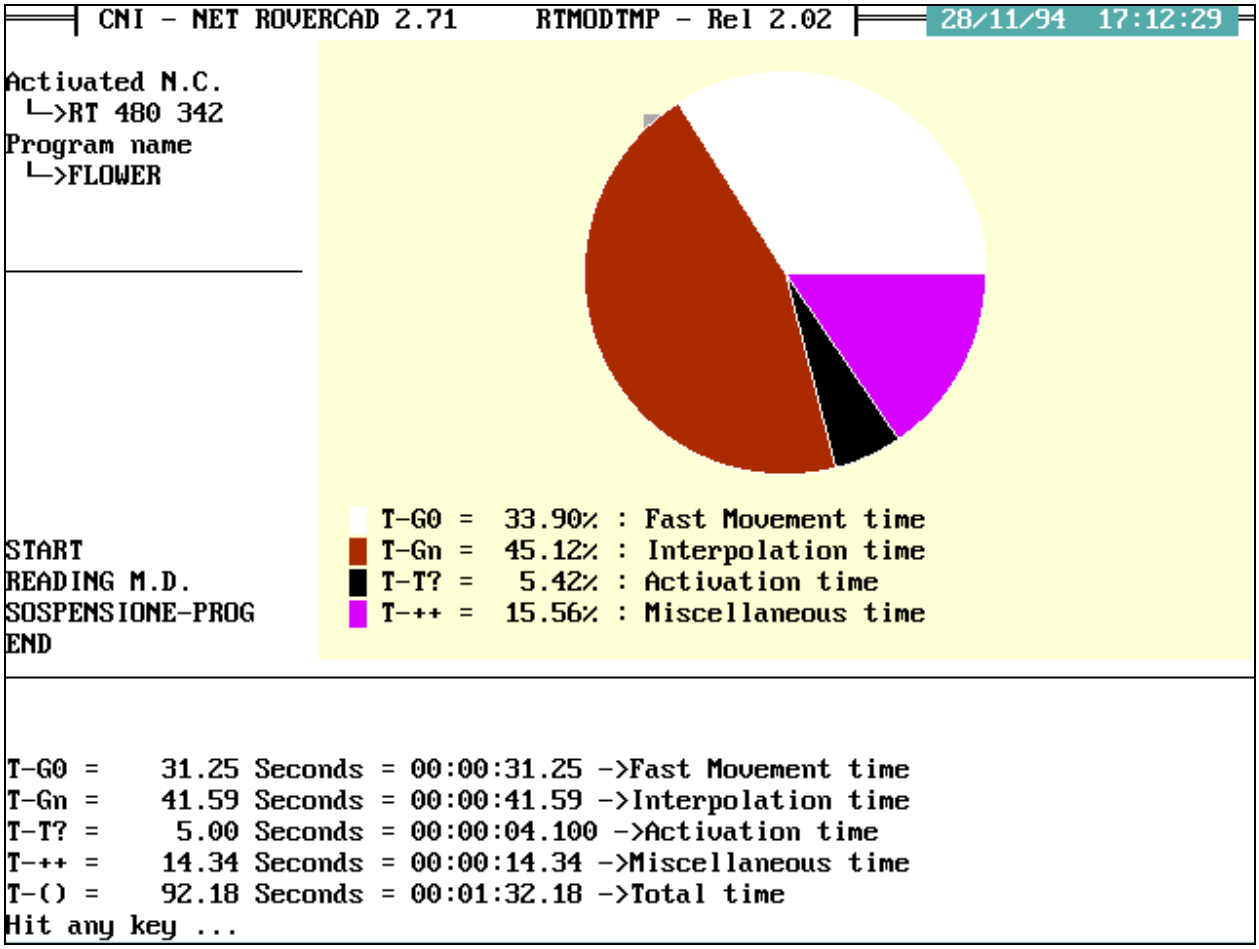


Figure 5.10 Result of an elaboration.

The four categories of timing:

Fast movements times	Total of times required for movement of axes in the 'fast' mode and not in interpolation.
Interpolation times	Total of times required for axis movement in interpolation.
Activation times	Total of times required for activation and disactivation of the spindles.
Miscellaneous times	Total of supplementary times set in program configuration.
Total time	The sum of all times with no exclusion.

CHAPTER 6

Work List Editor.

This editor allows you to control machine operation and makes it possible to create a list of programs to be run.
If the programs included in the work list have been created with this software and checked graphically and running time has been estimated, you will have at your disposal all the necessary data for planning production for a certain period of time and all data can be transmitted from the production manager's office to the NC system to start production. For the transmission of data the operator will use the "***Diskette Manager***" (on page 9) or the "***Manager for Serial Communication with the NC system***" (on page 99).
The editor is configured through the EESER file of the NC RT480 with the maximum number of work list lines and the number of characters of the last data that makes up a work list line.
When the Editor starts running the main menu appears immediately, showing the options managed by the program:

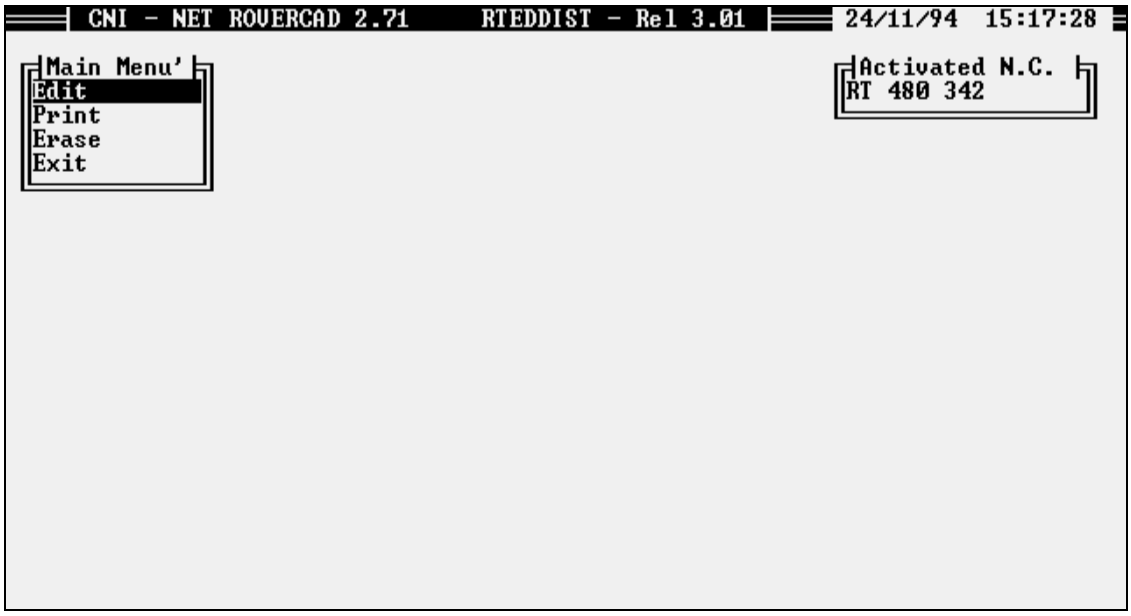


Figure 6.1 Main menu shown when the program starts.

6.1 Editing the work list

After selecting the "**Edit**" option (fig. 1.1) a window appears for specification of a file name:

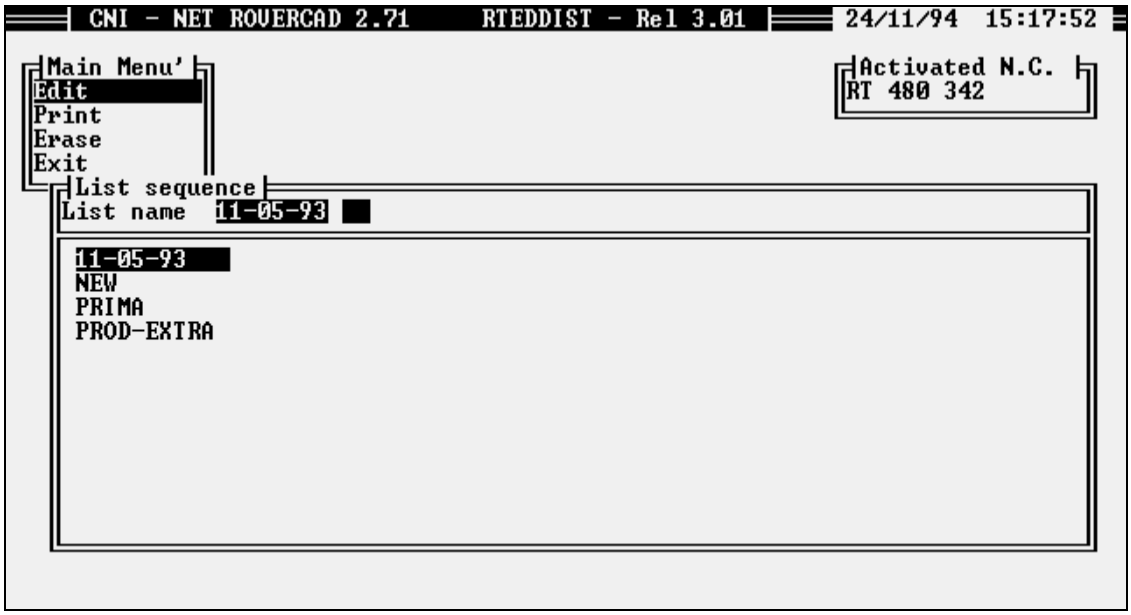


Figure 6.2 Window for selection of a work file.

If the file does not exist, confirmation is requested - otherwise the operator is asked to insert the name of the file to be saved when exiting.

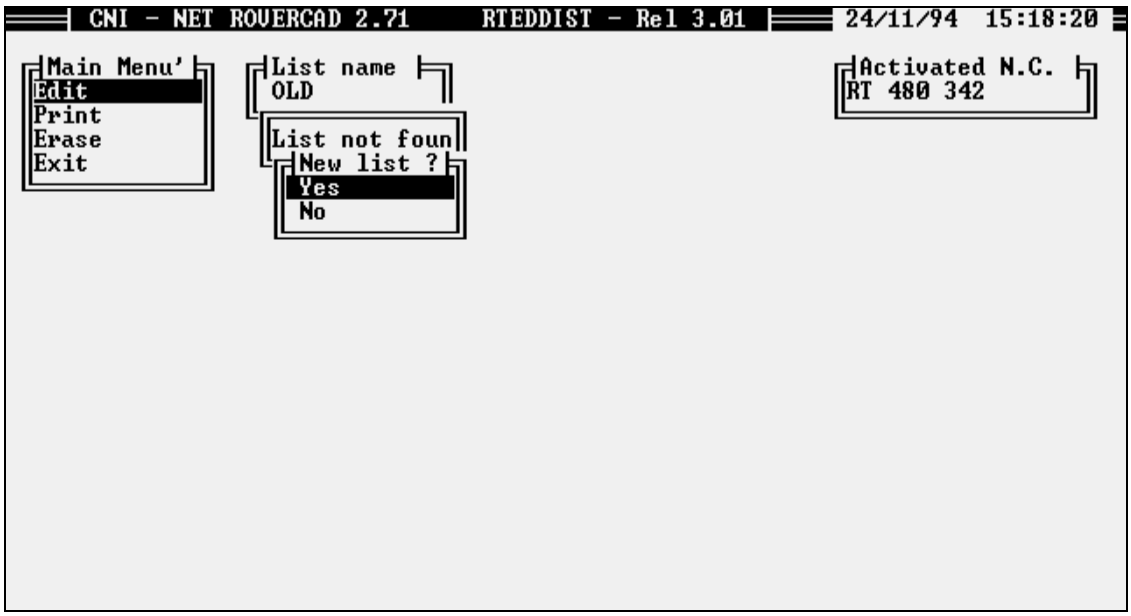


Figure 6.3 Confirmation in the case of a new file.

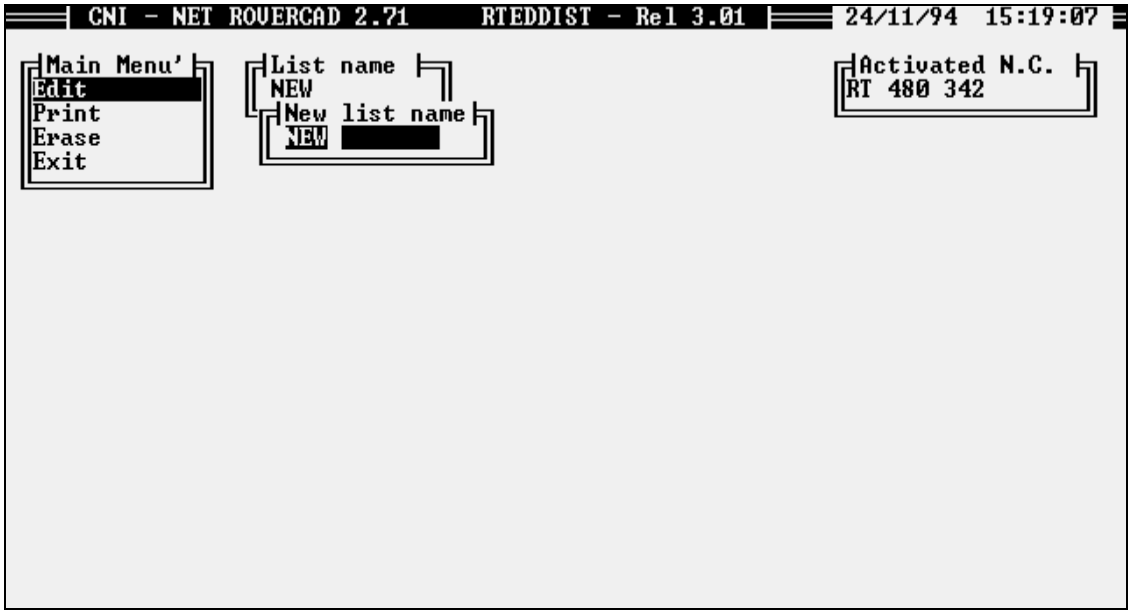


Figure 6.4 Specifying a name when saving data.

If the name of the file coincides with the name of a file that already exists (different from the file currently being manipulated), you are asked to confirm that you actually want to write over the data in the previous file, which will be lost.

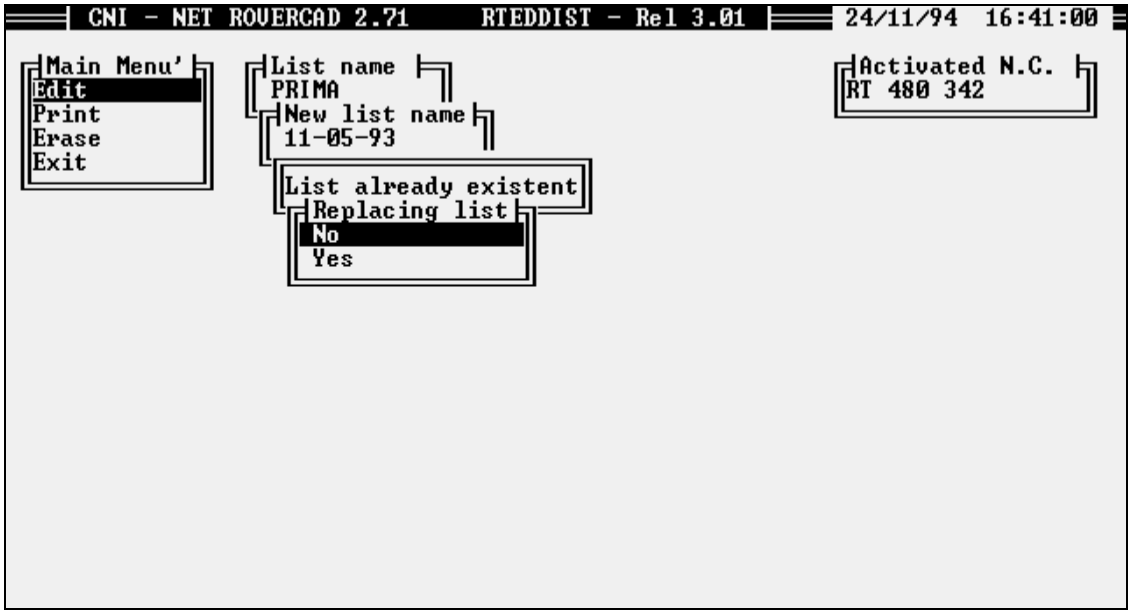


Figure 6.5 Confirmation in the case of an already existing file.

At this point a window appears for insertion of data in the work list:

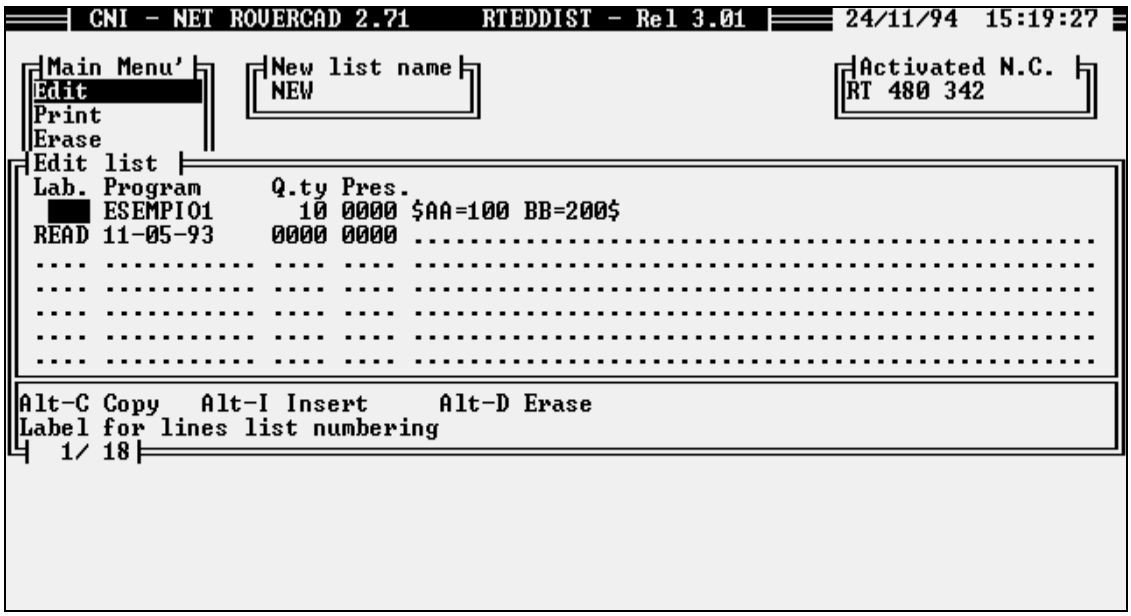


Figure 6.6 Window for editing the work list.

The meaning of each field indicating data in work list lines:

Lab.	Label or command to be carried out when the NC interprets the step.
Program	Name of the program to be run.
Q.ty	Number of pieces to elaborate with the same program.
Pres.	Number of pieces already elaborated with the same program. The field is kept updated by the NC as pieces are worked on by the program.
'***free column***'	Space available to user for messages or for parameters to be passed to the program.

The first field '**Lab.**' includes four characters that creates a label for a jump or a real command from the NC. The label can be, for example, '**P1**' or the '**;**' character, which disables the line and tells the program to skip execution. The commands available are as follows:

READ	Reads the work list, the name of which is specified in the second field ('Program'), and starts running it.
WRIT	Writes the work list active in the in the memory with the name specified in the second field ('Program').
STOP	Interrupts execution of the work list.
KILL	Eliminates from the disk the work list specified in the second field ('Program').

The second field '**Program**' can contain a command for execuing a loop or the '**JMP**' command , which forces a jump to a label. The data is inserted as '**JMP** **<label>**. For example:

JMP P1 (jump to the line with the P1 label in the 'Label' field)

When execution of the work list reaches a step in which there is a command forcing a jump to a label, execution continues on the line of the specified label. Normally, in order to execute a loop, the label will be placed before the jump command so that the program returns to the line that originated the jump. The jump is repeated as many times as is indicated in the '**Q.ty**' field and updates the '**Pres.**' field each time with the number of jumps executed from this line. When the number of jumps carried out (in the 'Pres.' field) equals the preset number (Q.ty field), the line containing the jump command is considered as being 'terminated' and execution can go on to the next line. The 'Pres.' field is incremented before a jump is made such that it is not the number of jumps executed which is counted but rather the number of times the lines included between the label and the jump command are run. Finally, the 'Pres.' field is considered as the starting point for counting the number of pieces operated on.
The free column allows for insertion of simple comments or parameters to be passed to the program to be executed. In the latter case the parameters have to be enclosed between two '$' (dollar) characters for recognition.

Example 1

Work list with a 'jump to label' command and logical scheme of interpretation by the NC system:

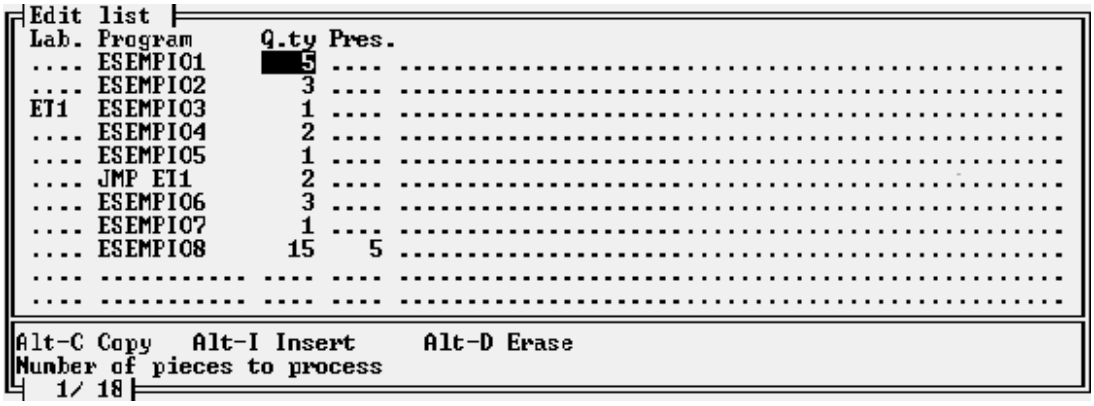


Figure 6.7 First example of a work list.

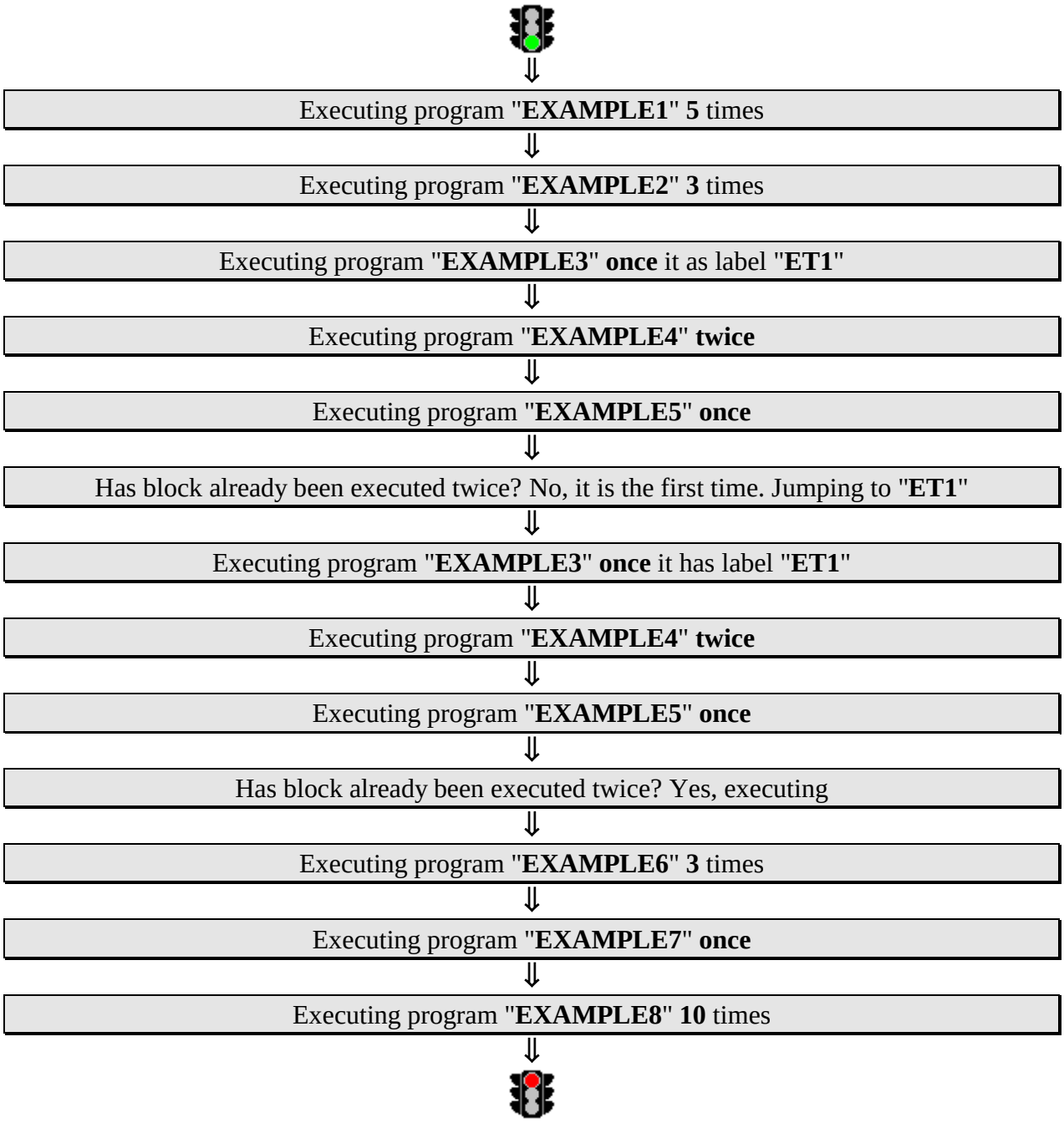


Figure 6.8 Interpretation of the work list.

Example 2

Work list with parameters for the program and reading of another list:

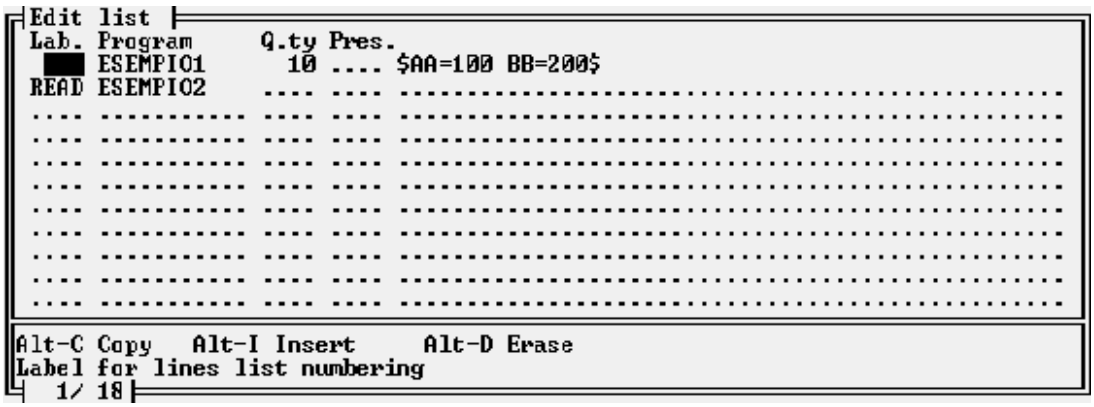


Figure 6.9 Second example of a work list.

In this case the executor of the work list in the first line takes the parameters enclosed between the '$' characters and makes them available to the program. In the second line the executor reads the work list EXAMPLE2 and starts to run it.

6.2 Print.

This option, the second in the main menu in figure 6.1, allows the operator to obtain hard-copy of the work list data file. After choosing a file (as occurs when editing the work list - see fig. 1.2) and setting up the printer, the file will be printed.

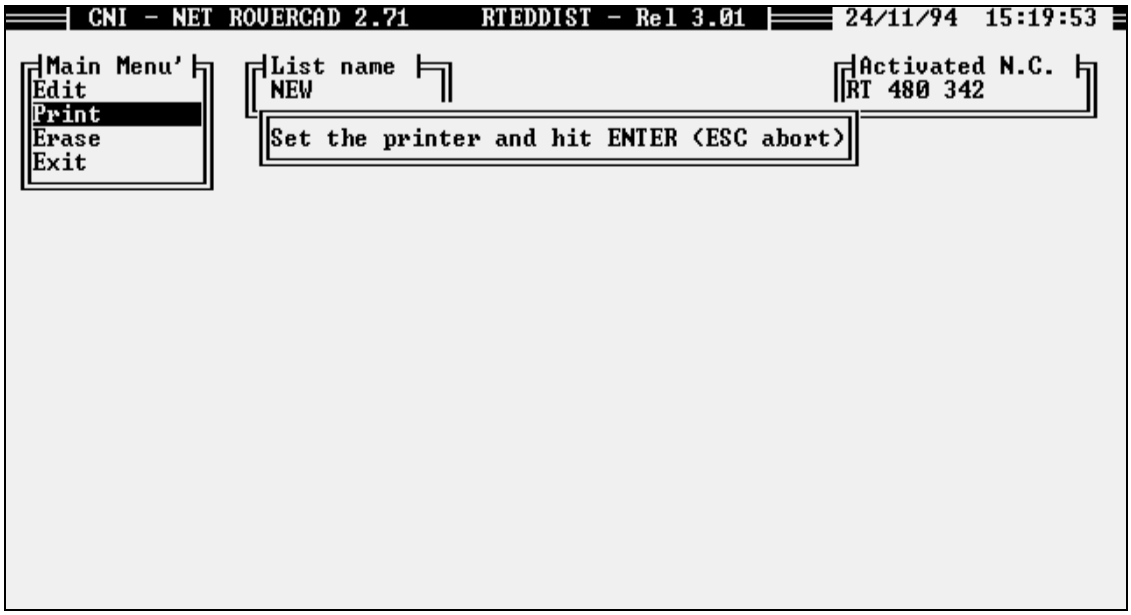


Figure 6.10 Confirming the print option for a work list.

6.3 Delete

This option, the third in the main menu in figure 6.1, allows the operator to eliminate from the disk any files he no longer needs. After selecting the files (as occurs when editing the work list - see fig. 1.2), the operator is asked to confirm deletion of the file indicated. Remember that once deleted, the file(s) can no longer be retrieved.

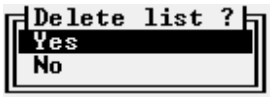


Figure 6.11 Confirmation of deletion.

CHAPTER 7

Manager for serial communication with the NC system.

A fundamental part of this package is the communications setup with the NC system for the exchange of information and data. This program allows for direct transfer of data to the NC sytem through a set of leads (described in a separate section) and provides a direct line of communication from technical / drawing offices to production areas. Two operation modes are managed: the **LOCAL** and **REMOTE** modes. The local mode allows you to operate from the PC terminal, for transmission and reception of files to and from the NC system, while the remote mode sets the program for reception of commands from the NC system itself, which means that transmission and reception operations can be run directly from from this part of the system. In the 'local' mode it is possible to transmit programs that have been optimized or extract those present in the NC system and re-transmit them after modification with the Program Editor. With the 'remote' mode you will also make PC archives available to your NC system, thus allowing you to consult, transmit or receive files as you please.
We shall dedicate one paragraph (1.1) to the 'remote' mode, while the remaining paragraphs will refer to the 'local' mode.
When the program is started, the first thing to be done is to specifiy the mode of operation:

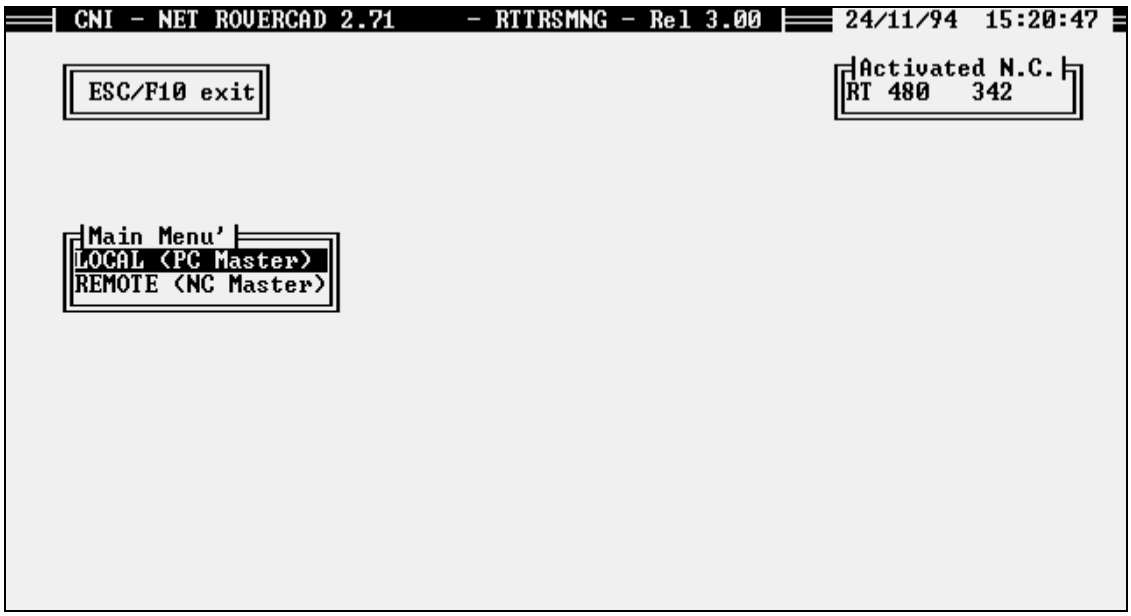


Figure 7.1 Selecting the operation mode.

7.1 Operation in 'REMOTE' mode.

From the window (figure 7.1) that appears next select '**REMOTE**'. An area is created for the display of commands and operations 'controlled' by the NC system. During this phase it is the NC system that takes the initiative, transmitting or receiving files, and the program need only carry out what the NC system tells it to do. The first message '**TESTING CONNECTION**' indicates attempts to set up communication with the program that controls serial communication within the NC system.

Figure 7.2 Attempt to connect with NC system.

As long as the message remains present, which may even be for a few minutes, real communication still has to be established. There is not just one solution to the problem as there are many possible causes. For further information see the paragraph "***Modes of Communication***" on page 106.
At this point, all being well, the message '**CONNECTION OK**' will appear to inform the operator that dialog with the NC system is now possible.

Figure 7.3 Communication enabled in the 'REMOTE' mode.

If, for any reason, there is a communication failure, an error message appears, which is normally 'time-out' (**E.13**). This is because if the NC system stops 'responding' to the signals sent to it, a series of attempts to re-establish communication is made for a certain time interval, at the end of which (time-out) all operations are terminated.
In this area other types of messages may appear indicating reception of commands from the NC system. Almost all of the messages begin with one of the codes listed below:

TX command - transmission of files to NC
RX command - reception of files from NC
DIR command - list files in PC
ERA command - delete files from PC
REN command - re-name files in PC

To end communication and return to the main menu shown in figure 7.1, press the **ESC** key. You will note that the message area disappears and a window will pop up warning you of the interruption.

Figura 7.4 End of communication.

Press any key to return to the main menu.

7.2 Operation in 'LOCAL' mode.

From the window (figure 7.1) that appears next select '**LOCAL**'. During this phase it is the NC system that takes the initiative to transmit or receive files and the NC system need only carry out what the PC system tells it to do.
We shall not make any special distinction between reception and transmission as the windows that appear and the operations to be carried out are practically the same. It is only necessary to specify the direction of the copying procedure in the first window that appears, with a stylized symbol of a personal computer, an NC system and an arrow indicating the direction of the transmission operation (==>>==>> **Transmission**, <<==<<== **Reception)**. The cursor keys can be used to change the direction of the arrows (confirm with <**ENTER**>).

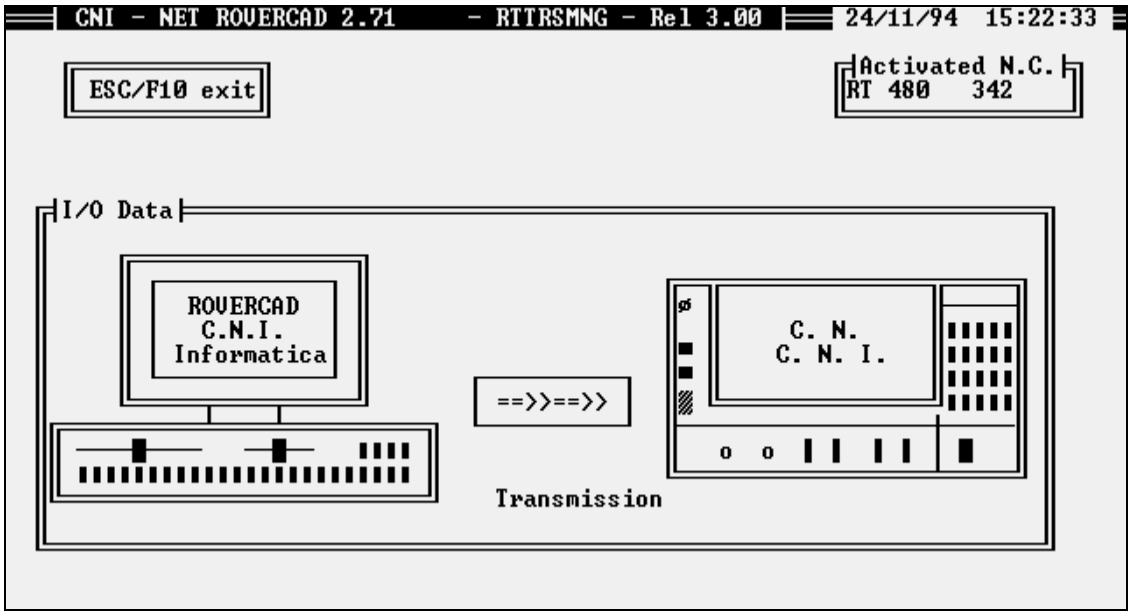


Figure 7.5 Selecting the direction of communication.

A window in the upper part of the screen indicates the operation being carried out (transmission / reception) and the type of file being manipulated.

Figure 7.6 Window indicating that operations are being carried out.

The only difference between the file-type lists for reception and transmission is that in the reception listings there are two extra items for "**STATISTICS**" and "**STATISTICS BDE**".

*Figure 7.7 File-type windows for **reception** and **transmission**.*

As far as the items "**PROGRAMS**, "**SUB-PROG.**", "**CYCLES**" and "**LISTS**" are concerned, a window will appear for file selection as illustrated below:

Figure 7.8 Selecting the name of the file to be manipulated.

After selecting the file or group of files using the asterisk charater '*' press **<RETURN>** and the files will then be sent or received. When the asterisk is used, a window appears in the centre of the screen to indicate the name of the file currently being moved. In the example we have selected files beginning with **'T' (T*)**.

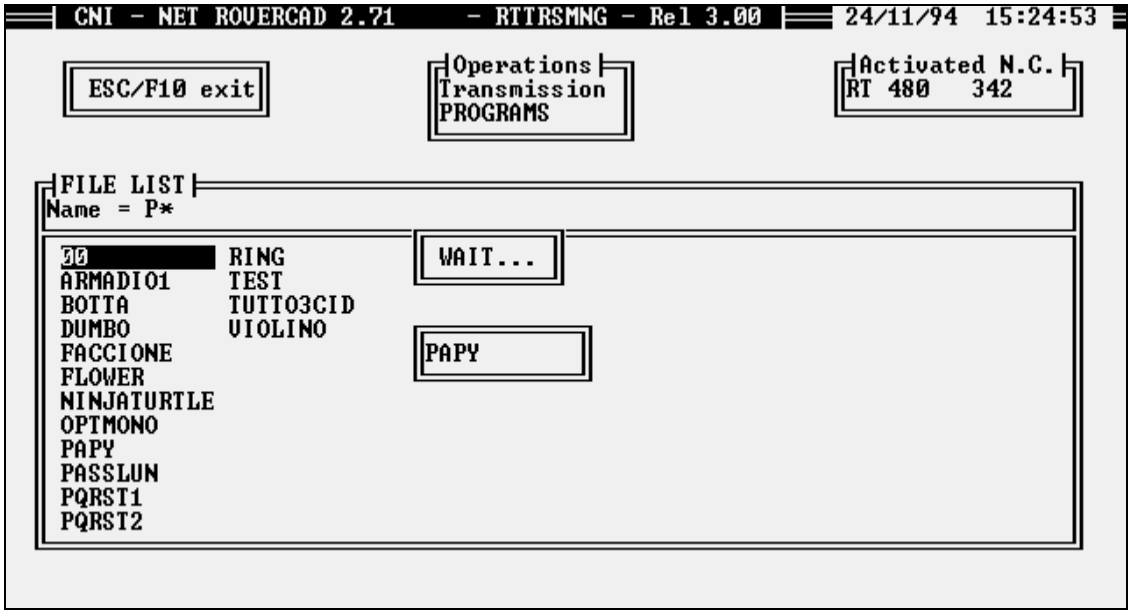


Figure 7.9 Transmission or reception of a group of files.

As soon as the operation ends, a window appears to indicate that the operation has been completed successfully. For errors see the paragraph "***Communication Modes***" on page 106.

Figure 7.10 End of Transmission or reception

In the case of "**LISTS**" an automatic routine is included to transmit / receive the files included in the work list itself. The file in the second field will be considered for each line of the work list unless it has as one of the following label (1st field) codes: **'READ', 'WRIT**', '**STOP**', '**KILL**', '**JMP**' or '**READ**'. As a consequence of this distinction, a window appears to ask the user if these particular programs have to be copied too. If no confirmation is given, we continue and return to the file-name selection menu, otherwise the operation will then start.

Figure 7.11 Copying work list files.

It may happen that the work list programs are not all present because of deletion or because they have not yet been elaborated. When the copying procedure finds that a file does not exist, a window appears to allow the operator to decide which action to take.

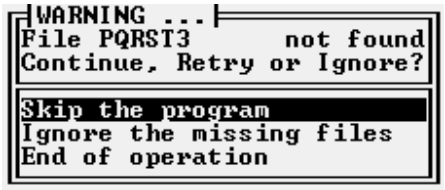


Figure 7.12 Message shown when a work list file has not been found.

The first item allows us to ignore a missing file. This window re-appears if another file is missing. The second item however can stop this window from appearing as it can tell the program to ignore all missing files. The third item simply ends the operation immediately.
The menu item for selection of a file type (fig. 1.7) for "**PLC/DATA**" automatically carries out the operation without asking for file names. The data is memorized in files with specific names and the necessity of requesting these names is thus avoided.
The item "**MACHINE DATA**" is for transmission / reception of all machine control data and a window will appear for selection of the file groups required. This window can be configured but note that it reflects the characteristics of the NC system and therefore items may vary.

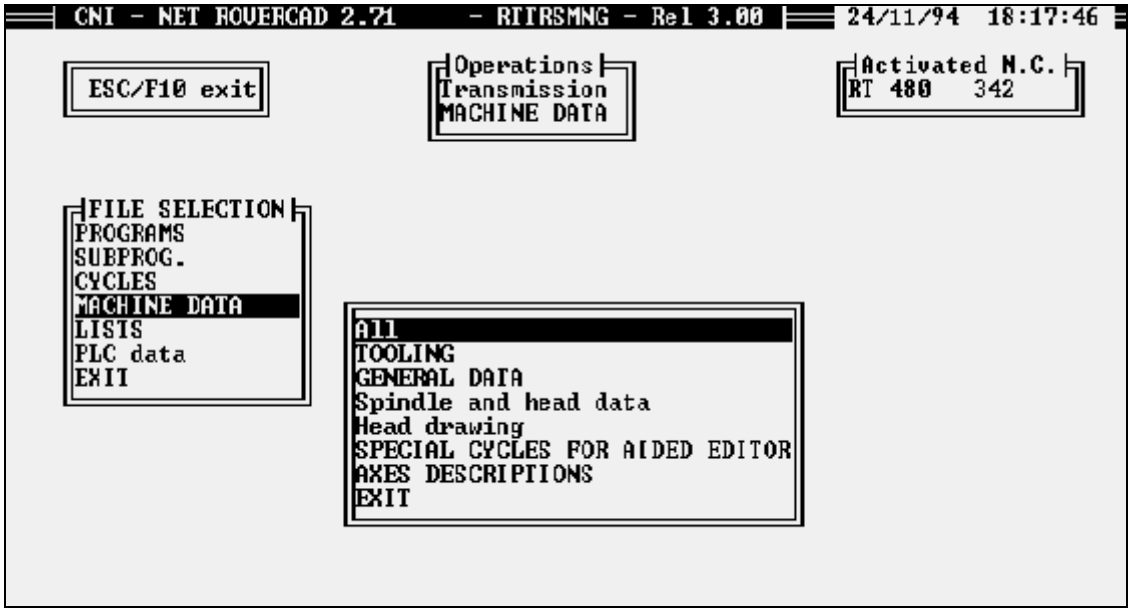


Figure 7.13 Window for machine data management.

It is possible to copy groups of files one at a time or all together (if "**ALL**" is chosen).
The items contained in this window correspond with the Machine Data Editor (**MDE**) tables:

"**TOOLING**" (TOOL-UP) Manages all "**TOOL-UP**" tables in the **MDE**.

"**GENERAL DATA**" Manages the "**GENERIC DATA**", "**ORIGIN DATA**" and "**AXIS DATA**" tables of "**MACHINE DATA** " in the **MDE**.

"**SPINDLE AND HEAD DATA**" Manages the "**DEFINITION OF HEADS**" tables and the four "**CORRECTOR**" tables of "**MACHINE DATA** " in the **MDE**.

"**HEAD DRAWING**" Manages a file which can be given graphic form in the NC system.

"**SPECIAL CYCLES FOR AIDED EDITOR**" Manages configuration files in the Assisted Editor.

"**AXIS DESCRIPTIONS**" Manages files containing texts with the descriptions of the axes that appear in the "**AXIS DATA**" table in **"MACHINE DATA** " in the **MDE**.

The conversion of machine data is run (before transmission to the NC system and after reception from the NC system) to allow for translation of data into the suitable format. An error which may occur is non-compatibility between the two environments as they are preset for different data. For example, having a NC with two work centres (two physical heads) and an active machine on a PC configured for only one centre or a number of axes in the NC different from the number in the machine active on the PC. The user must therefore always transfer machine data from a NC to its corresponding machine (See **"Machine manager and NC selector**" under the heading "**Selecting an NC centre**" on page 5).
We can now take a look at the last items in the window shown in figure 7.7 i.e. reception of **"STATISTICS"** and **"STATISTICS BDE"**. For "Statistics" only one window appears for insertion of the name of the file in which all the NC system statistics data will be copied. As far as the "Statistics BDE" is concerned, a further configuration file is manipulated. A window thus appears to allow for selection from the statistics and configuration files. For the former the same procedure used for simple statistics is used, while for the latter the procedure is the same as that for copying PLC data as names are pre-specified also for configuration.

7.3 Communication mode.

To set up dialog between a PC terminal and the NC system all operations must be run in the proper manner, from the choice of cable to the editing of communication parameters.
With regard to the choice of cables, there are different ways of connecting up to an NC system of the **NC RT480** type so the user should refer to the installation manual at the section on **"Serial connection PC - NC"**. Once the type of cable and the NC serial connection has been determined you will have to set the port speeds for both pieces of equipment. As far as the NC system is concerned you can refer to the **NC RT480** User's Manual. Normally the ports are programmed with the default data: 9600 baud, parity none, 8 data bits, 1 stop bit and data flow control XON-XOFF. This creates a string as follows: **9600, N, 8, 1.** To set the communication data on the PC, access the **Machine Data Editor** and select **"COMMUNICATION"** from the main menu, on page 46. A window will appear for insertion of the data:

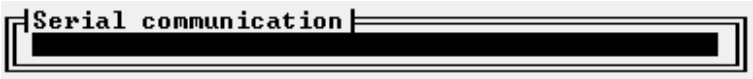


Figure 7.14 Setting communication parameters on the PC.

The following data is now inserted:

000COM1:9600,N,8,1

in which:

000	Three fixed characters - always three zeroes
COM1:	Code for the serial port. This example uses the first port, while the second port is set with **COM2**:, the third with **COM3**: and so on.
9600	Standard transmission speed. Other values available are 1200, 2400, 480, 9600 and 19200.
N	Sets 'No parity control'. Other settings are: O for odd and E for even.
8	Bit stops. Other values: 7, 6 or 5.
1	Stop bits. Other values: 2

The protocol used for transmission of data is almost always as given in this example. Note that, generally, it is possible to change the transmission speed rate and the port used but not other data. It is very important to remember that any modification of transmision parameters must be made for the ports of both environments.
For the description of error codes see the appendix in the section corresponding to the **RTTRSMNG** module.

Appendix A

Errors list.

Notes on errors relating to Graphics or the Graphics Interpreter (abbreviation: IT)

Errors are communicated in two ways:

a) With the process abbreviation followed by the error code e.g. **IT100**.

b) With a double error message to be decoded as follows:

_The process abbreviation followed by a 5-figure code ranging from 23000 to 30000 indicates the type of error that has occurred.

_The process abbreviation followed by a 5-figure code ranging from 20000 to 22999 indicates the point where modifications have to be made. Interpret as follows:

Numbers from 1 to 9 and multiples of 10 indicate the number of the spindle, tool head or axis referred to;

The hundreds and thousands indicate the number of the centre (01 - 29).

Whenever the error is not associated with spindles or tools, the last two figures of the code will automatically set at 99, hile the hundreds and thousands will continue to indicate the centre which is involved.

15 configurations are possible; errors for configuration **1** are given in the manual.

The errors are repeated for the subsequent configurations but the code number will change and increase by **200** for each configuration.

E.g.: Err. 23850 1st configuration
Err. 24050 2nd configuration
Err. 24250 3rd configuration
Err. 24450 4th configuration
and so on.

Example 1:

second code IT21312
2(null) 13(centre) 12(spindle, tool, head, axis)

Example 2:

second code IT20499
2(null) 04(centre) 99(not associated)

For the list of errors and their description see the manual ***ERRORS LIST RT480***, process **IT**.

Notes on errors relating to the Assisted Editor (abbreviation: AS o AD)

Errors are communicated in two ways:

a) With the process abbreviation followed by the error code e.g. **AS1**.

b) With a double error message to be decoded as follows:

_The process abbreviation followed by the number 4, the window number (2 figures) and the error code (2 figures).

_The process abbreviation followed by the number 4 and the line number (4 figures).

The first mode of error communication (a) is used for generic errors, while the second (b) is used for interpretation of commands for window definition.

For the errors list and corresponding description see the manual ***ERRORS LIST RT480***, process **AS or AD**.

Notes on errors made in the Examples of Programming environment (abbreviation: ES)

Errors are communicated in two ways:

a) With the process abbreviation followed by the error code e.g. **ES1**.

b) With a double error message to be decoded as follows:

_The process abbreviation followed by the number 4, the example or sub-routine number (2 figures) and the error code (2 figures).

_The process abbreviation followed by the number 4, the nesting level (1 figure) and the line number (3 figures).

The first mode of error communication (a) is used for generic errors, while the second (b) is used for interpretation of commands for the definition of examples.

Example 1:

ES40211 ES40049

Example number:	02	
Error code:	11	(meaning: "Option not valid")
Nesting level	0	
Error on line number (excluding comments):	049	

Example 2:

ES40518 ES41003

Sub-routine with label:	05	
Error code:	08	(meaning: "Non-existent sub-routine evoked")
Nesting level	1	
Error on line number (excluding comments):	003	

For a list of errors and their description see the manual ***ERRORS LIST RT480***, process **ES**.

Description of errors - module RTTRSMNG

Code	Description
E.01	Unknown command
E.02	Wrong command
E.03	Drive not valid
E.04	Wrong file name
E.05	Error in 1st part
E.06	Error in 2nd part
E.07	Wrong parameter
E.08	Failed to open file
E.09	No file
E.10	Checksum error
E.11	Syntax error
E.12	Insufficient space on disk
E.13	Time out
E.14	Failed to open port
E.15	Wrong type of file
E.16	Wrong command option
E.17	Wrong number of commands
E.18	Wrong echo command
E.19	File RTCOMMAN.DAT not present
E.20	Machine in start status
E.23	Parity error
E.24	Over-run error
E.25	Framing error
E.26	Statistics disabled

Description of errors - module RTCVDM

Code	Description	Meaning
F - 1	File unusable	Errors file cannot be managed; disk probably full or incorrect path.
F - 2	CAN NOT START CONVERSION!	Parameters file cannot be opened.
F - 3	Invalid data format	Data format of parameter files not recognized.
F - 4	Invalid data	The fundamental parameter for the parameter file was not found.
F - 5	Not enough memory to start	Insufficient memory for operation.
E - 1	Error on file $DEFMAC.DAT	The machine configuration file cannot be opened.
E - 2	Error on read_car function	Error in basic reading routines: the file is damaged or cannot be recognized.
E - 3	Error on read_long"	Error in basic reading routines: the file is damaged or cannot be recognized.
E - 4	Error on read_2b_1	Error in basic reading routines: the file is damaged or cannot be recognized.
E -5	Error reading file %s	Error in reading because of missing or damaged file.
E -6	Old style data needs to be updated in file %s	Machine data files found are part of an old release .
E -7	Invalid ORIGIN in the simmetric origin association table: %hd° row, %hd° col	Error in data in symmetric origin table.
E -8	No data specified in the HEAD DATA TABLE	No data was specified in the "Head Data" table.
E -9	____ FILE LOCKED! ____	The file cannot be opened because it is locked by another program. For network installation only.
E -10	Can not open %s file	The converted data file cannot be opened.
E -11	Invalid ORIGIN in the Y-axe simmetric origin association table: %hd° row, %hd° col	Error in data in the table of origins symmetrical to the Y axis.
W -1	Invalid tool type	Invalid bit in the "Tool Type" table.
W -2	You should specify the Origin types (1-4) in the ORIGIN DATA table.	Cannot find the file with origin types in the "Data Origin" table.
W -3	Invalid SPINDLE TYPE in the spindles/rotation-axes association table: %s axe, %hd° row	Invalid spindle type in "Spindles connected to to Rotation Axes" table.
W -4	Invalid SPINDLE NUMBER in the spindles/rotation-axes association table: %s axe, %hd° row	Invalid spindle number in "Spindles connected to Rotation Axes" table.

W -5	Invalid Origin types (from 1 to 4) in the ORIGIN DATA table, %hd° row	Invalid origin type in "Origin Data" table.
W -6	Spindle %hd° not configured to support GROUPS	Spindle not configured to support router aggregates.
W -7	Spindle %hd° not configured to support Tool Change with GROUPS	Spindle not configured to support tool-change with router aggregates.

Trouble-shooting - module RTCVDM

E -6	Enter the machine data editor and save the data. The 4 tables of the first configuration: the "Tool Types", "Router Correctors", "Special Correctors" and the table of "Routers and Blades" are particularly important.
E -7	Enter the machine data editor and check that the data in the "Symmetric Associations" table is coherent with the data in the "Origin Data" table.
E -11	Enter the machine data editor and make sure the data in the "Symmetric Associations - Y" table is coherent with the data contained in the "Origin Data" table.
W -1	Enter the machine data editor and make sure the tool type indicated in the "Table of tools" and "Routers and Blades" table is indicated in the "Tool Types" table.
W -2	Enter the machine data editor and edit "T" fields (origin type) in the "Origin Data" table (values from 1 to 4).
W -3	Enter the machine data editor and "T" fields (spindle type) in the "Spindles connected to Rotation Axes" table (values from 0 to 3 - check for existence of corresponding Corrector table).
W -4	Enter the machine data editor and check "M" fields (spindle number) in the "Spindles connected to Rotation Axes" table - check for existence of corresponding Corrector table).
W -5	Enter the machine data editor and check "T" fields (origin type) in the "Data Origin" table (values must be from 1 to 4).
W -6	Enter the machine data editor and insert "1" in the "ag" field (aggregate number) of the "Correctors" table that generated the error. This enables management of power take-offs that support the router aggregates.
W -7	Enter the machine data editor and insert "1" in the "ag" field (aggregate number in the "Correctors" table that generated the error. This enables management of the power take-offs that support the router aggregates.

Description of errors - module OPTMULTI

Code	Description	Meaning
E - 1	Open tool file	Error found in opening file machine data/ configuration (in normal conditions must not appear)
E - 2	Read tools data	Error found in reading machine data/ configuration (in normal conditions must not appear)
E - 3	Tools data	Error in machine data/configuration (in normal conditions must not appear)
E - 4	Open drill file	Error found in opening the file drilling tables (in normal conditions must not appear)
E - 5	Read drill data	Error found in reading the file drilling tables (in normal conditions must not appear)
E - 6	Drill data	Error found in data in drilling tables (in normal conditions must not appear)
E - 7	Open parameter file	Error found in opening the parameters file (in normal conditions must not appear)
E - 8	Read parameter	Error found in reading the parameters file (in normal conditions must not appear)
E - 9	Write program file	Error in writing program file (in normal conditions must not appear)
E -10	No memory for drill data	Max number of holes managed has been exceeded (max 400 holes/ dowel insertion)
E -11	Work memory full	Limit of working memory for optimization has been exceeded. The memory continues but can lose overall performance of program produced.
E -12	No memory program	Available space for program used up. The optimized program is larger than the program size normally managed (in normal conditions must not appear).
E -13	No memory for parameter	Memory used for storing parameters used up. (max 20 parameters)
E -14	Invalid parameter	Invalid parameter name. Length of the parameter is greater than 3 characters or the parameter does not start with a letter.
E -15	Invalid face	Invalid side number used in the drilling tables (accepted values: 0,1,2,3,4).
E -16	Invalid corner	Invalid corner reference number used in the drilling tables (accepted values: 1, 2, 3, 4)
E -17	Parameter not found	A parameter not previously assigned has been used in an expression between parameters.
E -18	Tools not available	The program does not detect the presence of tools which can be used for drilling the hole required.

E -19	Program line too big	A line created during program editing is too long and cannot be managed.
E -20	Invalid dimension	The dimensions of a workpiece are incomplete, not present or not valid.
E -21	Invalid diameter or thickness	Tool diameter or length is not valid or has not been set.
E -22	Invalid drill type	Tool type is not valid or has not been set. (accepted types: 1, 2, 3, 4, 5, 6, 7, 8, 9)
E -23	Invalid corner	Invalid corner reference number used in drilling tables (accepted values: 1, 2, 3, 4)
E -24	Syntax error	Error in syntax in expressions between parameters.
E -25	Operatore or) not found	In expressions between parameters the closing bracket or operator is missing.
E -26	Operand not found	The term of an expression is missing.
E -27	Function not defined	The function used has not been defined.
E -28	Too)	Too many closing brackets in an expression between parameters.
E -29	Too operation not termined	Too many expressions are in the suspended state.
E -30	Invalid constant	An invalid constant has been used in an expression between parameters.
E -31	) not found	A closing bracket is missing in an expression between parameters.
E -32	Division by zero	The expression between parameters includes a division with zero divisor.
E -33	Square of negative value	A square root with negative value used in an expression between parameters.
E -34	Too many tools	The maximum number of managed tools has been exceeded (max 64+32 tools/spindles).
E -35	Too many groups	The maximum number of managed aggregates has been exceeded (max 10 aggregates).
E -36	Too many tools groups	The maximum number of tools per aggregate has been exceeded (max 12).
E -37	Too many cycle	Maximum number of cycles per tool type managed has been exceeded (max 10).
E -38	Too many head	Maximum number of drilling heads managed has been exceeded (max 3).
E -39	Too many axis	Maximum number of axes connected to drilling heads has been exceeded (max 3).
E -40	Too many origin	Maximum number of work origins managed has been exceeded (max 16 origins).
E -41	Drill out of panel	A hole position has been defined beyond the corner of the panel.
E -42	Open elaboration data file	Error in opening an elaboration data file (in normal conditions must not appear).

E -43	Read elaboration data	Error in reading elaboration data (in normal conditions must not appear).
E -44	Invalid elaboration data	Invalid elaboration data (in normal conditions must not appear)
E -45	Too many data for elaboration	A discrepancy exists between set data and data obtained. (in normal conditions must not appear).
E -46	Open discard file	Error in opening the elaboration-unload file (in normal conditions must not appear).
E -47	Write discard file	Error in writing data in the elaboration-unload file (in normal conditions must not appear).
E -48	Invalid axe direction	Working direction of an axis has not been specified or different from X,Y,Z.

Description of errors - module INTERF

Code	Description	Meaning
F - 1	No graphic mode available	Generic video initialization error.
F - 3	Error on load machine data	Error in opening/writing machine data.
F - 4	Error on load default data	Error in opening default data file.
F - 5	Error on error file	Error in opening the errors file.
F - 6	Unknown error (if not previously specified)	If this message is not preceded by another error, it means that an unrecognized or program-controlled error condition has been found.
F - 7	error on read command data	Error in opening/reading the operation data file.
F - 8	Writing error	Generic error in writing in a file.
F - 9	Loading error	Generic error in reading from a file (this message may appear in association with a message indicating a specific condition).
F -10	Jumping error	Positioning error within a file.
F -11	Parameter not specified	Generated by the fact that certain data has not been set and is associated with: <entry> instr .. : indicating that name of the entry or exit cycle into/from the area of interference is missing.
F -12	Internal inconsistency	Internal error condition found in the program itself.

Description of errors - module RVEDOPT

Code	Description	Meaning
E - 1	Error on access I/O files	Generic error in file accessing i.e. opening or writing.
	No graphics mode available	Generic error in initialization of video.
E - 3	Open elaboration data file	Error in opening file containing data for configuration of elaboration.
E - 4	Too many elboration data	Error in setting parameters in the configuration file (work directory or machine data directory).
E - 5	Read elaboration data	Error during reading of the file containing data for configuration of elaboration.
E - 6	Invalid elaboration data	A parameter in the configuration file has not been recognized.
E - 7	Simm. origin not specified	Error during selection of stops as the symmetric origin has not been specified in the "SYMMETRIC ASSOCIATION" table in the Machine Data Manager.
E - 14	Can not open main file: %s	The main program file cannot be opened.
E - 3	Writing error	Error in opening or writing in parameter files for affiliated processes.

Description of errors - module RVRTCVPR

Code	Description	Meaning
F - 1	No graphic mode available	Generic error in screen initialization.
F - 2	Error in writing program	Generic error in writing on disk.
F - 4	Error reading tools data	Error in reading machine data.
F - 5	Error reading command data	Error in opening or reading operation data file.
F - 7	internal inconsistency	Internal program error.
F - 8	reading error	Generic error in reading from disk.
F -11	<dtm> memory initializing error	Error during initialization of memory.
F -12	<dtm> not enough memory	Insufficient memory for containing machine data.
F -13	<dtm> reading error	Error in reading machine data (a physical error).
F -14	<dtm> too many data found	Too much machine data has been inserted.
F -15	<dtm> field not correct	Machine data read has not been edited/inserted in the correct manner.